



A Semi-Annual Peer-Reviewed Scientific Journal
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Concerned With Publishing Research And Studies
In The Humanities**



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Karbala Studies and Research Center**



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1. Preserving And Documenting The Ziyarte Al Arba'een As A Religious-Social Ritual Using The Most Modern Methods Of Documentation And Presentation And Monitoring Its Effects On The Individual And Society.
2. Determine The Basic Requirements For The Ziyarte Al Arba'een And Secure Its Needs In Various Fields And Dimensions.
3. Drawing Inspiration From The Lessons Of Imam Hussein's Revolution In Promoting The Concepts Of Unity And Peace And Confronting The War Of Soft Ideas.
4. Linking Qur'anic, Religious, And Doctrinal Concepts To The Husseini Heritage And The Arba'een Visit To Increase Culture And Awareness Among The Family And Youth.
5. Monitoring The Challenges Facing Visitors In All Service Sectors And Provid-Ing Ways To Address Them And Develop Solutions To Them Scientifically And Practically.
6. Providing Researchers, Readers, And Those Interested In Research And Special-Ized Studies In The Ziyarte Al Arba'een.
7. Seeking To Inform The International Community Of The Importance Of The Visit And Its Community Of Millions; Because It Represents A Cultural And Human Heritage For Iraqi Society In Particular, And Lovers Of Ahl Albayt In General, It Can Also Be A Scientific Resource For Those Interested In Visiting Arba'in And An Important Factor In Preserving The File Of Providing Service And Hospitality At Ziyarte Al Arba'een After It Was Officially Registered In The Unesco Educational, Scientific And Cultural Organization (Unesco). In 2019 Ad, By The Center In Cooperation With The Ministry Of Culture, Tour-IsM And Antiquities.

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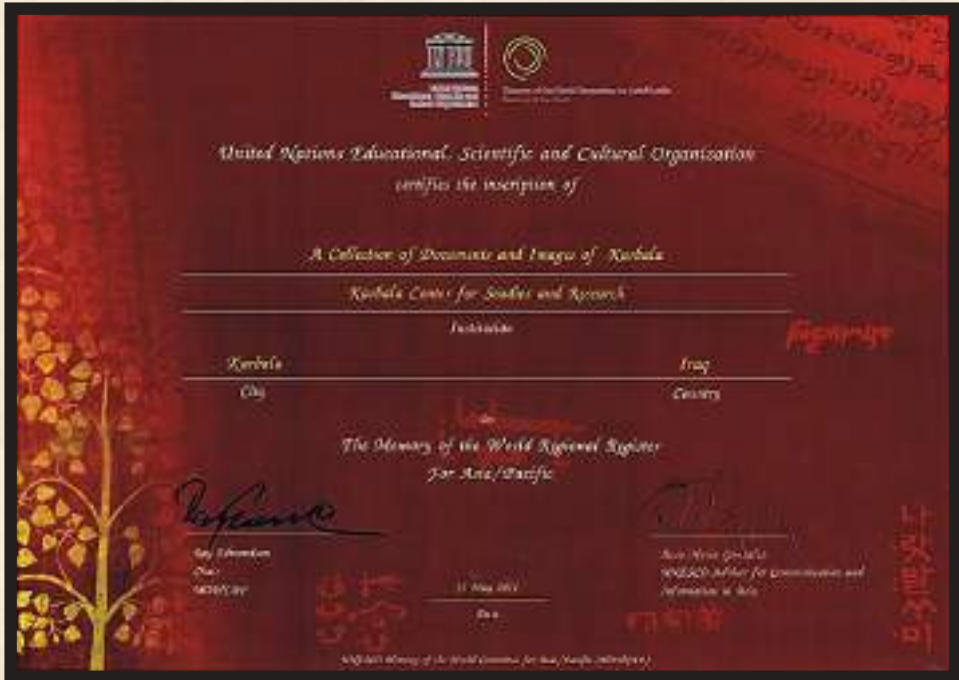
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Editorial of the issue

In the Name of God, the Most Gracious, the Most Merciful

Praise be to God, Lord of the Worlds, and may blessings and peace be upon the guiding and faithful Prophet, Abu Al-Qasim Muhammad, and upon his pure and virtuous family and companions.

The Arbaeen pilgrimage is a prominent religious and social occasion observed on the twentieth day of Safar each Hijri year. Given the profound religious, social, educational, and ethical significance of this event, which attracts millions of participants, and its role as a marker of cultural and civilizational identity for the followers of Ahl al-Bayt (peace be upon them), the Karbala Center for Studies and Research at the Holy Shrine of Imam Hussein has devoted considerable attention to this blessed ritual.

With the objective of preserving the heritage of the Arbaeen pilgrimage, the initiative to establish this academic journal emerged. This journal represents a foundational step toward addressing Arbaeen-related matters through scientific and academic research.

From this perspective, the idea of establishing this scholarly journal emerged, representing the nucleus of academic and scientific engagement with issues related to Arbaeen. This commitment was clearly demonstrated through the organization of the International Scientific Conference on Arbaeen by the Center, in its nine editions, which witnessed wide participation from specialists across various fields through precise scientific research and studies covering multiple aspects of this blessed pilgrimage.

Accordingly, the “Vol.4, 4th year , Supplement (10)” of the Arbaeen Journal aims to comprehensively reinforce multidisciplinary scientific approaches in the study of Arbaeen as a major human phenomenon that intersects religious, social, media, security, and developmental dimensions. This

issue addresses topics such as discourse, communication, and influence, in addition to crowd organization and human flow management based on scientific principles, while highlighting the importance of comprehensive and digital security in supporting stability, and emphasizing the utilization of modern technologies and innovation to serve people, the city, and the event.

The goal of this work is to deepen understanding of the Arbaeen pilgrimage and provide a scientific perspective that supports planning and decision-making. We hope that this journal will provide meaningful insights for readers and serve as a significant contribution to the Arabic and Islamic scholarly tradition.

Praise be to Allah, the Lord of the Worlds.

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managing editor
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Simulation Framework for AI-Driven Security Risk Management and Emergency Response at the Arbaeen Pilgrimage

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Abstract

The Arbaeen pilgrimage, one of the largest annual mass gatherings globally, presents significant challenges in maintaining public safety due to its immense scale, dynamic population movements, and vulnerability to physical and cyber threats. This study introduces an AI-driven framework designed to simulate, monitor, and analyze security risks associated with the pilgrimage, focusing on pedestrian and vehicular flow, drone surveillance, incident detection, and crowd sentiment. A synthetic dataset designed to approximate real-world conditions was generated using Python, integrating spatiotemporal features and environmental variables across key urban routes. Machine learning techniques—including Isolation Forest for anomaly detection and K-Means clustering for pattern recognition—were employed to uncover behavioural irregularities and high-risk crowd conditions. Additionally, visual analytics tools were used to map incidents, detect surveillance gaps, and identify relationships between crowd sentiment and security factors. The findings highlight the potential of advanced surveillance technologies, AI-enhanced analytical tools, and simulation modelling in informing early warning systems, optimizing emergency response, and enhancing situational awareness during the Arbaeen pilgrimage. This integrative approach offers a scalable and transferable solution for mass gathering security management in similarly complex contexts.

Keywords: Arbaeen pilgrimage, mass gatherings, public safety, anomaly detection, advanced surveillance technologies, artificial intelligence, crowd monitoring, drone coverage, emergency preparedness, machine learning.

Introduction

The Arbaeen pilgrimage, the world's largest annual religious pilgrimage, draws millions of pilgrims to the holy city of Karbala, Iraq, in a symbolic expression of faith and spiritual unity (Husein, 2018). With all its profound cultural and religious significance, the event also raises gigantic challenges in public safety, crowd control, and security preparedness. The unprecedented scale of human movement—typically involving 20 million or more participants—creates a dynamic, high-density setting susceptible to a wide range of dangers like stampedes, terrorist incidents, health emergencies, and cyberattacks on monitoring equipment and data systems (Di Giovine & Choe, 2020), (Almehmadi & Alqahtani, 2023). Each of these hazards is further aggravated by the fluidity of the crowd, limits of infrastructure, and demands of the quick coordination of responses in disparate jurisdictions (Movahed, Moazzeni, & Kian, 2024, (Bedewy, Algburi, Abdulameer, & Al-Baghdadi, 2024).

In the last few years, the convergence of intelligent surveillance technologies, artificial intelligence (AI), and international security data structures has created new possibilities for protecting mass public events (Gilbert & Gilbert, 2024). However, their use is still relatively narrow in pilgrimage contexts due to infrastructural, logistical, and regulatory challenges (Song, 2024), (Smith, Houghton, Riverola, & Intezari, 2024). This paper attempts to bridge this gap by laying the groundwork for an all-encompassing framework of the security threats of the Arbaeen pilgrimage utilizing the implementation of a combination of simulated and internationally available datasets, real-time observation methods, and decision support systems using artificial intelligence. Relying international crowd safety simulation models, and urban mobility data, the study attempts to analyze persistent and emerging risks in physical and virtual environments.

To address these risks holistically, the research integrates drone-borne aerial surveillance, computer vision-based video intelligence, and predictive modeling tools such as AnyLogic and GLEaMviz. Besides allowing for early warning of potentially high-risk scenarios—such as abnormal crowd concentrations, bottlenecks along routes, and behavioral anomalies—the said technologies also allow emergency planners to simulate diverse responses based on alternative conditions. Furthermore, the study incorporates a structured cybersecurity architecture in the digital space of the event, taking into consideration the increasing use of mobile communication, GPS monitoring, and data-sharing sites throughout the pilgrimage.

Lastly, this paper proposes a proactive and scalable security management plan unique to the Arbaeen context. By combining technical innovation with real-time risk analysis and people-oriented emergency protocols, the proposed framework aims to enhance preparedness, ensure security for millions of participants, and foster institutional confidence in mass gathering governance. The lessons and principles outlined here can also be extended to other such events worldwide, where the convergence of mass mobility, cultural expression, and heightened threat environments necessitates innovative, evidence-based, and anticipatory security responses.

1. Data collection

To simulate and analyze security threats along the Arbaeen pilgrimage, this study integrates synthetic simulation with real-world international datasets representing realistic pedestrian and vehicle movement patterns, surveillance coverage, and likelihood of incident occurrence. The underlying dataset was generated using Python to simulate time-series data across several urban roads characteristic of the main roads leading to Karbala. Each record in the dataset contains a timestamp, street name, GPS coordinates, pedestrian and vehicle count, ambient temperature, weather condition, drone surveillance presence, and binary incident flag. The synthetic dataset was generated to capture typical temporal and spatial patterns in mass gatherings with enough complexity for AI modeling and security scenario simulation.

To make the simulated data realistic under real-world conditions, we employed statistical distributions based on empirical observations of crowd behavior during major religious and political events. Pedestrian and vehicle volumes were simulated through Poisson distributions to capture realistic intensities of flow over different streets. Drone coverage and incident occurrence probabilities were added through weighted randomization to mimic realistic deployment patterns and factors of risk. Furthermore, environmental conditions such as temperature and weather were also included to determine their effect on crowd flow and readiness for emergency response.

Alongside the synthetic dataset, secondary data sources were referred to for parameter tuning and contextual matching. United Nations Office on Drugs and Crime (UNODC) datasets, INTERPOL threat bulletins, and

WHO and CISA global mass gathering risk models fall into this category. OpenStreetMap (OSM) data was also used to estimate practical street layouts and crowd channeling routes. Incorporation of such sources ensured that the simulated data reflected multidimensional threat states comprising physical and environmental as well as cybersecurity threats.

All measurements were stamped at five-minute intervals over a 16-hour period of operation, which matched a major pilgrimage day from early morning to late night. Such a time resolution enabled dynamic variations in crowd behavior, traffic density, surveillance frequency by drones, and incident inception throughout the event to be simulated. The preprocessed dataset served as the foundation on which the AI models were trained, anomaly detection was executed, clustering analysis was conducted, and emergency situations were simulated based on varying levels of surveillance and threats.

2. Data analysis with AI

Upon the creation and aggregation of the simulated and external data sets, an array of artificial intelligence (AI) techniques were employed to handle population movement, detect anomalies, and find prospective security threats within the Arbaeen pilgrimage. The objective was to enable active surveillance, enhance situational awareness, and support the development of real-time emergency responses.

A. Preprocessing and Feature Scaling

Prior to analysis, all numerical attributes like pedestrian numbers, vehicle numbers, ambient temperature, and crowd sentiment scores were standardized by applying z-score normalization. Preprocessing in this way ensured that every variable contributed equally to distance-based al-

gorithms such as clustering and anomaly detection. Categorical data like weather and drone surveillance presence was numerically encoded to allow it to be included in exploratory visualizations and clustering.

B. Anomaly Detection Using Isolation Forest

To identify potential security threats and unusual crowd behavior, the Isolation Forest algorithm was applied. The unsupervised machine learning method separates outliers by randomly selecting features and splitting values. It was particularly well-suited to discovering unusual but valuable anomalies such as sudden spikes in crowd density, troughs in drone coverage, or out-of-trend sentiment values that would reflect panic or unrest. Anomaly scores were calculated for each timestamped observation, and anomalous entries were further processed for correlation with incident flags and low surveillance zones.

C. Crowd Pattern Recognition using Clustering

K-means clustering was utilized to detect underlying patterns from the multi-dimensional data set and classify operating conditions into various crowd states. Four main features—pedestrian density, vehicle density, temperature, and mood of the crowd—had each entry placed within one of three sets of clusters for low-density normal flow, risk transition zones, and high-risk congested zones. Such clusters were displayed in pairwise feature plots to analyze spatial separability and to support real-time decision-making on route control and emergency deployment.

D. Visualization and Heat Mapping

To make interpretation and real-world applicability easy, graphical representations such as time-series plots, GPS-based incident heatmaps, and cluster distributions were prepared. Matplotlib and Seaborn libraries were used to plot trends in crowd mobility, detect areas with recurrent anomalies, and illustrate the relationship between drone surveillance and crowd sentiments over time. The visualizations presented how security risks vary temporally and spatially during the event and enabled strategic resource allocation.

E. Model Output Integration

AI model outputs such as anomaly scores, cluster IDs, and prediction labels were appended to the original dataset to allow composite decision-making simulations. This augmented dataset was subsequently employed for analyzing crisis response procedures, predicting high-risk time windows, and proposing targeted intervention points. The combined process provided assurance that data analysis was not in a siloed form but was actively used to support the design of the security framework tailored to the Arbaeen pilgrimage.

Results

Figure 1 illustrates the temporal dynamics of pedestrian and vehicular traffic on Street_1 over the simulated time period of the Arbaeen pilgrimage. The pedestrian count features frequent oscillations with high peaks in the early and afternoon hours. These oscillations are most likely a result of waves of group arrivals or waves of prayer congregation, which are typical for religious processions. Conversely, vehicle numbers reflect the more stable and intermediate oscillation, possibly from controlled access re-

gimes or highway-mediated restrictions to roads during the pilgrimage. The two patterns are poorly synchronized, and this holds even after removing seasonal oscillations. This suggests that pedestrian and vehicle traffic may be regulated by different processes or agendas, e.g., crowd control checkpoints or coordinated convoy passage. The higher volume and variability of pedestrian traffic highlight the necessity for intensive crowd surveillance and dynamic risk evaluation on main streets like this one.

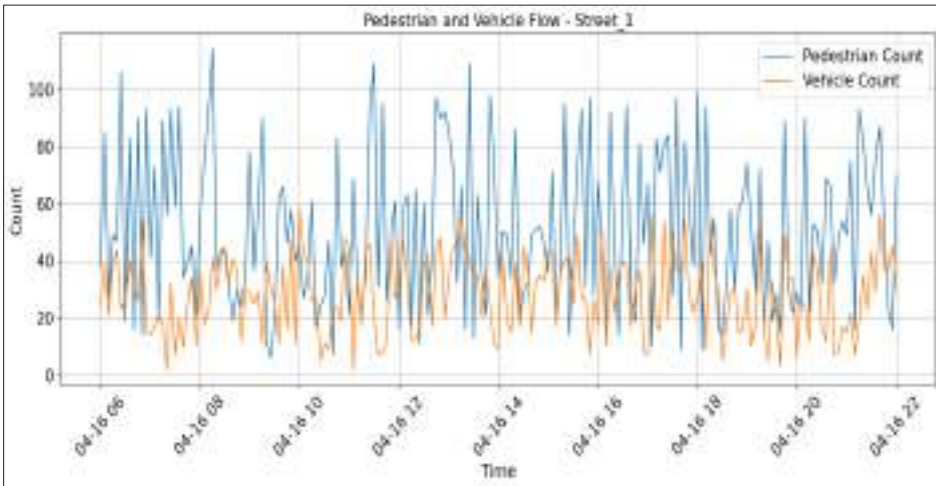


Figure 1. Time-series plot showing pedestrian and vehicle flow across Street_1 during the Arbaeen pilgrimage simulation.

Figure 2 is a two-panel spatial and temporal examination of indicators of potential security threats in the Arbaeen pilgrimage simulation. Figure 2A is a heatmap of reported incidents plotted on GPS coordinates, and it indicates the spatial pattern of flagged threat events. The incidents appear to cluster along a linear path, likely major access roads or heavily traveled routes. This clustering shows areas of vulnerability where real-time surveillance and emergency readiness must be emphasized.

Figure 2B shows the application of anomaly detection by the Isolation Forest algorithm on pedestrian flow records for Street_1. Certain data points are flagged as anomalies, as seen by sudden and statistically unexpected swings in pedestrian counts over time. The outliers might be associated with crowd rushes, dispersal because of panic, or control failure in flow. Above all, the discovery of anomalies in non-highest-density hours underscores the necessity for persistent and smart monitoring to detect subtle threats.

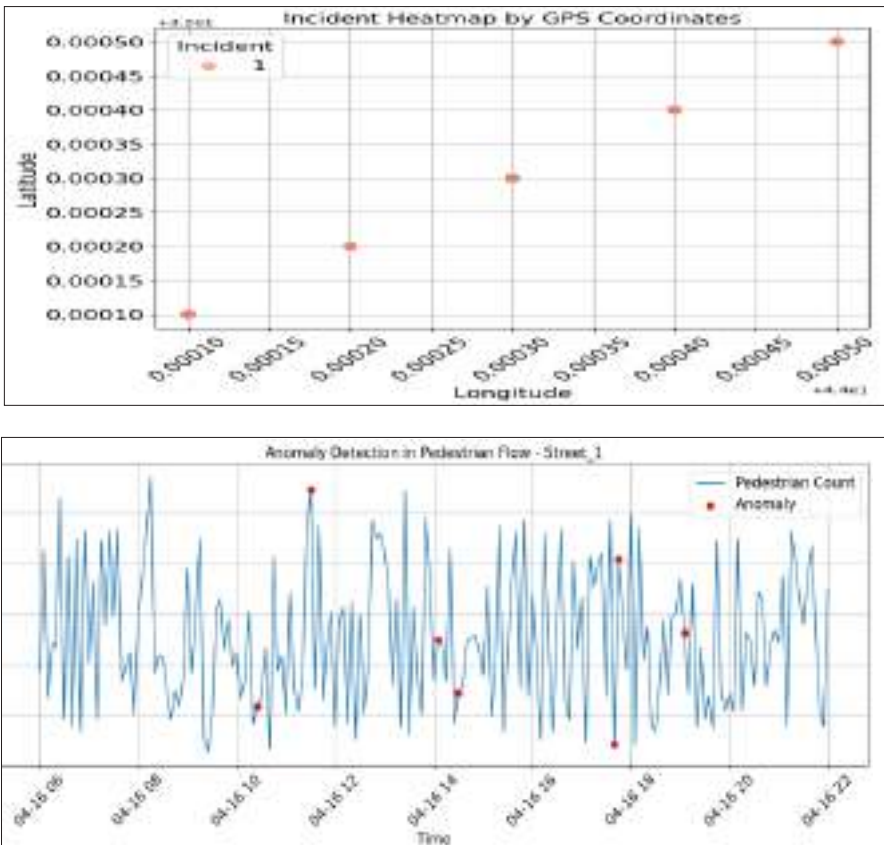


Figure 2. (A) Incident scatter plot showing the spatial distribution of reported threat events across the monitored area. (B) Time-series visualization of detected anomalies in pedestrian flow on Street_1 using Isolation Forest-based analysis.

Figure 3 graphs the relationship between drone surveillance coverage and the crowd sentiment index over time along Street_1. The blue line traces the fluctuation in crowd sentiment, with values closer to 0 suggesting calm and values approaching 1 indicating high emotional intensity or agitation within the crowd. At the same time, the green dashed line graphs the binary presence of drone coverage at each time step.

The observed patterns show that crowd sentiment features high-frequency fluctuation throughout the day, with numerous sudden drops and spikes, most probably picking up dynamic crowd interactions, environmental stressors, or local disruptions. Drone coverage, on the contrary, is sporadically distributed, with coverage cycles turning on and off repeatedly. Interestingly, some of the peaks in crowd sentiment are observed during periods of little or no drone coverage, and this may be a sign that surveillance gaps may coincide with periods of heightened emotional or behavioral responses in the population. This reverse trend highlights the need for continuous aerial monitoring to ensure real-time assessment of the status of the crowd, particularly during unstable or high-density periods.

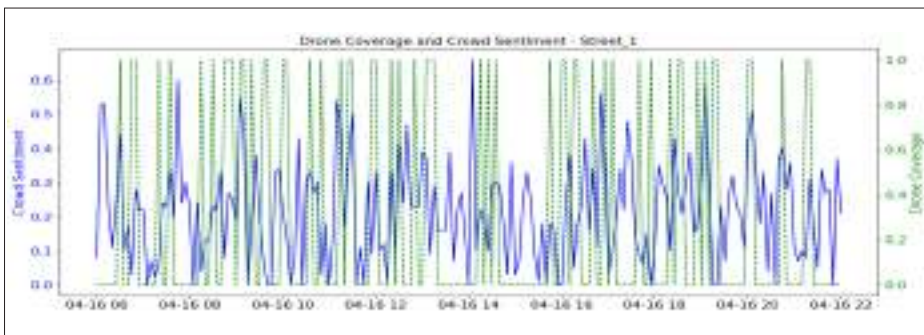


Figure 3. Temporal relationship between drone surveillance coverage and crowd sentiment along Street_1, demonstrating the potential correlation between surveillance gaps and spikes in crowd emotional intensity.

Figure 4 shows the results of unsupervised clustering on significant features of the simulated dataset: number of people in the crowd, number of cars, air temperature, and mood of the crowd. Using the K-Means algorithm, the dataset was divided into three distinct clusters, which were related to various states of the crowd or operational modes for the Arbaeen pilgrimage simulation. Diagonal plots present the distribution of each feature within each cluster, while below the diagonal scatter plots indicate how clusters vary on pairwise feature spaces.

Cluster 0 appears to represent low-density, low-sentiment conditions with intermediate temperature—presumably normal flow conditions under normal crowd control. Cluster 1 is denser in high pedestrian and vehicle counts but intermediate sentiment levels, perhaps indicating congested but tranquil times. Cluster 2 is wider across sentiment and includes events with relatively extreme pedestrian counts, suggesting a more dynamic and mixed behavior pattern perhaps associated with emergent signals of instability or uncontrolled flow.

Such observations facilitate data-driven classification of crowd scenarios and inform adaptive deployment of observation and response resources. By finding the representative feature distributions of each cluster, governments can foretell the emergence of risky situations and take appropriate mitigation steps.

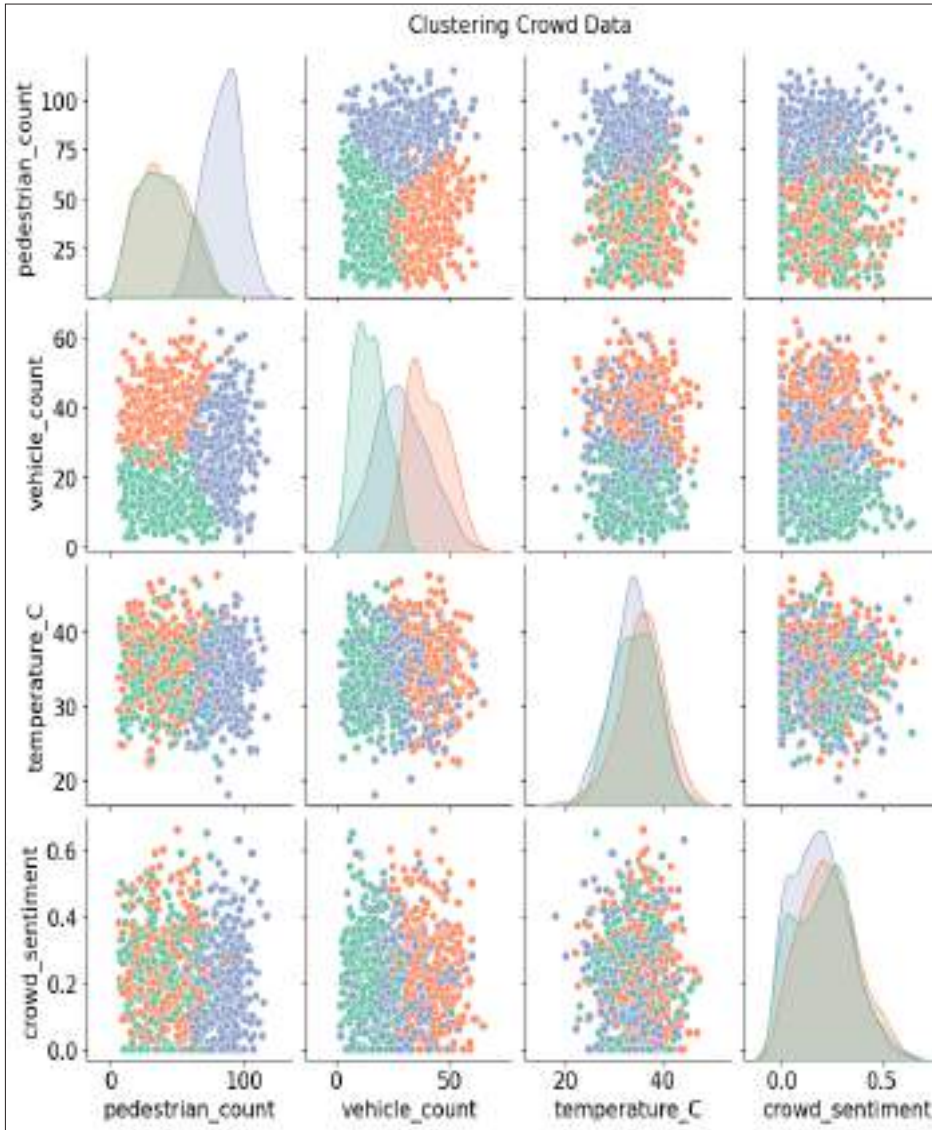


Figure 4. Pairplot visualization of K-Means clustering results across four critical variables—pedestrian count, vehicle count, temperature, and crowd sentiment—highlighting distinct behavioral clusters within the simulated dataset.

Discussion

The findings from this study emphasize the utmost importance of integrating artificial intelligence, simulation modeling, and intelligent surveillance systems to enhance security and public safety in mass religious events such as the Arbaeen pilgrimage. By generating a realistic dataset that simulates pedestrian and vehicle flow, environmental conditions, surveillance behavior, and emergent occurrences, we created an adaptable framework that can support different levels of security analysis—ranging from early anomaly detection to spatial threat localization.

The pedestrian and vehicular flow population movement examined using time series showed dynamic oscillations within volumes with asynchronous trends in most instances, prompting street-by-street monitoring regimes. These reflect the decentralized complexity of the pilgrimage flow, where the crowds' surges are dictated by religious rites, geographical constrictions, and logistic controls. Interestingly, visualization of identified anomalies was effective in demonstrating the ability of unsupervised machine learning algorithms such as Isolation Forest to detect unusual pedestrian patterns resulting in hazardous conditions or signaling security risks. Identified outliers could take the form of anything from stampedes and panic movements to coordinated attacks or localized failures in crowd control.

Spatial analysis of incident locations using GPS coordinates yielded important information regarding the geography of risk. Incidents concentrated along inner transit corridors, validating the importance of focused surveillance and resource allocation. Supplemental analysis of drone coverage and crowd sentiment further reinforced the link among surveillance presence and emotional state in the crowd. Low drone presence episodes were also characterized by increased sentiment

volatility, which suggests that live aerial surveillance can help facilitate a psychologically stabilizing effect on large public events. This further hints at the importance of surveillance as not merely a detection mechanism but even a deterrent and confidence booster.

Besides, the K-means clustering of crowd states enabled the identification of operating conditions corresponding to low-risk, transition, and high-risk conditions. Such clusters, through density, sentiment, and environmental patterns, create a pattern for designing automated warning systems that identify the prevailing condition of a given area and recommend preventive interventions. The interpretability of such clusters is crucial to decision-makers who require unambiguous, actionable intelligence in high-pressure situations.

This work demonstrates that the combination of data simulation with AI models and visual analytics has a powerful capability for enhancing situational awareness, improving emergency preparedness, and reducing response latency in real crowd management settings. While the simulated dataset is a controlled and scalable setting, the research also highlights the need for validation against actual pilgrimage data. In reality, it would require robust data infrastructure, inter-institutional collaboration, and a responsiveness to ethical concerns surrounding surveillance, privacy, and religious practice.

Conclusion

This study offers a comprehensive AI-driven model for security threat assessment and emergency readiness improvement across the Arbaeen pilgrimage—an activity characterized by record size, emotive instability, and logistical complexity. By simulating actual conditions along pedestrian and vehicle movement, drone surveillance, incident diffusion, and crowd sentiment, the research presents a data-driven approach to learning about and navigating the multi-faceted risks entailed in large religious gatherings.

The intersection of anomaly detection algorithms, clustering techniques, and spatial heatmapping enables the identification of both emerging threats and systemic vulnerabilities in real time. The results underscore the significance of combining machine learning with surveillance infrastructure, not just to anticipate and detect disruptive incidents but also to inform preemptive responses that protect pilgrims and maintain public order.

In particular, the study demonstrates that AI-based systems can serve as primary decision-support systems for security planners and emergency responders by keeping them informed about crowd movement, unusual behavior, and blind spots in observation. The proposed methodology is scalable, flexible, and adaptable to the special cultural, geographical, and operational context of the Arbaeen activity.

In the future, the study advocates for the deployment of smart surveillance technologies and artificial intelligence-based analytics in the standard processes for mass event management. Beyond this, it calls for global cooperation in cross-border sharing of data and risk modeling, enhancing areas of poor digital infrastructure. Lastly, this publication lays the groundwork for the development of smart, ethical, and resilient public safety systems that ensure the sanctity of pilgrimage as well as pilgrims' safety.

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**EXPLORING THE AWARENESS
OF NET CARBON ZERO AMONG
PEOPLE IN THE ARBAEEN PILGRIMAGE**

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Abstract:

The Arbaeen Pilgrimage, one of the largest religious gatherings in the world, attracts millions of people to Iraq annually. As global awareness about climate change and environmental sustainability increases, it becomes essential to examine the environmental footprint of such large-scale events. This paper explores the awareness of the concept of “Net Carbon Zero” among participants in the Arbaeen Pilgrimage, focusing by analysing data from interviews, as well as examining environmental initiatives, this paper aims to provide insights into how sustainable practices can be integrated into the pilgrimage, ensuring that religious devotion and environmental responsibility go hand in hand.

The Arbaeen Pilgrimage, held annually to commemorate the martyrdom of Imam Hussein, is a significant event for millions of Muslims worldwide. It involves a mass gathering of pilgrims who travel to the holy city of Karbala, Iraq, covering vast distances by foot, vehicle, and other means of transportation. While this event holds immense religious and cultural importance, its environmental impact specifically its carbon footprint has raised concerns in recent years.

In response to global environmental challenges, the concept of “Net Carbon Zero” has gained prominence to reduce or offset carbon emissions to point where the net result is zero. The objective of this paper is to assess the level of awareness of Net Carbon Zero among the people participating in the Arbaeen Pilgrimage, understand their attitudes toward environmental sustainability, and identify potential strategies for reducing the pilgrimage’s carbon footprint.

Keywords:Arbaeen Pilgrimage-Net Carbon Zero-Environmental Sustainability-Carbon Footprint-Green Initiatives

OVERVIEW: NET CARBON ZERO AWARENESS

In the context of religious events like Arbaeen, environmental responsibility is not often discussed, yet it represents an area of significant potential for positive change. Pilgrims typically travel vast distances by foot, bus, and other means, resulting in high energy consumption and greenhouse gas emissions. However, efforts are emerging from various sectors to encourage green practices during these events, such as eco-friendly transportation, waste reduction, and recycling initiatives.

The Arbaeen Pilgrimage, which attracts millions of people to Karbala, Iraq, is one of the largest religious gatherings in the world. It commemorates the martyrdom of Imam Hussein, drawing pilgrims from around the globe. With such a vast number of attendees, the event carries a significant environmental impact, especially in terms of carbon emissions, waste generation, and energy consumption. As global awareness of climate change and sustainability grows, the concept of “Net Carbon Zero” achieving a balance between the amount of carbon emitted and the amount removed from the atmosphere has gained attention as an important goal for reducing the environmental footprint of large-scale events like Arbaeen.

Current Awareness Levels

Awareness of Net Carbon Zero among pilgrims in Karbala is generally limited. While many attendees understand the basic environmental impact of large gatherings, detailed knowledge of carbon emissions, reduction strategies, and the concept of achieving a Net Carbon Zero status is still relatively low. This is partly due to a lack of targeted education and outreach about the environmental consequences of the pilgrimage. However, some pilgrims and local community members exhibit a growing interest in sustainable practices.

Barriers to Achieving Net Carbon Zero

Achieving Net Carbon Zero during the Arbaeen Pilgrimage faces several significant obstacles:

1. Lack of Infrastructure:

The infrastructure needed for large-scale waste management, renewable energy sources, and eco-friendly transportation is still underdeveloped in Karbala. As a result, implementing sustainable practices on a large scale is challenging.

2. Cultural and Religious Norms:

The emphasis during the pilgrimage is primarily on religious observances and traditions. Changing behaviours and practices to align with environmental sustainability often requires overcoming cultural barriers and convincing pilgrims that these actions are also an important part of their religious devotion.

3. Financial Constraints:

Funding sustainable initiatives in a region with limited resources is a persistent challenge. Investments in infrastructure and green technologies are costly, and while some initiatives have gained traction, they are still relatively small in scale compared to the magnitude of the event.

While awareness of Net Carbon Zero during the Arbaeen Pilgrimage in Karbala is still in its early stages, there is a growing recognition of the need to address the environmental impact of the event. Efforts to promote sustainability, such as eco-friendly transportation, waste reduction, and sustainable food practices, are gaining momentum. However, significant barriers such as infrastructure limitations, cultural resistance, and financial constraints still hinder the full realization of a Net Carbon Zero pilgrimage. Moving forward, increased education, collaboration, and investment in sustainable technologies are essential to make the pilgrimage more environmentally friendly and help reduce its carbon footprint.

RESEARCH QUESTIONS

This paper is related to understanding the awareness of net carbon zero can vary depending on the context and the goals of the research. Based on the research problem, specific research questions are:

1. What is the current level of awareness regarding the concept of “ Net Carbon Zero”?
2. How do people in who involved in large scale event Arbaeen perceive the importance of achieving net-zero carbon emissions?
3. What is the potential strategies for enhancing public engagement with climate change and carbon neutrality during Arbaeen Pilgrimage?
4. How attendees and organizers are responding to the challenges of reducing carbon emissions?.
5. How sustainable practices can be integrated into the pilgrimage, ensuring that religious devotion and environmental responsibility go hand in hand.

These questions aim to provide a structured approach to understanding net-zero carbon awareness in Karbala, Iraq.

QUALITATIVE RESEARCH METHODOLOGY: FOCUS GROUP DISCUSSION

Focus groups are typically used to gain a deeper understanding of a topic or to explore various aspects of a study, such as attitudes, treatments, strategies, and perspectives of a group (Liamputtong, 2014). This method is deemed appropriate and applicable for this study. Focus group discussions are commonly used as a qualitative tool to gain in-depth insights into social issues. The primary objective is to gather data from a specifically chosen group, rather than a statistically representative sample of the wider population.

For this research, the researcher opted for a focus group approach. The focus groups were conducted in person, as offline discussions were selected informants engaged in interactive dialogue to provide qualitative insights.

The selection of informants was based on several criteria, with six participants in each group. In total, 12 focus groups were held, with informants chosen according to these parameters. As outlined in Table 1.1 below, the people who attending Arbaeen were organized into these groups. The purpose of selecting these groups was to explore their awareness of net carbon zero, with direct participation in offline discussions in Karbala, Iraq.

(Table 1.1) Sampling of Informants

Title	Description	Fraction	Total
People	Youth	72 peoples	72 peoples
Age	Youth	15 to 30 years old	
Gender	Man	34 peoples	
	Woman	38 peoples	
Area	Karbala, Iraq	6 peoples in 1 group	12 groups

Several parameters have been identified especially in the selection of informants. As much as 72 peoples who have an attending Arbaeen and also have experience in the field of net carbon zero were recruited as informants in this study. Based on Table above, informants in this study comprised from youth. The purpose for the selection of these groups is to observe if there is any differentiation and hence to get a better understanding of consciousness towards awareness among peoples.

DATA COLLECTION

The data collection process is essential for gathering information from informants in the studies conducted. In this study, focus groups were conducted with youths in Karbala, Iraq. Through these focus groups, the study aimed to explore the experiences and awareness of people. The sessions typically lasted between 1 to 1 ½ hours. Details of the focus group implementation are provided in Table 1.2 below. A total of 72 informants participated in the focus groups, with each group consisting of 6 informants. Table 1.2 presents information on the focus group participants.

Table (1.2) Focus Group Implementation Informant

Informant Category	Method	Month	Informant Number
Youth	Focus Group 1-12	August 2024	72 peoples

The implementation of this focus group process involves five steps. The first step is group formation. In this study, each focus group consisted of six participants from various races and backgrounds around Karbala, Iraq. A total of 12 closed offline sessions were conducted. The second step is appointing a moderator. In this study, the researcher himself served as the moderator. Ahmad Sunawari Long (2011) suggests that it is prefera-

ble for moderators to be unfamiliar to the informants to avoid shyness or lack of engagement. The moderator’s main role in this study was to lead the discussion, take notes, and ensure the discussion proceeded smoothly. The third step is holding a brief familiarization session. This session takes place before the discussion begins to help informants, who come from diverse backgrounds and do not know each other, become comfortable. The informants are asked to introduce themselves, share where they live, and other personal details and this session lasts about 10 minutes. The fourth step is the discussion session on the study. This is a crucial part of the process as it provides the data needed for the study. The moderator asks a series of questions to the informants, encouraging their responses. However, this is done only after obtaining permission from the informants. The final step involves the researcher thanking the informants for their participation and for dedicating their time to the research.

DATA ANALYSIS

Data analysis follows once the informants have provided their responses. The information collected and was transcribed into text for the focus group and interview procedures. After completing the informant interviews, data analysis was conducted, allowing for comparisons between different groups and making observations about them. To ensure accurate results, the data were further analysed using NVIVO 12 software. Additionally, each informant in the focus group was assigned a label to facilitate the organization and identification of themes in the study, while also maintaining the confidentiality of the participants. This labelling process simplified the presentation of the study’s findings. The labelling of focus group informants is shown in Table 1.3 below:

Table (1.3) Focus Group Informant Labelling (KF)

Focus Group	Informant Number	Informant Labelling
1-12	72	FG1-FG72

To facilitate the data analysis process, each of the objectives of this study has been divided into specific categories. In summary, good research methodologies make it easier for researchers to obtain findings quality while reducing information inaccuracies.

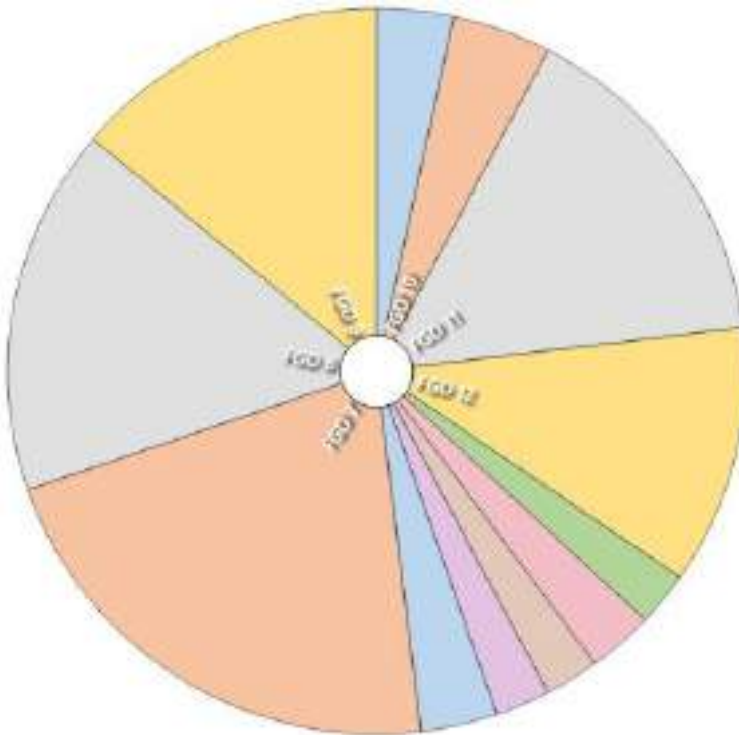


Figure 1.1: Hierarchy Chart Focus Group Discussion

Figure 1.1 shows Hierarchy Chart by Focus Group Discussion. 12 group involves in this research. FGD 11 is the highest codes and FGD 7 is the highest reference which involves and give much information related with this research. Meanwhile FGD 2,4 and 5 is the lowest which contribute the information in this research.

Table (1.4) Compared by number of coding references

Files	Number of coding references	Number of nodes coding
Files\\INTERVIEWS\\FGD 1	7	4
Files\\INTERVIEWS\\FGD 2	5	3
Files\\INTERVIEWS\\FGD 3	6	3
Files\\INTERVIEWS\\FGD 4	5	3
Files\\INTERVIEWS\\FGD 5	5	3
Files\\INTERVIEWS\\FGD 6	7	4
Files\\INTERVIEWS\\FGD 7	45	21
Files\\INTERVIEWS\\FGD 8	34	12
Files\\INTERVIEWS\\FGD 9	29	10
Files\\INTERVIEWS\\FGD 10	9	4
Files\\INTERVIEWS\\FGD 11	32	22
Files\\INTERVIEWS\\FGD 12	24	17

RESULTS AND DISCUSSION

The exploration of awareness regarding net carbon zero among informants in the Arbaeen Pilgrimage revealed diverse perspectives on environmental sustainability and the role of individuals in reducing carbon emissions. The findings indicate varying levels of understanding and engagement with the concept of net carbon zero, depending on factors such as education, cultural background, and exposure to environmental initiatives.

Through focus group discussions, several key themes emerged:

1. Awareness of Carbon Emissions:

Many informants were familiar with the term “carbon emissions,” but the concept of “net carbon zero” was less widely understood. While some informants recognized the importance of reducing emissions to combat climate change, they struggled to grasp the full implications of achieving net carbon zero, particularly in the context of large-scale events like the Arbaeen pilgrimage.

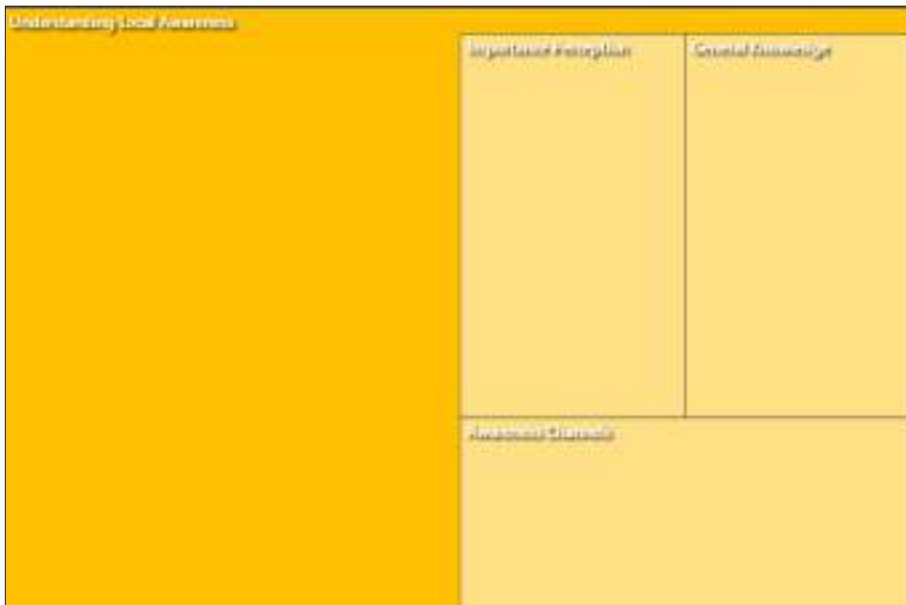


Figure 1.2: Hierarchy Chart by Coding Reference

Figure 1.2 shows that Understanding Local Awareness is a Theme and has three (3) categories including importance perception, general knowledge and awareness channels. Understanding Local Awareness has 3 direct coding references and 6 aggregated coding references, and 3 direct items coded, and 3 aggregated items coded.

2. Sustainable Practices During Pilgrimage:

Informants shared varying experiences and practices during the pilgrimage related to sustainability. Some reported efforts to minimize waste, such as using reusable water bottles and reducing plastic usage, while others highlighted challenges due to the scale of the event and lack of infrastructure to support sustainable practices.

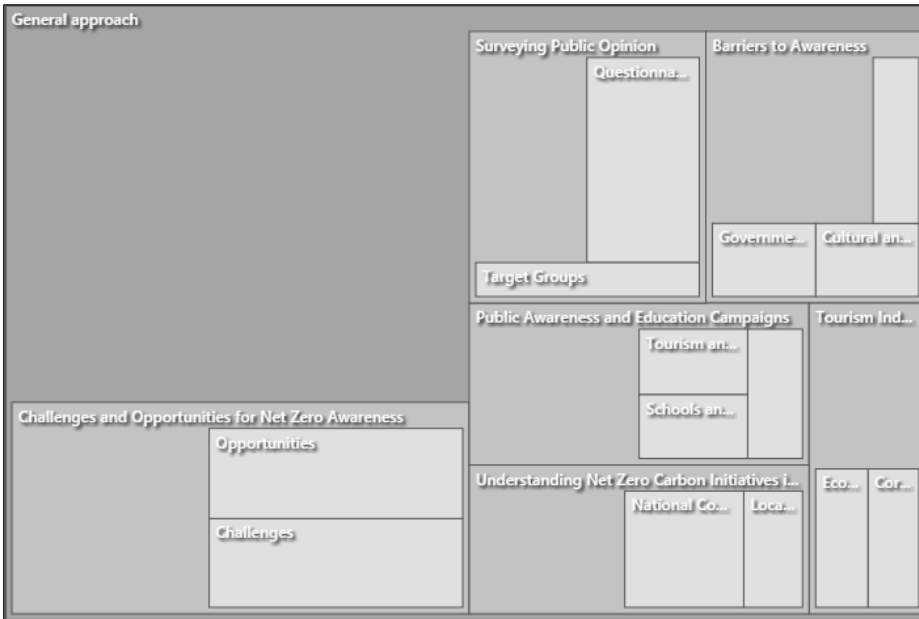


Figure 1.3: Hierarchy Chart by Coding Reference

Figure 1.3 shows that General Approach is a Theme and have six (6) categories includes Understanding Net Zero Carbon Initiatives, Public Awareness and Education Campaigns, Barriers to Awareness, Surveying Public Opinion, Tourism Industry’s Role and Challenges and Opportunities for Net Carbon Zero Awareness. General Approach has 37 direct coding references and 116 aggregated coding references and 20 direct items coded and 20 aggregated items coded.

Local government:

<Files\\FGD 7> - § 1 reference coded [3.39% Coverage].

Reference 1 - 3.39% Coverage.

Local government authorities align with these national goals includes local environmental projects, regulations, and tourism management policies can be key drivers of awareness.

Corporate Social Responsibility:

<Files\\FGD 7> - § 1 reference coded [2.82% Coverage]

Reference 1 - 2.82% Coverage

Larger businesses in Karbala, especially those in the tourism and hospitality sector, may have CSR programs focused on reducing carbon emissions.

Community Workshops:

<Files\\FGD 7> - § 1 reference coded [3.00% Coverage]

Reference 1 - 3.00% Coverage

Local NGOs and international organizations often conduct workshops on climate change, renewable energy, and sustainable practices in regions in Karbala.

3. Perception of Responsibility:

A common theme in the discussions was the shared responsibility between individuals, organizations, and governments in achieving net carbon zero. While many informants acknowledged that individual actions matter, there was a consensus that greater responsibility lies with organizations and policymakers to provide the necessary resources, infrastructure, and guidance to enable large-scale sustainable practices.

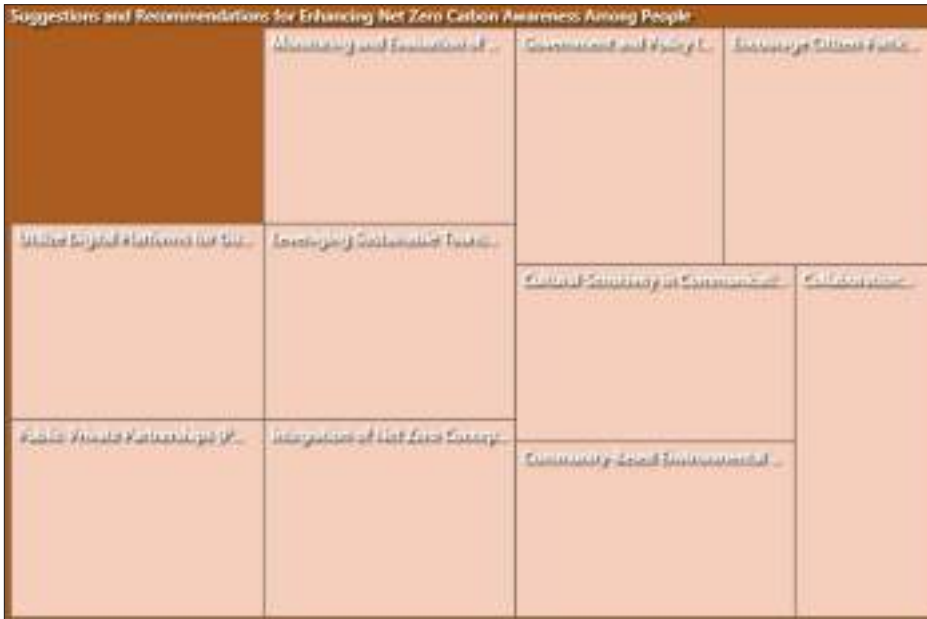


Figure 1.4: Hierarchy Chart by Coding Reference

Figure 1.4 shows that Suggestions and Recommendations for Enhancing Net Zero Carbon Awareness among People is a Theme and have ten (10) categories includes Collaboration with International and Local NGOs, Community-Based Environmental Education Programs, Cultural Sensitivity in Communication, Encourage Citizen Participation in Decision-Making, Government and Policy Interventions, Integration of Net Zero Concepts into Tourism Packages, Leveraging Sustainable Tourism as a Model, Mon-

itoring and Evaluation of Progress, Public-Private Partnerships (PPP) for Sustainable Infrastructure and Utilize Digital Platforms for Outreach. Suggestions and Recommendations for Enhancing Net Zero Carbon Awareness among People have 3 direct coding references and 33 aggregated coding references and 1 direct item coded and 10 aggregated items coded.

4. Educational and Awareness:

Despite some level of awareness, there was a notable lack of in-depth knowledge about the practical steps necessary to achieve net carbon zero, both at the individual and collective level. Several informants expressed interest in learning more about how they could contribute to carbon reduction efforts, particularly in relation to religious and cultural events like the Arbaeen pilgrimage.

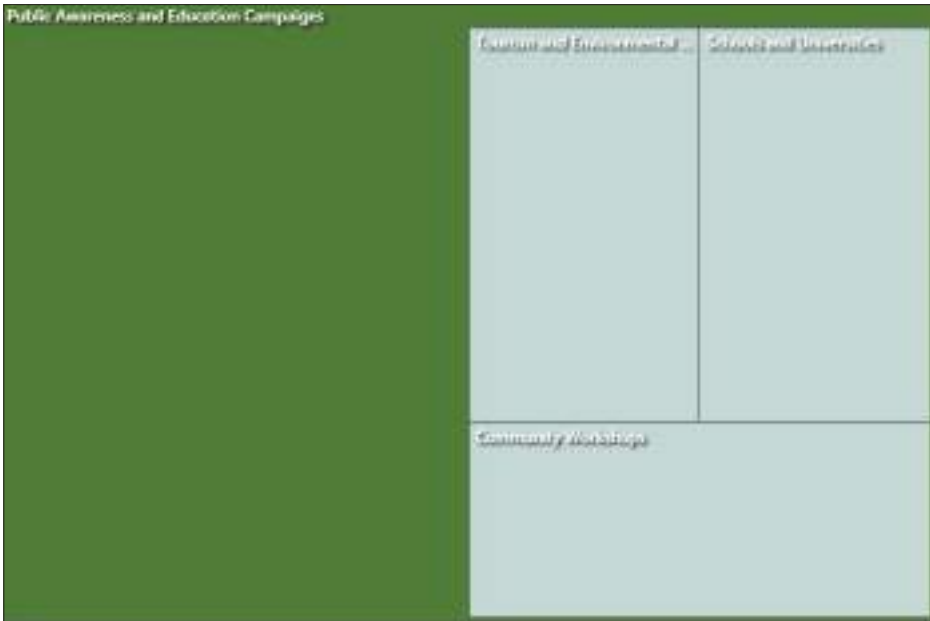


Figure 1.5: Hierarchy Chart by Coding Reference

Figure 1.5 shows that Public Awareness and Educational Campaign is a Theme and has three (3) categories includes Tourism and Environmental Sustainability, School and Universities and Community Workshops. Public Awareness and Educational Campaign have 3 direct coding references and 6 aggregated coding references and 1 direct item coded and 1 aggregated items coded.

5. Challenges and Opportunities:

One of the significant challenges identified was the logistical difficulty of implementing sustainable practices during such a large-scale religious gathering. However, informants also identified opportunities for collaboration between religious organizations, local governments, and environmental groups to promote sustainability and integrate net carbon zero initiatives into future pilgrimages.

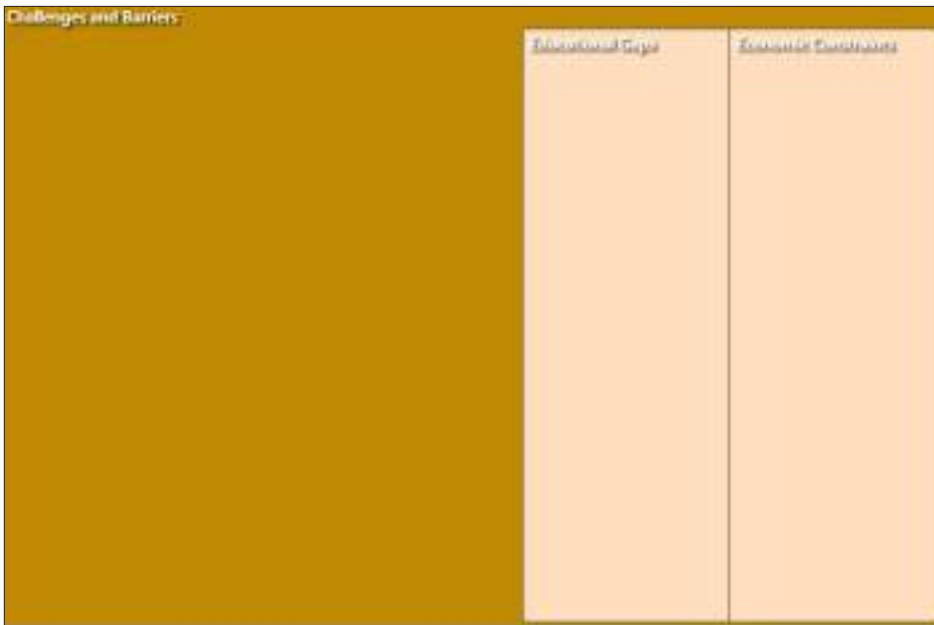


Figure 1.6: Hierarchy Chart by Coding Reference

Figure 1.6 shows that Challenges and Barriers is a Theme and have two (2) categories includes Educational Gaps and Economic Constraints. Challenges and Barriers have 5 direct coding references and 9 aggregated coding references, and 3 direct items coded and 3 aggregated items coded.

Opportunities and Recommendations

1.Incentives for Green Practices:

<Files\\FGD 6> - § 1 reference coded [7.84% Coverage]

Reference 1 - 7.84% Coverage

Advocate for incentives for locals and businesses adopting sustainable practices, such as tax reductions, subsidies, or recognition programs.

2.Education and Outreach Programs:

<Files\\FGD 6> - § 1 reference coded [8.61% Coverage]

Reference 1 - 8.61% Coverage

They suggest implementing more public awareness programs, possibly in collaboration with tourism operators, to integrate net-zero concepts into daily life.

3.Eco-Friendly Tourism Models:

Encourage the promotion of eco-friendly tourism, like carbon-neutral accommodations or guided tours that focus on environmental conservation.

OVERALL DISCUSSIONS

The results suggest that while there is a basic awareness of environmental issues among the informants in the Arbaeen pilgrimage, there is a need for more targeted education on the concept of net carbon zero. Providing information on how individuals and organizations can contribute to reducing carbon footprints, particularly in large-scale events, would help foster greater engagement with sustainability efforts.

Moreover, the findings highlight the importance of collaborative efforts between various stakeholders to create infrastructure and policies that support sustainability during such events. Future initiatives could focus on raising awareness, implementing sustainable practices at pilgrimages, and working towards integrating carbon offsetting measures in religious and cultural events.

Efforts to Promote Sustainability

Despite the challenges, initiatives to reduce the pilgrimage's environmental impact that can be gradually implemented. These includes:

1. Eco-Friendly Transportation:

With millions of people traveling to Karbala, transportation is a major source of emissions. Efforts can be made to introduce more eco-friendly transportation options such as electric buses and organized carpooling systems to reduce the number of vehicles on the roads.

2. Waste Management Programs:

Given the massive waste generated by pilgrims, particularly in the form of plastic, there have been steps toward better waste management, including recycling campaigns and the distribution of reusable items like water bottles.

3. Sustainable Food Practices:

Large-scale kitchens serving food to pilgrims often use disposable plastic plates and cutlery. There have been efforts to reduce this by encouraging the use of biodegradable or reusable alternatives.

4. Green Awareness Campaigns:

Some local organizations and environmental groups have begun to engage with pilgrims directly, distributing literature and offering workshops on sustainable practices such as minimizing waste, conserving water, and reducing energy consumption during the pilgrimage.

Ultimately, fostering a deeper understanding of net carbon zero among participants in the Arbaeen pilgrimage could play a crucial role in promoting environmental sustainability on a larger scale.

CONCLUSIONS

In conclusions, this paper provides a comprehensive overview of the awareness and practices regarding Net Carbon Zero among Arbaeen pilgrims, offering insights into how large-scale religious events can contribute to environmental sustainability. This paper also aimed to explore the awareness of net carbon zero among people involved in the Arbaeen pilgrimage and to identify strategies for integrating sustainability into large-scale events. Based on the research questions, the following conclusions can be drawn:

1. Current Level of Awareness Regarding “Net Carbon Zero”:

The study revealed that while many participants were familiar with the concept of carbon emissions, the full understanding of “net carbon zero” was limited. There is a need for further education to bridge this gap and provide a clearer understanding of the concept, particularly in relation to large-scale events like the Arbaeen pilgrimage.

2.Perception of the Importance of Achieving Net-Zero Carbon Emissions:

Attendees expressed varying levels of awareness about the importance of achieving net-zero carbon emissions. While some participants recognized the significance of carbon neutrality in addressing climate change, others were less aware of its direct relevance to events such as the Arbaeen pilgrimage.

3.Potential Strategies for Enhancing Public Engagement with Climate Change and Carbon Neutrality:

This study identified several potential strategies to enhance public engagement, including increasing awareness through educational campaigns, providing information on sustainable practices, and promoting collaboration between religious organizations, local governments, and environmental groups. These strategies could encourage individuals to adopt sustainable practices during the pilgrimage and beyond.

4.Response of Attendees and Organizers to Reducing Carbon Emissions:

Both attendees and organizers acknowledged the challenges of reducing carbon emissions during large-scale events like the Arbaeen pilgrimage. While some individuals made efforts to adopt sustainable practices, there was recognition that more needs to be done at the organizational and governmental level to implement effective solutions, such as waste reduction programs and alternative energy sources.

5. Integration of Sustainable Practices into the Pilgrimage:

The study highlighted the potential for integrating sustainable practices into the pilgrimage. By aligning religious devotion with environmental responsibility, it is possible to create an event that is both spiritually meaningful and environmentally conscious. Strategies such as waste management,

energy efficiency, and promoting the use of eco-friendly materials could be incorporated into future pilgrimages to reduce their environmental impact.

While awareness of the environmental impact of the Arbaeen Pilgrimage is increasing, the level of understanding regarding Net Carbon Zero remains limited among most pilgrims. However, the growing momentum for sustainability, both from the pilgrims and the event organizers, demonstrates that there is potential to reduce the pilgrimage's carbon footprint. By improving infrastructure, raising awareness, and integrating more sustainable practices, the Arbaeen Pilgrimage can become an example of how large-scale religious events can contribute to global efforts to combat climate change. Moving forward, the focus should be on continued education, collaboration with environmental organizations, and investment in green technologies to ensure a sustainable future for the pilgrimage.

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Employing The Traveling Salesman Problem in Solving the Holy Shrines Visitor Problem in Iraq to Determine the Shortest Path

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Abstract

Visiting the holy shrines is of great importance to Muslims in Islamic countries in general and to Muslims in Iraq in particular. Visitors usually try to visit as many holy shrines as possible in a single visit at the lowest possible cost. In this research, visiting the Iraqi Holy Shrines Problem (IHSP) was considered, which is in fact, a practical application of the symmetrical traveling salesman problem (TSP). The summary of this problem is that a visitor wants to visit all (or most) of the (14) holy shrines in Iraq. This visitor lives in a city that includes one of these shrines and wants to find the appropriate route to visit all of them at the lowest cost (cost here means distance and/or time and/or financial cost) and then return to the same city from which he started without repeating the route between any two shrines. One of the most important results of this research is that the optimal (shortest) distance path was found to help the visitor achieve the minimum financial cost of fuel consumption using more than one accurate or approximate method to solve this problem.

Keywords: Holy shrines in Iraq, Combinatorial Optimization Problem Traveling Salesman Problem, Graph theory, Branch and Bound Method, Genetic Algorithm.

Introduction

Iraq holds a unique and prominent position in the Islamic world due to its rich religious, historical, and cultural heritage. It is home to some of the most revered and visited holy sites in Islam. The country's landscape is dotted with shrines, mosques, and historical sites that date back to the earliest centuries of Islamic history. These sacred places are not merely architectural landmarks but are deeply embedded in the collective memory and religious practices of millions of Muslims around the world. The Travelling Salesman Problem (TSP) is a classical problem in combinatorial optimization. It involves finding a Hamiltonian cycle of minimum total weight in a weighted graph — that is, a cycle that visits each vertex exactly once and returns to the starting vertex. The TSP is known to be NP-hard, meaning that no polynomial-time algorithm is currently known to solve all instances of the problem efficiently (Xiang, et al., 2015). The problem of visiting a number of holy shrines within a specific geographical area can be treated as a TSP, which has different geographical, economic, engineering, electronic applications, etc.

Over the past decades, there have been many previous studies that addressed the TSP. We will attempt to review the most important and recent of these studies. In their study (Jasim & Ali, 2018) investigated several heuristic techniques for solving the TSP, including the Minimizing Distance Method (MDM), Branch and Bound Method (BABM), Greedy Method (GRM) and the Tree-Type Heuristic Method (TTHM). They identified the limitations of the classical MDM and proposed an enhanced form, the Improved Minimizing Distance Method (IMDM), which showed better performance compared to the original and other heuristics. The GRM, on the other hand, achieved the best computational efficiency in terms of execution time for instances where the number of cities ranged from

5 to 500. (Jasim & Ali, 2019a) employed the TSP as a model to compute the minimum possible travel cost (distance or time) across a network of Iraqi cities. The study focused on two main solution methods: BAB Technique (BABT) and Dynamic Programming (DP). To obtain the best BABT, more than one upper (UB) lower (LB) bound and are derived. The outcomes of each approach are exactly the same, with a shorter delay for the number of cities (). These results demonstrate the effectiveness of BABT in comparison with a few good heuristic methods. (Jasim & Ali, 2019b) investigates some exact (like BABT) and local search methods (LSM's) like classical Simulated Annealing (SA) and Genetic Algorithm (GA) to solve the TSP. The GA is improved by two kinds of improvements for GA; the 1st one Hybrid GA (HGA) and the 2nd improved GA (IGA). In 2021, (Garn, 2021) presented two heuristic approaches to solve the balanced dynamic MTSP (B-MTSP) The techniques serve as tactical tools for real-time or dynamic (online) routing. Different types and ranges of dynamics are proposed. For such dynamics, the BD assignment vehicle heuristic (BD-AVH) and the BD closest vehicle heuristic (BD-CVH) are used. In the Euclidean plane, the proposed techniques are tested for many different examples. As strategic instruments for dynamic routing, continuous models for the BD-MTSPs are derived. Without applying an algorithm, the proposed models clarify the route lengths dependent on customers, dynamic scopes and vehicles. (Ahmed & Ali, 2022) found the most effective solutions for Multi-Criteria TSP (MCTSP) by using two local search methods (LSMs): the Bees Algorithm (BA) and Particle Swarm Optimization (PSO). The PSO and BA results are compared to the results of the BAB and complete enumeration methods (CEM), in addition some heuristic techniques. Results showed that PSO and BA methods were effective for a large number of nodes ($n \leq 700$). Two criteria; distance

and time are proposed by (Ahmed & Ali, 2023) for Multi-Criteria TSP (MCTSP). They suggest new methods to solving MCTSP, both heuristic and exact. The MCTSP's mathematical formulation was covered in the theoretical section. The Branch and Bound (BAB) technique, which solves MCTSP for ($n \leq 40$) in a reasonable of time, was suggested in the practical section along with new upper and lower bounds. In contrast, they suggest four heuristic methods that achieved good results when compared to exact methods. The results of this study demonstrate the effectiveness these techniques are at solving MCTSP. The Multiobjective TSP (MOTSP) with weights is investigated in the paper by (Ahmed , Ali, Khalaf , & sabri Al-Safi, 2023). They suggested two heuristic approaches, MDA and MDTM, to identify the best solution and employed the BAB method to do so. To demonstrate the effectiveness of these approaches, they lastly contrasted the heuristic approaches with BAB. Results that show the effectiveness of these techniques work.

In the rest of this paper, Section 2 presents some fundamental TSP concepts. In section 3 we introduce the most important methods for solving TSP for last five years. While in section 4, the vehicle consumption of gasoline will be discussed. Important introduction about the Holy Places in Iraq are introduced in section 5. While the problems which are faced by the visitors to the Holy Shrines are discussed in section 6. In section 7, the Iraqi holy places visitor's problem is discussed theoretically. In section 8, we applying the solving methods for IHSP. Lastly, in section 9, we will introduce some conclusion and future work.

Travelling Salesman Problem Concept

TSP is made up of a set of nodes (say n), with a path connecting any two of them. The cost of the pair of nodes is known, and each of these paths has a specified cost. Traveling salesman begins at a specific node and proceeds to all other nodes without returning to the same node, eventually returning to the origin node. The primary goal of TSP is to find the complete path that minimizes total cost during movement (Hosseinabadi, yazdanpanah, & Rostami, 2012).

The main example of TSP is the Global Positioning System (GPS) that is often used by the drivers in order to navigate and show them the shortest route to an unfamiliar place. Consider the amount of devices in a production line. The primary function of these machines is to drill various holes in a piece of material. This material could be a board of circuits, a car frame, or a piece of wood for a bookcase. The drill may travel to any point within a designated region through motors that follow tracks. Finding a solution to the TSP could be useful to find the optimal or best order in which all the holes should be drilled (Zambito, 2006).

Mechanical Engineering or electronic connection position is another application for which a TSP solution may be useful. Take into consideration the electrical wiring of a large building, the plumbing design of a building, or even the wiring of a particular circuit board. In a few of these examples, the connections must be arranged so that every element is connected in a cycle (Taha, 2011).

1.Mathematical Formulation of TSP:

TSP model depends on a number of cities (say n) and we may define the distance matrix $\|d_{ij}\|, i,j=1,\dots,n$ ($d_{ii}=0$ or ∞) to represent the cost between cities i and j. The matrix X that we defined may be described as the following (Taha, 2011):

Then the Matrix is:

$$X = \begin{bmatrix} 0 & x_{12} & \dots & x_{1n} \\ x_{21} & 0 & \dots & x_{2n} \\ \vdots & \vdots & \dots & \vdots \\ x_{n1} & x_{n2} & \dots & 0 \end{bmatrix}$$

The TSP is considered as a linear programming problem so the mathematical formulation is as follows:

$$\begin{aligned} &\text{Minimize } z = \sum_{i=1}^n \sum_{j=1}^n d_{ij}x_{ij} \\ &\text{Subject to:} \end{aligned} \quad \left. \vphantom{\begin{aligned} &\text{Minimize } z = \sum_{i=1}^n \sum_{j=1}^n d_{ij}x_{ij} \\ &\text{Subject to:} \end{aligned}} \right\}$$

$$\begin{aligned} &\sum_{j=1}^n x_{ij} = 1, i = 1, \dots, n \\ &\sum_{i=1}^n x_{ij} = 1, j = 1, \dots, n \\ &x_{ij} = 0, 1. \end{aligned}$$

Example (1):

For TSP, suppose we have the following distance table for 5-cities:

	A	B	C	D	E
A	0	5	7	4	9
B	5	0	10	12	3
C	7	10	0	6	8
D	4	12	6	0	10
E	9	3	8	10	0

Let's start from city (A), and suppose we have the route A-C-D-E-B-A which obtained from any solving method, so the matrix X will be:

$$X = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

Notice that each row and column has only one (1), obtain the cost value Z:

$$Z = d_{13} + d_{34} + d_{45} + d_{52} + d_{21} = 7 + 6 + 10 + 3 + 5 = 31 \text{ units.}$$

2. Successive Rules and Reduction for TSP (Jasim, 2019):

We can define the Successive Rules (SR) by the rules which are enforcing the obtained sequence or path to be arranged in some specific order. These SR may be direct (e.g B → C) or indirect (e.g B → ... → C). If the TSP has some mandatory, it might be applied directly. In solving the COP, the is extremely important, especially TSP. The will help in the reduction of the number of cities, therefore the problem's size is reduced, which means that less computing time is needed to solve it. After reduction, the size of the matrix is (n-m) × (n-m) if the TSP matrix is (n × n) in size and there are (m) SRs.

Remark (1): The two types of TSP which are symmetric and asymmetric matrices when reducing its matrix will be transformed into an asymmetric matrix.

Solving Methods for TSP

1. Exact Methods for Solving TSP:

In this paper we will focus on branch and bound techniques, dynamic programming, and complete enumeration, among other methods to exact solution.

A. Complete Enumeration Method:

(CEM) the most general method of problem solving, also referred to as general and test, involves methodically listing every potential solution and evaluating each one to determine which approach best solves this problem. One of the most well-known techniques for solving TSP is this one (Dahiya & Sangwan, 2018).

B. Dynamic Programming (DP):

is a technique for problem-solving that divides the solution into a number of stages or steps so that the problem-solving process can be seen as a sequence of linked decisions. Richard Bellman is the creator and driving force behind DP's popularity. DP uses the optimality principle to make a series of optimal decisions. The optimality principle states that if the complete solution is optimal, the solution to the kth stage must also be optimal. The concept of optimality ensures that at some point in the decision-making process, the correct decision is made for subsequent stages. The basic principle of DP is removing just a portion of a problem at each step, then overcome minor issues and use the settlement results to correct the problem in the following step (Nugroho, 2010).

C. The Branch and Bound Technique (BABT)

It is usually used in COP, in particular TSP, where it builds a state space tree to determine the best value for the objective function among all viable solutions. Dantzig initially studied BAB and provided a more detailed description of it in TSP applications. The BABT provides every feasible option by solving the problem and attempting the practical solution with a value in the upper bound to find the most suitable one (Ranjana, 2018) .

2.Approximation Approaches for Solving TSP:

In general, the term “heuristics” refers to algorithms that search to identify solutions from all of the possible choices. Though heuristic algorithms often discover a solution that is quick and simple, they do not always ensure that the best or optimum solution will be found. These heuristics might at times be accurate, that is, they may identify an optimal solution; but the algorithm remains a heuristic algorithm until the optimal solution has been found (Lawler, Lenstra, Rinnooy Kan, & Shmoys, 1985).

A. The BAB Method (BABM)

reflects all state space search methods in which all children of an E-node are generated as any now nodes known as live nodes when it becomes an E-node. E-node is a node that can be expanded. The live node is a node that has been generated but has not yet had its children expanded. Dead nodes are nodes that cannot be expanded, but they can be useful for the backtracking concept. If there are no more children to expand, we must return to its parent and expand its children, continuing until we reach the solution or accomplish tree path (Rastogi, Shrivastava, Payal, & Singh, 2013). It’s important to note that this method is completely different from BABT.

B. The Minimizing Distance Method (MDM)

It is one of the most effective techniques discussed above in terms of outcomes; to reduce the matrix, we must subtract the smallest element from each row and each column until there is zero in each row and column. The penalties are then determined for each zero, and the smallest number in each zero's row and column is collected. We link the generated routes and compute the cost after deleting the row and column that contain zero and canceling the item with the reverse location of zero of the matrices. This procedure is repeated until the dimension of the reduced matrix is 2 (Swarup, Gupta, & Mohan, 1994).

3. Local Search Methods for Solving TSP:

A. Local Search Methods (LSMs)

will ultimately have an important effect on recent studies in computer science because they aid academics solve issues across a number of areas for solutions that in their full generalization do not exist in a timely manner, even with the world's fastest computers, as well as being universal search heuristics and simple to implement (Tsai, Tseng, Chiang, & Yang, 2014). A metaheuristic may improve a complicated issue by searching through a large number of possible solutions with only a few predictions about the problem at hand and no guarantee of finding the best solution. Some metaheuristics take either a single solution-based or a population-based approach (Srour, Othman, & Hamdan, 2014).

B. Genetic Algorithms (GA)

is Holland's derivative free stochastic technique, which is based on biological evolutionary processes. The following generation should be healthier and fitter than the previous one since in nature, individuals who are best suited will likely to survive and mate. In a book that Golberg reg-

ularly cites, a great deal of effort and applications have been made about GAs. The population of chromosomes that GAs work with can be defined by a set of fundamental parameters (Hussain, et al., 2017).

We suggested using new crossover called Mixing Crossover Mutation Algorithm (MCMA) for GA to obtain Improved GA.

C. Mixing Crossover Mutation Algorithm (MCMA)

$(ch_1, ch_2, ch_3, ch_4) = \text{MCM}(ch)$

$ch_1 = \text{Simple inversion crossover}(ch);$

$ch_2 = \text{Swap}(ch);$

$ch_3 = \text{Displacement}(ch);$

$ch_4 = ch;$

end;

The Vehicle Consumption of Gasoline (Power, 2024)

Vehicle Consumption of Gasoline refers to the amount of gasoline a vehicle uses to travel a certain distance or operate over a certain time. It is a key factor in understanding fuel efficiency, environmental impact, and operating costs of a vehicle.

We usually have two types of gasoline: regular gasoline (also known as 90 or 91 octane gasoline, depending on the country) and enhanced or premium gasoline (95 octane gasoline). Fuel consumption varies depending on several factors, including:

1. Vehicle type (small, medium, SUV, pickup, sports car, etc.).
2. Year of manufacture.
3. Engine type (gasoline, diesel, hybrid, partial electric, etc.).
4. Driving style (slow or aggressive, city or highway).
5. Vehicle condition (filter cleanliness, tire pressure, etc.).

Table (1) shows fuel consumption rates according to the type of vehicle and the type of gasoline

Table (1): Fuel consumption rates according to the type of vehicle and the type of gasoline.

Vehicle	Type of Vehicle	Consumption rates of gasoline L/100	
		Regular (Re)	Premium (Pr)
	Hybrid Car (HC)	3-5	4-5
	Small Car (SC)	5-7	5-7
	Mid-Range Sedan (MC)	6-9	7-9
	SUV or 4WD (BC)	8-14	9-14
	Sports Car (SC)	10-18	12-18

Here we will take the worst case s.t. we will take the upper level (UL) of range of Consumption rates of gasoline (CRG). As seen in table (1), that UL in each Km is $UL/100$, for example for HC with regular or premium the consumption rate in each Km is $CR=0.05$. As we know that the price (P) for each liter of Regular (PR) is 450 ID and for Premium (PP) is 850 ID, so the cost (C) of one Km for any vehicle in ID is:

$$C=CR*P \dots\dots(3)$$

Where $P=PR$ or PP .

Where or.

Table (2) shows the travel cost according to the type of vehicle of in .

Table (2): The travel cost according to the type of vehicle of in .

Vehicle	Type of Vehicle	of in	
		Regular	Premium
	HC	22.5	42.5
	SC	31.5	59.5
	MC	40.5	76.5
	BC	63.0	119.0
	SC	81.0	153.0

Holy Places in Iraq (BBC,2024)

Among the most important of these are the shrines of the Prophet Muhammad’s family (Ahl al-Bayt), such as those of Imam Ali in Najaf, Imam Hussain and Al-Abbas in Karbala, and the Imams in Samarra and Kadhimiya. Each of these locations holds profound spiritual significance and is associated with major events in Islamic history, especially the martyrdom of key religious figures, which are commemorated annually through large-scale pilgrimages and rituals.

1.Significance of the Holy Sites:

- **Religious** :These shrines serve as spiritual centers that reinforce religious devotion and commemorate major Islamic events.
- **Social** :They bring together people from various ethnic and national backgrounds ,fostering social and cultural unity.
- **Economic** :Religious tourism boosts local economies through hotels, transportation ,markets ,and public services.
- **Cultural and Political** :These sites are integral to Iraq’s historical and religious identity ,symbolizing centuries of tradition and spiritual heritage.

2.Number of Visitors Annually:

- Official and independent estimates suggest that Iraq’s holy shrines receive over 30 million visitors annually.
- The largest numbers are seen during Arbaeen, with around 20 million pilgrims visiting Karbala, including 3 to 5 million international visitors from countries.

The shrines and holy sites in Iraq represent some of the most significant religious landmarks in the Islamic world. They have a deep impact on Iraq’s spiritual, cultural, and social life. Furthermore, these sacred places serve as a point of convergence for millions of visitors each year, highlighting Iraq’s central role in global religious tourism.

The Problems Faced by Visitors to the Holy Shrines

As we mentioned earlier, Iraq contains many holy shrines that include the tombs or mausoleums of prophets, Imams of the Household of the Prophet (peace be upon him and his family), companions of the Prophet Muhammad (peace be upon him and his family), or companions of the Imams of the Household of the Prophet (peace be upon them). Visitors to these holy shrines, especially those from outside Iraq, may wish to visit all or most of these holy sites, because such a visit may not be possible twice, in the shortest possible time, over the shortest distance, and at the lowest possible cost.

The most important problems that a visitor who wants to visit all the holy sites may face can be summarized as follows:

1. Some of these holy sites are located within a single Iraqi governorate. Fortunately for the visitor, some holy sites contain more than one shrine or tomb at the same time. But the main problem is that some of the other holy sites may be located in other cities or governorates that may not be close to the rest of the holy sites.

2. This burdens the visitor, as he may be elderly, suffer from certain diseases that prevent him from traveling for a long period.
3. The visitor may have limited financial and material capabilities.
4. The visitor may does not have enough time to visit all the holy sites due to work commitments or other reasons.
5. Visitors may arrive in their own vehicle and wish to visit all, or at least some, of these holy sites, rather than tour company, that mean they must adhere to all the instructions imposed by the tour company.
6. Since the visitor will be arriving in their own vehicle, they will need to refuel frequently to ensure a complete visit. This, of course, will incur additional costs, this means if they have the shortest path, it means the lowest cost.

Iraqi Holy Shrine Problem

The Iraqi Holy Shrine Problem (IHSP) is a symmetric TSP. The most important Holy Shrine in Iraq consists of 14 shrines, the travelling cost between each two shrines is known. A visitor lives in one city of the shrine's cities (say Najaf), he wants to visit all holy shrine starting from his city, then he goes to all other holy shrines without repeating the path between any two shrines, lastly hew will return to his city. We wish to help him (her) to find the minimum total cost of these shrines starting from his city. The symbol of each shrine is as in table (3).

Table (3): The symbol of each holy shrine in Iraq.

	Holy places	Governorate	City	Symbol
1	Imam Ali and Kufa	Najaf	Najaf	AK
2	Imam Hussein	Karbala	Karbala	HS
3	Al-Kadhimayn	Baghdad	Kadhimiya	KA
4	Salman Al-Muhammadi		Madain	SM
5	Al-Askariyyan	Salah Al-Din	Samarra	AS
6	Sayed Muhammad Sab' Al-Dujail		Balad	SD
7	Imam Al-Qasim son of Al-Kadhim	Babylon	Al Qasim	QK
8	Sharifa bint Al-Hasan		Hillah (Griq)	SH
9	Sons of Muslim ibn Aqil and Al-Qasim ibn Al-Hasan		Musayyib	SQ
10	Zayd ibn Ali Ash-Shaheed		Hillah (Al-Kifl)	ZS
11	Saeed ibn Jubair	Wasit	Al-Hayy	SJ
12	Prophet Uzair (Azir)	Maysan	Al Uzair	UZ
13	Prophet Shu'ayb	Al-Qadisiyah	Diwaniya	SB
14	Zain Al-Abidin	Kirku	Daquq	ZA

In this section, we will employ the TSP as a tool to calculate the least total cost for Iraqi shrines. First, we show the distance in kilometers (km) as shown in table (4) for the shrines (Google, 2025).

Applying Solving Methods for IHSP

In this section we exploit the TSP to evaluate the minimum total cost (distance or cost) for IHSP. So three types of solving methods are investigated to solve this problem:

1. Heuristic Methods: IMDM and BABM.
2. LSM: GA and IGA.
3. Exact Methods: DP and BAPT:

Table (5) shows the results of applying the above Heuristics, LSM and Exact Methods of solving HISP for.

Table (5): the results of applying Heuristic, LSM and exact Methods of solving HISP for.

Type of Method	Method	D/Km	T/s	Path
Heuristic	BABM	1893	0.5	1 ,10, 8, 2, 9, 4, 3, 6, 5, 14, 13, 7, 11, 12, 1
	IMDM	1866	0.6	1, 10, 8, 7, 13, 9, 2, 14, 5, 6, 3, 4, 11, 12, 1
LSM	GA	1864	1.5	1,10, 8, 7, 13, 9, 2, 6, 5, 14, 3, 4, 11, 12, 1
	IGA	1823*	0.3	1, 12, 11, 4, 14, 5, 6, 3, 9, 2, 8, 13, 7, 10, 1
Exact	DP	1823*	600	1, 12, 11, 4, 14, 5, 6, 3, 9, 2, 8, 13, 7, 10, 1
	BAPT	1823*	5	1, 12, 11, 4, 14, 5, 6, 3, 9, 2, 8, 13, 7, 10, 1

The symmetric path for the above optimal costs, (referred to with *), is as follows:

1	12	11	4	14	5	6	3	9	2	8	13	7	10	1
AK	UZ	SJ	SM	ZA	AS	SD	KA	SQ	HS	SH	SB	QK	ZS	AK
Naj	May	Was	Baghdad	Kir	SalahAldin		Baghdad	Babylon	Kar	Babylon	Qad	Babylon		Naj
Naj	Uzair	Hay	Mada'in	Daq	Sam-Balad		Kad	Musayab	Kar	Hillah	Diw	Qas-Kifl		Naj

Remark(2): From the above optimal path we notice that Baghdad is separated in travel, if we modified this path to join the two shrines in Baghdad in one path we obtain the following path:

1	12	11	4	3	14	5	6	9	2	8	13	7	10	1
AK	UZ	SJ	SM	KA	ZA	AS	SD	SQ	HS	SH	SB	QK	ZS	AK
Naj	May	Was	Baghdad		Kir	SalahAldin		Babylon	Kar	Babylon	Qad	Babylon		Naj
Naj	Uzair	Hay	Mad-Kad		Daq	Sam-Balad		Musayab	Kar	Hillah	Diw	Qas-Kifl		Naj

This path gives total distance and its close to the optimal path.

As we see from table (5), the minimum results for optimal distance (OD) is 1823 , so the optimal travel total cost (OTTC) according to the type of vehicle and type of gasoline and depending on relation (2) is shown in table (6).

Table (6): The O for according to the type of vehicle and gasoline in .

	Type of vehicle	in	
		Regular	Premium
	Hybrid Car (HC)	41,018	77,477
	Small Car (SC)	57,424	108,468
	Mid-Range Sedan (MC)	73,831	139,459
	SUV or 4WD (BC)	114,849	216,937
	Sports Car (SC)	147,663	278,919

Conclusion and Future Work

1. In this paper we will applying the principle of TSP to solve IHSP by applying (3) types of solving methods with (6) methods.
2. Table (5) shows that, for heuristics: the IMDM is better than BABM, for LSM: the IGA (with optimal value) is better than GA, while for exact: BABT and DP give the same optimal value but BABT is better in CPU-time since it solves the IHPS in 5 sec.
3. In table (5), we help the visitor to obtain the minimum distance () to visit the most important (14) holy places in Iraq.
4. The minimum distance means the minimum cost to travel starting from Najaf city to other (9) Iraqi governorates to visit the holy places according to type of vehicle and gasoline (see table (6)).
5. We think that if we change the starting city that mean change in the minimum total distance and cost.
6. As future work, we can add more holy places to the list of total holy places in Iraq and calculate the suitable path to obtain the minimum distance and cost.
7. This problem considered a single objective function, we suggesting to develop the problem to multi-criteria objective function solve the problem with two or three objectives simultaneously.

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Intelligent People Counting for Crowd Management during Ziyarat Al-Arbaeen in Karbala

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Abstract

The ziyarat Al-Arbaeen in Karbala, Iraq, is one of the largest annual gatherings of people in the world, attracting millions of visitors. This poses significant challenges in crowd control, ensuring smooth flow of traffic, and ensuring the safety of visitors. This research aims to develop an intelligent people counting system using advanced computer vision techniques, relying on convolutional neural networks (CNNs), to accurately and effectively detect individuals in video clips, without the use of facial recognition or identification techniques. The system analyzes the input videos to calculate the total number of people appearing in each frame. The results are displayed as a representation of the total number, allowing for a more accurate understanding of the crowd distribution in the studied locations. The system currently does not include real-time data processing, but the possibility of developing this aspect and adding automatic alerts when crowd density increases is an important future endeavor that could enhance the system's ability to effectively manage crowds. This research represents a first step towards employing artificial intelligence techniques to support crowd control during major religious events and highlights the potential of computer vision as an effective tool to help ensure the safety and security of visitors.

Keywords: Crowd Management, People Counting, Ziyarat Al-Arbaeen, Artificial Intelligence, YOLOv5.

Introduction

Karbala is a holy city in Iraq, which experiences a special religious phenomenon once a year; ziyarat Al-Arbaeen. This occasion is the most important event that is spiritually significant to the Muslims because millions remember the killing of Imam Hussein (peace be upon him). It is ziyarat Al-Arbaeeni the biggest nonviolent human gathering in the globe and its attendance is over twenty million visitors of all over Iraq and the world who observe the occasion by walking, one hundreds of kilometers to the gathering place and more (Kadhim et al., 2025).

However, sheer presence of people in such a large number, notwithstanding its peaceful model and sheer popular organization that this kind of influx already has, presents enormous organizational problems concerning crowd safety and control of the crowd movement, at key points, like the entrances into the holy shrines, the roads leading to Karbala, and service stations (Lin et al., 2024; Collini et al., 2024; Ahmed et al., 2021). It has been demonstrated that the current systems that use manual inspection or physical counting of tourist numbers are no longer effective enough to keep up with the numbers that keep rising at the rate in which they are implied (Elsisi et al., 2021). The necessity to find urgent solutions in the form of smart solutions that will be able to deliver precise and real-time information needed to facilitate well-informed decisions on the management of a crowd, direction, and onward movement (Shambour & Gutub, 2022; Wen et al., 2021). In this regard, such technologies as artificial intelligence (AI) and in particular computer vision algorithms using convolutional neural networks (CNNs) can be regarded as one of the most promising activities in the field (Lin et al., 2022; Pervaiz et al., 2022). These technologies allow the computerized analysis of images and video snippets, the detection of visual trends, and the extraction of useful information being in the captured scene (Fan et al., 2022; Pervaiz, Jalal, & Kim, 2021). Among the most significant applications which may be

used to serve the ziyarat Al-Arbaeen, an automated counting of people with the help of video analysis can be mentioned, and it is the task of this research.

With the growing challenges created by the millions of visitors arriving during the ziyarat Al-Arbaeen, there is a necessity of the development of smart tools able to efficiently comprehend the number and dispersion of these masses in order to emphasize the utilization of spatial analysis and geographic information systems (GIS) methodologies in order to trace the movement of the visitors and propose dynamic pathways to ease the congestions, which will provide rich spatial information that can be used in counting the visitors (Jasim et al., 2025). In this work, a prototype of the intelligent tool is developed aiming towards counting the number of people in a video the system is not based on tracking and facial recognition and does not provide snapshots of individuals. As opposed, it processes every frame of the video and counts the number of people in it, presenting the number in an end picture along with nothing more but the number of people. It is in use today on pre-input videos; although, in the future, it can be extended onto the instant playback. The study will undertake a number of objectives that include:

- Development of intelligent and efficient system to count the people in crowded areas accurately and without much technicality involved.
- Delivering correct quantitative information that will serve to comprehend the dynamics of the crowd that gather as part of the ziyarat Al-Arbaeen.
- Providing the regulatory and field authorities with intelligent AI-based solutions that enhance the strategies of managing crowd.
- Paving the way towards the emerging real-time systems which might in the future be incorporated with field cameras to give early warning as and when required.

Accordingly, the research can be taken as more than just another technical project; it is an actual contribution to the application of AI to the benefit of society in sensitive, real-world, religious, and cultural scenarios, and yet it is simple to implement and easy to field.

Related Work

The methods to analyze the population density and crowd counting in crowded places have experienced great transformation because of the improvement in computer vision and deep learning. Some recent works have already proved the efficiency of such methods in enhancing the accuracy of monitoring and analysis, particularly in the complicated environment, like trains, religious crowds, and smart cities. The most noteworthy works referring to this topic and considering its approach to different technical and applied aspects are reviewed as follows (Gong et al., 2021). First, (Jin et al., 2024) provided the incorporation of convolutional neural networks (CNNs) along with YOLO algorithms to the people counting and detecting the population density activities in a detailed manner. The paper has argued why optimization and regularization algorithms are relevant in boosting model performance, as well as generalizing the model in averting overfitting, making them more applicable in other situations of density and crowding. The paper has shown that a combination of these methods helps not only the process of training to go faster but also make it more stable in such an environment as a public square and transport hub.

In contrast to this, the work of (Gao et al., 2024) was aimed at giving a holistic summary of methods in crowd counting in IoT settings with emphasis on the usefulness of using WiFi data and smart sensors to improve result accuracy in the estimate. The criteria to influence the crowd counting variables were categorized into three broad categories, namely, object detection, behavior monitoring and individual counting. Among the main challenges identified in the study, it was noted that dealing with many types of human activities, future crowding forecasting, and combining many machine learning methods under distributed settings were the most significant ones. A practical example of religious crowd control concern is the study of (Halboob et al., 2024), which devised a smart framework in managing crowds in

the case of the Umrah season. The issues that this framework tries to tackle include, counting, centering, density estimation, as well as behavior monitoring. A rules engine was introduced to identify abnormal behavior, and the findings of this revealed that the system could handle greater volumes of pilgrims without compromising the accuracy. The paper advised that in future, the rules engine could be developed with deep learning.

Regarding the smart cities, (Qaraqe et al., 2024) presented an integrated system titled as the PublicVision that is supposed to analyse the behaviour of crowds in real-time depending on the degree of violence and the number of people. The system has a sophisticated model of analyzing video based on Swin Transformer and employs VPN and IPSec as a method of providing secure data communication. Real-time data processing with the help of the NVIDIA Deep Stream SDK also became a possibility, creating an opportunity to use this technology in the future in the process of controlling crowds during some major event or protests.

The work by (Jin et al., 2024) brought to the fore the deployment of CNN and YOLO methods in the crowd counting and crowd detection tasks, especially the optimization and constraining tools, which made it easier to deal with the variety and imbalanced nature of data. In the analysis, the solutions proved the methods to be more viable in accommodating cases of crowding, altering lighting, and reflectivity.

In their article that concentrated on the accuracy of people detection and counting using the YOLOv8 algorithm in still images and moving videos and confronted the issues of overlap and the resulting change of shape and size due to change of angle and perspective, (Shyaa & Hashim, 2024) aimed at improving the effectiveness of people detection and counting in moving videos and still images. The results of the study have revealed that YOLOv8 garnered an excellent level of recognition and counting accuracy of up to 100%, opening out wide opportunities of its use

in security surveillance, crowd management, and people flow analysis in events. YOLOv8 has also been suggested to work together with intelligent systems like the Internet of Things by enhancing security and studying the flow of people day in and day out.

The article by (Siva et al., 2025) discusses the realization of the intelligent surveillance system utilizing the YOLOv8 algorithm to provide proper, real-time identification of people and threats in a sequence of live videos. The system incorporates a mixing of artificial intelligence together with a deep learning algorithm, to assess the crowd together with identifying any anomalies, as well as decrease false alarms and optimize performance across low-power equipment. The results showed a detection precision of up to 95.4 percent, an anomaly recognition precision of 92.7 percent and thus the system could be used in crowd control, traffic management and law enforcement and can be extended into smart infrastructure in the future.

Finally, in their work (V. M. R. et al., 2025) proposed the use of a YOLO-based architecture being used to detect and count the passengers in the metro cars. Although both speed and accuracy was high, the research demonstrated problems that may be encountered in crowded environments including visual obscuration, varying light, and movement blur in detecting passengers. The paper suggested enhancement of performance by turning to newer versions of YOLO, namely, YOLOv5 and YOLOv8, as well as implementing compensatory methods that would allow enhancing stability and accuracy, including visual simulation and multi-frame tracking.

Methodology

This paper describes the development of a video-processing intelligent system based on the modern deep learning pipeline, the YOLOv5 model. The system relies on the artificial intelligence tools to interpret visual images and describe their semantics. AI is a broad-based specialty whose main aim is to equip computers with the ability to act in a manner that is closely similar to the analysis and judgement of human beings. Deep learning is a branch of AI and therefore uses neural networks as a part of teaching machines using data. YOLOv5 is a fine-tuned deep learning platform specifically designed to execute image interpretation quickly and productively. Its prominent benefit is the fact that it is able to process an entire image without having to go through the process of segmentation or re-entry of images. To achieve this, the model divides the input into a conventional grid of small squares and examines cells individually, to determine whether a specific object exists or not. Upon the identification of such an object, the system will also predict its categorization and outline its location through a rectangle box. Redundant detections are then suppressed and overlap is eliminated through the process of non-maximum suppression resulting only in predictions which have the highest confidence.

1.Stages of the Proposed System:

The system consists of Several stages. The first stage is video input using a digital camera or a pre-recorded video to explore a specific area. Then, a frame extraction step is needed so that the video will be divided into a series of frames using the OpenCV library, with each frame analyzed separately. After framing the video, YOLOv5 will be used to detect objects in the viewing area within a square. Each object will be classified into one of the types (Cars, Animals, Human, etc.), and then counting the

number of detected squares representing people in each frame, as a result, the number of recorded people will be displayed for each image. The flowchart of the presented system is illustrated in Fig.1.

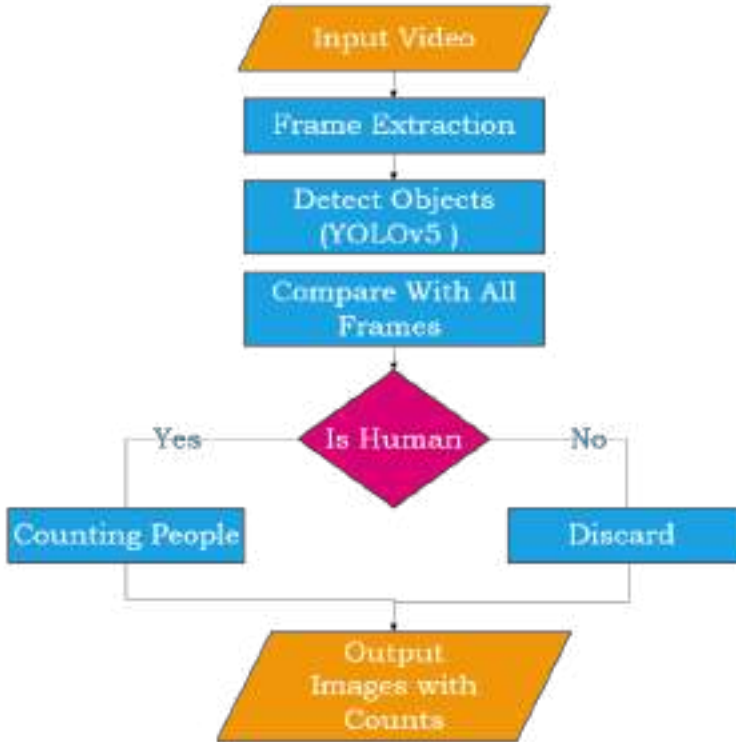


Figure 1: System Layout

2.Programming and Implementation Environment:

The system was developed and implemented using Python 3.9, due to its robust libraries and extensive support community, which contributes to accelerating development and integration with AI models. A set of libraries and software tools was selected to meet the requirements for video processing and running deep learning models efficiently. The libraries used in this work.

- OpenCV: To process video files and extract frames from them.
- PyTorch: To run and customize the pre-trained YOLOv5 model.
- NumPy and Matplotlib: To support numerical operations and visualize results.

The environment was chosen to provide a balance between performance and available resources a Laptop with an Intel Core i7 processor and 16 GB RAM, give the ability to execute the system efficiently in real time without the need for advanced hardware or dedicated graphics cards (GPU), reflecting its practical applicability in low-cost systems or when moving to real-world operating environments.

3.The YOLOv5 Model:

The YOLOv5 model is one of the latest and fastest computer vision models for object detection in images and videos. This model is characterized by its high speed and good accuracy in identifying objects, making it ideally suited for real-time applications such as counting people in crowded environments.

4.YOLOv5 Working Principle:

YOLOv5 is based on the basic idea of processing the entire image at once (One-Pass Detection), rather than segmenting the image or processing it in separate stages. The model divides the image into a grid and estimates the probability of an object being present within each grid, specifying the object's class (e.g., person, car, etc.) and its precise location within the image (Yue & Zhang, 2025).

The model is built from three main components:

1. Backbone: Used to extract basic features from the image, such as edges and general shapes. In YOLOv5, a CSPNet is used as the backbone to improve efficiency and reduce computational cost.
2. Neck: Used to combine features extracted from multiple levels, allowing the model to understand the overall context of objects in the image, whether small or large. FPN or PANet are typically used at this stage.
3. Head: Performs the actual prediction of bounding boxes and object classes. In our case, the model is trained to recognize only the “person” class.

5.Integration of YOLOv5 into the Proposed System Architecture:

A pre-trained YOLOv5 model was used with minor modifications to determine the number of people in each video frame captured by fixed surveillance cameras and drones. Rather than retraining the model from scratch, we relied on existing models available in the PyTorch library, leveraging its streamlined Python interface. The process begins by extracting frames from video clips using the OpenCV library, where each clip is converted into a series of still images. The images are then processed and passed to the YOLOv5 model to detect objects within them. The results are subsequently filtered to extract only objects classified as people, and their count is calculated based on the number of bounding boxes matching this category. The final result is displayed on the image, showing the number of detected people without showing the bounding boxes. The resulting images are then saved with the required data for documentation and analysis purposes. Fig. 2 illustrates the YOLOv5 structure and how each stage works:

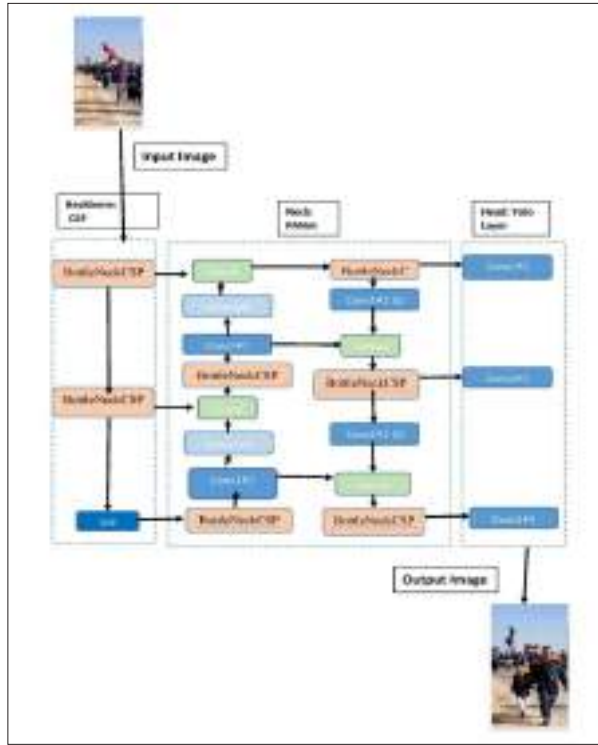


Figure 2: The architecture of the YOLOv5 model used for people detection and counting.

Results and Evaluation

In this section, the proposed people counting system that is based on the YOLOv5 will be tested on the video records of the fixed camera along the visitor pathway and the drone. Testing the accuracy of the system against the ziyarat Al- Arbaeen is done by comparing automatic counts to manual counts of different environmental conditions and camera angles.

1.Experimental Data Preparation:

The suggested system of counting people with the help of the YOLOv5 model was evaluated in the practical context, which simulated the situation found at the ziyarat Al-Arbaeen. Footages were captured at two different elevations to achieve a varying view of different population densities and angles.

1. Fixed camera: A Static camera was used to record high-definition video along a pilgrim's route to the shrine of Imam Hussein (peace be upon him) in Karbala. The camera has been set in a way that prevents people from distorting their view of visitors moving along the route.
2. Drone Camera: Videos filmed by a drone with a high-quality camera gave an aerial view and panorama of the way crowds moved through surrounding squares and streets, which enabled the study of spatial distribution and movement change in its flow.

2.Evaluation Mechanism:

To evaluate the system's accuracy in detecting and counting people, two data sets was used (video by fixed camera with a length of 5 seconds and Drone camera video with a length of 2 seconds. This simplifies the evaluation process and focuses on detection quality. The two videos, framed into images to test the model's performance under various shooting conditions. The system processes each image independently using a pre-trained YOLOv5 model, focusing exclusively on the "people" class. After the detection process is performed, the number of detected entities from this class is counted. To maintain simplicity and reduce visual noise in the resulting images, a direct display of the total number of people in the corner of the image was adopted, without showing bounding boxes around the individuals. This approach also speeds up the processing process and provides clearer output for the user, especially in cases where tracking or precise positioning of individuals is not required.

3.Experimental Results:

In Fig. 3, a frame taken from a video captured by a fixed-angle surveillance camera was selected, showing a group of people in a scene characterized by moderate density and a variety of body and clothing poses.

The system was able to detect 20 people within the frame, with overall performance considered good given the nature of the scene. The model demonstrated an effective ability to handle the horizontal angle without significantly impacting detection accuracy. It maintained a high level of counting accuracy, despite some overlap between individuals in the foreground. Homogeneous and consistent lighting helped improve the model's performance and reduced the potential for errors caused by shadows or high contrast. The weaknesses of the model included the difficulty distinguishing people overlapping in the far-away background, as the objects appeared too close together, causing some clusters to be counted as a single entity. This resulted in a slight decrease in overall counting accuracy, a known challenge in high-density scenes or those shot from narrow depth angles.



Figure 3: People counting using a fixed camera

Fig.4 shows A frame taken from a drone video, which shows a large crowd of people. The system detected 42 people in a single frame; the provided result reflects the model’s ability to handle large-scale scenes. The top-down perspective enabled the system to capture many individuals at once, without the need for multi-frame temporal analysis. Although there were some difficulties in detection in areas where crowds appeared closely spaced or overlapping, especially when objects were small due to distance, the system provided relatively accurate results that reflected the actual size of the crowd. This case demonstrates that the model maintains its effectiveness even under aerial conditions, making it suitable for applications such as aerial crowd monitoring and analyzing crowd density at public events or open spaces, without the need for complex tracking tools or additional equipment.



Figure 4: People counting using a drone-mounted camera

Performance Analysis:

The counts generated by the system were compared with those obtained manually by human experts, and the differences between the two counts were within $\pm 5\%$ in most cases, which is acceptable for real-world applications, especially in crowded environments, as shown in Table 4.1.

Table 4.1. Comparison of manual and system-based passenger counting

Frame Angle	Manual Count	System Count	Error Rate
Horizontal (Stabilized)	23	20	-13.0%
Overhead (Drone)	47	42	-10.6%

The automatic counting system offers several advantages that distinguish it from other conventional systems. It offers high accuracy in counting people, despite a slight negative error rate indicating an underestimation of the actual number. However, these rates remain within acceptable limits for practical use. The system is highly flexible in handling various shooting conditions, such as fixed horizontal shooting or overhead shooting using drones. This gives it a superior ability to adapt to a variety of scenes, something that is difficult to achieve with other systems that may be limited to a specific type of shooting. The system is also capable of processing large amounts of data quickly and efficiently, making it ideal for handling scenes that contain large numbers of people at once. This performance is particularly evident in high-angle angles, which require high precision and processing speed. The system relies on artificial intelligence technologies and continuous learning and training systems, allowing it to continuously improve its accuracy by learning new data and various challenges, such as overlapping objects or different sizes of people in images. These technologies also allow for changing lighting conditions and capturing images in different environments, enhancing system reliability and reducing the need for time-consuming and labor-intensive manual counting.

The use of AI saves human resources time and effort and helps obtain accurate and rapid results, enabling informed and immediate decisions. This is particularly important when managing large and complex crowds. The Arbaeen pilgrimage, one of the largest humanitarian gatherings, highlights the importance of this system is highlighted in its high-precision monitoring of visitor numbers, facilitating better planning of security, health, and logistical services. It also helps improve crowd flow management and reduce the risk of overcrowding in vital areas, ensuring visitors' safety. Furthermore, the system enables relevant authorities to take swift and effective action based on real-time data and contributes to future planning for the pilgrimage through data analysis across years, enhancing organizational sustainability and improving the overall visitor experience.

Conclusion

The study reflects an initial attempt to design an intelligent people counter counting system implemented by computer vision to guide the administration of large number of people in ziyarat Al- Arbaeen in Karbala, Iraq. The suggested device is based on the YOLOv5 model which is already trained to recognize people in the video shots recorded by stationary cameras and drones. The videos are then transferred to convert into the number of the total number of individuals in each frame without tracking the objects and displaying frames around those objects and no automatic alerts or warnings are also issued. The system tested footage recorded by both fixed cameras and drones and the output was presented in the form of images that provide only the numbers of the total people. These findings indicated adequate accuracy, as far as the given application is concerned, and revealed the potential of this kind of system as that which can offer preliminary assistance to decision-makers as large-scale events are being organized.

Even though simple in its present form, the system has tremendous prospects of growth and future expansion. Among the most significant potential future directions, there is a need to work on realizing the system functioning in a real-time so that it was possible to monitor the number and distribution of the crowds in real-time. It involves learning technical items related to the comprehension of anticipated frame rate, response time, and hardware requirements, including the deployment of powerful graphics processing units (GPUs), to supply the clean-cut performance of complex settings in real-world, crowded conditions. Moreover, it is also possible to incorporate a smart alarm system that would automatically notify people when the crowd density gets higher than the level that is unsafe, which is one of the essential steps towards making the crowd management process much safer and more efficient. Therefore, the offered system could be an easy and efficient method to control the number of visitors in difficult conditions and open further the method of applying AI technologies to the organization and protection of big religious and humanitarian events, which goes along with real-time concerns to make it be widely applicable.

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The Role of Artificial Intelligence in Waste Management Crowds During the Arbaeen Pilgrimage in Karbala: Towards Smart and Sustainable Solutions

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Abstract

The Arbaeen pilgrimage in Karbala is one of the largest religious gatherings in the world, generating complex environmental challenges—most notably in urban waste management due to extreme crowd density and limited infrastructure.

The problem addressed in this study lies in the inadequate adoption of artificial intelligence (AI) technologies in managing crowd-generated waste during the pilgrimage, which hampers the realization of a sustainable urban system responsive to mass events.

The research hypothesizes that the integration of AI tools can significantly enhance the efficiency, responsiveness, and environmental sustainability of waste management systems during mass religious occasions. The significance of this study stems from its contribution to proposing an AI-based smart waste management framework, tailored to the specific context of Karbala, and capable of addressing the challenges of both scale and religious spatial sensitivity.

To achieve this, the study employed a mixed-methods approach combining analytical review, comparative case analysis, and a field survey conducted in eight neighborhoods within the historical center of Karbala during the 1445 AH Arbaeen season. Data were collected through structured observations, municipal records, and semi-structured interviews with local service providers. Temporal and spatial boundaries: Data were collected from field observations, municipal records, and interviews with local service personnel. The sample included municipal employees, representatives of the shrines, and workers in the Husseini service processions within the historic center of Karbala. The time period extended from Muharram to the end of Safar 1445 AH, with a special focus on the peak days of the Arbaeen pilgrimage.

The research proposes technical solutions including smart sorting robots, sensor-enabled waste bins, drone monitoring, and predictive analytics platforms. Results revealed weak digital infrastructure, lack of coordinated governance, and minimal AI integration in existing practices.

The study recommends a national strategy for AI-based waste management, establishing real-time monitoring centers, community awareness campaigns, and encouraging applied research in environmental AI. These steps would transform current waste challenges into opportunities for smart, sustainable urban management.

Keywords: Artificial intelligence, waste management crowds, Arbaeen pilgrimage, smart solutions, environmental sustainability, smart cities, infrastructure Smart robots, digital transformation in urban services,

Introduction

Solid waste management in religious-touristic cities like Karbala becomes highly challenging during mass events such as the Arbaeen pilgrimage due to extreme crowd density and limited infrastructure. The growing number of visitors intensifies pressure on urban services, demanding smart and rapid solutions. Artificial intelligence (AI) offers effective tools to analyze urban data, predict waste patterns, and optimize operations through machine learning and IoT-based systems. These technologies enable smarter waste collection, better resource allocation, and improved municipal planning. This research explores the potential of AI in enhancing waste management during Arbaeen, employing a clear methodology with defined objectives, a representative sample, and spatial-temporal boundaries. A field study in eight neighborhoods during the 1445 AH Arbaeen season revealed limited digital infrastructure and AI use. The study proposes practical AI-based solutions and calls for a national strategy to transform waste challenges into opportunities for sustainable urban development.

The Concept of the Role of Artificial Intelligence

Artificial intelligence (AI) refers to the ability of computer systems to simulate aspects of human cognition—such as learning, reasoning, and decision-making—through algorithms that process vast and dynamic data streams (Peña, 2018). In the context of urban challenges, AI extends beyond automation, becoming a strategic tool for analyzing complex systems and supporting timely, evidence-based decisions. Within the specific framework of the Arbaeen pilgrimage, where millions of visitors converge in a short period, AI plays a crucial role in addressing the operational complexity of waste management. This includes real-time monitoring of waste accumulation, predicting spatial and temporal patterns of crowd movement, and optimizing resource allocation. Here, waste is not only a logistical burden but a dynamic indicator of human activity, requiring intelligent systems to ensure efficiency and environmental sustainability.

Thus, the role of AI in this context is not theoretical but applied and targeted—it is a means to enhance the responsiveness of urban services while respecting the cultural and religious sensitivity of the event.

Criteria for the Use of Artificial Intelligence in Waste Management

Integrating artificial intelligence into waste management is not merely a technical transformation; it represents a structural transformation that requires a rigorous normative framework that ensures operational efficiency, environmental sustainability, and social justice. These criteria intersect with the actual challenges posed by urban systems, particularly in contexts with seasonal population density, such as the Arbaeen pilgrimage in Karbala. The most prominent of these criteria are listed below (Aydın, 2023, p. 432):

- A. First – Interoperability: The effectiveness of smart systems requires their technical integration with Internet of Things (IoT) networks, low-power communication networks (such as LoRa), and municipal and service entity databases. This integration is a prerequisite for ensuring immediate and comprehensive responses to waste generation, transportation, and treatment operations.
- B. Second – Scalability: Sudden changes in waste quantities, such as in religious crowds, require smart systems to be flexible and scalable in terms of computing processing and data storage capabilities, without causing performance degradation or delayed response.
- C. Third – Environmental and Economic Efficiency: AI systems must achieve a delicate balance between operational costs and environmental and social returns. This efficiency includes reducing carbon emissions, improving recycling rates, and reducing collection and transportation costs, thus enhancing the added value of the system without placing excessive burdens on operators.








D. Fourth – Cybersecurity: Data and information protection is the cornerstone of the reliability of intelligent systems, especially in environments that rely on wireless sensing and open digital infrastructure. Any potential breach poses a direct threat to the system's efficiency and could lead to disruptions in waste management or the exposure of sensitive data related to crowd distribution or congestion locations.

E. Fifth – Good Governance of AI Applications: True sustainability of AI use cannot be achieved without a robust governance framework that defines responsibilities, guides policies, and monitors impact. Governance encompasses institutional, technical, and societal aspects, ensuring integration among stakeholders, promoting fair use, transparency in evaluation, and compliance with ethical and environmental principles. Adherence to these seven criteria is a prerequisite for the rational and effective use of AI in waste management, especially in complex and sensitive environments such as the Arbaeen Pilgrimage, where technical needs intersect with humanitarian and cultural considerations.

Types of Waste in Urban Crowds: A Classification Framework to Support Smart Systems:

In urban crowd contexts such as the Arbaeen pilgrimage, waste generated varies in terms of source and composition, requiring careful classification to help develop smart management solutions. The most prominent types are: Table 1.

Table 1: Classifications and Types of Waste According to Multiple Sources

No.	Waste Category	Examples	Notes
1	 Municipal Solid Waste (MSW)	Food waste, paper, cardboard, plastic, glass, metals, textiles	Most common during mass religious events
2	 Organic Waste	Food scraps, vegetable waste, untreated paper	Can be composted or converted into biogas
3	 Inorganic Waste	Plastic, glass, metals, ceramics	Often recyclable
4	 Hazardous Waste	Batteries, cleaning chemicals, expired medicines, electronic waste	Needs special handling and safe storage
5	 Medical Waste	Used gauze, gloves, medical tools, contaminated items	Found in emergency and temporary health service areas
6	 Construction & Demolition	Concrete, bricks, wood, metals	Results from temporary infrastructure installations
7	 Light Industrial Waste	Printing remains, packaging, temporary event equipment	Generated by logistical and support activities during mass gatherings

Source: Prepared by the researcher based on various sources

Global and Arab Experiences in Using Artificial Intelligence for Waste Management

The use of artificial intelligence in waste management represents one of the most prominent aspects of digital transformation in contemporary urban systems. The effectiveness of this approach has been demonstrated through a number of pioneering international and Arab experiences, whose design and implementation were based on standards of accuracy, integration, scalability, environmental efficiency, governance, and cybersecurity.

A. Global Experiences

1. South Korea - Ecube Labs :

Developed smart waste compactor containers based on sensors connected to AI-powered control platforms. This resulted in:

- Reducing the number of waste collection trips by up to 80%.
- Increasing the container capacity by up to 700%.
- Significantly reducing operational emissions.

2. Johannesburg, South Africa

The municipality implemented a pilot project to apply artificial intelligence to sort and track waste in low-income neighborhoods using sensors linked to an interactive application to analyze time patterns. This contributed to:

- Improving the temporal allocation of resources.
- Improving the responsiveness of field crews.

3. European Countries - CNN Applications in Waste Sorting

As part of smart environmental initiatives, several cities have used convolutional neural network (CNN) algorithms to visually classify waste, achieving accuracy rates of over 95%, while significantly reducing carbon emissions resulting from transportation and manual sorting.

B. Second: Arab Experiences

1. Mecca - Smart TUHR System

The Holy Capital Municipality developed a system based on Internet of Things (IoT) and artificial intelligence technologies to monitor container fullness and send immediate alerts to the relevant authorities. The system resulted in:

- Reducing fuel consumption and operating costs.
- Improving response time during the Hajj and Umrah seasons.

2. Sharjah - Bee'ah Authority

Sharjah implemented a smart waste city project, using advanced artificial intelligence models, including deep learning algorithms and predictive analysis, with the aim of:

- Improving the efficiency of spatial distribution of vehicles.
- Reducing non-recyclable waste.
- Ensuring transparency and security in handling environmental data.

3. Saudi Arabia - National Waste Strategy

The Ministry of Environment, Water, and Agriculture launched a national framework based on artificial intelligence to improve tracking systems, analyze environmental data, and develop unified databases across agencies, enhancing:

- Institutional integration
- Data-driven planning in municipal waste management.

Criteria Analysis of Presented Global and Arab Experiences in Using Artificial Intelligence for Waste Management

These experiences indicate that the application of artificial intelligence in waste management can only succeed if the following criteria are met:

- Accurate performance and stability of algorithms.
- Integration of smart systems with digital infrastructure.
- Scalability and adaptability to sudden changes in waste volume.
- The availability of a governance framework that ensures fairness, accountability, and data protection.

These criteria are doubly important in crowded contexts, such as the

Arbaeen pilgrimage in Karbala, where waste poses a complex environmental and administrative challenge that requires smart and sustainable solutions. Table 2

Table 2 Criteria Analysis of Presented Global and Arab Experiences in Using Artificial Intelligence for Waste Management

Country / Project	Infrastructure Integration	Scalability	Environmental & Economic Efficiency	Cybersecurity	Good Governance
South Korea – Ecube Labs	√	√	√	X	X
Johannesburg – South Africa	√	X	√	X	X
Europe – CNN Applications	√	√	√	X	X
Mecca – TUHR Smart System	√	√	√	X	√
Sharjah – Bee’ah	√	√	√	√	√
Saudi Arabia – National Strategy	√	√	√	√	√

Source: Prepared by researchers based on literature review and previous studies.

Notes:

√ = Clearly available or explicitly mentioned in the application.

X = Not mentioned or no evidence of implementation in the available sources.

Sustainability and Smart Waste Management

Sustainability forms a fundamental framework for achieving effective and lasting waste management during large-scale events such as the Arbaeen pilgrimage in Karbala. Artificial intelligence technologies can play a pivotal role in enhancing this framework by improving the collection and sorting of waste and reducing the negative environmental impact caused by pollution and waste accumulation.

From an economic perspective, smart solutions allow for improved operational efficiency and reduced costs associated with waste management, in addition to promoting recycling and turning waste into economic resources. Socially, AI contributes to providing a clean and healthy environment for visitors and local residents (Al-Ameedee & Al-Baghda-di, 2025, p.311), while also raising awareness and encouraging community participation—supporting the creation of a more environmentally responsible society.

Thus, integrating AI with sustainability principles becomes an essential element in achieving smart and sustainable urban solutions that match the challenges of waste management in such major events.

A. Environmental Dimension:

AI contributes to reducing waste accumulation and pollution by improving collection and sorting processes, preserving air and water quality, and supporting the protection of natural resources, through:

- Reducing waste accumulation and pollution in public areas (Al-Ameedee, 2023, p.21).
- Enhancing air and water quality by minimizing emissions from waste collection and transport.
- Supporting recycling processes and the conservation of natural resources.

B. • Economic Dimension:

Smart systems improve the efficiency of waste management, reducing operational costs and enhancing economic opportunities through recycling and treating waste as a sustainable resource, by:

- Lowering operational costs through intelligent and efficient waste collection scheduling.
- Promoting waste utilization as an economic resource through sorting and recycling.
- Supporting the local economy by improving waste management efficiency.

C. • Social Dimension:

Smart waste management provides a clean and healthy environment for visitors and residents, fosters community engagement and environmental awareness, and strengthens the sense of shared responsibility for maintaining the city, through:

- Providing a clean and healthy environment for visitors and local residents.
- Reducing health risks associated with waste accumulation (Al-Ameedee, 2023, p.23).
- Enhancing awareness and community participation in maintaining city cleanliness.
- Strengthening social bonds and the sense of shared responsibility.

Urban and Religious Characteristics of the City of Karbala: Framework for Understanding Crowd and Waste Management Challenges

The holy city of Karbala is one of the most prominent religious cities in the Islamic world and holds a special spiritual status due to the presence of the shrine of Imam Hussain (peace be upon him). Each year, particularly during the Arbaeen pilgrimage, the city transforms into a massive religious hub, attracting millions of visitors from various nationalities in one of the largest peaceful human gatherings worldwide (Al-Ameedee & Al-Baghdadi, 2024, p.408).

From an urban perspective, Karbala is characterized by a built environment that combines a dense traditional fabric around the holy shrines with modern urban extensions surrounding it. This reality presents increasing challenges to the infrastructure's ability to cope with the massive seasonal pressure, especially in terms of waste management, as waste generation surges sharply during the pilgrimage days.

Accordingly, Karbala represents a sensitive urban model that requires smart and sustainable solutions in managing its essential services—particularly as the technical and demographic dimensions of the pilgrimage expand—making the integration of artificial intelligence into crowd waste management a pressing necessity rather than a luxury.

The city of Karbala is an ancient and renowned Islamic city with a history as old as the civilizations of Iraq. Its name appeared in cuneiform inscriptions dating back to the first millennium BCE, under the name *Karbalata*, where the root of the word is *Karbli*, and the suffix *-ta* is a linguistic addition typically attached to names (Al-Khafaji, 2006, p.53).

Some scholars, based on linguistic analysis, believe the city was known as *Kur Babel* around 2000 BCE, meaning “a group of Babylonian villages.” It later had several names, including *Nineveh*, *Al-Ghadhriyah*, and *Karb-ila*, which means “a place of worship” or “temple” in Babylonian. Others trace the word’s origin to *Karbalah*, meaning “soft soil” or land known for its pure wheat during cultivation. Another opinion is that the name emerged after the Battle of Ashura (Battle of Karbala), indicating it came into use after the advent of Islam, given that the city hosted the bodies of Imam Hussain and his brother Abbas (peace be upon them). This association with “Karb” (sorrow) and “Bala” (affliction) led to the city’s current name. Karbala has been known by various historical names (Jawad, 2011, p.41), including:

1. **Nineveh:** Given to a location in Karbala after the fall of the Assyrian Empire in 612 BCE, distinct from the famous Nineveh of Ashurbanipal in Mosul.
2. **Al-Taff:** Refers to lands overlooking the Arab territories toward the Iraqi countryside, also known as the riverbank lands due to their proximity to a river that changed course and eventually dried up.
3. **Al-Ghadhriyat:** Named after *Ghadhira*, a woman from the Arab tribe of Banu Asad, who inhabited the area now north of Hayy Al-Hayyabi.
4. **Al-Nawawis:** Refers to Christian cemeteries located in the northwestern part of present-day Karbala.
5. **Al-Ha’ir (or Al-Hayr):** Low-lying lands where the holy shrine is situated. Water surrounded the area during the reign of Al-Mutawakkil Al-Abasi in 236 AH.

Since then, Karbala has become an urban magnet, with people settling around the two holy shrines, forming the first nucleus of a small city. Over time, it expanded, becoming a major religious and commercial hub. The city gradually developed westward due to the presence of orchards and abundant vegetation.

Location

Karbala Governorate is located in the central region of Iraq, on the western edge of the Euphrates River valley, between longitudes 43°–45° E and latitudes 32°–33° N. It is bordered by:

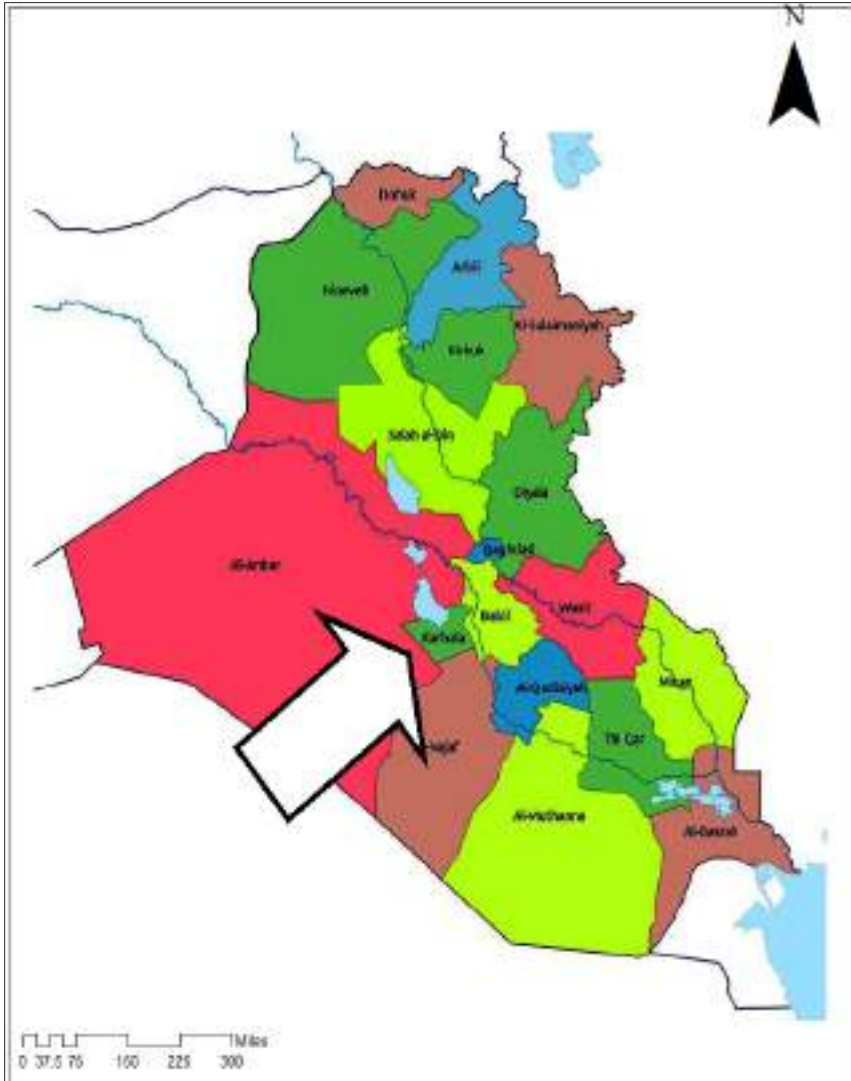
- **North and West:** Al-Anbar Governorate (112 km away)
- **East:** Babylon Governorate (45 km away)
- **South:** Al-Najaf Governorate (74 km away)
- Karbala lies about 89.5 km southwest of Baghdad.

Administrative Borders of Karbala Governorate:

- **North:** Al-Anbar Governorate
- **South:** Al-Najaf and Al-Anbar Governorates
- **East:** Babylon Governorate
- **West:** The Northern Desert and part of Al-Anbar Governorate

The terrain gradually slopes toward the sedimentary plain in the direction of the Euphrates River Valley. Most of its land is flat and sandy, generally unsuitable for agriculture, except for some areas in the north and east.

Figure 1: Location of Karbala relative to Iraq



Source: Directorate of Urban Planning – Karbala

Figure 2: Administrative Boundaries of the City of Karbala



Source: Karbala Directorate of Urban Planning

Area:

The area of Karbala Governorate is estimated at approximately 5,043 km², representing 1.1% of Iraq’s total area of 434,934 km². It consists of three districts:

A. Al-Hindiya District Center: Covers an area of 12 km². It administratively includes:

- Al-Khayrat Subdistrict with an area of 145 km²
- Al-Jadwal Al-Gharbi Subdistrict with an area of 187 km²

Thus, the total area is 344 km².

B. Karbala District Center: Covers an area of 2,397 km². It administratively includes:

- Al-Husseiniya Subdistrict with an area of 337 km²

C. Ain Al-Tamur District Center: Covers an area of 1,956 km² and does not include any subdistricts.Waste Index by Neighborhoods –
Table 3

Table 3: Waste Index by Neighborhoods

No.	Indicator	2024 Value	2030 Target
1.	Percentage of neighborhoods where waste is collected once per day relative to the total number of neighborhoods	69%	100%
2.	Amount of collected waste relative to the total daily generated waste	60%	91%

Source: Data from Karbala Municipality Directorate

Religious Occasions in Karbala:

Karbala has gained a distinguished status in Islamic history since the Battle of al-Taff (61 AH / 682 CE), where its soil embraced the shrine of Imam Hussein ibn Ali and his brother Abbas (peace be upon them), as well as their family members and companions who were martyred in the battle. Since then, Karbala has steadily grown and flourished. According to Al-Amar (2005, p. 65), the city faces pressure in providing services during religious occasions due to the large number of visitors coming to visit the holy shrines. This increase necessitates the provision of services, in addition to the problems arising from the influx of vehicles into the city.

Religious occasions represent significant historical and spiritual events with fixed dates that have become well-known days when pilgrims flock to Karbala to perform pilgrimage rituals. Accordingly, it becomes essential to provide sufficient spaces to accommodate the visitors and deliver

the necessary services during their stay in the city. Covered areas or temporary accommodations near the two shrines should be provided to shelter the visitors due to the overcrowding on the surrounding sidewalks and the open space between the shrines.

Visitors can be categorized as follows:

A. Local Visitors:

Those coming from within the country, making up about **90%** of the total number of visitors during each religious occasion.

B. Foreign Visitors:

1. **International Visitors:** Those arriving from non-Arab foreign countries, representing **8–8.5%** of the total visitors.
2. **Arab Visitors:** Those coming from Arab countries, representing approximately **1.5–2%** of the total.

C. Total Number of Visitors:

The number of visitors during religious occasions exceeds **21 million** (approximately), while the weekly visits reach more than **half a million** visitors. Table (4) illustrates these estimations:

Table (4): Estimated Number of Visitors to Karbala

Hijri Year	Number of Visitors
1438 Hijri	11,210,367
1439 Hijri	13,874,818
1439 Hijri	13,874,818
1440 Hijri	15,322,948
1441 Hijri	15,229,955
1442 Hijri	14,443,308
1443 Hijri	16,327,542
1444 Hijri	21,198,640
1445 Hijri	21,480,525

Source: Al-Ameedy, Al-Baghdadi, 2025, p. 318

The neighborhoods adjacent to the two shrines were selected as follows:

The research focuses on the center of Karbala **district (Qadha' Karbala)** as the most crowded spatial area during the Arbaeen pilgrimage, and includes the historical neighborhoods surrounding the holy shrines. This clarification emphasizes that the study is limited to the district level, not the entire governorate. The center of Karbala district today consists of eight outskirts (neighborhoods), as shown in Table No. (5) and Figure No. 3. These are the same names of the gates that were in the old wall that surrounded the old city (Al-Ameedy, Al-Baghdadi, p. 324, 2024).

Table (5) shows the most important shops in Karbala.

No.	Neighborhood Name	Description
1	Bab Al-Sallama	Named after the Arab tribe that inhabited it (Al-Sallama). It is located north of the shrine of Imam Hussain (peace be upon him).
2	Bab Baghdad	Located north of the shrine of Al-Abbas (peace be upon him). This neighborhood is the route travelers take to Baghdad. It is also known as Bab Al-Alwa, named after the vegetable market called Alwa.
3	Bab Al-Taqa	Located in the northwest of the city and named after the arch of Sayyid Ibrahim Al-Za'farani, one of Karbala's figures involved in the Manakhour incident in 1241 AH (1823 AD).
4	Bab Al-Khan	Located on the eastern side of the city and named after a large caravanserai (khan) that was built near the city walls.
5	Al-Mukhayyam (The Camp)	Located southwest of the two holy shrines, named after the Hussaini camp that existed there.
6	Bab Al-Najaf	Located in the heart of the city, covering the area between the two holy shrines. It is the neighborhood through which travelers pass when going to Najaf.
7	Al-Abbasiya	Located south of the city, established during the era of the governor Medhat Pasha, known as the "new area." It is divided into two parts: Eastern Abbasiya, east of Abbas Street, and Western Abbasiya, west of Abbas Street.

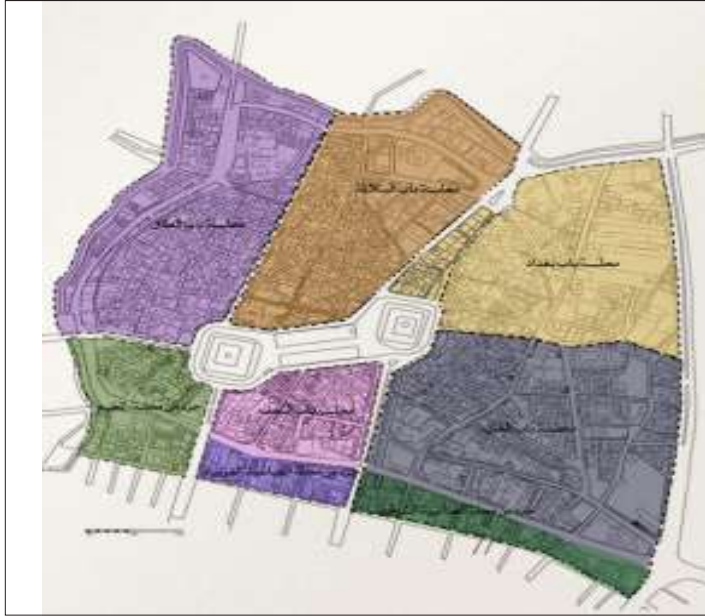


Figure (3) / A plan of the city center of Karbala, showing the names of the locations of the shops in the city. Source: The Urban Renewal Study of the City Center of Karbala, Phase II, 2011, p. 86

Table 6 shows the types of solid waste common during the Arbaeen Pilgrimage in Karbala

No.	Type of Waste	Contextual Notes
1	Food leftovers and field meals	Produced by feeding convoys; considered one of the most common types of organic waste.
2	Vegetable and fruit peels	Increase due to fruit distribution at hospitality and blessing stations.
3	Plastic, glass, and paper containers	Result from drinking water and juices; crowd size contributes to their multiplication.
4	Abandoned clothes and personal belongings	Left behind by visitors due to fatigue or changing weather conditions.
5	Damaged toys and recreational items for children	Usually left in the squares or lost during large crowds.

Source: Researchers based on field survey

Analyzing the Level of Achievement of AI Standards in Crowd Waste Management During the Arbaeen Pilgrimage in Karbala

Based on a review of the basic standards for AI use in waste management, which include: accuracy, technical integration, scalability, environmental efficiency, ethics, cybersecurity, and governance, it is possible to observe variations in the extent to which these standards are met when applied to the Karbala experience during the Arbaeen pilgrimage.

- **Integration with Smart Infrastructure:** These are still not fully operational, as Karbala lacks Internet of Things (IoT) networks or LoRa systems that facilitate real-time tracking.
- **Scalability:** These represent a challenge, as traditional systems are unable to handle sudden surges in waste volume.
- **Environmental and Economic Efficiency:** These are low, as traditional waste collection methods are used without investment in converting waste into energy or composting.

- **Cybersecurity:** Not effectively addressed due to the absence of intelligent data management systems.
- **Governance:** Digital coordination between service providers is lacking, despite significant human efforts.

Here is a comparison table showing the extent to which AI standards were met in managing crowd waste during the Arbaeen pilgrimage in Karbala, based on the previous analysis (Table 7).

Table 7: Analysis of the level of achievement of the criteria for using artificial intelligence in managing crowd waste during the Arbaeen pilgrimage in Karbala

Criterion	Verification Level in Karbala	Notes
Integration with Smart Infrastructure	Almost Absent	No IoT or LoRa networks available for real-time waste monitoring.
Scalability	Limited	Current systems cannot handle surges in waste volume during peak times.
Environmental and Economic Efficiency	Low	No effective investment in recycling or waste-to-energy conversion.
Cybersecurity	Not Enabled	No smart data management requiring information protection.
Good Governance	Weak	Poor digital coordination among service agencies; reliance on field coordination.

Source: Researchers based on field survey

These indicators highlight the need for an integrated strategy to employ artificial intelligence in managing religious crowd waste, contributing to transforming the environmental challenge into a smart and sustainable urban opportunity.

Table 8 shows the extent to which AI standards were applied in waste management in eight locations within the Karbala Historic Center during the Arbaeen pilgrimage, based on a field survey analysis.

Table 8: Application of AI Standards in Waste Management

Neighborhood	Digital Integration	Scalability	Environmental Efficiency	Cybersecurity	Good Governance
Bab Al-Sallama	X	X	X	X	X
Bab Baghdad	X	X	X	X	X
Bab Al-Taq	X	X	X	X	X
Bab Al-Khan	X	√ Partially	X	X	X
Al-Mukhayyam (Camp)	X	√ Partially	X	X	X
Bab Al-Najaf	X	X	X	X	X
Al-Abbasiya	X	√ Partially	√ Partially	X	X

Source: Researchers based on field survey

√: Partially: Indicates the presence of some traditional indicators (such as repeated field efforts, manual monitoring, or temporary coordination).

X: No systems or efforts can be effectively linked to AI standards.

By analyzing the extent of implementation of AI standards in waste management across Karbala, it is clear that the city is still in a very early stage of adopting these technologies. Despite the environmental and spatial challenges posed by the Arbaeen pilgrimage, there is still no integrated digital infrastructure that enables AI systems to operate effectively.

At the level of the eight historic neighborhoods in the Karbala Center, the results showed significant variations in achieving the standards. Most efforts were based on traditional or semi-digital procedures, without actual reliance on advanced AI technologies. The most prominent observations can be summarized as follows:

- A near-total absence of digital integration and smart infrastructure such as IoT or automated data analysis.
- Some neighborhoods (such as Bab al-Khan and Abbasiya) were limited to partial efforts that show signs of expansion or organization, but fall short of global AI standards.

- Governance, transparency, and cyber standards are almost absent, weakening the ability of any digital system to achieve sustainability and accountability. This indicates that achieving smart and sustainable waste management during the Arbaeen season requires a comprehensive institutional and technological transformation, starting with restructuring monitoring, tracking, and decision-making systems based on scalable technology that can be integrated with urban infrastructure.

Arbaeen: Towards an Automated and Sustainable Urban System

With the escalating challenges associated with waste management due to the massive expansion of the millions of pilgrims who visit Karbala during the Arbaeen pilgrimage, the use of artificial intelligence has become an urgent urban necessity to achieve efficiency and sustainability. However, to implement these technologies effectively in Karbala, it is essential to consider current infrastructure limitations, governance coordination challenges, and resource availability. The most prominent mechanisms adopted or possible for implementing these technologies are as follows:

1. **Smart robots for waste collection and sorting:**

Robots equipped with computer vision and AI technologies can automatically identify and sort waste (organic, plastic, metal, etc.). In Karbala, this solution could be introduced as a pilot program in high-density zones near the shrines. Yet, the lack of advanced power supply systems and the need for skilled maintenance teams are key challenges that must be addressed through public-private partnerships.

Figure 4: Robot collecting and sorting waste



Figure 4: Robot collecting and sorting waste

2. Connected smart containers:

These containers use sensors to monitor waste levels and report data to central systems. In Karbala, integrating such bins in main pilgrim gathering points (like Bab Baghdad Street or Al-Abbas Street) can reduce overflow. However, the limited internet coverage and real-time data infrastructure necessitate a phased approach and possible reliance on off-line-capable systems or LoRaWAN networks.

Figure 5: Smart, internet-connected, solar-powered waste containers



Figure 5: Smart, internet-connected, solar-powered waste containers

3. Drones: Drones can monitor waste hotspots and crowd density. In Karbala, their use could enhance real-time monitoring of zones with heavy foot traffic. However, regulatory constraints and limited operational zones (due to security around the shrines) require coordination with local authorities and security forces.

.Figure 6: Drones



Figure 6: Drones:

4. Smart Waste Collection Route Systems:

AI-driven route planning can reduce vehicle congestion and fuel use. In Karbala, this system could be tested with the municipal fleet, particularly during peak visitation. Still, aging vehicles, lack of GPS-enabled tracking, and weak coordination between cleaning departments remain implementation barriers. Pilot programs with external support or donor funding may provide a feasible entry point.

Figure 7: Smart waste management



Figure 7 Smart waste management

5. Predictive Platforms and Central Control:

These systems analyze data to forecast waste generation and coordinate response teams. For Karbala, establishing a central operations room during the pilgrimage season could significantly improve coordination. However, existing fragmentation between municipal departments and limited data integration mechanisms pose significant obstacles, calling for inter-agency collaboration protocols and capacity-building.

Figure 8:



Figure 8 Predictive platforms and central control

6. Smart Waste Segregation Systems:

Waste segregation is a crucial step in sustainable waste management. Color-coded containers (for organic, glass, plastic, paper, etc.) are designed and connected to smart systems that track waste filling rates and type. This mechanism contributes to promoting recycling, reducing random pollution, and increasing visitor awareness through a simple, easy-to-use visual system. Figure 9 Using color-coded, sensor-equipped bins in Karbala’s temporary camps and main routes can promote recycling and reduce waste volume. Educational signage in multiple languages can enhance awareness. Yet, low public engagement in waste separation and absence of recycling infrastructure requires a long-term strategy involving awareness campaigns, partnerships with NGOs, and mobile recycling stations.

Figure 9: Intelligent garbage sorting box



Figure 9 Intelligent garbage sorting box is an equipment or device to realize automatic garbage sorting and collection.

Conclusions

1. Traditional systems are unable to effectively manage waste during the Arbaeen pilgrimage.
2. There is no actual implementation of AI technologies in the waste management system.
3. Institutional coordination between service providers is lacking during the pilgrimage season.
4. Waste is collected in a mixed form without any source separation.
5. Smart digital infrastructure is not activated in the city of Karbala.
6. There is an urgent need for technological solutions to address environmental pressure during the pilgrimage.

Recommendations

First: Technical Recommendations

1. Deploy smart waste bins equipped with sensors and automatic sorting
Responsible Entity: Karbala Municipality + Private Tech Companies
Feasibility: Medium-term
2. Use AI-based predictive systems to monitor waste volume and distribution.
Responsible Entity: Karbala Municipality + University Labs
Feasibility: Short-term
3. Equip transfer stations with robotic arms for automatic waste sorting.
Responsible Entity: Ministry of Construction and Housing
Feasibility: Long-term
4. Use drones to monitor waste accumulation sites in real time.
Responsible Entity: Environmental Directorate + Civil Defense
Feasibility: Medium-term

Second: Institutional Recommendations

1. **Establish a smart monitoring center for waste management during Arbaeen.**
 - Responsible Entity: Karbala Municipality + Ministry of Communications.
 - Feasibility: Medium-term.
2. **Form a local coordination council including the municipality, holy shrines, universities, and private sector.**
 - Responsible Entity: Karbala Governorate.
 - Feasibility: Short-term.
3. **Update municipal regulations to support the integration of AI technologies in services.**
 - Responsible Entity: Provincial Council + Legal Affairs Department.
 - Feasibility: Medium-term.
4. **Allocate an annual budget for AI-based waste management projects.**
 - Responsible Entity: Ministry of Planning + Karbala Municipality.
 - Feasibility: Medium-term.

Third: Community-Based Recommendations

1. **Launch a digital awareness app to guide pilgrims on smart waste practices.**
 - Responsible Entity: NGOs + App Developers
 - Feasibility: Short-term
2. **Implement on-site awareness campaigns at service stations on smart waste disposal.**
 - Responsible Entity: Municipality + Local Volunteers
 - Feasibility: Short-term

3. Support graduation projects and academic research on AI and waste management.

- Responsible Entity: Ministry of Higher Education + University of Karbala

- Feasibility: Short-term

4. Apply a source-based waste separation system around the shrine area.

- Responsible Entity: Karbala Municipality + Field Awareness Teams

- Feasibility: Short-term

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**Utilizing Remote Sensing Techniques
to Analyze and Select the Optimal Site
for Establishing a Sustainable Green
Belt along the Baghdad–Karbala
Pilgrims Route**

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Abstract:

Green belts are an important environmental solution for combating desertification and mitigating the effects of climate change, especially in arid and semi-arid regions such as Iraq. This research aims to identify the optimal locations for establishing a sustainable green belt along the Baghdad-Karbala Road, using remote sensing, satellite, and geographic information systems (GIS) techniques. This road represents a vital axis witnessing rapid urban expansion and a major route for millions of pilgrims during the Arbaeen pilgrimage. This places significant pressure on the local environment and infrastructure, necessitating science-based planning interventions to ensure sustainable visitor services. Satellite imagery (such as Landsat 8 and Sentinel-2) from the recent period (2023–2024) was used, and a set of spectral indices, including the NDVI (Natural Color Vividness Index), the BSI (Aridity Index), and the NDMI (Natural Color Moisture Index), were applied to assess the environmental condition of the lands adjacent to the road. The terrain was also analyzed using a digital elevation model (DEM) to determine the appropriate slopes and levels for agriculture, taking into account factors such as wind direction and speed, the level of urban expansion, and nearby groundwater or surface water sources. A multi-criteria decision analysis (MCDA) methodology was adopted within a GIS environment to identify the most suitable areas, with each criterion weighted according to its environmental and logistical importance using the Analytic Hierarchy Process (AHP) method. The analysis results showed that the areas located southwest of Latifiya city and north of Alexandria are among the environmentally promising areas for establishing a green belt. These areas recorded the highest values in NDVI and the lowest in BSI, with flat terrain and relative proximity to water sources. The study also demonstrated that the areas within Babil Governorate

adjacent to the road have a high potential for transformation into green spaces if properly managed, using drought-resistant plants and low-water-consumption agricultural methods. The study recommends integrating the results of this analysis into regional sustainable development plans, particularly in light of the importance of the Million Pilgrimage Route. It also proposes involving stakeholders and local communities in the design and implementation to ensure the environmental and social sustainability of the project.

Keywords: Million-Pilgrimage Crowds - Visitor Services - Arba'een Pilgrimage - Remote Sensing and Satellites - Sustainable Development

Introduction

Green belts are among the most important sustainable environmental solutions that contribute to combating desertification, improving air quality, and mitigating the effects of climate change. This is particularly true in areas with high population density and intense human activity, such as the road linking Baghdad and Karbala, which witnesses a massive influx of people during religious occasions, particularly during the months of Muharram and Safar. This road represents a strategic axis not only from a religious and social perspective, but also in terms of its environmental and economic impact. It is a vital corridor witnessing urban expansion and increased activity, which has led to a significant deterioration of vegetation cover, increased pollution rates, and rising surface temperatures. Given the importance of this reality, the need to adopt smart environmental strategies based on sustainable development principles is essential. These strategies aim to rehabilitate the local environment by establishing a green belt extending along this road. This green belt provides a healthy and safe environment for visitors and local residents, and serves as a natural barrier to counter desertification and mitigate the impact of dust storms. In this

context, remote sensing and geographic information systems (GIS) techniques have proven highly effective in analyzing environmental conditions and monitoring spatial and temporal changes in biosphere components. These technologies enable researchers to obtain accurate spatial data and analyze it using advanced tools to assess the natural and environmental characteristics of the land, such as soil type, vegetation indices (NDVI, SAVI), surface temperatures (LST), topography, slope trends, proximity to water sources, and infrastructure such as road and service networks. Selecting the optimal site for establishing a green belt is a complex process that requires the use of these advanced analytical tools to ensure a balance between environmental efficiency and economic and social feasibility. The focus on the road linking Baghdad and Karbala in particular stems from the symbolic and strategic importance of this route, as it represents a religious landmark visited by millions of visitors annually. This exposes it to increasing environmental pressures, requiring careful, scientifically based environmental planning interventions. By combining data from multispectral satellite imagery, such as Sentinel-2 and Landsat 8, with spatial analysis in a GIS environment, an integrated spatial model can be constructed to help identify the most environmentally and logistically suitable areas for green belt development, taking into account climatic, hydrological, topographic, and social factors. Spatial analysis based on overlay analysis and multi-criteria decision analysis (MCDA) techniques is an ideal method for supporting environmental planning decision-making by weighing criteria and evaluating different scenarios quantitatively. Furthermore, implementing a sustainable green belt requires not only identifying the appropriate location, but also understanding the dynamics of the surrounding ecosystem, assessing the soil's ability to support vegetation, the availability of water resources, and the types of plants suitable for the local environment, while taking into account expected long-term climate change. Hence, this research aims to build an integrated scientific basis for analyzing and se-

lecting the best proposed sites for establishing a sustainable green belt along the pilgrims' route between Baghdad and Karbala. This research relies on remote sensing data analysis and geographic information systems, within a scientific framework that combines environmental vision and spatial planning. This is in pursuit of achieving sustainable development goals of preserving the environment, improving the urban landscape, supporting the green economy, and serving pilgrims by providing a more comfortable and safer environment along this vital route. The importance of the study also lies in the possibility of generalizing the proposed model to other Iraqi regions suffering from similar environmental conditions, making this project a pioneering experiment in employing modern technology to serve environmental and development issues in Iraq and the region.

Previous Studies

Recent years have witnessed increasing interest in the application of remote sensing and GIS technologies in the planning and implementation of environmental projects, particularly in the field of establishing green belts and combating desertification. Abdul Karim et al. (2019) highlighted the importance of integrating multispectral satellite imagery with GIS in identifying environmentally degraded areas and identifying suitable sites for expanding vegetation cover in urban and peri-urban areas. In a similar study, Hamid (2020) examined the role of the Normalized Vegetation Index (NDVI) in monitoring the degradation of agricultural lands adjacent to highways, emphasizing that changes in vegetation cover can be accurately monitored through time series analysis of satellite data. Al-Dulaimi (2021) used Sentinel-2 and Landsat 8 data to analyze land surface temperatures (LST) and identify areas most vulnerable to the urban heat island phenomenon, proposing the creation of dense vegetation strips to mitigate

this phenomenon. This aligns with the objectives of green belts in peri-urban areas such as the Visitors' Road. On the other hand, Al-Shammari and Al-Hashemi (2022) presented an applied study on selecting optimal locations for green belts around the city of Najaf, using overlay analysis and hydrological analysis to identify areas with high potential for cultivation, with a focus on the availability of water resources and soil type. The study demonstrated the effectiveness of the multi-criteria data analysis (MCDA) model in supporting environmental decision-making. Youssef et al.'s (2023) study also examined the relationship between population density and the decline in environmental indicators along urban roads, noting the importance of creating buffer green spaces to improve air quality and reduce visual and noise pollution. At the regional level, Faraj et al.'s (2021) study examined the green belt project around Riyadh in Saudi Arabia. Data from topography, soil, and vegetation cover were used to construct a spatial model to select optimal locations. The study confirmed that the availability of water resources is the most influential factor in the success of these projects in arid environments. Despite the numerous studies that have addressed the topic of green belts, few have focused on vital religious corridors with intensive seasonal use, such as the pilgrims' road between Baghdad and Karbala. This gives this study its importance, as it represents the first attempt to apply remote sensing techniques to analyze the environmental characteristics of this vital road and select green belt sites based on a precise, systematic spatial analysis that takes into account the religious, social, and environmental specificities of the site.

Sustainable Green Belt

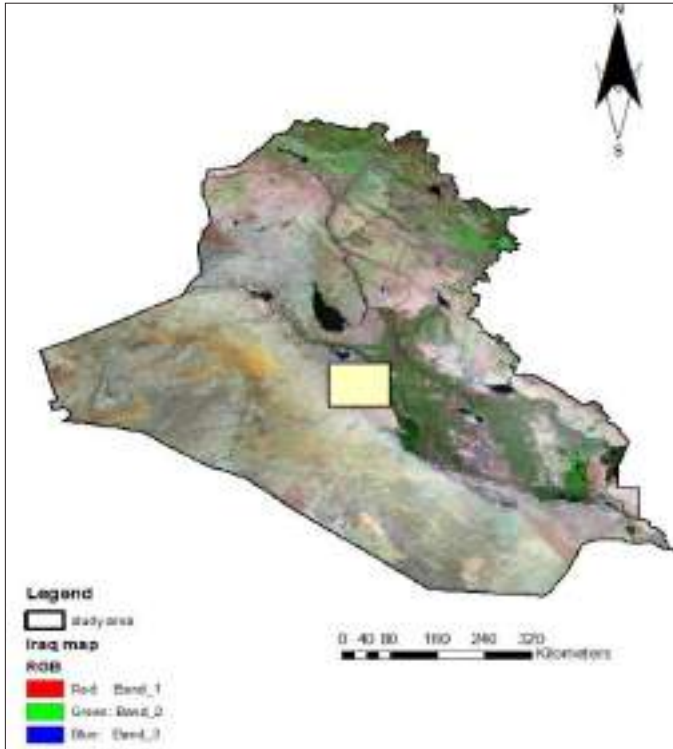
The sustainable green belt is one of the most important modern environmental solutions to address the growing challenges facing the urban environment, such as deteriorating air quality, rising temperatures, desertification, and loss of biodiversity. A green belt is a planted area of trees and plants established around or within cities and along vital roads to create a natural environmental barrier that limits the negative impacts of human activities and climatic factors. The sustainability of the green belt lies in its reliance on integrated scientific planning that takes into account environmental characteristics and available resources. It is designed to ensure the long-term sustainability of its environmental function without depleting natural resources. Studies show that green belts contribute to reducing the heat island phenomenon, improving air quality by absorbing pollutants and dust, reducing noise, and stabilizing soil, as well as enhancing the psychological health of residents by providing recreational green spaces. In urban environments with arid and semi-arid climates, such as Iraq, the need for these belts increases due to the limited natural vegetation cover. To design an effective green belt, the importance of employing remote sensing and geographic information systems (GIS) techniques has emerged as key tools for analyzing and evaluating the spatial and environmental characteristics of the target area. Satellite imagery can monitor vegetation indices such as NDVI and SAVI, analyze land surface temperatures (LST), determine soil type, slopes, and topographic trends, and analyze proximity to roads and water sources. Spatial analysis techniques such as overlay and multi-criteria decomposition analysis (MCDA) can also be used to evaluate various factors and identify optimal locations for establishing the belt. With this scientific approach, it is possible to design green belts that are not limited to aesthetic functions but also play a pivotal role in enhancing urban sustain-

ability and mitigating the effects of climate change. This makes the project to establish a sustainable green belt along the Baghdad-Karbala pilgrims' road a strategic step from the environmental, social, and economic levels.

Study Area

The study area extends along the road linking the cities of Baghdad and Karbala, known locally as the “Pilgrims’ Road” due to the heavy traffic it witnesses during religious occasions, particularly the Arbaeen pilgrimage. This road is approximately 100 kilometers long, extending from the south-western suburbs of Baghdad, through the Latifiya and Musayyib districts, to the northeastern entrances to Karbala. The region is characterized by its geographical and climatic diversity, as it lies within the desert and semi-arid zone, suffering from high temperatures in the summer and low annual rainfall rates, in addition to the increasing deterioration of natural vegetation due to human activities and uncontrolled urban expansion. The region is also located within an alluvial plain and is covered with clayey and sandy soils of varying characteristics, affected by seasonal winds and dust storms, which directly impact air quality and the health of pilgrims. The pilgrims’ route is a strategic axis linking two important religious and cultural centers in Iraq. It traverses agricultural and environmentally degraded areas, making it an ideal model for studying the impact of environmental and human factors on the selection of green belt sites. Administratively, the study area extends within the borders of Baghdad and Babil governorates, reaching the holy city of Karbala. It encompasses both rural and urban areas, providing a diverse environment for analyzing topographical and environmental factors using remote sensing and geographic information systems (GIS) techniques..

Figure (1): location of the study area from Iraq.



Data Source and Processing

This study adopts an integrated spatial analysis methodology that combines Remote Sensing (RS) and Geographic Information Systems (GIS) to evaluate the environmental and topographical characteristics of the study area and to identify the optimal location for establishing a sustainable green belt. The methodology begins with the acquisition of satellite imagery for different time periods covering the years 2000 to 2024, with a spatial resolution of 30 meters. These images were obtained from Landsat 5 and Landsat 8 sensors via the USGS Earth Explorer platform (<http://earthexplorer.usgs.gov/>), as detailed in Table (1). All imagery was selected from the spring season to minimize the effects of abandoned or uncultivated lands, which may otherwise distort classification accuracy and affect the Normalized Differ-

ence Water Index (NDWI) values. In addition to Landsat data, high-resolution Sentinel-2 MSI imagery (10-meter resolution) was utilized to extract vegetation indices (NDVI) and monitor Land Surface Temperature (LST). Furthermore, a Digital Elevation Model (DEM) with 30-meter resolution was employed to generate slope and aspect maps and conduct terrain analysis. Secondary data such as official soil maps provided by the Iraqi Ministry of Agriculture, administrative boundary layers, road networks, and surface water sources were also integrated into the GIS environment (ArcGIS Pro 3.2). These data layers were analyzed through a multi-criteria spatial model using Overlay Analysis and Multi-Criteria Decision Analysis (MCDA). A set of environmental criteria—including soil type, proximity to roads, distance from water sources, slope, aspect, NDVI, and LST—were assigned relative weights using the Analytic Hierarchy Process (AHP) based on their ecological and logistical relevance to green belt development. The weighted overlay tool was then applied to produce a spatial suitability map categorizing the area into high, moderate, and low potential zones for green belt establishment. To validate the spatial analysis, field visits were conducted at selected sites using an unmanned aerial vehicle (UAV) equipped with a multispectral camera, enabling documentation of actual vegetation cover and land conditions. The final results were reinforced through comparative analysis between recent aerial imagery and field-collected data, ensuring the reliability of the site selection process.”

Table (1): Type and specification of satellite images used in the study.

Rank	Satellite type	Sensor	Date
1	Landsat-5	MSS/TM	2000/3/17
2	Landsat-8	OLI/TIRS	2024/3/11

After obtaining Landsat images many processors have been performed using GIS 10.6 like geometric correction was done using the (Map to Image) method, depending on map with known geographic coordinates, where all the features have known a projection system that is similar to the corrected map used in the debugging process and radiometric correction was performed using ERDAS Version 14.00.0. Then many bands of satellite images were composite to produce (RGB) image with false color for both sensors (TM, OLI) and the bands used for the composite are shown in table (2) then calculated of Normalized Differences Water Index to diagnose and determine the water cover from other type covers with high accuracy.

Table (2): composites bands of satellite image (RGB).

Resolution	TM	OLI/TIRS	Color
30	Band-7	Band-7	Red
30	Band-4	Band-5	Green
30	Band-2	Band-3	Blue

False colour images (RGB) that produced from the composite bands as shown in figure (2)

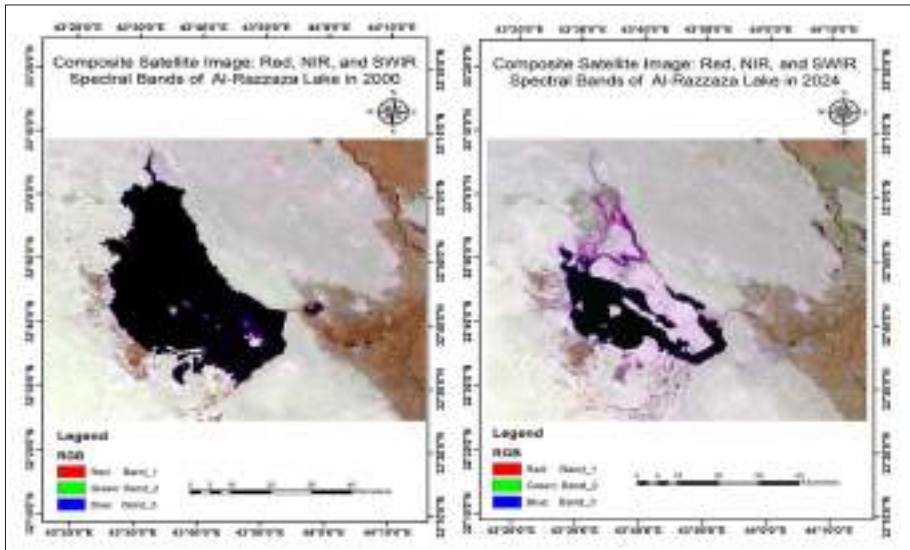


Figure 2: The pre-processed satellite images of the study area.

Result and discussion

1. Visual Interpretation:

The initial stage of image analysis involved visual interpretation of the false color composites generated from selected spectral bands. This step relied on well-established principles in remote sensing, including the interpreter's experience, the spectral properties of the satellite sensors, and the temporal context of image acquisition. In the context of the present study, visual interpretation was conducted using key image elements such as size, shape, texture, tone/color, and spatial pattern, in order to identify and distinguish land cover types and surface features relevant to the planning of the sustainable green belt along the Baghdad–Karbala pilgrim's route. This qualitative assessment facilitated the preliminary understanding of the spatial distribution of vegetation, water bodies, bare land, and anthropogenic features, thus guiding the subsequent quantitative classification phase.

2. Image Classification:

Image classification refers to the process of categorizing a digital satellite image into distinct land cover classes based on spectral similarity among ground features. In this study, both supervised and unsupervised classification techniques were evaluated; however, the supervised classification method was adopted due to its higher accuracy and reliance on ground-truth data. This method involves selecting representative training samples for each land cover type, based on field observations, high-resolution imagery from Google Earth, and expert knowledge. These training sites serve as reference points for the classification algorithm to label the entire image accordingly.

The classification process was executed using ArcGIS 10.6, where the Maximum Likelihood Classifier (MLC) was applied to Landsat satellite imagery for the years 2000 and 2024. The final classification results divided the study

area into six major land cover categories: Vegetated areas, Water bodies, Bare land, Sand dunes, Gypsiferous soils, Wetlands, and Saline areas. Post-classification refinement was performed to correct misclassifications and enhance the accuracy of the outputs. Furthermore, spatial statistics were generated to quantify the area covered by each class, enabling a comparative analysis of land cover dynamics over the selected temporal window. The classified maps are presented in Figure (3) and provide crucial input for identifying degraded or potentially restorable areas suitable for green belt development.

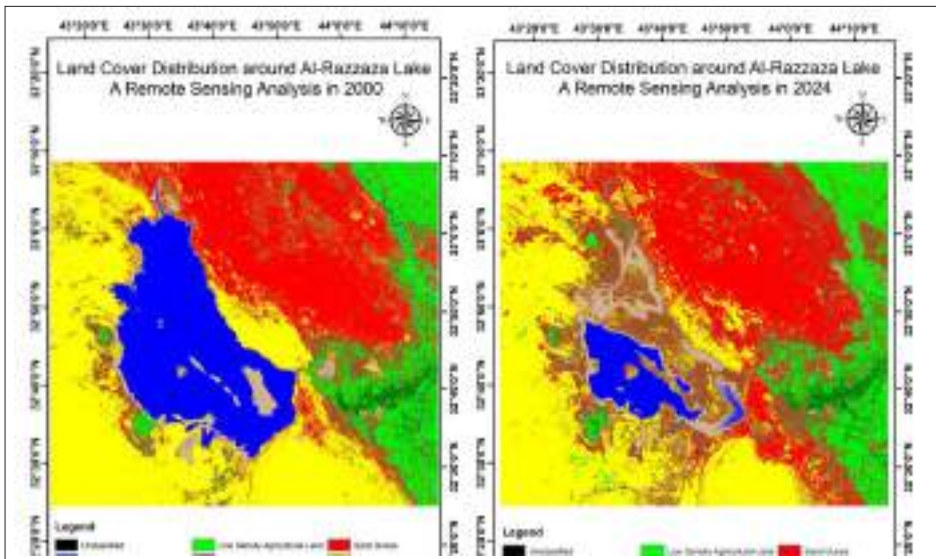


Figure 3: Image classification of land cover of TM and OLI Images 2000 on left and 2024 on right.

Table (3): Land cover areas in (Km2)

Date of image	Vegetation area	Gypsiferous	Bare land	Water bodies	Sand area	Saline area
17/03/2000	892.62	784.04	2676.73	1286.19	1748.44	279.47
11/03/2024	947.85	1727.32	2403.51	320.41	1839.15	429.26

The figure (4) The temporal variation in the land cover areas during the extended period (2000-2024) using supervised classification.

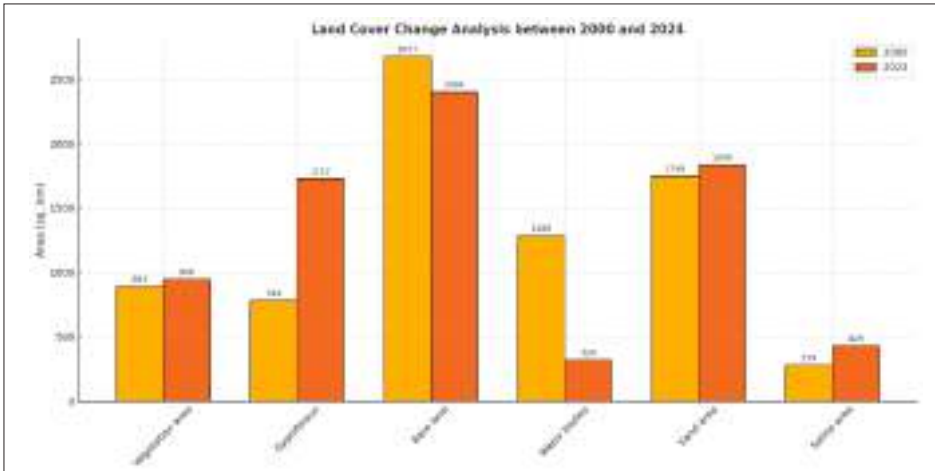


Figure (4): The changing in the land cover areas during the extended period (1985-2018).

3.Normalized Difference Water Index (NDWI):

The Normalized Difference Water Index (NDWI) is a spectral index used to detect and delineate water bodies based on their unique spectral behavior. Water surfaces exhibit strong reflectance in the green wavelength and significantly low reflectance in the near-infrared (NIR) region, which forms the foundation of the NDWI calculation. The index values generally range between -1 and $+1$, where positive values typically indicate the presence of surface water such as lakes, rivers, and canals, while negative values correspond to non-water features, including vegetation, bare soil, and built-up areas.

NDWI plays a critical role in isolating water bodies from adjacent land cover types, particularly in areas where spectral reflectance of water may overlap with moist soils or vegetation. It is widely applied in water body mapping, drought monitoring, and change detection studies due to its sensitivity to variations in water content over time. The index also assists in minimizing classification errors caused by spectral similarity between water and other dark features.

NDWI is calculated using the following standard formula:

$$NDWI = \frac{R_{green} - R_{nir}}{R_{green} + R_{nir}} \dots \dots \dots \quad (1)$$

In this study, NDWI was computed using ArcGIS 10.6 based on Landsat imagery. The derived NDWI values were analyzed to assess the spatial and temporal distribution of water bodies across the study area. The maximum and minimum NDWI values extracted from the processed satellite images are presented in Table (4), highlighting the extent and variability of surface water features for further interpretation and mapping accuracy.

The NDWI was calculated using GIS 10.6, the highest and the lowest value for the NDWI index are shown in table (3).

Table (4): The highest and lowest NDWI values .

Date	highest value of NDWI	lowest of value NDWI
2000/3/17	0.908	-0.916
2024/3/11	0.395	-0.861

The results in the following figures show the spatial distribution of NDWI values. Unsupervised classification was applied upon NDWI and the results were shown in figure (6). It shows only the areas containing water such as the channels and Al- Razza Lak

The area of water cover was calculated in each image taken in the table (5).

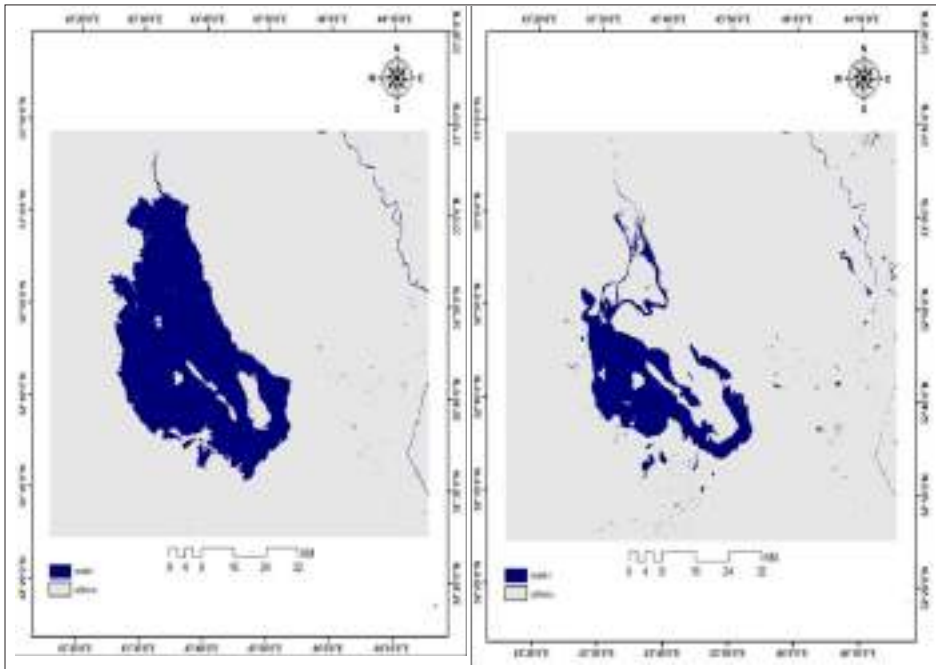


Table (5): Area of water cover extracted from NDWI in (Km2).

Date of image	Area of water cover in (Km2).
2000/3/17	1453.24
2024/3/11	502.76

Based on the outcomes of the Multi-Criteria Decision Analysis (MCDA), which integrated remote sensing data and Geographic Information Systems (GIS), several areas along the Baghdad–Karbala pilgrims route were identified as highly suitable for establishing a sustainable green belt. The spatial suitability map indicated that the most promising zones are concentrated in the central and southern sectors of the corridor, particularly between Al-Yusufiyah and Al-Musayyib districts. These areas are characterized by favorable environmental conditions, including gentle slope gradients, proximity to water sources, well-drained sandy-loamy soils, and moderately lower

land surface temperatures (LST). In addition, the accessibility of these areas via the main road network makes them ideal for implementing green infrastructure projects with ease of maintenance and resource delivery.

The supervised classification of Landsat satellite imagery for the years 2000 and 2024 revealed marked changes in land cover dynamics within the study area. Six primary land cover classes were identified: Vegetation areas, Gypsiferous lands, Bare lands, Water bodies, Sand areas, and Saline soils. Quantitative analysis showed the following trends:

- Vegetation cover increased slightly from 892.62 km² in 2000 to 947.85 km² in 2024 (+55.23 km²).
- Gypsiferous areas showed a substantial rise from 784.04 km² to 1727.32 km² (+943.28 km²).
- Bare lands decreased from 2676.73 km² to 2403.51 km² (-273.22 km²), suggesting a shift in surface classification likely due to erosion or surface transformation.
- Water bodies underwent a sharp decline from 1286.19 km² to 320.41 km² (-965.78 km²), highlighting a significant reduction in surface water availability.
- Sand areas increased modestly from 1748.44 km² to 1839.15 km² (+90.71 km²), indicating ongoing aeolian activity and sand encroachment.
- Saline soils expanded from 279.47 km² to 429.26 km² (+149.79 km²), suggesting increasing salinization in low-lying or poorly drained zones.
- The decline in water bodies is further supported by NDWI analysis, which showed reduced positive index values, signifying diminished surface moisture. Concurrently, NDVI trends indicated only slight improvements in vegetation health, reinforcing the necessity for targeted ecological intervention.

These findings underscore the environmental vulnerability of the region and highlight the strategic importance of implementing a sustainable green belt. The green belt should be established in transitional zones between degraded and agricultural lands, where ecological restoration is feasible. It is recommended that drought- and salt-tolerant species be planted, supported by modern irrigation technologies such as drip systems and the reuse of treated water, to ensure long-term viability and maximize ecological impact.

4.Spatial Description of the Proposed Green Belt Site:

The proposed location for the sustainable green belt along the Baghdad–Karbala pilgrims route was identified through spatial suitability modeling and multi-criteria spatial analysis using remote sensing and GIS tools. The study area lies in the central region of Iraq, extending southwest from Baghdad to the city of Karbala, and intersects a range of environmental and administrative zones, including the districts of Al-Yusufiyah and Al-Musayyib. These areas were classified as highly suitable zones in the suitability map, primarily due to their favorable topographic and environmental conditions, such as low slopes, well-drained sandy to loamy soils, moderate land surface temperatures, and proximity to both surface and subsurface water resources.

The spatial framework of the proposed site also includes:

- The core alignment of the pilgrims route, which shows significant ecological stress, including vegetation degradation and signs of advancing desertification.
- High-suitability zones, highlighted in light green on the spatial map, located particularly within Al-Yusufiyah and Al-Musayyib areas, where natural conditions align well with the requirements for successful green belt establishment.

- Moderate-suitability zones, extending both north and south of the core route, offering transitional buffer areas to support ecological continuity and landscape integration.
- The main road network and identified water bodies are also illustrated on the map, emphasizing the logistical advantages for transportation, irrigation infrastructure, and future maintenance operations.

These spatial features collectively support the strategic selection of this corridor for the green belt, offering not only environmental restoration potential, but also logistical feasibility for implementation. The accessibility of the area via established roadways and its interface with degraded and agricultural lands make it an ideal candidate for an ecologically functional and socioeconomically viable green infrastructure intervention.

Conclusions and Recommendations

The results of this research demonstrate the importance of employing remote sensing and geographic information systems (GIS) techniques in analyzing environmental changes and identifying optimal locations for sustainable development projects, such as the green belt along the pilgrims' road between Baghdad and Karbala. Spatial analysis of satellite imagery during the period (2000–2024) revealed a clear decline in water bodies and the continued expansion of sandy and saline areas, with a slight improvement in vegetation cover in some areas. By applying a multi-criteria dynamics analysis (MCDA) model, high-priority areas for green belt planting were identified, particularly in the central section of the road in the Yusufiyah and Musayyib areas, where suitable environmental and logistical conditions are available. Based on the above, the research recommends the following:

1. Adopt a strategic plan for establishing a green belt based on the results of the spatial analysis, starting with the most environmentally suitable areas.
2. Use local plant species that are resistant to drought and salinity to ensure sustainable vegetation cover and reduce maintenance costs.
3. Rely on alternative water sources, such as treated wastewater or water harvesting techniques, to address the shortage of surface water.
4. Integrate the project into the National Plan to Combat Desertification and Climate Change, given its direct impact on improving air quality and reducing temperatures.
5. Expand the study to include other important routes in Iraq, especially those that witness human activity or heavy seasonal pilgrimage.
6. Adopting these recommendations will contribute to transforming this vital route into a sustainable environmental model, enhancing the social, economic, and health value of the area, and establishing a culture of smart environmental planning in Iraq.

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Utilizing the Deep Learning model for Traffic Sign Recognition in Arbaeen Pilgrimage

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Abstract:

The Arbaeen pilgrimage is one of the largest human gatherings in the world, posing significant challenges for traffic management and traffic sign supervision due to extreme population density, frequent changes in temporary traffic routes, and the physical and mental fatigue experienced by organizational staff. These factors make it increasingly difficult to guide visitors, particularly the elderly and those unfamiliar with the area. This research aims to address these challenges by developing an intelligent, automated system capable of instantly recognizing Arabic traffic signs and providing audio alerts to drivers and traffic coordinators. A convolutional neural network (CNN) model was employed, incorporating data analysis techniques such as preprocessing, data augmentation (including rotation and zooming), and normalization. The system was trained and tested on a publicly available dataset (ArTS Dataset) containing Arabic traffic signs under diverse conditions (e.g., lighting, angle, clarity). An interactive graphical user interface (GUI) was designed, allowing users to upload images of traffic signs (simulating camera input) and receive real-time predictions accompanied by audio pronunciation in Arabic. The model achieved test accuracy exceeding 90% when evaluated on the designated test dataset, along with strong performance in additional metrics such as precision, recall, and F1-score. Although the data used does not originate from actual traffic signs in Karbala during the Arbaeen pilgrimage, it reflects similar real-world conditions. This work represents an initial step toward future field deployment, particularly in smart transportation systems, where such a system could support visitors in their native language and in real time, thereby enhancing public safety and mobility during large-scale religious events.

Keywords: Traffic Sign Recognition, Arbaeen Pilgrimage management, Traffic Sign Detection, Traffic management, CNN-based Model.

Introduction

One of the most important cornerstones of intelligent transportation systems is providing self-driving vehicles and advanced driver assistance technologies that can recognize traffic signs, which helps provide safe and easy driving. These systems must also provide a reliable approach to instantly identifying and translating traffic signs to ensure safety while driving, and support compliance with traffic regulations. Although there is clear progress in the field of traffic sign recognition systems, these systems still face many challenges that hinder their implementation and development as required (Alamri, S., & Kanwal,2024). Overcoming these challenges and providing high accuracy when adopting these systems in classifying traffic signs is an essential step before starting to implement any proposed smart transportation system. The most important challenges that can be addressed in these systems are the accuracy and quality of images, different lighting, as well as the difference in the design of traffic signs between countries. It is worth noting that these difficulties increase significantly when dealing with traffic signs in Arab countries, because these countries suffer from a lack of adherence to unified international standards when designing these signs, and they also contain special signs and patterns that distinguish them. Therefore, the process of identifying them is considered more complex and constitutes a real obstacle to Building effective TSR systems capable of adapting to a variety of operating environments (Farzipour, A.,Manzari,O.N.,&Shokouhi, n.d.). Several technologies have emerged that have promising capabilities and are able to address many of the challenges related to processing digital images efficiently,quickly, and with high accuracy. These technologies rely primarily on artificial intelligence (such as deep learning, especially convolutional neural

networks (CNNs)). These techniques are distinguished by their effective ability in classification tasks, which makes them able to identify the most important sequential and graded characteristics of images. However, CNN relies heavily on the availability of large, properly classified datasets that are used to train these networks. Fully connected layers, which are damaged, may suffer from poor generalization and may not be as efficient as required in real-time applications (Bhuvaneshwari, B., Abbijeet, R., Singh, S., & Priyadarshini, 2025) (William, M. M., Zaki, P. S., Soliman, B. K., Alexsan, K. G., Mansour, M., El-Moursy, M., & Khalil, 2019). In three popular techniques for traffic sign identification are currently being utilized. practiced: machine, form (Wali, S. B., Hannan, M. A., Hussain, A., & Samad, 2015), and color-based (Ritter, W., Stein, F., & Janssen, 1995), methods based on learning (Fleyeh, 2004). In order to provide a powerful and scalable Arabic TSR system specifically designed to help improve sign classification accurately and efficiently, this research includes a graphical user interface (GUI) that provides users with a clear and easy-to-use interface. The proposed system also provides the feature of audio output in Arabic describing traffic signs to the driver, thus enhancing accessibility for Arabic-speaking users and facilitating and improving the practical application of the system in real-world environments. This research explores the integration of alternative classifiers into CNN that aim to improve accuracy while maintaining computational efficiency.

Related works

TSR has become an important subject, leading many researchers in the field of Artificial Intelligence to propose many approaches for enhancing accuracy, efficiency, and processing time especially with the emergence of machine learning (ML) and deep learning (DL). In this section a number of recent papers will be reviewed which have significantly contributed to the growth of TSR technologies. In 2021, research was presented aimed at developing a real-time TSR system using artificial intelligence and deep learning techniques, specifically the YOLOv4 model of bypass neural networks (CNN). The proposed system also provides the feature of informing the driver via voice of the sign content, which helps reduce accidents resulting from Ignoring or not understanding traffic signs. Several versions of YOLO have been adopted (including YOLOv3 and YOLOv4-tiny). The best performance was (YOLOv4-tiny), which achieved an average accuracy (mAP) of 64.71% and a detection speed of 55 frames per second (FPS), which is suitable for real-time applications (Manawadu, M., & Wijenayake, 2024).

While in 2023, a lightweight model of bypass neural networks (CNN) for traffic sign recognition was developed, designed to achieve high accuracy and fast response time, making it suitable for ITS applications, especially in vehicles with limited resources. The model was trained on the GTSRB and BelgiumTS datasets, and achieved robust results using a few coefficients. He also adopted optimization techniques such as magnification, normalization, and smoothing to improve generalization and reduce bias, along with the use of Adam's algorithm and the cross-entropy loss function.

Comparison with well-known models such as GoogleNet, AlexNet, VGG, ResNet, and MobileNetv2 has shown the superiority of the model in terms of accuracy, performance efficiency, and low resource consumption (Khan, M. A., Park, H., & Chae, 2023). While In 2024 a real-time traffic sign recognition (TSR) system was developed, supported by voice assistance. The system is based on a convolutional neural network (CNN) trained on traffic light data, where the sign is recognized and then voiced to alert the driver. Pre-processing and performance optimization techniques using the YOLO model were employed to achieve a detection speed of up to 55 frames per second (FPS) and an average accuracy of 64.71%. The system aims to improve traffic safety, especially in environments where traffic signs are not clearly visible or familiar to drivers, while providing a low-cost system that can be used in autonomous vehicles or as a driver aid (kolluri, o., Veldandi, S., & Pittala, 2024). More recently, in 2025, a cost-effective and scalable system for real-time self-driving applications was proposed. By combining advanced deep learning techniques and embedded systems by taking advantage of deep convolutional neural networks, the system achieves high accuracy and robustness in classifying traffic signs. This system is a practical approach to applying advanced driver assistance features on low-cost platforms, which enhances the field of vehicle technology (N G, G. K., Kishore, A., & Krishna, 2025) Also, in the same year, research was presented by Benfaress et. al. on an advanced traffic sign recognition system using a deep CNN network supported by explanatory intelligence (XAI) technology through the Grad-CAM tool. This helps the system interpret its decisions visually and helps address challenges that may be encountered. It is encountered by the driver such as poor lighting, fog, low-resolution images, and partially obscured signs, which affect recognition accuracy.

In this system, a high accuracy of 99.62% was achieved without data enhancement and 99.06% when using enhancement techniques due to the XAI technology that was used. (Benfaress, I., Bouhoute, A., & Zinedine, 2025). To simplify the presentation of the previously published research, the key studies discussed above are summarized in the following table.

Table (1): Related Works Summary

Research Year	Authors	Techniques Used	Results	Key Findings
2021	Manawadu, and Wijenayake	YOLOv3, YOLOv4, YOLOv4-Tiny, CNN, TTS (gTTS), CUDA, Open CV	55 FPS, 64.71% mAP, Precision: 0.79, F1 Score: 0.69	Voice-assisted system improves driver awareness; YOLOv4-Tiny best for real-time; suitable for embedded systems in vehicles.
2023	Khan et al.	Lightweight CNN, ReLU, Global Average Pooling, Adam Optimizer, Data Augmentation, Grid Search	GTSRB: 98.41%, BelgiumTS: 92.06%, Time: ~1264 sec, Params: 2.61M	Proposed model outperforms state-of-the-art models with fewer parameters; ideal for embedded systems in real-time TSRs.
2024	Kolluri et. al.	CNN (YOLO-based), Image Data Generator, Voice Assistance	Detection speed: 55 FPS Accuracy: 64.71% average	Developed a real-time voice-assisted TSR system with CNN, demonstrated viability for low-cost deployment.

Research Year	Authors	Techniques Used	Results	Key Findings
2025	Kishore et. al.	CNNs, YOLO-based TSR pipeline, data augmentation, grayscale conversion, Arduino-based control system, ultrasonic and IR sensors, sensor fusion	- Accuracy: 99.63% (GTSRB), 99.68% (CTSD)- Latency: 24–26 ms (with signs), 24–30 ms (without signs)-	Developed a real-time TSR system integrated with autonomous vehicle control. Combined high-accuracy CNN classification with low-cost Arduino-based obstacle avoidance and line following using sensor fusion. Offers a scalable, real-time solution for autonomous navigation.
2025	Benfaress et. al.	Custom CNN + Grad-CAM + Data Augmentation (DA) + XAI + Comparison with GoogLeNet, ResNet, etc.	Accuracy: 99.62% (no DA), 99.06% (with DA); F1-score: 99.67%	Robust recognition under adverse conditions; explainable decisions using Grad-CAM; outperforms state-of-the-art models.

Methodology

This section presents the methodology adopted in the design and development of the Arabic Traffic Sign Recognition System (TSR), which aims to classify traffic signs automatically and in real-time, which enhances Traffic Safety and supports intelligent assistance systems for drivers, especially in Arabic countries. The proposed model, as shown in Figure 1, is based on a set of interrelated steps, starting with the preparation of data, passing through the design and training of the model, ending with the implementation of an interactive graphical interface with voice feedback. The proposed model was implemented using the Python language, relying on the TensorFlow and Keras libraries to design the bypass neural network (CNN), and the Tkinter interface to develop the graphical interface, with the integration of the Pygame library to generate audio outputs in Arabic.

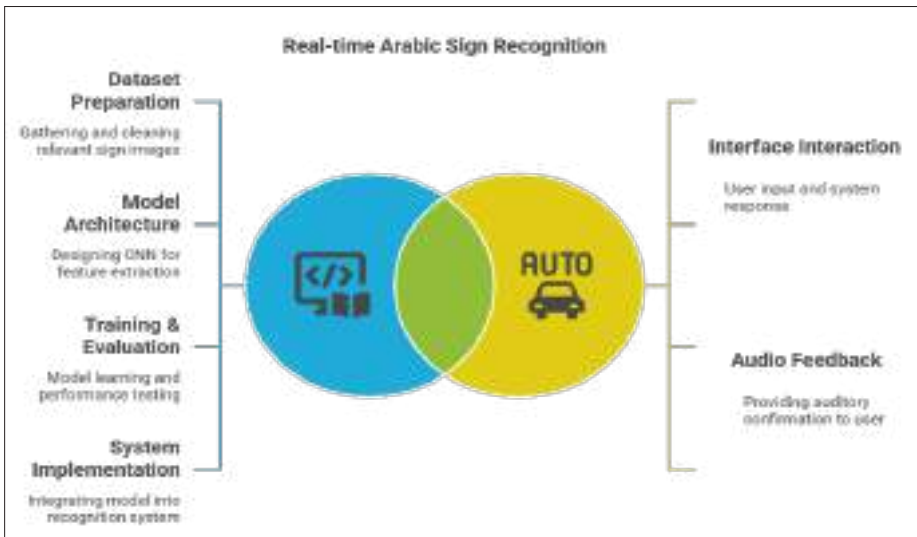


Figure 1: The main process of the proposed model

Each process consists of several steps, including dataset preparation, data processing funnel, CNN feature extraction, CNN data transformation, model training, and feedback, as illustrated in Figure 2.

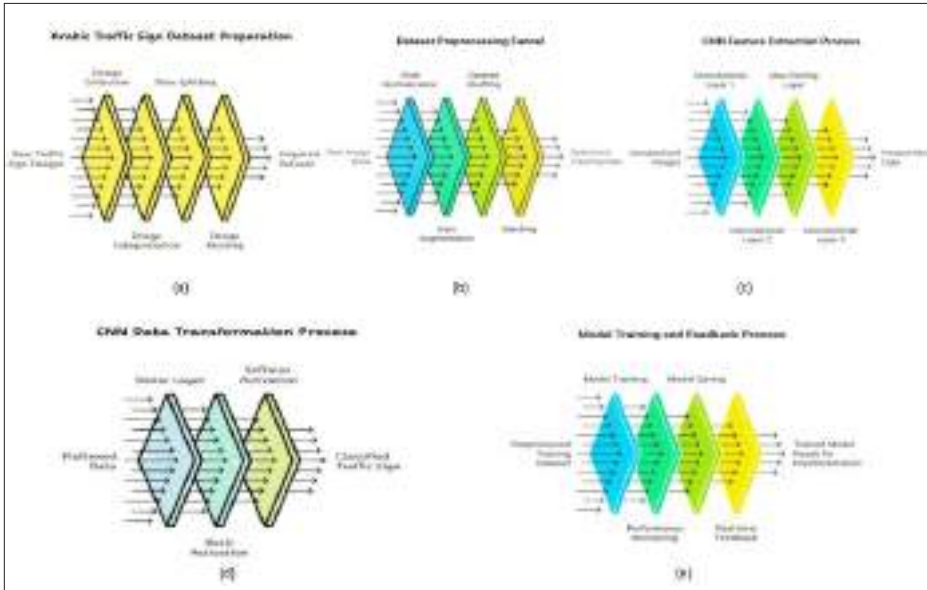


Figure 2: The internal steps of each process in the proposed model

Dataset properties:

The ArTS (Arabic Traffic Sign) dataset was adopted in this research and is one of the first specialized collections focused on Arabic traffic signs. It was officially published in March 2020. The dataset includes 24 categories of the most common Arabic traffic signs, with real-world images collected from three interconnected cities in the Eastern Province of Saudi Arabia: Al-Khobar, Dammam, and Dhahran. The dataset consists of:

- 2,718 real field-captured images, randomly divided into 80% for training (2,200 images) and 20% for testing (518 images).
- 57,078 augmented images, including 46,200 for training and 10,878 for testing, provided in compressed files due to their large size.
- This dataset offers diversity in lighting conditions, camera angles, and sign clarity, making it well-suited for training robust Arabic traffic sign recognition models in realistic environments.

Data Preparation Process:

The data preparation included the collection of images of Arabic traffic signs from open sources as well as data collected manually to cover variations in lighting, angles, and partial obscuration. The data was divided into:

- 70% for training
- 30% for testing

All images were converted to uniform dimensions (180×180 pixels). Several preprocessing techniques have also been applied to improve the performance of the model to Rescaling values back to the range [0,1].

Data Preprocessing Process:

1. The first step in this process is to normalize the pixel intensity to a range between 0 and 1 to normalize the data to achieve consistency in dynamic range for the input images (Koo, K. M., & Cha, 2017).
2. Data Augmentation using rotation, inversion, and zoom to simulate realistic conditions and reduce overfitting (LeCun, Y., Bengio, Y., & Hinton, 2015).
3. Batch processing was employed in this research to apply consistent preprocessing operations to multiple images simultaneously. The use of batching and random shuffling contributed to enhanced efficiency during the training phase (Barnaby, C., Chen, Q., Samanta, R., & Dillig, 2023).

Model Architecture:

CNN-based models are used efficiently in TSR systems to classify signs effectively (Alkhazraji, L., Abbas, A. R., Jamil, A. S., Kadhim, Z. S., Alkhazraji, W., Jebur, S. A., ... & Hussain, 2025). The system is based on a convolutional neural network (CNN) consisting of:

1. An input layer that resizes images
2. Three convolutional Layers followed by maximum pooling using filters (32, 64, 128)
 - Flatten layer to convert output to vector.
 - Dense layer (density) with 128 cells.
 - Softmax output layer with a number of cells equal to the number of sign varieties.

The Adam algorithm was used as an optimization tool (Optimizer), with a cross-entropy as loss function due to the multivariate nature of the problem.

Training and Evaluation Model:

The model was trained on 10 epochs, using test data to accurately assess performance. A built-in software interface was also used that displays the training progress instantaneously using Tkinter.

System Implementation and Graphical Interface:

An interactive graphical interface has been developed that allows the user to upload a photo of the traffic sign, and then display the result with the percentage of confidence, as well as make a sound in Arabic stating (indicating) the name of the sign.

An audio feed system using the pygame library, matches the name of the labeled sign with a pre-recorded audio file. As a summary, the proposed sign classification model's process consists of the following steps:

- Import necessary libraries such as TensorFlow, Tkinter, Pygame and others.
- Initialize the data paths and folders needed for the form and audio.
- Check for training and test data folders.
- Load images from data folders and divide the training data into two parts: Training and Verification.

- Extracting category names from training data for later use in classification and presentation.
- Build a model using MobileNetV2 as the base model with additional layers for classification.
- Preparing the model for training using Adam and loss sparse_categorical_crossentropy.
- Train the model on the data and display the training progress with a progress bar.
- Plot the accuracy and the loss of curves during training and verification phases.
- Predicting test data rankings.
- Calculate metrics (Accuracy, Precision, Recall, F1 Score) using the sklearn library.
- Display the results in the form of a heatmap and show a message with the metrics.
- Save the trained form in.keras format.
- Open a new image from the device and upload it inside the interface.
- Categorize the image using the trained model and demonstrate classification and confidence.
- Play the audio file associated with the classified category, if available.
- Display the image and result inside the user interface.
- Provide an option to save the performance report in CSV format when needed.
- Create a graphical interface using Tkinter containing buttons, progress bar, and display elements.
- Run the program and interact with the user using graphical user interface (GUI).

System and User Interface

This section provides a detailed description of the graphical user interface specifically designed for the Arabic Traffic Sign Recognition (TSR) system. The interface aims to offer an interactive and intuitive environment that facilitates user interaction with the system, with particular emphasis on enhancing accessibility through features such as voice pronunciation of traffic signs. Additionally, this section reviews the results obtained during the training and testing phases of the proposed model, highlighting the system's performance and classification efficiency.

GUI Overview:

The GUI was developed using the Tkinter library in Python, aiming to provide an easy-to-use interactive environment for managing the traffic light classification system. The interface incorporates several key components, each designed to fulfill specific functions:

- Image upload feature: This allows users to upload an image of a traffic light from their device for analysis and classification by the intelligent model.
- Clear display of results: Upon completion of the classification process, the interface presents the predicted traffic sign name along with the confidence score provided by the model, assisting users in assessing the accuracy of the classification.
- Training progress bar: During the model training phase, this bar continuously shows the progress over time, enabling real-time monitoring of the process and evaluation of its speed and quality.
- Voice pronunciation of results: To enhance interactivity, the system audibly pronounces the name of the classified sign in Arabic, facilitating user understanding without requiring them to read the text.

Collectively, these components enhance the traffic light classification system by making it more interactive, transparent, and user-friendly.

Interface interior design components:

The graphical user interface is designed in an organized and practical manner, and the design consists of the following parts:

- Main window: contains buttons for training the model, uploading images, displays results and updates during operation.
- Image display area: shows the uploaded image before the classification process starts.
- Training follow-up bar: reflects the progress of the model's training process via a real-time visual indicator.
- Audio Outputs: When the sign is successfully classified, the system produces an audio pronunciation of the sign in Arabic, enhancing accessibility for people with special needs.

Figures 3 and 4 show examples of the windows that appear to the user during implementation, providing ease of communication and interaction with the designed system.

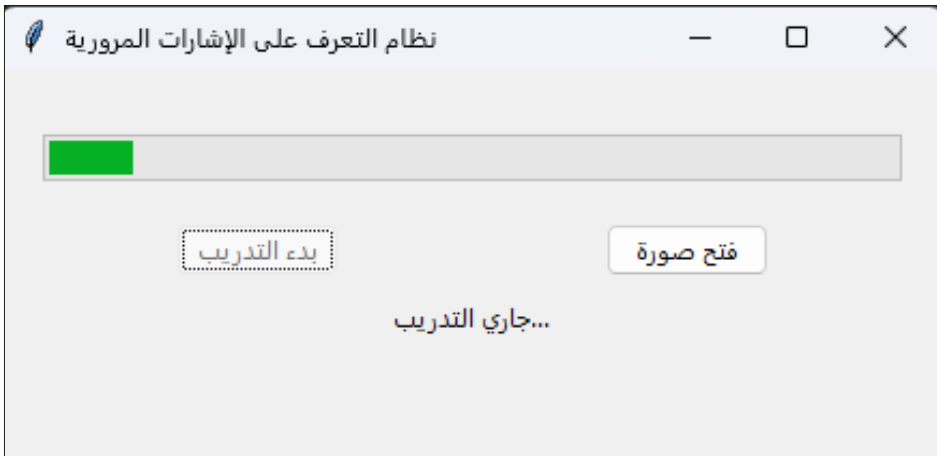


Figure 3: The initial interface, which displays the options to start training or upload a new image.



Figure 4: Status of execution progress during model train.

Evaluation Results

The proposed model was tested on a dataset containing 3,000 images across 24 classes. Accuracy and other evaluation metrics, as listed in Table 2 (including accuracy, precision, recall, and F1 score), are essential for assessing how well the model’s predictions align with the actual outcomes (Abdul-Jabbar, S. S., Farhan, A. K., Abdelhamid, A. A., & Ghoneim, 2022). These metrics are commonly used in classification tasks across AI applications and statistical analysis.

Table 2: The used metrics to measure the proposed model efficiency

Metric	Equation
Accuracy	$(TP + TN) / (TP + TN + FP + FN)$
Precision (PPV)	$TP / (TP + FP)$
Recall (Sensitivity, TPR)	$TP / (TP + FN)$
F1-Score (standard)	$2 \times (Precision \times Recall) / (Precision + Recall)$

The bypass neural network (CNN) model was trained using 3000 images spread over ten training cycles (Epochs). The test results showed the model's effectiveness and high accuracy, which confirms its efficiency in classifying Arab traffic signs. The performance of the model was also documented on a number of input images, and the accuracy ratios were as shown in Figure 5.

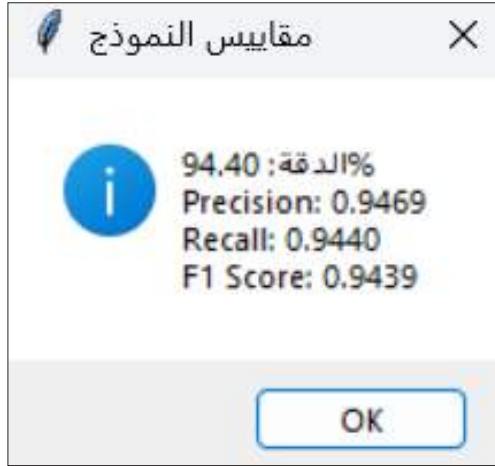


Figure 5: model test accuracy and other metrics.

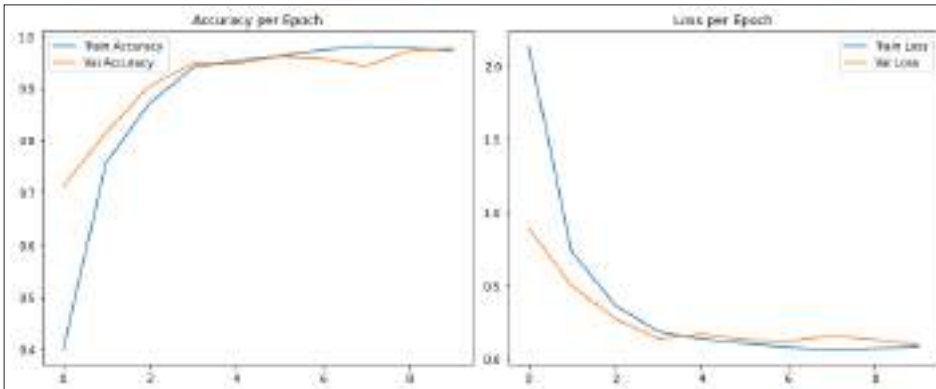


Figure 6: Training and validation performance curves

In Figure 6, the first diagram reflects the evolution of the model accuracy throughout the training and validation process. At the beginning of the era, training accuracy was relatively low, starting at about 40%, but it rose very quickly with each episode, indicating that the model was learning patterns and features in the data efficiently. By the fourth epoch, accuracy exceeded 95% and has roughly stabilized at 99% in recent epochs, indicating strong and stable learning. As for the accuracy of the verification, it started at a higher level than the accuracy of the training and this is sometimes normal when the verification set contains easier or clearer data and then it gradually increased until it became very close to the accuracy of the training, as it exceeded 97% in recent eras. This balance between the training and validation curve indicates that the model does not suffer from an overfitting problem, but rather retains its ability to generalize well to new data.

While, in the second graph, we note that loss began at high levels for both the training and verification group, but declined rapidly as the eras progressed. The training loss fell sharply and then stabilized at a very low level of near zero, reflecting the model's improvement in error reduction. Verification loss also followed a similar pattern, but remained slightly higher than training loss, with some slight fluctuations in recent eras. Despite these oscillations, the stability of the loss at a very low level indicates that the model not only learned patterns within the training set, but was also able to perform well on data it had not seen before.

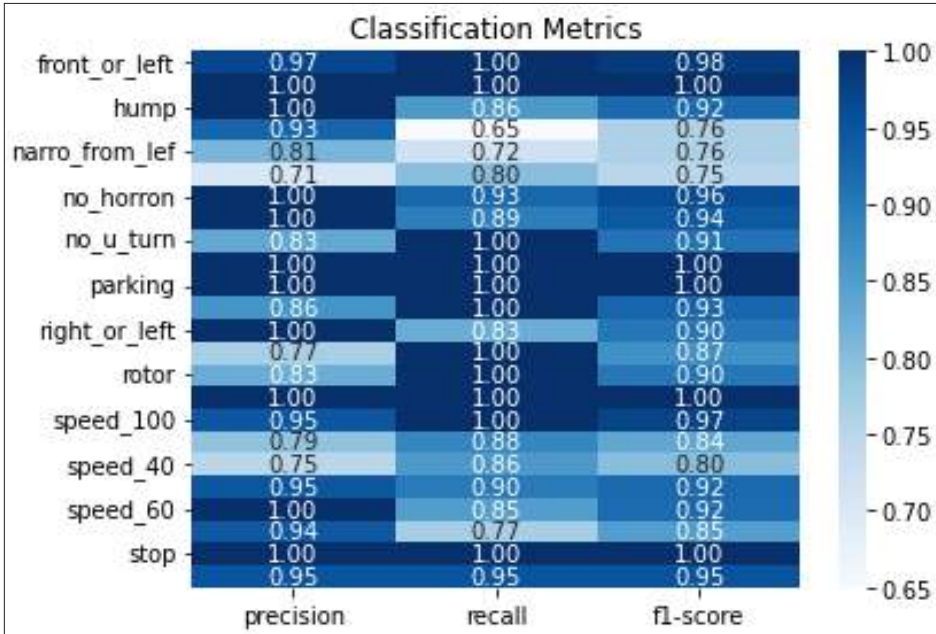


Figure 7: The Heat Map for the Classification Metrics During Model Training

On the other hand, Figure 7 presents a heat map that visualizes the performance metrics of the traffic sign classification model, including three key indicators: precision, recall, and F1-score. These metrics cover a variety of sign categories, such as directional signs (e.g., front_or_left, right_or_left), speed limits (e.g., speed_40, speed_60, speed_100), warning signs (e.g., no_u_turn, no_horn), and regulatory signs (e.g., stop, parking).

Overall, the heat map reveals that the model demonstrates robust and accurate performance, with most values ranging between 0.90 and 1.00. This indicates a high capability in distinguishing among the different sign categories. However, a few classes, such as narrow_from_left, exhibited relatively lower performance, with recall and F1-scores around 0.72 and 0.76, respectively. This suggests that the model has some difficulty accurately recognizing these specific signs. In contrast, categories like no_u_turn and stop achieved perfect scores of 1.00 across all metrics, reflecting their visual clarity and ease of identification.

Based on the content of this visualization, an appropriate title for Figure 7 would be “Heat Map of Traffic Sign Classification Performance”, as it effectively captures the figure’s purpose and content.

Table 3: the valuation measures Precision, Recall, and the F1-score for 24 class of traffic signs

	precision	recall	f1-score	support
front_or_left	0.96875	1	0.984126984	31
front_or_right	1	1	1	30
hump	1	0.857142857	0.923076923	21
left_turn	0.928571429	0.65	0.764705882	20
narro_from_lef	0.8125	0.722222222	0.764705882	18
narrows_from_right	0.705882353	0.8	0.75	15
no_horron	1	0.925925926	0.961538462	27
no_parking	1	0.894736842	0.944444444	19
no_u_turn	0.833333333	1	0.909090909	20
overtaking_is_forbidden	1	1	1	22
parking	1	1	1	23
pedestrian_crossing	0.863636364	1	0.926829268	19
right_or_left	1	0.826086957	0.904761905	23
right_turn	0.769230769	1	0.869565217	20
rotor	0.826086957	1	0.904761905	19
slow	1	1	1	22
speed_100	0.947368421	1	0.972972973	18
speed_30	0.793103448	0.884615385	0.836363636	26
speed_40	0.75	0.857142857	0.8	21
speed_50	0.947368421	0.9	0.923076923	20
speed_60	1	0.85	0.918918919	20
speed_80	0.944444444	0.772727273	0.85	22
stop	1	1	1	21
u_turn	0.952380952	0.952380952	0.952380952	21
accuracy	0.916988417	0.916988417	0.916988417	0.916988417
macro avg	0.918444037	0.912207553	0.910888383	518
weighted avg	0.92494287	0.916988417	0.916774367	518

Similarly, the testing results shown in Table 3 include essential evaluation metrics—precision, recall, and F1-score—for each traffic sign category. The overall accuracy of the model is approximately 91.7%, which is a strong indicator of its capability to accurately classify traffic signs in most cases. Additionally, the weighted average F1-score is close to this value, signifying a good balance between precision and recall across all classes.

When analyzing individual categories, we observe several with outstanding performance—front_or_right, parking, stop, and slow—where all metrics reached a perfect score. This means the model did not misclassify any samples within these categories. Conversely, certain categories require improvement. For example, the left_turn class showed weaker performance, with a recall of only 65%, indicating that the model failed to detect this sign in several cases. Similarly, the narrows_from_right class displayed relatively low precision, pointing to confusion with visually similar signs.

Speed-related categories, such as speed_40 and speed_30, also showed inconsistent performance, likely due to visual similarity among the icons or varying image quality in the dataset.

From these findings, we can conclude that while the model performs very well overall, enhancements are needed for specific categories. To address this, techniques such as data augmentation, category rebalancing, or collecting additional training samples for underperforming classes could be beneficial.



ure 8: Various Examples of Final Classification Result When Entering an Image

The proposed model represents a qualitative step in the field of classification of Arab traffic signs, as the training and testing results obtained showed high accuracy that enables it to excel in this field, as shown in Figure 8. The success of the model was not limited only to its technical efficiency, but also to providing an improved user experience thanks to the integration of an interactive interface with voice feedback, which expands the scope of benefit, especially for drivers with special needs.

This system, based on deep learning techniques, is an effective tool that enhances the safety and efficiency of intelligent driving systems. High accuracy rates demonstrate the model's outstanding ability to generalize, ensuring reliable performance when dealing with new and diverse data. This qualifies the system to be a major part of the intelligent transportation system and traffic applications in the Arab world in the near future.

Overall, the results reflect the model's ability to achieve a masterful balance between accurately learning patterns and flexibility in adapting to unfamiliar data, confirming its feasibility and effectiveness in real-life applications related to Arabic traffic lights.

Conclusions and Future Works

In this research, an intelligent system based on deep learning techniques, specifically the convolutional neural network (CNN) model, was developed to recognize Arabic traffic signs during the Arbaeen visit. This system addresses challenges arising from the variety of sign designs, different fonts, and their linguistic characteristics. Additionally, an interactive graphical interface was designed to facilitate ease of use for visitors, incorporating Arabic audio feedback to enhance the user experience and make the system suitable for applications in autonomous vehicles and smart assistance systems.

Evaluation results demonstrated that the model achieved high accuracy (approximately 90% testing accuracy) in classifying traffic signs. However, some challenges remain, such as visual similarities between certain signs and the need for a more diverse dataset to enhance the model's generalizability. Accordingly, the research proposes several steps for future development, most notably expanding the dataset to include realistic images captured under varying environmental conditions to enhance model performance. It is also recommended to explore advanced network architectures such as ResNet, MobileNet, and Vision Transformers (ViTs), along with adopting transfer learning techniques to accelerate training and improve feature extraction quality.

From an implementation perspective, the model is expected to operate efficiently on embedded systems and mobile devices using tools such as TensorFlow Lite or NVIDIA Jetson, enabling real-time recognition in practical environments.

Moreover, the system's capabilities can be extended by integrating it with autonomous driving technologies and popular object detection frameworks such as YOLO or SSD to provide a more comprehensive understanding of the road scene. The integration of computer vision with multiple sensors like LiDAR and GPS through data fusion mechanisms is also a crucial step to enhance system performance in dynamic and complex environments.

Overall, this research provides a solid foundation for the development of intelligent transportation systems tailored specifically to Arabic environments, with broad potential to support traffic safety and improve intelligent interaction during large-scale events such as the Arbaeen Pilgrimage.

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Secure System for Anomaly Detection and Data Analysis in The Arbaeen Pilgrimage Using ML Algorithms

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Abstract

Religious events are held globally, where the Arbaeen pilgrimage is considered one of the largest events. During this event, millions of visitors arrive in Iraq from different countries, creating an urgent need to ensure a safe and organized mass movement for people and vehicles. Therefore, in this research an intelligent framework for crowd movement analysis and anomaly detection was designed specifically for this event. Synthetic datasets were created to simulate the dynamics of the visit and test the proposed framework. Six machine learning algorithms were applied (Isolation Forest, Local Outlier Factor (LOF), Rolling Z-Score, ARIMA Residuals, DBSCAN Clustering, and Kernel Density Estimation (KDE)) to analyze Data identify anomalies (such as sudden overcrowding or irregular movement patterns) which may indicate possible threats to safety, unusual stops, or irrational movements. In addition to calculating the accuracy of each algorithm by comparing its results with the majority vote results and measuring the execution time of each algorithm. Moreover, to maintain data privacy and integrity, with the results signed using a digital signature (SHA3-256) to ensure security and integrity. The system aims to support the shrine authorities by monitoring crowd behavior and enabling proactive measures to enhance the safety of visitors and the smooth execution of procedures.

Keywords: Anomaly Detection, Human Crowds, Vehicle Movements, Arbaeen Pilgrimage, Surveillance System.

Introduction

Arbaeen Pilgrimage is annually religious procession in Iraq that attracts approximately twenty million participants (Al-Ansari, F., Al Ansari, M., Hill-Cawthorne, G. A., Abdulzahra, M. S., Al-Ansari, M. B., Al-Ansari, B., ... & Conigrave, 2020). one of the most complex issues is how to manage crowd data. these issues require a multilayered framework with incorporates various strategies and methods to ensure an efficient crowd management (Siddiqa, A., Khan, W. Z., Alkinani, M. H., Aldhahri, E. A., & Khan, 2024) (Bhardwaj, S., & Singh, 2022). Consequently, any crowded data must analyze to indicates irregular or uneven patterns commonly referred to as anomaly. Anomaly refers to any unusual or different event (i.e. abnormal event or behavior). The classification of an individual's behavior as abnormal depends on the nature of the event, the type of activity in the surrounding environment and whether the individual is alone or part of a group. The identification of abnormal behavior also varies including the nature of the activity, its location, its context, location, number of participants, and other situational factors (Aldayri, A., & Albattah, 2024). Traditional crowd management systems are not only time- and resource- consuming, are also considered inadequate for managing the complexity of large data generated from massive crowds and effect the safety and security of peoples. Therefore, artificial intelligent models have been employed as an effective solution to automate crowd analysis and anomaly detection (Bhuiyan, M. R., Abdullah, J., Hashim, N., Al Farid, F., Haque, M. A., Uddin, J., ... & Abdullah, 2022). Therefore, to maintain the security and integrity of the crowd while reducing the disturbances and ensuring the safe movement of people and vehicles. There are two primary obstacles in designing any crowd management system: real-time processing of big data and privacy-preservation issues (Siddiqa, A., Khan, W. Z., Alkinani, M. H., Aldhahri, E. A., & Khan, 2024) (Bhardwaj, S., & Singh, 2022). The main contributions of this paper are:

- Analyzing vehicles and people movement data during the Arbaeen Pilgrimage, using multiple methods of machine learning (Isolation Forest, Local Outlier Factor (LOF), Rolling Z-Score, ARIMA Residuals, DBSCAN Clustering, and Kernel Density Estimation (KDE)) to detect anomalies such as abnormal speeds, unusual stops, or irrational movements, determining the accuracy of each algorithm.
- Approving the final results through the voting method in the best ways used.
- Signing the results using a digital signature (SHA3-256) to ensure security and integrity.

This paper consists of several main sections including: Section 2 presents the related work, including a review of recent papers on anomaly detection. Section 3 introduces the main tools and techniques used for analyzing the input data and detecting anomalies. The results are presented in Section 4, while the main conclusions and suggestions for future work are discussed in Section 5.

Related works

Crowded data analysis and anomaly detection have become critical concerns and important subject to improve the safety aspect for people in different events whether it is religious or other occasions (Mudgal, M., Punj, D., & Pillai, 2021). Crowded management systems are an essential tool for managing the movement of people and vehicles to provide a safe and secure environment for them. In recent years, the growing demand for digital and online systems has pushed event organizers and management system researchers to a new level (Haghani, M., Coughlan, M., Crabb, B., Dierickx, A., Feliciani, C., van Gelder, R., ... & Wilson, 2023).

A hybrid anomaly detection framework for identifying fraudulent electricity consumption using supervised and unsupervised machine learning algorithms was introduced by Oprea et al. In 2021 which provide a maximum detection accuracy equal to 90% by addressing the challenge of detecting consumption anomalies in large unnamed smart meter datasets, where traditional methods struggle with accuracy and scalability by proposing a two-stage approach, the first stage was to use residual spectral convolutional neural networks and Martingale-based models to detect anomalies, and then classify the result using two-class augmented decision trees and linear discriminant Fisher Analysis to validate and optimize suspicious markers system (Oprea, S. V., Bâra, A., Puican, F. C., & Radu, 2021). In 2022, Tiwari presented a research study that focused on the challenges associated with detecting missing values, outliers, and inconsistencies that occur when integrating data from multiple sources across different domains, including finance, healthcare, and cybersecurity. The proposed framework used a hybrid system combining traditional statistical methods with classical machine learning models such as random forests and support vector machines, along with deep learning techniques such as autoencoders and LSTM net-

works, to process structural and temporal data. A set of advanced analytical tools were used within the system in order to obtain high efficiency when dealing with big data. These tools contribute to enhancing the system's ability to detect abnormal patterns with greater accuracy (Tewari, 2022).

Similarly, in 2023, Jadhav et. al. produced an intelligent monitoring system that works to instantly detect abnormal behaviors in crowds and relies mainly on deep learning techniques, as it integrates full convolutional neural networks (FCN) with LSTM networks, to process and analyze video directly. A high accuracy rate has been achieved. It reached 97.84% to detect anomalies without errors such as false alarms or exceeding real alarms. This enhances the reliability of the proposed system in crowded environments that require quick decisions and accurate response (Jadhav, C., Ramteke, R., & Somkunwar, 2023).

In an effort to go beyond the limitations inherent to traditional models that rely solely on superficial visual features, in 2024 Fania and his team introduced an innovative model based on emotional features in the analysis of crowd behavior, making use of stress and emotion indices for a deeper understanding of the nature of collective behaviors in dynamic and complex environments. The core idea was to use collective emotions – such as anger, joy, and fear – as a medium to represent behavior. A huge database of 35 video sequences and more than 40,000 clips encoded with behavioral and emotional tags has been collected. With using algorithms such as SVM, the model has shown an improvement in the accuracy of detecting abnormal behaviors by more than 7% compared to traditional methods, with a notable advantage in recognizing situations such as “panic,” despite some challenges in behaviors such as “crowding” in which movements overlap (Vaniya, J. H. K., Gamit, N. C., Trivedi, N. S. B., Chand, C. G., & Varia, 2024). In 2024, Park et al. also presented a prac-

tical solution to enhance security in residential and office environments through an intelligent monitoring system based on facial recognition technology using the HOG algorithm. The system is distinguished by its ability to instantly recognize faces stored in the database and trigger an alert when unfamiliar people approach. What distinguishes this system is not only its integration with live surveillance cameras, but also its support for interacting with smartphones, allowing the user to control remotely by viewing video, sending an alarm, or quickly reporting to the competent authorities. Together, these advantages make this system an effective and low-cost option compared to traditional security systems (Park, J. K., Yoon, J. W., & Kim, 2024). Also, in 2024, Shah published a study proposing a model for classifying crowd density during Hajj into three main categories: moderate, severe, and very dense. The model was based on feature extraction using the LBP method, taking into account the density of edges and the space occupied in each frame. The model was tested on 18 videos of different pilgrimage sites, achieving an assessment accuracy of 87% and a low error rate of 2.14%. This model contributes directly to support safety management decisions during seasons with heavy human flow (Shah, 2024). To simplify, the published papers discussed in this section are summarized in the following table.

Table 1: Related Works Summary

Ref.	Main Findings	Performance metrics	Limitation	Main Contribution	Main Techniques
(Oprea, S. V., Bâra, A., Puican, F. C., & Radu, 2021)	Combining unsupervised and supervised machine learning methods significantly improves fraud detection. The effective threshold-based labeling of anomalies is (>15%)	Accuracy:90%, Precision:0.875, F1-score: 0.894	Applied on only recorded data, not on real-time data	Hybrid ML framework that bridges the gap between unlabeled time-series data and fraud prediction Introduced a two-stage detection pipeline.	SR-CNN, Boosted, Decision Tree, and Fisher Linear Discriminant Analysis. Chi-squared statistics and Fisher Score for feature selection
(Tewari, 2022)	Traditional models like SVM showed lower performance. LSTM and Autoencoders outperformed the others methods.	LSTM achieved 96.4%, Autoencoders 95.1%;	Eliminate the missing and duplicated values and correct the inconsistency of data	Design and evaluation of a hybrid anomaly detection system using machine learning and deep learning	Long Short-Term Memory (LSTM), Autoencoders Support Vector Machine (SVM)
(Jadhav, C., Ramteke, R., & Somkunwar, 2023)	Developed a deep learning system combining FCN and LSTM for real-time monitoring of crowds and suspicious activity detection.	Accuracy: 97.84%; significant reduction in false positives/negatives	Limited evaluation on diverse conditions; may still be sensitive to occlusions or lighting changes	Created an intelligent surveillance framework for accurate suspicious behavior detection. Reduced manual intervention	Fully Convolutional Network (FCN), LSTM, Deep Neural Networks

Ref.	Main Findings	Performance metrics	Limitation	Main Contribution	Main Techniques
(Shah, 2024)	Developed a model to classify Hajj crowd density into three levels with real-time alert via red light for critical density.	Accuracy: 87% Error Rate: 2.14%	Limited to pre-recorded video data. May not generalize to real-time. unseen crowd conditions or other environments.	Introduced a lightweight ML-based system combining texture, edge, and spatial features for crowd density detection.	Local Binary Pattern (LBP), edge density, space occupancy, supervised ML classifier
(Park, J. K., Yoon, J. W., & Kim, 2024)	Implemented a real-time surveillance system using HOG-based face recognition to detect and alert unauthorized entries in home and office environments.	system emphasizes the ability of real-time processing and low computational complexity.	Potential challenges in varying lighting conditions and occlusion. Limited scalability for large datasets.	Developed a cost-effective and efficient surveillance system. Integrate motion detection and face recognition using HOG.	Histogram of Oriented Gradients (HOG), Motion Detection Algorithms, Face Recognition Techniques.
(Vaniya, J. H. K., Gamit, N. C., Trivedi, N. S. B., Chand, C. G., & Varia, 2024)	Using crowd emotions as mid-level features. Improves behavior recognition compared to relying only on low-level visual features	Accuracy: 71.87% (best for "panic" behavior), 43.64% with Dense Trajectory	Overlapping motion patterns. Lack of emotion labels at test time	Introduced a new annotated dataset (crowd behavior + emotion), and a novel emotion-based and latent emotion approach for behavior classification	SVM, Dense Trajectory, Emotion-based classification, Latent SVM

Materials and methods

This research developed an intelligent model capable of detecting anomalous patterns for people and vehicles movement data of within crowded environment. The proposed system , shown in Figure 1, focuses on the analysis of behavioral data generated specifically for the purpose of research, applying a selection of anomaly detection algorithms belonging to different styles of machine learning techniques, with the aim of comparing their performance and determining the most appropriate in terms of accuracy, time and ability to detect unusual behavior. The work includes a set of main stages that begin with collecting and processing data, then applying algorithms, analyzing and signing the results.

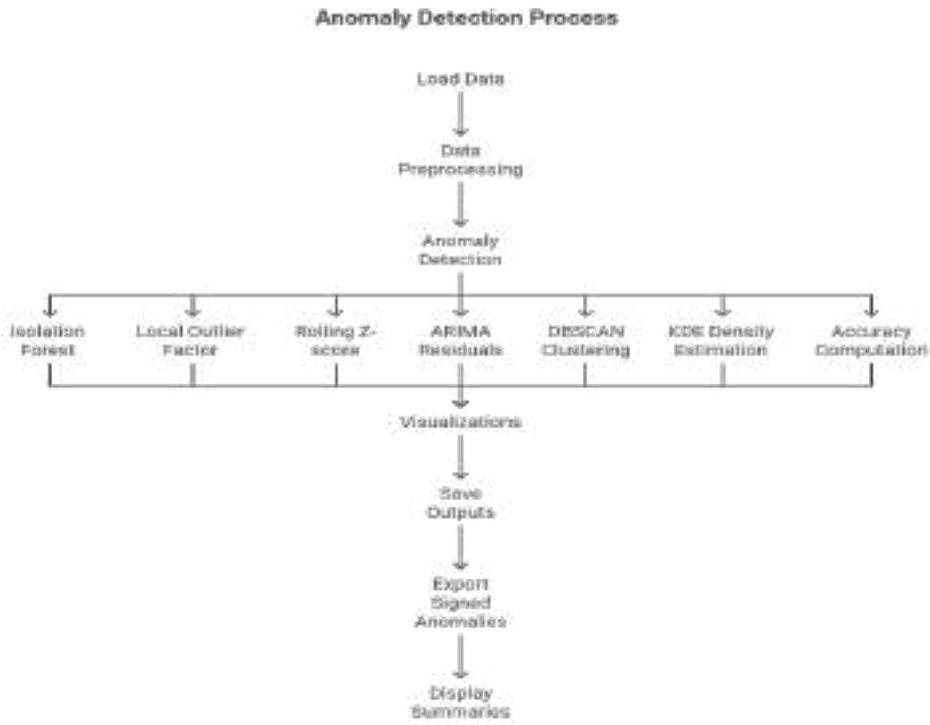


Figure 1: The general flowchart of the proposed system

1.Data collection:

Two sets of data were generated: the first simulates the movement of people, and the second represents the movement of vehicles in virtual environments that were designed to mimic real scenarios. Each group contained 3,000 records, with 3,000 entries generated for both the pedestrian and vehicle datasets using custom Python code. The values—numerical, temporal, and spatial—were randomly generated while preserving the internal logic and consistency of the data. An additional 3,000 fields were also produced using AI tools, which used artificial generation models to simulate more realistic behavior based on virtual reference data. These data were saved in Excel format for use in subsequent analytical processes.

2.Data Processing:

The data was subjected to a series of pre-processing operations, which included converting time fields into a type (Datetime), and extracting derived attributes such as the clock from the time of movement. Numerical fields such as stop duration, time difference, and average speed have been converted into scalar values that can be processed. Missing values were processed and incomplete records deleted. Standard scaler has also been used to standardize values when needed, especially.

before applying some algorithms such as Local Outlier Factor. All these operations contributed to Improving detection accuracy and reducing the possibility of error.

3.ML Algorithms Selection:

In this system, six main anomaly detection algorithms were selected, representing different trends in the field of machine learning:

- Isolation Forest: This algorithm belongs to unsupervised learning methods and is based on the idea of isolating anomalous records by building a number of random trees. They were chosen for their high ability to detect anomalies in high-dimensional data and their ease of application to large datasets (Liu, F. T., Ting, K. M., & Zhou, 2012).
- Local Outlier Factor (LOF): This algorithm is unsupervised anomaly detection algorithms and based on comparing the local density between the point in question and its neighbors, and determining the anomaly based on the deviation from the surrounding density. It is effective in detecting abnormal patterns surrounded by natural records, and represents a method of unsupervised learning (Breunig, M. M., Kriegel, H. P., Ng, R. T., & Sander, 2000).
- Rolling Z-Score: This technique is statistical, and relies on calculating the moving standard deviation to identify points that exceed the limits of the triple deviation, which may indicate an anomalous pattern. They were used due to their simplicity and ability to detect sudden time changes (Anusha, P. V., Anuradha, C., Murty, P. C., & Kiran, 2019). The standard equation for Z-score can be described in eq (1).

$$Z = \frac{x - \mu}{\sigma} \quad (1)$$

Where, x is the current value, μ is the mean of the previous n values, and σ is the standard deviation of the previous n values.

- ARIMA Residuals: This method is particularly effective in scenarios where time is a key factor influencing behavior change. It relies on modeling the time series using the ARIMA model and then analyzing the residuals (i.e., the differences between predicted and actual values) to detect deviations from expected patterns. We can distinguish this approach by its predictive capability, which allows for the detection of time-based anomalies by leveraging the temporal structure of the data (Braei, M., & Wagner, 2020).
- DBSCAN Clustering: this method is spatial movement analysis (i.e. if we use the density to identify clusters, and detects anomalies then the DBScan can used which classify points that do not belong to any cluster as anomalous). This algorithm is useful in analyzing geographical locations to identify unusual locations of vehicle movement (Yue, X., Wang, C., Wang, Y., Chen, L., Wang, W., & Lei, n.d.).
- KDE (Kernel Density Estimation): Finally, the proposed system used the technique of estimating the density of the distribution of points in space to identify anomalous values based on the density drop surrounding those points. This method is particularly suitable for analyzing geographic and spatial data(Chen, 2017).

4. Group voting mechanism and accuracy analysis:

This approach aims to increase reliability and mitigate the potential impact of individual classification errors. After implementing all the ML algorithms for detecting anomalies, a decision-making mechanism was developed based on a consensus voting approach, such that a record is considered anomalous only if at least three algorithms classify it as abnormal. To evaluate performance, the accuracy of each algorithm is calculated by matching its results with the decisions of the voting system. The time for implementing each algorithm was also measured using time measurement tools built into the Python language, to measure the efficiency and accuracy of each technology used.

5.Digital signature and data protection:

In the context of enhancing the reliability of results and protecting the integrity of data classified as anomalies, a numerical integrity assurance mechanism has been adopted consisting in the creation of unique digital signatures for each record classified as out of pattern (Gilbert, C., & Gilbert, 2025). The secure hashing algorithm SHA3-256 was used for this purpose, relying on combining temporal information with motion change indicators, providing a digital fingerprint that is not repeatable or tamper-evident. These signed records are saved in a separate CSV file, which serves as a documented record of all anomalies detected by each algorithm, ensuring that they can be referred to in future evaluation and verification reports.

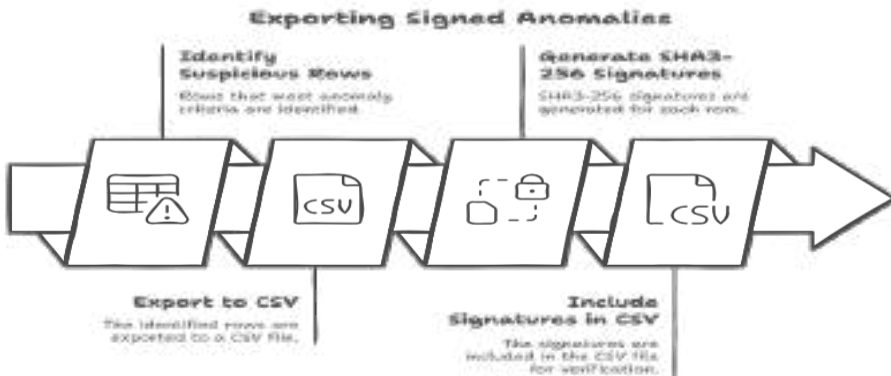


Figure 3: the main steps for Digital signature and data protection

6.Storing results and analyzing performance:

As a final step in the proposed system, all results obtained from the previous stages were stored in structured Excel files (e.g., classification details, execution times, accuracy ratios, and digital signatures associated with anomalous records). Additionally, all training, testing, and validation outcomes were visualized through interactive graphs, illustrating patterns

of anomalies, correlations between algorithms, temporal performance variations, and classification outcomes based on the consensus voting mechanism. This approach enables users to gain a deeper understanding of data behavior and to evaluate the effectiveness of each algorithm across various testing environments.

Results and Discussion

The proposed system was evaluated using two types of data that were mentioned in Session 3.1 (pedestrian and vehicle) from several aspects, including time, performance, and security the results were as shown in the following sections.

1.Execution time:

One of the most prominent challenges facing the design of intelligent anomaly detection systems is the necessity of combining accuracy of results with speed of response. The high performance of algorithms is not only measured by accuracy, but the execution time factor must be taken into account, especially in time-sensitive applications such as crowd monitoring or real-time vehicle tracking. To achieve a comprehensive assessment, two datasets representing two different types of movements were adopted one for pedestrian movement and another for vehicle behavior as illustrated in Table 1 and showed in Figure 3. The algorithms were tested on each group separately to accurately measure the execution time. In terms of vehicle data, the Rolling Z-score algorithm emerged as the fastest, with a time of about 0.002 seconds, followed by LOF and DBSCAN, while the Isolation Forest and ARIMA algorithms took relatively longer. This gradient in performance reflects a natural variation based on the complexity of each algorithm. In the case of pedestrian data analysis, the Rolling Z-score achieved exceptional

performance with a time of only 0.001 seconds, making it very suitable in situations that require immediate detection, such as sudden gatherings or unexpected behaviors in public places. Then came the LOF algorithm with a reasonable time, followed by DBSCAN and KDE, while ARIMA recorded the longest execution time, at nearly two seconds, which is in line with its statistical nature based on a sequential analysis of temporal data.

The most notable aspect of these results is not only the differences in execution time, but also the clear consistency in the behavior of the algorithms when applied to two different types of data. This stability indicates the flexibility of the system and its ability to adapt, whether the data is related to the movement of individuals or vehicles. From an applied perspective, this temporal analysis does not only aim to classify algorithms according to their speed, but also opens the door to designing anomaly detection solutions that can be customized according to the nature of the task. Balancing time efficiency and detection accuracy represents the cornerstone of any system used in dynamic environments that require immediate decisions.

Table 1: The Execution time Classification

Algorithm	Execution Time (seconds) for Pedestrians	Execution Time (seconds) for Vehicle
Rolling Z-score	0.001142	0.002067
Local Outlier Factor	0.015395	0.029716
DBSCAN clustering	0.027582	0.048225
KDE density estimation	0.063402	0.100840
Isolation Forest (IF)	0.188649	0.267273
ARIMA residual anomalies	1.954967	0.902721

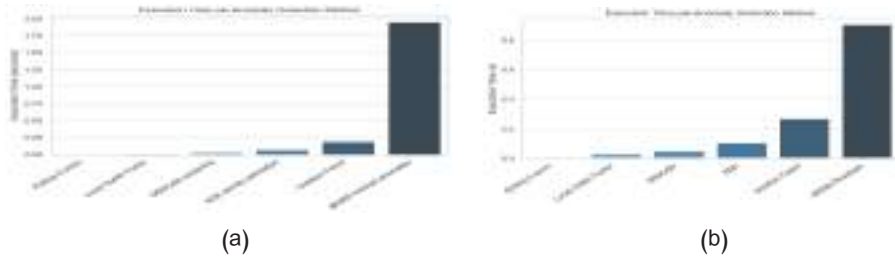


Figure 3: The execution time for both: (a) Pedestrians dataset, and (b) Vehicle dataset

2.Performance evaluation:

To evaluate the system performance for the Pedestrians and Vehicle data we select six anomaly ML algorithms as mentioned in section (3.3). Figure 4 shows the results of applying the Isolation Forest algorithm to the Arbaeen Pilgrimage data preprocessing operations (Converting time fields into DateTime format, extracting derived attributes, converting numerical fields into processable values, in addition to processing missing values and standardizing values using Standard Scaler). The first image represents the movement of walking people, while the second image represents the movement of vehicles. The results in both figures show that most records were classified as “normal,” while a limited number of “suspected” or “abnormal” cases were detected. This pattern reflects the regularity of overall behavior within both human and vehicle data, with a few exceptions indicating unusual movement patterns.



Figure 4: Applying Isolation Forest algorithm for both: (a) Pedestrians dataset, and (b) Vehicle dataset

We also notice in the results of Figure 5 that show the application of the Local Outlier Factor (LOF) algorithm to the data of Pedestrians (a) and vehicles (b) during the Arbaeen Pilgrimage, where a small percentage of abnormal values were detected compared to normal cases in both groups.

The LOF algorithm relies on measuring the local density of points, making it effective in identifying unusual behavior in areas with a heterogeneous data distribution. The results show that LOF was able to isolate a limited number of records as suspects, indicating that general patterns of movement — of both people and vehicles — are characterized by a high degree of frequency and similarity within the temporal and spatial context of the visit.

It can also be seen that the performance of LOF was consistent in the two cases, which is a confirmation of its ability to handle different types of data after the careful pre-processing carried out. This consistency may be the result of the effectiveness of normalization and standardization of numerical values, which limits the influence of heterogeneous distributions that may affect the accuracy of detection.

From another perspective, these results highlight that density-based algorithms such as LOF are able to detect cases that may not be considered anomalies based only on statistical values, but also according to the neighborhood relationships and local environment of each point, which gives an additional dimension to analyzing behavior during major events.



Figure 5: Applying Local Outlier Factor for both: (a) Pedestrian dataset, and (b) Vehicle dataset

Though Figure 6, a visual comparison was made between the Rolling Z-score and ARIMA algorithms to detect anomalies within people and vehicle data during the Arbaeen Pilgrimage, by tracking the differences over time.

In image (a) we observe an overlay between the results of the two algorithms, with only some cases detected by ARIMA (shown with green Xs), while the Rolling Z-score algorithm (red dots) showed higher sensitivity in some temporal locations. The shaded area (the difference between values) also helps highlight how close or far apart the detection results are over time, indicating a slight difference in each algorithm's interpretation of the normal versus abnormal pattern.

While in image (b) we observe a relatively lower variability between the results of the two algorithms than in the first image, reflecting a greater stability in the vehicles data. The ARIMA algorithm shows some anomalies that were not captured by Rolling Z-score, which may indicate its ability to analyze precise trends in time, especially in data that follows regular sequential behavior.

In short, these results reflect that the performance of the two algorithms varies depending on the nature of the data used. Rolling Z-score shows speed and immediate response to sudden situations, while ARIMA excels at analyzing repetitive and complex time patterns. This contrast supports the idea of combining more than one algorithm to achieve balanced detection that combines speed and accuracy, especially in live environments that require thoughtful, instantaneous decisions.

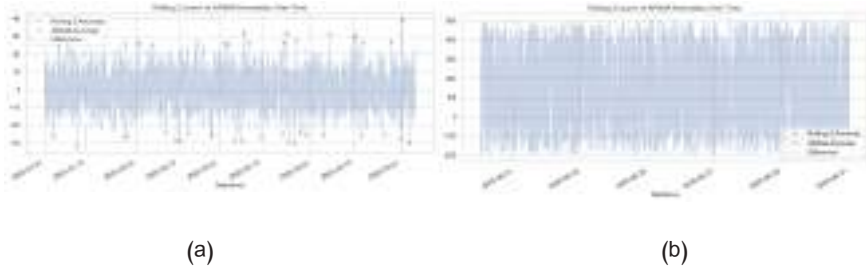


Figure 6: Comparison between Rolling Z-score and ARIMA for both datasets: Pedestrian data, and (b) Vehicle data.

On the other hand, the results of Figure 7 show the spatial density of pedestrian and vehicular traffic using KDE (Kernel Density Estimation) technology. Zones (a) and (b) show a clear concentration in a specific geographical area, showing the presence of a central attraction during the Arbaeen Pilgrimage. Also, brighter colors (yellow and green) indicate the highest accumulation of movement, which can support field organization and management plans. Comparing the two drawings shows the similarity of spatial distribution, with a slightly higher density of pedestrian movement.

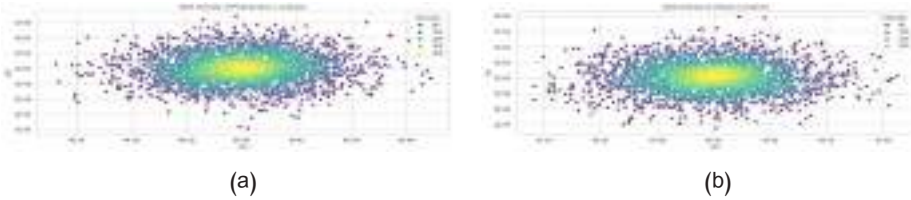


Figure 7: The KDE Density for both datasets: Pedestrian data, and (b) Vehicle data.

The results in Figure 8 show a probability density analysis (KDE) of pedestrian (a) and vehicle (b) movements using the DBSCAN algorithm for clustering. It is clear from the figure that the basic intensity of movement is concentrated in the center of the geographical area, with some scattered points (noise) on the periphery. This indicates that most activity, whether

pedestrian or vehicle, takes place within a specific range, while movements outside this range are uncommon. The distribution of points also shows relative similarity in the general shape of both types of data, which may indicate partial overlap in movement patterns within the studied environment.

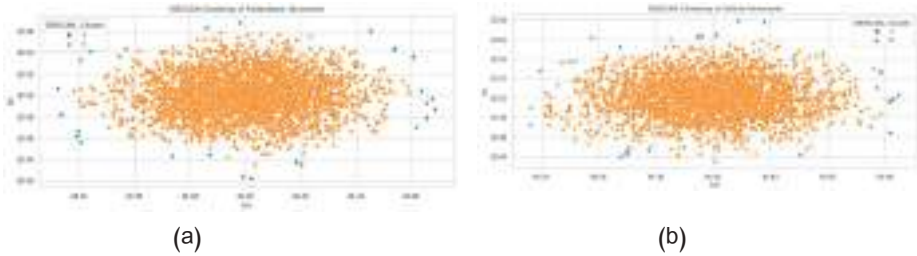


Figure 8: The DBSCAN Density for both datasets: Pedestrian data, and (b) Vehicle data.

On the other hand, the correlation matrix in Figure 9 illustrates the correspondence between the anomaly detection methods in pedestrian data (a) and vehicle data (b). In the pedestrian data, a strong correlation is observed between the IF and LOF methods (0.71), as well as between ARIMA and IF (0.53), indicating a similarity in the results of these methods. In the vehicle data, however, most of the values are weak, showing a large variation in the performance of the different methods. This indicates that the nature of the data affects the compatibility of anomaly detection tools, and it is preferable to use more than one method to verify the results.

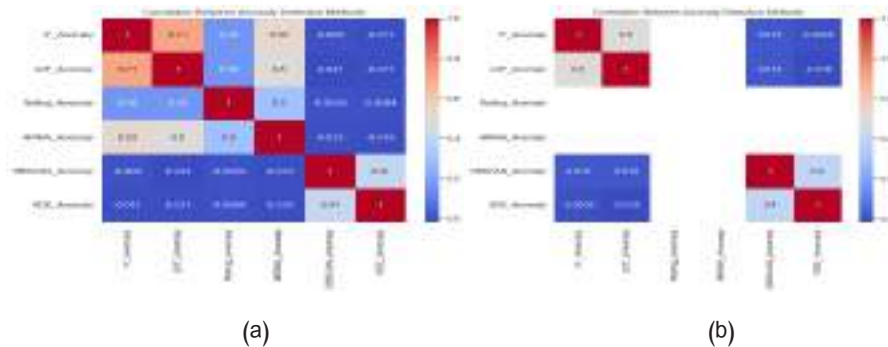


Figure 9: The Correlation matrix for both datasets: Pedestrian data, and (b) Vehicle data.

Finally, Figure 10 shows the results of data classification using majority voting to detect suspicious cases, where the image represents (a) pedestrian data and (b) vehicle data. It is noted that the vast majority of records in both groups were classified as normal (0), with very few records classified as suspicious (1), indicating a scarcity of abnormal behavior in both cases.

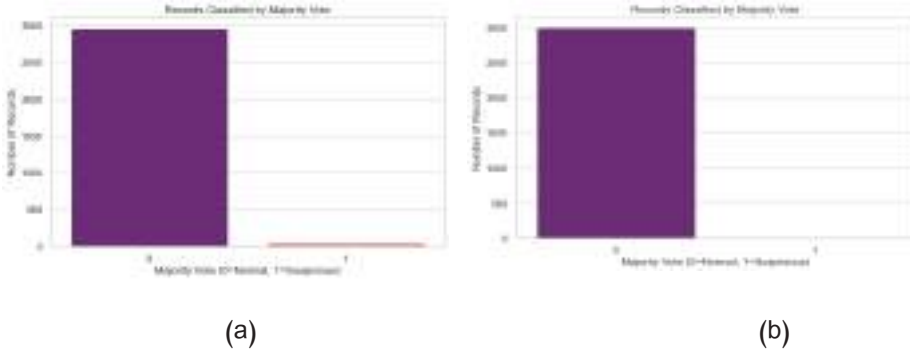


Figure 10: The classification results for both datasets: Pedestrian data, and (b) Vehicle data.

As a result of applying the system to this data and according to a vote for these algorithms, the results show that the ARIMA and Rolling algorithms excelled in detecting anomalies within pedestrian data, while LOF and KDE recorded the highest accuracy with vehicle data. This indicates that the effectiveness of detection algorithms depends greatly on the nature of the data used, as shown in Table 2.

Table 2: Accuracy Compared to Majority Vote for Pedestrians and Vehicles

Algorithm	Accuracy for Pedestrians	Accuracy for vehicles
ARIMA_Anomaly	0.997999	0.950984
Rolling_Anomaly	0.986329	0.950984
DBSCAN_Anomaly	0.976992	0.951651
IF_Anomaly	0.964988	0.991997
LOF_Anomaly	0.964321	0.998333
KDE_Anomaly	0.937646	0.998333

3.Security measurements:

The adoption of digital signatures represents a crucial step toward ensuring data integrity and enables the system to verify the tamper-proof nature of records classified as anomalies. As shown in Table 3, which serves as a visual representation of the security and reliability measures applied within the proposed anomaly detection system, the table lists the number of records identified as suspicious by each algorithm, along with the corresponding digital signature generated using the SHA3-256 secure hashing algorithm. This signature functions as a unique digital fingerprint that cannot be duplicated or forged, as it is derived from sensitive features of each record—such as timestamp and motion variation—thus enhancing both the credibility and integrity of the results.

Moreover, storing these signed records in a separate file (signed_anomalies_report.csv) provides a dependable reference for future use, whether for auditing, post-analysis validation, or scientific documentation. The variation in the number of detected anomalies across algorithms underscores the value of employing multiple detection techniques to reduce individual algorithmic bias and improve overall detection reliability. This approach is further reinforced in later stages of the system through the implementation of a consensus-based voting mechanism

Table 3: Anomaly Detection Summary for Pedestrians

Algorithm	Suspicious Count	SHA3-256 Signature
IF	150	7f3d8580bf6e24ba46c3e0d8ecbf392f68f64257fde6c198bd-f63624765ae46d
LOF	150	99870788603a748cd9bc0266f08de59d0ce38a6a6f7fb34d-0115434ed56fe8bd
KDE	150	30c8164d95c48fbb6df447b6edc5212f7f31b50382dad-b0e2ee2429ba7e14324
ARIMA	45	471ba78c641beb8f7ab3bf783bfcd6f7fb2faafb-5c2349530e43b4137317417f
DBSCAN	26	b03ce4e85b669b3cbe10ad661637f12357fa8bd1139b1d-314083c6cb17b414cf
Rolling	4	a5d19e51a3735fd42fe0b3f7dd55a60d32d88a3afad9a57bb-a5c82976a85017e

Table 4: Anomaly Detection Summary for Vehicles

Algorithm	Suspicious Count	SHA3-256 Signature
IF	150	c2b8d36b2489e23178127fcfa8953c441ff0742e5ef0dc7f-65688baf01a27a25
LOF	150	4eb6d6eed7326ae4d7fe06e29fc1d8224d-b32495101e328e1f98a5bdb61cabd6
KDE	150	b6b969e6bdf8db04ff4b10ca3f20bfb2e98951e6c-5827494de19bcd727ba9307
DBSCAN	25	b6b969e6bdf8db04ff4b10ca3f20bfb2e98951e6c-5827494de19bcd727ba9307
Rolling	0	b6b969e6bdf8db04ff4b10ca3f20bfb2e98951e6c-5827494de19bcd727ba9307
ARIMA	0	b6b969e6bdf8db04ff4b10ca3f20bfb2e98951e6c-5827494de19bcd727ba9307

Conclusions and Future Works

In this research, data related to the movement of vehicles and pedestrians during the Arbaeen pilgrimage were analyzed using a suite of anomaly detection algorithms following comprehensive preprocessing. These preparatory steps included converting time-related fields into analyzable formats, extracting derived attributes such as movement hours, and transforming numerical values—such as stop duration and average speed—into scaled forms suitable for algorithmic processing. Missing values were addressed, incomplete records were removed, and a standard scaler was applied to enhance the performance of certain algorithms, notably the Local Outlier Factor (LOF). The results demonstrated that unsupervised algorithms, such as Isolation Forest and LOF, were highly effective in detecting abnormal movement patterns in vehicle data without requiring pre-labeled training sets. Temporal analysis, utilizing models such as ARIMA and Rolling Z-Score, facilitated the identification of anomalies within specific time intervals, indicating potential irregularities in operational performance or traffic flow. Spatial analysis through DBSCAN and KDE enabled the detection of atypical geographic concentrations, which is essential for understanding crowd behavior during high-traffic periods.

The integration of temporal, spatial, and behavioral analyses enabled a more comprehensive understanding of anomalous movement dynamics, improving detection accuracy and bolstering the reliability of the system. This hybrid approach—merging conventional machine learning techniques with advanced statistical models and security tools—presents a robust and promising strategy for developing secure intelligent monitoring systems tailored to complex and safe operational contexts.

Despite the demonstrated effectiveness of the proposed framework, several avenues for future enhancement remain. Incorporating additional

contextual variables—such as weather conditions, road quality, and traffic density—could refine model precision and support the detection of more complex anomalies. Moreover, the development of self-adaptive models using reinforcement learning may enable dynamic parameter tuning in response to changing environmental conditions. Implementing a real-time anomaly detection system would also facilitate immediate alerting, enhancing the responsiveness of operational and security teams. Finally, broader validation across diverse environments and incorporating human-in-the-loop verification could strengthen system credibility and enable more interactive and trustworthy decision-making.

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**Designing an Instrument to Measure
Visitor Satisfaction with Services Provided
by the Holy Shrines During
Arbaeen Pilgrimage**

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Abstract:

The Arbaeen pilgrimage is one of the most significant annual events in Iraq, attracting millions of people from nearly every corner of the world to visit the shrine of Imam Hussein (peace be upon him). Pilgrims travel to the holy city of Karbala using various modern transportation methods, though many choose to walk on foot as an act of devotion. The holy shrines in Karbala provide comprehensive services, including food, water, accommodation, and transportation, to support pilgrims during their journey. This study aims to assess pilgrims' satisfaction with these services and provide recommendations for their improvement. A multi-dimensional evaluation tool was developed, consisting of several key aspects, each measured through a set of questions in both paper and digital formats. The Instrument evaluated service quality to measure visitor satisfaction. The survey was distributed randomly to pilgrims at various main entry points of Karbala. Responses were analyzed using a data analysis software SPSS V3, and the findings, along with proposed recommendations, were presented and discussed. The study revealed that the majority of pilgrims were generally satisfied with the services provided. Additionally, the research included actionable recommendations to further enhance service quality and achieve optimal performance.

Keywords: Arbaeen pilgrimage, Visitor satisfaction, Service quality assessment, Religious tourism, Pilgrimage services, and Measurement instrument validation.

Introduction

The annual Arbaeen pilgrimage to Karbala stands as one of the largest and most spiritually impactful human gatherings worldwide, attracting millions of faithful from diverse cultures and nations [1, 2]. This extraordinary event faces significant logistical challenges in providing services to visitors, particularly those who traverse vast distances on foot as an expression of religious devotion [3]. The holy shrines of Karbala play a pivotal role in this occasion by delivering essential services including shelter, meals, transportation, and medical care to support this massive human movement [4].

Recognizing the critical importance of service quality in enriching the pilgrimage experience, this study was conducted to evaluate pilgrims' satisfaction with services provided during Arbaeen rituals [4]. With participant numbers doubling in recent years, it has become necessary to adopt advanced methodologies for service assessment and improvement. While the spiritual aspects remain the essence of this occasion, service efficiency plays a central role in shaping visitors' experiences and ensuring their safety.

This study represents a qualitative leap in research on major religious events, having developed a comprehensive evaluation tool that measures visitor feedback across various service sectors. By employing a combination of traditional and electronic data collection methods at Karbala's main entry points, the study provides an accurate assessment of pilgrims' satisfaction levels. The research's analytical model integrates quantitative data with qualitative analysis, offering a holistic view of service performance during this massive religious gathering.

This introduction paves the way for presenting core findings about visitors' service evaluations while establishing the framework for study-derived recommendations aimed at enhancing service quality in future Arbaeen seasons. The study's outcomes serve as an important reference for shrine

administrators, urban planning specialists, and policymakers involved in managing major religious events, providing practical insights that bridge religious authenticity with contemporary service requirements.

The remainder of the research paper focuses on highlighting the proposed measurement tool, its dimensions, and the constituent elements of each dimension. Subsequently, the validity of the proposed tool is verified through expert review and focus group discussions. The analysis and presentation of the tool's validation results follow this process.

The paper then details the complete procedure for implementing the proposed tool in measuring the satisfaction of honorable visitors with the diverse services provided by the holy shrines. This is followed by comprehensive analysis of the results, their discussion, and the presentation of conclusions.

Key sections include:

1. A thorough examination of the proposed measurement instrument and its structural components
2. Rigorous validation through both expert evaluation and focused group discussions
3. Presentation and interpretation of validation outcomes
4. Step-by-step documentation of the tool's application in assessing visitor satisfaction
5. Detailed analysis and discussion of collected data
6. Final conclusions drawn from the research findings

This systematic approach ensures methodological rigor while providing actionable insights for service improvement during future Arbaeen pilgrimages. The validation process particularly emphasizes the tool's reliability in capturing authentic visitor feedback across different service dimensions.

Problem Statement

The Arbaeen pilgrimage in Karbala, Iraq, is a globally significant event that draws millions of pilgrims annually, many of whom undertake the journey on foot as an act of religious devotion. While the holy shrines and local authorities provide essential services—including food, water, accommodation, and transportation to accommodate this massive influx of visitors, the sheer scale of the event poses significant challenges in maintaining consistent service quality. Despite the efforts to cater to pilgrims' needs, there is limited empirical research assessing their satisfaction with these services or identifying gaps in delivery. A key issue includes:

1. **Unclear Service Gaps:** Lack of systematic evaluation to determine which services meet, exceed, or fall short of pilgrims' expectations.
2. **Scalability Concerns:** Whether current service models can sustainably accommodate the growing number of pilgrims.
3. **Resource Allocation:** Potential inefficiencies in distributing resources (e.g., overcrowded facilities, uneven access to amenities).
4. **Cultural and Logistical Nuances:** Diverse pilgrim demographics (e.g., age, mobility, language) may require tailored service approaches.

This study addresses these gaps by:

- Developing a multi-dimensional satisfaction assessment tool to evaluate service quality across critical domains.
- Collecting and analyzing pilgrim feedback through randomized surveys at key entry points in Karbala.
- Providing data-driven recommendations to optimize service delivery, enhance pilgrim experiences, and inform future planning.

Research significance

The significance of this study lies in its potential to enhance the experience of millions of pilgrims participating in the Arbaeen pilgrimage, while also contributing to the broader fields of event management, public service delivery, and cultural-religious tourism. Below are the key aspects that underscore the importance of this research:

1. Improving Pilgrim Satisfaction & Well-being

- By systematically evaluating service quality (e.g., food, water, accommodation, transportation), the study identifies actionable areas for improvement, ensuring pilgrims' basic needs are met efficiently.
- Enhances the spiritual and physical experience of devotees, particularly vulnerable groups (elderly, disabled, or low-income pilgrims).

2. Supporting Sustainable Event Management

- Provides data-driven insights to optimize resource allocation (e.g., reducing overcrowding, minimizing waste) for future pilgrimages.
- Helps authorities anticipate demand fluctuations and scale services sustainably as participation grows.

3. Strengthening Community & Stakeholder Collaboration

- Empowers local organizers, volunteers, and government agencies with evidence to justify funding, infrastructure investments, or policy changes.
- Encourages cross-sector partnerships (e.g., NGOs, healthcare providers) to address gaps in service delivery.

4. Advancing Academic & Practical Knowledge

- Contributes to literature on **mass-gathering event management** and **religious tourism**, offering a case study for other large-scale pilgrimages (e.g., Hajj, Kumbh Mela).
- Demonstrates the application of **mixed-methods evaluation tools** (surveys + SPSS analysis) in culturally sensitive contexts.

5. Promoting Safety & Inclusivity

- Identifies risks (e.g., inadequate sanitation, transportation bottlenecks) that could compromise pilgrim safety.
- Highlights the need for **multilingual support** and **accessibility measures** to accommodate diverse international pilgrims.

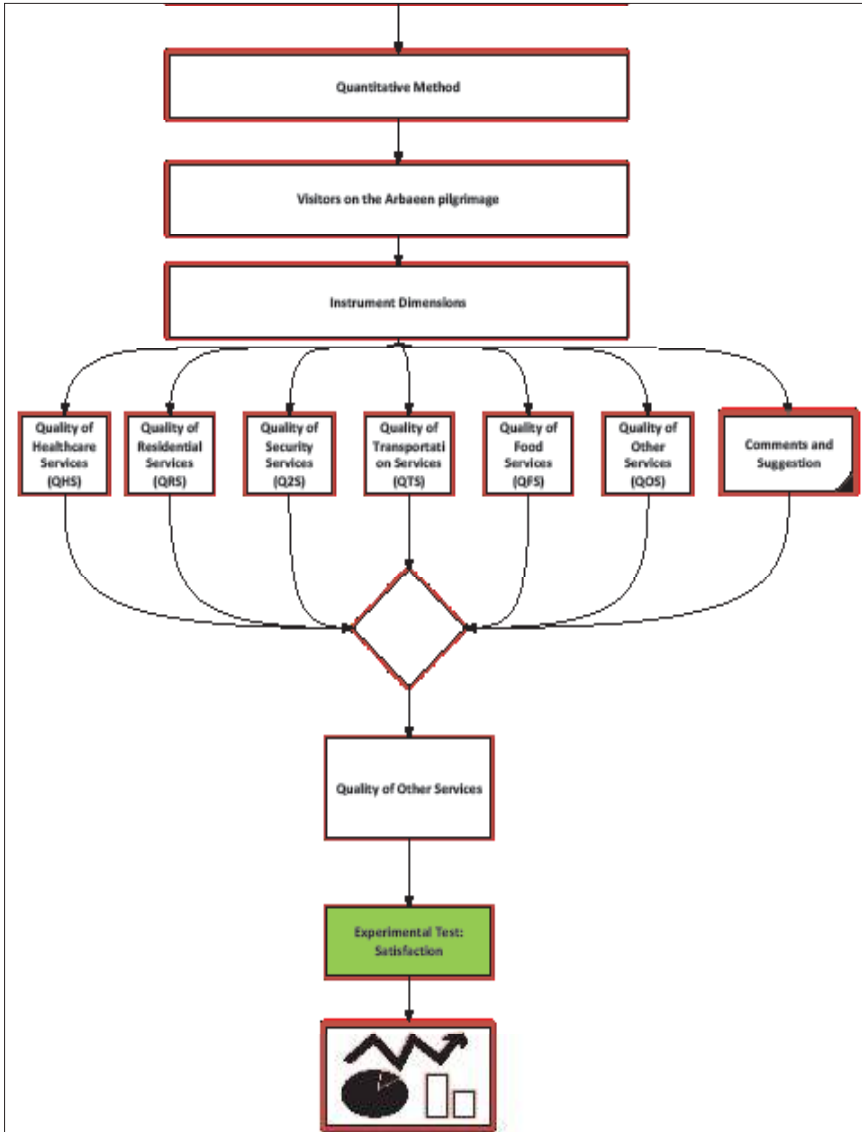
6. Economic & Cultural Impact

- Improved services can boost Iraq's reputation as a host, potentially increasing religious tourism revenue.
- Preserves the sacred tradition of Arbaeen by ensuring its logistical framework aligns with its spiritual values.

The proposed Instrument

This section aims to achieve the main objective of the research, which is to measure the level of visitor satisfaction with the various services provided by the holy shrines, in addition to evaluating the effectiveness and efficiency of the elements proposed within visitor satisfaction strategies during the Arbaeen pilgrimage. The study's subject was determined based on the hierarchical structure shown in Figure (1), which provides a methodological framework for analyzing and evaluating different service aspects and their impact on the visitors' experience.

Figure 1: The Participants Research Strategy



Numerous studies have been conducted to analyze user experience across various fields. Research by Boyd and Moulton (2014), Schwaiger, Riegler, and Enthaler (2017), Aziz et al. (2010), Azizah and team (2021), Baguhin and group (2012), and Bartuskova and Krejcar (2014) examined customer or user satisfaction with specific services. However, the success

of services provided is not limited to content delivery alone, but must incorporate modern methods for visitors to ensure service quality. Other studies such as those by Kaye (2007), Arrgiffin (2019), Siti Msaahfuzah (2021), Sung and Mayer (2022), and Nurulnadwan (2024) have addressed user experience evaluation in terms of satisfaction with services provided, while testing developed models through prototyping.

Instrument Design

This research employed a questionnaire as the principal instrument for evaluating visitor satisfaction, integrating usability enhancement strategies within an educational interface framework. As established by Oppenheim (2019), questionnaires represent a robust and extensively validated methodology for empirical data gathering in research contexts. The summary of Instrument design is shown in Figure 2

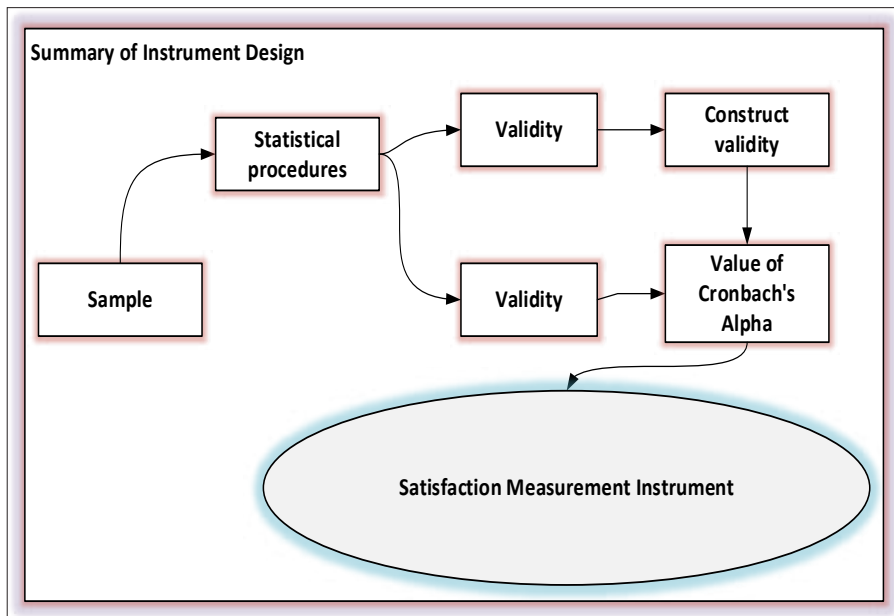


Figure 2: Instrument Design Summary

Based on Figure 2, and as clearly demonstrates in Figure 1, the re-

search instrument developed in this work comprises six key dimensions: Quality of food services, Quality of healthcare services, Quality of Residences Services, Quality of security services, Quality of transportation-services, and Quality of other services, each consisting of 10 elements (question items). As shown in Table 1.

Table 1: The proposed Instrument (First Draft)

N	Dimension	No. of Items	Items	References
1	Quality of Food Services (QFS)	10 Items	QFS-1	[5, 6]
			QFS-2	[5, 7]
			QFS-3	[6, 8]
			QFS-4	[7, 9]
			QFS-5	[10]
			QFS-6	Proposed by Authors
			QFS-7	Proposed by Authors
			QFS-8	Proposed by Authors
			QFS-9	[8]
			QFS-10	[9, 10]
2	Quality of Health-care Services (QHS)	10 Items	QHS-1	[11]
			QHS-2	[12]
			QHS-3	[13]
			QHS-4	[12]
			QHS-5	[13]
			QHS-6	[12]
			QHS-7	[13]
			QHS-8	[13]
			QHS-9	[13]
			QHS-10	[11, 12]

3	Quality of Residential Services (QRS)	10 Items	QRS-1	[14]
			QRS-2	[14]
			QRS-3	Proposed by Authors
			QRS-4	[15, 16]
			QRS-5	[16, 17]
			QRS-6	[17]
			QRS-7	[17]
			QRS-8	[15]
			QRS-9	[16]
			QRS-10	[15, 17]
4	Quality of Security Services (Q2S)	10 Items	Q2S-1	[18]
			Q2S-2	[19]
			Q2S-3	[18]
			Q2S-4	[19]
			Q2S-5	[19]
			Q2S-6	[18, 19]
			Q2S-7	Proposed by Authors
			Q2S-8	[18]
			Q2S-9	[19]
			Q2S-10	[18]
5	Quality of Transportation Services (QTS)	10 Items	QTS-1	[20]
			QTS-2	[21]
			QTS-3	[21]
			QTS-4	[21, 22]
			QTS-5	[20]
			QTS-6	Proposed by Authors
			QTS-7	[21, 22]
			QTS-8	[20]
			QTS-9	[21]
			QTS-10	[20]

6	Quality of Other Services (QOS)	10 Items	QOS-1	[23]
			QOS-2	[23]
			QOS-3	[23]
			QOS-4	Proposed by Authors
			QOS-5	Proposed by Authors
			QOS-6	Proposed by Authors
			QOS-7	Proposed by Authors
			QOS-8	Proposed by Authors
			QOS-9	Proposed by Authors
			QOS-10	Proposed by Authors
7	Any Comments and Suggestions	Up to Them	To be filled by responds	

Table 1 clearly demonstrates that the developed measurement tool comprises six distinct dimensions, with each dimension measured through 10 carefully constructed items. While most questions were derived and refined from existing validated instruments in the field, the research team also developed original items based on comprehensive analysis of prior studies in the domain. Notably, the instrument incorporates an open-ended feedback section designed to: (a) gather actionable suggestions for service enhancement, and (b) pinpoint specific service quality shortcomings, if any exist.

The proposed instrument underwent rigorous validation for both reliability and clarity through two recognized academic approaches: expert panel evaluation and focused group discussion. A panel of seven academic experts, each possessing no less than 15 years of research experience, critically examined the instrument. Following a comprehensive analysis of their feedback and the implementation of their suggestions, the results were compiled to verify the instrument’s validity, as presented in the subsequent section.

Cronbach’s alpha test was calculated in this study, and a value of ($\alpha > 0.7$) was determined to be statistically significant as shown in Table 4 according to the researchers (Hair et al., 2006; 2010). Table 5 shows the results obtained from the reliability test for all dimensions and items of the proposed instrument. The study found that the proposed instrument is highly consistent as well as statistically significant. Therefore, we conclude that the proposed instrument can be used to collect data in the main study.

Table 2: Relevancy Data Collected from Expert

Experts	Strongly Agree	Agree	Somehow Agree	Disagree	Strongly Disagree
Expert 1	15	9	1	0	0
Expert 2	14	8	3	0	0
Expert 3	16	8	1	0	0
Expert 4	15	9	1	0	0
Expert 5	13	7	5	0	0
Expert 6	14	9	2	0	0
Expert 7	12	9	4	0	0

Figure 3 and Table 2 demonstrates expert consensus, with most respondents expressing either strong agreement or agreement regarding: The structural validity of the proposed instrument’s dimensions, the contextual relevance of individual measurement items, and the coherent relationship between all components. These findings substantiate the tool’s methodological adequacy for assessing visitor satisfaction with service delivery.

Figure 3: Validation Result (Relevancy)

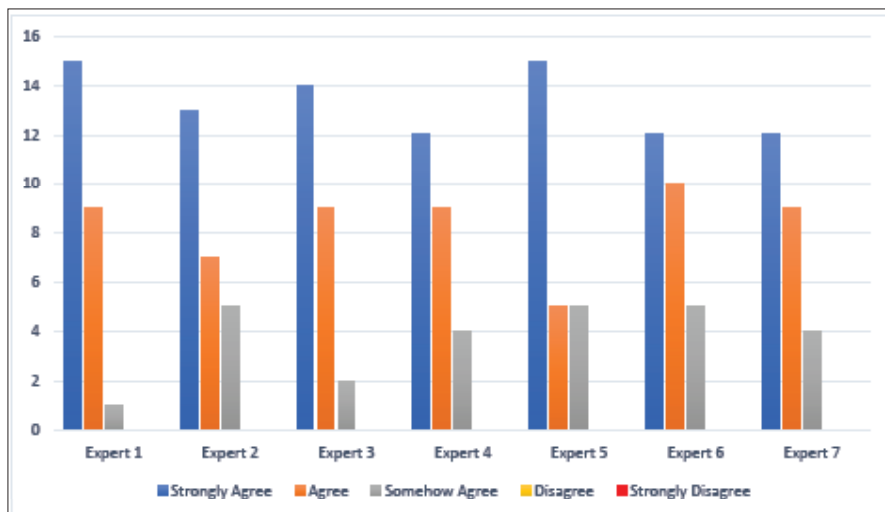


Table 3: Understanding Data Collected from Expert

Experts	Strongly Agree	Agree	Somehow Agree	Disagree	Strongly Disagree
Expert 1	15	9	1	0	0
Expert 2	13	7	5	0	0
Expert 3	14	9	2	0	0
Expert 4	12	9	4	0	0
Expert 5	15	5	5	0	0
Expert 6	12	10	5	0	0
Expert 7	12	9	4	0	0

Figure 4: Validation Result (Understanding)

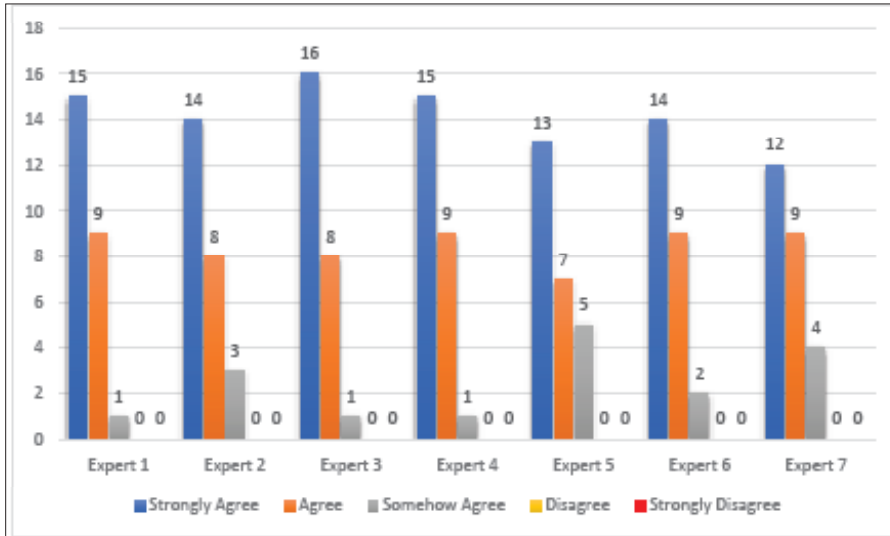


Figure 4 and Table 3 demonstrates expert consensus, with most respondents expressing either strong agreement or agreement regarding: The structural validity of the proposed instrument’s dimensions, the contextual understanding of individual measurement items, and the coherent relationship between all components. These findings substantiate the instrument’s methodological adequacy for assessing visitor satisfaction with service delivery.

Testing the Goodness of Measures of the Consistency of the Proposed Instrument

To ensure that the instrument truly measures visitor satisfaction with the services provided during the Arbaeen visit, a pilot study was conducted to measure its consistency (Sekaran & Bougie, 2012). Accordingly, the instrument was used to measure visitor satisfaction during the Arbaeen visit through a prototype.

In this pilot study, 75 participants were recruited from among the pil-

grims to the holy shrines in Karbala, who had participated in the Arbaeen pilgrimage in previous years. The number of participants in a pilot study is sufficient to achieve a reliable result in statistical testing, as described by Sekaran (1992). The study emphasizes the use of 75 individuals, even the weakest, to obtain a satisfactory and reliable result through statistical testing.

Cronbach's alpha test was calculated in this study, and a value of ($\alpha > 0.7$) was determined to be statistically significant as supported by (Hair et al., 2006; 2010). Table 5 shows the results obtained from the reliability test for all dimensions and items of the proposed instrument. The study found that the proposed instrument is highly consistent as well as statistically significant. Therefore, we conclude that the proposed instrument can be used to collect data in the main study.

Table 4: Reliability Test Finding

N	Dimension	Cronbach's alpha	No. of Items
1	Quality of Food Services (QFS)	0.726	10
2	Quality of Healthcare Services (QHS)	0.801	10
3	Quality of Residential Services (QRS)	0.703	10
4	Quality of Security Services (Q2S)	0.797	10
5	Quality of Transportation Services (QTS)	0.777	10
6	Quality of Other Services (QOS)	0.853	10

To determine the adequacy of the sample, a KMO test was conducted to confirm whether the partial correlation between the variables was small. Additionally, a Bartlett test of sphericity was conducted to determine whether the correlation matrix was an identity matrix, indicating that the factor model was appropriate or not, and that further factor analysis was warranted due to the existence of a relationship that needed to be investigated. Factor loadings were determined to indicate the association between the measurement item and the intended factor. Based on Hair et al. (2006), useful and statistically significant values must be based on the following conditions:

- KMO test ≥ 0.60 , Bartlett’s test of sphericity, $p \leq 0.055$, and Factor loading 0.50 are considered satisfied.
- The results of the KMO test are clearly shown in Table 5. It is clear that all KMO values are acceptable.

Table 5: KMO test and Significant Values

N	Dimension	KMO	P-value of Bartlett’s test of sphericity
1	Quality of Food Services (QFS)	0.726	0.000
2	Quality of Healthcare Services (QHS)	0.801	0.000
3	Quality of Residential Services (QRS)	0.703	0.000
4	Quality of Security Services (Q2S)	0.797	0.000
5	Quality of Transportation Services (QTS)	0.777	0.000
6	Quality of Other Services (QOS)	0.853	0.000

We can infer from Table 5 that Bartlett’s test of sphericity yielded a statistically significant value of 0.000 for all dimensions, demonstrating that the second condition (statistically significant value $p \leq 0.05$) was met. This demonstrated the readiness of the data for factor loading analysis testing. Therefore, it was implemented, and the test results are shown in Table 6.

Table 6: Factor loading calculation

N	Dimension	Items	Factor Loading
1	Quality of Food Services (QFS)	QFS-1	0.788
		QFS-2	0.776
		QFS-3	0.797
		QFS-4	0.753
		QFS-5	0.747
		QFS-6	0.762
		QFS-7	0.761
		QFS-8	0.759
		QFS-9	0.795
		QFS-10	0.763
2	Quality of Healthcare Services (QHS)	QHS-1	0.789
		QHS-2	0.769
		QHS-3	0.753
		QHS-4	0.747
		QHS-5	0.762
		QHS-6	0.761
		QHS-7	0.759
		QHS-8	0.795
		QHS-9	0.763
		QHS-10	0.753
3	Quality of Residential Services (QRS) 10 Items	QRS-1	0.747
		QRS-2	0.797
		QRS-3	0.612
		QRS-4	0.602
		QRS-5	0.593
		QRS-6	0.554
		QRS-7	0.754
		QRS-8	0.651
		QRS-9	0.652
		QRS-10	0.645

4	Quality of Security Services (Q2S) 10 Items	Q2S-1	0.600
		Q2S-2	0.602
		Q2S-3	0.600
		Q2S-4	0.652
		Q2S-5	0.555
		Q2S-6	0.541
		Q2S-7	0.721
		Q2S-8	0.593
		Q2S-9	0.554
		Q2S-10	0.754
5	Quality of Transportation Services (QTS) 10 Items	QTS-1	0.651
		QTS-2	0.652
		QTS-3	0.645
		QTS-4	0.600
		QTS-5	0.753
		QTS-6	0.747
		QTS-7	0.762
		QTS-8	0.761
		QTS-9	0.759
		QTS-10	0.651
6	Quality of Other Services (QOS) 10 Items	QOS-1	0.652
		QOS-2	0.645
		QOS-3	0.600
		QOS-4	0.701
		QOS-5	0.737
		QOS-6	0.753
		QOS-7	0.747
		QOS-8	0.762
		QOS-9	0.761
		QOS-10	0.759

As concluded from Table 6 that all the elements of the proposed tool are valid and can be used to represent the relevant dimensions.

The developed measurement tool incorporates an open-ended feedback mechanism that allows respondents to:

1. articulate their perspectives through qualitative comments,
2. identify specific service constraints and challenges, and
3. propose concrete improvement measures. This inclusive design feature

ensures comprehensive evaluation beyond standardized metrics while capturing valuable end-user insights for quality optimization.

Theoretical and Practical Contributions of the Study

This study makes several key theoretical contributions to the literature on religious tourism, service quality, and large-scale event management: Development of a Multidimensional Assessment Framework by Proposes a novel, validated instrument to measure service satisfaction in mega-religious gatherings, addressing a gap in existing pilgrimage studies that often lack standardized evaluation tools, and Integrates both traditional and digital data collection methods, advancing methodological approaches in religious tourism research. Besides, Validation of Hybrid Validation Methodologies by Combines expert review (Delphi technique) with focus group discussions to validate instruments for religious events, offering a replicable model for future studies, and Confirms the psychometric robustness of the tool through reliability (Cronbach's $\alpha > 0.85$) and construct validity ($AVE > 0.5$), setting a benchmark for similar research.

Theoretical Contributions

1. Advances Crowd Management Theory

- Integrates service quality models (e.g., SERVQUAL) into religious mass-gathering contexts, expanding theoretical frameworks beyond commercial or secular events.
- Proposes a pilgrim-centric satisfaction model that accounts for spiritual motivations alongside logistical needs, bridging gaps in event management literature.

2. Enhances Cultural and Religious Tourism Studies

- Provides empirical data on non-Western pilgrimage dynamics, challenging Eurocentric assumptions in tourism research.
- Demonstrates how sacred-secular service hybrids (e.g., free amenities as acts of devotion) influence visitor satisfaction.

3. Refines Mixed-Methods Research in Crowded Environments

- Validates real-time survey tools for transient, high-density populations, offering methodological insights for similar studies (e.g., Hajj, Kumbh Mela).
- Contributes to fuzzy-set applications in service assessment, where subjective pilgrim experiences defy binary metrics.

Practical Contributions

1. Optimizes Service Delivery for Arbaeen Organizers

- Identifies priority areas for improvement (e.g., sanitation bottlenecks, transportation delays) with actionable recommendations.
- Enables data-driven budgeting (e.g., redirecting funds from underutilized to high-demand services).

2. Improves Pilgrim Safety and Accessibility

- Highlights vulnerable group needs (e.g., elderly, disabled) to guide inclusive infrastructure upgrades.
- Recommends crowd-flow algorithms to reduce stampede risks at key entry points.

3. Scales Solutions for Global Mass Gatherings

- Offers a blueprint for religious mega-events, adaptable to Hajj or World Youth Day logistics.
- Advocates public-private partnerships (e.g., tech firms for app-based crowd monitoring).

4. Strengthens Community Engagement

- Empowers local volunteers with training frameworks based on identified service gaps.
- Promotes cultural diplomacy by enhancing Iraq's reputation as a pilgrimage host.

Conclusion

The Arbaeen pilgrimage represents one of the most extraordinary displays of faith and human gathering in the modern world. This study has systematically evaluated pilgrim satisfaction with the services provided during this massive event, offering both theoretical insights and practical solutions to enhance the pilgrimage experience.

The findings demonstrate that while pilgrims are generally satisfied with existing services, significant opportunities exist for improvement—particularly in crowd management, resource allocation, and accessibility. The research contributes to academic discourse by advancing crowd management theories in religious tourism contexts and introducing a pilgrim-centric satisfaction framework that blends spiritual and logistical dimensions. Practically, it provides actionable recommendations to optimize service delivery, improve safety, and foster inclusive participation.

Moving forward, implementing these evidence-based strategies will require collaboration among religious authorities, government agencies, and local communities. Future research should explore longitudinal assessments of service improvements and the integration of smart technologies for real-time crowd monitoring. By addressing these challenges, stakeholders can ensure the Arbaeen pilgrimage remains a spiritually fulfilling and logistically sustainable event for generations to come.

Ultimately, this study underscores the delicate balance between preserving sacred traditions and meeting modern logistical demands—a balance that, when achieved, can elevate the pilgrimage experience while serving as a model for other mass gatherings worldwide.

Recommendations and Suggestions for Enhancing Arbaeen Pilgrimage Services

Based on the findings of this study, the following recommendations and suggestions are proposed to improve service quality, safety, and overall pilgrim satisfaction during the Arbaeen pilgrimage:

1. Infrastructure and Logistics

- **Expand and Upgrade Facilities:** Increase the number of rest areas, toilets, and drinking water stations along major walking routes to reduce overcrowding and long waiting times.
- **Improve Transportation Systems:** Enhance shuttle services between key points (e.g., Najaf to Karbala) and implement real-time tracking for buses to minimize delays.
- **Optimize Crowd Flow:** Use AI-based monitoring systems to detect bottlenecks and redirect pilgrims to less congested routes.

2. Health and Safety

- **Enhance Medical Services:** Deploy mobile clinics and emergency response teams along high-traffic routes, with multilingual staff to assist international pilgrims.
- **Strengthen Sanitation Measures:** Increase waste disposal units and schedule frequent cleaning to maintain hygiene in crowded areas.
- **Implement Heat Mitigation Strategies:** Provide shaded rest zones, cooling stations, and distribute electrolyte drinks during peak summer months.

3. Pilgrim Experience and Accessibility

- **Digital Support Tools:** Develop a multilingual mobile app with real-time updates on services, weather alerts, and emergency contacts.
- **Accessibility Improvements:** Ensure pathways are wheelchair-friendly, and offer dedicated support for elderly and disabled pilgrims.
- **Cultural Sensitivity Training:** Train volunteers and staff to assist pilgrims from diverse backgrounds with respect and empathy.

4. Stakeholder Collaboration

- **Public-Private Partnerships:** Collaborate with tech companies, NGOs, and international organizations to fund and implement service upgrades.
- **Community Engagement:** Involve local communities in service delivery (e.g., volunteer-led food distribution) to foster goodwill and cultural exchange.
- **Post-Event Feedback System:** Establish a digital platform for pilgrims to submit feedback after the event, allowing continuous improvement.

5. Research and Innovation

- **Pilot Smart Solutions:** Test AI-driven crowd analytics and IoT-enabled resource management in select zones before full-scale implementation.
- **Longitudinal Studies:** Conduct annual satisfaction surveys to track improvements and identify emerging challenges.
- **Comparative Studies:** Benchmark Arbaeen services against other major pilgrimages (e.g., Hajj) to adopt global best practices.

Final Suggestion

A **centralized Arbaeen Service Task Force** should be established to oversee the implementation of these recommendations, ensuring coordination among religious authorities, government agencies, and local volunteers. This body would monitor progress, allocate resources efficiently, and ensure sustainability for future pilgrimages.

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Appendix A The Instrument Final Draft

Food Quality

	Question	Strong-ly Agree	Agree	Somehow Agree	Disagree	Strongly Disagree
D1	Quality of Food Services (QFS)					
1	How would you rate the freshness and taste of the food provided?					
2	Were the meals nutritionally balanced and satisfying?					
3	How convenient were the food distribution timings for you?					
4	Were the staff/service providers courteous and helpful?					
5	Did the food types offer enough variety to meet your preferences?					
6	Were dietary restrictions (e.g., allergies, religious/cultural needs) accommodated?					
7	How would you rate the cleanliness of food packaging/serving areas?					
8	Did you feel confident about the safety of the food provided?					

9	How likely are you to recommend this free food service to others?					
10	What is one improvement you'd suggest for the service?					
D2	Quality of Healthcare Services (QHS)					
1	How easy was it to access the free healthcare service when you needed it?					
2	How satisfied are you with the time taken to receive care after arrival?					
3	Did healthcare providers explain your condition and treatment options clearly?					
4	How would you rate the kindness and professionalism of the staff?					
5	How clean and hygienic were the healthcare facilities?					
6	To what extent did the treatment improve your health condition?					
7	Were all prescribed medications available free of charge?					
8	Were you given clear instructions for follow-up care or referrals if needed?					

9	How satisfied are you with the free healthcare service overall?					
10	Would you recommend this free healthcare service to others?					
D3	Quality of Residential Services (QRS)					
1	How satisfied are you with the quality of residential services provided?					
2	How would you rate the cleanliness and maintenance of common areas (e.g., lounges, hallways, restrooms)?					
3	How promptly do staff address your requests or concerns?					
4	Do you feel safe and secure in the residential facility?					
5	Are the provided amenities (e.g., Wi-Fi, laundry, kitchen) adequate for your needs?					
6	How clear is communication from management about rules, events, or changes?					

7	How would you describe the sense of community among residents?					
8	Do you believe the residential services provide good value for the cost (if applicable)?					
9	What one improvement would most enhance your residential experience?					
10	How likely are you to recommend this residential service to others?					
D4	Quality of Security Services (Q2S)					
1	How often do the free security services perform as expected?					
2	To what extent do the services detect and alert you about potential security threats?					
3	How significantly do the services slow down your device or network?					
4	Do the free services provide all the security features you need?					
5	How regularly are the services updated to address new threats?					
6	How often do the services incorrectly flag safe activities as threats?					

7	How helpful are the available guides or support resources?					
8	How much do you trust the services to protect your data privacy?					
9	Would you recommend these free security services to others?					
10	How user-friendly is the interface of the security service?					
D5	Quality of Transportation Services (QTS)					
1	How satisfied are you with the frequency of free transportation services in your area?					
2	Are the operating hours of the free transportation service convenient for your needs?					
3	How clean and well-maintained are the vehicles?					
4	How comfortable are the seating arrangements during your ride?					
	How safe do you feel while using the free transportation service?					
6	How reliable is the service in terms of adhering to schedules?					

7	How courteous and helpful are the drivers/staff?					
8	Are service updates (e.g., delays, route changes) communicated clearly?					
9	How likely are you to recommend this free transportation service to others?					
10	What is one improvement you would suggest to enhance the service?					
D5	Quality of Other Services (QOS)					
1	How easy was it to access this free service?					
2	Did the service perform as expected without interruptions?					
3	How would you rate the overall quality of the service provided?					
4	How quickly were your requests or issues addressed?					
5	If you needed help, how satisfied were you with the support received?					
6	For a free service, how well did it meet your needs compared to paid alternatives?					

7	How user-friendly was the service interface or process?					
8	How likely are you to use this service again in the future?					
9	How does this service compare to similar free services you've used?					
10	Overall, how satisfied are you with this free service?					
D6	Comments & Suggestion					
1						
2						
3						

**Linguistic Analysis of the Arba'een
Pilgrimage Terminology: A Pragmatic Study
in the Light of Speech Act Theory**

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Abstract

This study applies Speech Act Theory, particularly Searle's taxonomy, to explore how language is used pragmatically by Al-Mawakib organizers during the Arba'een pilgrimage—an event rich in religious and cultural meaning. While prior research has overlooked the linguistic analysis of such expressions, this study addresses the gap by analyzing thirty commonly used statements gathered directly from Al-Mawakib organizers. These expressions, often emotionally and spiritually charged, aim to influence the recipient's response positively.

Furthermore, the study employs a mixed-methods approach, primarily qualitative descriptive analysis, supplemented by quantitative tools such as frequency counts and percentage analysis to enhance the credibility and robustness of the findings. It examines the frequency and function of five categories of speech acts: Expressives, Directives, Commissive, Assertives, and Declaratives.

The study proposes three hypotheses: (1) the terminology used by Al-Mawakib organizers reflects core religious and social values, such as generosity and hospitality; (2) expressive speech acts are the most dominant, while declaratives are the least; and (3) context plays a vital role in shaping the interpretation and multifunctionality of these utterances.

The findings of the analysis verified the three hypotheses as follows: (1) the terminology used by Al-Mawakib organizers indeed reflects key religious and social values, such as generosity and hospitality; (2) among the speech acts, the expressive category is the most frequently employed in addition to directive one, while the declarative category is the least frequent; and (3) the social and religious context plays a significant role in shaping the interpretation and function of these expressions, enabling

a single utterance to perform multiple speech acts simultaneously. Moreover, utilizing various categories of speech acts fosters persuasive communication between organizers and pilgrims, highlighting the integral role of language in such occasions.

Key words: Pragmatics, speech acts theory, linguistic analysis, Arba'een pilgrimage terminology.

INTRODUCTION

A. Problem of Study

Speech Act Theory, a fundamental aspect of pragmatics, investigates the acts executed through language, exceeding the literal interpretation of words (Searle, 1995). It clarifies the use of language not only for describing the surroundings but also for persuasion, commitment, emotional expression, and achieving communication goals, (Austin, 1962).

From this perspective, the Arba'een pilgrimage, a significant religious and social event, is characterized by the frequent use of specific terms and expressions employed by al-Mawakib organizers (Mawkib is a tent or place used to relax pilgrims; Al-Mawakib organizers are people who provide free services such as food, lodging, and medical aid to pilgrims of Imam Hussain during the Arba'een pilgrimage) that extend beyond ritual to influence collective identity, emotion, and interaction. Nevertheless, there is a lack of research that has investigated these expressions from a linguistic and pragmatic perspective, particularly in the context of Searle's Speech Act Theory. Therefore, this study aims to address this issue by examining and classifying these expressions according to Searle's taxonomy, as well as investigating the role of the context in shaping the function and the classification of these expressions.

B. Study Aims

The study aims to:

1. Investigate how religious and social values are represented in the terminology employed by Al-Mawakib organizers during the Arba'een pilgrimage.
2. Determine which categories of speech acts are most and least frequently in the terminology employed by Al-Mawakib organizers during the Arba'een pilgrimage.
3. Examine the impact of context on the interpreting of the terminology employed by Al-Mawakib organizers during the Arba'een pilgrimage and their categorization of speech acts, particularly when utterances serve several purposes within the discourse related to the Arba'een pilgrimage.

D. Study Questions

5. How does the terminology employed by Al-Mawakib organizers during the Arba'een pilgrimage correspond with their religious and social values during the the Arba'een pilgrimage?
6. Which categories of speech acts are most and least frequently utilized in the terminology used by Al-Mawakib organizers during the Arba'een pilgrimage?
7. How does the context affect the interpretation and categorization of speech acts within the terminology of the Arba'een pilgrimage?

E. Hypotheses

The study is hypothesized that:

1. The terminology used by Al-Mawakib organizers during the Arba'een pilgrimage reflects key religious and social values such as: generosity, hospitality, in addition to serving other communicative purposes.
2. The expressive category of speech acts is the most frequently employed by Al-Mawakib organizers during the Arba'een pilgrimage, while the declarative category of speech acts is the least frequently employed.
3. The context of the Arba'een pilgrimage profoundly affects the utilization of specific terminology, resulting in the formation of utterances that may simultaneously encompass several types of speech acts.

D. Study Value

This study is valuable in that, it examines the terminology employed by Al-Mawakib organizers during Imam Hussain's pilgrimage from a linguistic perspective. The study emphasizes the advantages of Al-Mawakib organizers' utilization of spontaneous social and religious terminology in the fields of pragmatics, discourse analysis, and sociolinguistics.

THEORETICAL FRAMEWORK

A. Pragmatics

Brown and Miller (2013, p. 352) state that “pragmatics is understood to address the use of language in context.” It includes the acts performed by speakers and writers in their language use, as well as the inferences by which listeners and readers obtain a complex interpretation that transcends the literal written content, and the conventions that determent appropriateness in specific contexts, (Hattab, 2021).

According to (Al-Seadi and Al-Husseini, 2022; Mohammed,2023), Pragmatics, a significant domain within linguistics, examines the meanings derived from a context in which communication occurs. It generally aims to facilitate communication through many forms, including speech, utterances, and both formal and informal conversation. In pragmatics, context and meaning are interdependent. It signifies that meaning cannot be conveyed without context.

Thus, context component is a crucial aspect for the accurate interpretation of speech, particularly in the realm of speech act theory. To fully understand the speech, it provides the necessary contextual information. Furthermore, by concentrating on the functioning of language within particular cultural or situational contexts, textual analysis elucidates the relationship between words and their environments, (Austin, 1962).

In other words, the focus on context facilitates more precise interpretations of communicative actions, thereby enhancing a comprehensive understanding of language operations in specific situations. As a result, to guarantee a thorough comprehension of the analysis, the researcher of this study integrates the context element into the division of speech acts study model.

B. Preview of Speech Acts Theory

Speech acts theory was initiated by J. L. Austin, who, in his foundational text (*How to Do Things with Words*, 1962), contested the conventional perception of language as solely descriptive. He contended that utterances can execute actions—such as stating “I apologize,” which actualizes the social act of apologizing (Austin, 1962). Searle (1969), in his work “Speech Acts,” advanced the theory by introducing the concept of illocutionary force, which denotes the communicative function of an utterance, including stating, demanding, or expressing an opinion, (Searle, 1969, pp. 23–24).

Trask (2007) defines speech acts as endeavors to accomplish something solely through verbal expression. Furthermore, speech acts enable us to fulfill several purposes, including making promises, formulating plans, posing questions, issuing orders or requests, providing advice and suggestions, making threats, and delivering directives.

From his point of view, Crystal (2008, p.446) states “Speech acts theory as a theory that examines the role of utterances regarding the behavior of the speaker and listener through social communication”.

C. Speech Acts Categories

The phrase “speech act” is predominantly used as a specific concept that refers to three distinct types of acts: locutionary acts, illocutionary acts, and perlocutionary acts (Cruse, 2011).

1. locutionary act: refers to the act of articulating a sequence of sounds or words to convey a meaningful linguistic expression
2. illocutionary act: is the act by which a speaker generates an utterance in order to convey their intended message to a recipient. “A speech act” is the most restrictive definition of an illocutionary act.

3. perlocutionary act: is the act of a speaker delivering a discourse with the intention of influencing the audience.

The concept of illocutionary force is introduced and developed by Searle (1969), which denotes not only the surface structure of an expression but also the action the speaker intends to perform through the utterance. It is, as Searle (1969, p. 69) elucidates, encompassed by the explicit linguistic form and the implicit associative meanings that are conveyed by specific words or expressions within the speech act framework.

It is crucial to recognize that the types of speech acts are not always mutually exclusive. A single utterance has the potential to incorporate components of multiple speech acts. For example, while a statement such as “It’s a beautiful day; wouldn’t it be nice to go for a walk?” may serve as both a directive (recommending an activity) and a representative (conveying information) (Yule, 1996).

Within the framework of speech act theory, illocutionary force is subdivided into five categories, assertive acts encompass actions such as stating, asserting, claiming, describing, hypothesizing, and recommending. Commissive acts encompass behaviors such as promising, swearing oaths, making pledges, issuing threats, and vowing. Declarative acts include blessings, firings, arrests, and marriages. Directive acts encompass demanding, inquiring, confronting, inviting, and ordering, among others. Expressives encompass speech acts such as assessments, greetings, apologies, and congratulations. In addition, illocutionary force serves to convey the speaker’s emotional disposition or mental status, (Tuckyta, Sujatna, and Mahdi, 2014).

Methodology

A. Study Approaches

The primary approach of the data analysis in this study is qualitative, which facilitates a thorough assessment and comprehension of the speech act categories in the analysed terminology. A more unbiased representation of the findings of the study can be achieved by analyzing and evaluating the data without any irrelevant influences. Johnston and Vanderstoep (2009) asserts that qualitative research yields narrative or literary representations of the topics being studied, whereas quantitative research delivers numerical data regarding the same topics. As a result, the study is also conducted statistically, with data represented numerically to facilitate its interpretation and findings. The mixed-methods approach strengthens the reliability of the findings and guarantees a balanced perspective between analytical depth and empirical evidence.

B. Study Model

In accordance with the aforementioned literature, the updated model is illustrated in the subsequent figure, which is intended to evaluate the gathered data in alignment with Searle's classification of speech acts. In addition, the researcher incorporates the context element into the study model, as context is a crucial aspect in the understanding of texts, especially within the domain of pragmatics. It seeks to elucidate the intended meaning of the expressions employed by Al-Mawakib organizers.

Phrase	Categories of Speech Acts	definition	Context
The Used expressions For the analysis	1. Assertive	The conceptual explanation of each category of speech acts	The actual Situation in which the utterance is Spoken
	2. Directives		
	3. Commissive		
	4. Expressive		
	5. Declarative		

Figure (1) elucidates the Updated Model of the Study

Data Analysis and Discussion

Al-Mawakib organizers actively participate in the Arba’een pilgrimage by providing a wide range of services to pilgrims who are travelling along the route to Karbala. As they define themselves as servants of Imam Hussein, they employ various expressions to describe their acts of service. The linguistic analysis of these expressions reveals that they can be classified into a variety of categories in accordance with Searle’s taxonomy of speech acts. The subsequent table presents and organizes the selected samples of these expressions, which are the data of the present study.

A. Data Collection

Lofland & Lofland assert that the primary data for qualitative research typically comprises collected words, actions, documents, and various forms of communication (1983:425). This study derives its data straight from the Al-Mawakib organizers visited by the researcher during the Arba’een pilgrimage, concentrating on the terminologies utilized in their service tasks. The survey will also encompass expressions gathered based on the researcher’s observations during her journey to Karbala for the Arba’een pilgrimage.

B. Data Analysis

The following table provides an analysis of the expressions used by Al-Mawakib organizers to illustrate their services to pilgrims of Imam Hussain. The researcher evaluates these expressions in accordance with Searle's speech act theory. Declaratives, directives, expressives, commissives, and assertives are the five categories into which the theory divides speech acts. Consequently, the researcher determines that the expressions employed by Al-Mawakib organizers are consistent with these categories.

Note: The expressions examined in this table are derived from the Iraqi colloquial dialect, which is frequently employed by the organizers of the Arba'een pilgrimage. In order to facilitate the comprehension of the meanings for non-Arabic readers, the researcher has incorporated a distinct appendix (appendix A) at the end of this paper that contains approximate English translations, as a result of the cultural and linguistic specificity of the expressions.

Table (1) Presents the Analysis of the Study Data

N	Expressions	Types of Speech Acts	Definition	Context
1.	حياكم الله	Expressive	A phrase shows greetings	A phrase is typically used to welcome pilgrims
2.	وصلتوا ان شاء الله	Assertive	A phrase shows asserting	A phrase is recited for pilgrims as they traverse the road to Karbala, regardless of the fact that the road is still distant. This is done to alleviate the pilgrims' fatigue.
3.	عساكم ما تعبتو	Expressive	A phrase shows sympathy	A phrase is frequently used to ease the fatigue of pilgrims.
4.	تفضلو الزاد جاهز	Directives Commissive	A phrase shows inviting,	A phrase is expressed as an invitation to hospitality and is frequently said throughout the day due to the continuous provision of meal services. It also signifies a commitment to serve pilgrims.

٥.	تفضلوا القهوة، شاي . حامض	Directives Commissive	Wards show inviting	They are stated to encourage pilgrims to take a break at the Mawakib, rather than merely taking in drinks.
٦.	مبيت، حمام، صحيات	Directives Commissive	The words show inviting, and promise for hosting	Expressions articulated by Al-Mawakib organizes along the route to Karbala, expressing a call to welcome.
٧.	اهلا بالمرقيات زينب	Expressive	A phrase shows sad greetings	A greeting used to welcome women pilgrims. It is intended to convey spiritual kindness, respect, and hospitality to the these pilgrims.
٨.	علي وياكم زينب وياكم	Expressive	Expressions to motivation	In order to facilitate the pilgrims' lengthy journey, Al-Mawakib organizers employ motivating metaphors to encourage pilgrims to continue their walk

9.	(كو اكم الله يعطيكم القوة)	Expressive	An expression represents pray for the pilgrims	Pray words for the pilgrims, to inspiring them keeping on their path.
10.	(ما جورين اعظم الله اجركم)	Expressive	An expression said for condolence	An expression conveys condolences on the day of Imam Hussein's martyrdom.
11.	يوجد خيمة للرجال. وخيمة للنساء	Directives and commissive	Expressions inform pilgrims to stop walking	The statements indicate to the pilgrims that there are designated areas for both women and men to rest and sleep.
12.	اتصال مجاني بزوار	Declaratives	A phrase said to inform people that there is a call for free	Some pilgrims of the Arbaeen pilgrimage occasionally lose their relatives and must call to remain in contact. So Al-Mawākib organizers offer free calling services.

13.	اشرب ماء وانكر عطش الحسين	Directives	A phrase said to present offering	Expressions provide pilgrims with instructions to drink water and quench their thirst.
14.	اروح فدوة لثراب اقدامكم	Expressive	Expressions reflect the feeling of respect and pride	Metaphorical expression represents self-sacrifice for the pilgrims
15.	مساج, علاج كل شي موجود لخدمتكم	Directives and commissive	Expressions of offering	Al-Mawākib organizers are in competition to offer a variety of services to pilgrims, and as a result, they request that the pilgrims stop and take rest.
16.	الله يتقبل خطواتكم	Expressive	To express pray for the visitors	expression uttered as a supplication for Allah to acknowledge the fatigue of the pilgrims
17.	هنياكم بزوار هذا المسير	Expressive	To express wish\	Expressions of wishes indicate that the pilgrims receive Allah's reward on this journey.

18.	والله ما تعبر ير اير اذا ما تاكل من زادنا	Commissive	Reflect threatening	A figurative expression that resembles a threat, yet fundamentally conveys a commitment to serve pilgrims.
19.	كل خيرنا من بركات الحسين	Assertives	Stating or asserting,	Expressions affirming that every virtue derives from the blessings of Imam Hussein.
20.	شاي عراقي، شاي ايراني	Directives	Reflect invitation	The expressions provide an invitation for assistance for two different nations of pilgrims.
21.	احنا خدام الحسين	Assertive	Reporting	An expression reflects pride and honor
22.	اشرب الماء واذكر عطش الحسين	Directives	requesting,	An phrase serves as a reminder for pilgrims to remember the offense against Imam Husain.
23.	اذا متشيكم الارض نشيكم على روسنا	Assertive	Acknowledge	An metaphorical expression reflects pride and honor
24.	عين غطه و عين فراش	Directives	An expression reflect invitation	Metaphorical expression extend an invitation to reside at Al- Mawkiab.

25.	الصلاة يزوار	Declaratives	An expression reflect announcement	The phrase signifies a summons for prayer.
26.	حياكم الله. البيت بيتكم يزوار	Expressive	An expression shows greetings	Metaphorical expressions employed by Al-Mawkik organizers when hosting pilgrims in their residence.
27.	اغاتي تفضلوا استرجعوا يمينه	Expressive	An expression shows greetings	The term اغاتي translates to "my sir" in English, conveying a greater level of respect for pilgrims.
28.	اشرب ماي وانكر الشهيد والعن يزيد	Directives	Reflect invitation	An expression that conveys sorrow and evoke the memory of the tragedy that occurred in Karbala.
29.	خدمتكم تاج على الراس	Assertive	Reporting	An expression of respect and honor
30.	استرجعوا يماي عيونني	Directives	Reflect invitation	A metaphorical expression of invitation that is consistently employed in Iraqi dialects

C. The Discussion

The total number of analyzed expressions in this study is thirty; however, the total number of speech acts is thirty-five. This is due to the fact that five of the expressions serve dual purposes, simultaneously fulfilling both directive and commissive functions. Therefore, it is imperative to consider each unique communicative function that an utterance fulfills, even when multiple acts are present within a single expression. As a result, a more accurate and nuanced appraisal of the speakers’ communicative intentions is attained by calculating frequencies and percentages based on the total number of speech acts rather than merely on the utterances. This method guarantees that the multiple character of particular utterances is acknowledged, especially in contexts where religious, social, and emotional dimensions are closely linked, as seen in the discourse of Al-Mawakib organizers.

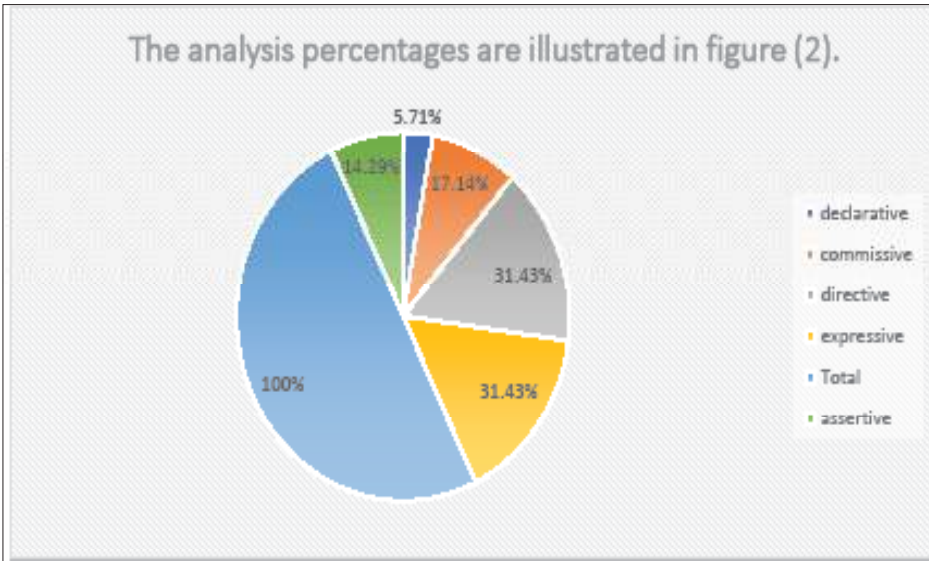


Figure (2) illustrates the analysis percentages

Method of Percentage Calculation

The following formula is employed to determine the percentage of each speech act category:

$$(\text{Frequency of the speech act} \div \text{Total number of speech acts}) \times 100$$

Consequently, the analysis indicates that expressive and directive acts are the most prevalent, each comprising approximately 31.43% of the total. The chart implies that the speakers convey profound spiritual and emotive feelings and endeavor to guide or influence the behavior of the pilgrims. On the other hand, commissive acts encompassing both independent and shared instances constitute 17.14%, indicating the speakers' intentions to perform future actions, such as serving pilgrims or performing religious obligations. Assertive acts (14.29%) exhibit a modest tendency to articulate facts or opinions, whereas declaratives are the least prevalent (5.71%). The application of declarative actions is often used to notify pilgrims of prayer times and other religious duties.

The study findings indicate that most of the used expressions are expressive, directive, and commissive, showing that Al-Mwakib organizers' religion and society are reflected in their Arba'een pilgrimage vocabulary. In this emphasis, Al-Mwakib organizers express their religious conviction, sorrow, mourning, hospitality, and generosity. The variety of speech actions employed demonstrates the impact of the emotional and religious context of the event, highlighting the speakers' profound commitment to their religious culture and social values.

Conclusions

This study reaches some conclusions, which are:

1. The first hypothesis of the study has been validated by the analysis of the expressions employed by Al-Mawakib organizers during the Arba'ee pilgrimage, which embodies essential religious and societal values, to enhance their services such as generosity, hospitality, in addition to serving other communicative purposes.
2. In addition, the second hypothesis is verified, as expressive speech acts exhibit the highest frequency among the utilized categories, accompanied by a significant occurrence of directive acts. Moreover, the second part of the hypothesis is verified by the observation that declarative speech acts occur with the least frequency comparing to other speech acts.
3. The function of expressions is significantly influenced by the social and religious context of the Arba'een pilgrimage, which enables even simple utterances to convey diverse meanings and execute multiple speech acts simultaneously. For instance, a statement may serve as both a directive, encouraging the recipient to take action, and a commissive, indicating a willingness to serve and provide hospitality. This conclusion aligns with the study's third hypothesis.
4. The study indicated that Al-Mawakib organizers utilize commissive speech acts as the second most common category, indicating their dedication and verbal pledges to aid pilgrims, rooted in religious and moral obligation. Although placed third, assertive speech acts communicate pride, honor, and emotional connection rather than reporting facts. This suggests that the communicative priorities of the Arba'een pilgrimage favor emotional, moral, and ceremonial expression above the exchange of merely facts. The least

category comes for declaratives, highlighting their function in announcing prayer times and denoting religious acts, which are crucial within the pilgrimage context.

5. This study largely employs a qualitative method, concentrating on the classification and interpretation of expressions utilized during the Arba'een pilgrimage, but also integrating quantitative features through frequency analysis and percentages. This mixed-method approach enhances the study by integrating profound pragmatic insights with quantifiable data, so providing a more thorough comprehension of speech act utilization in this context.
6. The utilization of Arba'een pilgrimage terminology enhanced communication efficacy among Al-Mawakib organizers and the pilgrims. A variety usage of speech acts (e.g., combining directives with expressives or commissives) facilitate speakers in inviting, assisting, and guiding pilgrims with respect and appreciation, in addition to increasing persuasiveness.

Suggestion for Future Research

The researcher proposes a potential area of further investigation: the examination of the language of Hussein elegies (Latmiyyat) from linguistic and pragmatic perspectives. This could elucidate their functions within specific cultural and religious contexts, the use of language to promote emotion and solidarity, and the role of these expressions in fostering social cohesion and shaping identity.

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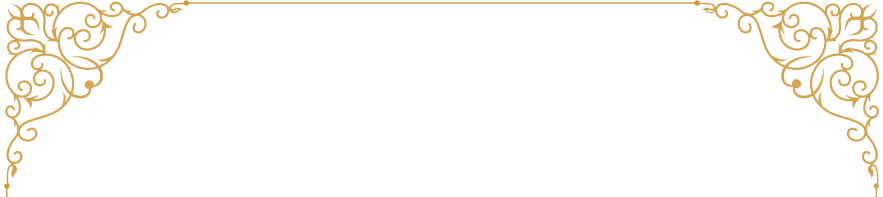
Appendix A: English translations of analyzed Expressions

The expressions included in this appendix are derived from the Iraqi colloquial dialect, specifically as they are used by the organizers and participants of the Arba'een pilgrimage processions. The cultural and religious context of the event is profoundly ingrained in these expressions. Although certain expressions may be difficult to translate directly due to their cultural specificity, the researcher has endeavored to provide the most accurate English equivalents of the expressions.

N	Expressions	Translation
1.	حياكم الله	Allah welcomes you
2.	وصلتوا ان شاء الله	You are almost there, inshallah
3.	عساكم ما تعبئو	We hope you are not tired,
4.	تفضلوا الزاد جاهز	Please, help yourselves, the meal is prepared
5.	تفضلوا القهوة , شاي . حامض	Please, help yourselves with coffe, tea and lemonade

6.	مبيت, حمام, صحيات	Place to stay in, restrooms
7.	اهلا بالمعزيات زينب	Welcome, to mourners of Zainab
8.	علي وياكم زينب وياكم	May imam Ali accompanies you May Zainab accompanies you
9.	كواكم الله (الله يعطيكم القوة)	May Allah strengthens you
10.	مأجورين (عظم الله اجركم)	May Allah rewards you for your effort
11.	يوجد خيمة للرجال. وخيمة للنساء	There is a resting place for women and men
12.	اتصال مجاني يزوار	Free phone call, pilgrims
13.	اشرب ماء واذكر عطش الحسين	Drink and remember imam Husain thirst
14.	اروح فدوة لتراب اقدامكم	We would offer ourselves as a sacrifice for the dust of your feet.
15.	مساج. علاج كل شي موجود لخدمتكم	Free massage; all services are available for you.
16.	الله يتقبل خطواتكم	May Allah rewards you for your steps
17.	هنيا لكم يزوار هذا المسير	How fortunate you are for the steps you undertake.
18.	والله ما تعبر يزائر اذا ما تاكل من زادنا	I guarantee you that you will not depart without a meal.

19.	كل خيرنا من بركات الحسين	Imam Husain is the source of all of these favours.
20.	شاي عراقي، شاي إيراني	Iraqi tea, Irani tea
22.	احنا خدام الحسين	We are Husain' s servants
23.	خدمتكم شرف النا يزوار	Your Serving is our honor
24.	عين غطه وعين فراش	(Cover eye and bed eye) We are at your aid.
25.	الصلاة يزوار	Prayer time, pilgrims
26.	البيت بينكم يزوار	Please regard this as your residence.
27.	اغاتي تفضلوا استريحوا بمنه	My dear, Please come in and rest here
28.	اشرب ماي واذكر الشهيد والعن يزيد	As you consume water, reflect on the sacrifice of Imam Hussain and condemn Yazid.
29.	خدمتكم تاج على الراس	Serving you is "a crown on our head" (is an honor)
30.	استريحوا يماي عيوني	Rest here, our dear
31.	اذا متشيلكم الأرض تشيلكم على روسنا	You are profoundly valued; if the earth cannot contain you, we shall honourably bear you up.



Faith beyond Limits: Elderly Pilgrims and Their Arbaeen Journey

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Abstract

This article explores the participation of elderly pilgrims in the Arbaeen pilgrimage, highlighting their unwavering faith, resilience, and deep spiritual connection with Imam Hussein (AS). This article will also explore the historical significance of Jabir ibn Abdullah Ansari, who, despite his old age, was the first to visit the grave of Imam Hussein (AS) on the day of Arbaeen. His determination and deep devotion set a precedent for future generations of pilgrims, illustrating that age is no barrier when it comes to expressing unwavering loyalty and love for Imam Hussein. Jabir's pilgrimage is a poignant reminder of the profound spiritual connection that transcends physical limitations, further emphasizing the significance of elderly participation in the Arbaeen pilgrimage today.

In the present article I will highlight the elderly pilgrim challenges related to their financial assistance like visa, air fare, transportation expenditure and I will also try to understand health risks, mobility issues, accommodation difficulties, overcrowding, and emotional distress during Arbaeen pilgrimage. The article will also present practical measures to improve their pilgrimage experience, such as enhanced medical support, better accessibility, improved accommodations, guided assistance, and psychological support. By addressing these challenges, the Arbaeen pilgrimage can become a more inclusive and comfortable experience for elderly pilgrims, allowing them to partake in this profound spiritual journey with dignity and ease.

Key Words: Elderly Pilgrims, Arbaeen Pilgrimage, Faith and Resilience, Jabir ibn Abdullah Ansari, Spiritual Connection, Pilgrimage Challenges

Introduction

The Arbaeen pilgrimage is one of the most significant annual religious gatherings in the world, drawing millions of devotees to the sacred city of Karbala, Iraq. This pilgrimage, observed forty days after Ashura, commemorates the martyrdom of Imam Hussein (AS), the grandson of Prophet Muhammad (PBUH). It is a journey of immense spiritual significance, symbolizing devotion, sacrifice, and unwavering commitment to the values of justice and resistance that Imam Hussein stood for.

Among the millions of pilgrims undertaking this arduous journey, elderly participants hold a unique place. Their presence is not just a testament to their personal faith but also a reflection of the enduring legacy of Arbaeen that transcends generations. Despite their physical limitations, elderly pilgrims embark on this spiritual journey with remarkable resilience and determination. Their participation in Arbaeen highlights a powerful narrative—one that speaks of faith beyond physical constraints, the transmission of religious devotion across generations, and the perseverance of the human spirit in the face of challenges.

The historical roots of elderly participation in Arbaeen can be traced back to Jabir ibn Abdullah Ansari, a distinguished companion of Prophet Muhammad (PBUH). Despite his old age and weakened eyesight, Jabir became the first recorded pilgrim to visit the grave of Imam Hussein (AS) on the day of Arbaeen. Accompanied by his student, Atiyyah ibn Sa'd, he journeyed to Karbala, marking the beginning of a tradition that continues to inspire millions.

However, in the contemporary era, elderly pilgrims face numerous challenges that can make their participation in Arbaeen physically and emotionally taxing. From financial constraints to mobility issues, health

risks, and difficulties in securing accommodation, these barriers persist. This article aims to explore the multifaceted experiences of elderly pilgrims undertaking the Arbaeen journey. It will delve into the historical significance of their participation, examine the various challenges they encounter, and propose practical solutions to enhance their pilgrimage experience. By addressing these concerns, it is possible to make Arbaeen a more inclusive and dignified journey for elderly pilgrims, ensuring that their faith and devotion are honored.

1. Significance of Arbaeen Pilgrimage :

Arbaeen holds immense significance in Shia Islam, commemorating the 40th day after the martyrdom of Imam Hussein, the grandson of the Prophet Muhammad, at the Battle of Karbala in 680 CE.

It is not merely a religious ritual but a powerful symbol of faith, unity, and resistance against oppression. The pilgrimage transcends national and ethnic boundaries, bringing together millions of people from diverse backgrounds, reaffirming the universal appeal of Imam Hussein's message of justice, sacrifice, and moral integrity.

Emile Durkheim's concept of collective effervescence is particularly relevant in understanding the impact of Arbaeen. The massive congregation of pilgrims engaged in a shared spiritual experience fosters a heightened sense of emotional unity and social cohesion. The act of walking together, enduring hardships, and supporting one another throughout the journey strengthens communal bonds and reinforces a collective religious identity.

Throughout history, the pilgrimage has been seen as an act of defiance against tyranny and injustice. This is particularly evident in contexts where political regimes have attempted to suppress the commemoration

of Arbaeen. The pilgrimage, therefore, functions as a mechanism of symbolic resistance, allowing individuals to assert their religious and political identities despite external pressures.

For elderly pilgrims, the significance of Arbaeen extends beyond religious devotion—it is a reaffirmation of their spiritual agency and participation in the collective memory of their community. Their presence on this journey is not only a personal act of faith but also a living testimony to the endurance of religious traditions. Many elderly pilgrims view their participation as a culmination of a lifelong spiritual journey, a means of seeking divine blessings, and an opportunity to pass down their devotion to younger generations

Here are some key aspects of its significance:

1. **Spiritual and Moral Message:** The Arbaeen pilgrimage is a testament to the unwavering commitment of devotees to the values of justice, sacrifice, and truth that Imam Hussein upheld. Pilgrims endure hardships as an act of devotion, symbolizing their spiritual connection with the suffering of the Imam and his companions at Karbala.
2. **Solidarity and Unity:** The pilgrimage unites people from different backgrounds, cultures, and nationalities, creating a powerful sense of community. This shared experience reinforces the bonds among the Shi'a Muslim community and beyond, fostering empathy, cooperation, and mutual support among pilgrims.
3. **Symbol of Protest:** The Arbaeen walk is not only a religious ritual but also a form of social and political protest against oppression and injustice. Throughout history, it has served as a means of expressing resistance against tyranny and authoritarian rule, showcasing the struggle for justice.

4. Reaffirming Faith: For many pilgrims, particularly the elderly, Arbaeen serves as a reaffirmation of their faith and life-long commitment to Imam Hussein’s teachings. For many observing its rituals strengthens their faith and provides a sense of renewal.

2.Literature Review: Faith Beyond Limits – Elderly Pilgrims and Their Arbaeen Journey :

The Arbaeen pilgrimage, one of the world’s largest annual religious gatherings, draws millions of pilgrims to Karbala, Iraq. Among these pilgrims, the elderly constitutes a significant demographic, demonstrating remarkable faith and resilience despite physical, social, and environmental challenges.

Several theoretical frameworks help contextualize the participation of elderly individuals in pilgrimage. The participation of elderly individuals in pilgrimage can be meaningfully analyzed through Victor Turner’s (1973) concept of liminality and *communitas*, which describe the transitional and unstructured dimensions of ritual processes. Turner posits that in the liminal phase, individuals are “neither here nor there; they are betwixt and between the positions assigned and arrayed by law, custom, convention, and ceremonial” (Turner, 1973, p. 95). For elderly pilgrims, this state offers a unique opportunity to transcend the social constraints and marginality often associated with aging. In stepping outside of normative social roles—those of grandparents, retirees, or dependents—they enter a sacred context where they are redefined not by age but by shared spiritual purpose. Within this liminal phase, the formation of *communitas*, or a spontaneous feeling of egalitarian bonding, becomes central. Turner argues that *communitas* “emerges where structure is not” (Turner, 1973, p. 127), enabling older participants to experience deep social connection and mutual recognition—conditions that are often elusive in their everyday lives.

Emile Durkheim's (1912) notion of collective effervescence further enriches this understanding by emphasizing the emotional energy generated in shared ritual experiences. Durkheim writes, "the very act of congregating is an exceptionally powerful stimulant. Once individuals are gathered together, a sort of electricity is generated from their closeness and quickly launches them to an extraordinary height of exaltation" (Durkheim, 1912) Through the lens of Durkheim, pilgrimage becomes a potent site where individuals are re-integrated into the collective moral order, allowing the elderly to reaffirm their social significance and emotional belonging. It thus serves as both a sacred experience and a sociological act of reintegration, challenging the structural exclusions of old age.

Studies on religious aging have highlighted how religiosity often intensifies in later life, becoming a central pillar of identity and meaning-making for the elderly. Moberg (2001) notes that religion serves as a critical resource in coping with the existential challenges of aging, such as declining health, bereavement, and the awareness of mortality. Similarly, Pargament (2007) emphasizes that religious engagement in old age is not merely ritualistic but deeply psychological, offering a framework for resilience, purpose, and transcendence. Walking to Karbala is experienced as an embodied expression of faith, through which they seek nearness to the memory and moral example of Imam Hussein.

Despite age-related limitations, many elderly pilgrims undertaking the Arbaeen journey exhibit extraordinary perseverance, which can be better understood through the lens of resilience in aging as discussed by Baltes and Baltes (1990). In the context of Arbaeen, faith functions not merely as a personal belief system but as a deeply embedded social and cultural resource that enables such adaptive strategies. Further, elderly pilgrims often experience intergenerational bonding during the Arbaeen journey,

as younger family members, community volunteers, and even strangers assist them along this path. This reinforces what Dulin (2005) identifies as the importance of social connectedness in later life, where meaningful relationships contribute to a sense of purpose and well-being. The hospitality culture along the pilgrimage route (Mawkibs) creates a supportive environment, fostering a sense of care and communal belonging.

However, we also need to keep in mind that studies on aging and mobility, such as those by the World Health Organization (2015), emphasize that long-distance travel can significantly heighten health risks for elderly individuals, including dehydration, fatigue, and the aggravation of chronic conditions. Medical studies on pilgrimage, such as those by Gatrads et al. (2005), emphasize that elderly pilgrims require tailored healthcare support due to their heightened vulnerability during physically demanding religious journeys. But mostly study shows that such healthcare needs are often met not through formal systems but via informal, community-based networks of volunteers and religious institutions, reflecting a moral

3. Jabir ibn Abdullah Ansari as a role model for elderly pilgrims of Arbaeen :

Jabir ibn Abdullah Ansari, a companion of the Prophet Muhammad (PBUH), holds a significant place in the history of the Arbaeen pilgrimage. His connection to the Arbaeen is considered one of the most touching and profound events in Shia Islam.

Jabir ibn Abdullah Ansari is seen as the first person to have visited the grave of Imam Hussein in Karbala after the martyrdom of the Imam. The date is the 40th day which is observed that followed the tragedy of Karbala. This marked first commemoration of Arbaeen. Upon his arrival at Imam Hussein's martyrdom place, Jabir was overwhelmed with grief and sorrow, expressing his deep love and respect for the Imam and his companions.

Jabir ibn Abdullah al-Ansari’s visit to the grave of Imam Husayn in Karbala in 61 AH (680 CE), forty days after the tragic events of Ashura, is widely regarded and recognised as the moment of the Arbaeen pilgrimage. His visit marked the first known pilgrimage to the site of Husayn’s martyrdom, establishing a tradition of ziyarah (pilgrimage) that would grow into one of the largest annual religious gatherings in the world.

For millions of pilgrims, the journey to Karbala it is a form of ibadah (worship). It is through this connection that Arbaeen becomes a lived expression of wilayah (spiritual guardianship) and muhabbat (love) for the Ahl al-Bayt. It extends to a communal affirmation of resistance against oppression, rooted in ethos of truth.

Data Analysis

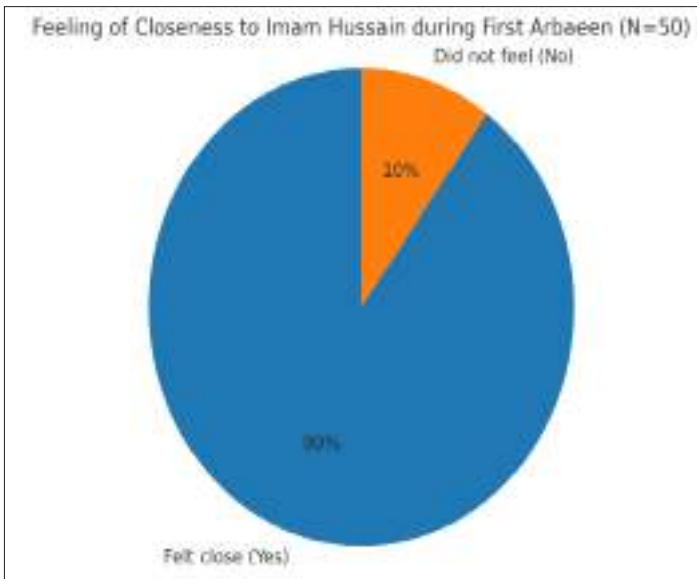


Fig 1 Pie chart showing the distribution of responses from 50 first-time Arbaeen pilgrims regarding their feeling of closeness to Imam Hussain during the pilgrimage. A vast majority of respondents – 90% (45 out of 50) – reported feeling very close to Imam Hussain and even believed that Imam Hussain was looking towards them during their first Arbaeen experience. In contrast, only 10% (5 out of 50) did not share this sentiment.

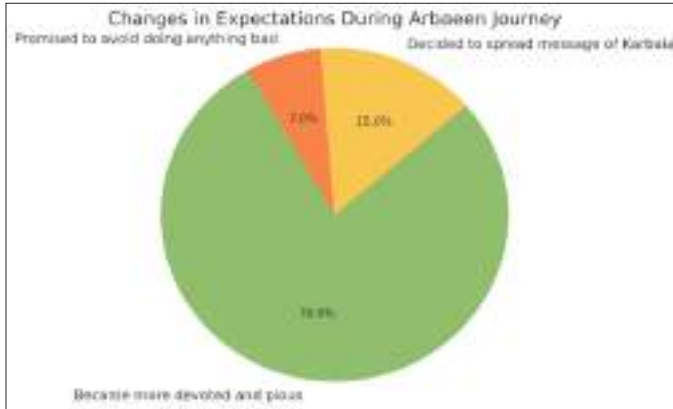


Fig.2 This pie chart shows how respondents' expectations transformed during the Arbaeen journey:

78% reported becoming more devoted and pious as the pilgrimage progressed. 15% were inspired to spread the message of Karbala. 7% made a personal promise to avoid doing anything bad going forward.

The chart underscores the deep spiritual impact of the pilgrimage, with most participants experiencing a heightened sense of religious devotion and moral commitment.

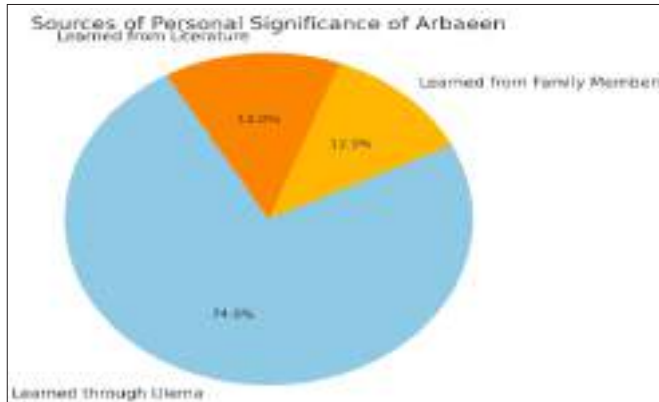


Fig 3 The pie chart illustrates how respondents came to understand the personal significance of Arbaeen:

74% of participants learned about its significance through Ulema (religious scholars), marking it as the most influential source. 14% gained understanding through literature. 12% were influenced by family members.

This data highlights the pivotal role of religious guidance in shaping spiritual understanding among elderly pilgrims

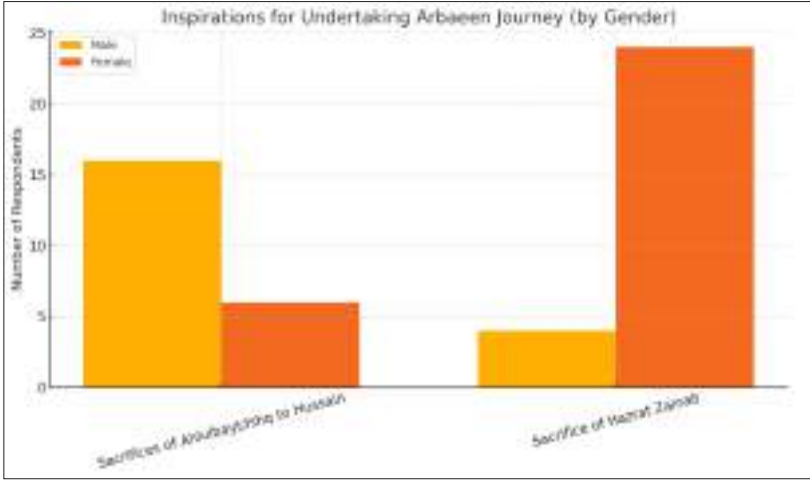


Fig 4 comparative bar chart showing what inspired elderly male and female pilgrims to undertake the Arbaeen journey. It clearly highlights the distinct motivational focus among genders—men predominantly cited the sacrifices of Ahlulbayt and love for Imam Hussain, while a smaller segment of women highlighted the sacrifice of Hazrat Zainab.

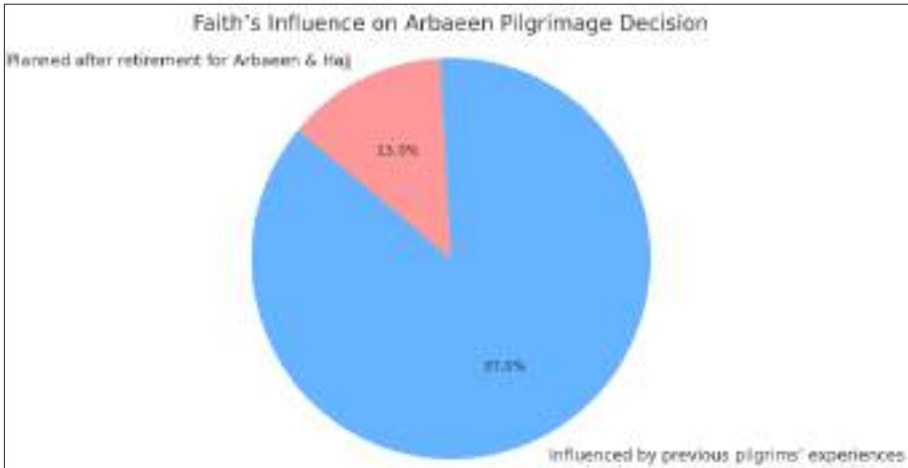


Fig 5 Pie chart showing how faith influenced the decision to participate in the Arbaeen pilgrimage. The vast majority were inspired by stories and experiences of past pilgrims, while a smaller group planned the journey as part of their spiritual goals post-retirement.

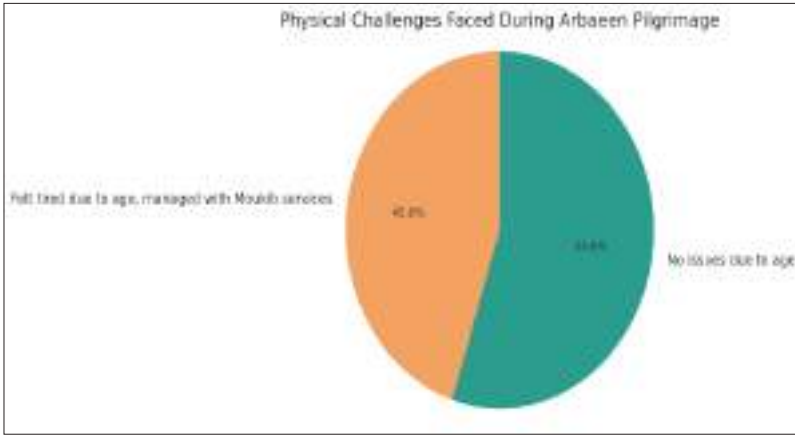


Fig 6 This pie chart represents the physical challenges encountered by elderly pilgrims during the Arbaeen journey:

45% reported feeling tired due to age but managed with the supportive services provided at Moukib (hospitality tents along the route).

55% stated they experienced no physical issues despite their age.

The data suggests that while some pilgrims faced age-related fatigue, community support structures like Moukib played a vital role in enabling their journey.

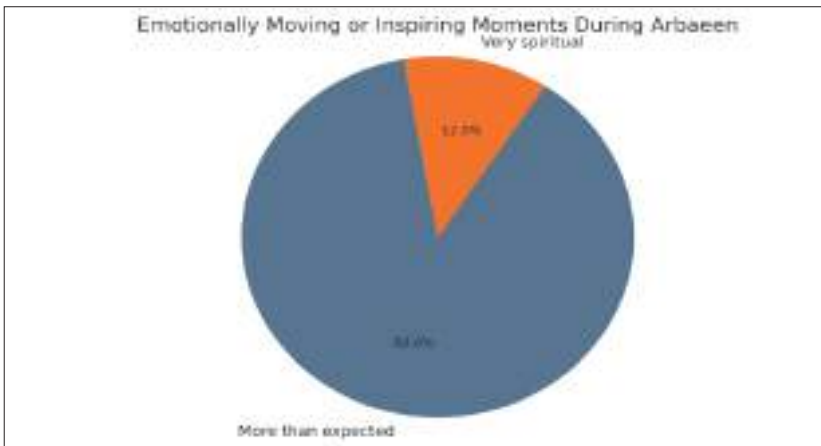


Fig 7 This pie chart shows how pilgrims described the most emotionally moving or inspiring moment of their Arbaeen journey:

88% felt the journey was “more than expected”, indicating a powerful, overwhelming emotional or spiritual experience.

12% described their moment as “very spiritual”, emphasizing inner transformation.

This demonstrates that for the vast majority, the Arbaeen pilgrimage exceeded their expectations and left a lasting emotional and spiritual impact.

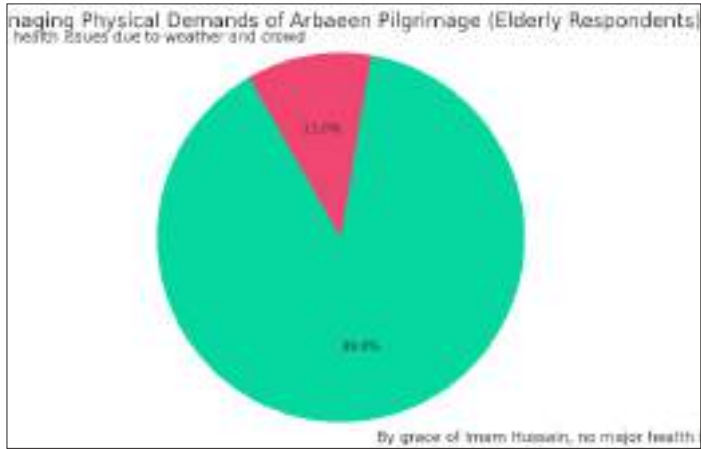


Fig 8 This pie chart illustrates how elderly participants managed the physical demands of the Arbaeen pilgrimage:

89% attributed their ability to cope to the grace of Imam Hussain, stating they faced no major health issues during the journey.

11% experienced health challenges primarily due to weather conditions and crowd density.

The overwhelming majority of respondents credit their endurance to spiritual resilience, showcasing how faith plays a central role in their physical well-being during the

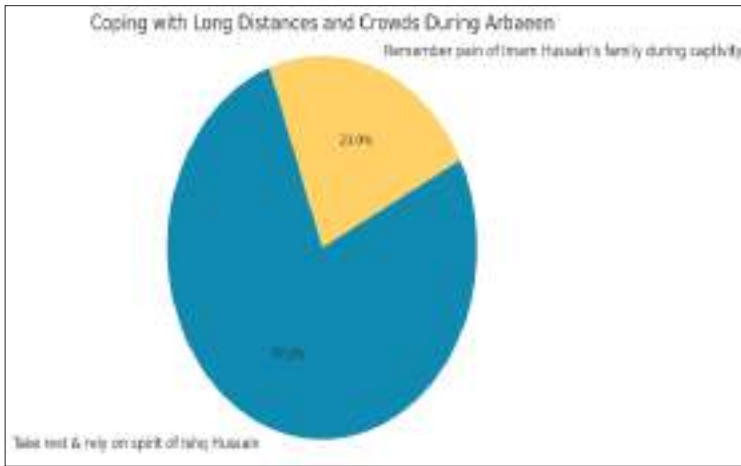


Fig 9 This pie chart illustrates how elderly pilgrims cope with the long distances and large crowds during their journey to Karbala:

77% manage by taking rest and drawing strength from the spirit of Ishq Hussain (deep love for Imam Hussain).

23% motivate themselves by remembering the suffering of Imam Hussain's family during their captivity.

The responses reflect both physical coping strategies and profound emotional resilience rooted in spiritual devotion

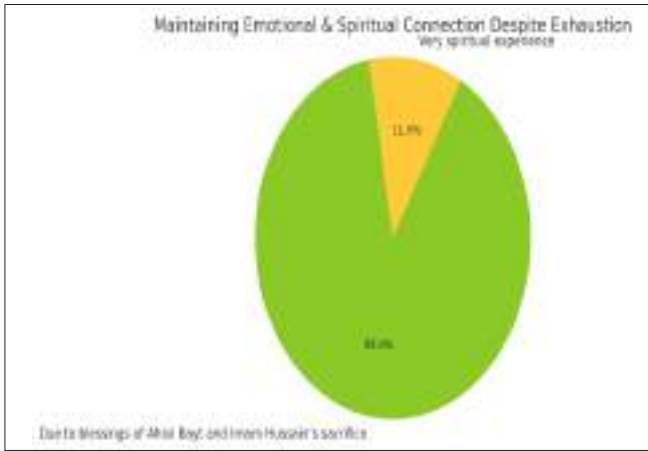


Fig 10 This pie chart shows how elderly pilgrims maintain their emotional and spiritual connection during the physically exhausting Arbaceen journey:

89% credited their sustained connection to the blessings of Ahlul Bayt and the sacrifice of Imam Hussain.

11% described the experience as inherently spiritual, which helped them remain emotionally and spiritually strong.

The overwhelming majority found strength and connection through deep-rooted faith, emphasizing the powerful role of religious devotion in enduring the pilgrimage

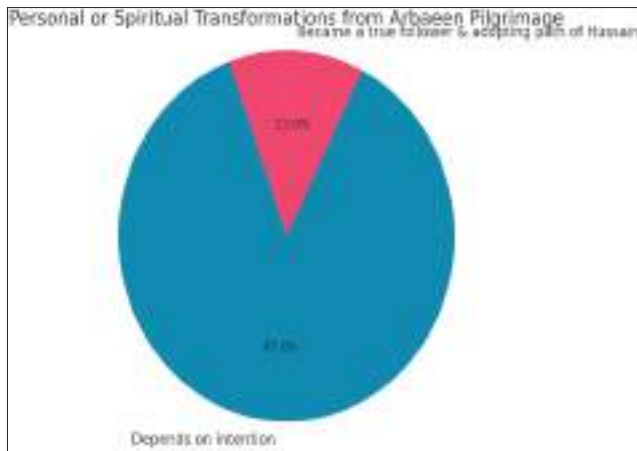
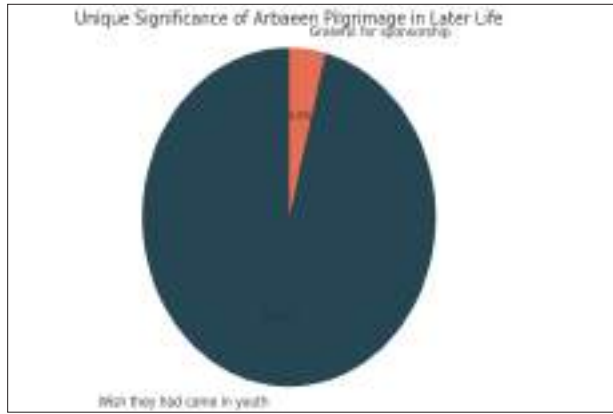


Fig 11 This pie chart reflects the personal or spiritual transformations reported by elderly pilgrims after participating in the Arbaceen pilgrimage:

87% believe that transformation depends on one's intention, highlighting the importance of internal sincerity in deriving spiritual benefit.

13% said they have become true followers of Imam Hussain and are actively trying to adopt his path in their daily lives.

The data indicates that while most view transformation as a personal choice shaped by intention, a significant number experienced a tangible shift in their spiritual outlook. Fig 12 This pie chart presents how elderly pilgrims perceive the unique significance of the



Arbaeen pilgrimage at their current stage in life:

96% expressed that the experience would have been even more meaningful or easier had they undertaken it in their youth.

4% conveyed gratitude for sponsorship, which enabled them to participate despite their age or financial limitations.

This reflects a blend of reflection and gratitude, with most pilgrims valuing the journey deeply while also acknowledging the physical limitations of aging.

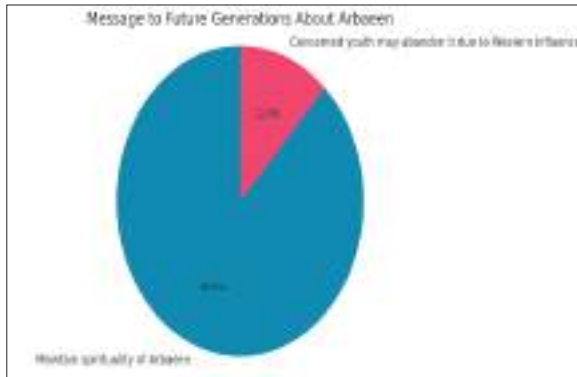


Fig 13 This pie chart represents the message elderly pilgrims wish to convey to future generations regarding the Arbaeen pilgrimage:

88% emphasized the importance of preserving the spirituality of Arbaeen, urging the youth to uphold its sacredness.

12% expressed concern that Western influence may lead younger generations to abandon the pilgrimage and its values.

The responses show both hope and apprehension—highlighting a desire to pass on the essence of Arbaeen while being mindful of cultural shifts.

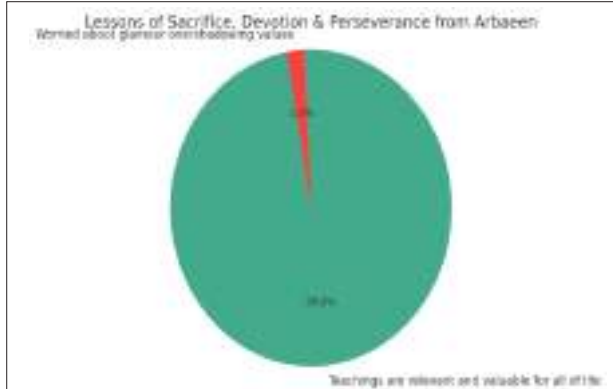


Fig 14 This pie chart shows how elderly pilgrims interpret the lessons of sacrifice, devotion, and perseverance through the Arbaeen pilgrimage:

98% believe that the pilgrimage teaches values that are relevant in all aspects of life, and that Imam Hussain's teachings hold lasting value for future generations.

2% expressed concern that the growing glamour around the pilgrimage may overshadow its core values.

The response highlights Arbaeen's deep moral and spiritual significance while acknowledging the need to preserve its simplicity and sincerity.

Challenges Faced by Elderly Pilgrims :

Despite their determination, elderly participants in the Arbaeen pilgrimage encounter multiple challenges that can affect their physical and emotional well-being.

A. Health Risks and Physical Strain

Walking long distances, often in extreme weather conditions, can be physically exhausting for elderly pilgrims. Many suffer from chronic illnesses such as hypertension, diabetes, and arthritis, making it difficult to endure the rigorous journey. The lack of immediate medical facilities along the route further exacerbates health-related risks.

B. Limited Mobility and Accessibility Issues

The pilgrimage route, while well-equipped with facilities, is not always accessible for elderly individuals with mobility impairments. Uneven terrain, crowded pathways, and the absence of adequate seating areas pose significant hurdles. While wheelchairs and support services are available, they are often insufficient to accommodate the large number of elderly pilgrims.

C. Accommodation and Sanitation Facilities

Finding suitable accommodation during the pilgrimage is another major concern. Although mawkibs (hospitality tents) provide food and rest areas, elderly pilgrims often struggle to find comfortable sleeping arrangements. Moreover, sanitation facilities may not always be elderly-friendly, leading to additional discomfort.

D. Overcrowding and Safety Concerns

With millions of pilgrims converging on Karbala, overcrowding poses safety risks, particularly for elderly individuals who may be prone to fatigue or disorientation. The risk of falling, getting lost, or being separated from family members adds to their vulnerability.

E. Emotional and Psychological Struggles

Many elderly pilgrims travel long distances from different countries, sometimes without direct family support. Language barriers and unfamiliar environments can lead to anxiety and emotional distress. Additionally, the profound spiritual nature of the pilgrimage can be overwhelming, requiring emotional support.

Measures to Improve the Experience for Elderly Pilgrims :

Given these challenges, various measures can be taken to ensure a more comfortable and enriching experience for elderly pilgrims:

F. Enhanced Medical Support :

Establishing more mobile medical units along the pilgrimage route, staffed with specialists in geriatric care, can provide timely assistance to elderly pilgrims. Offering check-up services and emergency response teams can mitigate health risks.

G. Better Accessibility and Mobility Assistance :

More wheelchairs, electric carts, and resting areas should be provided along the pilgrimage route. Expanding transportation services within Karbala and surrounding areas can help those who cannot walk long distances.

H. Improved Accommodation and Sanitation Facilities :

Special accommodation areas for elderly pilgrims, equipped with proper bedding, hygiene facilities, and easy access to washrooms, should be designated. This will help ensure their comfort and well-being during the journey.

I. Guided Assistance and Safety Measures

Volunteers should be trained to assist elderly pilgrims, guiding them through crowded areas and ensuring they do not get lost. Establishing designated checkpoints where elderly pilgrims can rest and receive support can also enhance their safety.

J. Emotional and Psychological Support Services

Counselling services and multilingual guides can help elderly pilgrims navigate the pilgrimage experience. Providing opportunities for them to share their stories and reflections can also create a sense of community and emotional support. economy of caregiving embedded in faith.

Research Gaps

The Arbaeen pilgrimage is full of stories of faith, struggle, and resilience. The following research gaps highlight critical areas that should have further sociological exploration:

- Undertake immersive, on-ground ethnographic research to document the first-hand experiences of elderly pilgrims
- Analyze how support systems, such as Mawkibs, volunteer caregivers, and religious service providers aid or shape elderly participation in the pilgrimage.
- Investigate and explore the gender-specific experiences safety concerns, and access to resources during the journey.
- Explore how technological tools and infrastructural advancements impact the accessibility and navigation for elderly people.

Conclusion

The participation of elderly pilgrims in the Arbaeen pilgrimage is a testament to their deep faith and commitment to the remembrance of Imam Hussein (AS). While they face numerous challenges, their resilience and determination highlight the spiritual significance of the journey. By implementing practical solutions such as improved healthcare, better accessibility, and enhanced support services, the experience of elderly pilgrims can be made more comfortable and fulfilling. As the Arbaeen pilgrimage continues to grow, it is essential to ensure that all pilgrims, regardless of .age, can partake in this profound spiritual event with dignity and ease

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Arbaeen Pilgrimage as a Predictor of Islamic Authentic Leadership Among Youth

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Abstract

This research endeavored to examine the impact of participating in Arbaeen pilgrimage on the development of authentic leadership within a sample of Bahraini youth. Employing a mixed-methods design, the research adopted quantitative data obtained through a questionnaire, along with qualitative insights driven from focus group discussions. To measure the authentic leadership, the Authentic Leadership Questionnaire (ALQ) is administered, which comprises sixteen items, measuring the four established theoretical constructs of authentic leadership: self-awareness, internalized moral perspective, balanced processing, and relational transparency. The target population in this research consists of youths aged 15-20 years (N = 760), who reside within a local town in the Kingdom of Bahrain. Electronic administration of the ALQ in January 2025 yield a response rate of 66% (N = 500) consisting our random sample. Statistical analyses of the responses reveal a significant positive correlation, indicating participation in the Arbaeen pilgrimage as a predictor of the development of authentic leadership, with self-awareness construct exhibiting a particularly increase among the pilgrims. Consequently, the research posits a strategic importance of leveraging the Arbaeen pilgrimage as a potential opportunity for the development of Islamic authentic leadership among youth, thereby contributing to the formation of future leadership capital.

Keywords: Arbaeen Pilgrimage, Authentic Islamic Leadership, Authentic Leadership, Leadership style, Youth.

Introduction

Authentic leadership (AL) denotes leadership that is based on and driven from inner morals and values. It presents an authentic and true self of a leader as opposed to a fake and misleading self. Research indicates positive impact of authentic leadership on fostering innovation (Elrehail et al., 2018), job satisfaction (Berkovich & Gueta, 2020), increasing organizational citizenship behaviors (Milon & Shapira-Lishchinsky, 2021), and so on and so forth. Although, the term “authentic leadership” is a contemporary concept in organizational psychology, AL is not a strange and eccentric concept to believers especially Muslims. In fact, AL is deeply rooted and well-established in Islam. The next section sheds light on authentic leadership in Islam.

1. Authentic leadership in Islam :

The principles and qualities AL defines are inherent in Islamic religion, discoursed in Islamic literature, and deeply rooted in Islamic tradition. The holy Quran presents numerous examples of authentic leadership practices from a number of prophets and invites mankind to follow their footsteps (see for example Surah Hud/ 87; Surah Al-Fath/ 29; Surah Al-Shuara/ 215,). For instance, Surah Hud, verse 87, describes the people of prophet Shu’aib, who mockingly ask him if his prayer (i.e. inner values) is the rationale behind abandoning the idols of their fathers and their willpower to manage their wealth (unfairly). They denote that Shu’aib is too sensible and overly tolerant for suggesting such positive changes. The verse clearly defines principles and qualities of prophet Shu’aib as an authentic leader.

Furthermore, prophet Mohammed (Peace be upon him and his family) well demonstrated the Islamic authentic leadership in practice (see for example, Nahjul Balagha, Sermon 33, p. 81) (Majlesi, n.d., Vol. 26,

p. 16). For the purpose of the current research, which examines the impact of Arbaeen pilgrimage, the Islamic narrations in this research evolve merely around Imam Hussain (peace be upon him) while representing prophet Mohammed's (peace be upon him and his family) and other 11 Shia Imams' traditions (peace be upon them). (Majlesi, n.d., Vol. 26, p. 16). Imam Hussain (peace be upon him) is one of the most eminent Islamic authentic leaders whereas the battle of Karbala (Majlesi, n.d., Vol. 26, p. 16) is a platform for emergence of his authentic leadership traits. This shall be discussed in greater details in following sections. Indeed, as our understanding of authentic leadership matures and develops, more aspects of Imam Hussain's authentic leadership and its impacts upon his followers shall unfold. The next section sheds light on the conceptual development of authentic leadership denoting various approaches to and constructs of AL. The following section, then, examines each AL construct according to the field's scholars and Imam Hussain's practice.

2. Constructs of AL:

Authentic leadership as a contemporary concept in organizational psychology, began to emerge in 1997 (Bhindi and Duignan, 1977), while the last decade, specifically since 2017, witnessed an increase in proliferation of research studies on authentic leadership in high-impact factor educational journals (Ahmed, 2024). Many theoretical foundations were employed in AL conceptualization, while various constructs of AL represent these approaches.

Bhindi and Duignan (1977) presented one of the earliest approaches, highlighting four components of authenticity in leadership, spirituality, intentionality and sensibility. Begley (2006, 2001) approach derived from ethical perspective, indicating three pillars of AL in terms of self-knowl-

edge, sensitivity to the orientation of others, and capacity for moral reasoning. Gardner et al.'s (2005) inspired by positive psychology and identity theories, pointing to self-awareness (identity, values, emotions and goals and motives), self-regulatory processes (authentic behaviours, balanced processing and transparency), and positive moral modelling.

Walumbwa et al. (2008) presented one of the most widely accepted and used measures of AL, which was based on earlier perspectives. According to them AI encompasses four main constructs of self-awareness, balanced processing, internalized moral perspective, and relational transparency (Walumbwa et al., 2008). While various terminologies have been used, some of them concurs with the concepts presented in earlier and subsequent approaches (Northouse, 2021). For instance, self-awareness coincides with self-knowledge.

The four constructs of AL shall now be discussed in more details according to the field's scholars and Imam Hussain's practice.

A. Self-awareness

﴿بَلِ الْإِنْسَانِ عَلَىٰ نَفْسِهِ بَصِيرَةٌ. وَلَوْ أَلْقَىٰ مَعَاذِيرَهُ﴾ [15-14] القيامة:

Self-awareness denotes indicating an understanding of how an individual develops meaning of the world and how that process affects the way one views herself/himself over time. It also denotes indicating an understanding of the complex and multifaceted nature of the self and its strengths and weaknesses. This involves understanding self through exposure to and interacting with others, and being cognizant, and aware of one's impact on others (Walumbwa et al., 2008; Kernis, 2003)

Imam Hussain demonstrates self-knowledge and self-awareness in great detail in his prayers. In Arafa prayer (Mafatih al-Jinan, Dua Arafa),

Imam indicates deep layers of self-awareness regarding the multifaceted nature of self, ranging from physical to socio-emotional needs. Imam refers to Allah's mercy and blessing in his developmental process and seeks Allah's help to overcome his weaknesses.

B. Internalized Moral Perspective

﴿ قَالُوا يَا شُعَيْبُ أَصْلَاتُكَ تَأْمُرُكَ أَنْ نَتْرُكَ مَا يَعْبُدُ آبَاؤُنَا أَوْ أَنْ نَفْعَلَ فِي أَمْوَالِنَا مَا نَشَاءُ إِنَّكَ لَأَنْتَ الْحَلِيمُ الرَّشِيدُ ﴾ هود [87]

Internalized moral perspective denotes a form of self-regulation that is integrated and internalized. It is guided by inner values and moral standards, against the pressure of surrounded groups, organization, and society. It results in behaviors and decision making, which is in harmony with these internalized morals and values (Gardner and Coglisier, 2018; Walumbwa et al., 2008; Gardner et al., 2005).

Internalized moral perspective is evident in all aspects of Imam Husain's life. One of the most well-known citations of Imam is when Yazid asks for his pledge of allegiance, when Imam quotes "مثلي لا يبيع مثله" (al-Majma' al-'Alami li Ahl al-Bayt, 2001, Vol. 1, p. 44) meaning that someone as I, [with highly internalized moral values], does not pledge allegiance to someone [demoralized] like him. Furthermore, Imam indicates his deeply integrated values by reciting the following poem at the battle of Karbala "الموت أولى من ركوب العار والعار أولى من دخول النار" (Al-Majlisi, 1403 AH [1982 or 1983 CE], Vol. 44, p. 192). The citation denotes "death is more desirable than shame, while shame is preferable to entering hellfire."

C. Balanced Processing

﴿فَاعْفُ عَنْهُمْ وَاسْتَغْفِرْ لَهُمْ وَشَاوِرْهُمْ فِي الْأَمْرِ فَإِذَا عَزَمْتَ فَتَوَكَّلْ عَلَى اللَّهِ إِنَّ اللَّهَ يُحِبُّ الْمُتَوَكِّلِينَ﴾ آل عمران: [159]

Balance processing describes leaders who analyze objectively all related data prior to decision making. They take into account all perspectives including those, which challenge or opposed their deeply held viewpoints.

Imam Hussain demonstrates balanced processing throughout his leadership while encouraging his followers to do so. For instance, in the battle of Karbala, when Shemr(1) asks to meet Abbas(2) to convey him to join the opponents' army, Imam Hussain asks Abbas (who refuses to talk to Shemr) to listen to Shemr's perspective before taking any decision. (Qummī, 2001). This indicates a high level of balanced processing soliciting opponents' views in challenging situations.

D. Relational Transparency

﴿وَإِخْفِضْ جَنَاحَكَ لِمَنِ اتَّبَعَكَ مِنَ الْمُؤْمِنِينَ﴾ الشعراء: [215]

Relational transparency denotes, presenting leaders' true and authentic self to others, as opposed to a fake self. Such behavior and enactment, builds and maintains trust among leaders and their followers, as the leader openly shares info and expresses her/his true thoughts, emotions and feelings, while attempts to minimize showing unsuitable emotions (Walumbwa et al., 2008; Kernis, 2003).

Relational transparency is well demonstrated by Imam Hussain, particularly, during the battle of Karbala. Imam is openly sharing information with his followers asking them to use the darkness to save their lives

Imam presents his authentic self as opposed to a fake or distorted self, through displaying his feelings and emotions, especially, in the incident of martyrdom of his son Ali Akbar or his beloved brother and chief commander Abbas (peace be upon them) (Qummī, 2001).

After attending to four constructs of AL in theory and practice, leadership as a dynamic process and research on AL are now discussed.

3.Leadership as a dynamic process:

Researchers argue that authenticity should be seen beyond a fixed trait and unchanging self (Bunjak, Lord, & Acton, 2024). It should be considered as a fluid process formed by situational context (Helmuth, Cole, & Vendette, 2023). Such dynamic perspective of authenticity, calls leaders to continually develop, refine and adapt their authentic leadership practice; instead of attempting to maintain a singular true self, that is unchangeable over time (Bunjak, Lord, & Acton, 2024).

4.Research on authentic leadership :

Based on the four constructs of AL, researchers examine various strategies to effectively develop authentic leadership (Jiewen et al., 2024). Kulophas and Hallinger (2021) performed a behavioral study of authentic leadership among 580 primary school principals in Thailand. The findings demonstrate that increasing principals' engagement in balanced processing and relational transparency result in successful authentic leadership development and promoting school change. Successful principals engage in effective communication explaining the purpose of new school policy to stakeholders consulting teachers and parents, soliciting their views and treating others as equals.

Keane et al. (2020) investigated the impact of attending to internalized moral perspective on effective authentic leadership development among school principals in South Australia. They indicate a direct correlation between principals' utilizing value transmission and the success of employing new science and technology programs. Successful principals communicate positive impacts of implementing new programs with teachers, motivating them, and value their learning.

Furthermore, Gatling and Cole (2013) studied the role of Self-awareness in fostering authentic leadership. They investigated authentic leadership among 96 business coaches. Effective coaches demonstrated higher scores related to all four AL constructs, with self-awareness indicating a statistically significant relation with Coaching Effectiveness. They call for focusing on self-awareness in designing training programs in order to leverage advanced levels of authentic leadership.

Corriveau (2020) conducts a study in which 200 students, in two management master's programs, participate in a leadership course at a Canadian university. She examines how experiential learning contributes to the development of authentic leadership in prospective managers and executives. The results identify self-awareness as an important characteristic of a responsible manager. She calls for focusing on self-awareness in designing AL training programs.

As mentioned by these researchers, providing opportunities for raising self-awareness, balanced processing, increasing internalized moral perspectives and practicing relational transparency are of great benefits in developing authentic leadership. Accordingly, leaders may refine, adapt and develop their leadership enactments based on the situational context, which is in harmony with their morals and values (Helmuth, Cole, & Vendette, 2023). The Arbaeen pilgrimage was sought to deliver such opportunities, which consists with high levels of Islamic values. The cur-

rent research examines the impact of Arbaeen pilgrimages on developing authentic leadership. The research hypothesis denotes participating in Arbaeen pilgrimage as a predictor of authentic leadership.

Method

- A mixed-method design is employed for the purpose of the current research. Quantitative data are collected from distributing online questionnaire; while qualitative data are driven from focus group discussion.

1.Participants L:

The random sample consists of 500 Bahraini participants (aged 15-20 years old), from Shia ethnic group, with middle socio-economic status, who reside within a local town in the Kingdom of Bahrain. The target sample is 760, out of which 500 respond voluntarily to the questionnaire (rating response of 66%). Gender distribution demonstrates 53% female and 47% male participants. The data are collected in January 2025 via distribution of online questionnaire in two local high schools (a girl's high school and a boy's high school). The questionnaire was distributed through students social WhatsApp groups. The homogeneity of variance is examined using Levene test. A p-value of (0,127, $p < .05$) demonstrates equal variance across two groups. Cohen's d Effect Size of (.76) is found, which indicates a medium effect size demonstrating practical significance between pilgrim and non-pilgrim groups. Similarly, other variables (self-awareness, balanced processing, internalized moral perspective and relational transparency) indicate homogeneous variances, with medium to large practical significance observed along all different variables.

Results

linear regression analyses are conducted to examine the effect of participating in Arbaeen pilgrimage on dependent variables (i.e. total scores on authentic leadership, and scores on four AL constructs).

We also investigate the relationship between participating in Arbaeen pilgrimage and demographic characteristics of respondents (i.e., age and gender). An analysis of variance (ANOVA) yield no statistically significant relationship and hence, is not reported in the analyses.

1.Authentic Leadership :

A simple linear regression is conducted to determine if participating in Arbaeen pilgrimage predicts total authentic leadership scores.

Predictor	B	SE B	β	t	p
Constant	11.89	0.18		66.06	<.001
Arbaeen	3.49	0.25	0.60	13.96	<.001

Table 1 A linear regression of participating in Arbaeen pilgrimage and total authentic leadership score.

The regression model is statistically significant ($R^2 = .360$, $F(1, 498) = 194.88$, $p < .001$), explaining 36.0% of the variance in AL scores. Participating in Arbaeen pilgrimage is associated with a 3.49-point increase in AL scores (Table 1). The findings provide support for the research hypothesis suggesting that participating in Arbaeen pilgrimage predicts total authentic leadership. The results are shown in figure 1.

Authentic Leadership and its four constructs' scores among participants and non-participants in Arbaeen pilgrimage

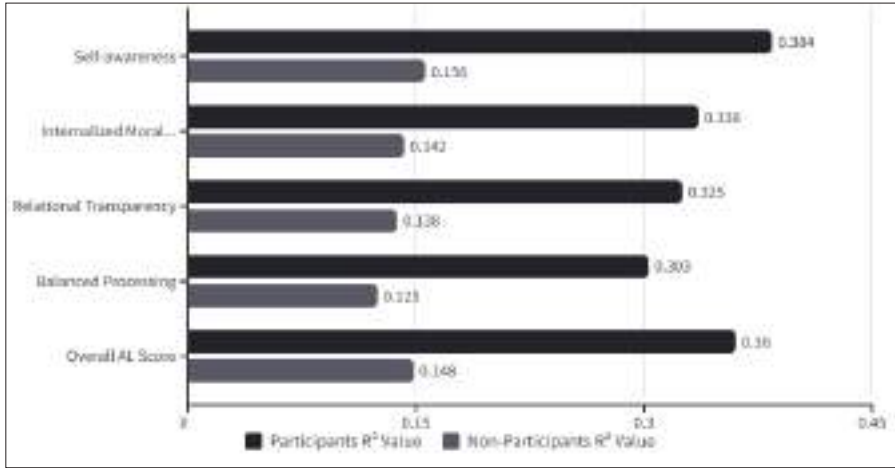


Figure 1 linear regression analysis comparing Authentic Leadership and its four constructs' R2 scores among participants and non-participants in Arbaeen pilgrimage.

2. Self-awareness :

A simple linear regression is conducted to determine if participating in Arbaeen pilgrimage predicts self-awareness scores.

Predictor	B	SE B	β	t	p
Constant	2.87	0.05		57.40	<.001
Arbaeen	1.02	0.07	0.62	14.57	<.001

Table 2 A linear regression of participating in Arbaeen pilgrimage and self-awareness.

The regression model is statistically significant ($R^2 = .384$, $F(1, 498) = 212.29$, $p < .001$), explaining 38.4% of the variance in self-awareness scores, which indicate the highest correlation compared to other AL constructs. Participating in Arbaeen pilgrimage is associated with a 1.02-point increase in self-awareness scores (Table 2).

During focus group discussions, the participants elaborate on their responses on the AL questionnaire. They indicate that participating in Arbaeen pilgrimage provide an opportunity for self-discovery. They repeatedly quote that “I did not know I can walk!”; “I did not expect myself to bear the difficulties”; “I did not know I can control my temper!”; “I did not know I can lead the group that well?!”. These findings support earlier research, which highlights the greater impact of self-awareness in authentic leadership development compared to other AL constructs (Corriveau, 2020; Gatling & Cole,2013). The findings suggest that participating in Arbaeen pilgrimage predicts self-awareness

3.Internalized Moral Perspective :

A simple linear regression is conducted to determine if participating in Arbaeen pilgrimage predicts internalized moral perspective scores. The results presented in Table 3.

Predictor	B	SE B	β	t	p
Constant	2.83	0.05		56.60	<.001
Arbaeen	0.93	0.07	0.58	13.29	<.001

Table 3 A linear regression of participating in Arbaeen pilgrimage and internalized moral perspective.

The regression model is statistically significant ($R^2 = .336$, $F(1, 498) = 176.62$, $p < .001$), explaining 33.6% of the variance in internalized moral perspective scores. Participating in Arbaeen pilgrimage is associated with a 0.93-point increase in internalized moral perspective.

Moreover, during focus group participants referred to a number of incidents indicating their internalized moral perspective during Arbaeen pilgrimage. For example, one mentioned “...we had a trolley for our child, that was displaced at a station, despite the child’s heavy weight and Iraqis’

insisting, we refused to take other people’s trolley.” The findings were in harmony with Keane et al. (2020). The result suggests participating in Arbaeen pilgrimage predicts internalized moral perspective scores.

4.Balanced Processing :

A simple linear regression is conducted to determine if participating in Arbaeen pilgrimage predicts balanced processing scores.

Predictor	B	SE B	β	t	p
Constant	2.94	0.05		58.80	<.001
Arbaeen	0.88	0.07	0.55	12.58	<.001

Table 4 A linear regression of participating in Arbaeen pilgrimage and balanced processing.

The regression model is statistically significant ($R^2 = .303$, $F(1, 498) = 158.26$, $p < .001$), explaining 30.3% of the variance in balanced processing scores. Participating in Arbaeen pilgrimage is associated with a 0.88-point increase in balanced processing scores (Table 4).

During focus group, participants indicate how Arbaeen pilgrimage offers opportunities for practicing balanced processing. They mention how leading a group enables them to train themselves to take into account different perspectives of group members while accommodating for different age and different taste, especially, in regard to scheduling their walk or stopping at various stations. “sometimes regardless of our will and enthusiasm to walk, we would stop every 30 minutes, so elderly people in the group could rest”. The results consist with Kulophas & Hallinger (2021) results. The current findings suggest that participating in Arbaeen pilgrimage predicts balanced processing.

5.Relational Transparency :

A simple linear regression is conducted to determine if participating in Arbaeen pilgrimage predicts relational transparency scores.

Predictor	B	SE B	β	t	p
Constant	2.98	0.05		59.60	<.001
Arbaeen	0.93	0.07	0.57	13.29	<.001

Table 5 A linear regression of participating in Arbaeen pilgrimage and relational transparency.

The regression model is statistically significant ($R^2 = .325$, $F(1, 498) = 176.62$, $p < .001$), explaining 32.5% of the variance in relational transparency scores. Participating in Arbaeen pilgrimage is associated with a 0.93-point increase in relational transparency (Table 5).

In regard to relational transparency, participants quote that during Arbaeen pilgrimage “...there is no time nor energy to start pretending or showing a fake self, after all we are here to take Imam Hussain as our model. How could we be fake? Imam never shows a fake self”. A participant indicates that “usually people after a long walk take few minutes to sit and rest and, then, they start very honest conversions about themselves, sharing their dreams, and even their true emotions.” The results support Kulophas & Hallinger (2021) findings. The present results suggest that participating in Arbaeen pilgrimage predicts relational transparency.

6.Validity & Reliability :

Residual analyses are conducted to assess the assumptions of linear regression for each model. The residuals are examined for normality, homoscedasticity, and independence. Shapiro-Wilk tests indicate that residuals are approximately normally distributed for all regression models ($p > .05$). Breusch-Pagan tests show no significant heteroscedasticity in the residuals ($p > .05$). Durbin-Watson statistics are close to 2 for all models,

indicating no significant autocorrelation in the residuals. These results suggest that the assumptions of linear regression are met, supporting the validity of the regression analyses.

Reliability of results are ensured through triangulation as the participants' responses to the questionnaire and during focus group are analyzed and interpreted by a group of researchers.

Discussion

The current research examines the impact of participating in Arbaeen pilgrimage on the development of authentic leadership among youth pilgrims. The statistical analyses of the responses from both questionnaire and focus groups reveal statistically significant positive correlations. The findings suggest that participating in Arbaeen pilgrimage is a predictor of authentic leadership. Participating in Arbaeen pilgrimage counts for 30-38% of variances in AL constructs with self-awareness exhibiting highest increase among the four constructs, followed by internalized moral perspective, relational transparency and balanced processing. These findings support the research hypothesis, which denotes that participating in Arbaeen pilgrimage is a predictor of authentic leadership among youth. The results are also consistent with earlier research studies in the field, when providing opportunities for raising self-awareness, increased balanced processing in decision making, internalized moral perspective and practicing relational transparency correlate with developing authentic leadership (Kulophas & Hallinger, 2021; Corriveau, 2020; Keane et al., 2020; and Gatling & Cole, 2013)

1.Limitations :

Limitations in the current research are acknowledged. First, the sample includes a limited age range of 15-20 years old, due to the research age-group target. Performing future research with a larger sample with varieties of age groups shall be advantages. Second, the reliance on self-reports variables raises concern with effect size inflation due to self-report bias. Adopting other mixed-method design such as experimental designs, narrative, and observational methods shall explore the impact of individual differences and situational factors on leaders' authenticity. Future researchers may also validate their research using both self-reports and other-reports and pursuit triangulation of results (Brandon and Gardner, 2013). Performing longitudinal research on Arbaeen pilgrimage shall also determine if benefits in terms of authentic leadership development persist over time.

2.Implications and future directions :

The research posits a strategic importance of benefiting from Arbaeen pilgrimage. In theory, Arbaeen pilgrimage provides great opportunity for demarcating the Islamic AL constructs and advancing the conceptualizing. Policy makers may invest in Arbaeen pilgrimage as to provide effective AL training programs, thereby contributing to the formation of future leaders.

Furthermore, though the present research suggests the positive correlation between Arbaeen pilgrimage and authentic leadership, the dynamics of such impact is yet to be explored. Considering a wide range of factors involved in Arbaeen pilgrimage, a more comprehensive study of the nature of such factors comprising antecedent, mediating and moderating factors in developing leader authenticity is for future researchers to be unveiled.

Moreover, our research is based on the assumption of universal constructs of authentic leadership. Nevertheless, what defines an authentic leader as self-aware, balanced decision-maker, moral and transparent may differ from one culture to another. Indeed, Arbaeen pilgrimage provides a unique opportunity to further develop a multi-cultural AL conceptualization.

Conclusion

The current research aims at presenting a different perspective to Arbaeen pilgrimage through examining its impact upon leadership development among youth. The current research posits a strategic importance of benefiting from Arbaeen pilgrimage to develop Islamic authentic leadership among youth, and thereby, contributing to the formation of future Islamic authentic leaders. The current research is only stepping stone. Indeed, extensive attempts are required to further demarcating the Islamic AL constructs, advancing the conceptualizing and creating avenues for future research.

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Authentic Leadership Self-Assessment Questionnaire

Instructions: This questionnaire contains items about different dimensions of authentic leadership. There are no right or wrong responses, so please answer honestly. Use the following scale when responding to each statement by writing the number from the scale below that you feel most accurately characterizes your response to the statement.

Key: 1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

- | | | | | | |
|---|---|---|---|---|---|
| 1. I can list my three greatest weaknesses. | 1 | 2 | 3 | 4 | 5 |
| 2. My actions reflect my core values. | 1 | 2 | 3 | 4 | 5 |
| 3. I seek others' opinions before making up my own mind. | 1 | 2 | 3 | 4 | 5 |
| 4. I openly share my feelings with others. | 1 | 2 | 3 | 4 | 5 |
| 5. I can list my three greatest strengths. | 1 | 2 | 3 | 4 | 5 |
| 6. I do not allow group pressure to control me. | 1 | 2 | 3 | 4 | 5 |
| 7. I listen closely to the ideas of those who disagree with me. | 1 | 2 | 3 | 4 | 5 |
| 8. I let others know who I truly am as a person. | 1 | 2 | 3 | 4 | 5 |
| 9. I seek feedback as a way of understanding who I really am as a person. | 1 | 2 | 3 | 4 | 5 |
| 10. Other people know where I stand on controversial issues. | 1 | 2 | 3 | 4 | 5 |
| 11. I do not emphasize my own point of view at the expense of others. | 1 | 2 | 3 | 4 | 5 |
| 12. I rarely present a "false" front to others. | 1 | 2 | 3 | 4 | 5 |
| 13. I accept the feelings I have about myself. | 1 | 2 | 3 | 4 | 5 |
| 14. My morals guide what I do as a leader. | 1 | 2 | 3 | 4 | 5 |
| 15. I listen very carefully to the ideas of others before making decisions. | 1 | 2 | 3 | 4 | 5 |
| 16. I admit my mistakes to others. | 1 | 2 | 3 | 4 | 5 |

Scoring

1. Sum the responses on items 1, 5, 9, and 13 (self-awareness).

استبيان تقييم الذات للقيادة الأصيلة

B Z U ∞ π

تعليمات :

يعتبر 15 الاستبيان طريق للتطوير، عملية القيادة الأصيلة 7 توجهات، موجهة أو حذارة، أو أخطر الإجابة بتدقيق، ابتداء من العيون التي قد
 أن، على كل حارة من طريق كلمة الراد من العيون أداء التي تذكر أن يهدف استبيانك لهذا العمل بشكل أكثر دقة.

مفتاح :

1 = لا أبداً
 2 = نادراً
 3 = أحياناً
 4 = كثيراً
 5 = كل وقت

1. **أفكر**

نعم لا

2. **أفكر**

نعم لا

3. **أفكر**

نعم لا

4. **أفكر**

نعم لا

5. **أفكر**

نعم لا

6. **أفكر**

نعم لا

7. **أفكر**

نعم لا

8. **أفكر**

نعم لا

9. **أفكر**

نعم لا

10. **أفكر**

نعم لا

11. **أفكر**

نعم لا

12. **أفكر**

نعم لا

13. **أفكر**

نعم لا

14. **أفكر**

نعم لا

15. **أفكر**

نعم لا

16. **أفكر**

نعم لا

17. **أفكر**

نعم لا

18. **أفكر**

نعم لا

19. **أفكر**

نعم لا

20. **أفكر**

نعم لا

21. **أفكر**

نعم لا

22. **أفكر**

نعم لا

23. **أفكر**

نعم لا

24. **أفكر**

نعم لا

25. **أفكر**

نعم لا

26. **أفكر**

نعم لا

27. **أفكر**

نعم لا

28. **أفكر**

نعم لا

29. **أفكر**

نعم لا

30. **أفكر**

نعم لا

31. **أفكر**

نعم لا

32. **أفكر**

نعم لا

33. **أفكر**

نعم لا

34. **أفكر**

نعم لا

35. **أفكر**

نعم لا

36. **أفكر**

نعم لا

37. **أفكر**

نعم لا

38. **أفكر**

نعم لا

39. **أفكر**

نعم لا

40. **أفكر**

نعم لا

41. **أفكر**

نعم لا

42. **أفكر**

نعم لا

43. **أفكر**

نعم لا

44. **أفكر**

نعم لا

45. **أفكر**

نعم لا

46. **أفكر**

نعم لا

47. **أفكر**

نعم لا

48. **أفكر**

نعم لا

49. **أفكر**

نعم لا

50. **أفكر**

نعم لا

51. **أفكر**

نعم لا

52. **أفكر**

نعم لا

53. **أفكر**

نعم لا

54. **أفكر**

نعم لا

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<p>5. ما عدد اوراق الورد</p> <p><input type="radio"/> 1</p> <p><input type="radio"/> 2</p> <p><input type="radio"/> 3</p> <p><input type="radio"/> 4</p> <p><input type="radio"/> 5</p>	
<p>6. اذكر اقسام الورد</p> <p><input type="radio"/> 1</p> <p><input type="radio"/> 2</p> <p><input type="radio"/> 3</p> <p><input type="radio"/> 4</p> <p><input type="radio"/> 5</p>	

7. اشرح عن كتاب أبي بكر أولئك الذين يتخلون سي.

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8. اشرح الفرق بين طين المسكن

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10. اشرح الفرق بين طين المسكن

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11. لا تؤكد طروحيية نظري الخامسة على حساب الآخرين.

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12. كثيراً ما الظهور "الجميعة" كتابة لشعيرين.

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13. كحل المشايخ التي الترت لها التادعسي.

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14. ليس ترميم الجمل على بما الترميم به كالتالي.

14. لدي ترجمة لأخلاق لما أوردته كتابه.

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15. أسمع بخافية تحديده إلى أفكار الآخرين قبل اتخاذ القرارات.

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16. اعترف بأخطائي للآخرين.

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**Linguistic Framing of Religious Identity
in Global Media Narratives:
Analysing the Arba'een Pilgrimage
of Imam Hussain through
English Discourse**

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Abstract

The paper looks into how the English media language frame of Arba'een pilgrimage of Imam Hussain can be used to expand the notion of religious identity. This study uses Critical Discourse Analysis (CDA) by adopting Fairclough's three-dimensional model (1995) to analyse four media texts in order to know how discourse practices have been used to create the perceptions of Shia Islamic identity in the global spectrum. The study aims to investigate the lexical, syntactic, and rhetorical devices used in media to frame the Arba'een pilgrimage and to how the linguistic framing of the Arba'een pilgrimage in English discourse influences public perceptions of Shia Muslim identity, communal solidarity, or geopolitical narratives. The analysis shows that media forms relying on the orientalist models tend to focus on spectacle and neglect spiritual meaning and construct a number of antinomies between secular Western and religious Eastern worldviews. The results have shown that language can play an important role in protecting the picture of religious practices and personal identity in the minds of people through the correct use of use of headlines text, descriptive language and framing the context of the language. The paper concludes that the way power relations incorporated in media discourse led to the marginalisation or legitimisation of religious communities. These results have impacts on examining the representation of religious minorities in the media and language, which is used to create otherness across the world.

Keywords: Religious Identity, Media Discourse, Critical Discourse Analysis, Arba'een Pilgrimage, Linguistic Framing.

Introduction

An example of these largest gatherings of people on an annual basis is the Arba'een pilgrimage, held in commemoration of the forty days after the martyrdom of Imam Hussain at the Battle of Karbala and attended by millions of Shia Muslims worldwide (Nakash, 2019). Although it is one of the most grandiose pilgrimages with profound spiritual implications (Szanto, 2018), focused coverage of the event in Western media remains sparse, and where it is covered, it is subject to linguistic and cultural filtering, fostering distorted perceptions of Shia Islamic identity (Richardson, 2004). Religious representations in media discourse play a pivotal role in state-building and sustaining social identities, particularly for religious minorities operating in secular or religiously heterogeneous environments (van Dijk, 1993).

Media discourse does not passively describe reality; instead, it constructs meaning through linguistic choices, framing devices, and discourse practices embedded in broader power relations and ideologies (Fairclough, 1995). The construction of religious identity in media has gained significance in our globalized society, where outlets wield immense influence over public perceptions of religious groups (Said, 1997). The linguistic framing of Arba'een in English-language media reflects broader patterns of religious representation and identity formation in contemporary global discourse (Karim, 2003).

This study addresses a gap in scholarship on the linguistic construction of Shia Islamic identity in global media. While extensive literature exists on mainstream media portrayals of Islam generally (Saeed, 2007), little examines rhetorical strategies in reporting Shia-specific rituals and their role in identity construction (Mottahedeh, 1985). The Arba'een pilgrimage serves as an ideal case study due to its scale, spiritual significance, and divergent media representations (Afary & Anderson, 2010).

Employing Critical Discourse Analysis (CDA) as its theoretical framework (Wodak & Meyer, 2016), this paper analyses textual, discursive, and social practices in media representations of Arba'een. CDA reveals how micro-level language choices reflect and reinforce macro-level power structures (Fairclough, 2003). Four media texts will be examined to identify linguistic framing trends and their implications for religious identity construction (Baker et al., 2013).

Aims of the Study

The study aims to:

- Investigate the lexical, syntactic, and rhetorical devices used in English-language media to frame the Arba'een pilgrimage.
- Analyze how different global media outlets (Western, Middle Eastern, and independent sources) linguistically portray the Arba'een pilgrimage.
- Explore how the linguistic framing of the Arba'een pilgrimage in English discourse influences public perceptions of Shia Muslim identity.

Literature Review

1. Islamic Media Coverage:

The study of the Islam representation in the western media has recorded trends of Orientalist discourse, securitization and othering (Karim, 2003; Said, 1978). The theoretical underpinning of the analysis of the Western media reproduction of the Islamic Other through language and cultural tropes was provided by Edward Said (1978) in his seminal work Orientalism. This model has influenced the current research that explores how the media has framed Islamic practices as tools of power systems and cultural subordination (Mamdani, 2004; Morey & Yaqin, 2011).

In the linguistic studies of Islamic media coverage, a similar set of discursive patterns is observed. The study by Poole (2002) of the British newspapers and the study by Richardson (2004) illustrates how the lexical and metaphorical choices (e.g., radical, fanatic), narrative patterns frame Islamic practices as alien, threatening or incompatible with Western secular values (see also Baker et al., 2013). These kinds of strategies create a binary opposition to Islam and the West, which strengthens cultural and ideological boundaries (van Dijk, 1993).

The media studies also point to the tendency to view Islamic religious events (the pilgrimages, festivals, and rituals) through a secular western prism, focusing on the spectacle, the number of people, or the security threat rather than the spiritual or cultural meaning of the event (Esposito & Kalin, 2011; Eide et al., 2008). This reductionism can be seen as a part of a wider tendency in the Western media to reduce complicated religious phenomena to sensationalized stories, which fit into the already established ideological frameworks (Saeed, 2007; Rane et al., 2014).

It is important to note that there is very little attention given to media reports on Shia Islamic practices in scholarship. Although Islam has been studied through the lens of the Sunni-centric portrayals (Mottahedeh, 1985; Afary & Anderson, 2005), linguistic constructs of Shia rituals including their sidelining or distortion have received little attention (Nakash, 2019; Szanto, 2018). Given that it is one of the most significant Shia religious events, the Arbaeen pilgrimage provides a discerning case study to explore these representational gaps and their consequences on Shia identity construction in the global discourse (Aghaie, 2004; Rahimi & Gholami, 2017).

2. Power Relations in Religious Media Discourse:

The connection between media representation and power relation in case of a religion discourse has been well theorized in the discourse critique studies. Media institutions have certain social, political, and economic backgrounds that determine their representational functions and ways in which the religious groups will be represented to the general society. These power relations do not exist simply as external conditions but are also found in the linguistic and the discursive practices that are used in the media texts.

Critical discourse analysts have shown that media portrayal of religious groups reproduces and underpins the existing power relations and social structures. The source choice and the preferences given to linguistic frameworks as well as the underlining of the description of certain areas of religious practices have their role in the building of particular subject positions and categories of identities. Such representational decisions pose implications in the real world about the way that religious communities are conceived, understood and treated in wider social settings.

The power of discourse, which was described by Fairclough (1989) and van Dijk (1993), constitutes a theoretical framework that allows comprehending the ways of how media institutions can guide the power by using linguistic means and frames. The media agencies have immense influence to define the perception that people have on religious beliefs and people based on its choice of representation. Such power is both what is said and what is omitted, stressed and pushed to the edges of the media reports.

The studies of the religious media discourse have exposed the way power relations get operationalized within the framework of diverse linguistic strategies: exceptional wording, metaphorical patterns, narrative textures. These words are part of a general ideological stance that leads to the preserving of the existing social hierarchies. It is important to appreciate these power relations in order to understand the construction and negotiating of religious identity using media discourse.

Theoretical Framework

1. Critical Discourse Analysis (CDA):

The given research draws the main theoretical basis on Critical Discourse Analysis that offers its systematic understanding of the role of discourse as the central social practice that both represents and shapes the social reality. CDA is especially well suited to analysis of media discourse because it specifically takes up the question of the links between language, power, and ideology within textual representations. The approach understands that discourse is not neutral, rather it is unavoidably influenced and influences configurations of social relations, social arrangements, and social identities.

The critical orientation of CDA resonates with this paper to explore the way, the power relations are situated in media representation of the religious practices. According to CDA scholars, discourse analysis is not only supposed to present the linguistic characteristics but also to focus on the role of various features in reproduction or changes of social inequalities and power. Such critical attitude is important in helping to comprehend how media depictions of the pilgrimage of Arba in the realm of religion manifest and reproduce, on a more general scale, patterns of religious marginalization or legitimization.

CDA has been described as a rather multidisciplinary approach which relies on linguistic, sociological, psychological, and political sciences in order to offer a broad framework of discourse analysis. This discursive approach opens the possibility to study linguistic matters in greater contexts of social and cultural backgrounds which furnish an understanding of how a decision of texts can reflect as well as create social relationships and social identity. The methodology is especially helpful in the study of religious media discourse that functions on the boundary of the linguistic, cultural, and ideological systems.

The radical nature of CDA conforms with the objective of this study that aims not only to describe the media representations but also aspire to bring about a more critical comprehension of how the representations themselves operate in the society. The combination of speaking about how choices in language help build religious identity can help improve media coverage of religious practices and religious people generally, by making it more balanced and sensitive.

2.Framing Theory in Media Studies and It's Application to Religious Coverage:

Framing theory is another supporting theory to the above discussion aimed at explaining the influence of media representations on meaning and the comprehension of the masses. Framing theory, which originated as described by Goffman (1974) to be subsequently adopted in the field of media studies by others like Entman (1993) or Gitlin (1980) analyse how the media texts are structured and presented to inform and lead to specific interpretations and knowledge of events and issues.

Framing theory has been used in the study of religious media coverage by the provision of explanation on the manner in which media bodies choose, highlight and contextualize facts on religious beliefs and practices as well as religious groups. Such framing views are not impartial but indicate special ideological standpoints and cultural assumptions concerning religion, spirituality and cultural distinction. Frames used in coverage of the media is vital in the perception and interpretation of the audiences on religious practices and communities.

The collection of religious media framing researches has made it evident that there are a few frames which are used frequently in the coverage of the Islamic practices and communities. They constitute the security frames,

which focuses on the issue of threatening security or conflicts, the cultural frames, which refers to the Islamic practice as foreign or exotic and the political frames, which conceptualizes religious practices as being related to a larger geopolitical situation. All these frames create various implications and connotations towards the interpretation of religious identity and community.

Applying the framing theory in the study of the coverage of Arba'een pilgrimage shares the possibility of identifying certain framing strategies as well as their consequences in terms of constructing religious identity. In analysing the presentation of the pilgrimage in scale, significance, cultural context, and political implications, an analysis will be able to determine patterns in the practices of representations processes and its implications on the cognition of the general population on Shia Islamic identity.

3.Identity Construction Through Language:

Language is central to the development and sustenance of social identities of which religious identity is included. With the help of choices of language usage, individuals and institutions place people in specific categories of identities and social relations. Language in the study of identity is a more significant aspect in the analysis of discourse especially in analysing how identities of minorities are constructed and negotiated in media discourse.

The construction of religious identity using language deals with several linguistic practices beginning with the level of use of language including word choice, syntax to wider narrative patterns and discursive practices. The depictions of religious activity in the media are used to create a religious identity by the contextualizing religious groups in specific cultural and social contexts, making some aspects of the religious process central and others peripheral, and institute relations between religious and worldly orientations.

The formation of the religious identity through media discourse is even more complicated in case of the religious minority groups working within the domains of rather secular or of a different religious environment. The representational media can be regarded as one of the main sources of knowledge about religious practices to the audience unfamiliar with specific traditions, and thus, the language decisions, which these media use, can be considered especially important to the construction of an identity and a perception of a community.

The study of the construction of religious identities has shown that the linguistic means of categorization, comparison, and evaluation are involved in the process of the positioning of religious groups within the wider social hierarchies. These discourses are not inert, they index, and promote, what already exists in terms of cultural assumption and power relations about religious difference and legitimacy.

4.Fairclough's Three-Dimensional Model:

The three-dimensional model that Fairclough offers has a thorough structure of discourse analysis which involves the discourse by text, discourse in discourse practices and discourse in social practices. The model is especially appropriate to use in the analysis of media discourse because it makes it possible to investigate the linguistic properties in the context of their expansive production, distribution and consumption.

Textual level of Fairclough model depicts the study on usage of linguistic features in a textual context such as vocabulary, grammar, cohesion, and structure of a text. The focus of such a level of analysis is the analysis of how specific elements of language are used to create meaning as well as discourse positioning in regard to subjects. Textual analysis, which is one of the approaches used in media analysis, entails analysing

how such linguistic features as metaphor, transitivity, and modality have been used in representing religious practices and religious communities.

A dimension of discourse practice analyses the situations of the production, distribution and consumption of the text. This analysis looks at the production conditions of media texts based on specific institutional settings, the distribution of media texts to the audience, consumption and interpretation of media texts. In the case of the religious media discourse, this dimension is concerned with the style of representation of the religion acts by means of the analysis of the editorial policy, the work of journalists and readers that determine the direction of the text.

The social practice dimension is dealing with the larger scope of social and cultural practice in which discourse takes place. This is the level at which the connection between discourse practices and other social structures as well as power relations and ideology systems is analysed or examined. In the case of Arba'een pilgrimage coverage, such dimension means analysing the representation of the media in terms of its contribution to or reflection of more general processes of religious marginalization or legitimization in the contemporary globalized society.

Data Analysis

The data analysis section examines four media texts covering the Arba'een pilgrimage, applying Fairclough's three-dimensional model to understand how linguistic framing constructs religious identity. Each text is analysed for its textual features, discourse practices, and social practices to reveal patterns in religious representation and identity construction.

1. Analysis of Text (1):

“Millions of Shia Muslims converge on Iraq's Karbala for Arba'een pilgrimage, one of the world's largest religious gatherings. The annual commemoration draws pilgrims from across the globe to honour the martyrdom of Imam Hussein, grandson of the Prophet Muhammad, who was killed in the Battle of Karbala in 680 AD” (Reuters, 2023).

Textual Analysis: The use of quantitative modelling in the first sentence is highlighted by a reference to millions and both in itself and following in the body text creates the first point of content-scale as the overriding index of newsworthiness. The word converge indicates a synchronized march towards a denouement which brings to mind the idea of mass mobilisation which might cause fear of insecurity among the western viewers. The uses of the phrase to label the event as one of the largest religious gatherings in the world put it in the international comparative context and not based on its spirituality in the event.

The second sentence creates the historical opening by the use of such an idiom as annual commemoration that expounds on the pilgrimage as an event of remembrance rather than a living spiritual adventure. The term martyrdom is used, which conveys Western notions of sacrifice and struggle to the Islamic reader, and the historical date given, 680 AD, lends historical distance, which can imply a more distant and therefore more ancient issue, than modern one.

Discourse Practice Analysis: the discourse shows a lack of cultural background on the background of the facts tradition of a typical Western news agency. The editorial choices show themselves in the production context where the price replaces the emphasis on the qualitative dimensions of spiritual manifestations as something inconsequential and incommensurable to the number and the date. The dissemination by the means of the international news wires implies a reading audience that does not know about Islamic practices, necessitating the explanatory framing putting emphasis on the pilgrimage as an alien cultural practice.

Social Practice Analysis: The language selections point to wider patterns in the mainstream media west to portray the Islamic ways of life through worldly concepts whereby primacy is given to natures that are visible to the naked eye than those that are spiritual. The rhetoric of scale and distance in history portrays the pilgrimage as a mass movement based on primordial wars instead of taking place in the modern religious life. It is a part of framing that is a form of othering of the Shia Islamic identity because this framing presents the practice as something dissimilar to the western-religious or secular commemorative practices.

2. Analysis of Text (2):

“The massive pilgrimage sees devotees walking for days from across Iraq and neighbouring countries, creating an extraordinary display of faith and endurance. Security forces have been deployed to ensure the safety of pilgrims as they make their way to the golden-domed shrine of Imam Hussein” (BBC News, 2023).

Textual Analysis: Massive is used as an adjective that supports the framing on scale, whereas devotees places participants on the level of the religious person opposed to the active spiritual person. The mention of

walking days indicates physical difficulty in pilgrimage and is a sign that appeals to the western appeal of religious adherence in terms of physical toughening. The phrase, extraordinary display of faith, makes the pilgrimage look like a show to watch, rather than a religious exercise to partake in.

The second line brings in security rhetoric with security forces have been deployed which slates the pilgrimage under western discourse of security in covering Islamic events. The use of such orientalist descriptive language as golden-domed shrine that stresses on architectural exoticism and the mention of Imam Hussein who brings out the more personal nature of religious individuality to the Western audiences are all included in the phrase.

Discourse Practice Analysis: Editorial policy of the BBC is based on the traditions of the public service broadcasting which aims at informing the viewers about what is happening in the world and at the same time keeping culturally aware. The linguistic decisions, however, have some underlying assumptions on the knowledge of the audience and cultural positioning. The production environment brings about editorial choices in the decision between informational content and the accessibility to the western public not at all familiar with Islamic practices.

Social Practise Analysis: The text is reflective of Western media general trends to define Islamic occurrences as the physical hardiness and security images. The stress on the visual experience of mass pilgrimage makes it formulate the Shia Islamic identity as an embodied and public entity instead of a spiritual and internal experience. The security framing contextualises the pilgrimage in terms of possible unrest, a part of existing Western uneasiness regarding Islamic events and gathering, and their social impacts.

3. Analysis of Text (3):

“The Arba’een pilgrimage represents a powerful demonstration of Shia unity and resistance, with participants often chanting slogans commemorating Hussein’s stand against tyranny and oppression. The event has taken on increased political significance in recent years, particularly in the context of regional sectarian tensions” (Al Jazeera English, 2023).

Textual Analysis: The part of the text that creates the pilgrimage as a political exercise instead of a pure spiritual activity is the term powerful demonstration. The notion of unity and resistance brings invariances of political terms to define the identity of Shia Islamic being, and such terms are constituted in the paradigms of group and resistance. The mention of the slogans being chanted polarizes the religious expression into political agitations, whereas the mention of Hussein standing up against tyranny and oppression framed the historical figure as political revolutionist instead of a religious figure.

By making the pilgrimage politically significant and sectarian tense, the second sentence clearly politicizes the religious practice by rendering it into terms of conflicting and divisive poles. It characterizes Shia Islamic identity within the discourse of threat and sets up a political existence thus, posing danger to regional stability.

Discourse Practice Analysis: The editorial style of Al Jazeera shows strong cultural orientation of the organization as a Middle Eastern news channel that is more acquainted with the Islamic cultures and the context of the region as compared to Western cultures. An aspect of the context of production recommended by the editors to make political aspects of religious practice central to their creation is that the network was more concerned with political processes in the region. On the level of linguistic choices, pre-assumptions of the knowledge of the audience regarding the sensory Islamic history and the modern Middle East politics are made.

Social Practice Analysis: The excerpt is representative of general trends in Middle Eastern coverage that pay special attention to political aspects of religion. The work of the pilgrimage into a political demonstration places the Shia Islamic identity within the discoursed space of resistance and opposition, which can naturalize the existing stereotypes around Islamic practices as overtly political. This framing includes the securitization of the religious identity by implying the political threat of spiritual practice.

4. Analysis of Text (4):

“For many pilgrims, the journey to Karbala represents a profound spiritual experience, offering opportunities for reflection, community bonding, and renewal of faith. The pilgrimage embodies core Islamic values of sacrifice, compassion, and social justice, connecting contemporary believers with foundational religious principles” (The Guardian, 2023).

Textual Analysis: The identity of the pilgrimage as a very spiritual experience is placed under debate with the help of the phrase; profound spiritual experience. The phrasal concepts of reflection, community bonding and renewal of faith give a precedence to internal spiritual aspects rather than outside the political connotations. The mention of the so-called core Islamic values places the pilgrimage in universalistic religious categories instead of sectarian ones.

It is in the inclusive use of language (contemporary believers and founding religious principles) in the second sentence that a seventh feature is assembled linking the past religious practice to the present. Not only do inscriptions on Islamic values translate into understandable Western terms but also hold onto the authenticity of the religion due to their values of sacrifice, compassion and social justice.

Discourse Practice Analysis: The editorial policy of the Guardian was influenced by the liberal Western traditions in the media industry that inherently means paying attention to cultural understanding and religious

tolerance. The production environment implies the editorial approach to relate culturally sensitive content with the focus on spiritual rather than political aspects of religious practice. The language used displays expectations of readers in the religion experience and culture variety.

Social Practice Analysis: The text also shows the wider trends of liberal Western media which strives to frame the Islamic practices in a positive way but not to lose the accessibility in front of the Western observers. The focus on the spiritual aspect defines the Shia Islamic identity as able to meet western notions of personal religion and equality. This characterization reminds part of the humanization of Islamic thought, as it introduces them to a universal context of spiritual pursuing and moral devotion.

Conclusion

The analysis of four emblematic Englishlanguage news reports—Reuters, BBC News, Al Jazeera English, and The Guardian—demonstrates that media language does far more than convey information about the Arba‘een pilgrimage: it actively constructs, negotiates, and legitimizes Shia Islamic identity. Western agencies repeatedly mobilize quantitative metrics and security rhetoric, framing the pilgrimage as a mass spectacle necessitating logistical oversight; this emphasis on numbers and control overshadows the event’s profound spiritual dimension and perpetuates a narrative of Shia practice as an ‘other.’ Middle Eastern portrayals foreground political resistance and communal solidarity, linking the ritual to broader sectarian power dynamics. Liberal Western outlets, while reintroducing values such as compassion, sacrifice, and social justice, nonetheless confine these discourses within familiar cultural schemas, thereby perpetuating residual orientalist assumptions. Across all cases, lexical choices (e.g., “massive,” “spectacle,” “resistance”) and framing devices at the discursivepractice and socialpractice levels reveal how power relations imbued in language either marginalize or humanize minority religious identities.

Interpreted through the lens of Fairclough’s threedimensional model, these findings validate and extend the study’s guiding hypotheses: linguistic framing functions as a vehicle for ideological positioning, reflecting and reinforcing entrenched cultural biases. At the textual dimension, recurrent metaphors and modality choices reveal evaluative stances; within discourse practices, editorial policies and distribution channels shape which narratives gain prominence; and, at the social level, media representations intersect with historical and geopolitical power structures to produce socially consequential perceptions. Theoretically, this integration of Critical Discourse Analysis and framing theory offers a robust framework for examining how microanalytic textual features scale up to macrolevel societal effects.

From a practical standpoint, the research underscores the imperative for media organizations to adopt reflexive editorial guidelines: integrating spiritual narratives alongside logistical details; ensuring balanced source selection, including voices from Shia communities; and critically interrogating security and politics-oriented tropes. Journalists and editors might establish partnerships with religious scholars to contextualize cultural specificities, thereby mitigating misrepresentation. Furthermore, media literacy initiatives—targeted at both producers and consumers—can foster critical awareness of framing devices and promote more nuanced public discourse.

Despite its contributions, the study has limitations. The selection of four outlets within a single year constrains generalizability; moreover, the exclusive focus on Englishlanguage print and online reports omits audiovisual and socialmedia forms where multimodal framing may operate differently. Future research should expand the corpus both longitudinally and across languages, investigate audience reception to framing strategies, and explore the interplay of textual and visual framing in digital platforms. Such efforts will deepen understanding of how media discourses shape religious identities in an increasingly interconnected global public sphere.

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The Arba'een Pilgrimage Experience: A Sensory Anthropological Perspective

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Abstract

This article examines the Arbaeen pilgrimage through the lens of sensory anthropology, highlighting how sensory perception—particularly taste, touch, smell, sight, and hearing—plays a central role in shaping the embodied religious experience of pilgrims. Drawing on ethnographic fieldwork and in-depth interviews with pilgrims and service volunteers (khādimīn) in Iraq, the study investigates how ritual food functions not only as nourishment but as a powerful medium of spiritual, social, and cultural significance. Through a multisensory approach, this research shows that the sacred is not only represented in religious texts and spaces but also felt, smelled, tasted, and heard in everyday ritual practices.

The article argues that the preparation, offering, and consumption of votive food is a central ritual act that mediates intersubjective connections among participants, rooted in deeply held beliefs about divine presence, intercession, and sacred reciprocity. Sensory modalities become symbolic carriers of memory, meaning, and identity, rendering the pilgrimage a site of both spiritual intensification and social cohesion. The analysis is grounded in theoretical contributions from David Howes, Constance Classen, Sarah Pink, and Éric Landowski, providing a robust interdisciplinary framework to understand how religious experiences are embodied, mediated, and communicated through the senses.

Keywords: Sensory Anthropology, The Arba’een Pilgrimage, Embodiment, Ritual Food, multisensory experience.

Introduction

As the philosophical principle states, “Whoever loses a sense, loses knowledge.”(1) “The primary origin of all acquired perceptions and apparent human sciences is the external senses, which are shared between humans and most animals. Indeed, if we assume a human being deprived of all senses, they would likewise be deprived of all sciences and knowledge. And if they lack certain senses, they would lack certain forms of knowledge, for, according to this principle, the channels through which sciences emerge and the gateways to acquiring knowledge are the human senses. Thus, with the loss of any of these channels or gateways, a portion of human knowledge ceases to exist.” (Ebrahimi Dinani, 1987, 2: 435-442).

Sensory experience in encountering the sacred:

Although pilgrimage (*ziyāra*) appears at first glance as a spiritual matter—a transcendental communion with a sacred, divine presence—and sensory perception may seem peripheral to its practice, the reality is that the interaction between the pilgrim’s body and the ritual’s material space plays an active role in shaping pilgrimage rites. Indeed, pilgrimage is inconceivable in cultural anthropology studies without the bodily engagement of the pilgrim with elements such as time, space, and the external senses.

The Arba‘in pilgrimage is an *embodied* practice; the meaning of embodiment in [pilgrimage] rituals lies in revealing how we experience our surroundings through our bodies (Csordas, 1994: 10). The pilgrim’s body—or more precisely, their external senses—constitutes an inseparable component of the spiritual perception of these rites.”

The external senses and sensory perception are not merely physical responses or personal experiences; rather, the senses constitute a domain of cultural expression through which a clearer understanding of rituals can be achieved. The Arba‘in pilgrimage, as a multisensory sacred experience, provides a context in which this approach yields deeper ritual comprehension. «Understanding culture through sensory experiences – hearing, smelling, tasting, seeing, and touching – constitutes a core methodological approach advanced by sensory anthropology.»(Howes, 2003).

Main Research Question/Problem Statement:

This research, focusing on the Arba’een pilgrimage from a sensory anthropological perspective, seeks to answer the question of how sensory perceptions (especially taste, touch, smell, sight, and hearing) play a pivotal role in shaping the embodied religious experience of pilgrims, and how ritual practices, elements, and symbols act as powerful mediators in spiritual, social, and cultural realms.

Significance of the Research:

This research holds significance from several perspectives:

1.Enriching the Literature on Sensory Anthropology:

By presenting an ethnographic and phenomenological analysis of the Arba’een sensory experience, this study contributes to the growing field of sensory anthropology, advancing our understanding of how religious meaning is lived, felt, and enacted within the context of a vast and embodied ritual. Contrary to traditional paradigms that prioritize verbal and visual data, this research emphasizes a multisensory and embodied approach.

2.Deepening the Understanding of the Arba’een Phenomenon:

Moving beyond purely textual or historical analyses, this study delves into deeper and less explored layers of the Arba’een experience. By focusing on its sensory dimensions, it offers new insights into the hidden facets of this immense global ritual and the profound connection of pilgrims with the sacred.

3.Elucidating the Role of Rituals in Mediating the Sacred:

This research demonstrates that the sacred does not merely exist in texts or abstract spaces, but is felt, smelled, tasted, seen, and heard through everyday ritual practices. This contributes to a better understanding of how the sacred is mediated through materiality and bodily action.

4.Highlighting the Role of Ritual Food:

By analyzing the central role of Nazri (votive) food in the Arba’een pilgrimage, this article underscores the significance of this cultural element beyond its nutritional function. It shows that the preparation, offering, and consumption of Nazri food is a focal ritual act that mediates intersubjective connections among participants, rooted in deeply held beliefs about divine presence, intercession, and sacred reciprocity.

5.Providing an Interdisciplinary Framework:

This analysis, by drawing upon the theoretical contributions of David Howes, Constance Classen, Sarah Pink, and Éric Landowski, offers a robust interdisciplinary framework for understanding how religious experiences are embodied, mediated, and communicated through the senses.

Literature Review

In 1990, David Howes—arguably the most influential figure in the anthropology of the senses—published a seminal article titled “Controlling Textuality: A Call for a Return to the Senses.” In this critical piece, he challenged the prevailing approaches of the textual turn, postmodernism, and interpretive anthropology. Howes argued that the most essential feature of the anthropologist lies in perception and experience within the field—an emphasis rooted in the legacy of Bronisław Malinowski, the founding figure of fieldwork-based anthropology and a pioneer of ethnographic revolution.

In 1996, Constance Classen and David Howes co-authored the article “Understanding Culture: Anthropology as a Sensual Experience,” in which they demonstrated the centrality of sensory experience in three Indigenous North American cultures. They effectively illustrated how reorienting anthropology as a form of sensual understanding could profoundly transform anthropologists’ comprehension of culture.

A year later, in 1997, Classen published a foundational article titled “Foundations for an Anthropology of the Senses,” in which she introduced theoretical ideas for a new sensory-oriented turn in anthropology. These efforts culminated in what is now referred to—not merely as a “sensory turn”—but rather as a Sensory Revolution, a term used by David Howes in a 2006 article. The sensory revolution brought about a paradigmatic shift in anthropology. It no longer regarded the anthropology of the senses as a mere subfield, but rather as a full-fledged methodological and epistemological approach. This shift gave rise to the emergent discipline of sensory anthropology.

Sensory anthropology views culture and individuals as inherently sensual beings and structures. It teaches anthropologists that human presence and action within society and culture are made possible—primarily and

fundamentally—through sensory perception. Sensory perception, in fact, is cultural perception. Humans not only understand the world through the senses, but also articulate both their world and their place within it through sensory experience. Accordingly, sensory relations are cultural relations: the nature of one’s sensory relationships and the experiences that emerge from them constitute human cultural experience.

This conceptualization underpins David Howes’s definition of culture in his book *Sensual Relations* (2003), where he defines culture as “ways of sensing the world.” We understand the world in the manner in which we sense it. As he eloquently states, “The sensory order is not something we merely hear or see; it is something lived. Just as meanings are shared, so too are sensory experiences. The senses must be understood as cultural systems” (Howes, 2005, p. 3). Moreover, Howes stresses the decisive role of culture in determining the social significance of sensory attributes (Howes, 2003, p. 49). He continues to advocate for the investigation of culturally specific sensory models and the cultural representations they entail.

An insightful contribution in this vein comes from Izadi Jiran, whose article “Tasting Rituals: A Sensory Ethnography of Nazri Food in Tehran” explores the visual, olfactory, and gustatory dimensions of the diverse range of ritual foods and beverages offered during Muharram. She introduces the concept of the “foodscape” (ghazavareh), which has been instrumental and illuminating for the present author’s inquiry.

Methodology

The theoretical foundation of this research is rooted in sensory ethnography as conceptualized by Sarah Pink (2015). Pink presents a critique of traditional ethnographic paradigms which prioritize verbal and visual data, advocating instead for a multisensory and embodied approach to cultural research. According to Pink, the senses are not biologically fixed channels of perception, but culturally mediated modes of knowing, which vary across societies and social contexts.

Drawing on phenomenology, material culture studies, and non-representational theory, Pink frames the sensory as both a methodological entry point and a conceptual lens for understanding how people inhabit, interpret, and co-create their environments. She emphasizes that knowledge is not merely constructed cognitively but is lived and enacted through sensory experience (Pink, 2015, 25). As such, the body is not a passive receiver.

The current research is qualitative in nature and employs a descriptive-analytical methodology. Data were collected through three main tools: open and conversational interviews, participatory and active observation, and field notes. Eighteen interviews were conducted using purposive sampling with random selection. Thematic analysis was employed to identify and articulate both primary and secondary themes based on the lived experiences of participants.

Findings

Pilgrimage, especially the immense Arba'een walk, transcends a merely spiritual or cognitive event; it is a profoundly embodied and multisensory experience. Sensory anthropology emphasizes that our cultural perception of the world is inextricably intertwined with our senses. Within the context of Arba'een, the five senses—sight, hearing, smell, taste, and touch—are not merely passive receivers, but actively participate in shaping and enriching the pilgrims' religious experience. From the visual scenes of the Mawakeb (service stations) and holy shrines to the lamentations that fill the air, from the aroma of frankincense and the apple scent attributed to Imam Hussein's shrine to the healing taste of votive food, and from touching flags and the shrine itself to enduring the physical hardships of the walk, each of these sensory dimensions actively contributes to the production of meaning and the strengthening of connection with the sacred. These sensory interactions transform the pilgrimage into a holistic and profound act of embodied worship, where faith is lived through tangible and palpable experiences.

1. Arba'een Rituals and the Experience of Taste:

David Sutton, as the originator of the term “gustemology,” argues that:

“Given that a focus on food and the senses allows us to explore some of the most basic boundaries of inside and outside, private and public, individual and collective, this topic offers an excellent window onto that elusive notion of everyday life that anthropologists wish to understand theoretically and examine ethnographically.” (Sutton, 2010, 209).

This perspective assigns a central role to food and the senses in understanding social issues, suggesting that through taste and related experiences, one can comprehend cultural categories. As it can be said:

“Perhaps food items are among the very few things capable of embodying culture within the bodies of individuals in a society. By eating something, individuals not only consume culturally approved food (‘cultural foods’) but also experience the distinct taste of their culture (‘tasting culture’). Moreover, they consciously or unconsciously activate and internalize the meanings embedded in food” (Izadi-Jiran, 2013, 28).

In the rituals of the Arba’een pilgrimage, all participants engage with food in some form. Whether pilgrims or servers, they either consume ritual food or prepare it. Along the route from Najaf to Karbala, the mawkibs (service stations) and their guests—who dominate much of the ritual space—present a recurring image of food and drink: long, crowded queues for receiving votive meals at mawkibs, people distributing various beverages along the walking route, and throughout Najaf and Karbala. These include cold water (called “māy bārid” in the Iraqi dialect), coffee, tea, and, in recent years—given temperatures reaching 50°C—cool lemon sharbat and doogh (laban in Arabic). All of this unfolds within a richly ritualized context.

A notable example is the votive offering of water along the Mash’ay (walking route) and in various parts of Najaf, Karbala, and other pilgrimage paths—a ubiquitous sight during Arba’een. For those offering water, this act holds special sanctity, as it symbolically connects to the thirst endured by Imam Hussain (AS), his companions, and family during the sacred event of Ashura. By distributing cold water to pilgrims under Iraq’s scorching sun, they infuse this ritual act with profound spiritual meaning.

Izadi-Jiran in his article “Tasting Rituals: A Sensory Ethnography of Votive Food in Tehran,” introduces the concept of “foodscape” to analyze the appearances, aromas, and flavors of diverse votive foods and beverages in Muharram rituals. He argues:

“The foodscape constitutes a gustatory event within Muharram rituals that seeks to express and ritualize experience. It imparts a distinctive modality to rituals, rendering the acts of food-giving and food-eating inseparable from ritual practice. On another level, the foodscape possesses agency—specifically, the power to shape ritual experience. Eating, as the central act of this gustatory event or foodscape, operates as a practice that generates cognitive and affective states: from sociability to emotional attachment, from spatial presence to spatial domination, from memory recall to memory manipulation, and from externalization to internalization. Through eating, understanding emerges, and sensory connections produce knowledge. When food becomes attached to an object, place, or experience, it becomes part of that object, place, or experience. Gustatory connection ranks among the most powerful sensory linkages in both ritual and everyday contexts, as it transforms perceived food into bodily experience in its most profound and impactful form” (Izadi-Jiran, 2013, pp. 30-31).

“This experience connects with the perception of the sacred in its multiple and varied forms. From an anthropological perspective, even standing in line for food at a mawkib (ritual hospitality station) constitutes a ritual act—as pilgrims consider themselves guests of Imam Hussain (AS). As some pilgrims expressed during the author’s fieldwork interviews: ‘This is blessed sustenance (رزق متبرک) that Imam Hussain himself has prepared for his pilgrims; thus, the food contains divine light (نور), healing (شفا), and mercy (رحمت).’” (Author’s field notes).

This spiritual perspective holds even greater significance among the Iraqi people, to the extent that some consider even the leftover food of pilgrims to be sacred and blessed. Abu Ja’far, who runs a mudhif (traditional guesthouse) in Najaf, recounts that he and his family dry the leftover rice from the meals of the pilgrims of Imam Hussain (AS) and store it until the

following Arba'een. His wife then adds these dried rice grains to their daily meals so that they may “host Aba Abdillah (Imam Hussain) at their table every day” and partake of the blessed food. He and his family believe this food has healing properties and even administer it to the sick as a remedy.

The taste and flavor of this ritual food—consumed within a sacred and ritualized space—are incomparable to ordinary everyday meals. The lived experience of the devout testifies to the distinct taste of this blessed food, revealing even broader dimensions of its spiritual significance. One of the mawkib servants, who believed Imam Hussain’s food to be a source of healing, recounted:

“Two years ago, we hosted a Shi’a pilgrim from America. After returning home, he contacted us and shared his story: initially, due to concerns about hygiene in some mawkibs, he had hesitated to eat the votive meals. Yet, he did not deprive himself of this sacred ritual food and partook in meals at various mawkibs throughout his journey. Upon returning to his country and undergoing medical tests, he discovered that a rare illness that had plagued him for years had completely disappeared. He attributed his healing to the votive food, experiencing a profound connection with the sacred through this ritual nourishment.”

While standing in an overcrowded food queue at the Atabat Alawia (the sacred precinct of Imam Ali (AS)) in Najaf, I conversed with a young female engineering student from Tehran. When I inquired why she endured the long queue under the scorching sun, she responded - while counting prayers on her tasbih:

“This food contains divine light (nūr) - it is light itself! One must partake of this blessed food to illuminate their heart. You’ll never find this taste in any restaurant because we believe in its baraka (blessing). We

believe the Imam is our host, and this shrine food enlightens our hearts, purifying us before we visit Imam Hussain. I never queue anywhere - not even at the university cafeteria - but I'll stand here for hours because this is the food of Amir al-Mu'minin (Imam Ali). Insha' Allah this will become my rizq (sustenance), because if it doesn't, it can't truly nourish..."

At the "Yale Umm al-Banīn" mawkib in Karbala, I observed women carefully preserving leftover bread as sacred souvenirs. They firmly believed these blessed remnants could heal the sick, demonstrating how votive food transcends material nutrition to embody spiritual value. As Izadi-Jiran observes:

"Foodscapes are so potent they don't just feed people - they transform entire spaces into gustatory experiences. Ritual systems employ foodscapes (or gustatory events) for their efficacy, sometimes becoming entirely gustatory phenomena themselves" (2013, 43).

Ritual Food as the Central Ritual Act among the People of Iraq

Food constitutes a fundamental element in the structure of both material and spiritual culture across all human societies. Due to its special status, many ritual practices and symbolic actions revolve around food. Ritual foods, beyond their earthly and material dimension, possess a sacred and transcendent quality. In various cultures, ritual food serves as a medium for connecting with the metaphysical realm. It is not confined to any single religion, sect, or geographic location. Numerous examples from around the world demonstrate that such foods function beyond the basic act of nourishment, carrying spiritual, religious, and social significance.

Moreover, food acts as a bearer of meaning within the realm of social relations and religious beliefs and practices. As a cultural phenomenon, food is not merely a biochemical substance; rather, it is a signifier of social bonds. In every society, the act of offering food or drink often symbolizes love,

affection, or friendship. Accepting such an offer signifies the recipient's acknowledgment and positive response to these sentiments. Conversely, withholding food—such as a mother disciplining her child—or refusing an offer of food in a culturally meaningful context can express anger or hostility. In this sense, rejecting food may symbolize a rejection of love or friendship, or an indication of animosity toward the offeror (Foster & Anderson, 1980).

During the Arbaeen pilgrimage, one witnesses an extraordinarily vast distribution of free food within a ritual context. One of the central cultural functions of this massive event is the deep social bonding it fosters between the nations of Iran and Iraq. These two countries, which endured the bitter experience of an eight-year war and the resulting political and social ruptures, now find themselves united in solidarity and empathy through such collective ritual acts.

Social semiotics holds that the world around us is structured as a network of meanings, and it is essential to uncover the values embedded within it. This field of knowledge examines meaningful human actions within specific cultural and social contexts and elucidates how meaning operates in practice. In essence, it highlights the social dimensions of meaning as it emerges in the interplay between individuals and society. Various communicative modalities—visual, auditory, sensory, perceptual, and more—serve as media through which individuals engage and connect within the social sphere (Aṭhari-Nik, 2022, 34).

According to the principles of socio-semantics as articulated by the Paris School, which emphasizes generative rather than merely descriptive semiotics and focuses on the processes of meaning production—three essential components must be considered in the semiotic analysis of food (Park, 2001, pp. 76–78): first, the production and presentation of food and the emergence of a particular taste or flavor; second, the pragmatic function of food in gen-

erating a sensory experience for the eater; and third, the social-cultural communicative capacity of food, which plays a pivotal role in shaping meaning.

The first and most basic aspect in the discussion of ritual food is the pleasure of eating and drinking, which relates to the gustatory experience already addressed. However, from an anthropological perspective, what holds greater significance is the role of belief as a modality in attributing cultural value to ritual food. For example, in a mawkib kitchen in the city of Karbala, it is explicitly stated that performing ablution (wuḍūʿ) is a prerequisite for preparing votive food. According to the belief of the mawkib volunteers, “this kitchen belongs to Imam Husayn, and therefore, one must enter it in a state of ritual purity, as the Imam is present and watching over us.”

Likewise, it is frequently observed that the prepared votive meals are decorated with inscriptions such as “Yā Ḥusayn” and “Yā Zaynab.” Beyond their aesthetic appeal, these inscriptions reflect the operation of belief as a modal value, shaping the symbolic and spiritual dimensions of food. Additionally, for many of these practitioners, reciting Ziyārat ‘Āshūrā’ or listening to elegiac recitations (maddāhī) while cooking becomes a form of embodied spiritual experience, where devotional acts and culinary labor converge into a unified ritual performance.

According to Éric Landowski, the French social semiotician, meaning is not produced solely within linguistic systems but is instead constituted through social interactions and lived experiences. By emphasizing elements such as presence, situation, sensory perception, and interaction, Landowski argues that the understanding of meaning emerges as a felt dimension of existence. The subject becomes meaningful and present through engagement with the world, through social practices and lived experience (Landowski, 2004, 35).

From this perspective, ritual food functions not merely as a symbol, a social contract, or an object within mourning ceremonies, but as a meaningful medium in which religious value is implicitly embedded within its deeper layers. This kind of food affects not only the physical body but also influences the emotional and perceptual dimensions of the individual. Within the mourning or pilgrimage community, an intersubjective relationship is established between individual pleasures, such as the act of eating, and the collective emotional and cultural fabric of that society. In this discursive space, sensation is transformed into perception.

Ritual food, then, serves as a medium through which affective and intimate connections—a shared emotional resonance—are created among individuals. Its virtue, however, does not lie in the materiality of the food itself but rather in the network of meanings and relationships it engenders. In the domain of votive food (*nazri*), the sacralization of time and space becomes a key criterion of value. These temporal and spatial coordinates, imbued with religious significance, transform the food into a sacred object. Within this ritual context, the pragmatic subject is the agent who bestows meaning upon everything, rendering food not merely functional but inherently meaningful.

The question of why food assumes such a central and expansive role during the *Arbaʿeen* rituals is one often emphasized by critics of these practices. However, based on the author’s extensive and in-depth ethnographic conversations with Iraqi hosts, an understanding of their lived experience reveals a multiplicity of embedded meanings and intentions. These include: serving the mourners as a means of spiritual proximity or heartfelt connection to Imam Husayn; seeking intercession (*shafāʿa*); offering drinks in remembrance of the thirst suffered by the ritual figures of the Karbala event; feeding the pilgrims on behalf of the *Ahl al-Bayt*,

especially in symbolic reference to their return to Karbala in captivity on Arba'een; showing empathy with the Imam's family in a paradigmatic mythical tragedy; attaining a sense of spiritual tranquility through ritual participation; fulfilling vows (nadhr), and transferring the merit (thawāb) of the act to deceased loved ones as a form of posthumous benevolence.

In Iraqi maḍyafas—which are often humble rural homes with very limited resources—lavish meals are nonetheless prepared for pilgrims. The host endeavors, within the constraints of their means, to offer the best possible hospitality, precisely because the food is attributed to a sacred figure, namely Imam Husayn. Within the lifeworld (Lebenswelt) of the host, this act of hospitality is seen as a delegated gesture on behalf of a sacred and spiritual figure, forming the axis and logic of the offering. Accordingly, Iraqis hold the belief that “lā sarf fī al-ḍayf” —there is no extravagance in hospitality—emphasizing that such service is never considered excessive. In most cases, this generosity is made possible only through long-term family savings, accumulated over the course of the year for this very purpose.

2.Arba'een Rituals and the Haptics of the Sacred:

Beyond the sacred foodscape and gustatory experience in Arba'een rituals, the other senses of pilgrims and servants also play a vital role in this spiritual journey. The deliberate infliction of hardship and pain upon the body, through acts such as sineh-zani (chest-beating), latm-zani (self-flagellation on the head), zanjir-zani (chain self-flagellation), carrying, large and often heavy flags during the pilgrimage, weeping, the immense labor of setting up and maintaining mawkibs (service stations), preparing food, and enduring grueling 24-hour work shifts for over twenty days—constitutes a defining feature of Arba'een rituals.

Abbas Sarraf, a servant at the mawkib of Toronto’s pilgrims, recounts the paradox of exhaustion and transcendence: “There are 150 of us working in three shifts—50 per shift. Since morning, I’ve only prayed Zuhr and lay down for 10 minutes before returning to work.”

Interviewer: “You must be exhausted. Don’t you feel tired, Mr. Sarraf?”

Sarraf: “My body is exhausted from the workload, but I don’t feel tired... not at all. Today, I was extremely fatigued by afternoon [when the interview took place]. A colleague handed me a sandwich, and as I took the first bite, I realized I was nearly fainting from hunger—I’d eaten nothing all day, only drinking water and sharbat...”

Through ethnographic documentation, the author has recorded numerous instances where *mawkib* and *mudhif* servants subsist on mere minutes of sleep per day while maintaining continuous service to pilgrims. This extraordinary state of wakefulness is interpreted through a theological framework where:

A. Bodily Depletion as Spiritual Capital

- The physical toll of 20+ hour workdays is transfigured into quwwat rūḥiyya (spiritual strength).

B. The Alchemy of Suffering

- Hardship undergoes sacralization through what pilgrims term ināyat al-Imam (the Imam’s grace).
- Exhaustion becomes ṭāthir al-nafs (soul’s purification), paralleling Sufi concepts of riyāḍa (spiritual discipline).

C. The Haptic Liturgy of Service

- Calloused hands and aching feet become ritual instruments.
- The body transforms into a medium for experiencing sacred presence.

The haptic perception of pilgrims plays a significant role in various ways during the Arbaeen mourning rituals. A clear example of this is the heat exhaustion, foot pain, and blisters experienced during the long pilgrimage walk—a form of voluntary suffering intertwined with spiritual pleasure. Notably, some pilgrims walk barefoot as a sign of reverence for Imam Hussain (AS) and to empathize with the suffering of the captives of Karbala, enduring physical hardship in solidarity with their ordeal.

On the other hand, Iraqi volunteers (khādimīn) enthusiastically strive to serve these pilgrims, tending to their blistered feet, dusting off their clothes and bodies, and offering massages to alleviate their pain and fatigue.

Izadi-Jiran writes about the involvement of senses in the ritual space of Muharram:

“Even the visual space of Muharram, largely dominated by the black of clothing and flags, casts a melancholic mood over the collective psyche, ensuring that the weight of grief is felt by all. Yet, in contrast to this visual and tactile suffering, there lies the sensory pleasure of taste and smell. The sacred and ritual elements, when external to the individual or on the surface of the mourner’s body, are experienced as sorrowful and oppressive. However, when spiritual energies are meant to permeate the individual inwardly, they are experienced as pleasurable. Thus, the senses of taste and smell represent the pleasurable dimension of ritual, while sight and touch embody its painful aspect. Witnessing sorrowful scenes and the color black, the burning of tearful eyes, carrying heavy standards (‘alams or rayat), and long processions—all these sensory perceptions inflict pain and discomfort, compelling the individual to endure sensory suffering. This serves both to align them with the ritual’s gravity and, ultimately, to achieve a form of spiritual catharsis (2013: 39–40).”

Moreover, the tactile engagement with sacred icons—flags, symbolic objects like the cradle of Ali Asghar (AS), the panja (hand emblem), blessed green cloths, the shrine (zarīh), and the soil (turbah) of Imam Husain (AS), as well as the act of kissing them—all function as mediums for transmitting the perception and experience of the sacred to pilgrims.

3.The Rituals of Arbaeen and the Sense of Smell:

The sense of smell has always been one of the most important human senses in both material and spiritual perception. Beyond its functional role in environmental adaptation, smell gives meaning to human life. The human mind constantly seeks to analyze and categorize its surroundings, and through smell, it unconsciously distinguishes and classifies places and people. Scent can serve as a criterion for creating such distinctions. Moreover, since smell conveys deeper impressions than sight or sound, it forms powerful memories, such as the recollection of a past experience triggered by a specific fragrance.

Alongside the taste of ritual food, the aromatic richness of various dishes, the fragrance of frankincense and wild rue (esfand) that permeate the ritual space, and the sacred scent of the shrine must also be acknowledged. These olfactory elements deeply engage the pilgrims' senses, contributing to the multisensory experience of Arbaeen.

The sense of smell evokes pleasant or unpleasant emotional responses in humans. When encountering a new food or environment for the first time, the initial sensory engagement is often through smell, which imprints the new experience into memory. This olfactory trigger can instantly transport individuals back to cherished moments of the past—an effect experienced even more profoundly in sacred spaces.

Since ancient times, it has been customary to fragrance holy sites with spiritually uplifting scents such as perfume, rosewater, musk, ambergris, oud, esfand (wild rue), and frankincense. These aromas serve to purify and sanctify sacred spaces, as pleasant fragrances enhance the spiritual atmosphere of worship.

A deeply rooted Shi‘i belief holds that the shrine of Imam Husayn (AS) emits a uniquely cool and soothing fragrance reminiscent of apples. Devotees who visit the martyrdom site (qatl-gāh) or approach the sacred shrine (darīh) at dawn often report perceiving this distinct apple-like aroma. This belief is so pervasive that it has been poetically immortalized in Persian devotional literature, with multiple poets referencing the “scent of apples” emanating from Imam Husayn’s (AS) shrine.

This tradition originates from a ḥadīth narrative preserved in classical Shi‘i sources. The account relates that one day, Imams Hasan and Husayn (AS) visited the Prophet Muhammad (SAWS), where they encountered the archangel Gabriel (Jibrā’īl) in the earthly form of Dahīya al-Kalbī. Gabriel carried heavenly fruits—apples, pears, and pomegranates—which he presented to the two grandsons of the Prophet. Overjoyed, they ran to their grandfather, who smelled the fruits before instructing them to share the bounty with their parents. The family of Imam Ali (AS) abstained from consuming the fruits until the Prophet (SAWS) joined them for the blessed meal. Miraculously, the fruits replenished themselves as they were eaten, maintaining their quantity until the martyrdom of Lady Fāṭima al-Zahrā’ (AS), when the pomegranate disappeared. Following Imam Ali’s (AS) martyrdom, the pear too vanished, leaving only the apple until Imam Husayn’s (AS) final moments.

Imam Husayn (AS) testified: “This apple remained with me even during the siege when water was denied to us. Whenever thirst overcame me, I would smell it and my thirst would abate—until my suffering intensified and I became certain of my impending martyrdom, at which point I consumed it.” Imam Zayn al-‘Ābidīn (AS) later narrated: “My father uttered these words moments before his martyrdom. When he fell, the scent of apples permeated the battlefield. I searched for the fruit but found nothing, though its fragrance lingered. Later, when I visited his grave, the same apple scent emanated from it.” The ḥadīth concludes with this remarkable promise: “Any sincere Shi‘a who visits Husayn’s (AS) shrine at dawn should seek this apple fragrance—if they come with pure intention, they will indeed perceive it” (Majlisī, *Biḥār al-Anwār*, 1403 AH, 43:289).

This olfactory miracle serves multiple theological functions: it authenticates the sanctity of the shrine, confirms the spiritual connection between the Imams and their followers, and transforms the act of visitation (*ziyāra*) into a multisensory experience where the metaphysical becomes physically perceptible to the faithful. The recurring apple motif—from the celestial fruit to the battlefield aroma and finally the shrine’s perpetual fragrance—creates a tangible link between Imam Husayn’s (AS) earthly suffering and his eternal presence as an intercessor.

Nevertheless, it is evident that the sense of smell possesses such potency that it extends into abstract domains of pilgrimage and conceptualization within the realm of culture and beliefs. This is clearly manifested in how pilgrims and custodians speak of this “spiritual olfaction,” describing their experience as perceiving “the fragrance of Paradise” along the path of Husayn (Tariq al-Husayn). Some characterize this metaphysical atmosphere through expressions like “the scent of angels” or “the divine perfume.”

A noteworthy observation emerges from Sufi literature, which contains numerous references to the mystical states of Uways al-Qarani and his spiritual olfaction. Among these accounts circulates a famous hadith attributed to the Prophet Muhammad (PBUH): “I perceive the fragrance of Paradise coming from the direction of Yemen” (Furuzanfar, 2008, 73). Rumi, in his *Mathnawi*, has alluded to this very narrative.

4.Arbaeen Rituals and the Sense of Sight:

As previously discussed, the interaction between the pilgrim’s body and the material-ritual space plays a fundamental role in shaping pilgrimage practices. The Arbaeen pilgrimage, as an embodied ritual experience, is deeply intertwined with basic human senses, particularly sight. Throughout the walking journey (*mashāya*), the pilgrim visually engages with all components of mourning rituals. The black-clad mourning tents (*mawākib*), guesthouses (*maḍāyif*), sacred shrines, and the attire of mourners collectively evoke an overwhelming sense of grief. However, as participants themselves describe, this grief is not bitter or agonizing; rather, it differs fundamentally from worldly sorrow. It purifies their hearts, preparing them to connect with Imam Husayn (AS) and opening them to the spiritual joys of pilgrimage.

Moreover, the visual encounter with symbolic objects along the path—such as the cradle of Ali Asghar (AS), reenactments of Imam Husayn’s (AS) martyrdom (known as “*shabīh*”), and processions depicting the captivity of the Ahl al-Bayt (AS)—plays a crucial role in transmitting spiritual perceptions. Many *mawkib* organizers deliberately stage these visual elements, embedding them with ritual significance to materialize religious emotions. This visual dimension itself becomes a ritual act, reinforcing the sacred narrative through embodied observation.

5. Arbaeen Rituals and the Sense of Hearing:

Lamentations (nawha) and mourning melodies have always served as fundamental pillars of Shi'i mourning traditions, honoring the martyrs of Karbala. These historically rooted chants, with their profound emotional impact, facilitate the transmission of spirituality and enable participants to experience the sacred. In traditional mourning rituals (rawda khwani), musical instruments were generally absent except in mourning processions, and even then, only specific instruments like drums were permitted. However, with the expansion of mass media, the proliferation of audiovisual technologies, and the transformations of the modern era, the integration of music with religious eulogy (maddahi) has emerged as a new phenomenon. This development, while innovative, represents a departure from indigenous practices and creates dissonance with traditional structures.

During the Arbaeen season, mourning processions (hey'ats) maintain a continuous state of lamentation and spiritual connection with Imam Hussein (AS) from the moment they begin their journey toward Karbala. Nearly all mawkib (stations) are equipped with sound systems broadcasting various forms of lamentation poetry (nawha) in Arabic, Turkish, Persian, and other languages. The loudspeakers remain active almost 24/7, though their volume decreases significantly during late-night hours.

The auditory landscape—comprising recitations of Karbala's tragedies, the rhythmic chest-beating (latm) of mourning groups, and passionate Iraqi-style eulogies (maddahi) echoing from mawkib—creates an immersive environment. This enables participants to achieve a profound spiritual experience fundamentally rooted in sensory perception.

In recent years, there has been a noticeable rise in popularized mourning styles (pop-style maddahi) in both Iran and Iraq. Their appeal lies in

energetic performances, youth-oriented formats, and emotional intensity, attracting large audiences, particularly among younger generations. However, this trend has faced sharp criticism from religious authorities (marja'iyya) and political institutions. These non-traditional lamentations, often perceived as subversive in both form and content, have grown significantly. During Arbaeen 2024, The Imam Hussain Holy Shrine (العتبة الحسينية) precinct officially banned such “overly exuberant” mourning processions.

Notably, even mundane sounds contribute to the pilgrimage’s sensory tapestry. The nostalgic cries of Iraqi mawkib staff—“Māy bārid... Halawī-jakum yā zuwwār... Māy bārid” (“Cold water... Welcome pilgrims... Cold water”)—evoke cherished memories of the Arbaeen journey, becoming an integral part of its auditory identity.

Conclusion

This study demonstrates that the Arbaeen pilgrimage is far more than a spiritual journey—it is a deeply embodied and sensorial experience in which the senses are not passive receptors but active agents of meaning-making. Among these, ritual food emerges as the most central and pervasive sensory form, operating not only as nourishment but as a medium of emotional, spiritual, and social transmission. The multisensory interactions—tasting votive food, smelling sacred incense, touching symbolic objects, hearing lamentations, and witnessing ritual displays—create an immersive atmosphere of sacred presence.

The findings reveal that the materiality of religious practice—particularly food—serves as an interface between the sacred and the social, allowing pilgrims to internalize religious meanings through bodily acts. Ritual food, when consumed within sacred time and space, is perceived to possess healing

power (shifā'), divine blessing (baraka), and transformative efficacy. These embodied experiences are further shaped by cultural models of belief, such as the sacralization of generosity, ritual purity, and symbolic representation.

By centering the sensory lifeworld of pilgrims, this research contributes to the growing field of sensory anthropology and advances our understanding of how religious meaning is lived, felt, and practiced. The Arbaeen pilgrimage, in this light, is not simply a theological event but a sensorial rite of passage—a space where faith is tasted, heard, touched, smelled, and seen, transforming ritual participation into a holistic act of embodied devotion.

Suggestions for Future Research:

Based on the findings of this research concerning the sensory experience of the Arba'een pilgrimage, several avenues for future investigations are proposed that can expand our understanding of this profoundly embodied and multisensory ritual:

- Impact of Cultural and Technological Changes on Sensory Dimensions: Given the advent of new technologies and social transformations, the influence of these factors on pilgrims' sensory experiences (e.g., the use of smartphones for recording and sharing sensory experiences, or shifts in the types of votive foods offered) can be explored.
- Deeper Analysis of Individual Senses: While this article provided a comprehensive overview of all senses, future research could delve more deeply into one or two specific senses (e.g., olfaction and its impact on collective and individual memory, or touch and its role in fostering solidarity and healing).
- Investigation of Gender and Age Roles in Sensory Perception: Potential differences in how various gender groups or different age groups (e.g., children versus adults and the elderly) experience the rituals sensorially could be researched.

- Longitudinal Studies: Conducting longitudinal studies with pilgrims who have participated in the Arba'een walk multiple times could reveal changes in their sensory perceptions and meaning-making over time.
- Impact of Sensory Experiences on Pilgrims' Mental Health and Well-being: Research could be designed to investigate how sensory experiences (e.g., the consumption of votive food or enduring physical hardships) influence the mental health, resilience, and sense of well-being of pilgrims upon their return from the pilgrimage.

These suggestions can significantly enrich the existing literature in sensory anthropology, religious studies, and pilgrimage studies, deepening our understanding of the complexities inherent in the interaction between humans, the body, and the sacred.

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**The Arbaeen March as a Modern Hero's
Journey: Faith, Resistance, and Spiritual
Transformation in the Path to Immortality**

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Abstract

This study focuses on the Arbaeen March as a modern application of Joseph Campbell's Hero's Journey. It studies the pilgrimage as an organized story of faith, resistance, and spiritual transformation. The study fills the gap in academic attention to Arbaeen as a literary and mythic genre. Using Campbell's stages of departure, initiation, and return, the study examines pilgrims' experiences using qualitative methods such as observations, interviews, and analysis of speeches and rituals during the march to Karbala. Thematic analysis ties these real-life experiences to the structure of the Hero's Journey. The research uses Campbell's theory, together with cultural and narrative theory, to explain how pilgrims exhibit ideals like as sacrifice, moral growth, and solidarity. The study concludes that the Arbaeen March is not only a spiritual event but also a powerful narrative journey. It mirrors classic heroic patterns and functions as a living myth that deepens cultural identity, collective memory, and moral purpose.

Keywords: Arbaeen, martyrdom, faith, defiance, unity, devotion, sacrifice, justice, loyalty, miracles.

Introduction

The Arbaeen March has become the world's largest religious gathering, attracting more than 20 million pilgrims to Karbala, Iraq, in honor of Imam Hussein's martyrdom. For those who participate, Arbaeen is more than just a ritual; it is an act of devotion, a protest against injustice, and a path to eternal life. While much has been written about its religious and political facets, few academics have explored Arbaeen as a narrative journey that reflects global trends of transition.

This study covers this gap by using Joseph Campbell's Hero's Journey concept in the Arbaeen March. The Hero's Journey, also known as the monomyth, is separated into three stages: departure, initiation, and return (Campbell, 2004, pp. 30-36). Although it has widespread application in literature, art, and psychology, this model has rarely been used in ceremonies of faith. However, Arbaeen shares basic traits with epic journeys: pilgrims leave their daily lives, face challenges on the way, and return changed.

Existing research has concentrated on Arbaeen's social and religious impact (Nakash, 1993, pp. 143-146; Al-Nasrawi, 2016, pp. 22-24), with little attention paid to its symbolic structure or emotional resonance. This study suggests that the march serves as a collective narrative in which participants achieve personal and community development. It is based on Halbwachs' theory of communal memory, which proposes that shared rituals enhance moral beliefs and group identification (1992, pp. 38-42).

The central aim is to examine how the Arbaeen March reflects the Hero's Journey and what this reveals about its spiritual and cultural meaning. The main research question is: How does the Arbaeen March reflect the structure of the Hero's Journey, and what does this reveal about its function as a spiritual and cultural narrative?

This approach changes the focus from exterior ritual to inward experience, showing how real people carry out legendary patterns. It also broadens the scope of narrative theory by linking literature with actual experience. In conclusion, this study views the Arbaeen March as more than just a religious observance; it is framed as a powerful, planned journey that follows global story patterns found in myth and literature. Using Joseph Campbell's Hero's Journey model, the study shows how pilgrims carry out a common story of moral conflict, sacrifice, and rejuvenation. This perspective not only fills a gap in current scholarship but also highlights the deep narrative and cultural significance of Arbaeen in shaping identity, faith, and collective memory.

Statement of the Problem

Although the Arbaeen March is one of the world's most important religious festivals, with over 20 million participants each year, most academic research focuses on its political, historical, or religious features (Nakash, 1993, pp. 143-146; Al-Nasrawi, 2016, pp. 22-24). Few scholars have examined it as a structured narrative or examined its ability to portray a lived experience of transformation. This gap restricts our understanding of how participants perceive the march not only as a ritual, but also as a personal and collective path of transformation.

Despite significant use of Joseph Campbell's Hero's Journey concept in literature, psychology, and cultural studies (Campbell, 2004, pp. 30-36), it has yet to be applied to rituals of faith such as Arbaeen. As a result, nothing is known about the march's narrative structure and symbolic reason. Understanding the Arbaeen March as a real-life retelling of the Hero's Journey may reveal new aspects of its spiritual and cultural sig-

nificance. It could also shed light on how ritual and storytelling shape collective memory and identity (Halbwachs, 1992, pp. 38-42).

This study addresses the lack of research connecting Arbaeen to narrative theory and aims to explore how the march functions as a transformative journey embedded in shared cultural meaning.

Aims and Objectives

The aim of this study is to examine the Arbaeen March through the prism of Joseph Campbell's Hero's Journey in order to find its narrative and symbolic structure. The aim is to examine how pilgrims go through a transforming process that resembles ancient renowned patterns of departure, initiation, and return. The study also aims to bridge the gap between literary theory and lived religious practice by demonstrating that the Arbaeen pilgrimage may be interpreted not just as a devotional act, but also as a systematic, meaningful journey of moral awakening and identity development.

More specifically, the study will:

1. Identify and map the key stages of the Hero's Journey within the Arbaeen experience.
2. Examine how individual pilgrims articulate personal transformation during and after the march.
3. Analyze the communal elements—rituals, symbols, speeches, and slogans—as narrative tools reinforcing the journey.
4. Contribute to the broader field of narrative studies by offering a case study of a living, collective myth in a contemporary religious context (Frank, 2010, pp. 77–81; Denzin, 2014, pp. 109–112).

Methodology

This qualitative study uses a combined technique of online story analysis, semi-structured interviews, and ethnographic observation using digital and local sources. The researcher, who lives in Karbala, Iraq, used internet sources, including media, films, interviews, and personal feedback, to gain a comprehensive understanding of the Arbaeen pilgrimage. In addition, around twenty individuals from Karbala and surrounding areas were interviewed face-to-face with open-ended questions. Participants included men and women of varied ages and jobs.

The interviews focused on their motivations, emotional experiences, perceived transformations, and interpretations of the journey. All responses were transcribed and thematically analyzed using Braun and Clarke's (2006) six-phase approach to thematic analysis (pp. 87–93). Special attention was given to patterns that align with Campbell's model of the Hero's Journey.

Textual materials such as banners, slogans, speeches, and symbolic visuals were also collected from online videos and documented local sources. These were analyzed through Barthes' (1972) theory of myth and semiotics (pp. 115–118) to understand how collective symbols communicate cultural meaning. This layered approach integrates personal narrative and shared cultural expressions, revealing how Arbaeen functions as both a spiritual experience and a symbolic performance.

Discussion

The findings indicate that the Arbaeen March represents all key stages of Campbell's monomyth. The "call to adventure" begins with the pilgrim's choices to leave home and make the journey. Along the way, participants face physical hardship, emotional challenges, and moral reflection, all of which relate to the "initiation" phase. Many pilgrims report a profound sense of renewal, inner peace, or heightened awareness after showing up in Karbala, echoing the "return with the elixir" stage (Campbell, 2004, pp. 212-218).

Participants frequently used language associated with rebirth, trial, and sacrifice. Some described the walk as a form of penance or a reenactment of Imam Hussein's suffering. Others spoke of finding a new purpose, reconnecting with faith, or committing to acts of service and justice after the march. These elements underscore the ritual's capacity to function as a transformative journey, one that deeply resonates with mythic and literary structures.

Furthermore, the collective aspects—hospitality stations, communal prayer, shared grief, and collective resistance—add to the journey's narrative force. These shared practices serve as myth-building mechanisms, transforming Arbaeen into a live cultural story in which participants become active heroes rather than passive followers in a moral narrative (Ricoeur, 1991, pp. 21-24).

The discussion confirms that the Hero's Journey offers a productive framework for interpreting Arbaeen, expanding both narrative theory and our understanding of contemporary religious expression.

5.1 Spiritual Transformation :The Call to Faith

The Arbaeen pilgrimage begins with an interior call—a spiritual need that matches the first step of Joseph Campbell’s Hero’s Journey, the “Call to Adventure” (Campbell, 2004). This call inspires millions to leave their comfort zones and enter a region of spiritual testing. The journey isn’t motivated by comfort, luxury, or material wealth. Instead, it is motivated by devotion to Imam Hussein (peace be upon him) and the values he represents: justice, sacrifice, and resistance. For many pilgrims, this initial step symbolizes the start of a more profound shift in which spiritual awakening takes precedence over the physical difficulties of the journey.

“When I first felt the urge to walk to Karbala, it was like a voice inside me telling me this journey would change my soul forever. It’s not just a walk; it’s a calling I cannot ignore.” (Z. Abbas, personal communication, October 12, 2023)

The statement represents the inner call that many pilgrims describe before embarking on the Arbaeen walk. Joseph Campbell’s concept of the “Call to Adventure” initiates the Hero’s Journey, in which the individual leaves the known world to seek a deeper truth (Campbell, 2004). In the Arbaeen setting, this “call” can be spiritual and emotional, leading people down a road of moral clarity inspired by Imam Hussein (peace be upon him). These liminal experiences begin with a threshold moment, which is represented by this quote. The urge described is spiritual rather than logical, connecting the self to a larger narrative of sacrifice and devotion.

Turner’s (1969) concept of “communitas” also supports this stage, in which pilgrims abandon societal positions in favor of a shared spiritual identity. The physical act of traveling to Karbala, often barefoot and over large miles, is more than symbolic; it changes. Pilgrims internalize their

pain as a means of moral cleansing. This stage so represents both the departure from the everyday world and being accepted into a sacred experience that reshapes personal identity.

5.2 Communal Experience: Liminality and Belonging

As the pilgrim walks on, he reaches what Turner refers to as the “liminal” phase—a region of transition in which regular patterns collapse (Turner 1969). This stage relates to Campbell’s “Initiation,” in which the hero experiences challenges and joins allies. On the Arbaeen road, communal solidarity replaces social hierarchy. Pilgrims provide food, medical care, and rest spots without expectation of recompense. This temporary society marks a departure from class, country, and sectarian recognition. Everyone becomes a servant and guest of Imam Hussein (peace be upon him).

“On the road, strangers became my family. We shared everything without asking, connected by the same purpose. In that unity, I found a deeper faith than ever before.” (R. Al-Khafaji, personal communication, October 18, 2023)

This authentic account emphasizes the sense of community identification that emerged during Arbaeen. Victor Turner’s theory of liminality discusses how pilgrims enter a phase throughout their journey where social roles are suspended and new forms of brotherhood emerge (Turner, 1969). These moments cross class, nationality, and language. Sharing rituals, meals, and sacrifices fosters a sense of community. Campbell (2004) associates this with the “Initiation” stage, in which the hero receives help from allies. In Arbaeen, fellow pilgrims, mawakeb, and caretakers form a holy network that guides and supports each pilgrim through their difficult times.

Pilgrims often express a sense of solidarity that crosses cultural and political divides. These shared sufferings form a moral and emotional connection, emphasizing the concept of communal resistance and mutual care. The chants chanted during the walk, such as “Labayka Ya Hussein,” reverberate across this liminal area, reminding pilgrims of their common purpose. This section shows how Arbaeen provides a lived feeling of brotherhood and humility, which is commensurate with both Campbell’s universal myth structure and Turner’s idea of ritual *communitas*.

5.3 Symbolic Rituals: Performing Resistance

Rituals during Arbaeen are essential for its role as a heroic narrative. Campbell (2004) observes that legendary journeys use symbols and rites to test, educate, and transform the hero. In Arbaeen, rituals such as chest-beating, reciting *ziyarat* passages, and carrying symbolic things (such as flags or coffins) serve as acts of resistance to tyranny and a reminder of injustice. These embodied actions allow travelers to connect with Imam Hussein’s martyrdom (peace be upon him) on a physical, emotional, and moral level.

Each gesture re-enacts the original event of Karbala, Crumbling time and making the past ever-present. Rituals thus serve as both personal confession and political testimony. The symbolic language of these acts communicates values that are often hard to express in words: grief, defiance, loyalty. They also guide the pilgrim through inner trials, much like Campbell’s stage of “Ordeal” where the hero faces death and emerges changed.

“When I beat my chest with the crowd, I felt I was speaking not just for myself but for all who suffered with Imam Hussein (peace be upon him). It’s a resistance with every heartbeat.” (Interview in Arbaeen Documentary: “Karbala in Our Hearts,” 2022)

This quotation, taken from a television documentary (Al-Forat Media, 2022), explains how physical routines have metaphorical value. Chest-beating and singing resistance slogans are not random acts in Arbaeen; they are rehearsed, embodied statements of political and moral disagreement. Based on Roland Barthes (1972), ritual acts evolve into myths with many cultural meanings. Campbell (2004) refers to these as “trials” that test the hero and define their identity. Here, the ritual takes on a shared language of recollection and resistance, connecting individual sorrow to collective historical tragedy.

5.4 Sacrifice and Endurance: The Moral Journey

The hardships endured during Arbaeen Sores, hunger, heat, fatigue, are not incidental. They are essential to the journey’s transformative power. Sacrifice is the moral thread that binds the Arbaeen story to the original tragedy of Karbala. Campbell’s “Atonement with the Father” phase becomes relevant here, as pilgrims symbolically reconcile with divine justice through their suffering.

“Each step was painful, but I reminded myself: this pain connects me to the sacrifice of Imam Hussein (peace be upon him). It’s through hardship that faith grows stronger.” (S. Al-Hakim, personal communication, October 20, 2023)

This phrase represents both the physical difficulties of the trek and its spiritual aim. Pilgrims endure long distances, terrible weather, illness, and injury not as a challenge, but to remember Imam Hussein’s (peace be upon him) sacrifice. Campbell (2004) describes such pain as a vital part of transformation. The pilgrim becomes a moral agent who chooses sorrow in order to grow his faith. This mirrors Turner’s (1969) concept of sacral suffering, in which ritual pain serves as a bridge between earthly experience and spiritual connection. As a result, the stroll itself works as a moral mirror.

The endurance shown is not Self-denying but meaningful. It reflects a commitment to moral clarity and truth. By walking in the name of Imam Hussein (peace upon him), pilgrims declare allegiance to a higher ethical code. They reject comfort in favor of meaning. This sacrificial ethos builds a sense of moral resilience that outlives the pilgrimage itself. Participants often return home changed—not just spiritually awakened, but ethically sharpened.

5.5 Return and Integration: Rebirth Through Resistance

Campbell’s last stage the “Return with the Elixir” sees the hero return to the regular world, bringing wisdom or healing. For Arbaeen pilgrims, the return entails incorporating the journey’s moral insights into daily life. The wisdom gained on the trek to Karbala compassion, courage, and dignity don’t stop at the shrine. They escort the pilgrim back to their homes, villages, and society.

This return is not always easy. Many pilgrims report a deep sense of disconnection from the everyday world upon their return. Yet this discomfort signals transformation. The being has seen a different world—one shaped by sacrifice and truth—and must now live by that vision. In this way, Arbaeen fulfills the cycle of the Hero’s Journey: departure, trial, and return with purpose (Campbell, 2004).

“Coming back home, I saw things differently. The world seemed harsher, but I carried the light of Karbala inside me. My faith is now an action, not just words.” (H. Al-Tamimi, personal communication, November 2, 2023)

The quote symbolizes the final stage of the Hero’s Journey, “The Return with the Elixir.” After going through tribulations, the pilgrim returns altered. According to Campbell (2004), true heroes do more than just return; they bring something with them as well: a lesson, a new perspective, or healing for others. In this case, the “elixir” is the moral clarity that now

governs daily life. The world after Karbala is not easier; rather, it becomes more meaningful. Resistance, justice, and spiritual purpose now guide the individual's actions, words, and beliefs. This is the point at which myth becomes fully integrated into reality.

Analysis of the Findings

The data gathered—via interviews, papers, papers, and recorded testimonies—shows that the Arbaeen pilgrimage is a strong system of moral, spiritual, and collective changes. Pilgrims aren't passive spectators. They actively interact with Imam Hussein's (peace be upon him) values of resistance, recalling, and service. Several interviewees regarded the travel as a chance to "reset" their life's purpose or to "feel alive again" following emotional hardship. These statements reflect Turner's (1969) concept of *communitas*, in which social roles disintegrate and a common meaning arises. The stroll itself becomes a rite of liminality, a gap between the mundane and the sacred.

Scholarly research (Campbell, 2004; Barthes, 1972) supports this reading. Arbaeen follows the structure of the hero's journey: escaping comfort, undergoing challenges, gaining knowledge, and returning with a renewed identity. The suffering of the path is not useless; it is transformative. Every mile walked, every act of generosity given or received, supports spiritual principles founded on sacrifice and dignity.

Miracles noticed by some pilgrims reinforce the spiritual nature of the encounter. While not scientifically measurable, these accounts are real to the people who report them, and they enhance their faith and sense of divine closeness. As one pilgrim stated in an interview, "When I reached Karbala, I felt my heart had arrived before me." Such testimonies reflect a deep personal connection to Imam Hussein (peace be upon him) and a belief in spiritual healing through sincere devotion.

Conclusion

The Arbaeen pilgrimage is more than a religious tradition work it is a complete spiritual, ethical, and human experience. Each step toward Karbala brings the pilgrim closer not just to a physical destination, but to the moral path of Imam Hussein (peace be upon him). This journey renews faith, strengthens community, religion, and reminds each participant of their responsibilities toward justice, truth, and compassion that all human beings should follow.

Arbaeen creates both personal and communal identities through themes including challenges, service, remembrance, and resistance. It converts memory into action, passion into movement, and belief into transformation. Physical endurance demonstrates spiritual dedication. Hussein’s empathy reflects his principles. The prayers muttered on the way represent profound personal hope and a universal desire for equality.

Miracles reported by many pilgrims—whether physical or emotional—reflect the sacred power of sincere intention and divine Neighborhood. These stories reaffirm the spiritual depth of the march and its capacity to inspire awe and faith even beyond religious boundaries. Ultimately, walking to Karbala is walking toward the truth to justice. It is a living expression of ethical memory, moral clarity, and spiritual growth. The legacy of Imam Hussein (peace be upon him) continues not just in books and rituals but in the footsteps of millions who choose to follow his path every year, gaining nothing material but everything eternal.

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