



**A Semi-Annual Peer-Reviewed Scientific Journal**  
**Concerned with publishing research and studies.**  
**in the humanities**





# الاربعين

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



**The Holy Husseiniya Shrine  
Karbala Studies and Research Center**



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Concerned With Publishing Research And  
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Ramadan 1446 AH, March 2025 A.D



Republic Of Iraq - Karbala Governorate  
The Holy Husseiniya Shrine  
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P.o. Box 428 Karbala



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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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وزارة التعليم العالي والبحث العلمي  
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اشارة الى كتابكم المرقم م/٤٨١ بتاريخ ٢٠٢٣/٣/٨ ، والمتضمن استحداث واعتماد مجلتكم لاغراض النشر والترقيات العلمية وتسجيلها ضمن موقع المجلات الاكاديمية العلمية العراقية ، حصلت الموافقة بتاريخ ٢٠٢٣/٦/٢١ على اعتماد المجلة المذكورة في الترقيات العلمية والنشاطات العلمية المختلفة الاخرى ، واعتباراً من المجلد الاول - العدد الصفري - آذار- لسنة ٢٠٢٣ لتسجيل المجلة في موقع المجلات الاكاديمية العلمية العراقية. للفضل بالاطلاع وابلاغ مخول المجلة لمراجعة دانرتنا لتزويده باسم المستخدم وكلمة المرور ليتسنى له تسجيل المجلة ضمن موقع المجلات الاكاديمية العلمية العراقية وفهرسة اعدادها ، ويعتبر ذلك شرطاً أساسياً في اعتمادها بموجب الفقرة (٣١) من ضوابط استحداث واصدار المجلات العلمية في وزارتنا.

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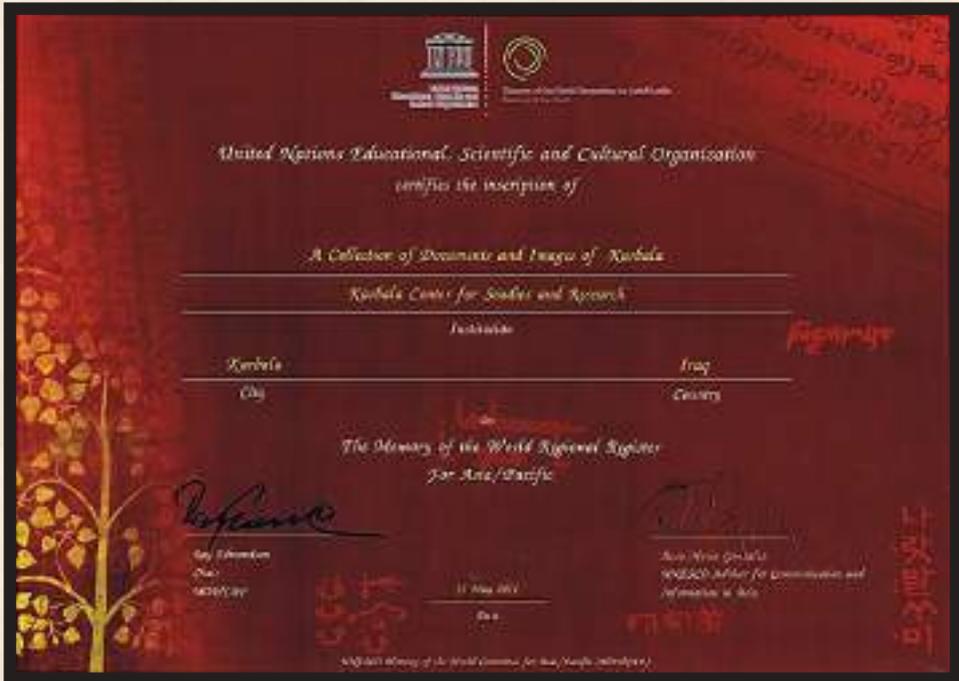
  
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## Editorial of the issue

### 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 good and pure family and companions.

And after.

The Arba'een visit of Imam Hussein, peace be upon him, has received great attention throughout its long history because of its great connotations and meanings in the souls of Muslims in general, and the Iraqi people in particular, because it embodied a set of humanitarian images, such as spreading the principle of peaceful coexistence among visitors with their different cultures and intellectual affiliations, and the extent of cohesion. Cultural and societal, self-denial and competition in providing services to various segments of the (Arba'een community), until this visit became a cultural and civilizational identity for our generous Iraqi people, which called on the Karbala Center for Studies and Research at the Holy Imam Hussein Shrine to strive diligently to register this visit in the international organization UNESCO as a ritual. Religious and social practice on the World Intangible Heritage List.

This issue devoted itself to publishing the proceedings of the Seventh International Conference of the Arba'een Visit, which was held by the Karbala Center for Studies and Research at the Holy Imam Hussein Shrine under the slogan (The Arba'een Visit...the authenticity of values and the title of civilization on 2324- AH, Safar 1445/September 82023 ,9-), which witnessed the participation of Wide international.

The Karbala Center for Studies and Research believes in the importance of studying the blessed Arba'een visit, so this year's edition of the Seventh International Conference was devoted to a set of scientific topics related to the topic of the visit and its basic dimensions. It should be noted here

that the conference sessions witnessed a wide attendance of research with an applied dimension, in addition to social and humanitarian research in which a large elite of specialists and researchers in several fields participated. The total number of research submitted to the scientific committee of the conference amounted to (177) research papers from inside and outside Iraq, distributed among: The main topics of the conference, and after presenting them to the scientific experts, (95) papers were accepted to participate in the conference, asking God Almighty that this scientific effort and its outputs benefit decision-makers to develop the service reality and the popular effort presented to the visitors of the Lord Abu Abdullah Al-Hussein.

And Praise be to Allah, the Lord of the Worlds

Scientific Committee of the Conference

managing editor

1446 AH – 2025 AD

**Ayatollah Khameneie the Supreme Leader's  
interpretation of the Arbaeen walk**

**Maryam Safara**

**Department of Psychology, Women Research Center, Alzahra  
University, Tehran, .**

**Samaneh Sadat Sadidpour**

**PhD sociology, Kharazmi University, Tehran, .**



## Abstract

This study deals with the Supreme Leader's interpretation of the Arbaeen walk with a qualitative approach from the methodical approach of the (topical) theory of re-examination and document analysis. From the point of view of the Supreme Leader, the phenomenon of Arbaeen, the largest gathering in the world, is one of the movements of faith that is considered among the positive and joyful points of our country and for our nation. Romantic behavior is spiritual in the material world and the movement is love and faith. It is a divine and spiritual phenomenon, unique and unprecedented, which has not been advertised, but it suddenly appears, the hand of God is more evident than anywhere else... It is a spiritual journey. This incident is extremely important. There are phenomena for which there is no advertising, no effort is made. It really cannot be described; Like many of these important divine phenomena, it cannot be properly interpreted; It means that this incident cannot be analyzed. This march gives greatness to the Islamic world; There are two groups of active activists, including marchers, hosts and opponents of the march, and the third group is those who monitor the march and Islamic issues. Iranian and Iraqi officials should make this march easy for those who love this work, which is the responsibility of the officials of different parts of the country. The management of the march and its survival is in the hands of Almighty God.

Keywords: Arbaeen procession, supreme leadership position, interpretation.

## 1. Introduction

Arbaeen Hosseini 20 Safar coincides with the 40th day of the Karbala incident and the martyrdom of Imam Hussein (A.S.). It is known that

the prisoners of Karbala came to Karbala on the 20th day of Safar, 61 AH, on their way back from Syria, to visit the tomb of Imam Hussain (AS). Also, on this day, Jabir bin Abdullah Ansari

came to visit the grave of Imam Hussain. Arbaeen pilgrimage is one of the special acts of this day, which according to a narration of Imam Hasan Askari (A.S.) is considered one of the signs of a believer (Tusi, Tehzib al-Hakim, 1407 AH, Volume 6, p. 52). Since the review of repetitive material in Arbaeen sometimes diminishes the importance of the event, in this research, after a description of Arbaeen, we will review the views of the Supreme Leader and with the help of content analysis, we will try to summarize his views. In this regard, Qazi Tabatabai writes in his research book about the first Arbaeen of Sayyid al-Shohda: Moving towards Karbala on the day of Arbaeen has been common among Shiites since the time of Imam Masoom (A.S.), and Shiites were bound to this movement even during the time of Bani Umayyad and Bani Abbas.

But what is the origin of Arbaeen, it must be said, in the sources, this day (Arbaeen) has been looked at in two ways.

**First:** Arbaeen is the day when the prisoners of Karbala returned to Medina from Syria.

**Second:** Arbaeen is the day when Jabir bin Abdullah Ansari, the companion of the Prophet of God (PBUH) entered Karbala from Madinah to visit the grave of Hazrat Aba Abdullah Al-Hussein (PBUH). Sheikh Mufid (AD 413) in "Masar al-Shia" which is about the days of the births and deaths of Imams Athar (peace be upon them), mentioned the day of Arbaeen and wrote: Arbaeen is the day when the shrine of Imam Hussain (AS) returned from Syria to Medina. Also, Arbaeen is the day when Jabir bin Abdullah entered Karbala to visit Imam Hussain (AS).

The oldest detailed prayer book available is the book "Musbah al-

Mutahujd" by Sheikh Tusi, one of the students of Sheikh Mofid, who also wrote the same thing. After remembering that the first day of the month of Safar is the day of martyrdom of Zayd bin Ali bin Al-Hussein (AS) and the third day of the month of Safar is the day when the Kaaba was set on fire by the Syrian army in the year 64 AH, Sheikh Tusi writes: The 20th of the month of Safar (forty days after the incident of Karbala) ) It is the day that the shrine of our Sayyid Aba Abdullah al-Hussein returned to Madinah from Syria, and it is also the day that Jabir bin Abdullah Ansari, the companion of the Messenger of God (PBUH), entered Karbala from Madinah to visit the grave of the Prophet. He was the first person to visit Imam Hussain (AS). On such a day, it is recommended to visit him and it is Arbaeen pilgrimage. (Musbah al-Mutahjad, p. 787)

First of all, some of the narrations about the visit of Imam Hussain (A.S.) mentioned in the Complete Book of Al-Ziyarat Ibn Qulawiyya mentions the crying of heaven, earth, sun, and angels for forty days over Imam Hussain (A.S.). (Arbain Shahid Ghazi, p. 386)

Second, Ibn Tavis raised a historical issue regarding Arbaeen being on the 20th day of Safar, and that is that if Imam Husayn (AS) was martyred on the 10th of Muharram, his Arbaeen would be on the 19th of Safar, not the 20th. In the answer, it is said that there were probably twenty-one days in the month of Muharram in which Imam Hussain (AS) was martyred. If it was a full moon, it should be said that they did not count the day of martyrdom (Bihar al-Anwar, vol. 98, p. 335).

## Research method:

The method of this study is qualitative and it is done with the help of content analysis technique. In research theories and reports, in the current study, the methodical approach of (topical) theory of re-examination has been used. While receiving their qualitative data, they are subjected to comparative analysis in order to provide the field of hypothesis formation with more adaptation to the realities of the samples. The society under study in this research is dedicated to documents. To select the sample, the purposeful sampling method was used. The sample volume consists of statements, visits and texts written about Arbaeen. The tools and techniques used in this research are document review. Data analysis is done continuously through the "continuous comparison" strategy. The validity of the findings is provided by accurately receiving the opinions about the questions. Also, since this research is qualitative research and is not done with the intention of making generalizations, reliability is not discussed about this research .

## Findings:

### Supreme Leader's opinion about Arbaeen

If the nations of the Islamic countries in all of this vast region - which constitute a very large fraction of the world's population - are not in detail, [but] in general orientations, the Islamic world will reach the peak of progress and excellence; [that] they are seen together in general issues; Being seen together has an effect. The fact that the presidents of Islamic countries or the intellectuals of Islamic countries speak against each other - even if it is only words - makes the enemy run away; gives

hope to the enemy; As is the reality today. Even if we stand by each other in our statements, it will give greatness to the Islamic world. It gives greatness to the character of the Islamic nation. Wherever we observed examples of this community, even if bodies and bodies were placed together, we saw that its reflection in the world became a source of honor and honor for Islam and Muslims; It became the source of the Prophet's reputation. When we pray the Eid prayer, we stand together and say: "I made it a feast for the Muslims, and for Muhammad, peace and blessings be upon him." is It is a source of honor and respect for the Islamic Ummah. The Hajj gathering is like this. This year, you noticed that millions of people gathered together in Hosseini's Arbaeen. This huge movement of a group of Muslims - of course, it was not exclusive to Shia, there were Sunnis as well - which was reflected in the world,

they bowed; honored; It was considered the biggest gathering in the world; who? Those who are monitoring Islamic issues. I think it is appropriate and I think it is necessary to thank the government of Iraq, the people of Iraq, the tribes of Iraq who sacrificed, served, showed generosity and magnanimity in this very important test. This year's Arbaeen incident in Karbala was a strange incident. This way was blocked by the enemies of Islam and the enemies of Ahl al-Bayt. See what a great movement happened! When even objects are placed together, this kind of reflection is found. If we are together, the Islamic countries, the Muslim nations - Sunni and Shia and the different sects of Sunnis and Shias - should have clear hearts with each other, should not have suspicion towards each other, should not have bad intentions, should not insult each other, see what will happen in the world. it fell; What honor will be given to Islam! Unity; unity.

What is actually the case is that the country is moving towards revolutionary concepts and revolutionary ideals and revolutionary facts; Now this movement may not be as fast as it needs to be, but it is there.

The country is progressing; We are making progress in various fields: we are making progress in the scientific field, we are making progress in the industrial field, we are making progress in the field of political honor, we are making progress in the field of intellectual development, we are making progress in spiritual fields. I will give an example later at the end of my speech. There are not one or two of these examples; We are making progress. There are so many good young people in the country; You can see what is going on in the virtual space now! How many problems of al-fatan exist in this virtual space, in satellites, and in these organizations, and young people are exposed to all of these, at the same time, you see what the Arbaeen procession is like, what it's like, what the prayers of university congregations are like. These are very important; Why should we not see these? These indicate that even spirituality, which is the hardest [part] - the spiritual part of culture - is progressing. Check out the Ramadan sessions; I am inquiring about this meaning, especially during the month of Ramadan, as well as Muharram and Safar (18) and I ask those who go to research, work and see what is the ratio of this year's Ramadan meetings to last year's; They go and bring reports; Man is really amazed by this progress, by this forward movement. Why shouldn't we consider these, why shouldn't we see them? These should be seen, analyzed and said; Those who have high-profile loudspeakers should express and say these things.

An example is this huge Arbaeen procession; It is truly a phenomenon, a divine phenomenon, a spiritual phenomenon. It really cannot be described; Like many of these important divine phenomena, it cannot be properly interpreted; It means that this incident cannot be analyzed. Let this huge population of millions walk, within a few years, this achievement will take shape! Yes, there was a march in the past, but this was not the news. We know that on different days, whether Arba'in or non-Arba'in - about Arba'in or some other times - Qallab moved from Najaf and different places in Iraq, and there were large crowds. But this

huge population of millions from different parts of the world - several million from Iran and millions from Iraq itself and from other countries - this huge movement, despite the terrorist threats that have always existed and still exist today, is an extremely huge phenomenon; is very

important. This shows the culmination of this thinking of fighting in the way of God and in the way of Islam and the general preparation of everyone in this way. And we hope that Almighty God blesses these movements and blesses the people.

Of course, here on the occasion of commemorating the Arbaeen march, while praying and wishing for the acceptance of this movement, we thank all those who participated in this march this year. from officials and cultural activists of Azerbaijan and Qom provinces.

Our young people found the way and millions of our people and people other than us, the people of Iraq and others, are moving in this way. We have created; It became a symbol. Arbaeen was always a walk, but this huge movement, which is a very beautiful and glorious symbol of the presence of Ahl al-Bayt followers and those interested in Ahl al-Bayt; It wasn't this, we didn't have this, God Almighty gave this to us, we should be thankful to God.

The youth community that I mentioned is the result of observing and learning about the activities of thousands of youth groups across the country, which are passionate about their activities, whether in scientific fields, whether in cultural fields, whether in sports fields, or in the fields of They are productive, have fun and are employed, offer new jobs and new initiatives and provide reserves for the future of the country .

The religious movements that I mentioned mean the passionate and warm religious meetings that existed throughout the year; Related to the issues of the imams (peace be upon them), related to important religious issues, such as itikafs and prayers, the month of Ramadan, the Arbaeen walk, and the important meetings of Ashura and the Muharram

decade; These are the positive and joyful points of our country and for our nation. (The Supreme Leader's office, 12/30/2015, Nowruz message on the occasion of the beginning of the year 2016)

In the final part of his speech, Ayatollah Khamenei, while thanking the Iraqi people and officials for the hospitality of the Arbaeen pilgrims, called the Arbaeen walk a great and unique phenomenon. The main national alliance of Iraqi Shiites with the leader of the revolution.

There are phenomena for which there is no advertising, no effort is made. You see, in order to gather 10,000 or 50,000 people together, how much advertising effort is done in the world, it will never end. Here, despite the many obstacles, only two million people from Iran get up to walk 80 kilometers – to walk, not to enjoy themselves and in Lamidan Hotel – they go to Karbala; How many times that from Iraq itself and from other regions; This is a divine event, this is a divine phenomenon; This shows that this way is the way of love; But not crazy love, love with insight; like parents' love for God; O Allah, grant me your love and the love of those who love you, and the love of all actions that bring me near; (2) this love and this love is love with insight; He knows, he understands and this attraction pulls him, this magnetism pulls him. Well, so the job is a big job; The phenomenon is a huge phenomenon. First of all, I welcome those who succeeded and left, and I request

God's acceptance for their work, and I express my envy towards their work – we were deprived, they succeeded. I thank the people of Iraq who welcomed and showed kindness and were able to manage this huge crowd within a few days. The incident is an extremely important incident.

In the first incident, the criminal and vicious takfiri groups, who were blinded by the huge Arbaeen procession and the unparalleled security of the Hosseini pilgrims, and thwarted their malicious conspiracies, took a cowardly and heinous revenge and once again showed their evil face

and evil intentions. They showed everyone. From other parts of the world, such as Nigeria, Pakistan, and Afghanistan, bitter and shocking news about the crimes of their fellow Muslims is also coming, and it once again warns all Muslims and sympathizers about the danger of Takfiri movement and their supporting governments. Message following the painful events of the martyrdom of pilgrims in Iraq and the train accident) in the terrorist explosion that occurred on Thursday evening (9/4/1395) around the Iraqi city of Halla by the Danish Takfiri group, more than 100 Arbaeen Hosseini pilgrims from different countries, including Iranian pilgrims were martyred and many were injured.

Well, this year, these days have coincided with Arbaeen days. Do you see this procession? Do you see this huge movement of millions between Najaf and Karbala, between Najaf and Imam Hussein? Do you see this enthusiasm? Do you see this movement? When this movement is accompanied by danger, this enthusiasm still exists in our nation, in our people, in our youth; This must be maintained, this is what guarantees the survival of this country.

My dears! The youth of our country is hopeful; The youth environment in our country is promising; Not that I don't know that now there are a bunch of young people who are going the wrong way, doing bad things; Why, I am aware of them too, but all in all, when I look at the youth environment of the country, I thank the Almighty God. With all these factors of deviation, with all these motivations, with this broad front of hostility and focus on the youth, we have a large group of young people who are believers, religious, revolutionary, people of appeal, people of passion and love for spirituality; This is not a small thing; This is a very important thing; It is a very big thing. Some are people of Quran, some are people of Itikaf, some people are people of Arbaeen walk, some people are people of standing in revolution fields and revolution demonstrations. It is so great, so precious; The enemy is against all of these.

Referring to the fraternal, intimate and loving relationship between the two nations of Iran and Iraq, despite eight years of war imposed by Saddam with the instigation of foreigners, he called it a strange phenomenon and added: the Arbaeen procession is an example of this friendly relationship in a way that the Iraqi people in welcoming Iranian pilgrims, they don't lack charity, love and devotion (Maqam, 09/03/2014, meeting between the President of Iraq and the Leader of the Revolution).

In another part of his speech, he called Hosseini's hospitality and generosity in welcoming the pilgrims of Arbaeen as one of the distinguished qualities of the Iraqi

people and added: this romantic and spiritual behavior is very important and remarkable in today's material world, and the depth of this virtue of the Iraqi people is still true. It is not known (Maqam of the Supreme Leader, 03/27/1394, the meeting of the Iraqi Prime Minister with the leader of the revolution), we can see that the national determination, thank God, was emerging. Our nation showed its firm determination both in enduring some problems that existed for it, and on the 20th day of Bahman, on Quds Day and in the great Arbaeen procession, it showed this determination and courage. Jihadist management was evident in some parts, thank God. In those parts where Jihadi management was observed by human beings, we also observed the progress there. Of course, this is not a special recommendation for 2019, both national determination and jihadi management are needed for this year and for all the leading Mehromums for our nation.

Usually, in these kinds of phenomena that people observe, for which there is no advertisement, but suddenly a phenomenon emerges in the environment of human vision, the hand of God is more evident than anywhere else... These are phenomena for which no advertisement is made, no effort is made. You see how much advertising effort is done in the world in order to gather 10,000 or 50,000 people together, it will never end. Here, despite the many obstacles, only two million people

from Iran get up to walk 80 kilometers - to walk, not to enjoy themselves and in Lamidan Hotel - they go to Karbala; How many times that from Iraq itself and from other regions; This is a divine event, this is a divine phenomenon; This shows that this way is the way of love; But not crazy love, love with insight; Like parents' love for God; O Allah, grant me your love and the love of those who love you, and the love of all actions that lead me to nearness; This love and this love is love with insight; He knows, he understands and this attraction pulls him, this magnetism pulls him. Well, so the job is a big job; The phenomenon is a huge phenomenon. First of all, I welcome those who succeeded and left, and I request God's acceptance for their work, and I express my envy towards their work - we were deprived, they succeeded. I thank the people of Iraq who welcomed and showed kindness and were able to manage this huge crowd within a few days. The incident is an extremely important incident.

Give thanks for this march incident. It is thanks, among other things, to keep those moods, those moods - which you saw or felt there during these two or three days when you were marching - in yourself; That brotherhood, that kindness, that attention to the province, that preparation of the body for suffering, that preferring toil and sweat and walk over comfort and laziness. This should be followed in all matters of life; This is thanks.

Among the branches of sugar, one is to make this work easy for those who love this work, which is the responsibility of the officials of different parts of the country. Sometimes accidents happen; Don't let these incidents [repeat], prevent them; This is also part of sugar. However, we should appreciate this blessing, it is a great blessing. And this, God willing, will be a lasting blessing and will be a source of honor and pride for the nation of Iran and the nation of Iraq. Now in the world they are trying not to let this strong spotlight be seen, but they can't, it will be seen; They

try to hide it or distort it, [but] none of it gets anywhere; When you continue the movement, it will inevitably reveal its truth.

Those who have traveled this path and do this act of love and faith, are really doing a good deed. This is a great slogan, La Tahlawā Shā'a'r Allah, this is definitely one of Allah's Shā'a'r. It is appropriate for people like me, who are deprived of such movements, to say, "Ya letna kanna ma'kam fanfuz, hugely." As we said, this movement is the movement of love and faith; In that faith and belief of the heart and true beliefs are stimulating and effective; Both love and affection. The thinking of the Ahl al-Bayt and Shiite thinking is the same; It is a combination of intellect and emotion; it is a combination of faith and love; A combination of the two. This is something that in other Islamic sects, the gap is noticeable; Sometimes they try to fill this void somehow, [but] it doesn't work; Who is there like the Prophet's family - these outstanding, distinguished, enlightened, royal elements - among the beliefs of other branches of Islam, that such people love them, interact with them, talk to them, greet them and ask them God willing, they will hear the answer; Who else is there? It is that this is an opportunity available to the followers of Ahl al-Bayt; This pilgrimage of the imams (peace be upon them), this spiritual flirtation with these nobles, these pilgrimages are full of excellent and privileged concepts that we have at our disposal.

This huge movement of people from Iran, from other Islamic countries, from India, from Europe, even from America and other countries, people come from far away to participate in this march. Two days, three days more or less - in this way, they move on foot; The people of Iraq justly receive them with great magnanimity and love; It is a very big and meaningful movement, and those who succeed should be proud of it.

..you noticed that millions of people gathered together in Hosseini's Arbaeen; This huge movement of a group of Muslims - of course, it was not exclusive to Shia, there were Sunnis as well - which was reflected in

the world, they bowed; honored; It was considered the biggest gathering in the world; who? Those who are monitoring Islamic issues (Supreme Leader, statements in the meeting with regime officials and guests of the 28th International Islamic Unity Conference, 19/10/1393)

I think it's appropriate here and I think it's necessary to thank the government of Iraq, the people of Iraq, the tribes of Iraq who sacrificed, served, showed generosity and magnanimity in this very important test. This year's (2nd) Arbaeen incident in Karbala was a strange incident. This way was blocked by the enemies of Islam and the enemies of Ahl al-Bayt. Look what a huge movement happened! When even objects are placed together, this kind of reflection is found. If we are together, the Islamic countries, the Muslim nations -Sunni and Shia, and the different sects of Sunnis and Shias - should have clear hearts with each other, should not have suspicion towards each other, should not have bad intentions, should not insult each other, see what will happen in the world. it fell; What honor will be right for Islam! Unity; unity .

The march of the Arbaeen Day ceremony is an example of this friendly relationship [the two nations of Iran and Iraq] in such a way that the Iraqi people do not leave anything short of generosity, love and devotion in welcoming Iranian pilgrims. The officials of Iran and Iraq should make the most of this space and opportunity for the interests of both countries.

Hospitality and generosity in welcoming Arbaeen Hosseini pilgrims are another characteristic of the Iraqi people. This romantic and spiritual behavior is very important and remarkable in today's material world, and the depth of this virtue of the Iraqi people is still not properly known .

Of course, these complaints of ours should not cause some people to want to get up, walk and move outside of the regulations; No, according to the regulations set by the Islamic State; Well, our friends in the government have thought, they have considered regulations and rules

for this work, these rules must be observed; There should be no way for those outside of these rules to say, "let's go and move like this, let's go to the desert - for example - let's go", this is not desirable; They must follow these rules (the position of the supreme leader, statements at the beginning of the foreign jurisprudence course about the Arbaeen walk, 9/9/1394)

Ayatollah Khamenei, the Supreme Leader of the Islamic Revolution yesterday morning (Monday) in the session of the Islamic jurisprudence lesson, referring to the great and exciting movement of the Arbaeen walk, said: Blessed are those who are walking and will reach the pilgrimage of Arbaeen, and that pleasant pilgrimage on the day of Arbaeen. addressed to Sayyid al-Shuhda peace be upon him. The leader of the Islamic revolution called the Arbaeen procession one of the most important events and a very beautiful and glorious symbol of the presence of the followers and those interested in the Ahl al-Bayt peace be upon him and added: From here we look at the steps of millions of pilgrims with enthusiasm and regret. And we should be thankful to the Almighty God for the blessing He has placed upon us by creating this great movement .

On January 29, coinciding with Hosseini's Arbaeen, one of the largest marches will be held in Mashhad and throughout Iran by order of the Imam, may God have mercy on him, to protest against Bakhtiar's rule and the establishment of the Islamic Republic.

### **Analysis of findings:**

If the nations of the Islamic countries... are with each other in general orientations, the Islamic world will reach the peak of progress and excellence; ... to be seen together in general issues; Being seen together has an effect. ...gives greatness to the world of Islam; The mere placing of bodies together in prayer is a source of honor for the Prophet; It is a matter of honor and respect for the Islamic Ummah. ... the huge

community, ... I would like to thank the government of Iraq, the people of Iraq, the Iraqi nomads who sacrificed, served, showed generosity and magnanimity in this

very important test. It was a strange incident this year's Arbaeen incident in Karbala. This way was blocked by the enemies of Islam and the enemies of Ahl al-Bayt. See.... Unity; Unity... the country is moving towards revolutionary concepts and revolutionary ideals and revolutionary truths; Now this movement may not be as fast as it is needed... there are good young people in the country; Why shouldn't we see? These should be seen, analyzed and said;

An example is this huge Arbaeen procession; It is truly a phenomenon, a divine phenomenon, a spiritual phenomenon. It really cannot be described; Like many of these important divine phenomena, it cannot be properly interpreted; This means that this incident cannot be analyzed. Let this huge population of millions walk, within a few years, this achievement will take shape! Yes, there was a march in the past, but this was not the news. This huge population of millions from different parts of the world - several millions from Iran and millions from Iraq itself and from other countries - this huge movement, despite the terrorist threats that have always existed and still exist today, is an extremely huge phenomenon. Is; is very important. This shows the peak of this thinking of fighting in the way of God and in the way of Islam and the general preparation of everyone in this way. And we hope that the Almighty God blesses these movements and blesses the people. We, of course, here on the occasion of remembering the Arbaeen march, while praying and wishing for the acceptance of this movement, we thank all those who participated in this march this year. We do.... Blessed is those who are walking or will walk and will reach the pilgrimage of Arbaeen... and they will read that pleasant pilgrimage on the day of

Arbaeen, God willing.

We are also looking here with enthusiasm and regret... because I can find my inner side as well... it is a very beautiful and glorious symbol of the presence of Ahl al-Bayt followers and those interested in Ahl al-Bayt; It wasn't, we didn't have it, God Almighty gave it to us, we should be thankful to God. The youthful community that I mentioned... the religious movements that I mentioned, I mean, the passionate and warm religious meetings that existed throughout the year; Related to the issues of the imams (peace be upon them), related to important religious issues, such as itikafs and prayers, the month of Ramadan, the Arbaeen walk, and the important meetings of Ashura and the Muharram decade; These are the positive and joyful points of our country and for our nation. ... while thanking the Iraqi people and officials for their hospitality to the Arbaeen pilgrims, they called the Arbaeen walk a great and unique phenomenon.

There are phenomena for which there is no advertising, no effort is made. You see, in order to gather 10,000 or 50,000 people together, how much advertising effort is done in the world, it will never end. Here, despite the many obstacles, only two million people from Iran get up to walk 80 kilometers - to walk, not to enjoy themselves and in Lamidan Hotel - they go to Karbala; How many times that from Iraq itself and from other regions; This is a divine event, this is a divine phenomenon; This shows that this way is the way of love; But not crazy love, love with insight; .... First of all, I welcome those who succeeded and left, and I request God's acceptance

for their work, and I express my envy towards their work - that we were deprived, they succeeded. I thank the people of Iraq who welcomed and showed kindness and were able to manage this huge crowd within a few days. The incident is an extremely important incident.

In the first incident, the criminal and vicious takfiri groups, who were blinded by the huge Arbaeen procession and the unparalleled security of the Hosseini pilgrims, and thwarted their malicious conspiracies, took a cowardly and heinous revenge and once again showed their evil face and evil intentions. They showed everyone. From other parts of the world, such as Nigeria, Pakistan, and Afghanistan, bitter and shocking news about the crimes of their co-Muslims is also coming, and it once again warns all Muslims and sympathizers about the danger of the Takfiri movement and the governments that support them... Well, this year, these days coincide with Arbaeen days Do you see this procession? Do you see this huge movement of millions between Najaf and Karbala, between Najaf and Imam Hussein? Do you see this enthusiasm? Do you see this movement? When this movement is accompanied by danger, there is still this enthusiasm in our nation, in our people, in our youth; This must be kept, this is what guarantees the survival of this country... My dears! The youth of our country is hopeful; ... there are young people who go the wrong way, do bad things; Why, I am aware of them too, but all in all, when I look at the youth environment of the country, I thank the Almighty God. With all these factors of deviation, .... this is very great; it is very valuable; The enemy is opposed to all of these... These days are the days close to Arbaeen. A unique and unprecedented phenomenon has emerged in recent years, and that is walking between Najaf and Karbala or some cities further away from Najaf to Karbala. Some from Basra, some from the border, some from other cities, walk and move. This movement is the movement of love and faith; We are also looking at this movement from afar, and we are envious of those who found this success and carried out this movement: although we are far away, we speak in your memory... there was no home dimension in their spiritual journey... Referring to the fraternal, intimate and loving relationship between the two nations of Iran and Iraq, despite the eight years of war imposed by Saddam with the instigation of foreigners, they called it a strange phenomenon and added: the march of Arbaeen

Day is an example of this friendly relationship in such a way that the Iraqi people in Reception of Iranian pilgrims does not leave anything short of generosity, love and devotion... In another part of his speech, he considered hospitality and generosity in welcoming Arbaeen Hosseini pilgrims as one of the distinguished qualities of the Iraqi people and added: this romantic and spiritual behavior In today's material world, it is very important and significant, and the depth of this virtue of the Iraqi people is not yet known. Our nation showed its firm determination both in enduring some problems that existed for it, and on the 22nd day of Bahman, on Quds Day and in the great Arbaeen procession, it showed this determination and courage. Usually, in this kind of phenomena that people observe, for which there is no publicity, but suddenly a phenomenon appears in the environment of human vision, the hand of God is more visible than anywhere else... Thank you for this march incident. It is thanks, among other things, to keep those

moods, those moods - which you saw or felt there during these two or three days when you were marching - in yourself; That brotherhood, that kindness, that attention to the province, that preparation of the body for suffering, that preferring toil and sweat and walk over comfort and laziness. This should be followed in all matters of life; This can be thanks... Among the branches of sugar, one is to make this work easy for those who love this work, which is the responsibility of the officials of different parts of the country... and this, God willing, will be a lasting blessing and It will be a source of honor and pride for the people of Iran and Iraq. Now in the world they are trying not to let this strong spotlight be seen, but they can't, it will be seen; They try not to be seen or distort it, [but] none of them get anywhere; When you keep moving, it will inevitably reveal its truth. This huge movement of people from Iran, from other Islamic countries, from India, from Europe, even from America and other countries, people come from far away to participate in this march. Two days, three days more or less -

in this way, they move on foot; The people of Iraq justly receive them with great magnanimity and love; It is a huge movement, meaningful and meaningful, and those who succeed should be proud... Millions of people came together in Hosseini's Arbaeen. This huge movement of a group of Muslims - of course, it was not only Shia, there were Sunnis as well - which was reflected in the world, they bowed; honored; It was considered the biggest gathering in the world; who? Those who are monitoring Islamic issues...

From here we look at the steps of millions of pilgrims with enthusiasm and regret and we must thank the Almighty God for the blessing he has bestowed on us by creating this great movement....

On January 29, coinciding with Hosseini's Arbaeen, one of the biggest marches will be held in Mashhad and all over Iran by order of the Imam, may God have mercy on him, to protest against Bakhtiar's rule and the establishment of the Islamic Republic. Ayatollah Khamenei and Martyr Hasheminejad give speeches about the continuation of the movement and the goals of the Islamic Republic of Iran. This is the last appearance of Ayatollah Khamenei in Mashhad

### Conclusion

First question: How is the Arbaeen phenomenon defined from the perspective of the Supreme Leader ?

The phenomenon of Arbaeen, the largest gathering in the world, is one of the religious movements that is considered among the positive and joyful points of our country and for our nation. Romantic behavior is spiritual in the material world and the movement is love and faith. It is a unique and unprecedented divine and spiritual phenomenon that has not been advertised, but suddenly emerges, the hand of God is more evident than anywhere else... It is a spiritual journey. This incident is extremely important. There are phenomena for which there is no advertising, no effort is made. It really cannot be described; Like many

of these important divine phenomena, it

cannot be properly interpreted; It means that this incident cannot be analyzed. Give thanks for this march incident

Second question: What factors are attributed to the greatness of the Arbaeen procession from the Supreme Leader's point of view ?

Referring to the fraternal, intimate and loving relationship between the two nations of Iran and Iraq, despite eight years of war imposed by Saddam with the instigation of foreigners, they consider it a strange phenomenon because there is no publicity for it, no effort is made. It is a very beautiful and glorious symbol of the presence of Ahl al-Bayt followers and those who are interested in Ahl al-Bayt that if the nations of Islamic countries are with each other in general directions, the Islamic world will reach the peak of progress and excellence; ... to be seen together in general issues; Being seen together has an effect. ...gives greatness to the world of Islam; The Arbaeen march shows the peak of this thinking of fighting in the way of God and in the way of Islam and the general preparation of everyone in this way .

Third question: In what contexts does the great Arbaeen procession take place ?

## **Two categories of active actors:**

### **Participants: including marchers:**

Shiites, Sunnis, India, from Europe, even from America, from cities far away from Najaf to Karbala, Nigeria, Pakistan and Afghanistan.

Hosts: members of the Iraqi people and officials, several million from Iran and millions from Iraq itself and from other countries; Special

thanks to the leadership of the Iraqi government, Iraqi people, Iraqi tribes .

## Opponents of the march:

Enemies of Islam and enemies of Ahl al-Bayt...criminal and vicious takfiri groups

The third group is those who monitor the march and Islamic issues .

Fourth question: What is the mediating (structural) facilitating conditions involved in creating a march ?

Iranian and Iraqi officials should make this march easy for those who love this work, which is the responsibility of the officials of different parts of the country

Fifth Question: What strategies are used to manage the huge Arbaeen procession ?

Management of the march and its survival: the effectiveness is in the hands of God Almighty. Let this huge population of millions walk, within a few years, this achievement will take shape! Yes, there was a march in the past, but this was not the news. This is really a phenomenon, it is a divine phenomenon, it is a spiritual phenomenon... It is governed by the strategy of unity, friendship and brotherhood.

Sixth Question: What are the consequences of the huge Arbaeen procession?

The officials of Iran and Iraq should make the most of this space and opportunity for the interests of both countries and it helps the greatness of Islam .

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**Spatial suitability for selecting a site for a plastic recycling facility to enhance bitumen, using remote sensing techniques and geographic information systems: A case study of the visitors' route to Karbala**

**Prof. Dr. Abdul Rahman Bilal Al-Ali**

college of Science , University of Baghdad

**Ibtisam Khanjar**

University of Baghdad / College of Science

**Ban Abbas**

**[dr.ban1969@gmail.com](mailto:dr.ban1969@gmail.com)**



## Abstract

In light of the increasing challenges posed by climate change and environmental crises, there is an urgent need to develop sustainable strategies that focus on improving the quality of bitumen, the basic component in the asphalt industry. This study aims to explore the use of remote sensing and geographic information systems (GIS) techniques to identify ideal places to set up plastic recycling facilities. Studies indicate that adding materials such as polyethylene terephthalate (PET) to bitumen improves its physical, mechanical, and chemical properties, especially in high-traffic roads such as city entrances and intersections. The exploitation of plastic waste accumulated during religious visits in Karbala in general and the Arba'een pilgrimage in particular for recycling is an example of making use of resources in a sustainable manner, especially in strengthening infrastructure. This study is consistent with Iraq's 2030 vision for sustainable development. Since 2016, the Iraqi government has adopted the 2030 Sustainable Development Goals and has taken serious steps to implement them. Key criteria for site selection include: proximity to sources of plastic waste, availability of basic infrastructure such as roads and public facilities, and compliance with local and national laws and regulations, including labor and raw materials, a deciding factor. The environmental impacts of the facility and the ability to expand to accommodate the increasing demand were also taken into account. The project takes advantage of precise spatial analyzes provided by satellite images and GIS tools, to study the geographical and environmental influences that may affect the effectiveness of recycling operations. Environmental indicators are also used to evaluate the environmental impact of each potential site and determine the economic benefits of each option. This research represents

an important step towards achieving more sustainable use of resources and improving the quality of materials used in infrastructure, which supports efforts to preserve the environment and enhance economic efficiency.

## 1-Introduction

Geographic Information Systems (GIS) are systems that create, manage, analyze, and map all types of data. GIS links data to a map, combining location data (where things are) with all kinds of descriptive information (what things are there). This provides a basis for mapping and analysis used in science and in almost every industry. GIS helps users understand patterns, relationships, and geographic context. Benefits also include improved communication and efficiency as well as improved management and decision making. In the context of Iraq's pursuit of achieving the sustainable development goals for the year 2030, which the government began adopting since 2016, the importance of this study lies in its being one of the few studies on waste dump sites in the city of Karbala and the first to use Geographic Information Systems (GIS) technology, spatial analysis, and data. Satellites to choose the best locations to create landfills according to health conditions and standards in the city under certain health conditions that serve the environment and citizens alike. Plastic waste constitutes a major burden on urban environments, as the increase in the crowds of millions of people in the city of Karbala, especially the Arba'een visit, which according to statistics reached 21,198,640 million visitors, the expansion of residential areas and their extensions, the rise in living standards, economic growth, the development of industries, and the limited

possibility of tracking waste in terms of... Its size, transportation, and disposal lead to the high volume of waste and the problems associated with it. Waste management is considered one of the biggest challenges facing municipalities in various cities of the world, because poor waste management leads to great dangers to the environment and the population. The city's success in managing this waste is a good indicator of the ability of institutions and organizations to work together to sustain the urban environment. The city of Karbala has recently been suffering from the most dangerous and widespread phenomena. The high prevalence of plastic waste in general has significant impacts on the city and its residents. Therefore, the testing process to choose a healthy and ideal plastic recycling facility location is not an easy process. Finding the best locations requires taking into account an entire geographic area and criteria, excluding unsuitable locations according to specific principles, and identifying the most appropriate locations. This study aims to promote the use of plastic waste in improving bitumen, which is vital for infrastructure and road development. Bitumen, the primary ingredient in asphalt, can be significantly enhanced by the addition of recycled plastic waste, increasing its durability and lifespan. Choosing the best locations to establish plastic recycling facilities requires a comprehensive view of the geographical area and the application of specific criteria that include distance from roads, urban areas, and water sources, and selecting lands with a low slope. This process, based on advanced spatial suitability analyses, aims to determine the optimal places to establish these facilities to achieve environmental sustainability and the required industrial development.

## 2. The use of polyethylene terephthalate cycled and organic bentonite hub to improve the properties of asphalt

The study is about the modified down material, which is characterized by being higher, more durable, resistant, and more endurable. To change in temperature, especially in hot climates, where a rise in air temperatures leads to An increase in the flexibility of asphalt and thus the emergence of many well-known road problems such as rutting Roads are a depression in the road surface in the form of grooves that extend longitudinally and appear in paths

Vehicle tires, and bleeding (bleeding), which is an upward transfer of asphalt binder materials, where they form a layer Sticky on the surface, and thermal fatigue cracks, where when they change. Temperatures in the surface layer produce, due to repeated cycles of temperature change, longitudinal cracks and Transverse, which are known as thermal stress cracks . The additives used in preparation .The study samples determined the cohesion and hardness of the asphalt bond materials by conducting a number of tests .It is used to diagnose the properties of asphalt, such as the penetration test at C25° and to examine it Softening point test, ductility test, and testing the sensitivity of asphalt to changes in Temperature susceptibility of bitumen found that the results obtained It indicated a significant improvement in the specifications of the asphalt bond material by adding both plastic materials and Clay together compared to models prepared by adding plastic only.

### 3-Study area

The city of Karbala is located in the Karbala Governorate in Iraq. It is located at latitude 32.62 and longitude 44.02, and rises above sea level by 32 meters. It is located 88 kilometers southwest of the city of Baghdad, and is connected to it by railway lines. In addition, it is located Near the western bank of the Euphrates River. As for the geographical location of the city of Karbala, it is located in central Iraq. It is approximately one hundred kilometers to the south from the Iraqi capital, Baghdad. It is bordered to the south by Najaf Governorate, to the east and northeast by Anbar Governorate, and to the west and northwest by Babylon Governorate. The city is located next to the Euphrates River. It is famous for its greenery, orchards, and palm trees. The city of Karbala is dominated by a desert climate, where temperatures rise relatively in the summer, sometimes reaching around 45 degrees Celsius at midday. However, in the winter, the temperature drops to zero degrees on some winter nights. As for rain, the city is affected by the desert climate. Because it is exposed to the desert and also to the alluvial plain from the east. The city witnesses religious visits throughout the year, and perhaps one of the most important visits that the city witnesses is the Arabian visit, which is considered one of the religious social and human occasions and rituals that are practiced on the twentieth of the month of Safar of every year according to the Hijri date, and given the religious and emotional characteristics of this million-strong demonstration. It has contributed to igniting thought that encourages volunteer and institutional work to an extent that exceeds all global institutional capabilities in this field. Over thousands of kilometers and from all directions leading to Karbala Governorate, and throughout the days of performing the rituals of the visit, we find old people, young men,

women, men, and even children, in processions, service bodies, government departments and institutions, and thresholds. Holy places, civil society organizations, and the media, who are in a tireless and continuous movement, are making exceptional efforts and spending huge sums of money, free of charge, to be used in the service of all visitors and expatriates from inside and outside Iraq. As shown in the figure (1).

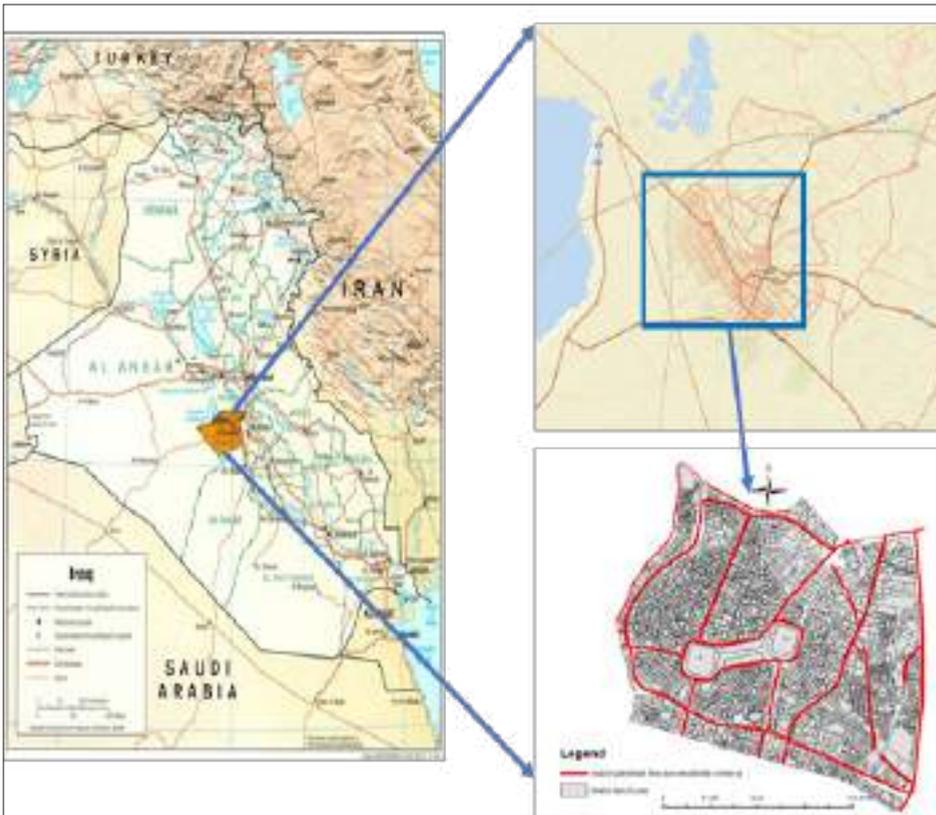


Figure (1): The geographical location of the Holy Karbala and the routes taken by visitors during the Arba'een visit: (Source: Researcher's work and General Authority for Geological Survey).

#### 4- Data used

To conduct research on the spatial suitability of a plastics recycling facility site for bitumen reinforcement using remote sensing and GIS techniques, we needed to collect a variety of geographic and environmental data which included:

1. Satellite data: satellite image in 2023 were used during the spring season on March 23 (acquisition time: CCT 9:38 AM) from USGS-certified Sentinel satellite program to determine the areas Urbanism, bare lands, and vegetation coverage. This data is useful for identifying areas that meet environmental and planning standards.
2. Climatic data: Giovanni data was used to obtain climatic data for the study area. It is a web platform of NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) and Distributed Active Archive Center (DAAC) developed by Goddard Earth Sciences Data and Information Services Center. (GES DISC) which provides a simple and intuitive way to visualize, analyze and access vast amounts of geoscience remote sensing data.
3. Topographic data: to identify areas with appropriate slope and avoid areas prone to flooding or with high elevations. It included the use of a radar image from the Japanese Aster satellite.
4. Infrastructure data: such as road locations, water and sewage networks, which will affect construction and operating costs. Which was used from the annual statistical bulletins of the Arba'een visit
5. This data will allow us to conduct an accurate spatial suitability analysis to determine the best locations for the recycling facility

based on a variety of criteria through the use of GIS programs to collect and analyze the data. The inputs represent the inputs of the proposed analysis and their relative weight in choosing the appropriate location, according to Table 1.

**Table (1):Criteria that represent the inputs to the spatial analysis of the proposal and their relative weight**

Standard	Scale	Relative weight
Distance between the city and major highways	A distance of no less than 500 meters	3
Local real estate regulation and land use	Barren lands and saline areas are considered excellent locations, while lands with dense agriculture and greenery are considered bad locations	3
Far from residential areas	It is located 500 meters away from existing residential projects or under mitigation	21

Water sources and wells	The distance between the site and the nearest water well should be 25 km	7
Slope and soil type	5% after perfect regression	5
temperature	It prefers higher temperature areas, which results in increased evaporation rates for the black sap	2
Relative humidity	It prefers less humid areas, which results in increased evaporation rates for the black sap	2

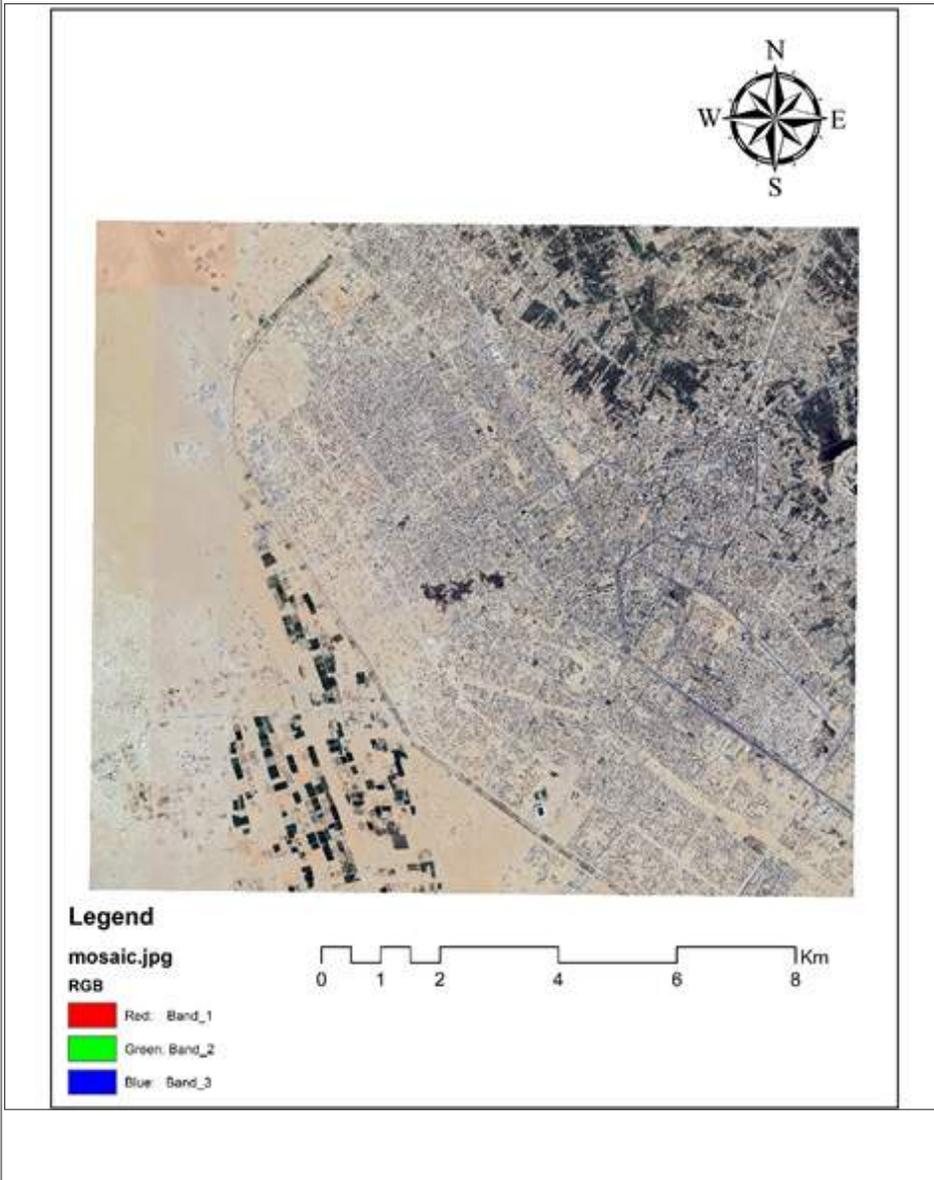
## 5-Methodology and Procedure

### 5-1 Digital image processing and classification:

After obtaining the images, some processing was performed using GIS 10.6, as the images contain geometric and radiometric errors. Therefore, a geometric correction of the captured image was performed using corrected satellite images in order to convert it to images with known geographical coordinates according to the UTM system for Iraq, and then it was Performing radiation correction to convert data into known radiation units or reflection units with logical values that represent the true reflection of ground features. Many bands were combined to produce a new image (RGB), where the spectral bands (MID IR, NER-

IR, GREEN) were combined to show differences in land cover more clearly than in grayscale images. After merging the spectral bands and making the corrections required by the satellite image, we analyze Image data through directed classification and selection of training samples, as these analyzes include the process of classifying the land cover of the city of Karbala to determine patterns of changes in urban areas, bare lands, and vegetation land by dividing image units into groups or classes based on the spectral parameters of the digital numbers of these units. If the image unit achieves specific spectral criteria or specific conditions, it is attributed to the class or group that is characterized by these spectral criteria, as it is considered the most important step in digital processing operations as it is the primary goal of these operations as the image is transformed into a thematic map about the phenomena in the studied area. And the figure (2) shows an image of the study area from the Sentinel satellite in false color and represents the final product of the correction and normalization process required for the data which will involve conducting and implementing all necessary analyses in the process of selecting the best location for establishing the plastic recycling facility.

Figure (2): false-color image (FCC) with bands (MID IR, NER-IR, GREEN) of the study area taken from the Sentinel-2 satellite, representing the final product of the radiometric correction and calibration process necessary for the data. This process will include implementing and conducting the necessary analyzes to choose the best location to establish a plastic recycling



## 5-2 Geological features and digital elevation models

A digital elevation model is a raster representation of a continuous surface that usually refers to the Earth's surface. The accuracy of this data is determined primarily by the resolution (distance between sample points). Other factors that affect accuracy are the type of data (integer or floating point), and the actual sampling of the surface when creating the original digital elevation model. The digital elevation model is one of the important methods and modern applications within the geographic information systems program, which provides a three-dimensional view of the terrain, which provides tremendous application potential in many sciences and fields, including its use as a tool for the geographic researcher, especially in the field of determining spatial suitability for choosing the location of the plastic recycling facility. The digital elevation model, which is based on satellite and aerial images, the Global Signature System, digital maps, and even corrected topographic maps, provides accurate measurements, analysis, and results when the digital elevation model is extracted from them, as it is possible to know the slopes, determine the locations of possible landslides, and direct, that is, know the effect of wind, rain, and solar radiation, and then determine The extent of the development of the soil and land erosion process. Good soil prevents odors from emitting from the facility and reduces erosion and wind scattering of buried waste. Suitable sites for establishing a landfill are those whose soils have slow permeability and weak pores, such as clay and calcareous soils, which reduces the leakage of landfill leachate fluids or leaching into groundwater and the spread of gases into adjacent areas. As for the slope, the waste cube area must slope slightly, which does not impede the natural drainage procedures for rainwater, does not pose a difficulty in construction and operation operations, or

cause waste seepage to leak into the groundwater formations that feed the area. Therefore, lands with a slope exceeding 25% can be excluded, and a slope of less than 5% is considered appropriate for creating a sustainable facility.

### 5-3 Spatial analysis of climatic characteristics

Protecting populated areas from any undesirable effects of a landfill is the goal sought by planners and those responsible for selecting and designing landfill sites. Scientific research has proven that a group of gases harmful to human health are often emitted from a landfill site, and that exposure to these pollutants at concentrations higher than the permissible levels and for long or short periods of time may increase the chances of contracting dangerous diseases. Therefore, it is necessary to choose a location for burying the waste, provided that it is placed in the direction opposite to the wind blowing relative to populated areas, thus forming a global standard and a public demand that must be taken into account and taken into account in order to accept the establishment of a sustainable facility for the waste landfill. In addition to temperatures and precipitation. In urban environments, air temperatures can rise dramatically due to urban heat islands, where materials used in construction and the dense buildup of industrial structures cause heat to be stored, affecting surface temperatures. Humidity affects the air's ability to conduct and store heat. Humid air retains heat more than dry air, which affects surface temperatures in particular. Evaporation from water surfaces and transpiration from plants also play a role in cooling the surface. According to international standards EN 1525, ideal air temperatures usually range between 29°C to 33°C during the winter and between 35°C to 40°C during the summer. These ranges

may vary slightly depending on the environments in which the project is implemented. Regarding humidity, the relative humidity within the environments should be between 30% and 60%. Humidity that is too high or too low can lead to discomfort and health problems for workers. The IDW method is commonly used in creating maps of different variables due to its accuracy and efficiency in processing spatial data, provided by ArcGIS 10.6 software to produce maps of the spatial distribution of climate data.

## 6- Results and discussion

### 6-1 Evaluation of environmental standards

When conducting the supervised classification process, five classes were identified located within the study area, representing three types of land cover (water, plants, and soil), and the plants were classified in turn into (dense plants and sparse plants), noting that land plants were not included in this study; Because it is spread outside the boundaries of the studied area, while the soil was classified into (dark soil and dry soil), this classification was applied by using the non-wave classification process, as well as through visual interpretation of satellite images, as the differences between the types are clear and distinguishable, in addition to Field information available in the annual statistical bulletins of the Arba'een visit and adapted by the General Secretariat of the Hussein Shrine. Note that the method used to implement the directed classification process is Parallelepiped. Using the capabilities provided by ArcGIS 10.6.

Bare lands, fallow lands, and saline lands that are not suitable for agriculture are considered the most suitable for establishing a Plastic

Recycling Facility, while agricultural lands are considered inappropriate and urban areas must be removed from the possibility of establishing the facility on them. The area has been classified into three main uses: urban and agricultural use, and abandoned lands (saline and decertified fallow). According to Table 2, which shows the percentages of land uses for the study area.

**Table (2): Areas and percentages of LULC based on the supervised classification**

Land use	Area (Km2)	Percentage %
Built up area	17.9	25.6
Agriculture land	11.5	19.1
Bare land	33.7	55.3

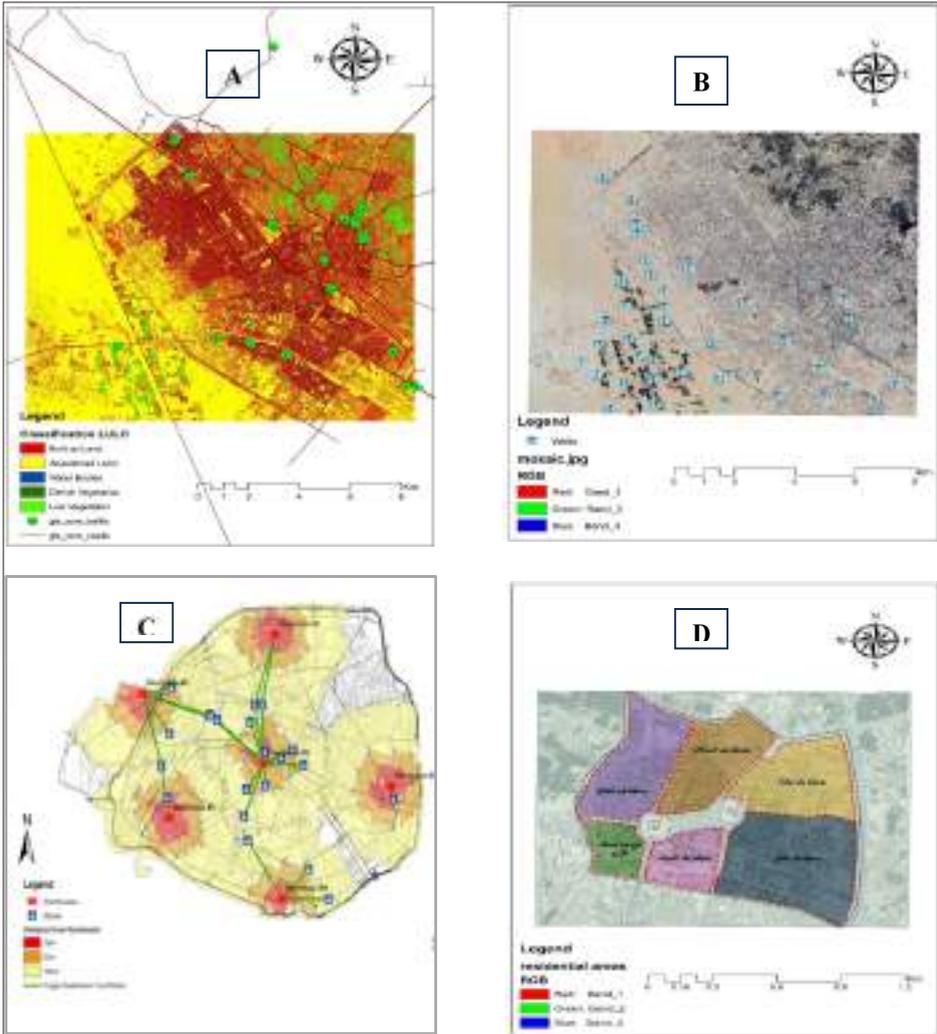
When planning a plastic recycling facility, it must be far from the main roads in order to reduce the health and visual effects and the annoying odors and fumes that cause inconvenience to vehicles passing on the road. Therefore, it is recommended to take a spatial scope around the main roads' of 1000 meters, which reduces the health and visual effects while maintaining the distance. Standardization. Also, away from rivers and wells, in order to avoid environmental risks that could occur if pollutants leak into river water or the well that residents depend on for drinking, agriculture, and various daily activities. Therefore, it is preferable for the landfill to be far from a river, and it is recommended to exclude any site located within 5 km of it. Rivers and wells in all directions, and areas located at a distance greater than 5 km are considered the most suitable for establishing a Plastic Recycling Facility.

The distance from side roads must be determined when planning

Plastic Recycling Facility. Therefore, a spatial radius around the side roads is recommended to be 250 meters to reduce the cost of transporting waste from its generation centers to the site. When planning Plastic

Recycling Facility, a separation distance from residential areas must be determined in order to protect residents from health and visual effects and the possibility of odors and fumes being transmitted to them, which causes the spread of diseases. It is recommended that a distance of 1,500 meters from residential areas be represented as a circle surrounding them. Figure 3 shows the final output of the environmental assessment processes, which included the distance between the city and major highways, Local real estate regulation and land use, far from residential areas and water sources and wells.

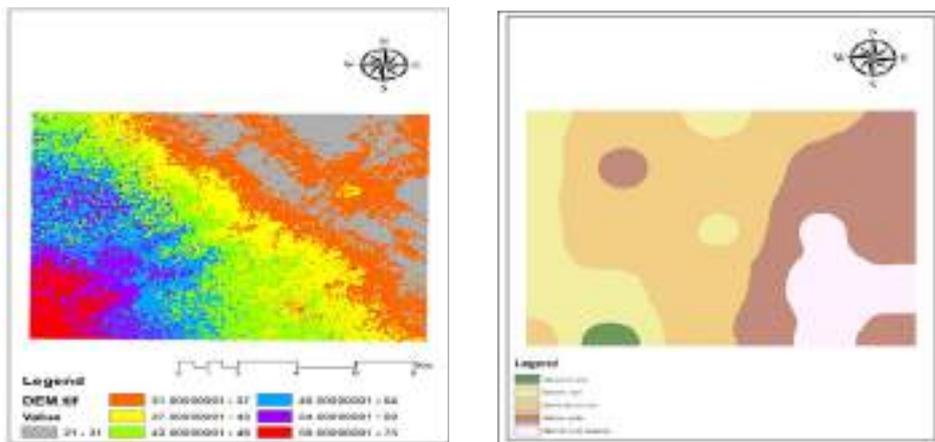
Figure (3): (A) map showing the classification of land uses and land cover of the study area and the most important traffic intersections in addition to the main transportation network within the region. (B) A map showing the spatial distribution of wells and drinking water sources. (C) A map showing the spatial and weight analysis of the transportation network within the city. (D) A map showing the important residential and neighborhood areas within the city



## 6-2 Geological criteria

The slope of the land surface represents an important element when planning to establish any project because of its direct impact on the appropriate location and the cost of preparing the site. This applies to a plastic recycling facility that needs flat or gently sloping land, and accordingly the slope was determined from. - 5% is ideal and the appropriate slope is less than 20%, but greater than 20% is an inappropriate slope. Soil is one of the important factors in determining suitable locations for establishing a plastic recycling facility because it is associated with soil types that have low permeability to prevent the seepage of pollutants into the ground. Low permeability represents high-density soils and rocky soils, and in the last stage comes sandy soils, which are characterized by their high permeability. And Figure (4) represents the digital elevation model of the study area to determine the slope ratio in addition to the spatial analysis of soil types in the study area

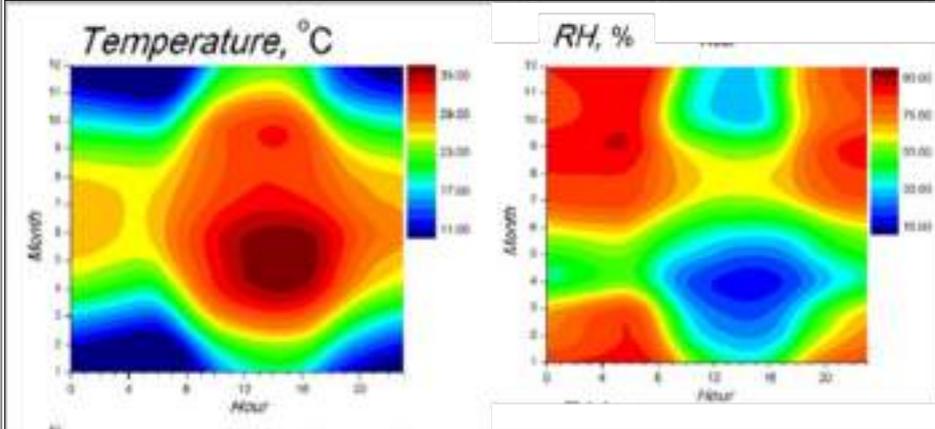
Figure (4): (A) radar map representing the digital elevation model (DEM) of the study area to determine the slope rate. (B) the spatial analysis of soil types in the study area



### 6-3 Climatic standards

Study of climatic parameters such as temperature and relative humidity is very important to determine the suitable location for a plastic recycling facility. These factors can affect the efficiency of operations within the facility and the sustainability of the materials used. Plastic can be affected by high temperatures, which may lead to damage or a change in its properties such as softness and strength. The temperature in the area must be determined because it has an impact on the evaporation speed of the leachate present on the site, which reduces the possibility of this leachate leaking and harming the surrounding environment. In environments with high humidity, plastic may absorb moisture, resulting in changes in its weight and physical properties. It usually ranges between 29°C to 33°C during the winter and between 35°C to 40°C during the summer. These ranges may vary slightly depending on the environments in which the project is implemented. Regarding humidity, the relative humidity within the environments should be between 30% and 60%. Humidity that is too high or too low can lead to discomfort and health problems for workers. Avoid extreme temperature increases as they may damage the plastic or change its properties, such as strength and flexibility. Humidity that is too low can also lead to static electricity problems, which may affect operations and worker safety. Figure (5) shows the spatial analysis of the monthly average temperatures and relative humidity in the study area.

**Figure (5): (A) Spatial analysis of monthly average for temperatures. (B) Spatial analysis of monthly average for relative humidity in the study area.**

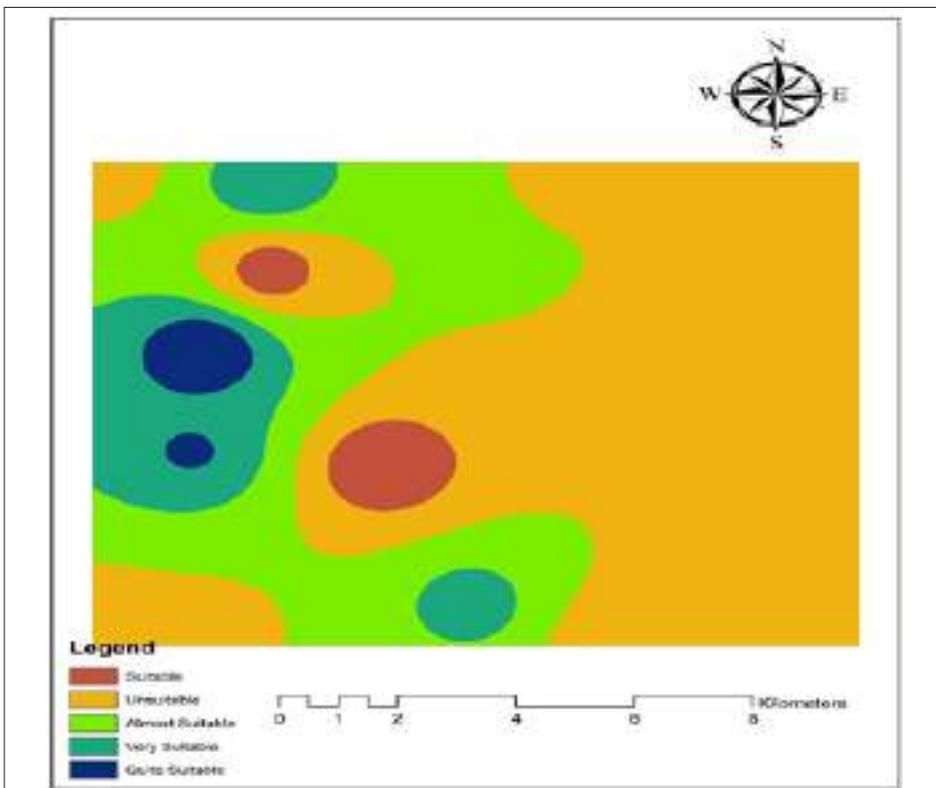


Based on careful integration of spatial data and specific criteria for selecting suitable locations for a plastic recycling facility in Karbala, three potential locations were identified as the best options, and these locations are shown in the final map in Figure (6), which summarizes the results of the study. Each of these locations has unique features that make it ideal for establishing a facility, consistent with the environmental, logistical, and regulatory considerations necessary to ensure efficient and sustainable operation of a plastic recycling facility.

Each site was evaluated based on several key criteria including: proximity to sources of plastic waste, ease of access to major road networks to facilitate transportation and distribution operations, level of environmental protection provided to surrounding areas, and environmental preservation. Also, the visual and health impact of the facility on local residents was taken into account, with an emphasis on minimizing the negative impact of activities associated with the facility on the local environment.

Detailed studies were also conducted to evaluate the land in terms of soil type, slope, and groundwater and river sources to ensure that the selected lands were suitable for the infrastructure and construction requirements of the recycling facility. The results reached enhance the facility’s efficiency in achieving sustainable development goals and reducing the environmental footprint of recycling operations

Figure (6): Map showing the proposed locations of the plastic recycling facility based on careful integration of spatial data and specified criteria



## 7- Conclusion

The purpose of this study was to determine the optimal locations for establishing a plastic recycling facility, in support of sustainable development within the framework of Iraq's Vision 2030, and to reduce environmental pollution resulting from plastic waste accumulated during religious visits to Karbala in general and the Arba'een visit in particular. To achieve this purpose, seven basic criteria were relied upon, on the basis of which geographically optimal locations were determined according to latitude and longitude, taking into account the balance of these criteria based on their priorities.

In this study, for the first time, geographic information systems were used to develop new standards based on the distance between cities and major highways, local real estate regulation, land use, distance from residential areas and water sources, in addition to taking into account the percentage of slope and the type of soil required, As well as climatic parameters such as temperature and relative humidity.

The study presents the possibility of benefiting several government agencies, such as municipalities, municipal waste departments, environmental organizations, and private recycling companies, by exploiting the research results to establish sorting centres in the identified optimal locations. This allows improved transportation management and optimal route planning according to the proposed model. By using various constraints in the model, more realistic conditions can be created to achieve accurate and useful future results.

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**Sustainable Groundwater for Karbala Pilgrims:  
Assessing the Viability and Efficiency of Groundwater  
Wells along the Baghdad-Karbala Pilgrimage Route  
using Remote Sensing Techniques**

**Abdulrahman B. Ali**

College of Science, University of Baghdad

**Email: [Abd199372@gmail.com](mailto:Abd199372@gmail.com)**

**Muaid Jassim Rasheed**

College of Science, University of Baghdad

**[muayid.j@sc.uobaghdad.edu.iq](mailto:muayid.j@sc.uobaghdad.edu.iq)**

**Fouad K. Mashee Al Ramahi**

College of Science, University of Baghdad

**[Phdfouad59@gmail.com](mailto:Phdfouad59@gmail.com)**



## Abstract

In this study, remote sensing data and spatial analysis techniques were used to study the validity and efficiency of groundwater in 45 wells. The study area included the Baghdad-Karbala Road, passing through the Jurf al-Sakhar district, extending over a distance of more than 80 kilometres (50 miles). The road begins from the city of Latifiya, where it connects with al-Qamishli Street at the Jurf al-Sakhar bridge in the village of al-Fadhiliya, to cross the city of Jurf al-Sakhar longitudinally, passing through the villages. agricultural areas, reaching the Al-Khanafsa and Al-Jamaliyya area, then to Karbala Governorate. Well locations were determined using Global Positioning System (GPS) and this data was processed and georeferenced to represent actual locations on satellite images. The Sentinel-2 satellite was used to capture images and were processed using ArcMap 10.6 software. The depths of the wells were studied and spatial analysis maps were produced based on the spatial extrapolation technique provided by the program. The results showed that the depths of the selected wells were within international standards and Iraqi standards, as the depth in Karbala reached 280 meters, while in Baghdad it reached 84 meters. The wells in the Baghdad Governorate formation were more productive than the wells near the administrative borders of the Karbala Governorate, as the highest production value reached 864 m<sup>3</sup>/day in the city of Latifiyah, while the highest value in the wells of the Al-Fadhiliya village reached 432 m<sup>3</sup>/day. day. day. The concentrations of chemical elements and physical properties of well water in the study area (Mg, Na, Ca, Cl, Pb, pH, EC)

were also studied. The results, based on the electrical connection, showed that 53% of the wells in the city of Latifiya and 64% in the Al-Khanfasa and Al-Jamaliyah areas are very suitable for use in irrigating livestock and poultry, while the percentage reached 14%. In the wells of the village of Al-Fadhiliya. The maps were drawn using the IDW method. The results showed that about 55% of the wells of the city of Latifiya and 67% of the wells of the village of Al-Fadhiliya fall between 40-55, and these values show that the water used for irrigation and watering crops is subject to restrictions.

**Keywords:** Sustainable Groundwater, Pilgrimage Route, spatial analysis techniques and The Sentinel-2 satellite Images.

## 1-Introduction

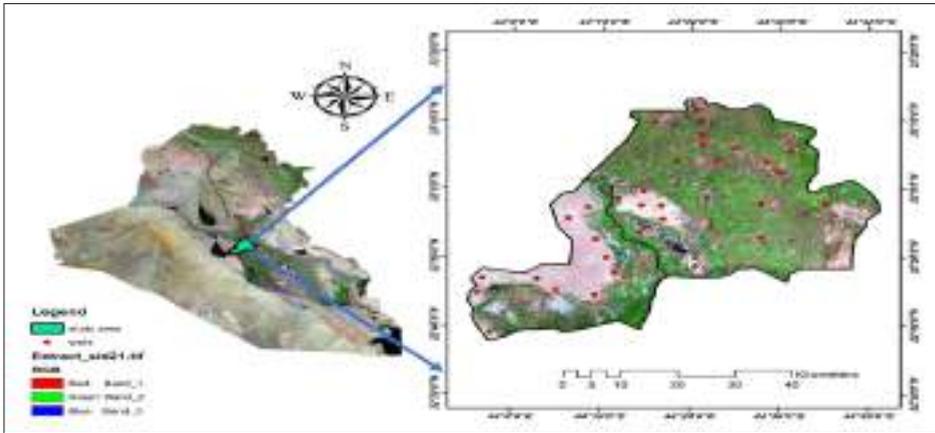
Groundwater occupies the forefront in areas where there are no sources of surface water from rivers and irrigation projects, where groundwater exists in the form of free ground water at depths of 1-5 meters below the surface of the earth in the plain parts and river valleys, and the depth of the groundwater surface increases to more than that in in the hills, groundwater moves towards rivers and streams to drain into them, while rainwater seeps in winter to replenish groundwater. In the summer, irrigation water seeps into it, and the level and concentration of groundwater changes depending on the withdrawal from it for irrigation and land use purposes, the availability of a drainage network, or the presence of a nearby river channel, as well as high temperatures, evaporation from the surface of the earth, wind movement, and the hydrological conditions of the region. The role and importance of groundwater

in the region has increased with the population increase during religious visits to Karbala in general and the Arbaeen pilgrimage in particular, in addition to the recurrence of years of drought in the recent period, especially since large parts of the region depend mainly on groundwater wells for agricultural investment, so Determining the suitability of groundwater for the purposes of human and agricultural consumption, through the application of modern techniques represented by the use of (GIS), in the analysis and spatial distribution of the qualitative characteristics of groundwater in the study area, is of great importance. The evaluation of water quality depends on several criteria, the most important of which is the total salt content and its ionic composition, which results in variation in its quality, as it depends on the type and quantity of dissolved salts resulting from the dissolution or weathering of rocks, such as the dissolution of gypsum and lime, which in turn are transported with irrigation water. Water quality is the subject of research and study in many countries, and the most important qualitative specifications for irrigation water that must be studied are agreed upon by most classifications. The US Department of Agriculture (USDA) indicated in its 1954 guide (Richards, 1954) that the most important characteristics determining water quality are the electrical conductivity value, the sodium adsorption rate, and the concentration of boron and bicarbonate. As for the classification of the Food and Agriculture Organization of the United Nations (FAO) (Ayers and Westcot 1985), they adopted the value of electrical conductivity for its direct effect on plant growth and the rate of sodium adsorption for its effect on soil permeability, water sinkage, and the concentration of chlorine, boron, and sodium as harmful ionic concentrations, and they adopted other incidental effects such as the concentration of nitrates. And bicarbonate and the degree of water

interaction. As for the classification of the same organization in 1992, they used salt concentration estimated by electrical conductivity to determine the type of salt water and came up with six types and types of salt water. As for the classification (Glim, 1997), it classified water into six types based on electrical conductivity and percentage Sodium adsorption, boron ion concentration, and chloride ion activity, which is a proposed guide for classifying irrigation water quality specific to Iraqi water. A study was conducted to evaluate the quality of groundwater in Karbala Governorate (Shukri, 2002). To evaluate the quality of groundwater for a poultry project, Karbala, the annual average electrical conductivity values varied. Between 2.06 - 6.48 dSm-1 and the values of the sodium adsorption rate ranged between 3.50 - 6.98 and it was classified under the C4-S2 category according to the American classification of 1954 (Richards, 1954) and under the acute problem according to the International Food and Agriculture Organization classification. The research aims to represent a set of qualitative characteristics of groundwater on the Baghdad-Karbala Road, passing through the Jurf al-Sakhar district, extending over a distance of more than 80 kilometres. The road begins from the city of Latifiya, where it connects with al-Qamishli Street at the Jurf al-Sakhar bridge in the village of al-Fadhiliya to cross The city of Jurf Al-Sakhar, passing through the agricultural villages, reaching the Al-Khanfasa and Al-Jamaliyya area, then to Karbala Governorate, using geographic information systems (GIS) and analyzing their spatial distribution, where each of the studied properties is represented by an independent map, and its categories are classified according to a set of criteria to provide See how valid this is Qualitative characteristics for purposes of drinking, irrigation, and watering animals over the area of the research area, and then performing a spatial matching process (overlay) on the maps of these

properties to reach the final determination of the areas in which groundwater is suitable for the purposes of drinking, irrigation, and watering animals, over the area of the study area.

## 2- Study area



the Baghdad-Karbala Roads, passing through the Jurf al-Sakhr district, extending over a distance of more than 80 kilometres. The road begins from the city of Latifiya, where it connects with al-Qamishli Street at the Jurf al-Sakhr bridge in the village of al-Fadhiliya, to cross the city of Jurf al-Sakhr longitudinally, passing through the agricultural villages. Reaching the Al-Khanafsa and Al-Jamaliyya area, then to Karbala Governorate. The region is located within the desert climate zone, which is characterized by very hot summers and moderate to cold winters. Summer is long and dry, with temperatures rising to more than 40 C during the day, while falling at night but remaining high. Winters are relatively short, with little rain and temperatures sometimes falling below zero at night on the coldest days. Monsoons are common and can stir up dust and sand, affecting visibility and agricultural activities.

The road represents great geostrategic and economic importance as it connects Baghdad and Karbala, making it a major hub for commercial and religious movement, especially during the Hajj seasons and the large religious visits that Karbala witnesses. The city witnesses religious visits throughout the year, and perhaps one of the most important visits that the city witnesses is the Arba'een visit, which is considered one of the religious social and human occasions and rituals that are practiced on the twentieth of the month of Safar every year according to the Hijri date, and millions of delegation's head towards the city. Figure 1 shows the location of the study area in Iraq

Figure (1): RGB image with bands (MID IR, NER-IR, GREEN) of the study area taken from the Sentinel-2 Satellite, showing the boundaries of the study area and the wells used.

### 3-Data Sources and Programs used:

The study relied on a variety of data, mainly represented by the following data:

Data on well water distributed over the research area extending on the Baghdad-Karbala Road, passing through the Jurf al-Sakhar district, extending over a distance of more than 80 kilometers (50 miles). The road begins from the city of Latifiya, where it connects with al-Qamishli Street at the Jurf al-Sakhar bridge in the village of al-Fadhiliya, to cross the city of Jurf al-Sakhr is located longitudinally, passing through the agricultural villages, reaching the area of Al-Khanfasa and Al-Jamaliyya, then to Karbala

Governorate, which has a number of (145) groundwater wells. For each of these wells, a set of spatial data is available that was obtained from (GPS) readings, represented by the coordinates of the geographic location (X., Y), and the other part of the data was represented by the descriptive data (Attributes Data) for these wells, which was represented by the qualitative analyses of the groundwater, which included the following characteristics (EC, TDS, Ca, Mg, SO<sub>4</sub>, CL, Na, Ca, HCO<sub>3</sub>).

Radar data and digital elevation models (DEM) were also adopted to identify the nature of the terrain surface of the area (elevation and slope).

Giovanni data was used to obtain climate data for the study area and is a web platform of NASA Goddard Geoscience Data and Information Services Centre (GES DISC) and Distributed Active Archive Centre (DAAC) developed by Goddard Geoscience Data and Information Services Centre (GES DISC). It provides a simple and intuitive way to visualize, analyse and access massive amounts of Earth science remote sensing data.

## 4-Study Methodology

### 4-1 Spatial Analysis of Physical and Chemical Properties

The study relied on the descriptive analytical approach and the quantitative approach to identify the qualitative characteristics of groundwater in the study area. Data related to the subject of the study was collected from the water of some wells approved by the Groundwater Directorate and the Environment Directorate in Muthanna Governorate, as well as from other selected wells

distributed throughout the study area. The results were analysed laboratory-wise and modelled map-wise using the ArcGIS 10.6 geographic information system program, which is one of the most modern and efficient programs in this field. Spatial interpolation tools, represented by the inverse distance weighted (IDW) method, were used for the purpose of derivation, digital processing, and cartographic output of the selected water sampling points. The concentrations of each element were represented by an independent map that was classified into three categories according to the approved planning standards, and then a spatial matching process (overlay) was performed on the maps of these elements after giving them assumed weights to reach the final determination of the wells whose groundwater is suitable for use.

The qualitative variables studied: The quality of groundwater is no less important than its quantity, and the desired quality of the existing groundwater depends on the use of that water. The qualitative variables of groundwater mean the sum of the dissolved salts it contains, and are expressed in terms of weight in parts per million A set of basic determinants were adopted in evaluating the validity Groundwater for drinking and irrigation purposes. In light of this, the decision was made to determine the areas in which groundwater well water is suitable for drinking and irrigation purposes. These determinants included the following variables:

1. Electrical Conductivity (EC): The electrical conductivity of water is its ability to carry electrical current, and its high value indicates the presence of a large percentage of salts, bases, and acids. The reason is either natural or human.
2. Dissolved Solids (T.D.S): This variable reflects some of the physical

and chemical characteristics of water, such as salinity and water quality. The movement of groundwater affects the effectiveness of water in dissolving limestone rocks and evaporates, thus raising the concentration of dissolved salts. This changing acquires a great importance in the process of classifying the qualitative of the underground water in terms of its suitability for the purposes of drinking and irrigation as well as watering the tales, which is the basic standard in determining or evaluating the validity of the water to water the animals in the first place.

3. Sodium (Na): The sodium ion is produced from the dissolution of minerals that make up salt rocks, such as halite, as well as from the weathering of clay minerals.

4. Calcium (Ca): The high percentage of calcium ions is due to the predominance of gypsum and limestone rocks, whether they are passing rocks or containing it, where calcium reacts quickly and combines with bicarbonate to form calcium bicarbonate.

5. Magnesium (Mg): Dolomite rocks, limestone, and clay minerals are the main sources of magnesium ion, which is formed as a result of the process of decomposition and dissolution in groundwater.

6. Bicarbonate ( $\text{HCO}_3$ ): The source of this ion is water reacting with carbon dioxide, forming carbonic acid. This water, in turn, reacts with carbonate rocks exposed in the study area, especially limestone, forming a calcium bicarbonate solution.

7. Chlorides Cl: The reason for its presence in the study area is due to the lamellar clay that prevails in rock formations such as the Injana and Fatha formations.

8. Sulphur,  $\text{SO}_4$ : The reason for its presence is due to the predominance of gypsum formations (gypsum and anhydrite) due to the formation of the hole, which have a high ability to dissolve and decompose in water. Table 1 shows the official measurements of the Iraqi specifications adopted in

evaluating the suitability of groundwater for drinking and irrigation.

**Table (1): The official measurements of the Iraqi specifications adopted in evaluating the suitability of groundwater for drinking and irrigation.**

Concentrations (mg/L)	Acceptable Upper Limits	Maximum Allowed Limits
Ca	75	200
Mg	50	150
Cl	250	600
SO4	200	400
TDS	500	1500
Na	250	-
HCO3	-	250
EC	750	1500

#### 42- Natural and Geological Characteristics of the Study Area

The natural characteristics of the study area, represented by the geological formation, surface, climate, and water resources, are effective controls because of their influence in determining the quantity and quality of groundwater, because the possibility of managing the environment according to what man wants is

still limited, as its effects appear in surface water resources, such as rivers, for example. However, they are directly responsible for determining the quantity and quality of groundwater under the surface of the Earth, which varies from one region to another. The geological structure also has an influential role in determining the locations of the areal extent of water by studying the effect of rock properties on the quantity and movement of groundwater. Climate elements also participate in determining the amount of groundwater, which is Rain and heat, the effects of which vary seasonally between summer and winter, and their role in the formation of groundwater, as well as the role of surface water resources in enhancing the amount of water recharge to that water. Geological construction plays an essential role in the availability of groundwater in terms of determining the locations of groundwater reservoirs and their extensions, as well as distinguishing their qualitative characteristics. The geological structure of the research area dates back to the Cretaceous period of the second geological time and the Holocene of the fourth geological time. The rock characteristics of these formations were reflected in the qualitative characteristics of groundwater in the region. The plain land formed an important range in the development of groundwater reservoirs. Climate plays a fundamental role in the availability of groundwater and its variation from one season to another and from year to year. The effect of this factor depends directly on the amount of rainfall and the distribution of temperatures, which directly affects the effectiveness of rain. Table (3) shows the climatic characteristics of the study area.

**Table (2): Monthly climate data in the study area**

Month	Rainfall rates/mm	Average Temperature/°C	Monthly Evaporation/mm
Jan	67.1	7.8	53.78
Feb	64.1	8.5	71.91
Mar	77.2	15.5	116.81
Apr	19.9	18.6	179.89
May	12.2	29.6	294.48
Jun	0.0	33.4	415.72
Jul	0.0	35.1	513.62
Aug	0.0	37.4	493.93
Sep	0.2	29.3	387.43
Oct	15.8	23	265.46
Nov	41.6	15.3	163.46
Dec	44.0	9.1	62.79
Average	32.65	23.74	3096.21

## 5- Results and Discussion

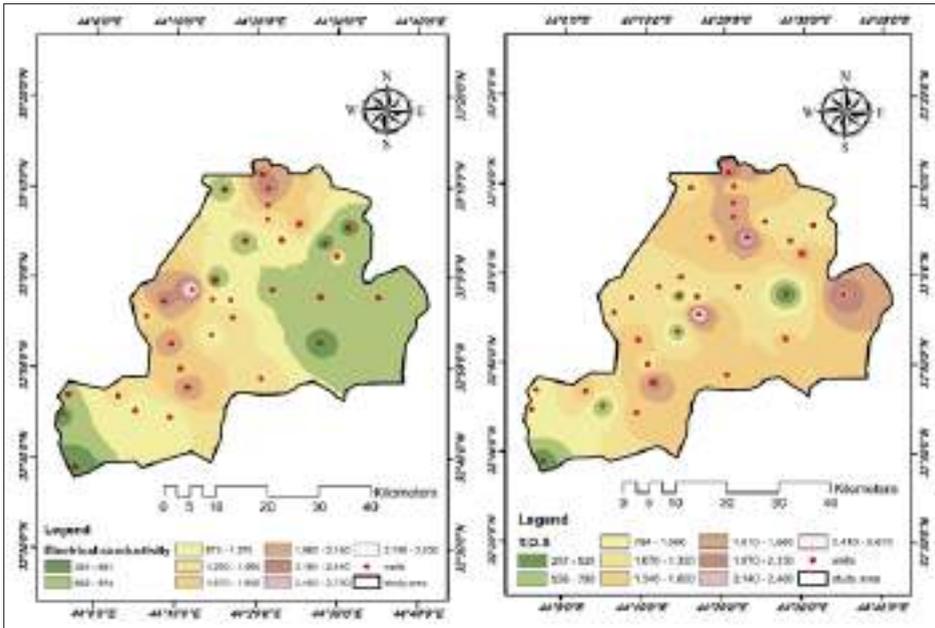
### 5-1 Spatial Analysis of the Qualitative Characteristics:

Spatial analysis of the qualitative characteristics of groundwater in the study area was conducted using spatial interpolation tools, represented by the inverse distance weighted (IDW) method, for the purpose of derivation, digital processing, and cartographic output of the selected groundwater sampling points, as the concentrations of each element were represented by an independent map that was classified into categories according to The approved planning standards and according to the Iraqi standard specifications, where the electrical conductivity value ranged between 387 and 3030, and as shown in Figure (2), it was classified into three groups, according to the specifications of the Iraqi standards table, as the first and second groups were within the permissible limits for drinking and irrigation and accounted for ( 44.14% of the area of the study area, while the third group was classified within the impermissible boundaries for irrigation and drinking purposes and occupied 55.86% of the area of the area.

The 57 and 2re (2), and the shape categories were classified according to the specifications of Iraqi standard standards (Table 2), into three groups, as the first and second groups fall within the permissible limits Drinking purposes Irrigation and occupied a percentage of (63.65)% of the area of the research area, while the last group was classified within the impermissible boundaries for irrigation and drinking purposes and occupied a percentage

of (36.35)% of the area of the area, which constitutes a positive element in investing in groundwater in this area.

**Figure (2): Spatial analysis of the physical and chemical properties of the wells of the study area. On the right the electrical conductivity (EC), and on the left is T.D.S.**

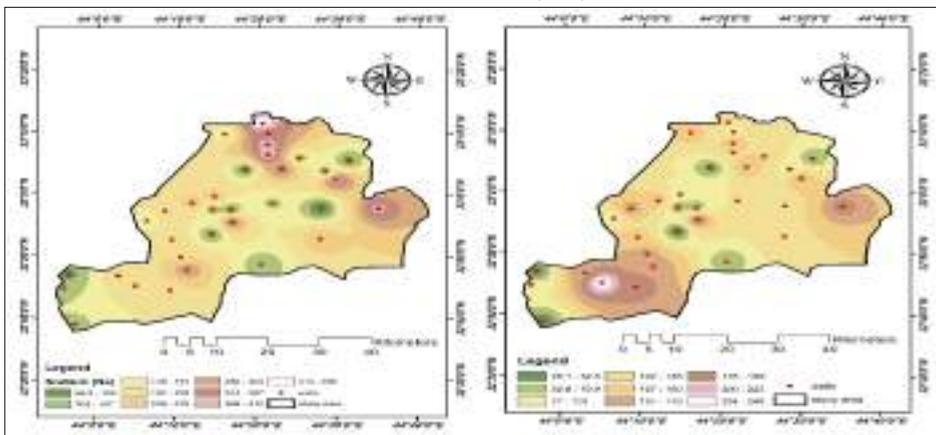


The sodium (Na) concentration values varied between 58 and 456 mg/L, as shown in Figure (3). The map categories were classified according to the Iraqi standard specifications (Table 2) into two groups. The first group was within the permissible limits and accounted for 79.24%, while the first group The second rate was 20.76% and was within the permissible limits for drinking purposes.

The percentage of calcium (Ca) concentration varied between 28 and 248 mg/L, as shown in Figure (3), and according to Iraqi

standard specifications (Table 2), the categories of the map can be classified into three groups. The first two groups belong within the permissible limits for drinking purposes and occupied 85.02%. From the area of the area While the third group belongs within the limits permitted for drinking purposes, and it occupied 14.98% of the area of the region.

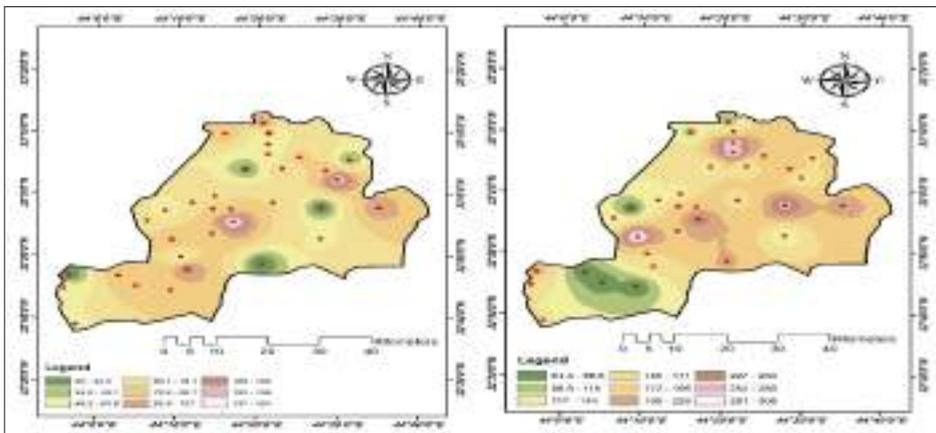
**Figure (3): Spatial analysis of the physical and chemical properties of the wells of the study area. On the right sodium (Na) concentration, and on the left the calcium (Ca) concentration.**



The concentration of magnesium varied between 20.1 and 151 mg/L, as shown in Figure (4), and based on (Table 2), According to the specifications of the Iraqi standard standards (Table 2), it was divided into three groups. The first and second groups were within the permissible limits for drinking and irrigation purposes and accounted for (65.49) % of the area of the research area, while the last group was classified within the permissible limits for irrigation purposes. And drinking, and it occupied 41.35% of the area of the region

The concentration of bicarbonate varied between 61 and 308 mg/L as shown in Figure (4), and based on (Table 2) it is clear that the distribution of the concentration of this element over the research area falls within the permissible limits for drinking purposes. The map categories were also classified into three groups. The first two groups belonged within the limits permitted for drinking purposes and occupied 81.02% of the area of the region, while the third group belonged within the limits permitted for drinking purposes and occupied 19.98% of the area of the region.

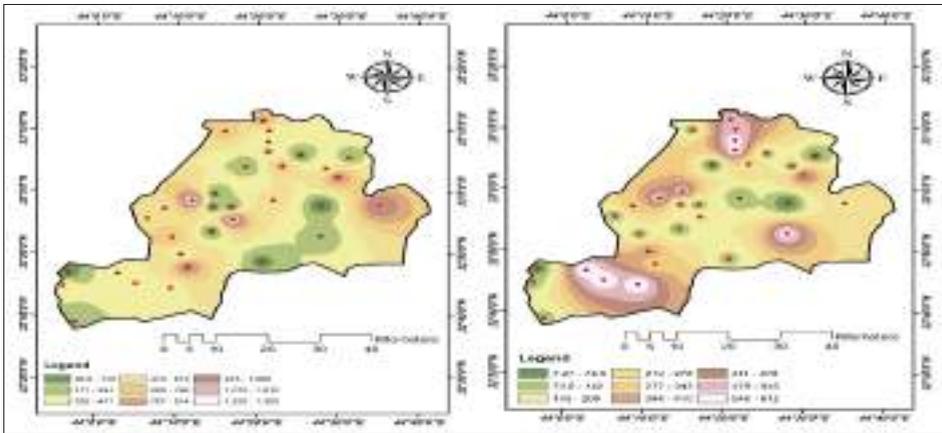
**Figure (4):**Spatial analysis of the physical and chemical properties of the wells of the study area. On the right magnesium (Ma) concentration, and on the left the bicarbonate (HCO<sub>3</sub>) concentration.



concentrations varied between 28.6 and 1360 mg/L and was classified into three groups, according to the Iraqi standard specifications (Table 2), where the first two groups belong within the permissible limits for drinking purposes 34.4% of the area of the area, while the third group occupied 65.6% of the area of the area, and this group wasn't within the limits permitted for drinking purposes.

The concentration of chlorides (Cl) varied between 7.25 and 612 mg/L, as shown in Figure (5). Based on the Iraqi standard specifications (Table 2), the map categories can be classified into two groups. The first group was within the permissible limits for drinking purposes, as it accounted for 98% of the concentration Area square While the second group occupied 2% of the area, which was outside the permissible limits for drinking purposes.

**Figure (5): Spatial analysis of the physical and chemical properties of the wells of the study area. On the right sulfate (SO4) concentration, and on the left the chlorides (Cl) concentration.**

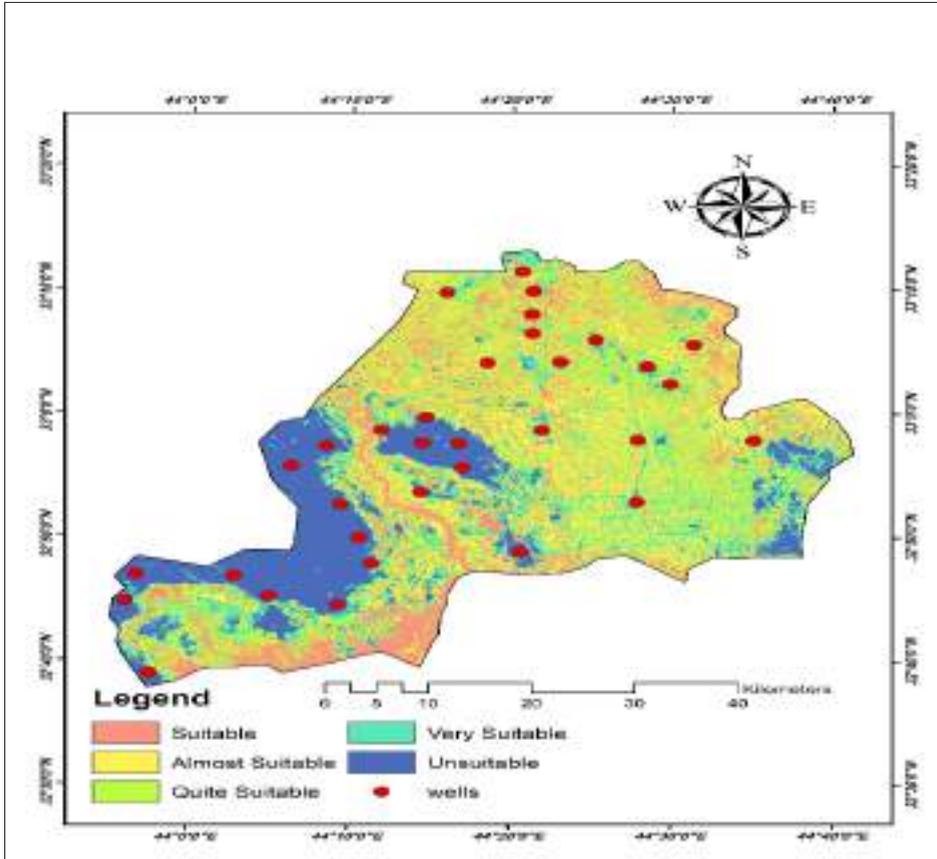


## 5-2 Spatial Correspondence of Maps of Physical and Chemical Variables:

Spatial matching of maps of physical and chemical variables is the process of integrating a set of different maps within a unified coordinate frame. This process is done by overlaying several layers of data, with each layer containing a specific characteristic. These data are processed digitally using computational capabilities, which

facilitates their analysis by merging and unifying the various data to produce a new map that includes comprehensive descriptive information for all the phenomena to be analyzed. This process is one of the main functions of geographic information systems. After performing spatial matching of the maps that include the physical and chemical variables specified for the study, the areas or polygons whose water appears suitable for drinking and irrigation are identified, The results of spatial matching, according to Iraqi standard specifications (Table 2), showed that the wells in the city of Latifiya and in the areas of Al-Khanafa and Al-Jamaliyah are very suitable for use in irrigating livestock and poultry at a rate of 66%, while the percentage reached 14%. In the wells of the village of Al-Fadhiliya. The results showed that about 55% of the wells of the city of Latifiya and 67% of the wells of the village of Al-Fadhiliya fall between 40-55%, and these values show that the water used for irrigation and watering crops is subject to restrictions. High in order to become highly efficient and practical in using it for drinking. While the wells near the city of Karbala were classified into three groups, according to the Iraqi standard specifications (Table 2), where the first two groups belonged within the permissible limits for drinking purposes and accounted for 34.4% of the area's square footage, while the third group occupied 65.6%. % of the area of the area. This group falls within the limits unpermitted for drinking purposes. as shown in Figure (6).

**Figure (6): The final output of the matching process based on the results of the spatial analysis of physical and chemical properties (The area isolating whose water is suitable for drinking and irrigation).**



## Conclusions

1. The spatial analysis of data on the qualitative characteristics of ground-water using modern techniques
2. It enabled the researcher to move from the descriptive analysis stage to the decision-making stage.

3. The presence of a strong spatial relationship between environmental conditions, which are mainly represented by the geological formations of the region, which is reflected in the qualitative characteristics of groundwater.

4. The values of the qualitative characteristics of groundwater varied between

5. Acceptance is 100% for the distribution of the element (Mg), and acceptance is 34% for the element (So<sub>4</sub>) based on the area of the study area.

6. The values of the qualitative characteristics of groundwater varied in terms of its suitability for irrigation purposes, between a percentage of (46%) for the element (EC) and a percentage of (60%) for the element (TDS).

7. The results of the spatial correspondence of the distribution of suitability values of the qualitative characteristics of groundwater for drinking purposes showed that (37%) of the area of the study area was water suitable for drinking purposes, while it was (55%) for irrigation purposes.

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# **An intelligent Automated Traffic System for Crowded Arbaeen's Pilgrimage**

**Dr. Hussein Tbena Kadhim**

Ministry of Science and Technology Industrial Research and  
Development Directorate

**[Hussein@almostafa.edu.iq](mailto:Hussein@almostafa.edu.iq)**

**Dr. Maithem Sabri Jaber**

Ministry of Science and Technology Industrial Research and  
Development Directorate

**[maithemsabri71@gmail.com](mailto:maithemsabri71@gmail.com)**

**Dr. Sameer K. Salih**

Ministry of Science and Technology Industrial Research and  
Development Directorate

**[SameerKleban72@gmail.com](mailto:SameerKleban72@gmail.com)**

**Hasan Abbas Hussein**

Ministry of Science and Technology Industrial Research and  
Development Directorate

**[enghasan1969@gmail.com](mailto:enghasan1969@gmail.com)**

**Omer Adel Abdalrazak**

Ministry of Science and Technology Industrial Research and  
Development Directorate

**[oalayobi@yahoo.com](mailto:oalayobi@yahoo.com)**



## Abstract:

An effective Automated Traffic System for crowds is a serious difficulty in many countries, like the Republic of Iraq, where millions of tourists from all over the world pay their respects at the holy monuments. This religious rite necessitates enormous groups performing the identical behaviors at certain times, making crowd management vital and difficult. Disasters such as stampedes, suffocation, and congestion become more possible when crowds are not properly managed and controlled, as happened in 2019 during Tuwairij's Ashura run. Nowadays, an intelligent Automated Traffic System for Crowd represents excellent solutions for crowd management and control, loss minimization, and the integration of various smart technologies. Furthermore, an intelligent Automated Traffic System for Crowd allows strong interaction and diverse connections between different devices over the Internet, resulting in big data.

This study proposes a smart approach to an intelligent Automated Traffic System for Crowd technology to manage crowds while avoiding congestion at the entry and exit points of the area between the Two Holy Mosques (Imam Hussein and his brother Imam Abbas, peace be upon them) in Karbala. The study employs a proposed mechanism that classifies visitors based on the data collected and takes advantage of an intelligent Automated Traffic System for Crowd and cloud

infrastructure to monitor crowds within a crowded area, identify evacuation routes for visitors, and guide visitors to avoid congestion in real time. In addition, the study aims to provide crowd safety and security based on actual scenarios by controlling and guiding visitor movements in accordance with potential hazard features, visitor behavior, and environmental factors.

**Keywords:** big data, cloud computing, crowd organization, intelligent crowd management, Internet of Things.

## introduction:

The eternal tragedy of tuff occupied a temporal size that extended from the year (61 AH) to the present day and will continue to stand at the borders of the land of Karbala, but extends over every land witnessing a conflict between the forces of truth and the forces of falsehood until it became (all the land of Karbala and every day of Ashura) as we can see in the square and the daily scene of events and as shown in the analogy in Figure 1.

**Figure 1: Illustrative  
Image of the Battle of Tuff (Pharaoh, 2015).**



Cities that host major events, such as religious rites, pilgrimage seasons, and historical ceremonies, often have large crowds present at the event site. The Al-Arbaeen ceremony, which takes place every year in Karbala, Iraq, is a significant and unique occasion. Large crowds are drawn to Karbala for religious activities, causing the region to become extremely crowded throughout the year. The graves of Imam Hussein and his brother Abbas (peace be upon them) are located in the city's distinctive urban core, which attracts many visitors (Alrawe & Qasim, 2018). To analyze this large-scale gathering, it is essential to examine and forecast the areas occupied by visitors and to propose a design concept for visitor transportation to and from Karbala.

Research on crowd dynamics during Arbaeen, focusing on crowd density, occupied areas, smart scheduling, statistical estimates, and crowd modeling, has been limited. Conversely, previous research has addressed various subjects from a different perspective: the relationship between architecture and socio-cultural traditions was reevaluated by Merie and Farhan (2022), particularly in the historic core of Karbala surrounding the two holy shrines. Within the Al-Muheet Road ring, mosques and shrines comprise the majority of the city, covering an area of more than one square kilometer. Karbala is unique among Islamic cities, as its heart is represented by the shrines. Despite its religious significance, Karbala has managed to retain its socio-cultural and heritage identity, partly due to the green spaces that surround it and its ability to attract millions of Muslim pilgrims each year. According to Nikjoo, Sharifi-Tehrani, Karoubi, and Siyamiyan (2020), Iraq hosts one of the world's largest annual pilgrimages, with approximately 20 million Shia Muslims attending. Many pilgrims begin their spiritual journey on foot from various locations, primarily Najaf and Basra, to reach Karbala for the Arbaeen commemoration. The study found that pilgrims arrive in Karbala at different times, and not all remain until the day of Arbaeen. This suggests that further research is needed to determine the peak attendance of the crowd. According to UNWTO estimates, there are over 600 million religious trips made globally each year, with between 300 and 330 million visitors attending significant religious sites (Moufahim & Lichrou, 2019). The world's largest annual pilgrimage, Arbaeen, draws millions of pilgrims from both

domestic and international locations, creating a significant demand for lodging and transportation services. As a result, ensuring the comfort and safety of pilgrims is essential and cannot be overlooked. Karbala is, therefore, an ideal setting for researching pilgrimage crowds. The work by Sharma, Bhondekar, Shukla, and Ghanshyam (2018) examined developments in crowd management technologies, such as data collection and processing, crowd modeling, and crowd control strategies. Various scientific and technical disciplines must collaborate to manage crowds effectively, as poor management can have disastrous consequences. It is an interdisciplinary field that requires knowledge of the psychological, social, and engineering aspects that influence crowd behavior and flow. Crowd management should be considered when planning public infrastructure in areas where high levels of congestion are anticipated. In addition to highlighting the safety concerns associated with large-scale mass gatherings, the authors of Karbovskii et al. (2021) offered a novel technique to forecast short-term crowd movement. Severe incidents, such as the Kumbh Mela stampede in Allahabad, India (2013), the Hajj crush in Mecca, Saudi Arabia (2006 and 2015), and the Love Parade disaster in Duisburg, Germany (2010), have occurred in recent history. Crowd management and behavior analysis are key components of safety assurance at such events. The ability to estimate crowd flows based on historical and current flows in a specific area poses a significant challenge in understanding crowd dynamics.

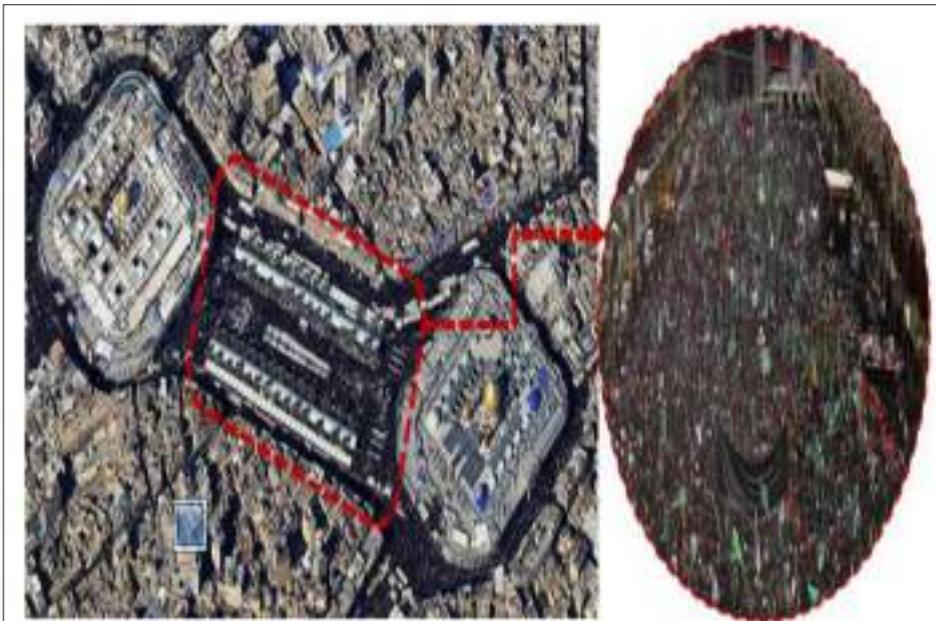
Alghamdi et al. (2022) focused on the necessity of realistic IoT-based smart modeling solutions to control crowding during religious events like the Hajj, where pilgrims' close contact during prayer, tawaf, and hotel stays can lead to the spread of illnesses. Intelligent scheduling and modifications in crowd flow can help curb the spread of infectious diseases and prevent stress and injuries from pilgrim collisions, particularly affecting elderly and female pilgrims. To better understand and replicate individual and collective pedestrian behavior in various scenarios, Gayathri, Aparna, and Verma (2017) conducted several experiments. These studies have the potential to enhance crowd safety. Nonetheless, there are notable distinctions between pedestrian behavior in public areas during regular events and that of large groups. A mass gathering occurs when more individuals than a certain number come together for a specific cause for a predetermined time at a designated location. Mass gathering events, especially during communicable disease alerts and responses, pose significant risks due to various factors, including densely populated areas, physical barriers preventing access, insufficient crowd control, and incomplete information about the surroundings and activities.

### **Problem Definition:**

The Arbaeen pilgrimage, which takes place every year from the first to the twentieth of Safar, is most crowded on the twentieth due to the Ziyarat Alarbaeen ceremonies. This results

in congestion in the areas surrounding the sacred sites, making it difficult for pilgrims to navigate. According to Figure 2, the increasing number of visitors necessitates the provision of sufficient space to prevent congestion and ensure a comfortable environment for the performance of Ziyarat Alarbaeen, which holds great spiritual significance.

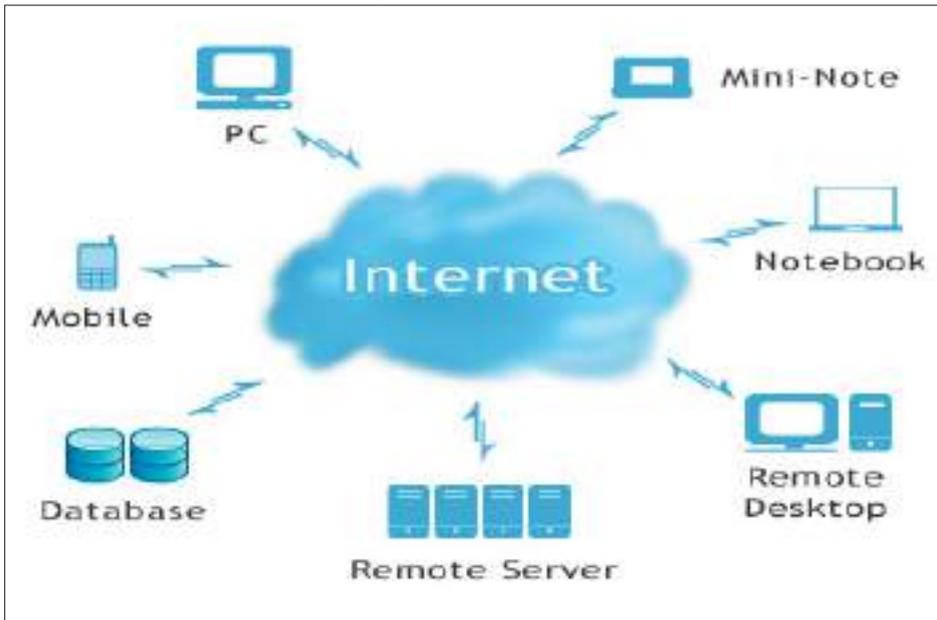
**Figure 2: An overhead picture of the Bayn Al-Haramayn zone and the crowd around the holy monuments (Abbas, Naji, Zainab, & Muneer, 2023).**



This research presents a method for analyzing visitor behavior using visitor data. By leveraging the Internet of Things (IoT) and cloud infrastructure, an efficient, safe, and reliable solution is implemented that utilizes connections and data available at the

cloud level, integrating various technologies to address crowd management-related tasks. Congestion scenarios are analyzed, and the primary types of visitor data affecting crowd management are classified. Additionally, by considering visitor behavior, environmental factors, and hazard characteristics, the study aims to enhance safety for the proposed evacuation routes and identify real-time evacuation pathways during crises. To ensure that public health criteria are met, the study also takes into account visitors' locations and governorates, as well as their medical conditions during evacuation (Figure 3).

**Figure 3: Various Facilites of the Internet Cloud (Alghamdi et al., 2022).**



The following is a summary of the study's primary findings:

The concept of crowd management through the Internet of Things (IoT) utilizes extensive data retrieved from various infrastructures related to shared and mass sensing.

The proposed strategy aims to enhance security and alleviate congestion in the Inter-Haramain neighborhood of the holy city of Karbala.

Development of effective crowd guidance methods to improve the security and safety of visitors.

Design of the selected area (between the two mosques) using geographic information systems (GIS).

Additionally, this study seeks to reduce or prevent disasters caused by congestion, which have previously led to injuries among many visitors during the pilgrimage (as occurred in 2019, when crowding resulted in the martyrdom and injury of numerous visitors). The goal is to provide a safe and reliable way to direct visitors to safer routes, thereby minimizing the impact of congestion-related accidents and creating a secure environment that allows visitors to perform their ceremonies easily and in an organized manner. The area of focus is the holy zone, which includes the two shrines and their surroundings, located approximately 100 km south of Baghdad, as shown in Figure 5. This area was chosen due to the presence of visitors performing the pilgrimage of Imam Hussein and Imam Abbas (peace be upon them), recognizing that it is relatively small compared to the number of visitors and the numerous service centers and Husseiniya processions along the streets and alleys within it. Consequently, most congestion incidents occur in this area.

**Figure 4: The Old Area  
of the Holy City of Karbala (Farhan & Nasar, 2022).**



### **Crowd-related scenarios**

In this section, various crowd-related scenarios that could arise during the Arbaeen pilgrimage are outlined. Each of these scenarios is discussed briefly in the following text:

#### **Normal scenario**

Visitors begin their pilgrimage by entering the shrines of Imam Hussein and his brother Al-Abbas (peace be upon them). After that, they engage in religious rites, praying and reciting desired supplications as they move through the area between the two mosques. Following this, visitors head to the Husseiniya processions, where they rest and participate in additional rituals.

Finally, those wishing to leave can take the main or secondary roads to the nearest parking lot, which will provide transportation according to their destination.

## **Dangerous scenario**

Visitors congregate at the entrances and exits of the sacred area, whereupon the flow of people gradually slows down until overcrowding occurs, impeding the public's ability to move freely. These incidents also lead to disorderly crowd behavior, which makes it challenging to finish the visitation ritual.

## **Exit scenario from entry roads**

As mentioned, rituals in holy Karbala include during visitation, visiting holy shrines, praying and supplication. After that, visitors make the return journey and here there may be a mass exit of visitors from the holy area to the outside through alleys and streets. As these crowds enter the visit, most of them enter and exit the holy area using the same paths. This scenario may lead to a large stampede, posing a risk of injuries to visitors due to suffocation and panic.

## **Misdirection scenario**

Due to the large number of visitors entering the holy city of Karbala, many visitors, especially vulnerable visitors, elderly or foreigners, may be separated from their families or groups so when missing visitors arrive in the holy city, they may find it

difficult to return because they cannot leave from the same path from which they entered, which causes them to crowd in certain areas without others.

### **Globally applied technologies:**

As mentioned in Figure 5, a variety of techniques are employed to achieve crowd control and avoid congestion in restricted spaces. These techniques include radio frequency identification (RFID), wireless sensor networks (WSN), and Internet of Things (IoT) systems that integrate various sensor technologies with intelligent methods.

The technology of wireless sensor networks was implemented at the Systems and Automation Research Center within the remote control project for smart irrigation gates in Najaf Governorate. This project facilitates supervisory control, data collection, and acquisition for irrigation gates, allowing for remote control through a central management system. Additionally, a monitoring project aims to establish a rapid interactive medium between citizens and security authorities, enabling immediate reporting of incidents and security breaches via smartphone applications. A national control center is responsible for receiving and processing these notifications, displaying them on the map of Baghdad city in real time for higher authorities and informing the relevant responders.



the Sacred House of God (STEVENSON, 2009).



It has been suggested to create an integrated system that combines CCTV, WSN, and RFID to track, monitor, and help individuals in a certain region. In order to provide any essential support, particularly in vital locations, the researchers divided the area into equal cells and used static readers to read each visitor's score within range. This data included blood pressure and heart rate. Modern technologies can help alleviate visitor difficulties due to their rapid processing of the huge amount of information and the high rate of data transfer, as these technologies enable the responsible authorities to Exchange information on visitor movements during the visit. Additionally, the researchers suggested a completely integrated closed-circuit television (CCTV) system that could use particle image velocity measurement to automate pedestrian traffic systems and predict

pedestrian traffic distribution with high efficiency and accuracy using high-density video cameras.

This study suggests a hybrid solution that combines WSN, CCTV, and RFID technologies. It gathers visitor traffic data in order to identify and steer clear of congestion by pointing people toward alternate routes. It is noteworthy that these hybrid approaches share many of the benefits and drawbacks associated with crowd control during the Hajj. The cloud platform is also utilized. Thus, the two modules of the suggested approach are the on-premises module and the cloud unit.

### **Suggested methodology:**

Before discussing the proposed study, it is necessary to show the realistic assumptions that must be taken into account when designing, where the hypotheses were formulated to suit the real scenarios of visitors and based on the information available in the volumes and related research, including:

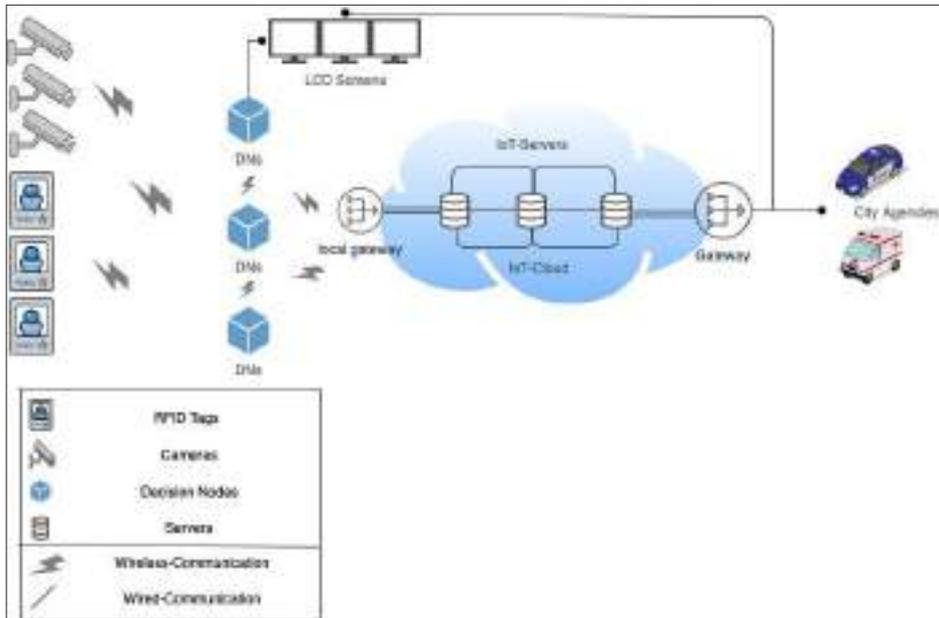
1. Prior to traveling to Holy Karbala, every guest receives an RFID card in their home city. But any other wearable device, like pins, stickers, or RFID wristbands, can take the role of cards.
2. RFID cards are connected to the IoT infrastructure that is supposed to be built across Iraq.
3. Visitors carry their RFID cards at all times during the visiting days.
4. Culture of society on the subject.

5. LCD screens are located in the sacred area connected to the cloud and consistently display the best route to guide visitors.
6. Visitors follow instructions and do not enter busy corridors as additional assistance and guidance for following instructions may be provided by security forces, as necessary.
7. Matching technology is used to determine crowd state from information gathered by cameras and other wireless sensor technologies in order to address RFID failure.
8. Since the cameras provide complete coverage of the area as well as data matching mechanisms provided by the RFID reader, the proposed method is based on the most accurate data provided by the cameras and RFID readers.
9. All one-way routes (entry or exit) have different priority levels, and each route has a specific capacity.
10. Cameras are placed in each track, with the quantity of cameras determined by the track's priority.

## Organizational Structure of the Suggested System:

The suggested system is made up of several parts that work together to monitor, simulate, guide, and lead tourists to their desired locations inside the holy city of Karbala by using the most efficient routes. The general structure of the system and its components are shown as in Figure 7.

**Figure 7: Organizational structure of the proposed system.**

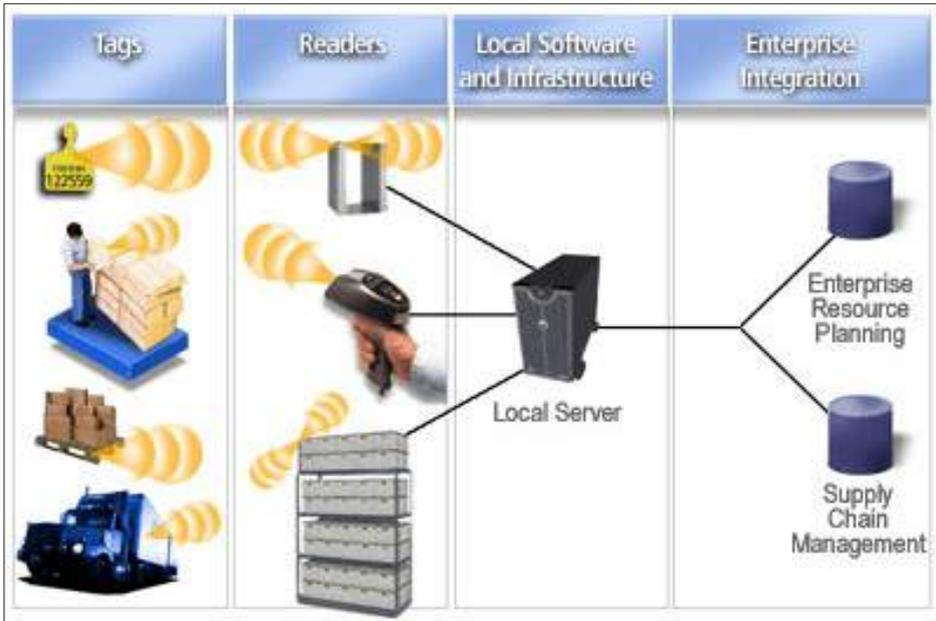


## RFID Cards and Reader:

RFID cards are an essential component of the system design. These devices serve as the primary tracking device, monitoring visitor behavior. Figure 8 views that each visitor carries an RFID card with information about their health status, age, and gender.

Each track features one or more RFID readers, which read private information from RFID cards and collect visitor information.

**Figure 8: RFID Card reader (Niu, Xu, Chen, & Liang, 2012).**



**Decision node contract:**

DNs are dispersed throughout various densities of routes. DNs gather information from environmental sensors, cameras, and RFID cards. They then use this information to calculate risk factors, coordinate with other DNs to carry out local evacuations, display detailed evacuation instructions on LCD screens, and send data to cloud servers.

The cameras act as a second input source that monitors and captures the behavior of individuals during the visit, as in Figure 9, the cameras are connected to DN networks to transmit information

related to the presence of congestion according to the visitor movements captured at each DN decision node.

**Figure 9: Illustrative image of surveillance cameras (Sheng, Yao, & Goel, 2021).**



## Cloud Computer Components:

### Input Data :

All system entities are accessible to the cloud. In this approach, data integration and exchange are the main tasks performed by the cloud. Moreover, when congestion is detected, the cloud makes the decision to evacuate. Moreover, the cloud can establish connections via LCD displays with tourists, local authorities, and the Baghdad Operations Center as necessary.

## Digital Portals:

The on-premises gateway serves as a link between on-premises sensors and the cloud for data transmission. During the visit, the external gateway serves as an interface between the IoT cloud and the operations center in Baghdad.

## LCD Screens:

In the holy city of Karbala, LCD panels are positioned at various intervals along every route. Depending on the route's length, priority, and number of intersections, each track has a varied number of screens with varying diameters that are deployed at different densities. For instance, a track with more priority and capacity can contain more screens. The paths determined by the cloud and decision nodes are continuously displayed on screens. Additionally, the efficient and user-friendly design of LCD screens is intended to give guests a simple route to their goal.

## Departments participating in the Arbaeen' ziyara:

During the visit, local and federal authorities—such as representatives from the Ministry of Health, security forces, civil defense, and any associated parties—play a crucial role at holy shrines and municipal districts. When harmful conditions arise, these circuits receive an alert from cloud servers that include a

copy of the information gathered, allowing them to take necessary action based on that information. Each route's designated DNs receive wireless transmissions of the data gathered from cameras and RFID readers. Under normal conditions, the DN collects data and sends it to the IoT cloud for processing through a local gateway, where it is further processed and reviewed. When an emergency occurs, DNs locally identify the best routes and display them on LCD screens; however, the courses could not be as precise locally as those determined centrally by the IoT cloud, which uses data provided by all system users. Consequently, the cloud updates the LCD screens and DNs immediately upon determining the optimal paths. Furthermore, when congestion and other risk factors exceed the threshold, the cloud alerts the relevant authorities.

### **Reading and analyzing crowd data:**

Suggested method Data is collected via RFID sensors, cameras and environmental sensors. RFID devices collect visitor information including the visitor's name, age, gender, and location while in front of the camera. Environmental sensors obtain environmental information such as weather and humidity and from this information as shown in Plan No. 12 and the following steps:

## **a-Environmental conditions**

Weather and air quality are examples of environmental circumstances that change with time and can be categorized into three types: favorable weather (sunny), medium weather (drizzle, fog, light wind), and unfavorable weather (dust and/or heavy rain). Environmental factors have a big impact on how visitors move. Furthermore, the hazards involved in evacuation are heightened by environmental factors.

## **b-Congestion level**

There are six levels of congestion based on severity: very low, low, low to medium, medium to high, high, and dangerous. Congestion is tracked and evaluated using RFID tags, cameras, and sensors placed along all routes. Congestion reduction techniques are applied by the system when it reaches a certain level (low to medium).

## **c-Visitor Classification**

Visitors must be categorized into distinct groups according to their age, gender, medical condition, and speed in order to be managed efficiently.

## **d-Classification of evacuation corridors**

Routes are assigned a priority rating determined by how far they are from important services like restaurants, hospitals,

entrances, exits, and other routes. The busiest routes are frequently those that are closest to these services.

## Suggested Algorithm

The study of crowd motion and interactions in computer vision has been the focus of machine learning based agent motion modeling techniques (AMMT) in recent decades. In order to represent the crowd, we have extracted both individual and motion information from the recorded trajectories using several AMMTs.

The crowd representation is achieved by combining the geometry modeling based algorithms (Van den Berg, Lin, & Manocha, 2008), heuristic models (Reynolds, 1987), and social force patterns (Helbing & Molnar, 1995). Additionally, the physical position of each agent or crowd member in smart cities is analyzed using these learning models. Using circles in (2 – D) feature space, this approach locates the crowd agents. To facilitate training, certain parameters are needed, including the radius, maximum speed, and number of closest neighbors.

The AMMT is expressed as a parameter-controlled non-linear function (f), denoted by  $\beta$ . The function uses the current crowd state  $t X$  to estimate the crowds at the following time step (t +1). Equations (1-3)

provide the following forecast for the subsequent step if the computation error is (Bt):

<b>Algorithm I: pre-processing and improving the crowd database</b>
<p><b>Input:</b></p> <p>The tested video frames of the captured crowd movies  <math>F=( F_1,F_2 ,.....,F_N)</math> <i>/* N is entire number of frames */</i></p>
<ol style="list-style-type: none"> <li>1- A group of frames from a crowd database that <u>has been saved</u> is used as a sample.</li> <li>2- The retrieved frames are <u>pre-processed</u> to convert the color picture to grayscale. The retrieved set of video frames (F) is <u>cropped and resized to 500 by 500 pixels</u>.</li> <li>3- Images that have been cropped and scaled have their pixel intensity values converted into a grayscale image using the contrast-limited adaptive histogram equalization (CLAHE) algorithm (Kumar, Singh, Dutta, &amp; Gupta, 2016a, 2016b; Kumar, Tiwari, &amp; Singh, 2016).</li> <li>4- Use the SIFT descriptor approach to identify and extract the set of features from improved pictures that are discriminating.</li> </ol>
<p><b>Output:</b></p> <p>Determine the similarity verifying percentage of spotted key-points of tested scene with stored dataset of crowd scene</p>

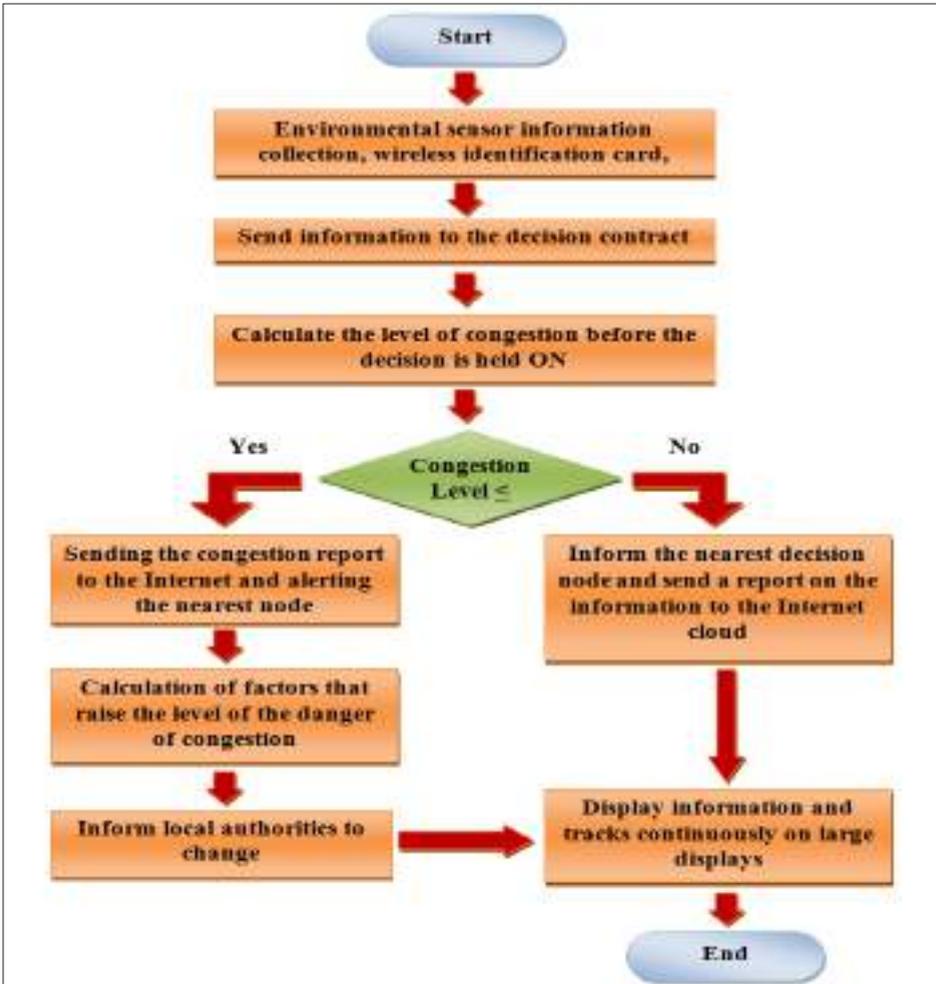
$$X_t = f(X_t) \tag{1}$$

$$X_{t+1} = f(X_{t+1}) \forall t \in (1, 2, 3, \dots, N) \tag{2}$$

$$X_{t+1} = f(X_t) + Bt \tag{3}$$

Finally, the flowchart of the suggested methodology is mentioned in Figure 10

**Figure 10: Flowchart of the Proposed Methodology.**



## 1-Conclusions:

Due to the significant increase in the number of visitors during the fortieth visit, the use of Internet of Things technology has become a necessity in the subject of crowd management, which uses data related to visitors and the environment to achieve rapid evacuation in crowded areas. Through the use of modern technologies such as digital cameras, environmental sensors and radio visitor card reader and processing them in real time, we have an accurate and adequate picture of the places of congestion and the most appropriate ways for visitors to exit after the successful completion of the visit without any obstacles. In future work, it is possible to expand the study by increasing the area controlled by the system to be information about visitors and their movements are many and accurate, and this study needs to be applied gradually and study unexpected cases and problems that may appear during the visit and develop appropriate solutions to complete the fortieth visit optimally.

## 2-Recommendations

Some of the content that individuals must implement in crowd management and apply has been presented, namely:

1. Commitment to the use of modern technology represented by surveillance cameras and remote sensors and other modern surveillance systems on the subject of crowd management.
2. Organizing training courses for cadres of local and central authorities on crowd management applications.

3. Using social media as a social activity to educate the community about modern technologies regarding the subject of RFID cards and its usefulness to the visitor during the visit.

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**Analyzing and tracking the data of the millions  
sized gatherings for the Arba'in visit and  
proposing alternative ways to relieve congestion  
using spatial analysis algorithms**

**Hala A. Jasim**

Department of Remote Sensing and GIS, College of Science,  
University of Baghdad

**[hala.abd@sc.uobaghdad.edu.iq](mailto:hala.abd@sc.uobaghdad.edu.iq)**

Mohammed I. Abd-almajied

Department of Remote Sensing and GIS, College of Science,  
University of Baghdad

**[mohammed.ismael@sc.uobaghdad.edu.iq](mailto:mohammed.ismael@sc.uobaghdad.edu.iq)**

**Hassan J Alatta,**

Department of Remote Sensing and GIS, College of Science,  
University of Baghdad

**[hasan.jaber@sc.uobaghdad.edu.iq](mailto:hasan.jaber@sc.uobaghdad.edu.iq)**

Loay E. George

University of Baghdad/ College of Science, University of Information  
Technology and Communication (UoITC)

**[loayedwar57@uoitc.edu.iq](mailto:loayedwar57@uoitc.edu.iq)**



## Abstract

The city of Karbala is one of the most important holy places for visitors and pilgrims from the Islamic faith, especially through the Arabian visit, when crowds of millions gather to commemorate the martyrdom of Imam Hussein. Offering services and medical treatments during this time is very important, especially when the crowds head to their destination (the holy shrine of Imam Hussein (a.s)). In recent years, the Arba'in visit has witnessed an obvious growth in the number of participants. The biggest challenge is the health risks, and the preventive measures for both organizers and visitors. Researchers identified various challenges and factors to facilitating the Arba'in visit. The purpose of this research is to deal with the religious and cultural events that occur during the Arba'in visit in Iraq by providing optimal and alternatives routes, and strategic resting points along the way from all cites to Karbala. This research depends on data analysis and artificial intelligence methods to determine the best routes and determine locations of the rest points accurately and effectively. These aims will be accomplished by analysing population distribution and potential paths. For the purpose of providing the best rest points on the proposed roads and decreasing the crowds within these stations, the rest stations are divided into two categories: main stations and sub-stations. The main stations contain services such as: rest places, accommodation, health and awareness services, in addition to providing food and drink; whereas the sub-stations comprise only rest places, sleep, food and drink. The research suggests that the main stations must be distributed at a distance of 5 km from each other, but the sub-stations must be situated at a distance of 1 km. This research presents an improved approach to route optimization and visualization, utilizing

GMap.NET library with a C# environment. The research integrates dynamic rest points generations at specified intervals, adding the capability to save real coordinates of these points and export the final maps as images, whereby the system improves usability and functionality for navigation and geographic information system (GIS) applications providing a user-friendly interface to detect the best routes between any two points. The methodology comprises fetching routes from Mapbox API, automatically adding main and sub points, and incorporating user-interactive elements for managing markers and adding or removing points according to population distribution and saving map views.

**Keyword:** Routes, Dynamic Break Point, Karbala, Crowds of Millions.

## Introduction:

The advent of geographic information systems (GIS) has been progressing quickly especially for navigation and route optimization. Today, most people depend on real mapping solutions, and there is a growing need for customizable and interactive map features. This research determines the best route for the visitor to be used in the Arba'in visit in Karbala with dynamic breakpoints at regular intervals that allows the visitor to save the current map view as an image. The proposed system holds on GMap.NET, a powerful mapping tool for .NET applications, and integrates with the Mapbox API for fetching optimized routes (Smith, 2020) (Doe, 2019) (GMap, 2023) (Mapbox, 2023).

## Literature Review:

Moheeb k. Alrawe and Mimoon m. Qasim in 2018, worked on the simulation of the movement of crowds of visitors in the Holy City of Karbala, Iraq. They state the difficulties and significance of finding solutions for crowds during important occasions, such as pilgrimages. The research emphasizes using simulation principles and the AnyLogic 7.0 Professional software to state a solution for how crowd are spread out for functional needs, service arrangements and space usage, in the city centre of Karbala (Alrawe, 2018).

Rizwan, K. Mahmood et al (2019) wrote about creating a database model and a mobile app to monitor Hajj pilgrims and assist them in their pilgrimage. Its target is to improve the organization and supervision of pilgrims during the pilgrimage, in Makkah. The suggested work incorporates geo-fencing technology to improve services and guarantee the execution of ceremonies in the most efficient way possible. The model concentrates on real time monitoring, assistance and tracking of ceremonies through geo-fencing. Important features include direction based on location, managing emergencies, and providing healthcare assistance (Rizwan, 2019).

Hanaa Ali Aldahawi (2021), authored a piece of research which spoke of the significance of relying deeply on the utilization of data analysis to monitor crowd movements, safety measures and operational efficiency during the Hajj and Umrah pilgrimages, in Saudi Arabia. The increase in the number of participants in gatherings, crowd management,

conflict resolution and advanced data analysis systems were necessities. Through developing the models and structures, big data applications struggle in improving safety protocols for the increasing streams and enhancing the overall experience for pilgrims. The field of data analytics provides a range of tools and frameworks to imagine and predict results and prove the success of Hajj and Umrah events. The benefit of data from sources such as sensors, smart gadgets and social media platforms facilitates precision healthcare solutions, traffic management strategies, hospitality services optimization will be efficient for crowd arrangement, during the pilgrimages (During, 2021).

Hisham H. Yusef et al (2023), gives a full review of crowd detection, monitoring, and management in various events like sports, music festivals, religious gatherings, and political campaigns. He points to the importance of organizing and controlling the movement of large crowds to prevent disasters such as pushing that lead to fatalities and injuries. This study is concerned with addressing the challenges of crowd identification, monitoring, behaviour analysis, and counting by utilizing recent technologies and methodologies for crowd management (Al-Ashmoery, 2023).

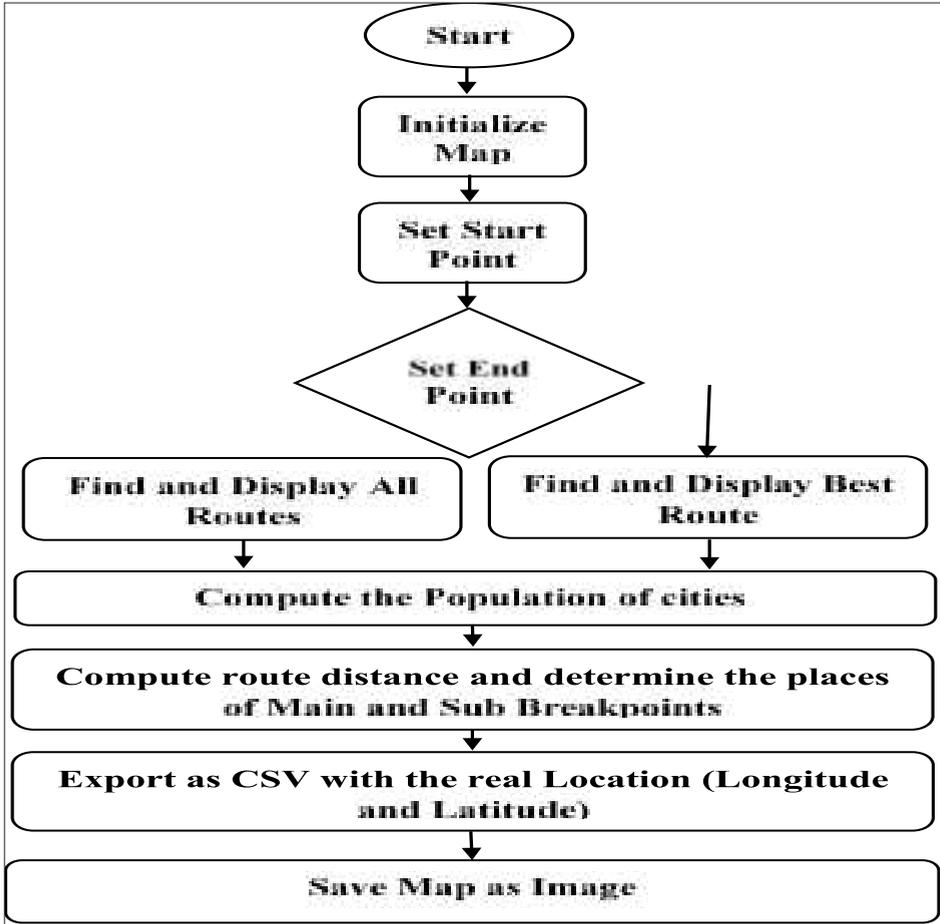
Foziah Gazzawe and Marwan Albaharin's (2024) research points to issues with traffic overcrowding during the Hajj by utilizing of AI and advanced communication technologies. It employs smart cameras and real-time data analytics to predict, manage, and operate the lighting for traffic congestion. The work could improve road safety, emergency response efficiency, and air quality. It could also boost local businesses and tourism revenues, enhancing economic

growth. The work shows the importance of AI in traffic management strategies (Gazzawe, 2024).

## Methodology

The proposed work creates a route between cities by determining the best route and then applying a dynamic breakpoint. Initially, routes are fetched from the Mapbox API, and breakpoints are generated at specified intervals (5 km for main breakpoints and 1 km for intermediate breakpoints). The flow-chart of the work can be seen in figure (1). The system ensures non-overlapping breakpoints by prioritizn breakpoints. Subsequently, a feature to save the current map view as an image is integrated, allowing users to capture and store map information for offline use. The system is implemented in C# using the GMap.NET library for map rendering and interaction.

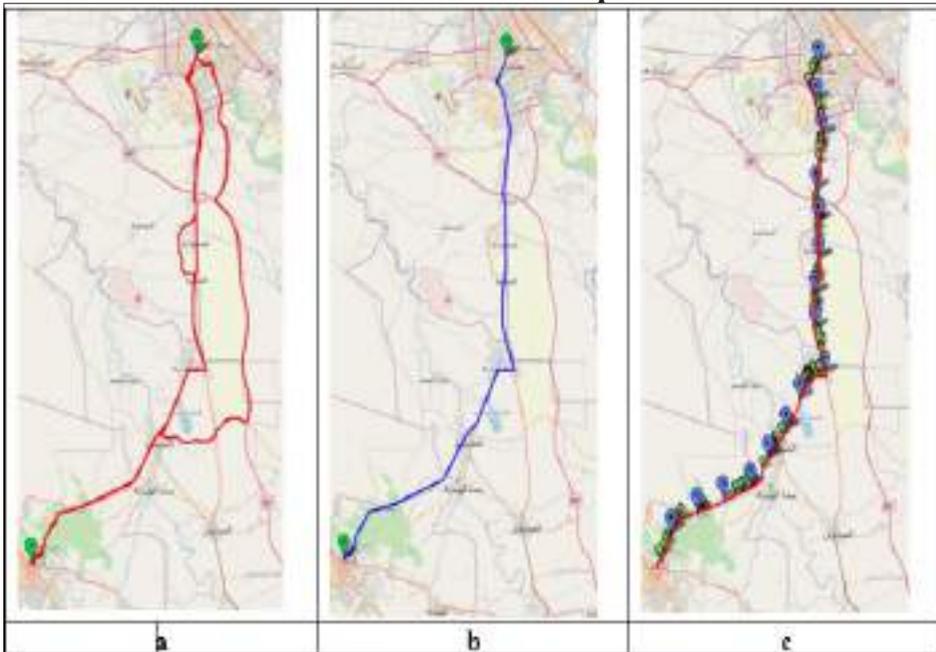
Figure (1): Flow-chart of the proposed work



## Results

The program successfully draws a route between two cities (3 cases: Baghdad – Karbala, Hilla – Karbala and Diwaniyah- Karbala). These results can be seen in figure (2-4). For each case, the program calculates the available route between cities. It concludes three route for each case and then a best route (least distance) is determined and shown in these figures. Dynamic break points were displaced in that route at distance (5km) between each one of it. These points are considered as main points and so sub-break points were applied between them (1km between them). The longitude and latitude of start and end points were listed in tables (1-3). Also, distance was calculated in these tables. The routes provide more interactive and user-friendly directions, making the system suitable for navigation and GIS applications.

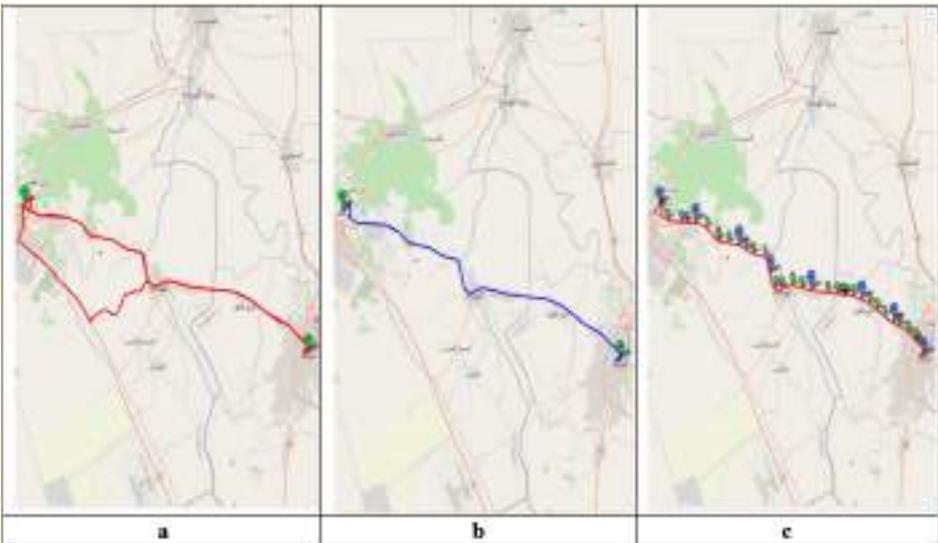
**Figure (2): Baghdad Karbala: (a) three routes (b) best route (c) best route with break point**



**Table 1: Baghdad Karbala Route and Distance**

Route Name	Start Latitude	Start Longitude	End Latitude	End Longitude	Distance (m)
Route (1)	33.31503	44.36608	32.616035	44.024891	104531.602
Route (2)	33.31503	44.36608	32.616035	44.024891	119115.656
Route (3)	33.31503	44.36608	32.616035	44.024891	98832.0452

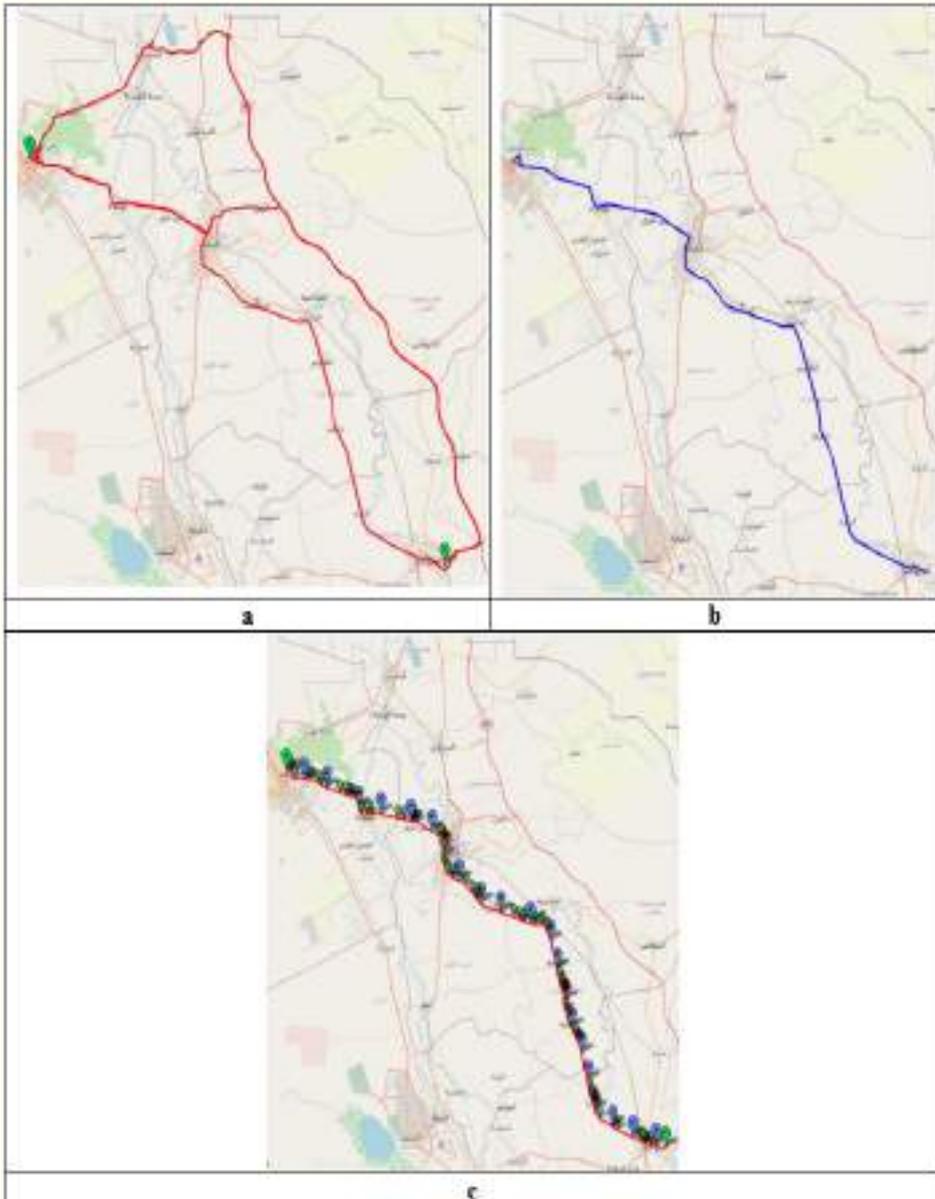
**Figure (3): Hillah Karbala: (a) three routes (b) best route (c) best route with break point.**



**Table 2: Hillah Karbala Route and Distance**

Distance (m)	44902.746	51392.582	45638.539
End Longitude	44.031725	44.031725	44.031725
End Latitude	32.616203	32.616203	32.616203
Start Longitude	44.432132	44.432132	44.432132
Start Latitude	32.483905	32.483905	32.483905
Route Name	Route (1)	Route (2)	Route (3)

**Figure (4): Nasiriyah Karbala: (a) three routes (b) best route (c) best route with break point.**



**Table 3: Nasiriyah Karbala Route and Distance**

Route Name	Start Latitude	Start Longitude	End Latitude	End Longitude	Distance (m)
Route (1)	31.987828	44.923254	32.616451	44.031793	151272.359
Route (2)	31.987828	44.923254	32.616451	44.031793	178232
Route (3)	31.987828	44.923254	32.616451	44.031793	127796.7909

## Discussion

The results of mapping routes show the availability of these route which can be selected from many cities to Karbala. These routes can be seen in figure (2a-4a). The best routes are shown in figure (2b-4b). Dynamic break points were displayed in figure (2c-4c). The longitude and latitude of the start point and end point with the distance between them were shown in table (1-3).

## Conclusion

This paper presents a novel approach to enhancing route optimization and visualization using GMap.NET, showcasing the system's ability to dynamically generate breakpoints. The system enhances the practicality and usability of navigation tools. Future improvements could include real-time traffic updates, user-defined interval settings for breakpoints, and support for additional map providers. Future work will focus on extending the system's capabilities and exploring additional use cases in various domains.

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**Hydro-chemical Study for Selected Wells in the  
Holy city of Karbala/ Central Iraq**

**Iman A. Al-Ali  
College of Science, University of Baghdad**

**Najah A. Abd  
College of Science, University of Baghdad**

**Hasan j. Alatta  
College of Science, University of Baghdad  
[iman.ali@sc.uobaghdad.edu.iq](mailto:iman.ali@sc.uobaghdad.edu.iq)**



## Abstract

Twenty-four groundwater samples were collected at different depths within the Dammam aquifer and Quaternary deposits. A detailed hydro-chemical study of water samples was conducted, including physical properties; Hydrogen number (pH), total dissolved solids (TDS), and electrical conductivity (EC), while the chemical analysis included the major anions;  $\text{SO}_4^{2-}$ ,  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ , and major cations;  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ , and  $\text{K}^+$ , in addition to the minor element ( $\text{NO}_3^-$ ). The results indicate a neutral to slightly alkaline water with pH of 7.17 which characterized by hard water that is neutral- slightly alkaline water. The TDS exceeds the permissible limits for drinking, with an average of 2787 ppm, which represents slightly brackish water. Conductivity EC indicates heavily mineralized water with EC of 4310.8  $\mu\text{s}/\text{cm}$ . The predominant cation was  $\text{Mg}^{2+}$ , and  $\text{Na}^+$ , while the predominant anions were  $\text{SO}_4^{2-}$ , and  $\text{Cl}^-$ . The prevalent cation in the aquifer  $\text{Na}^+$  of 49%, followed by  $\text{Ca}^{2+}$  of 30%,  $\text{Mg}^{2+}$  of 17%, and  $\text{K}^+$  of 4%, while the prevalent anion was  $\text{SO}_4^{2-}$  of 48%,  $\text{Cl}^-$  of 31%, and  $\text{HCO}_3^-$  of 21%. Groundwater is classified as unsuitable for drinking, while it is suitable for irrigation. The water type is  $\text{Na-SO}_4$  affected by the interaction between aquifer material (Halite, dolomite, and calcite), and the groundwater in contact.

**Keywords:** Holy city of Karbala, Hydro-chemical analysis, Water- rock interaction, water type, water suitability

## Introduction:

The Holy city of Karbala is a major religious and commercial center characterized by high population density, where visitors from all over the world flock to it, making use of its facilities and putting pressure on its surface and groundwater. Groundwater is the best alternative source of water due to the rareness of surface water which is affected by many natural and anthropogenic factors. Water resources deterioration, by the effect of any pollution, causes risks to the environment, human health, and damage to natural resources (Al-Mayyahi and Al-Ali, 2024). Also, the interaction between groundwater and ambient aquifer in contact is a major issue (Al-Dabbas, 2017).

Like other arid and semi-arid countries, Iraq has suffered from climate change and political factors related to the policies of neighboring countries, a severe water crisis that affected its quantity and quality, so groundwater was the safest solution to meet the requirements of life. The issue of water pollution, especially in areas that witness long periods of drought and high population density, receives great international attention because of its direct impact on the population, especially those that have a religious status and sacred rituals, such as Karbala Governorate, which receives millions of visitors to visit its two major shrines. The two holy sites put pressure on water resources, which may cause many health and environmental problems if controls are not put in place according to serious studies through which groundwater is evaluated for its suitability for various purposes, and the effect of rock-water interaction on water quality. In terms of climate conditions, the region suffers from aridness with hot dry summers and cold dry winters, while the mean annual rainfall does not exceed 85-90 mm between the months of January and April. The mean annual temperature is 24.1 oC, with evaporation of 2984 mm, relative humidity of 47.9%, the speed of wind

is 3.0 m/sec. The percentage of water surplus was 27.7 mm, and water deficit of 69.13 for the period 1980-2015. The climate classification of the Karbala area is continental and a dry climate, as well as the region having a significant water deficit of up to 93 % of the total rainfall values, with high rates of evaporation of 2993 mm yearly (Kadum and Al-Ali, 2022). The study area is restricted between latitudes 32° 20` -32° 40` North and longitudes 43° 19` - 43° 50` East (Fig. 1).

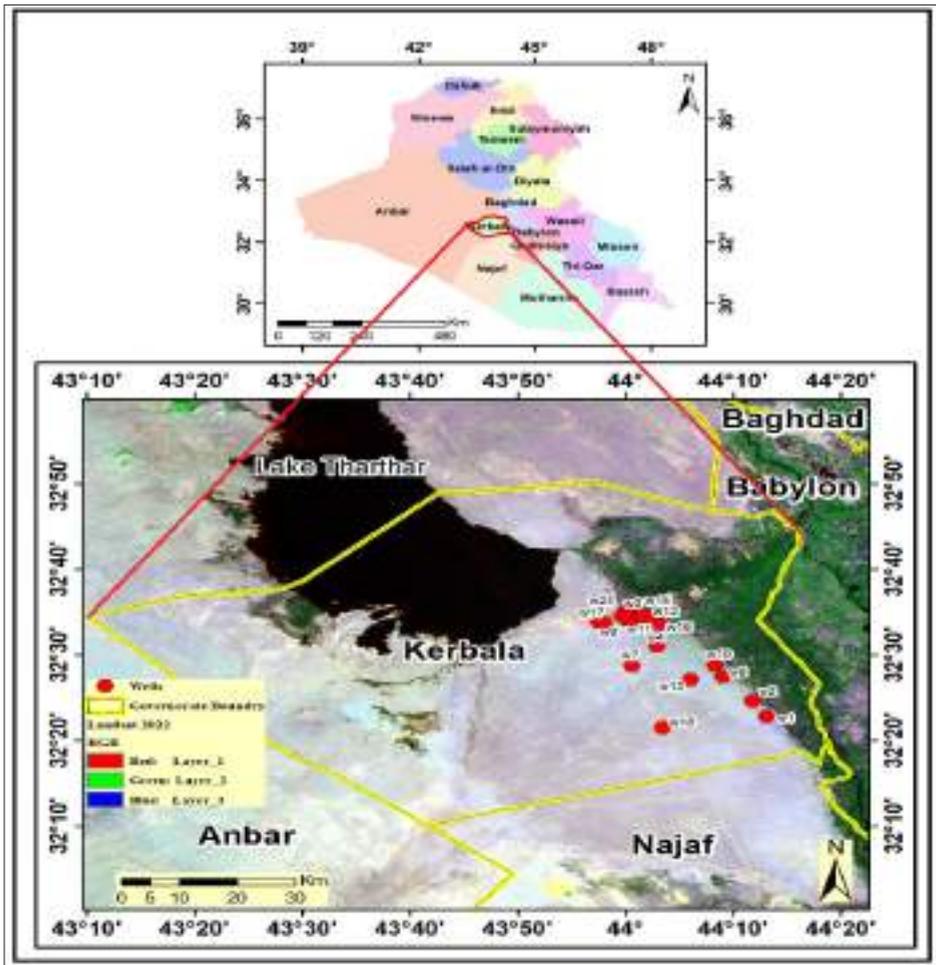


Fig.1: Karbala Governorate with groundwater sampling sites

Geologically, the quaternary sediment prevails in different areas in addition to the ambience of groundwater as transboundary aquifers, which clearly affected the quality of water by rock- water interactions, such as Al-Dammam, Euphrates, and Injana formations (Al- Mubarak and Amin, 1983, Sissakian, et al. 2000), (Figure 1).

The water resources in Karbala Governorate urgently need to be evaluated via water quality assessment due to the pollution factors they are exposed to, in addition to over- drafting as a result of the lack of drainage coming into Iraq and consequently salinization of both water and soil. In this field, many studies have tried to cover the hydrology and the geology of the city of Karbala, with a few of them covering the details of groundwater and its relationship with the aquifers and the reservoirs containing it, as it directly impacts the water quality and suitability for different uses (Al-Kubaisi, 2020, Noori, et al, 2017). Tectonically, the study area occurs within the stable shelf (Rutba-Jezira Zone), that with a large basement and no anticlines (Jassim and Buday, 2006). The geological formations arranged are as follows; Injana Formation (Upper Miocene), Fatha Formation (Middle Miocene), and Quaternary deposits which include; Pleistocene and Holocene sediments (Dawood, 2000). Evaluating the groundwater quality ensures the best investment in it, and prepares a hydro-geochemical study and optimal management of groundwater.

## Materials and Methods

Twenty-four groundwater samples were collected from different depths in April 2022 (Table 1). The collecting samples has been done by a team of specialized and professional hydrologists in clean bottles, that were washed with the water sample and filled to the neck. Stickers were also placed on which the sample number, its location, and well

depth were written. The analyses were carried out in the laboratories of the General Commission of Groundwater (GCGW). The water samples were tested for accuracy (A%), and relative difference (R. D%), as the following (Hem, 1985):

$$R.D \% = \dots(\text{Equ. 1})$$

$$A\% = 100 - R. D \dots\dots\dots(\text{Equ. 2}), \text{ Where:}$$

R.D: Relative differences, A: Accuracy

If  $R.D \leq 5$ :the result could be accepted.

If  $5 < R.D \leq 10$ :the result will be accepted with risk.

$R.D > 10\%$ : the result is uncertain, and cannot be depended on in the interpretations. All the water samples were accepted, with A% of 99.2- 97.8%. Eleven parameters of water quality were analyzed, includes; TDS, pH, EC, Na+, K+, Ca++, SO4--, Mg++, HCO3-, Cl- and minor element(NO3-), APHA, (2005). The location coordinate and water samples were listed in (Table 1).

**Table 1: Water quality parameters (physical and chemical) of Karbala wells in (ppm) units**

TDS ppm	3125
EC $\mu\text{s}/\text{cm}$	4890
NO3	0.6
HCO3-	596
SO4-2	938
Cl-	536
K+	90
Na+	606
Ca+2	175
Mg+2	155
pH	7.25
depth	48
Longitude East	32 33 45.5
Latitude North	43 58 3.4
Sample No.	W.1

2523	4270	2427	4270	1690	2100	2518	2720
3920	6530	3750	6540	2640	3250	3900	4200
1.2	1.4	1.2	1.3	1.3	0.3	1.1	1.2
435	523	102	517	180	371	338	497
736	1585	982	1584	598	678	797	660
571	791	568	788	323	392	559	624
16	128	35	128	5	12	3	29
403	475	423	485	267	352	407	418
251	409	177	415	204	181	253	308
94	263	110	265	89	92	135	149
7.15	7.12	7.12	7.18	7.15	7.14	7.17	7.2
24	22	24	18	44	65	42	24
32 34 30.1	32 35 00.4	32 34 07.0	32 34 36.4	32 34 11.4	32 21 29.9	32 33 48.6	32 33 35.0
43 59 43.5	43 59 54.6	44 02 25.8	44 01 48.9	44 00 09.0	44 03 28.8	43 57 33.5	44 03 05.0
W.2	w.3	w.4	w.5	w.6	w.7	W.8	W.9

1978	1932	2194	2293	2076	2650	3970	2644
3060	3000	3400	3550	3210	4100	6130	4090
1.1	0.8	1.8	2	0.3	1.2	1.1	1.2
210	204	460	221	367	486	611	129
555	547	714	811	672	649	1231	1026
597	590	346	560	388	613	738	595
13	12	7	10	12	29	62	35
266	261	344	232	348	407	659	485
191	186	200	274	177	297	361	205
123	118	97	161	88	138	256	140
7.14	7.2	7.24	7.18	7.16	7.2	7.16	7.2
28	29	42	24	18	42	22	38
32 34 35.1	32 34 13.2	32 27 05.4	32 34 07.0	32 34 13.4	32 28 44.3	32 33 48.6	32 27 27.7
44 01 39.0	44 01 16.8	44 06 05.3	44 02 25.8	44 01 01.2	44 08 21.1	43 57 33.5	44 09 01.6
w.10	w.11	w.12	w.13	w.14	W.15	W.16	w.17

3665	1895	2102	3968	4160	2830	3986	1690
5680	2930	3250	6120	6430	4380	6180	2640
1.4	1.1	0.4	1.2	2	1.3	0.6	0.3
517	199	370	610	638	508	526	102
1246	548	675	1230	1271	818	1449	547
720	583	393	737	777	635	708	323
11	10	12	63	62	18	93	3
610	253	353	658	668	428	601	232
347	169	182	360	400	280	372	169
181	110	93	256	295	112	202	88
7.25	7.22	7.19	7.12	7.19	7.2	7.17	7.12
70	18	18	22	18	36	26	Min.
32 28 46.1	32 34 47.4	32 34 41.8	32 31 01.2	32 34 44.8	32 24 38	32 22 45.9	
44 00 39.1	44 00 42.1	44 00 26.5	44 02 57.9	44 00 46.0	44 11 47.1	44 13 07.6	
w.18	w.19	w.20	w.21	w.22	w.23	w.24	

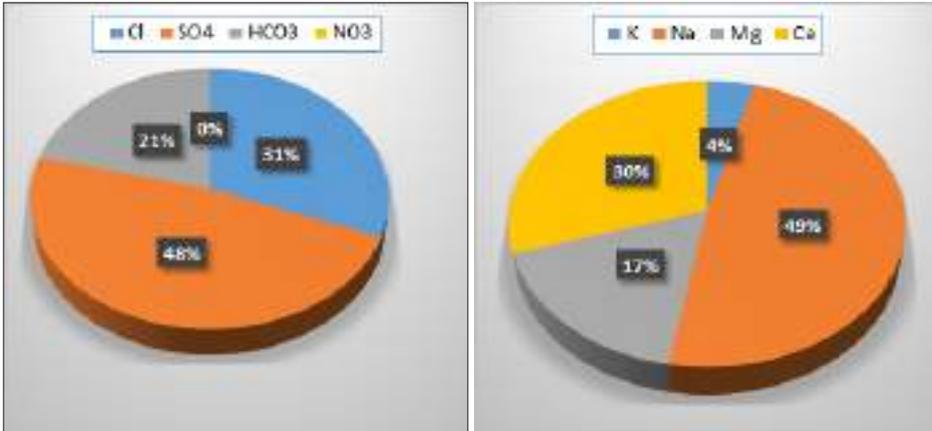
	4270	2787
	6540	4310
	2	1
	638	388
	1585	902
	791	578
	128	36
	668	425
	415	261
	295	152
	7.25	7.17
Max.		
Average		

## Results and Discussion

### 3.1. Physical and Chemical Analysis

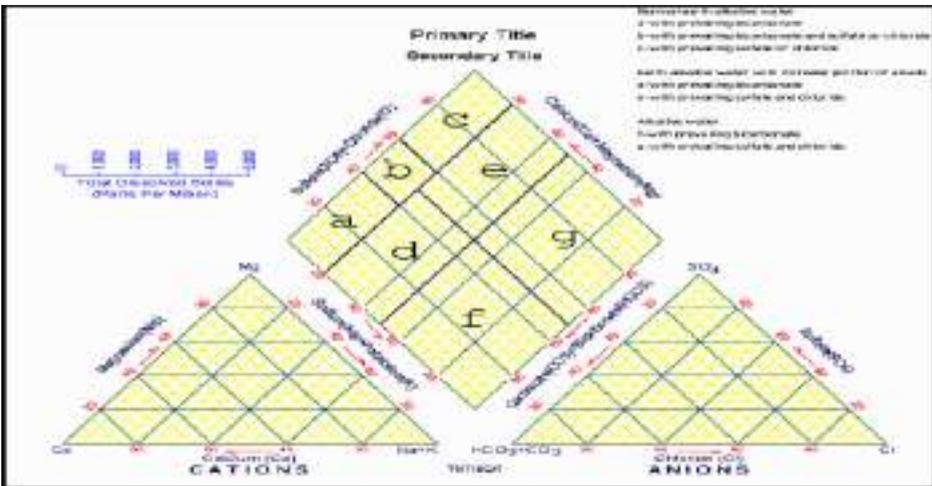
The standard value of pH recommended by WHO (2007) IQS (2009) ranges between 6.5 and 8.5, while the value of pH in Karbala wells range between 7.12 and 7.25, with a mean value of 7.17, and was classified as neutral with low alkaline. The salinity (TDS) varied highly in groundwater samples, as it ranged between 1690-4270 ppm, with a mean value of 2787 ppm, which was classified as slight water to slightly brackish water according to Drever (1997), Atlovski, (1962), and Todd (2007) (Table 1). The high salinity values of TDS were obviously in wells of low depths (w.3, w.5, W16, w21, w22, and w24), which reflect the leaching of salts and the infiltration via the soil structure to the groundwater, which reinforces the idea of water-rock interaction. The electrical conductivity (EC) ranged between 2640 and 6540  $\mu\text{s}/\text{cm}$ , with a mean value of 4310  $\mu\text{s}/\text{cm}$  (Table 1), which classified as slightly mineralized water to moderately mineralized water (Detay, 1997). The concentration of major ions indicated that  $\text{Na}^+$  is the prevalent cation in the aquifer, with a percentage of 49%, followed by  $\text{Ca}^{+2}$  with a percentage of 30%, while  $\text{Mg}^{+2}$  occupies 17%, and  $\text{K}^+$  percentage 4%, while the prevalent anion was  $\text{SO}_4^{-2}$  with a percentage of 48%, followed by  $\text{Cl}^-$  with a percentage of 31%, and  $\text{HCO}_3^-$  with a percentage of 21%. The concentration of  $\text{NO}_3^-$  in the groundwater sample ranges between

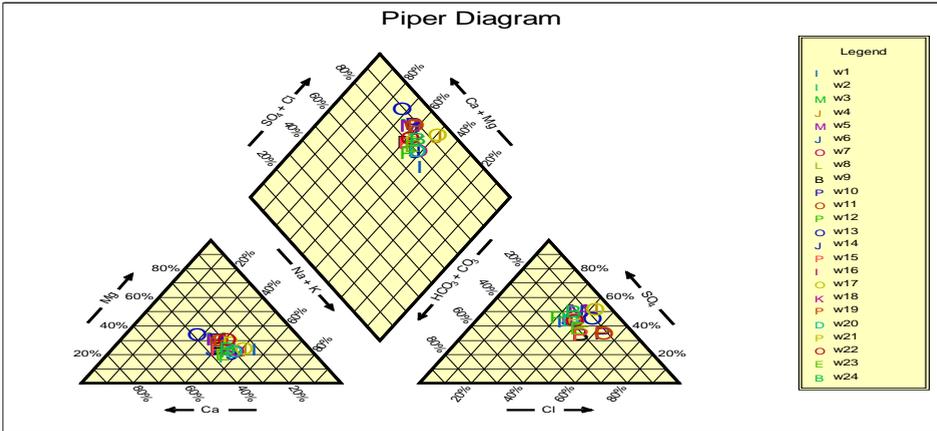
0.3 and 2 ppm, indicating high agricultural activities in the study area (Fig. 2).



**Fig. 2: Percentage of major ions, a: Cations, b: Anions**

Applying Piper Diagram for determining the water quality of Al-Dammam aquifer, indicated all the water samples lied within ‘e’ field which indicated water type of “ Normal earth alkaline water with prevailing sulfate and chloride “ (Fig. 3).





**Figure 3. Piper diagram (1944),**

**show the groundwater type of Karbala City**

Al-Dammam aquifer in Karbala Governorate is characterized by water type as Na-SO<sub>4</sub> which is represented in Korlof classification as the following:

TDS (2787) SO<sub>4</sub>-2 (18.78) Cl- (16.52) PH (7.17)  
 Na+ (25.13) Ca+2 (13.08)

### 3.2 Water- Rock Interaction

The interaction between groundwater and the ambient aquifer rocks were determined by applying the hydro-chemical functions; the value of  $rCa^{2+}/rMg^{2+}$  is of 1.08, as the ratio  $> 1$  reflects a calcite rocks contribution (Awadh et al, 2016). This means that the origin of Al- Dammam groundwater is between rain-water, and sea-water, and reflects the interaction between rocks (Halite, Calcite and Dolomite) and the water. According to the pH value, the median is of acidic rainwater.

According to (Maya and Lockus, 1995), if ratio of  $rCa^{2+}/rMg^{2+}$  is equal to 1, it reflects the dissolution of dolomite and limestone rocks in water. Since the groundwater samples of Karbala was located between 0.68 to less than 1.61, it indicates the contribution of calcite rocks to groundwater of Al-Dammam aquifer are greater than the dolomite.

The hydro-chemical function of  $rCa^{2+}/rMg^{2+}$  indicates the calcareous nature of the aquifer rocks, while the increase in the TDS concentration and  $Ca^{2+}$ , and  $Mg^{2+}$  indicate the chemical weathering of the dolomite, gypsum, and calcite rocks of Al-Dammam aquifer.

The second hydro-chemical ration is  $rNa/rCl$  and is used to determine the groundwater origin of the water, if it is meteoric ( $rNa/rCl > 1$ ) or marine ( $rNa/rCl < 1$ ). As a result, the groundwater of Al-Dammam aquifer in Karbala city is of meteoric origin for all water samples (Table 2) (Hounslow, 1995)

The hydro-chemical function of  $rNa/r(Na+Cl)$ , ranges between 0.38- 2.31, which indicates the distribution of halite rocks in the area, in addition to the occurrence of another source of excessive sodium amounts into the groundwater.

The ratio of  $rCa/r(Ca+SO_4)$  were less than 0.5, which indicates ion exchange of dolomite and calcite deposit occurred. In the studied area, the ratio is exceeding 0.5 in all the wells which reflects the dissolution of gypsum rocks and contribution of Al-Nfayil formation in to the groundwater system as recharged water during rainfall in addition to the excessive amounts comes of

leaching the agriculture lands.

The values represented by the ratio of  $rMg/r(Ca+SO_4)$  were more than 0.5 in all of the wells, reflecting the contribution of dolomite rocks more than calcite in the Al-Dammam aquifer (Table 2).

**Table 2. Hydro-chemical function of water samples (epm)**

Well NO.	$rNa/rNa+Cl$	$rCa^{2+}/rMg^{2+}$	$rNa/rCl$	$rCa/rCa+SO_4$	$rMg/rCa+SO_4$
W1	0.63	0.68	1.74	0.3	0.69
W2	1.08	1.61	1.08	0.44	0.55
W3	0.92	0.94	1.21	0.38	0.61
W4	0.53	0.97	1.14	0.3	0.69
W5	2.31	0.94	0.95	0.38	0.61
W6	0.56	1.38	1.3	0.44	0.55
W7	0.58	1.19	1.38	0.39	0.6
W8	0.52	1.13	1.12	0.43	0.56
W9	0.5	1.25	1.03	0.52	0.51
W10	0.4	0.94	0.93	0.45	0.54
W11	0.41	0.95	0.98	0.44	0.55
W12	0.45	1.25	1.53	0.4	0.59
W13	0.38	1.03	0.65	0.44	0.55

W14	0.58	1.21	1.38	0.38	0.61
W15	0.5	1.3	1.02	0.52	0.47
W16	0.57	0.85	1.37	0.41	0.58
W17	0.55	0.88	1.25	0.32	0.67
W18	0.56	1.16	1.3	0.4	0.59
W19	0.4	0.93	0.96	0.42	0.57
W20	0.58	1.18	1.38	0.39	0.6
W21	0.57	0.85	1.38	0.41	0.58
W22	0.57	0.82	1.32	0.42	0.57
W23	0.58	1.51	1.03	0.45	0.54
W24	0.56	1.11	1.3	0.38	0.61
Min.	0.38	0.68	0.63	0.3	0.51
Max	2.31	1.61	1.74	0.52	0.69
Ave.	0.62	1.07	1.16	0.40	0.57

## Suitability for Irrigation

According to the previous results, and the analyses of TDS in groundwater samples, for the Holy city of Karbala, it was concluded that it is not suitable for drinking, and it is recommended to treat and sterilize it before use.

Therefore, it was necessary to test the suitability of groundwater

for agriculture as it has an important role in the study area. The Sodium Absorption Ratio (SAR), is one of the important tests that express the risk of Na<sup>+</sup> absorbed from the soil, increasing its percentage harms the soil structure and decreases the porosity of the soil, (Ayres and Westcot, 1989). It is calculated as in the following equation (Todd, 2007):

$$\text{SAR} = \frac{r\text{Na}}{r\text{Ca} + r\text{Mg}}$$

### **All the concentration was in meq/l**

Wilcox (1948), developed a classification of the suitability of water for irrigation, which included four groups according to the value of SAR, and ranked them from least dangerous to the most as the following; S1, S2, S3, and S4. Based on this, the wells of Karbala were classified as S1 as the least dangerous, with an SAR value of 3.25. Therefore, it can be valid for irrigating the sodium- sensitive crops.

## **5. Conclusion**

The groundwater of Karbala Governorate occurs mainly within Al-Dammam aquifer; shallow wells were within the quaternary deposits which record a high salinity concentration. The origin of the groundwater is mainly of meteoric water origin, with a neutral pH, the EC values indicate Karbala groundwater is excessively mineralized and slightly brackish water. Chemical weathering is the prevalent processing affecting on water quality and ions concentration of water, the ion exchange occurs between clay minerals and groundwater.

The common water type is Na–SO<sub>4</sub>, indicating the dissolution of gypsum, calcite, and halite rocks. Groundwater can be described as earth-alkaline water with prevailing sulfate and chloride. Al-Dammam Aquifer rocks were interacting with the groundwater, and contribute with halite, calcite and dolomite rocks to provide the sodium, calcium, and

magnesium ions, while the source of sulfate is the dissolution of gypsum rocks. Groundwater samples were not suitable for drinking, while they are good for irrigating sensitive crops as the sodium absorption ratio (SAR) did not exceed 10 according to the classification of Wilcox (1948).

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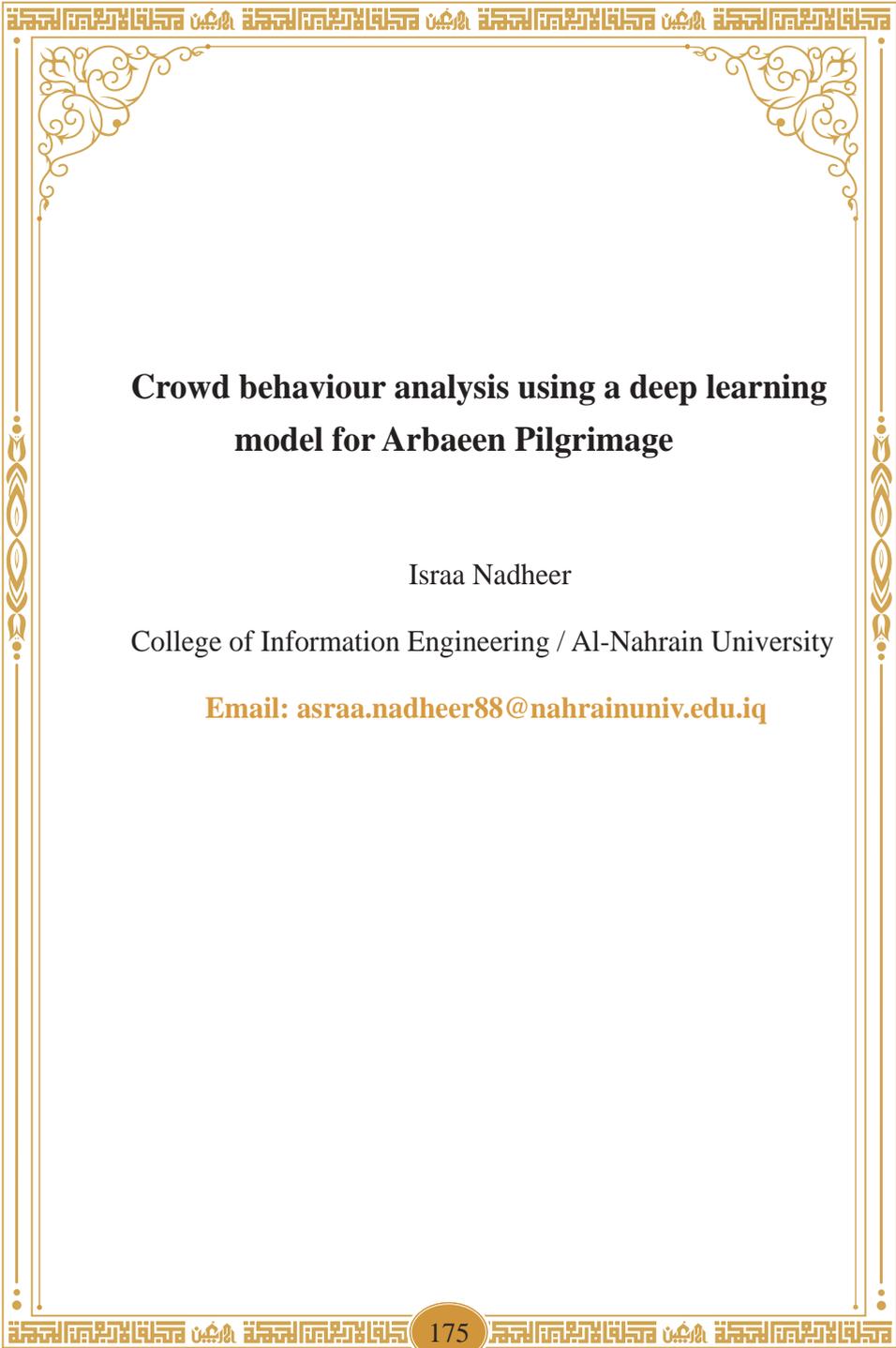
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## **Crowd behaviour analysis using a deep learning model for Arbaeen Pilgrimage**

Israa Nadheer

College of Information Engineering / Al-Nahrain University

**Email: [asraa.nadheer88@nahrainuniv.edu.iq](mailto:asraa.nadheer88@nahrainuniv.edu.iq)**



## Abstract

The purpose of this study is to analyse crowd behaviour using a deep learning model. This research investigates the effectiveness of deep learning techniques in estimating crowd levels, aiming to improve accuracy and efficiency in real-time applications. The study employs a convolutional neural network (CNN), architecture trained on a diverse dataset of crowd images. Key steps in the proposed approach include data preprocessing, model training, validation, and testing. Major findings indicate that the deep learning model achieves lower error rates in both the training and testing phases, demonstrating its robustness and generalisability. Specifically, the model attained a mean absolute error (MAE) of 55.34 and a root mean squared error (RMSE) of 98.32 during testing, compared to 56.5 MAE and 99.13 RMSE during training. These results highlight the model's capacity to generalise well to new, unseen data. The study concludes that deep learning models, when properly trained and validated, can significantly enhance crowd-level estimation, offering valuable insights for applications in public safety, event management, and urban planning. Future work will focus on expanding the dataset and refining the model to further improve performance and applicability. Overall, our study presents a promising advancement in crowd counting technology with practical implications for crowd management at large-scale events like the Arbaeen Pilgrimage.

## Introduction

In response to the growing demand for crowd flow monitoring, assembly control, and security services, numerous network models have been developed. These models aim to provide effective solutions for handling congested scenes (Haghani, 2023), (Musa, 2023). The evolution of analysis methods has progressed from simple crowd counting (which quantifies the number of people in an image (Haghani, 2023) to density map representation (which visualizes crowd distribution characteristics (Musa, 2023). Real-life scenarios have highlighted the limitations of merely counting individuals, as the same number of people can exhibit vastly different crowd distributions (Tang, 2021), (Hassen, 2022). To obtain more accurate and comprehensive information, density maps play a crucial role. In high-risk environments, such as during stampedes or riots, having precise distribution patterns becomes critical for making informed decisions (Owaidah, 2019).

Generating accurate crowd distribution patterns remains a challenge. One major difficulty arises from the prediction approach: density values are generated pixel-by-pixel, necessitating spatial coherence in the output density maps to ensure smooth transitions between neighbouring pixels. Additionally, diverse scenes—such as irregular crowd clusters and varying camera perspectives—complicate the task, especially when traditional methods lacking deep neural networks (DNNs) are employed (Ahmed, 2023) (Assefa, 2022). Recent advancements in congested scene analysis rely on DNN-based techniques due to their high accuracy in semantic

segmentation tasks and significant progress in visual saliency.

The Arbaeen pilgrimage to Karbala poses significant crowd management challenges due to the massive influx of millions of pilgrims from around the world. Safety concerns loom large, with the risk of stampedes and accidents in overcrowded conditions. Local infrastructure strains under the weight of the pilgrimage, causing traffic congestion, overcrowded transportation, and shortages of essential services. Sanitation and hygiene suffer, raising the potential for disease outbreaks. Security measures must be stringent to safeguard against threats. Logistical hurdles abound, requiring meticulous planning to manage crowd flow and provide necessary facilities. Environmental impacts, such as increased waste and pollution, further complicate matters. Effective communication and coordination among stakeholders are paramount for successful crowd management during this religious gathering. This study aims to address the significant crowd management challenges of the Arbaeen pilgrimage to Karbala, focusing on safety, infrastructure, sanitation, security, logistics, and environmental impacts. It proposes a crowd counting approach utilizing the VGG-16 architecture, a pre-trained CNN enhanced with morphological operations to improve feature representation and density estimation accuracy. The research explores how these advanced techniques can mitigate noise, enhance crowd counting precision, and be integrated into existing management strategies to improve safety and efficiency during the pilgrimage.

In this paper, we propose an approach that leverages a combination of advanced techniques and pre-trained CNN to achieve precise crowd counting, as shown in Figure 1. Firstly, we utilize the VGG-16 architecture, a powerful CNN known for its effectiveness in image classification tasks. We load the pre-trained VGG-16 model and extract features from both training and testing images. We place particular emphasis on employing morphological operations to enhance the feature representation extracted from crowd images. After binarizing the extracted features, morphological operations such as opening and closing are applied to refine the representation. These operations help to mitigate noise and emphasize the structural characteristics of the crowd, thereby improving the accuracy of density estimation. The deep features are then utilised as inputs for our regression model.

## Literature review

Enhancing the resolution of feature maps leads to finer details, resulting in higher-quality density maps that aid in crowd count estimation (Cao X, 2018) (Wan J, 2019). However, when pooling operations are employed to increase receptive fields in networks, the resolution of feature maps decreases, causing the loss of crowd image details. To maintain consistent input and output resolutions, the encoder-decoder structure is commonly used (Jiang, 2019) (Thanasutives P, 2021). In this structure, the encoder extracts input image features and combines them, while the specially designed decoder decodes the higher-level features required by these extracted

features. For instance, the multi-scale-aware fusion network with attention (M-SFANet) mechanism (Thanasutives P, 2021) enhances its encoder with Atrous spatial pyramid pooling (ASSP) (Chan AB, 2008), which extracts multi-scale features from the target object and fuses context information. To handle scale variations in input images, M-SFANet employs the context-aware network (CAN) module (Liu W, 2019) as the decoder. As deep neural networks, different layers contain varying crowd information, but some details are inevitably lost (Liu W, 2019). Dense Scale Network (DSNet) (Dai F, 2021) was proposed to effectively extract long-distance context information and maximize the retention of network layer details. Li et al (2022) introduced the densely connected multi-scale pyramid network (DMPNet) as a solution for crowd count estimation and the production of high-fidelity density maps. The central component of their network architecture is the Multi-scale Pyramid Network (MPN), which adeptly captures multi-scale features from crowd images while preserving input feature map resolution and channel count. To enhance information flow across network layers, dense connections are employed to link multiple MPNs. Additionally, the authors devised a novel loss function to improve model convergence. Extensive experiments conducted on three challenging benchmark crowd counting datasets demonstrate that DMPNet outperforms state-of-the-art algorithms in terms of both parameters and results.

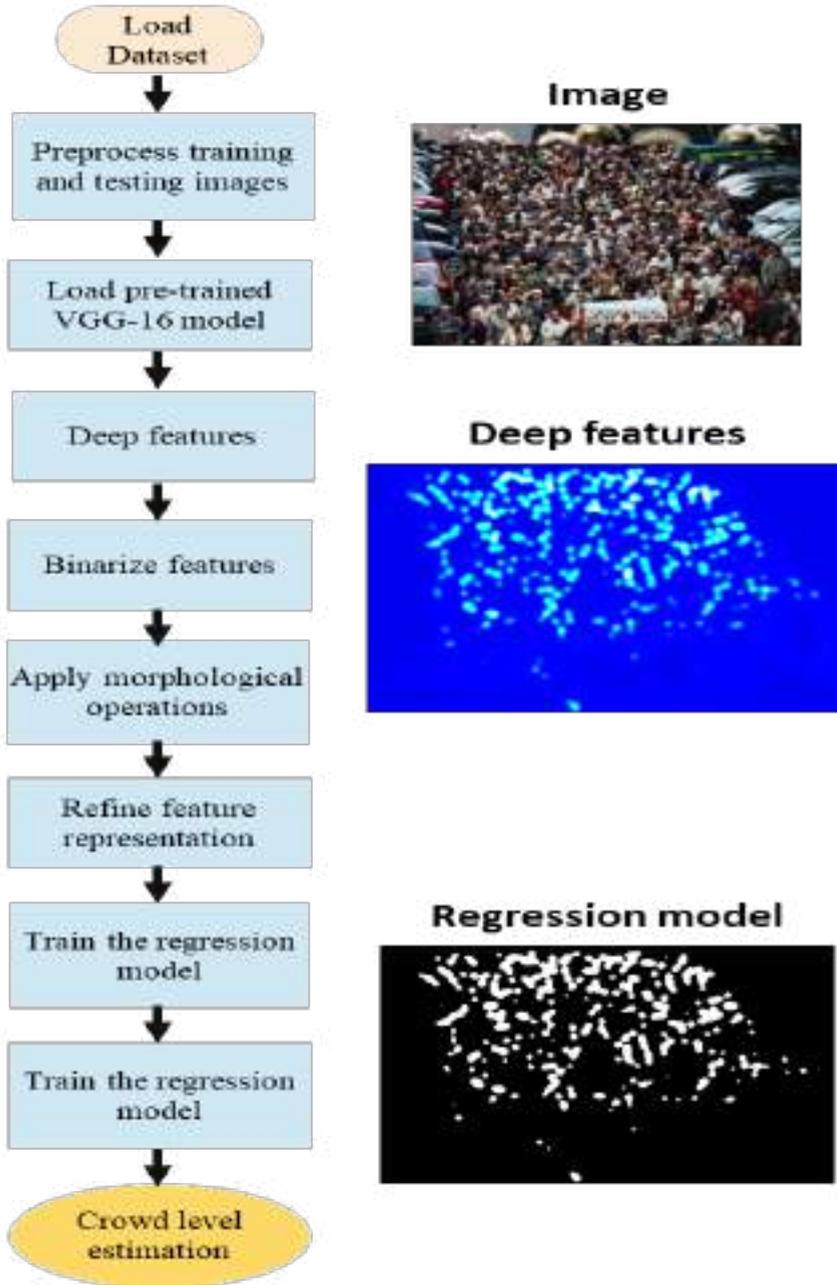


Fig. 1. The proposed approach where the flow chart represents the main steps and images on the right represent the main outcomes of main steps.

## Methods and materials

### Dataset

The Shanghaitech dataset (Zhang, Y, 2016) represents a significant contribution to the field of crowd counting, offering a rich collection of 1198 annotated crowd images. These images are strategically divided into two main sections: Part-A and Part-B, each serving distinct purposes in research and analysis. Part-A encompasses 482 images, while Part-B boasts a larger pool of 716 images, providing researchers with a diverse range of crowd scenarios to analyse. Delving deeper, Part-A is meticulously organised into train and test subsets, with 300 and 182 images, respectively. Similarly, Part-B follows suit, with 400 images allocated for training and 316 for testing. Such meticulous partitioning enables researchers to conduct robust evaluations of crowd counting algorithms across varying datasets. An essential feature of the Shanghaitech dataset is its meticulous annotation process. Each person within the crowd images is annotated with precision, marked by a single point positioned close to the centre of their head. This meticulous annotation process ensures the accuracy and reliability of the dataset for crowd-counting tasks. Impressively, the dataset boasts a total annotation count of 330,165 individuals, providing extensive ground truth for algorithm training and evaluation. Moreover, the origins of the images add an intriguing dimension to the dataset. Part-A images are sourced from the vast expanse of the internet, reflecting diverse contexts and scenarios. In contrast, Part-B images offer a

unique perspective, captured amidst the bustling streets of Shanghai. This deliberate selection of image sources enriches the dataset, offering researchers a comprehensive view of crowd dynamics across different environments and contexts.

## Proposed model

### Dataset Preparation

The dataset preparation phase involves several crucial steps to ensure the quality and consistency of the input data for the subsequent stages of the model. Initially, a dataset containing images depicting crowd scenes in urban environments is curated. These images serve as the foundation for the model's training and evaluation. To standardise the data and mitigate potential variations, preprocessing techniques are applied. These techniques encompass resizing images to a uniform size, enhancing contrast to improve visibility, and removing noise to minimize interference. By implementing these preprocessing steps, the dataset is refined into a homogeneous collection of images, setting the stage for accurate feature extraction and subsequent analysis. This meticulous dataset preparation process lays the groundwork for the model's efficacy in estimating crowd population density, ensuring that it operates on a consistent and reliable set of input images.

## Deep Feature Extraction using VGG-16

Deep feature extraction using the VGG-16 architecture (Ilyas, 2022) (Anand, 2022) plays a pivotal role in our model's approach to estimating crowd population density in images. By employing convolutional neural networks (CNNs), specifically VGG-16, this phase involves the transformation of raw image data into a compact and informative feature representation.

The process begins with the input image  $I$  being passed through a series of convolutional and pooling layers within the VGG-16 network, resulting in a set of hierarchical feature maps  $F = \{f_1, f_2, \dots, f_n\}$ , where  $n$  represents the number of feature maps. Each feature map  $f_i$  captures distinct visual patterns and spatial information present in the input image.

Mathematically, the feature extraction process can be represented as:

$$F = VGG16(I) \quad (1)$$

where  $VGG16(\cdot)$  denotes the VGG-16 network function.

Next, the extracted feature maps  $F$  are flattened into a vector representation  $X$ , which serves as the input to subsequent processing stages:

$$X = \text{flatten}(F) \quad (2)$$

The resulting feature vector  $X$  encapsulates rich semantic information about the input image, encoding both low-level and high-level features relevant to crowd population density estimation.

Through transfer learning, the pre-trained weights of VGG-16 are utilised to expedite the feature extraction process. By leveraging knowledge learned from large-scale image datasets, VGG-16 can effectively capture discriminative features relevant to crowd scenes, even in the absence of direct training on our specific dataset.

### Morphological Processing

Morphological processing (Said, 2021) (Goyal, 2011) (Bhutada, 2022) stands as a pivotal stage within our model’s framework for estimating crowd population density in images. Rooted in mathematical morphology, this technique manipulates the spatial structure of image features to enhance the resolution of density estimates derived from deep features extracted by the VGG-16 architecture.

The morphological processing pipeline encompasses a series of operations applied to binary representations of the extracted features. Initially, a thresholding operation is employed to binarize the deep features, producing a binary image  $B$  where pixels with values above a certain threshold are assigned a value of 1 (foreground), while those below are assigned 0 (background). Mathematically, this operation can be represented as:

$$\begin{cases} 1 & \text{if } F(i, j) > \text{threshold} \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

where  $F$  represents the deep feature map.

Subsequently, morphological operations such as erosion, dilation, opening, and closing are applied to the binary image  $B$  using structuring elements  $S$  to manipulate its spatial structure. These operations serve to remove noise, fill gaps, and smooth out regions of interest, thereby enhancing the accuracy and reliability of density estimates. Mathematically, the morphological operations can be expressed as:

$$\text{Erosion: } B \ominus S$$

$$\text{Dilation: } B \oplus S$$

$$\text{Opening: } B \circ S = (B \ominus S) \oplus S$$

$$\text{Closing: } B \cdot S = (B \oplus S) \ominus S$$

where  $\ominus$  denotes erosion,  $\oplus$  denotes dilation,  $\circ$  denotes opening, and  $\cdot$  denotes closing.

Through the application of these morphological operations, the spatial structure of the binary image  $B$  is refined, resulting in an enhanced representation that preserves the salient features relevant to crowd population density estimation. This refined representation serves as the basis for subsequent regression modelling, facilitating accurate and robust estimation of crowd population density in images.

## Regression Model for Density Estimation

The regression model (Hidalgo, 2013) (Kinaneva, 2021) for density estimation constitutes a critical component within our

methodology for accurately estimating crowd population density in images. Rooted in statistical learning theory, this model learns the mapping between morphologically processed features extracted from the images and ground truth density values, enabling precise estimation of population density across diverse scenes and conditions.

Mathematically, the regression model can be represented as:

$$Y=f(X)+\epsilon \quad (4)$$

where:

$Y$  represents the ground truth density values,

$X$  denotes the morphologically processed features extracted from the images,

$f(\cdot)$  represents the regression function, and

$\epsilon$  represents the error term.

The goal of the regression model is to learn the underlying relationship between the input features  $X$  and the corresponding density values  $Y$ , capturing the complex dependencies present in the data. This relationship is typically learned through optimization techniques such as least squares regression, where the model parameters are adjusted to minimize the discrepancy between the predicted and actual density values.

Once trained, the regression model can be utilized to predict crowd population density for new images. Given a set of morphologically processed features  $X_{test}$  extracted from an unseen

image, the regression model computes the predicted density values  $Y^{\text{test}}$  using the learned regression function ( $\cdot$ ):

$$Y^{\text{test}} = f(X^{\text{test}}) \quad (5)$$

The accuracy of the density estimates is evaluated using performance metrics such as mean squared error (MSE) or coefficient of determination (R-squared), which quantify the agreement between the predicted and ground truth density values.

By leveraging the learned mapping between input features and density values, the regression model enables precise estimation of crowd population density in images, facilitating applications in urban planning, crowd management, and public safety.

## Evaluation metrics

In our evaluation of crowd population density estimation, we employ multiple metrics to assess the accuracy and quality of the generated density maps. The Mean Absolute Error (MAE) and Mean Squared Error (MSE) are fundamental metrics used to quantify the discrepancy between the estimated counts and the ground truth counts across all images in a test sequence.

The MAE is defined as the average absolute difference between the estimated count  $C_i$  and the corresponding ground truth count  $CGT_i$  for each image  $i$  in the test sequence:

$$MAE = \frac{1}{N} \sum_{i=1}^N |C_i - CGT_i| \quad (6)$$

Meanwhile, the MSE represents the average squared difference

between the estimated counts and the ground truth counts:

$$MSE = \frac{1}{N} \sum_{i=1}^N |C_i - CGT_i|^2 \quad (7)$$

where  $N$  denotes the number of images in the test sequence,  $C_i$  is the estimated count, and  $CGT_i$  is the ground truth count.

The estimated count  $C_i$  is computed based on the generated density map, which is defined as the sum of all pixel values within the density map. The density map has dimensions  $L \times W$ , where  $L$  and  $W$  represent the length and width of the map, respectively. Each pixel  $(z_l)$  at coordinates  $(l, w)$  contributes to the count  $C_i$ .

$$C_i = \sum_{l=1}^L \sum_{w=1}^W (z_l) \quad (8)$$

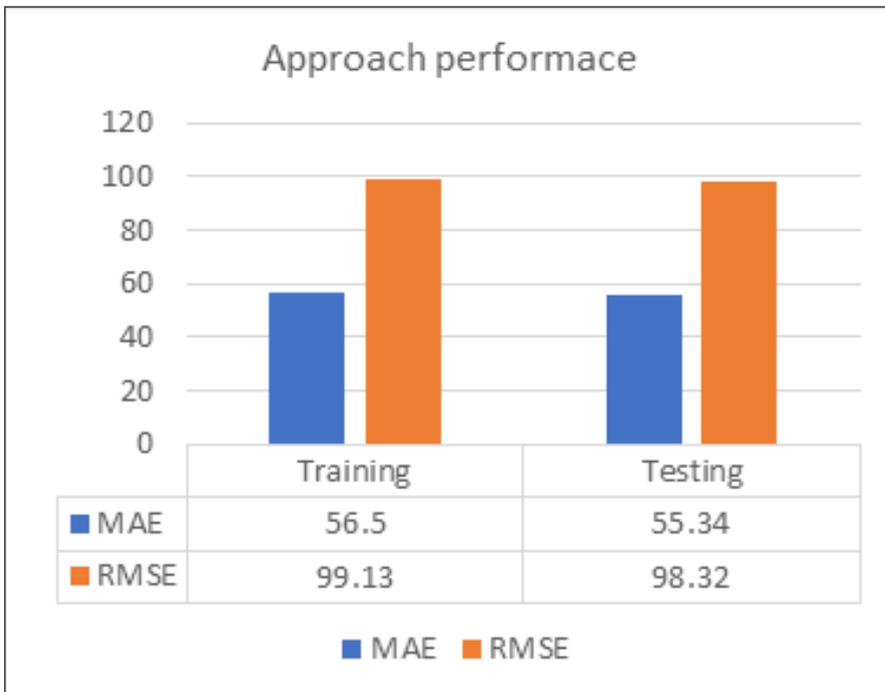
## Results and discussion

The results obtained from the proposed model on the ShanghaiTech Part A dataset demonstrate promising performance in estimating crowd population density. The Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE) metrics serve as indicators of the model's accuracy in both training and testing scenarios, as shown in Figure 2.

For the training phase, the model achieves an MAE of 56.5 and an RMSE of 99.13. These metrics suggest that, on average, the estimated counts deviate by approximately 56.5 individuals from the ground truth counts in the training set, with a root mean squared error of 99.13. These values indicate a moderate level of accuracy

in estimating crowd population density during the training phase.

During testing, the model’s performance remained consistent, with an MAE of 55.34 and an RMSE of 98.32. These metrics reflect similar levels of accuracy observed in the training phase, indicating that the model generalizes well to unseen data. The slightly lower MAE and RMSE values in testing compared to training suggest that the model effectively captures the underlying patterns in the data without overfitting to the training set.



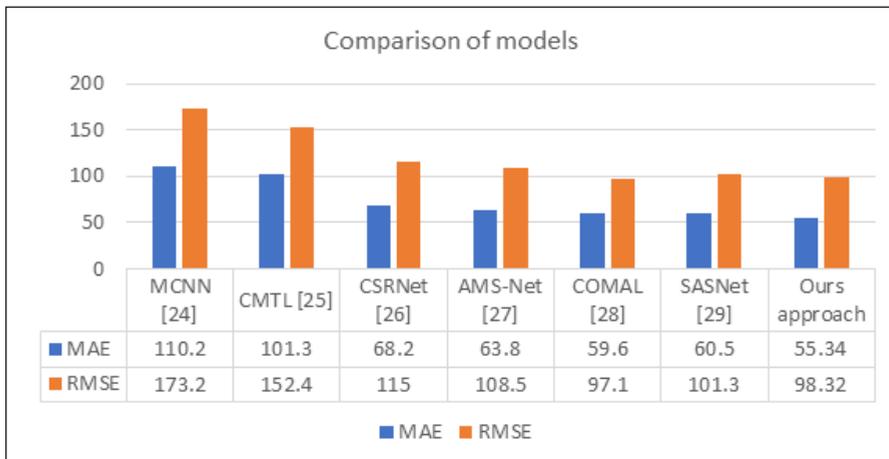
**Fig. 2. The performance of proposed approach using MAE and RMSE.**

In Figure 2, the lower values of MAE and RMSE indicate superior performance. Consequently, the testing phase results, with an MAE of 55.34 and an RMSE of 98.32, are better than the

training phase results, which show an MAE of 56.5 and an RMSE of 99.13. This outcome suggests that the model generalises well to new, unseen data. There are several potential reasons for this phenomenon. First, regularization techniques employed during model training might have effectively prevented overfitting, ensuring that the model did not merely learn the noise in the training data but captured the underlying patterns that are also present in the testing data. Additionally, the marginal difference between the training and testing errors might be attributed to random variation, which is common in practical datasets. Furthermore, the training dataset might contain more noise or outliers compared to the testing dataset, making it inherently more challenging to achieve lower error metrics during training. These factors collectively contribute to the observed performance metrics, underscoring the importance of robust model validation practices to ensure reliable and generalizable predictive performance.

Our approach to estimating crowd population density, as demonstrated on the ShanghaiTech dataset, showcases a remarkable advancement in the field compared to existing literature methods. Our model achieves an impressive MAE of 55.34 and RMSE of 98.32, outperforming several state-of-the-art methods (Figure 3) such as Multi-column Convolutional Neural Network (MCNN), CNN-based cascaded multi-task learning (CMTL), dilated convolutional neural networks (CSRNet), attention-guided multi-scale fusion network (AMS-Net), compositional multi-scale feature enhanced

learning (COMAL), and SASNet. The substantial reduction in error metrics signifies the efficacy and precision of our approach in capturing complex crowd dynamics accurately. This improvement can be attributed to the integration of cutting-edge deep learning architectures, morphological processing techniques, and meticulous data preprocessing strategies within our model. By leveraging these advancements, our approach excels at accurately estimating crowd density, providing invaluable insights for urban planning, crowd management, and public safety initiatives. The superior accuracy achieved by our model holds profound implications for real-world applications, enabling authorities to make data-driven decisions regarding resource allocation, infrastructure planning, and emergency response strategies during large-scale events and gatherings. Moving forward, continued research efforts will focus on further refining and optimizing our model to enhance its scalability, robustness, and applicability across diverse environmental conditions and datasets.



**Fig. 3. Comparison of related work and proposed approach using MAE and RMSE.**

The integration of the proposed model into the Arbaeen pilgrimage, renowned as the world's largest annual public gathering, heralds a paradigm shift in crowd management strategies and safety protocols. By harnessing cutting-edge image processing technologies and population density estimation algorithms, the model provides unprecedented insights into crowd dynamics and spatial distribution along the pilgrimage route. These insights empower authorities with a comprehensive understanding of crowd density patterns, enabling them to deploy resources judiciously, anticipate congestion hotspots, and orchestrate efficient crowd flow strategies in real-time. Moreover, the model serves as a linchpin in emergency preparedness efforts, providing invaluable support in identifying high-risk areas and facilitating swift and targeted response measures in the event of emergencies or unforeseen incidents. Beyond enhancing operational efficiency and public safety, the model's deployment underscores a commitment to optimizing the pilgrim experience, ensuring smoother logistics, and fostering a sense of security and well-being among participants. In essence, the adoption of the proposed model during the Arbaeen pilgrimage epitomizes a convergence of technology and tradition, ushering in a new era of innovation-driven crowd management practices that prioritize safety, efficiency, and the preservation of sacred traditions.

## Conclusion

In conclusion, our study demonstrates the effectiveness of our approach in achieving superior accuracy in crowd counting compared to existing state-of-the-art methods. The significant reduction in MAE and RMSE metrics highlights the robustness and reliability of our model in estimating crowd density with precision. This breakthrough holds promising implications for various real-world scenarios, particularly in crowd management and analysis.

Looking ahead, future work could focus on further refining our model architecture and optimizing training strategies to enhance performance even further. Additionally, exploring the integration of additional data sources and advanced techniques such as multi-scale feature extraction and attention mechanisms could yield additional improvements in crowd counting accuracy.

Implementing our approach in the context of Arbaeen Pilgrimage, a significant religious event that draws millions of pilgrims annually, could revolutionize crowd monitoring and management practices. By accurately estimating crowd density in real-time, authorities could proactively implement crowd control measures to ensure the safety and well-being of pilgrims. Moreover, insights gleaned from our approach could inform infrastructure planning and resource allocation for future pilgrimages, optimizing logistical operations and enhancing the overall pilgrimage experience.

In summary, our study presents a promising advancement in crowd counting technology, with the potential to make a tangible

impact on crowd management practices, particularly in large-scale events like the Arbaeen Pilgrimage. As we continue to refine and deploy our approach, we anticipate further advancements in crowd analysis and management, ultimately contributing to safer and more efficient gatherings worldwide.

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**LEVERAGING INNOVATIVE HEALTHCARE  
APPROACHES TO CROWD MANAGEMENT  
AND MAJOR EVENT PREPAREDNESS: A  
TECHNOLOGICAL PARADIGM SHIFT**

**RANIA AMAR  
Heart Disease and Surgery Center**



## Abstract

Iraq annually, specifically in the province of Karbala, a great millionaire visits with the fortieth anniversary of the martyrdom of Imam Hussein (peace be upon him), and it is from different parts of the world, where the number of visitors in recent years has reached about 22 million foreign visitors and in the shadow of all circumstances, even in the period of the COVID-19 pandemic. It is our responsibility to secure health care for visitors and manage it in innovative ways in line with the technological developments of health care that limit and almost prevent the occurrence of disease cases and fill the potential gaps for the spread of diseases, especially as we are in the era of technological development and artificial intelligence, where the use of advanced health care means would facilitate dealing with such huge numbers, ease of control, disaster prevention and crisis management.

In this research article, we will discuss the importance of advanced technological healthcare means and their contribution to facilitating the management of the health of visitors and the management of crowds in this major event, how to keep up with them gradually, starting with the simplest methods, what are the factors that help in their success, and what are the future visions to improve such a global million visit.

## (Introduction) CHAPTER1

### Introduction

Arbaeen is an important religious gathering that brings together millions of faithful visitors in the streets of Karbala - Iraq. The climax of the gathering is on Arbaeen day, which means 40 days, which is the period of mourning for Imam Hussein Ibn Ali, the grandson of the Prophet Muhammad, beginning on the 10th of Muharram (Ashura), Imam Hussein and his companions had been killed during it in the Battle of Al-Taf in 680 AD, many Shiite Muslims flock to Karbala in the days and weeks preceding Arbaeen. While participation is not an obligation in the Shiite faith like the annual Hajj trip (the Hajj to Mecca), millions of Shiite believers cross About their love for Hussein and his sacrifice in Karbala and their commitment to what the prophet's family.(Nur Ayoubi, 2021; Sara Hassan, 2023; Sinan Mahmoud, 2023)

The matter is not limited to Shiites or even Muslims, we find the participation of some Sunnis and even Christians and Hindus, but the majority of people who participate in the Arbaeen march are Shiite Muslims, which makes this event one of the most important events in the Shiite calendar.

This walk is timeless even in the summer, when temperatures reach 120 degrees Fahrenheit during the day. On the way to Karbala, we find the visitors who wear black, and carrying children in strollers wearing hats or placing wet clothes on their heads to avoid sunstroke and sunburn. So many people choose to walk at night. However, Imam Hussein's sacrifices inspire many to do charity and service along the way. There

are more than a thousand stops, or processions, where people can rest. (Sara Hassan, 2023; Sinan Mahmoud, 2023; Syed Shahriyar, 2023)

People organize and sponsor booths (Mawkibs) along the route, during which water, meals, and tea are distributed and various services are provided for free. Some carry banners and flags. Medical sites have also been built to help visitors. For 15 years, the Imamiya International Medical Organization has been traveling to Iraq to provide free medical and dental services(Sara Hassan, 2023). There are also free foot massages for those who walk, as some people do not wear shoes and suffer from severe pain. Some of the visitors coming to this visit may have been sick and may have forgotten their medications or this Arbaeen visit may have exacerbated their illnesses. Some of them get sick while they are on the huge march as a result of fatigue, infection, etc., which may lead to creating a health crisis from small cases in the crowds.

Although the Iraqi authorities, in cooperation with various local and foreign Shiite religious groups, have worked to ensure the safety and well-being of pilgrims, on the other hand, some challenges create problems for the authorities and pilgrims. Dozens of pilgrims, most of them Iranians, died a year ago in car accidents, while border authorities struggled to cope with the number of visitors(Sinan Mahmoud, 2023).

Crowd management is a difficult task and organizing an event of this size comes with its share of challenges. These numbers are constantly increasing, even during the COVID-19 pandemic the attendance of visitors was slightly lower than the previous year compared to the Hajj in Mecca amid a set of precautionary measures and instructions, which these numbers quickly increased in the following year(Hussein et al.,

2022). However, crowd monitoring and management has become an important research topic in the pursuit of innovative technologies that can help mitigate these risks, and the rapid progress in digital transformation has led to accelerated growth in the healthcare field.

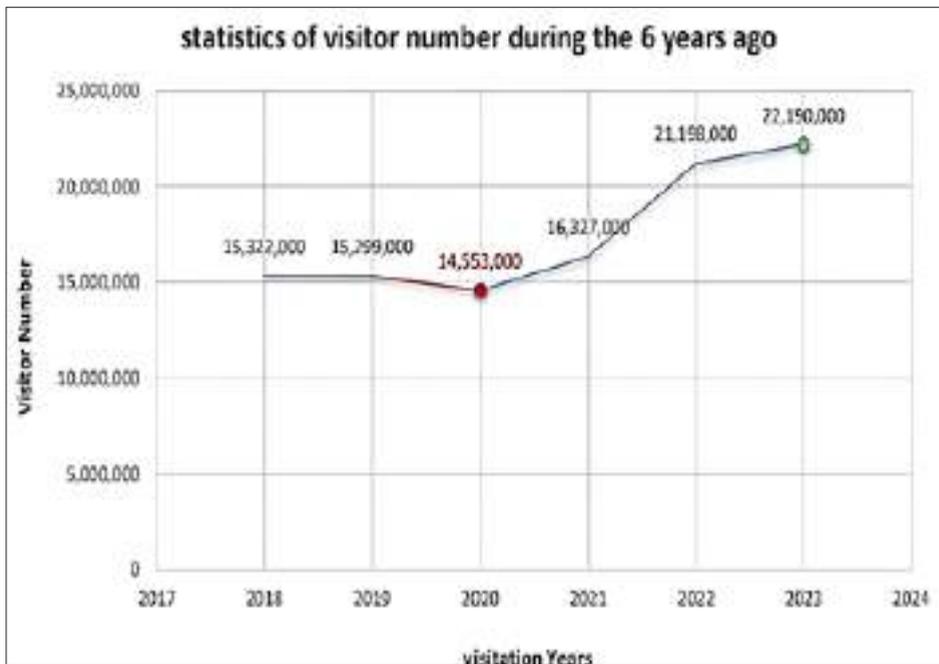
### **Aim and Research Questions:**

Based on the research gap in how to provide health care during the Arbaeen period and the use of advanced technologies and the possibility of keeping pace with artificial intelligence methods and being able to manage crowds and control emergencies in real-time, The questions were: What is the importance of the Arbaeen visit, what is the necessity of developing and implementing new strategies and technologies to provide health care services, how to avoid emergencies and control crowds, and what are the restrictions and possibilities that would advance the technological reality in the Arbaeen Event?

## CHAPTER2 (importance and Challenges)

Importance of Keeping up with Healthcare Technologies Many researchers have indicated the importance of integrating technologies to use them as a tool to control the flow and management of crowds from the perspective of improving safety and quality of service, and the global impact of the COVID-19 pandemic has led to the rapid development in the use of advanced technology. Such as mobile phone applications, patient

**Figure 1: The numbers show the size of the Arbaeen event and its importance, as the numbers of pilgrims from different countries and nationalities have been increasing over the years and continuing during the pandemic.(AlKafeel Global Network, 2023; مركز كربلاء للدراسات والبحوث, 2022 ,2021 ,2020 ,2019 ,2018 )**



monitoring techniques, determining the extent of the progression of the disease stage, and remote communication to save time, ensure patient security, manage crowded places, etc... But Looking at the Huge and prominent global gathering (Arbaeen), we find a lack of technologies that would provide health care to crowds and manage them smoothly. Although, several technologies have been applied in Hajj.

Relying on research and statistics that show the continuation of the Arbaeen pil

grimage despite the country being exposed to several epidemics and crises that would hinder the million-man visit, and clarifying the small percentage of health care services and technologies compared to the number of visitors, it is necessary to employ modern technologies, which are represented by light shade in presence and abundant giving, to ensure the comfort of the visitors and Their safety and health by ensuring that their physical and mental condition is complete and that they are free of diseases, and by monitoring the health status of those suffering from diseases during their presence and ensuring their return without aggra

vation and harm, especially in recent years when the visit became sync with the scorching summer season, so we find many visitor who wear black as part of the visitation ceremonies, wearing hats and carrying Umbrellas to avoid sunstroke and burns, and this is enough to improve them globally.

The researchers clarified the most important risks posed by large-scale events, the most prominent of which are health and safety risks, infectious and airborne diseases, crowd control, pressure in health care... etc. Mitigating and avoiding these risks is considered a basic line of

defense for responding at the same time to avoid long-term impact because it is usually not easy to see health risks, as their impact often has delayed consequences.

## The Most Prominent Challenges Facing Visitors:

After lengthy research, we found nothing that reduces the extent of the challenges and problems facing visitors along the path. Most of the services provided are free of charge by residents and sometimes by visitors to Karbala for honorary service and visitation. Despite the presence of medical detachments, they are somewhat far apart. When a visitor is in bad condition, heading to the nearest detachment requires some time to reach through the huge crowd, or he may need some immediate advice when feeling tired, as the march routes are not all public roads. Lack of managing and directing foreign visitors to the correct path, controlling the crowd, preventing overcrowding in specific areas, preventing the spread of diseases, creating gaps that create certain diseases, creating an infected environment, and avoiding stampedes, as happened in some years on Ashura and during the Hajj ceremonies in Mecca. Many families and individuals participated in the Arbaeen Road with their children, the elderly, and friends. There was an urgent need to track and keep in touch with the individuals during the journey, and to know their presence and the ease and speed of reaching them when they go missing.

It is necessary to follow up on the patient's condition when he is diagnosed, communicate with him along the way, and share his health file with medical detachments and kiosks for easy access to the required services.

## CHAPTER3(REVIEW TECHNOLOGIES)

### Methods applied in health care and crowd management:

Several research articles were reviewed to identify the most important innovative healthcare methods for managing health and crowds.

In a study, a model was presented for crowd management in the emergency department using non-invasive wearable devices, using a mathematical model with an algorithm that can collect vital parameters that describe the patient's condition immediately and communicate them to the workers, thus helping the workers prioritize assisting with critical cases faster and controlling crowds instead of a basis on First come first served which is not always effective(Metuge et al., 2022)

low-cost work was proposed to track three conditions of pilgrims at the same time, which are the path of movement, physical activity, and physiological health, using GPS and biosensors, and linking them to an approved data center and distributing them to pilgrims, especially in crowded places, to avoid the occurrence of cases of fainting and fatigue that cause trampling and stampede accidents during crowding In the future, the study suggests using artificial intelligence to evaluate speed and density and deliver warning messages to pilgrims and direct them with instructions(Al-Shaery et al., 2022).

Applying technologies such as Crowd Management Mobile Augmented Reality application (CMMAR) mobile augmented reality has helped visitors and the local administration organize the movement of crowds by monitoring visitors, analyzing their movements, identifying

missing visitors, helping them find the right directions, and informing their groups. It also helps operators in control rooms and Hajj employees on the ground to detect dangerous crowds through data shared between pilgrims, manage them, provide pilgrims with the situation, and respond to organizers' instructions(Owaidah, 2014).

PTS (Pilgrim Tracking System) is an application designed to be compatible with Android devices. It uses GPS. Hajj agents and campaign managers can stay in touch and track the pilgrims and the latter can find the group if they get lost with a route guide to the specified destination(Alshalani et al., 2020).

The research showed the possibility of using health care technologies such as smart medical applications, medical robots, remote communication, and virtual communication, where patients can receive first aid directions in emergencies, and the possibility of communicating with medical teams remotely for diagnosis and receiving rapid intervention (حسين علي محمد - ٢٠٢٣).

During the COVID-19 pandemic, a system was used that consisted of a mobile phone application and a cloud server. Health information is collected by specialists through home visits or phone calls and is analyzed by artificial intelligence to make the correct diagnosis and then direct treatment or transfer it to the nearest health center(Sarker et al., 2023).

Thermal cameras were also used with the help of drones to measure the temperature of infected people, process the captured data, and enable it to be stored and sent for evaluation(Conte et al., 2021).

A fluorescence sensor that supports 5G technology has been developed and connected to mobile devices and smartphones via Bluetooth. It detects Covid-19 and allows remote monitoring of patients(Guo et al., 2021).

Creating an application in the form of a smartphone platform that measures vital parameters as well as coughing to detect COVID-19, supported with the blockchain system and 5G connectivity(Muhammad & Hossain, 2021).

In Mecca, a wearable system with simple manufacturing was successfully tested and proven to be sensitive to crowd density. It consists of biometric sensors and two-way wireless communication modules that provide user interface and processing with 65% extensibility. Using an expandable printed circuit board PCB, information is collected and an alert is sent to the user. Emergency cases and submit them to the management center(Rojas et al., 2022).

This study examined next-generation technologies for structural health monitoring and demonstrated the effectiveness of the ability of wireless sensors when combined with advanced image and signal processors to form a powerful, lower-cost system that is summarized in (Figure 2)(Sony et al., 2019).

In this study, a system was developed that predicts crowd flow and congestion in real-time through agent-based simulation. Its effectiveness was tested in a large event in the vicinity of Tokyo Dome. The study discussed the scalability of the system and its application in large-scale events(Yasufuku & Takahashi, 2024).

**Figure 3:Next – Generation Sensing for SHM (Structural Health Monitoring)**

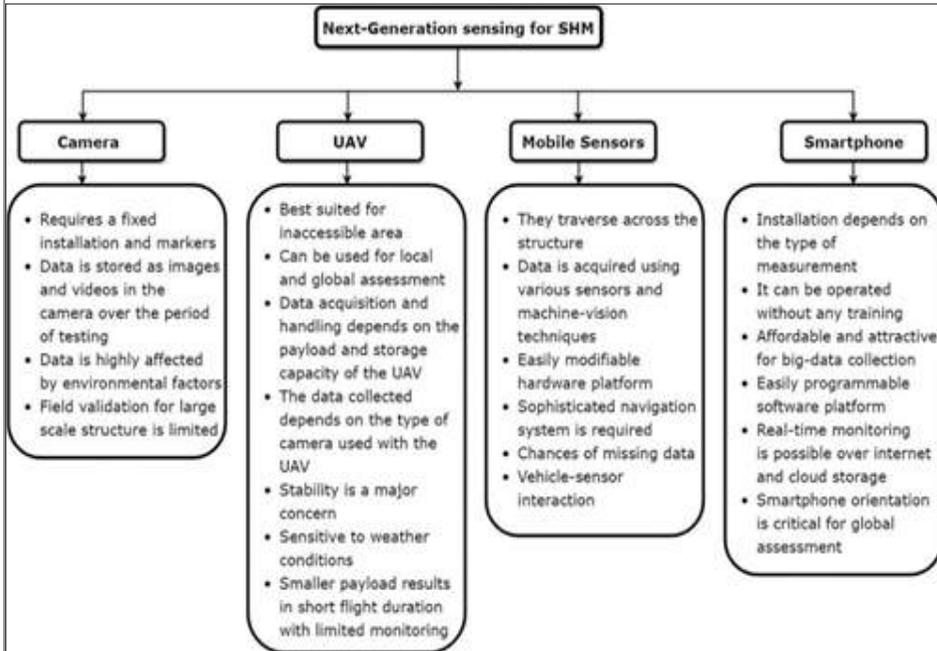
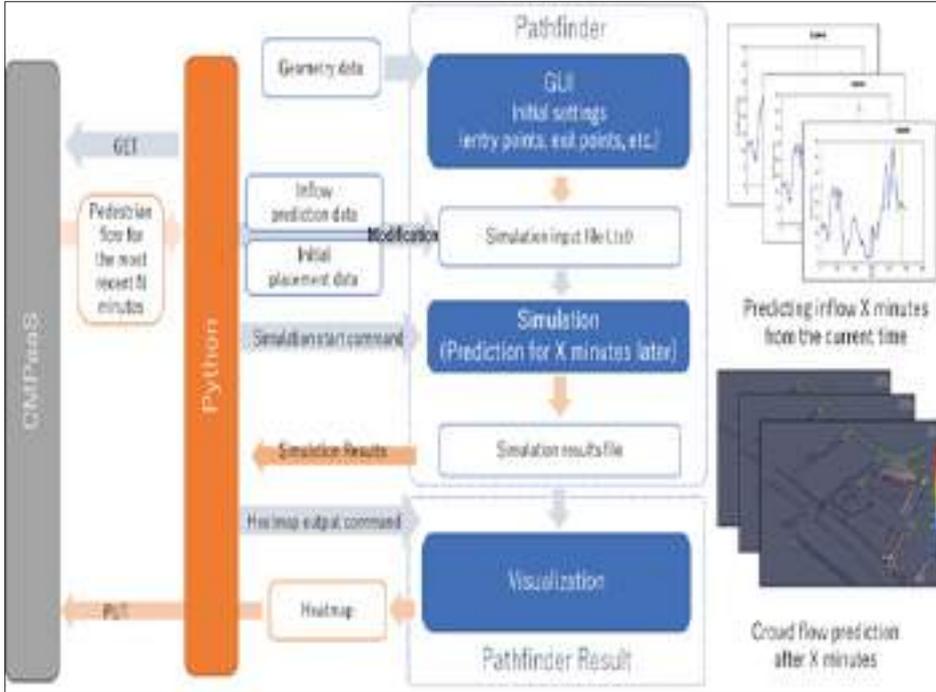


Figure 4: System Flow of Real-Time Crowd Flow Prediction



## CHAPTER FOUR (DISCUSSION)

### Constraints, Opportunities, and Future Scope:

To create a future for health care, manage it, and preserve the health of the individual, there must embrace scientific expertise and competencies capable of managing innovative technological technologies, keeping pace with them and developing them, and creating systems that will facilitate dealing in the medical environment and quickly collect health information for individuals from anywhere and transfer it to different system levels with high reliability and speed. Make the most of the time factor in indirect health care (IEH).

In developing countries, we find that keeping up with these medical developments and technologies is not just a vision, but a tangible reality. We need to work on a medical technological transformation to control the health of the huge number of visitors increasing annually during the Arbaeen event in a fixed area and other events that concern the health of the individual, such as the creation of diseases, the spread of epidemics, road accidents, stampedes, the time factor in receiving the necessary intervention...etc.

After extensive research in several studies and experiments, we find that these innovations revolve around almost fixed components:

1. Relevant components: biomedical sensors, which represent the beginning of any mobile medical system. The limitations lie in exploiting them for multiple uses, lightweight, and an acceptable, almost unobtrusive shape. There are sensors in the form of tattoos, gloves, shoes, bracelets,

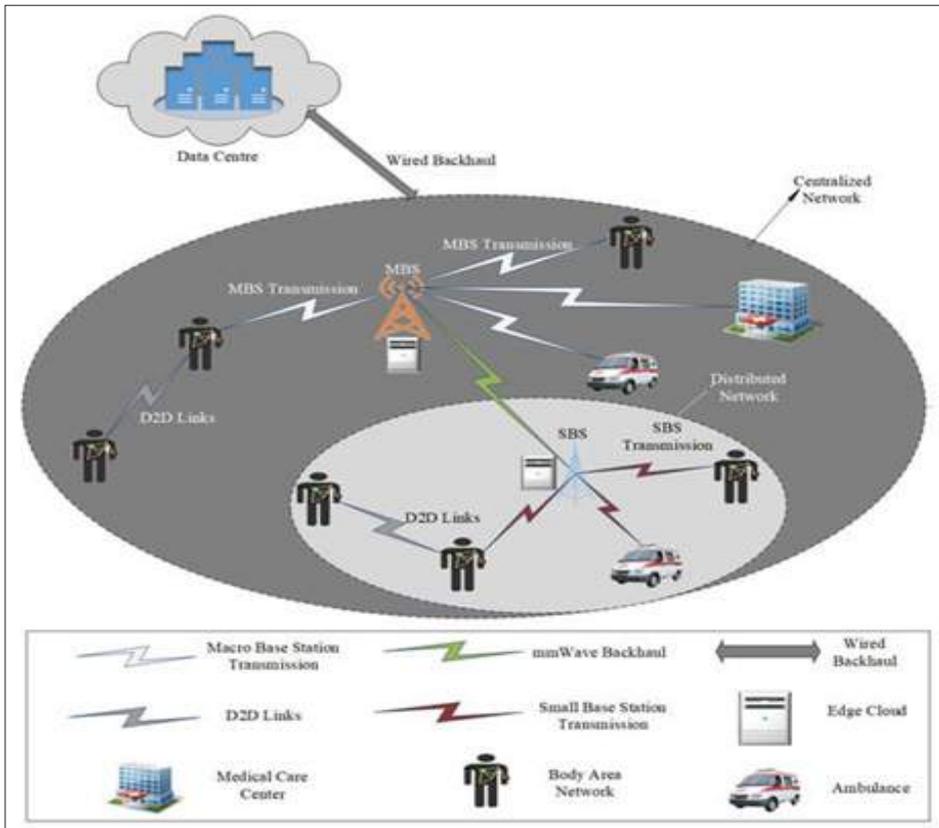
watches, and sensors built into phones...etc.

2. Transmission environment and means of communication: The use of 5G communications with IoT technologies plays an important role in creating smart health care. The integration of artificial intelligence (AI) in the future will contribute fundamentally to making the network more intelligent with healthcare applications. The possibility of 5G communication lies in low latency, wide-range coverage, and high energy efficiency(Ahad et al., 2020). These characteristics are required to transfer and exchange data between biosensors and mobile phones in healthcare applications framed in the Internet of Medical Things (IoMT), which brings billions of devices together(Chengoden et al., 2023; Moglia et al., 2022).

3. Data management and preservation: Data security and management are an important part of any medical system, so studies have shown that Blockchain technology meets the required standards (access to data at any time, fast and secure storage of medical data, collecting health entities in a unified system) as it is a management for system data across a network node that allows data to be exchanged and preserved. It is a peer-to-peer (P2P) network(Haleem et al., 2021) and cannot be hacked unless the resources of the shared public are collectively hacked(Abdellatif et al., 2020).

Identifying these technologies also requires medical awareness of the community and workers alike.

**Figure 5: A general architecture of a smart healthcare network based on 5G(Ahad et al., 2020).**



The technologies reviewed for healthcare and crowd control also emphasize the synergy between medical and engineering visions and the keeping pace of biomedical engineers with developments in the field of healthcare and crowd and disaster management in emergencies and crises. We note the absence of local capacity to sponsor biomedical engineering innovations that would advance local reality. Investing in these capacities, along with the capacity of local institutions, enhances disaster management with long-term, lower-cost solutions. With the local administration's recommendation to support investment in 5G communications and IoT, in addition to biomedical engineering.

### **Suggested models for implementation:**

Given the noticeable absence of local administration in keeping up with health care technologies, or as it is known as mobile health (m-Health) or electronic health (e-Health), we propose in this research work some methods derived from the technologies discussed to be preliminary step towards a technological transformation for managing the Arbaeen event.

Creating an integrated mobile phone application that will be promoted by the local administration to all visitors as a guide to the fortieth visit, supported by GPS technology, allowing the visitor to know the routes of the march, while pinning the points of medical detachments locations on the map, with the possibility of requesting immediate support from the application in the event of an emergency, to guide him to the nearest medical detachment. It also allows the creation of groups that can communicate with each other and can show the locations of group members to track and avoid cases of loss.

The application can be supported by artificial intelligence, sending a notification to the group if one of the individuals strays a certain distance and being able to suggest less crowded routes.

Creating wearable devices with simple models for children and the elderly, for those who do not carry smartphones within the groups, and the possibility of linking them to one of the group's phones.

Applying the idea of using a thermal camera with a drone to monitor crowds, predict danger, alert visitors, and receive instructions via text messages sent by the event organizing department after they receive data from the camera. It can be integrated with sensors or connected to a mobile phone application to measure the health of the air and breathing rate, notify organizers to take the necessary action, and alert visitors as well.

Using IoT, it is also possible to connect medical detachments within a single system and enhance all areas with health care services, as portable devices can be distributed to agencies and the booths (Mawkibs) as a mini-medical system and linked to the rest of the detachments within a single environment. The goal of this proposal is the possibility of treating emergency cases by sharing his medical condition from the nearest Mawkib and following it up from the detachments others and receive the necessary instructions.

We hope that these proposals will be on the ground and the beginning of innovations that will invest in this broad and intelligent field and benefit as much as possible from the technologies that have been reviewed, and that the presented research will be a door for researchers to innovate in this field and study it.

## CHAPTER FIVE (CONCLUSION)

### Conclusion:

When researching the Arbaeen event, its importance, and the increase in numbers annually within a specific geographical area, we find the danger of huge crowds to the health and safety of visitors compared to the lack of crowd management methods and health care techniques and the laxity in keeping pace with this technological development. The literature indicates that crowd management has become an urgent need, especially after the COVID-19 pandemic and the spread of epidemics and Infectious diseases resulting from gaps amid huge crowds. Connected health, connected health (C-Health), has become mature and proven as a scientific field, and most developing countries have kept pace with technological development in health care for individuals and crowds and are in the process of supporting it with artificial intelligence to reduce the momentum in health institutions by using telemedicine and the ability to Crowd management and control during disasters and crises, with the necessity of having IoT systems and 5G communications, and the necessity of investing in the field of biomedical engineering.

### List of Abbreviations

GPS:	Global Positioning System
e-Health	Electronic Health
m-Health	Mobile Health
C-Health	Connected Health
IoT	Internet of Things
IoMT	Internet of Medical Things
IEH	Indirect Health Care
P2P	Peer-to-Peer
SHM	Structural Health Monitoring
PTC	Pilgrim Tracking System
PCB	Printed Circuit Board
CMMAR	Management Mobile Augmented Reality

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**Scientific studies on:"Forensic analysis of fake videos in large-scale events towards automated detection and mitigation"**

Maha Sabri Altememe

College of Computer Science & Information Technology,

University of Karbala, Iraq

[maha.sabri@uokerbala.edu.iq](mailto:maha.sabri@uokerbala.edu.iq)

Wael Mahdi Brich

Information & Telecommunications Public Company, Ministry of

Communications

[albdairy.waal@itpc.gov.iq](mailto:albdairy.waal@itpc.gov.iq)



## Abstract

Mass gatherings, especially the Arba' in pilgrimage in Karbala, are a fertile ground for the spread of deepfake videos. These gatherings rely heavily on visual content circulating on social media and crowd-sourced platforms. Adversaries can exploit this by creating fake videos that mislead people and confuse public opinion. Based on the study's recommendations, there are some ways to combat the spread of deepfake videos in the context of mass gatherings. In this work, we classify deepfake detection methods according to the applications they are used for: hybrid multimedia detection, image, audio and video detection. This study aims to provide the reader with an enhanced understanding of: how deepfakes are created and identified; the latest developments and discoveries in this field; the deficiencies in current security measures; and the four areas that need further research and thinking. According to the results, the most widely used deep learning technique in research is traditional neural network (CNN) methodology.

## Introduction

The Artificial Intelligence and deep learning technology that is created by a fake image or video is called a deep fake. Although AI can achieve amazing results, detecting deepfakes using AI is still a difficult and complex process. Deep learning is an essential tool for identifying deepfakes. Promising deepfake detection techniques

include convolutional neural networks (CNNs), recurrent neural networks (RNNs), and generative adversarial networks (GANs). It can lead to a variety of issues, such as influencing public opinion or using false evidence in court. In light of these variables, we must possess the skills that enable us to distinguish between reality and illusion. This paper provides a comprehensive analysis of the literature on algorithm-based deepfake detection techniques. Deepfake is a term used to describe a variety of face alteration techniques that uses advanced technology including computer vision and deep learning (DL).

Four categories comprise face modification: identity switch, full-facial synthesis, attribute manipulation, and expression swap (Balaji et al., 2021). One of the most popular forms of deepfake video is identity swap, also referred to as face swap, in which the faces of the targeted individuals are substituted for the faces of the source people (Jafar et al., 2020). Users may find it challenging to differentiate between fabricated images and videos and deepfake news when they combine the two (Matern et al., 2019). Through its widespread distribution on social media, this kind of deepfake has the potential to have a major negative impact on people's lives (H. H. Nguyen, Yamagishi, et al., 2019). The use of deep learning in detecting deepfakes is crucial. Advanced algorithms like Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Generative Adversarial Networks (GANs) have shown promise in identifying deepfakes.

To address this threat, the research recommends several proactive measures:

1. Developing advanced detection algorithms and verification tools: These can be integrated into social media platforms and other content aggregators to identify and remove deepfake videos in real-time, preventing their widespread dissemination.

2. Implementing robust fact-checking and content moderation protocols: Event organizers, media outlets, and social media platforms should work collaboratively to quickly identify and debunk any manipulated or misleading content related to the gathering.

3. Empowering users with media literacy education: Equipping the public, especially attendees of these events, with the skills to recognize and critically analyze online content can help mitigate the impact of deepfake videos and other forms of disinformation.

4. Establishing clear communication channels and rapid response mechanisms: Organizers, authorities, and platforms should have well-defined processes to promptly address and correct any false narratives or manipulated content that emerges during or after the event.

By proactively implementing these strategies, the research suggests that the threats posed by deepfake videos and other forms of visual manipulation can be significantly reduced in the context of massive public gatherings, preserving the integrity of these

important events and the broader public discourse.

## Related Works

There are several varieties of deepfake detection techniques available today, and each has benefits and drawbacks of its own. In order to obtain more accurate findings, this work attempts to analyze these approaches from other papers and highlights how they might be integrated and altered in a new project.

This study (D. Guera<sup>n</sup> and E. J. Delp, 2018), proposes a temporal-aware process to automatically recognize deepfake videos. Understanding the production process of deepfake videos is the first step in identifying them. With this knowledge, we will be able to pinpoint the weak places in the production process of deepfakes and exploit them to recognize them when they occur. Frame-level scene inconsistency is the first feature used in the strategy presented in this study. There are 300 videos in this dataset, which is derived from the HOHA dataset. This technique could identify whether the section under study is from a deepfake video or not with an accuracy rate of above 97%.

In this paper (M. A. Younus and T. M. Hasan, 2020), This approach uses the limitation that the deepfake algorithm can only produce fake faces with a certain size and resolution while creating videos. An additional blur function needs to be added to the synthetic faces in order for them to fit and resemble the source's face arrangement in the original videos. The produced face and

the background of the deepfake films it creates are exclusively blurry as a result of this alteration. The technique compares the blurred synthesized ROI and the surrounding context using a specialized Haar wavelet transform function in order to identify such inconsistency. The accuracy percentage of this suggested model is 90.5.

In this study (Mousa Tayseer Jafar et. Al, 2020), a method for detecting deepfakes utilizing mouth features was proposed. This article describes the design and implementation of a deepfake detection model with mouth features (DFT-MF), which uses a deep learning technique to isolate, analyze, and verify lip/mouth movement in order to detect deepfake films. Next, a face's mouth region is cropped. For the face, there will be set coordinates. To estimate the location of 68 (X, Y) coordinates, a face landmark detector is utilized, working on a typical image frame. The next phase involves excluding all faces with closed mouths and tracking faces with only open mouths and teeth with a good degree of resolution. By computing three variables: words per phrase, speech rate, and frame rate, CNN is used to categorize videos as real or fraudulent based on a threshold number of bogus frames. If a video has more than fifty bogus frames, it is labeled as fake; otherwise, it is labeled as authentic.

### 3. Deepfake detection methods

#### 3.1. Fake image detection

The process of detecting and marking images that have been altered or edited in some way is known as “fake image detection,” and it usually involves the use of machine learning algorithms and image processing techniques. Numerous studies and projects deal with the topic of false picture identification, employing a variety of techniques, including deep learning models, to identify facial changes in videos—DeepFakes, Face2Face, and FaceSwap, for example. Texture analysis, especially for faces produced by generative adversarial networks (GANs), can be used to distinguish between real and synthetic faces.

Developing generalized representations to describe the artifacts produced by generation models are possible through tools and services available for fake image detection, such as the Fake Image Detector, which uses advanced techniques like Metadata Analysis and Error Level Analysis (ELA) to detect manipulated images. However, it’s important to note that no method is 100% accurate, and there is always a risk of false positives or negatives. Fake face image detection is the most difficult challenge in the field of image forgery detection.

Fake images can be used to create false personas on social networking sites, which makes it possible for personal data to be stolen. For instance, the fake picture generator can be used to

produce potentially harmful images of celebrities with unsuitable material. Specifically, Deepfake replaces the face of an original image with a different person's face using GANs. The GAN models are more likely to generate realistic faces that can be precisely spliced into the main image because they were trained on 10 out of 100 images.

### 3.2. Fake Video detection

The process of identifying and marking videos that have been altered or created using artificial intelligence (AI) is known as fake video detection. With the advancement and accessibility of deepfake technology, this is becoming more and more crucial. Many techniques, including monitoring motion patterns, modeling the human vocal tract, and evaluating color changes in faces to infer blood flow, are being developed for the purpose of detecting false videos. These techniques seek to identify minute indications of video tampering and separate them from authentic footage. Researchers are also investigating the use of blockchain technology and watermarking to determine the source of information and stop deepfakes from spreading. However, it is important to note that technology alone cannot solve the problem of deepfakes, and education and media literacy are also crucial for combating the spread of misinformation (D. Guera and E. J. Delp, 2018).

There are several common methods for detecting deepfake videos:

- Analysis of color changes in faces: This method analyzes the color changes in facial regions to infer blood flow and detect signs of manipulation.
- Motion pattern analysis: This method studies the motion patterns in videos to detect any abnormalities that may indicate manipulation.
- Modeling the human vocal tract: This method models the human vocal tract to detect any inconsistencies in the audio of a video, which may indicate manipulation.
- Watermarking and blockchain technology: These technologies can be used to establish the provenance of media and prevent the spread of deepfakes.
- Machine learning and artificial intelligence: These techniques can be used to train models to detect subtle signs of manipulation in videos.
- Training datasets: Creating and using large and diverse datasets to train machine learning models to detect deepfakes.
- Temporal sequence analysis: Analyzing the temporal sequence between frames to discriminate real videos from fake ones.
- Biological signals analysis: Analyzing biological signals such as eye blinking and heartbeat to detect deepfake videos.
- It's worth noting that the field of deepfake detection is constantly evolving, and new methods are being developed all the time. Additionally, deepfake detection methods should be used in

conjunction with education and media literacy to effectively combat the spread of misinformation.

### 3.3. Fake Audio detection

Audio analysis plays an important role in detecting deepfake videos as well as deepfake audio. In the case of deepfake videos, audio analysis can help identify inconsistencies between the audio and visual elements of the video. For example, if the lip movements of a person in a video do not match the words being spoken in the audio, it could be an indication that the video has been manipulated using deepfake techniques. In the context of deepfake audio, audio analysis can help differentiate between organic and synthetic speech. By analyzing the acoustic and fluid dynamic differences between voice samples, it is possible to identify whether a given audio sample was generated organically by a human or synthetically by a computer. So, audio analysis can help detect deepfakes by identifying inconsistencies between the audio and visual elements of a video, as well as by differentiating between organic and synthetic speech in the case of deepfake audio.

### 4. Deep Fake Detection Techniques by Deep Learning

Although deep learning models can directly extract or learn features from the data, their feature extraction and selection mechanisms have made them widely employed in computer vision. In deepfake detection studies, we found the following deep learning-

based models have been used: convolutional neural network (CNN) model (e.g., XceptionNet, GoogleNet, VGG, ResNet, EffcientNet, HRNet, InceptionResNetV2, MobileNet, InceptionV3, DenseNet, SuppressNet, StatsNet), recurrent neural network (RNN) model (e.g., LSTM, FaceNet), bidirectional RNN model, long-term recurrent Table 5. Distribution of used models. Deep Ensemble Learning (DEL), Hierarchical Memory Network (HMN), Multi-task Cascaded CNNs (MTCNN), Convolutional Neural Network (RCNN), and Faster RCNN models are among the models.

#### 4.1.RNN-based neural network architecture for deepfake detection

In implementing a deepfake-detecting neural network architecture based on RNNs, a sigmoid activation function for binary classification (actual or fake) may be used in the final output layer, which is followed by fully connected layers and one or more RNN layers. To extract spatial or temporal characteristics from the video frames, it is also usual practice to employ other types of layers, such as convolutional layers or attention mechanisms. Using a suitable optimizer (like Adam), a loss function (like binary cross-entropy), and an evaluation measure (like accuracy), you can train the RNN model using the prepared dataset. Additionally, methods like early halting, batch normalization, and dropout can be used to enhance generalization and avoid overfitting [6]. Figure 1 presents the fundamental diagram of neural networks architectures.

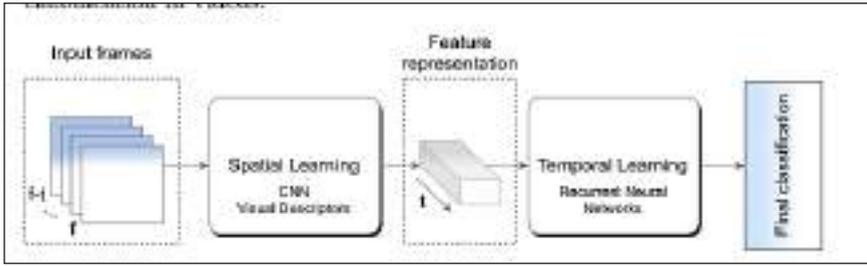


Figure (1) diagram of neural networks architectures [3].

CNN-based neural network architecture for deepfake detection

CNN-based neural network architectures, such as XceptionNet, GoogleNet, VGG, ResNet, EfficientNet, HRNet, InceptionResNetV2, MobileNet, and InceptionV3, are frequently employed for deepfake detection. These architectures work well for computer vision applications like deepfake detection since they are made to extract and learn features from data. This is an illustration of how to use Keras to create a CNN-based deepfake detection model. A collection of artificial neuron layers working together is called a convolutional neural network. Like their biological counterparts, artificial neurons are mathematical functions that analyze the weighted sum of all aggregate inputs and then provide an activation value. Each layer of a ConvNet produces many activation functions when an image is fed into it; these activation functions are then passed on to the following layer. In the first layer, critical features such as edges that are horizontal or diagonal are removed. The subsequent layer receives this information and uses it to identify more intricate features like edges and combinational edges. Based on the activation

map of the preceding convolution layer, the layer categorization yields a range of confidence ratings (numbers between 0 and 1) that represent the likelihood that the image will fit into a particular “class” (Hsu, C.-C., Zhuang, Y.-X. and Lee, C.-Y, 2020) In Figure 2 workflow diagram for CNN deepfake detection.

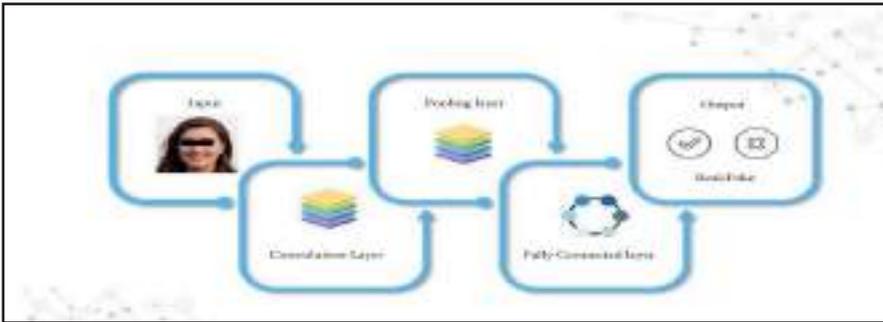


Figure (2) Workflow Diagram for CNN Deepfake Detection

## 4.2. LSTM-based neural network architecture for deepfake detection

To create a deepfake-detecting neural network architecture based on LSTMs, one or more LSTM layers, fully connected layers, and a final output layer with a sigmoid activation function for binary classification (actual or fake) can all be found in the architecture. Using a suitable optimizer (like Adam), a loss function (like binary cross-entropy), and an evaluation measure (like accuracy), train the LSTM model using the prepared dataset. Additionally, methods like early halting, batch normalization, and dropout can be used to enhance generalization and avoid overfitting (A. M. Almars, 2021). In Figure 3 workflow diagram for CNN-LSTM deepfake detection.

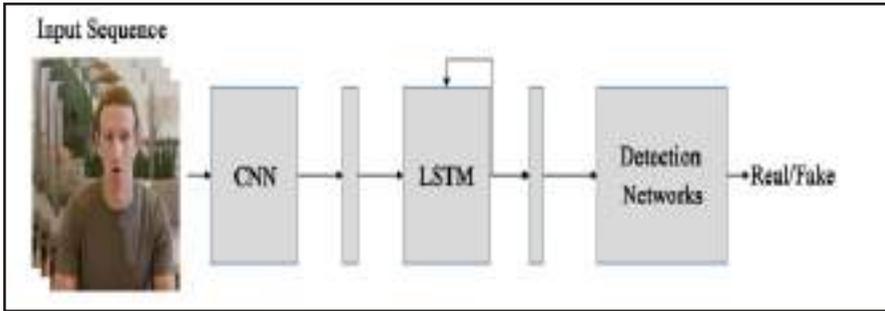


Figure (3) Workflow Diagram for CNN-LSTM Deepfake Detection

## 5. Deepfake Generation Technique

### 5.1. Generative Adversarial Networks (GANs)

Since recent GAN-based deepfake models acquire a great degree of realism, deepfake detection and prevention are extremely difficult undertakings. Using a pre-trained GAN to create deepfake samples is one way to approach this issue. Then, using different approaches such as ensemble methods, pixel-by-pixel comparison, or feature extraction, these samples can be compared with the original deepfake. Figure 4 explain GNA architecture.

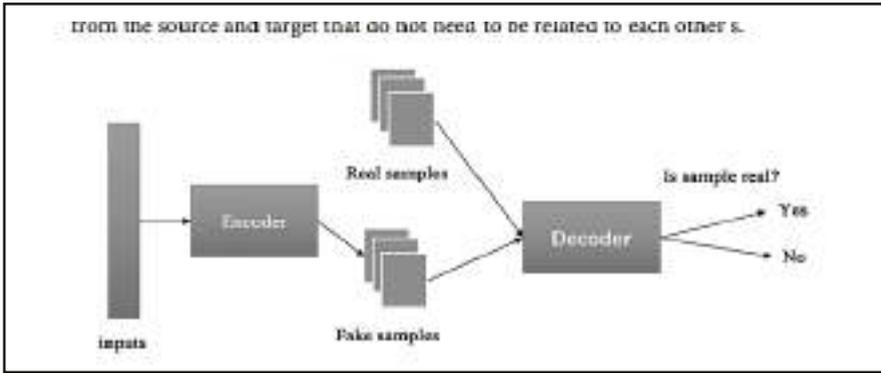


Figure (4) GNA architecture (Pouyanfar, S., et al., 2018)

Deepfake Generation: A type of deep neural network that is frequently used to produce deep fakes is called a generative adversarial network, or GAN. The ability of GNAs to learn from a set of training data sets and provide a sample of data with the same features and attributes is one of their advantages. GANs, for instance, can be used to replace a person’s “fake” image or video with a “real” one (D. Guera and E. J. Delp, 2018). An encoder and a decoder are the two neural network components that make up the architecture of GANs. To create fake data, the model first trains on a sizable data set using the encoder. The phony data is then learned from the actual data using the decoder. However, in order for this model to produce faces that look realistic, a lot of data—both photographs and videos—is needed. Figure 2: The architecture of the GNA. The encoder first gets random input seeds to create a fictitious sample, as seen in the picture. The decoder is trained using those fictitious samples. The decoder, which is essentially a binary classifier, receives inputs in the form of genuine and fake samples. It then uses the SoftMax function to separate the true data from the fake.

## 6. Methodology

This document includes a concise overview of several studies that detail several techniques for identifying fake images and videos. In order to obtain more accurate findings than current methods, we will also discuss how those methods might be merged or adjusted for our new project.

Here is an outline of a study that aims to investigate deep learning techniques for deepfake detection:

- **Data Gathering and Preparation:** A large dataset comprising both authentic and deepfake photos and videos is gathered. To guarantee consistency and quality, the dataset is cleansed and preprocessed.
- **Feature Extraction:** Relevant features are extracted from the dataset using the proper deep learning algorithms. For this, methods such as VGG, ResNet, or Efficient Net can be applied.
- **Model Development:** To address the issue of deepfake detection, a number of deep learning models are created. One can utilize CNNs, RNNs, and GANs separately or in combination. The models' performance can be raised by using strategies including ensemble techniques, fine-tuning, and transfer learning.
- **Model Evaluation:** A variety of metrics, including accuracy, precision, recall, and F1-score, are used to assess the models' performance. To accurately evaluate the model's performance, cross-validation methods such as k-fold cross-validation can

be applied.

- **Hyperparameter tuning:** To maximize the performance of the model, hyperparameters are adjusted. For this, methods such as Grid Search, Random Search, or Bayesian Optimization can be applied.
- **Final thoughts and Upcoming Projects:** Conclusions regarding the efficacy of the suggested deep learning methods for deepfake detection can be made in light of the findings. Additionally, areas for further study and development can be noted.

## 7. Conclusion

Massive public gatherings, such as protests, rallies, or festivals, have become a prevalent feature of modern society. These events often attract large crowds and generate significant media attention, both through traditional news outlets and social media platforms. This makes them an attractive target for bad actors who may seek to spread disinformation or manipulate the narrative surrounding these events.

One of the key concerns raised in the research is the growing threat of deepfake videos - synthetic media that can convincingly depict people saying or doing things they never actually did. In the context of massive public gatherings, deepfake videos could be used to create false narratives, discredit protest movements, or sow discord among participants. The widespread availability of photos and videos in social media materials has led to the rise in

popularity of deepfakes. This is especially crucial today because people may readily disseminate and share these kinds of fake contents on social media platforms and have easier access to the tools needed to create deep fakes. There has been a lot of interest in deep learning techniques across many fields.

Several deep learning-based techniques have been put out recently to effectively detect phony photos and videos and solve this problem. In this paper, we first go over the programs and resources that are currently in widespread use for producing phony photos and videos. After that, we examined the state-of-the-art deepfake approaches and separated them into two main categories in this paper: image and video detection. We gave a thorough explanation of the architecture, tools, and performance of the existing deepfake methods. Lastly, we have talked about the difficulties that still exist and offered suggestions for further deep learning research on deepfake detection.

While deep learning has demonstrated impressive results in detecting deepfakes, the quality of deepfakes has been rising. For the purpose of effectively identifying phony movies and photos, the existing deep learning techniques must therefore also be improved. Furthermore, there is currently no reliable way to determine which architecture is best suited for deepfake detection or how many layers are required for deep learning algorithms. In order to increase social media platforms' ability to handle the widespread effects of deepfakes and lessen their effects, another field of research is the integration of deepfake identification techniques.

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**Using time series analysis to predict the  
number of visitors to Imam Hussein's Ar-  
.baeen in 2024 and 2025**

**Manar Naji Ghayyib**

Baghdad university collage of science

[manar.naji@sc.uobaghdad.edu.iq](mailto:manar.naji@sc.uobaghdad.edu.iq)

**Elaf Mohammed Abd**

Baghdad university collage of science

[elaf.m@sc.uobaghdad.edu.iq](mailto:elaf.m@sc.uobaghdad.edu.iq)

**Aqeel Zuhair Azeez**

Baghdad university collage of science



## Abstract

The visit known as the Arbaeen happened forty days after Imam Hussein's (peace be upon him) martyrdom on the tenth of Muharram in the year 61 AH. Delegations from various Iraqi cities and villages travel to Karbala, the home of Al-Hussein (peace be upon him), and they are accompanied by sizable delegations of Ahl al-Bayt school adherents from a variety of nations, including Iran, Bahrain, Kuwait, Lebanon, Pakistan, and others. In this research, we examine the estimation values for the numbers of visitors by utilizing time series analysis and A few tests are the mathematical time period needed to validate our findings. To determine whether the results are accurate by the sample number of visits from 2017 to 2023 provided by the Holy Imam Hussein Shrine's General Secretariat. Because government organizations and the Holy Shrine need to be able to provide efficient services, including a counter for food and health services and a comfortable place for visitors to sleep, it is vital to forecast the number of visitors.

**Keywords:** time series, ARIMA(0,1,0), SARIMA, autocorrelation

## 1.Introduction

Karbala is situated at longitude 44.01039 and latitude 32.60685 in the southwest of Baghdad, 105 kilometers away from it. 30 meters above sea level is where it is situated.[1]

Therefore, those who are knowledgeable and knowledgeable are really interested in statisticians

Due to the fact that it offers forms, facts, percentages, and statistics to respect any phenomenon Given the fortunate number that the fortunate forty-first visit will make up There has been a little increase in the number of tourists, both Arabs and foreigners, in almost all elements and variables of the place [2]. The degree of labor and material resources as well as the excellent service rendered prior to local, Arab, and foreign processions, volunteers, and Hussein Shrine parts [3].

The aim of this research forecasting the number of visitors to help the government for taking serves for people in Arbaeen time [4].

### 3.Materials and Methods

#### 1.The Time Series [6]

time series collective views  $X_t$  happened at time  $t$  and can be expressed as the form

$X_1, X_2, \dots, X_t$  s.t  $X_t$  It shows the importance of the timely observation  $t$  This approach works with all variables To help decision-makers make the best choice, time series data for the past era are being analyzed with the goal of predicting how many visitors will be came in the future

The ability to predict the future through time series does not require a theoretical foundation; rather, it relies on previous changes in the variable's values. This indicates that expectations for the future are not concerned with the impact of a variable's value on the other variables

One prerequisite for time series is that they must be  $X_t$  It is stable and presumes knowledge of the model's parameters. which produces the mean squared error with the lowest value, ie

(1).....

### 3.2: Autocorrelation (AC)

The nature of the procedures themselves is where the issue with autocorrelation in time series data first arises. There may be accumulated inaccuracies in years or decades as a result of measurement errors in this form of data collection.[5]

Autocorrelation may be caused by consecutive time points, as well as by failing to include variables in the function

(2).....

t.s

In other words, the sample's autocorrelation function has the following structure

(3).....

(4).....

### 7]MAE( Error Absolute Mean :3.3

The discrepancy between the predicted and actual values is calculated in absolute terms as the absolute error. The following formula can be used to determine MAE.

(5).....=MAE

### 3.4: Mean Absolute Percentage Error (MAPE)[8]

To compute this precision as a percentage, MAPE is computed as the average absolute percent error for every time minus real

values split by actual values. The resulting is the formula:

$$MAPE = \dots\dots\dots(6)$$

**RMSE( Error Square Mean Root :3.5**

The absolute fit of the model to the information points actual is symbolized by RMSE. It can be computed by the following formula:

$$(7)\dots\dots\dots = RMSE$$

**4. Statistical Study**

**4.1:time seri of visitors**

One of the most significant Iraqi cities is the holy city of Karbala, which is home to numerous religious sites that are well-known throughout the country as well as artifacts, Iraqi history, and religious sites. The information in Table (1) indicates that the Holy Imam Hussein Shrine publishes statistics annually to support researchers in their research. It means that the services offered to guests through the thresholds are the best [10].where table(1) from The statistical bulletin is published by the Holy Shrine of Hussein, Karbala and Al-Wathuth Center

**Table (1) number of visitors**

year	Visitors
2017	15385000
2018	17000000
2019	15229955
2020	14553308
2021	16327542
2022	21198640
2023	22019146

## 4.2 Box-Jenkins Procedure

Time series modeling heavily relies on the Autoregressive Moving Average (ARMA) model. While they can model unknown processes with the fewest parameters when compared to autoregressive models (AR) and moving average models (MA), ARMA models offer the very effective linear models of fixed time series.

Forecast of visitors are hard and challenging because of its nonlinear paradigm and wide changes in intensity [5]. Autoregressive Integrated Moving Average (ARIMA) modeling is one of the effective techniques [8]. The autoregressive moving average (ARMA) model, created by George Box and Gwilym Jenkins in the 1970s [14], is a generalization of the ARIMA model. Due to the fact that it encompasses a range of types, including season,

absence of season, and stability The ARIMA model is promoted as a thorough statistical modeling approach for time series [9].

In a study by Momani [11], the ARIMA model was employed to forecast visitors data, and it was asserted that the forecast's outcome was favorable. Ponnampereuma and Rajapakse [12] also discovered that ARIMA might be used to predict visitors over the short term.

### 4.3: Seasonal Autoregressive Integrated Moving Average (SARIMA)

Additional seasonal components are incorporated to create the seasonal ARIMA model. It is basically stated as SARIMA (p, d, q) (P, D, Q), where S is the seasonal interval. The non-seasonal part of the model is called lowercase notation, and the seasonal part is called uppercase notation. Similar expressions are used in the seasonal ingredient of the model as in the non-seasonal ingredient, but there is a seasonal rearward shift. The following is the equation [15]:

$$\dots\dots\dots(8)$$

With

where  $y_t$  is the actual data; and  $\phi$  represents AR component coefficient and MA component

coefficient respectively;  $c$  is the constant value;  $\mu$  is the mean value of the series and  $\epsilon_t$  is the random error, which also known as white noise.  $B$  represents the non-seasonal backshift operators and  $d$  is the non-seasonal differencing order. For seasonal part,  $B^S$  is the seasonal AR

component coefficients while is the seasonal MA component coefficients.  $B$ - is the seasonal backshift operators and  $D$  representing the seasonal differencing order.

Test statistical

## 5.Result

In this section study the result of analysis for the data by statistic rules write in above sections, from analysis we found ARIMA (0,1,0) the best model to get the forecasting for visitors by following mothed

### 5.1: Autocorrelation (AC)for visitors

In this part take autocorrelation for visitors by ARIMA (0,1,0) we look in table (2) R Square equal (0.872) this mean the modal is best for forecasting the number of visitors and the figure (1) Probability of visitors.

**Table (2) Model Summary and Parameter Estimates**

Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1

1049903.750
-2103417919
.049
5
1
6.685
.872
Linear

From table (2) note that  $\text{sig.} < 0.05$  this mean model is active and we can take model to forecast

Figure (2) the probability of visitors

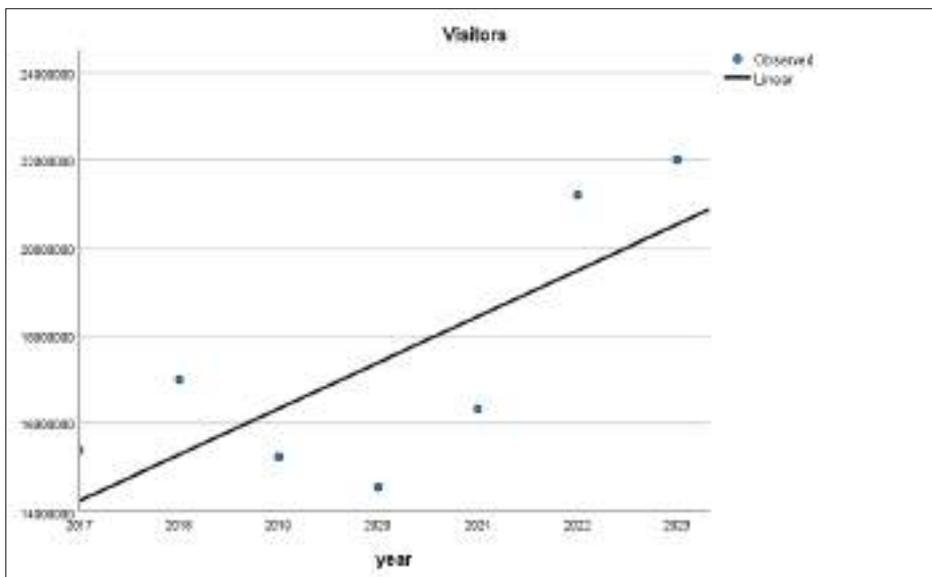
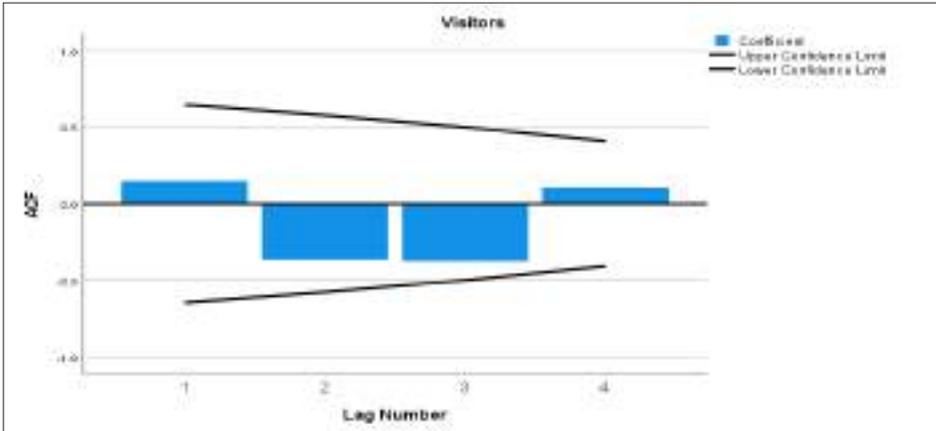


Table (3) Autocorrelations

Series: Visitors					
Lag	Autocorrelation	Std. Error <sup>a</sup>	Box-Ljung Statistic		
			Value	df	Sig. <sup>b</sup>
1	.148	.323	.211	1	.646
2	-.368	.289	1.840	2	.399
3	-.378	.250	4.124	3	.248
4	.104	.204	4.382	4	.357
a. The underlying process assumed is independence (white noise).					
b. Based on the asymptotic chi-square approximation.					

Table(3) take autocorrelation for four lag for bax-ljung

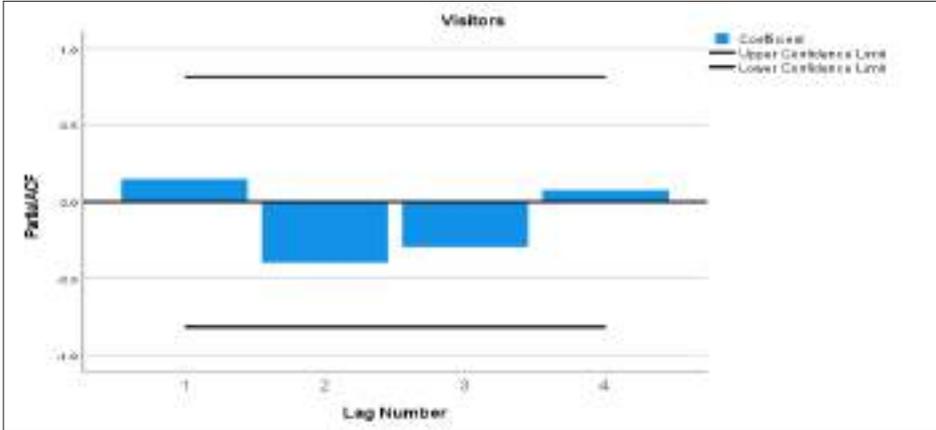
**Figure (2) Autocorrelations**



**Table (4) Partial Autocorrelations**

Series: Visitors		
Lag	Partial Autocorrelation	Std. Error
1	.148	.408
2	-.399	.408
3	-.295	.408
4	.075	.408

**Figure (3) partial Autocorrelations**



According to the ACF plot and PACF plot of the residuals in Figures (3) (4), none of the spikes are significant and are therefore not autocorrelated because they are all inside the boundaries. All four of these graphs for the residuals support the notion that the variance is constant and the mean of the residuals is zero. As a result, the remainders data almost follows a normal distribution. Consequently, it can be said that this model is suitable for use, and the expected value is shown in the center red line of the time series plot

**Figure (4) compare between ARIMA (0,0,0) and ARIMA (0,1,0)**

From figure (4) Note that ARIMA (0.,0,0) model is not better model because the result for sample interval very far from fit Unlike the other model, the results were very close to fit

**Table (5) forecasting of visitors**

year	Forecasting the visitors
2024	22587270
2025	22937174

After applying the statistical laws, it was found that the prediction rate is according to the table (), as this indicates a stable and controllable increase in the provision of services (health, roads, and other services), as the service that is available to this large number of people needs a lot of attention from the holy shrines. To confirm the results obtained, we use error criteria to determine whether the models used in prediction are appropriate as in the table (6)

**Table (6) The Comparison of The Performance of Prediction Models**

	ARIMA (0,0,0)	ARIMA (0,1,0)
RMSE	19005432	22985310
MAPE	23876543	22976543
MAE	20987654	22912345

## 6. Conclusion

We discovered that the number of visits is (22587270) for the year 2024 and (22937174) for the year 2025, and that the numbers are increasing steadily and are under the control of the institutions after carefully investigating mathematical and statistical approaches. Serving the Arba'een visit is a duty for all state ministries since it expands the nation's economic opportunities, particularly the globe is currently shifting away from the use of oil sources, which are still recognized as official sources in our nation's economy, and toward the use of clean energy. The Arbaeen visit portrays a strong economic facade in this way, and everyone in the must pledge to work hard to uphold the noble reputation of the country .

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**SMART SPACE AND COMMUNICATION  
TECHNOLOGIES APPLICATIONS TO SERVE  
REMOTE MANAGEMENT AND CONTROL  
IN THE ZIYARAT AL-ARBAEEN**

**Dr.Parviz Tarikhi**  
**PhD, Physicist, Space Science and Technology Specialist**  
**Independent Researcher, Iran**

[parviz\\_tarikhi@hotmail.com](mailto:parviz_tarikhi@hotmail.com) ,

**Asst.Prof.Dr.Abdulkareem Abd Ali Mohammad**  
**PhD, Engineer, Space Technology & Antenna and Propagation**  
**Specialist Iraq**

[abdulkareem.abdali@gmail.com](mailto:abdulkareem.abdali@gmail.com)



## Abstract

Ziyarat Al-Arbaeen is one of the annual religious and cultural global events, which involves presence of a large number of visitors from the Middle East region in particular and all around the globe in general. Its importance in terms of appreciating higher human values embodied within this comprehensive revival project, amidst the intellectual challenges that confront humanity in its various dimensions and inclinations is undeniable. To this mean benefiting of the modern technologies as a strong and effective tool for well managing and control of this event can play a vital role. It includes space applications technologies and engineering such as GIS and remote sensing, telecommunications, artificial intelligence, medical sciences and technologies, informatics, mathematics, statistics, and so on. In this presentation, the authors with background in space science and technologies, and telecommunications focus on and highlight effectiveness and importance of these fundamental and infrastructural technologies. Authors believe that the joint work and cooperation of the organizational and independent experts from the relevant entities and sharing knowledge and experience can lead to increment of the synergy of work for well managing and control of the event.

Authors, who are from Iraq and Iran, worked for long term in their relevant national space technology and communication organizations in both managerial and specialized levels. They share the feasible and accessible potentials and possibilities in both countries for well managing and control of the Ziyarat Al-Arbaeen event by giving the related examples that is available separately in both countries and suggest joining forces by the relevant entities, scientists and experts in this connection. In this presentation, authors determine the steps of ideas in order of priority and importance, which inevitably involve creativity. They believe that the idea of experimenting with collaboration and remote work will certainly yield success.

## Introduction

Global and annual religious and cultural march of Ziyarat Al-Arbaeen, involves presence of immense number of mostly Shia Muslim visitors and pilgrims from all around the globe, particularly the Middle East region.

The significance of Ziyarat Al-Arbaeen lies in its religious, spiritual, and cultural importance, particularly within Shia Muslims. Arbaeen marks the end of a 40-day mourning period following Ashura that is the martyrdom anniversary of Imam Hussein ibn Ali, the grandson of the Prophet Muhammad, at the Battle of Karbala. The number 40 holds special significance in Islamic tradition that represents a period of mourning and reflection.

Arbaeen is observed by millions of almost Shia Muslims, who undertake a pilgrimage to Imam Hussein's shrine located in Karbala, Iraq. This pilgrimage is considered a powerful expression of faith, remembrance, unity, and resistance against oppression. (Bharakda 2023, Wikipedia 2023) It is also a time for communal prayer, recitation of Quran, and performing charitable acts in honor of the deceased Imam and his loyal entourage and relatives. (Bharakda 2023)

The Arbaeen pilgrimage culminates in one of the largest peaceful gatherings in the world, symbolizing the eternal struggle between good and evil, self-sacrifice, and the continuation of Prophet Muhammad's mission. (Wikipedia 2023) It is a profound demonstration of devotion and solidarity among the participants, reflecting the deep impact of Imam Hussein's sacrifice on the collective memory of the Islamic community. (Ali 2023, Shiadirectory 2023)

For well managing and arranging it, benefiting of the modern technologies, especially, space technologies and applications can act as a strong and effective tool. It includes space applications technologies and engi-

neering such as GIS and remote sensing, telecommunications, artificial intelligence, medical sciences and technologies, informatics, mathematics, statistics, and so on.

Recent advancements in these applications and technologies are yet being applicable to which it is going to be referred in the next sections of this paper. There is seen important role in managing of huge human population present in the event like Ziyarat Al-Arbaeen benefiting of Internet and wireless communications networks.

In this paper, a systematic observation from technical and managerial points of view on the subject is developed expecting to lead a useful and beneficial conclusions, suggestions and recommendations for well managing and organizing the event.

### On Ziyarat Al-Arbaeen March

Arbaeen anniversary is one of the major religious occasions for Shia Muslims. It falls on the twentieth of the month of Safar. Every year, millions of visitors go to Karbala to perform the rituals of visiting the shrine of Imam Hussein bin Ali.

The total number of visitors in the year 2016 AD - 1438 Hijri was 11,210,367 man, woman and child. The number increased in 2017 AD - 1439 Hijri, into 13,874,818 visitors, while in 2018 AD - 1440 Hijri, the number has increased again to 15,322,949, followed by another increase in 2019 AD - 1441 Hijri to more than 15,329,955 visitors. (KCSR 2020)

In 2023 (Nour News 2023) the number of visitors exceeded 22 million totally from inside and outside Iraq. Millions of visitors head to the city of Karbala as participants in huge processions named “Moukeb”, in groups or as individuals.

This huge religious event involves walking long distances from the cities of Iraq all the way to Karbala. There are groups that begin March weeks before the start of the Ziyarat Al-Arbaeen from the Ras Al-Bisha area in the Al-Faw Peninsula in the Basra Governorate in southern Iraq to Karbala (Fig. 1), while this distance is more than 600 kilometers. Other visitors also walk from the capital, Baghdad, and the cities of Hilla and Kufa towards Karbala. In fact, there are many other routes for the same walk.



Fig. 1: A map showing the visitors' walking route during the Ziyarat Al-Arbaeen, starting from the Ras Al-Bisha area on the Al-Faw Peninsula in Basra Governorate, southern Iraq, to Karbala [Source: <https://www.bbc.com/arabic/articles/cj7905k0ke3o>]

From Iran, where some visitors also come on foot, the march begins a month before Ziyarat Al-Arbaeen date. As for visitors arriving from other countries by air, many of them commemorate the anniversary of Arbaeen by walking for two continuous days from Najaf, wherein the shrine of Imam Ali bin Abi Talib located, towards Karbala. (Fig. 2)

Arrival of visitors to the holy shrines in Iraq is described as “the largest religious gathering and the largest foot march in the world.”



Fig. 2: A map showing the visitors’ walking route during the Ziyarat Al-Arbaeen. Walking for two consecutive days from the city of Najaf towards the city of Karbala. On this road, visitors from Islamic countries come with many Iraqis from different governorates, where they go to Najaf to participate in the walking procession. [Source: <https://www.bbc.com/arabic/articles/cj7905k0ke3o>]

On the Ziyarat Al-Arbaeen anniversary, Iraqis open their houses to visitors. Along the walking routes, residents of the walking route areas of all ages stand holding food and drinks in their hands, offering them to visitors and inviting them to rest and stay nightly in their homes. (Fig. 3 and Fig. 4)



Fig. 3: The wonderful picture shows an Iraqi offering cold water to visitors.

Such a scene is frequently seen along the March paths, where residents of the walking path areas of all ages stand to serve the visitors. [Source: <https://en.shafaqna.com/172692/serving-mawkibs-to-arbaeen-pilgrims-in-iraq-photos/>]

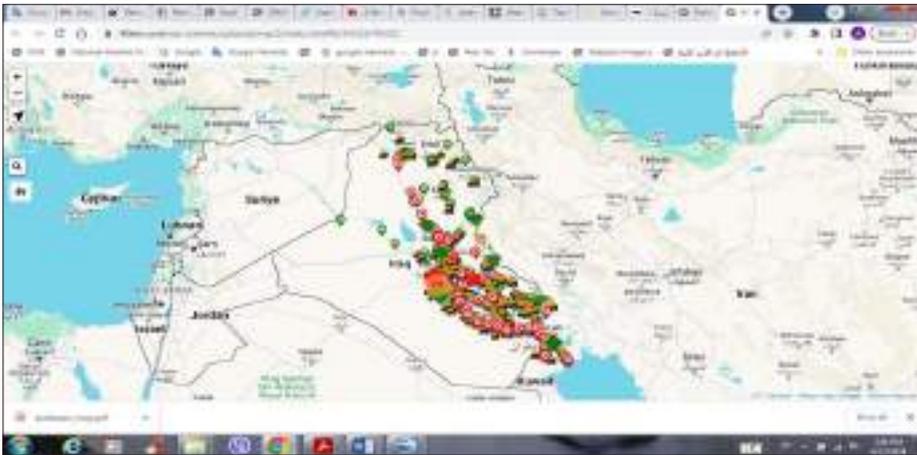


Fig. 4: A picture showing an Iraqi preparing grilled fish for visitors at his home.

Such an activity is seen commonly along the walking paths, where residents of the walking path areas of all ages stand up to invite visitors to their homes to eat or stay overnight. [Source: <https://en.shafaqna.com/172692/serving-mawkibs-to-arbaeen-pilgrims-in-iraq-photos/>]

These people save their money in order to open a hostel wherein they host visitors, or open their homes for sleeping and feeding. These scenes are unique and has never been observed elsewhere in the world.

Guesthouses, called Husseini Moukebs, are also widespread. These Moukebs are the facilities built by their owners in order to invite visitors, and they provide them with free food and sleeping place during the visiting period of Ziyarat Al-Arbaeen (Fig. 5). Voluntary medical clinics also extend along visitors' routes to help those who may need clinical aids and health care (Fig. 6).



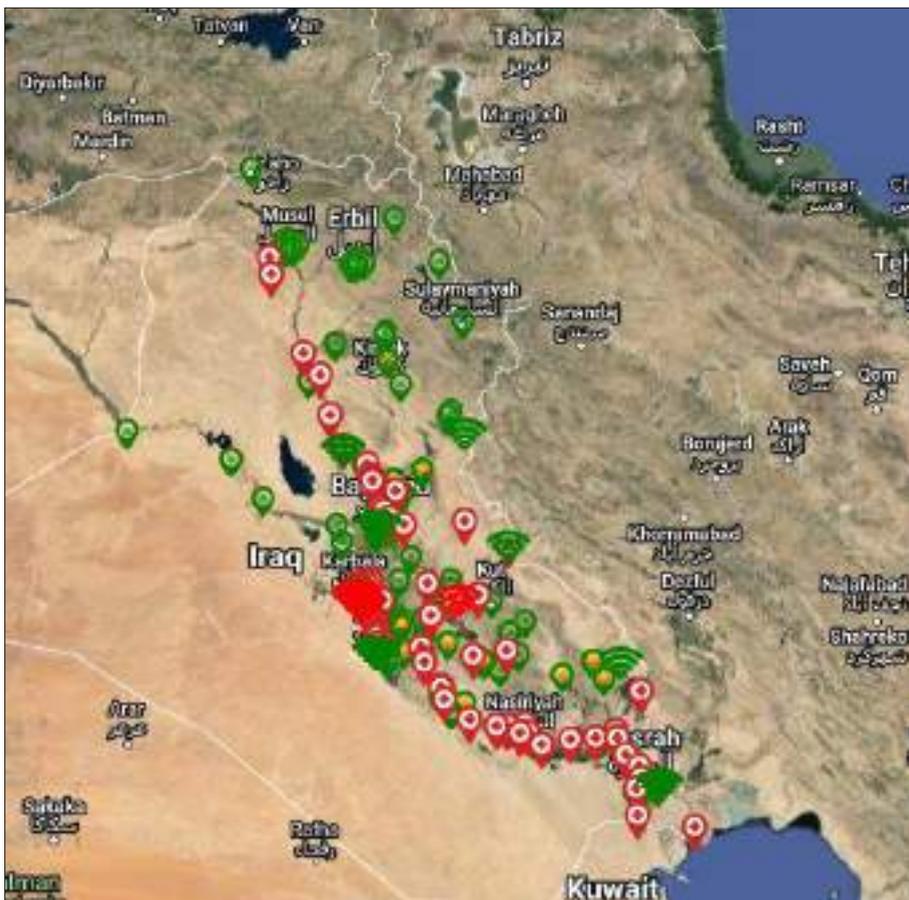


Fig. 5: Google map containing the locations of the processions (Moukebs) spread along the main road and secondary roads designated for walking by visitors of the Ziyarat Al-Arbaeen. [Source: <https://40een.com/wp-content/uploads/map2/index.html#7/32.343/45.923>]



Fig. 6: Image shows one of the volunteer medical clinics extending along visitor routes to assist those who may need clinical assistance and healthcare. Many volunteer medical clinics extending along visitors' routes offer their services free of charge. [Source: <http://kan-news.com/kan/?p=17549>]

Along the walking routes, there are widespread funeral gatherings for mourning the incident and tragedies that befell the family of Imam Hussein. The sounds of the slurs, which are traditional lamentation poems, are raised and the audience of visitors interact with them. They have developed over the centuries, and special melodies have been added to them, and they now include different types. A variety of sad chants, differing according to the culture of each country.

Many visitors come through organized campaigns to visit Najaf, Karbala, Kadhimiya, Samarra and other holy places during the Ziyarat Al-Arbaeen season. Accommodation operations are organized in Karbala during the visit period for groups and processions in Husseinias, tents, procession houses, hotels, and others.

Visitors are organized into groups called processions “Moukebs” from inside and outside Iraq. The total number of Moukebs were more than ten thousands in 2023 (AlSumaria TV 2022), and more than 28 thousands service processions for the year 2023. (Mawazin News 2023)

These Moukebs walk from their place of residence in Karbala with spatially planned routes and at specific times until they arrive Imam Hussein shrine and Imam Abbass shrine. The Moukebs start walking in solemn condolence walk on specific dates. They are organized according to a program prepared by the authority responsible for organizing the registration of processions and managing their walk. Fig. 7 illustrates a map of the visitors’ route from their place of residence in Karbala with spatially planned routes. It helps determine their walking times until they reach the shrine of Imam Hussein and the shrine of Imam Abbas.



Fig. 7: A service map for Arbaceen visitors, showing the main and secondary roads of the Holy Karbala Governorate in addition to the sites and important points there. The map determine the route from their place of residence in Karbala with spatially planned routes. [Source: <https://alkafeel.net/news/index?id=13900&lang=ar>]

Most visitors coming from Iraqi provinces and foreign countries stay for more than 10 days to attend visitation activities and visit other holy shrines in Al-Kadhimiyah, Samarra, and other places. Great efforts are made to serve visitors from the moment they enter the country and begin the visit ceremony until their departure.

Because of the large number of visitors, especially on peak days, many visitors lose their place and their group. The number of missing people reached 10,726 individuals during the Arbaeen visit in 2023. (fig. 8) The Guidance Centers for the Lost, which are supervised by the Al-Abbas' Holy Shrine, reported missing of 10,726 persons to their relatives during the Ziyarat Al Arbaeen. (ABNA 2022).



Fig. 8: Due to the large number of visitors, it may cause many visitors to lose their place and their communities. The number of missing persons reached 10,726 individuals during the Arbaeen visit in 2023 according to the Centers for Guidance of Missing Persons affiliated with the Abbasid Holy Shrine. Image shows one of the centers for finding missing persons. [Source: <https://en.abna24.com/story/1306490>]

All of this requires logistical operations and support from various levels of society. During this visit, most of the food, drink, and housing are provided free of charge to millions of visitors. In the holy cities, huge sites are established for cooking food, which are transported and distributed to visitors at various times during the day and night, in addition to processions' specific catering and cooking services.

This great walk is accompanied by the deployment of various security forces on the walking routes and inside the holy cities. Parallel to these walking routes, vehicle roads and railways are available to transport visitors back and forth in day and night.

The Arbaeen visit is accompanied by extensive cleaning campaigns in all the visitors' walking facilities as well as inside the city of Karbala. Fig. 9 shows one of the cleaning workers in the square between the Two Holy Mosques after the end of the visit. (Al Kafeel 2020)



Fig. 9: One of the cleaning workers in the square between the Two Holy Mosques cleans after the end of the visit. [Source: <https://en.shafaqna.com/175199/karbala-cleaning-campaign-of-area-between-the-two-holy-shrines-after-ziyarat-arbaeen-photos/> ]

## Existing and available infrastructure

Technology plays important role in managing human populations like Ziyarat Al-Arbaeen with the presence of the Internet and wireless communications networks. (Fig. 10) The progress of information systems, information communication technology, and data transfer between various computer servers has played a major role in multimedia applications and their diverse uses. Cellular phone networks also played a major role in digital communications systems and became significant basis for various applications technological systems that have communications channels at the core of their system design. Computers and smart cell phones have also become essential technologies that serve the management of human populations.



Fig. 10: This photo shows one of the sites where free Internet and communications services are available to serve visitors. [Source: <https://40een.com/en/news-en/internet-service-en/the-expansion-of-the-free-internet-and-communication-network-is-taking-place-throughout-the-entire-holy-province-of-karbala/>]

Algorithms, smart programs, and artificial intelligence are what have given power to manage the processes of organizing human populations via building platforms supported by applications that serve populations and individual management. Data documentation processes, their uses, and analysis software act as essential tools for such development.

GIS (Geographic Information Systems) and GPS (Global Positioning Systems) technologies have become important tools for assessing and updating the status of applications that serve important management for human populations. The visual data interpretation presented by GIS systems supports different applications.

Telecommunications dominating our everyday lives. This sector requires a continuous exchange of information that requires time accuracy. GPS has suited this requirement most and has been widely adopted for this specific purpose. Satellite images from various satellites have become the basis for geographic information systems applications.

It provides many applications that serve very important areas in the Ziyarat Al-Arbaeen in terms of management, monitoring, planning, and even real-time monitoring of weather and climate. It is worth noting that many of the data for these satellites images and their products can be obtained from available international platforms and websites.

In addition, aerospace technologies as drones and balloons have proven their usefulness in monitoring, imaging, communications. Drones can be used in providing variety of aids to people for different purposes.

## Useful applications and software platforms capable of serving to visitors

Important applications can be applied for the Ziyarat Al-Arbaeen by using modern technology in all its different forms and types and available infrastructure. It mainly includes:

### **A. Electronic applications on smart phones:**

An application for sharing religious monologues and the richness of supplications for visiting the Al-Hussein Shrine and the Al-Abbas Shrine directly with family and friends.

Using artificial intelligence mapping technology in smartphone applications to obtain information about various walk paths, holy places, and important facilities during visiting events, providing real-time directions and alerts to help the visitor to avoid crowds.

Smart cell phone applications that provide the necessary information and electronic directions to facilitate the movement of visitors and reduce crowding.

An interactive application that arranges sounds that allows the visitor to know and hear his/her location, find his/her destination, and determine the locations with respect to group members if they are dispersed among the human crowd. This application can be realized through the presence of a GPS system on the smart phone.

Setting up and creating an application to authorize qualified persons to visit the holy shrines with the aim of making it easier for Muslims who are unable to perform the visit of Ziyarat Al-Arbaeen, including the sick, the elderly, those with limited income, and others.

### **B. Robots and smart screens:**

Using robots and smart screens in some important areas and near holy places can provide services and assistance to the visitors. These robots can provide information and instructions and facilitate communication and interaction with visitors in different languages. With technologies based on artificial intelligence, its mission is to disseminate reliable religious guidance, with a touch screen and the ability to multi-language communications.

### **C. Specialized platforms and websites:**

Digital platforms to facilitate the process of registration and obtaining permits. It also aims to facilitate Ziyarat Al-Arbaeen procedures for reducing the time and effort required to complete procedures from the beginning of the visit until departure.

A platform for the purpose of managing logistics services related to transportation, accommodation, nutrition, health care and security, in addition to analyzing data and identifying places that need to provide additional services or improve infrastructure, on an ongoing basis and in real time.

Digital application platforms for booking travel tickets and booking hotel accommodation at holy sites.

Platforms for religious guidance and information purposes.

Artificial intelligence and digital platforms that leverage the ingenuity for artificial intelligence like ChatGPT, Google Bard AI, and social media platforms gives people the ability to overcome language and geographic barriers and connect with each other seamlessly and easily.

Using technology based on artificial intelligence by taking advantage of the smart identity engine, which can recognize and authenticate identity documents, this technology contributes to speeding up the processing of visitors' documents, especially during peak periods.

Providing a smooth and advanced practical technology for visitors to the holy shrines with the development of a complete strategic plan in which various electronic services, applications and websites are introduced. These digital platforms contribute to the maintenance, operation and development of electronic systems and services including the configuration of dedicated electronic servers to set up network controls and smooth flow, wired and wireless distribution, and the establishment of modern rooms for data and information centers.

#### **D. Intelligent transportation**

Smart transportation technology that helps facilitate visitors' walking within the holy shrine areas. Smart transportation is used to facilitate transportation and reduce congestion by specific and recurring schedules. These are provided for different means of transportation.

To facilitate movement and walking of visitors between different sites the Global Positioning System Technologies (GPS) and smart applications to track visitors' movements is used to direct them to desired locations.

Follow up on visitors buses and solve any emergency problems that occur while they are on the move using tracking system by providing and installing tracking devices and its accessories for buses. These devices can read the fuel level, the engine temperature and receives alert orders in case the engine temperature rises to avoid malfunctions. It is also possible to send distress messages to report any emergency that may occur on the bus. All of this can be done through a platform through which the remote tracking devices installed at parties can communicate, and the devices send the same signals to the transportation information center to ensure the readiness of buses. This platform contains traffic maps and the status and route of each bus that appears on the map. The possibility of installing cameras inside and

outside buses to monitor visitors and to ensure their safety and the safety of their belongings, and installing screens to educate them inside buses.

Internet of Things technology and smart transportation are being used to facilitate movement and guidance for visitors, as holy areas are equipped with advanced systems that use Internet of Things technologies.

Monitoring and supporting of intelligent traffic control, using artificial intelligence systems for monitoring and surveillance, and the use of facial recognition technologies to ensure the safety of visitors and monitor human movement flows.

The use of artificial intelligence in the Arbaeen visit is an opportunity to enhance logistics services. Intelligent algorithms and programs manage the processes of organizing human crowds with high efficiency.

Intelligent traffic control is considered one of the modern technologies that contribute to improving traffic flow and avoiding congestion, while visitors' movement is controlled using radar devices and control traffic lights.

### **E. Use of smart devices**

Using smart devices such as bracelets, smart IDs, and smart watches to read the visitors' vital signs, in addition to the possibility of equipping the visitors with devices linked to their smartphones. Information such as heart rate, blood pressure and other vital indicators are read and recorded in such smart system, and this information will be sent to the ambulance and emergency teams in real time or periodically.

Electronic tracking devices is the main part of tracking system, which are one of the most reliable modern technologies. This system determines the locations of visitors and their routes in various tracking coverage areas using GPS devices. In addition, modern technologies help in tracking emergencies and providing the necessary health care to visitors.

## **F. Monitoring and protection intelligent traffic control**

Using artificial intelligence systems for monitoring, surveillance and the use of facial recognition technologies to ensure the safety of visitors and monitor human movement flows. The use of artificial intelligence in Ziyarat Al-Arbaeen is an opportunity to enhance logistics services.

Intelligent algorithms and programs manage the processes of organizing human crowds with high efficiency. This ensures the safety of millions of visitors who flock to Holy Karbala. Real-time data analysis enables rapid response to any emerging challenges. This ensures a smooth and safe pilgrimage experience for everyone.

Intelligent traffic control is considered one of the modern technologies that contribute to improving traffic flow and avoiding congestion. The movement of visitors can be controlled through the use of radar devices and control traffic lights.

### **Technologies that can serve Ziyarat Al-Arbaeen**

According to what stated above, the most important techniques during the Arbaeen visit season can be listed as below:

- Electronic payment technologies that can be used to facilitate the payment process and financial transfers related to visitors.
- Biometric technologies such as facial recognition and fingerprints, which are used to verify the identity of visitors, and facilitate the process of entry and exit from various sites.
- Logistics and navigation technologies such as GPS and electronic mapping technologies, which can be used to help visitors to identify different locations and routes and direct them.
- Communication technologies such as smart applications and wireless communication technologies, which are used to provide information, communicate with visitors, and guide them.

- Medical technologies such as health monitoring technologies and rapid laboratory analysis, which are used to maintain the safety of visitors and prevent diseases and epidemics.
- Artificial intelligence techniques that can be used to analyze data and information related to the visit, and provide the necessary instructions and recommendations to improve the performance of Arbaeen March.
- Audio and lighting technologies, which can be used to provide audio instructions and appropriate lighting for visitors at the holy shrines and other locations where crowds of visitors travel.
- Robotic technologies that can be used to provide services and assistance to visitors in various locations for providing to them water, food, medicines, and assistance with transportation.
- Environmental technologies that can be used to provide appropriate environmental services to visitors for providing hygiene, sanitation, and waste management.

### Significant technological systems for Ziyarat Al-Arbaeen services

Ziyarat Al-Arbaeen March that is one of the largest annual peaceful gatherings in the world, has seen the integration of various technologies to enhance the experience and safety of the visitors. Some ways that the technology is playing a role are given here:

#### A. Virtual Reality (VR) Experiences

Initiatives like VR Karbala allow users to immerse themselves in the historical events of Karbala through realistic animations and sound, providing a unique educational and spiritual experience. (Shah 2019).

## **B. Ride-Hailing Services**

To facilitate travel in Iraq, especially in cities like Karbala and Najaf, ride-hailing apps offer services in multiple languages, ensuring safety, security, and convenience for visitors. (Shah 2019).

## **C. Cyber Ziyarat**

For those unable to attend in person, cyber ziyarat has become a popular way to engage with the event remotely through video calls, sharing pictures, and voice notes. (Shah 2019).

## **D. Soft Power and Diplomacy**

The Arbaeen March also plays a role in soft power strategy performance in Iraq, fostering social ties and cooperation between Iraq and countries like Iran, as well as with Iraqi Shia groups to manage the March. (Masoudi & Nourian 2023).

These technological advancements not only help manage the logistics of such a massive event but also enhance the spiritual and cultural experience for the participants. Explore how these technologies are developed and implemented, their impact on the pilgrimage experience, and their broader implications for international relations and cultural exchange is needed to be studied in details while it is out of scope of this paper.

In all, a list of technologies used during the Arbaeen March is as follows:

1. Communication Networks- To manage the massive influx of pilgrims, Iraq enhances its mobile and internet infrastructure to ensure connectivity for safety and coordination. (Ingram 2020).
2. Health and Safety- Medical stations equipped with modern technology provide healthcare services to the visitors. Drones may also be used for aerial surveillance to monitor crowd movement and manage emergencies. (Ingram 2020).

3. Logistics and Accommodation- Advanced logistics systems are in place to manage the distribution of food and water, as well as to organize accommodation for millions of visitors. (Ingram 2020).
4. Transportation- Special transportation systems, including buses and trains, are often arranged to transport visitors to and from various points during the Arbaeen March. (Ingram 2020).
5. Security- Security forces use surveillance cameras and other security technologies to ensure the safety of the visitors throughout the event. (MEE 2022).
6. Environmental Management- Waste management technologies are employed to handle the large amounts of waste generated during the march, ensuring environmental sustainability. (Ingram 2020).

The above-mentioned technologies play focal role to ensure that the Ziyarat Al-Arbaeen March is conducted smoothly and safely, accommodating the needs of the immense number of visitors yearly.

Moreover, during the Arbaeen March, a variety of technologies are utilized to manage the massive influx of visitors and ensure their safety and well-being. Some examples are as follows:

- Communication Networks: To handle the communication needs of millions of visitors, temporary mobile towers and additional Wi-Fi hotspots are often deployed to enhance connectivity.
- Medical Services: Mobile medical units and telemedicine services are provided to offer healthcare to visitors along the routes.
- Transportation: Buses, cars, and other vehicles are often organized in a fleet to transport visitors over long distances. GPS tracking is used to manage the flow and ensure safety.
- Food Distribution: Automated systems and supply chain technologies are employed to distribute food and water to the visitors efficiently.

- Security: Surveillance drones and CCTV cameras are used for crowd monitoring and control, ensuring a safe environment for the visitors.

These technologies contribute to the harmonious organization of the March, despite the challenges posed by the large number of visitors. Additionally, the Arbaeen March has been noted for its spontaneous organization, where everything from food to medical care is provided free of charge, with local warehouses transformed into big kitchens to feed all visitors. (Ingram 2020)

The March also has significant cultural and social impacts, strengthening social convergence and cooperation among participating groups, which is an important aspect of the March's management. (Masoudi & Nourian 2023)

### **Security systems for secure management of Ziyarat Al-Arbaeen**

Security is of great importance for Ziyarat Al-Arbaeen and must be considered with the utmost care.

Presence of dissidents reached the point where a suicide bomber killed a large number of visitors gathered in areas where they walking performance Al-zeara. An example of this is what happened in 2010 and 2012. A suicide bomber killed at least forty-four Arbaeen visitors and wounded some seventy (VOA News 2010), near Nasiriyah.

Therefore, the visit is performed under tight security guarded by tens of thousands of Iraqi forces and volunteers in various places along the distances traveled by the visitors.

Consequently, the security of large crowds of visitors requires security awareness among all visitors through instructions and directions for all visitors from inside and outside the country. Security monitoring in all its forms so that it leads to the discovering sabotage plans before they happen. Security plans must also be tight and flexible enough to surround and deal with any terror and sabotage situation when it occurs.

### **Intelligent management and monitoring of Ziyarat Al-Arbaeen for support and emergency purposes**

Managing large crowds in Ziyalat al-Arbaeen and organizing them in a safe and effective manner requires planning, coordination, organization, and control of the movement and behavior of individuals, as visitors participate in many social, economic, cultural, and religious activities. Presence of the large number of visitors may cause painful incidents such as suffocation, stampedes, injuries, and deaths. Therefore, crowd management includes planning advance to reduce these risks.

Performing effective and efficient management requires the following:

- Defining the goals of managing visitor crowds by determining what is needed to achieve in the itinerary and organization. Then direct efforts to serve these goals.
- Careful planning to organize crowds of visitors and direct them towards specific goals. This includes choosing the appropriate location and preparing the necessary equipment and tools to effectively organize the itinerary and accommodation of visitors.
- Implementing the plans that have been developed and controlling visitors' path movements and behavior in a safe and effective manner.
- Visitors management requires good communication with Moukeb man-

agement and understanding their needs and aspirations. Then interact with it in such a way that suits the surrounding circumstances and requirements.

- Crises and accidents pose a risk to the safety of visitors and staff responsible for their management. There must be plans for crisis and incident management and quick and effective action to act in emergency situations.

To achieve intelligent management and control in the Arbaeen march to serve visitors requires expanding the use of modern technologies in the areas of developing decision-making processes and governance in procedures and services through the design of electronic platforms and applications for the purposes of support in normal circumstances, emergency situations, and risk management. The intelligent management of the Arbaeen visit uses complete technology and a safe process, and includes the pre-arrival stage for visitors, then arrival and departure, transportation, providing health and safety, accommodation for visitors, and performing the visitation ceremonies in the best possible way.

All of this requires management and operation services for information technology (IT) systems, which includes managing technological services provided by integrated smart information technologies, and requires deep experience, a distinctive approach to implementing or developing technologies, and advanced software tools and processes. This is done by implementing a strategy to achieve management requirements and logistical support challenges.

IT services serve the following basic areas in accordance with the set objectives, which are infrastructure management, information and data security management, network management, technical support management, monitoring management and application management. Thus great benefits are achieved in the work and include overcoming infrastructure challenges, Daily reduce IT risks, enhance IT security, predict costs, enjoy

high-quality performance, enhance IT service availability, improve operational efficiency, enhance IT service operations and management and finally advance business growth.

An example of this is making an emergency plan for the Arbaeen pilgrimage of Imam Hussein, within the health aspect, to confront communicable diseases in general. This is done by distributing immediate ambulance vehicles near emergency centers and rapid response teams, in order to deal with critical emergency cases, and medical detachments within the city of Karbala and external roads, all of which are connected to the digital communications network and linked to field hospitals and city hospitals for the purposes of electronic management and rapid response. Working on preventive and curative measures during the Arbaeen visit, the necessity of conducting swabs and analyzes of human beings at the entrances to roads and visitors to emergency centers and health centers, and investing in the visit to conduct vaccinations at vaccination outlets to vaccinate citizens with anti-viral vaccines, as well as working to raise awareness and educate visitors about the dangers of epidemics and how to prevent them.

## What would be beneficial to be carried-out

The fundamental commitments, which is suggested in the following lines, could be beneficial and useful in fulfilling well performance of Ziyarat Al-Arbaeen. Considering of the actions listed below solicits using modern technologies among which the air and space applications can play basic roles.

- Establishing a Specialized Council for decision making and setting up the basics of future planning and developing of useful applicable ideas, with the aim for sustainable planning to develop processes for enduring success of Ziyarat Al-Arbaeen
- Establishing and organizing a Steering Committee to implement and control of the decisions made by Specialized Council
- Launching a focal web-site along with associate social media sites and blogs for exchanging and sharing ideas, news, knowledge, experiences, and conducting education and training for interested visiting scholars, specialists, and public knowledge seekers
- Smart data archiving for study and analysis purposes in conjunction or independent of the above-mentioned web site.
- Developing plans to attract individuals and institutions into voluntary work to prepare applications for cell phones serve Ziyarat Al-Arbaeen
- Developing plans to attract mobile phone companies to support the systems that serve Ziyarat Al-Arbaeen visit.
- Developing a plan to invite large companies to submit proposals to serve Ziyarat Al-Arbaeen visit
- Intelligent media management to follow up Ziyarat Al-Arbaeen visit
- Smart management of whole Ziyarat Al-Arbaeen March and events between different levels of officials.

## Improving the quality of Arbaeen March

Some different techniques can be applied during the Arbaeen March to improve several aspects, including:

### 1. Improving security and safety:

Modern technologies can be used during March to improve security and safety, such as:

- Facial recognition technologies.
- Explosives and weapons detection techniques

### 2. Facilitating visiting procedures

Various technologies can be used during the March to facilitate procedures, such as:

- Electronic payment technologies.
- Biometric recognition techniques.

### 3. Providing information and guidance:

Modern technologies are used in the March to provide information and guidance to visitors, such as:

- Smart mobile applications.
- Lighting and sound devices.

### 4. Improving services:

Various technologies can be used in the March to improve the services provided to visitors, such as:

- Robotics technologies.
- Artificial intelligence.
- Logistics techniques.

### 5. Providing a healthy and clean environment:

Various technologies are used in the March to provide a healthy and clean environment for visitors, such as:

- Sanitation techniques.
- Trash management.

6. Providing transportation:

Different technologies can be used in the March to provide, manage and improve different means of transportation, such as:

- Buses.
- Trains.
- Planes.

7. Improving health care:

Various technologies are used in the March to improve the health care provided to visitors, such as:

- Health monitoring techniques.
- Rapid laboratory analysis.
- Field hospitals.

8. *Improve accommodation:*

Various technologies can be used in the March to improve the accommodation for visitors, such as:

- Providing air-conditioned tents.
- Squares
- Locations of processions and definition of their services
- Health facilities.
- Cleanliness.
- Cooling.

9. *Facilitating communication methods:*

Various technologies are used during the March to facilitate the process of social communication between visitors. Therefore, smart mobile applications and social media can be used.

## Suggestions and Conclusions

In this paper, the technologies that is being applied or could be applied for well managing and organizing the Arbaeen March are addressed and explained. These technologies are supported by mainly air and space, and communication technologies as infrastructure or indirectly related to this afore mentioned technologies. However, there are some of the technological advances that would allow the authorities to welcome back multi-million visitors of Ziyarat Al-Arbaeen. It includes, booking slots on an app to perform a 1,400-year-old religious rite; smart health technology to check on the frail and infirm; and holographic doctors 700 kilometers away to diagnose them remotely. (Nihal & Al Shaibany 2022)

Using apps like the Smart Pilgrim would make it more convenient for visitors to make bookings internationally. They will be able to adopt new and advanced tools that help them arrange all aspects of their trip.

At the international airport arrivals, the state-of-the-art technology could allow for doctors kilometers away in a focal center, to diagnose the incoming patients and ill people via a hologram. Health authorities can also prove round-the-clock medical assistance through toll-free numbers using relevant apps.

The lounge complex at specific sites at the area could be equipped with state-of the-art health centers, with three 24-hour Red Crescent ambulance teams. These health centers can handle numerous visitors daily. The treatment could range from simple check-ups to dentistry and life-saving heart surgery as instance. Moreover, high-tech mobile clinics can offer services to the visitors.

Even before the pilgrimage start, a team of robots can be managed to sanitize the holy sites as part of pandemic-control measures to protect worshippers from bacterial and viral threats. Each robot carrying container of sanitizer can be programmed to work for designated hours without human intervention.

Group of scholars can be assigned to answer visitors' queries during the Arbaeen March and interactive robots with touchscreens can be stationed at the main entrances of the shrines or outdoor areas where the ceremony takes place to help in providing needed information and guidance.

To help the elderly and people with disabilities electric vehicles could be stationed and made available to provide service if needed. Electronic umbrellas could be in operation to protect people from the sun and robots dispense bottles of water or other trashes. Massive water coolers and sprinkler systems can be installed in convenient locations to help cool visitors, reduce heat and refresh the air.

The ICT infrastructure entities can provide services using interlinked towers to enable telecom operator clients to serve the visitors. This can provide faster connection between travelling visitors and their families back home

Holding an exhibition for international companies to present their products in the field of developing services for visitors and processions will encourage many international companies to display their products and capabilities, especially if they become aware of the role of governorates and Moukebs in the Arbaeen visit. Creating a platform to advertise this exhibition and the possibility of displaying it through the platform will help a huge number of companies participate to display their products on the platform.

Announcing the need for computer applications and smart phone applications. After defining the application requirements, many talented people will come forward in preparing different applications that serve visitors of Arbaeen March, especially if an award for strong and qualified applications is announced.

The necessity of creating a package of names for master's and doctoral projects in scientific and engineering universities to build and develop systems that serve the March and invest and participate in scientific minds in developing services at the Arbaeen visit.

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**Repetitive Behaviour of Dust Storms  
in The Holy City of Karbala Governorate  
and their relationship  
to Some Weather Factors.**

**Prof. Dr.Ahmed Fattah Hassoon**  
Department of Atmospheric Sciences – College of  
Science - Mustansiriyah University

**[ahmed.fattah79.atmsc@uomustansiriyah.edu.iq](mailto:ahmed.fattah79.atmsc@uomustansiriyah.edu.iq)**

**Hind Kamil Kareem Salem Al\_Whaili**  
Department of Atmospheric Sciences – College of Science -  
Mustansiriyah University



## Abstract

Dust storms are considered as one of the important weather phenomena that have harmful and negative effects on the environment in various aspects. They arise and occur frequently depending on multiple topographical and climatic factors. In this study, data from the Iraqi Meteorological organisation and Seismic Monitoring IMOS recorded at the Karbala metrological Station was used to test and examine the statistical behaviour of dust storms for the period from 1980-2022 by dividing those dust storms into severe, moderate, and light depending on the extent of visibility and the period the dust storm lasted. Studies compared the frequency of dust storms with the weather conditions, such as wind, rainfall and max and min. air temperature. The results showed that there was a decrease in the tendency for dust storms frequency by 9%, accompanied by a decrease in the recorded wind speeds to about 2% within the average speed of about 2.7m/s. As for rain alone, there was also a decrease in its trend's quantities by about 0.28 within the annual average for four decades, which reached 94 millimetres. On the other hand, max. and min. temperature records increased about 1C0, but this increase is part of global warming and doesn't affect dust storm frequency rate alone, but can be worked with other atmospheric elements. From the current results, we concluded that the frequency of dust storms in Karbala province is affected by the boundaries of the local governorate, and there are other factors which play a role in the statistical behaviour of the frequency in the

occurrence of dust storms, which may be regional or global. The results can be used to give warnings to visitors heading to Karbala to take necessary precautions and prepare for the occurrence of dust storms in seasons of drought and lack of rain.

Keyword: Holy City of Karbala, Wind speed, Rainfall, max. min air temperature, Dust storm Frequency

### **Introduction:**

Dust storms are weather events that occur near the surface, which are produced by wind destruction and the separation of deposit particles far from a surface (Middleton, 2017). Dust results initially in waterless or semi-dry locations, which accounts for some 33% of the surface of the Earth. In reality, the northern hemisphere produces about 90% of worldwide floating mineral dust, which will be likewise accumulated (Hassoon et al, 2021, Duce, 1995). Dust storms effect are seen on many fronts, reflected or scattered solar radiation leading to weakening the efficiency of the solar cell, causing a decline in communication and machine-driven apparatuses, and effecting air quality and therefore being responsible for harmful illnesses (Boğan et al, 2022). Iraq is situated in the northern part of the subtropic section; the Northwest winds govern most sections of the country for extensive times of the year (Hassoon and Roomi, 2023). The presence of Iraq to the east of the Mediterranean Sea means it is altered by the environment of this

zone throughout the winter, which gives slight rainfall during this period (Duce, 1995). In addition, the placement of Iraq close to the Arabian Gulf region allows for hot and moist winds supplemented by cyclones most of the time triggering the rise in dust particles in the air (Khudur, 2014). The climate of Iraq is categorized by semitropical, mainland, waterless to semi-arid. The heaviest rainfall is displayed in the mountainous regions, which are an essential water resource for Iraq. Main soil types that exist across Iraq are silt adjoining clays, which contain elements smaller than 70  $\mu\text{m}$  in (thickness) and are easily transported via wind movement (Roomi, 2017). The main sources of the progression of dust storms in Iraq is climatic change specifically the extreme reduction in annual report rate of rainfall (Mohammed and Hassoon, 2019). Other details are genetic deviations, marshlands drainage, degradation of soil, the behaviour of farming, water possessions corrupt supervision which lead to reductions in green cover, desertification and scarcities which lead to the development of dust storms (Hassoon et al, 2021). Deficiencies and arid conditions add to the decline of soil grains, besides, wind also affects the presence of dust storms (Jassim et al, 2012, Al-Khudhairy et al, 2023). Many scientists and researchers deal with the study of dust storm behaviour in the middle and south region areas of Iraq. For example: Ibrahim I. Mohammed and Ahmed F. Hassoon (2019), used data (visibility, wind speed and direction and total rain amount) from the Iraqi Meteorological Organization and Seismology to investigate stations for middle and southern Iraq spread across the period from 2001 - 2017 to compare

annually the severity of dust storms during rainy seasons. It was determined that there was a converse association between rainfall and severe dust storms, and the lowest quantity of rainfall was in Nukhayb station 1304.6mm throughout the training period with 62 severe dust storms[9]. Asaad Sh. M. Alhesnawi et al (2019) , gathered samples of dust from March 2017 to February 2018 at three positions rural, urban and industrial to observe the monthly state of dust in Karbala, The results of this study discovered that the amount of dust falling ranged 9.66-96.04 g/m with average 36.47 g/m, most of which are of diverse and unequal shapes and the dimensions of dust particles ranged from 13.22-30.80  $\mu\text{m}$  (Alhesnawi et al, 2019). Jaafar Hussain Hamad Al-Hamd, N. M. Alwan (2020) identified and categorised the delivery of green spaces associated to the total area of the city Centre of Holy City of Karbala, wherein the distribution of green spaces for each citizen was concluded to estimate the conservational quality of the city. Accordingly, the fall down dust was accumulated on dust collection tubes and measured at numerous sites, reviewing the usual winds and its relationship with the allocation of green spaces and the city's green belt design. The study applied the Normalized Difference Vegetation Index (NDVI) method to produce maps for the measures of dropping dust and current winds direction (Al-Hamd and Alwan, 2020). Aws A. Al-Khudhairi et al (2023) analysed and examined tendencies of numbers of dust storms and their conduct in thirteen meteorological stations. Blowouts all over Iraq for the period 30 years and trends of dust storms included monthly data of dust

storms existences which were analysed spatially and temporally using the linear regression method, and spatially epitomized by using ArcGIS (Khudur, 2014). Aws A. Al-Khudhairy and et al (2023) also explore sand and dust storms recognition in Iraq using Moderate Resolution Imaging Spectroradiometer (MODIS) data, both from Terra and Aqua satellite techniques for the year 2022. MODIS Surface Reflection Factor Daily L2G Global 1 km and 500 m data were employed to calculate the Normalized Difference Dust Index (NDDI), Normalized Difference Dust Index (NDDI) is utilized for the discovery of sand and dust storms (Al-Khudhairy et al, 2023). The aim of this study is to analyse and identify dust storms recorded in Karbala by weather stations installed in Karbala city for the past 40 years. The analysis considers frequency of occurrence, for light and sever dust storms, also periods of occurrence and time of occurrence; the study deals with the effects of some basic atmospheric elements on the activity of dust storm persistency, such as rainfall and wind speed.

## 2. Location

Karbala province is positioned southwest of Baghdad, 105 km westward of the Euphrates Waterway on the boundary of the Western Desert. The region is positioned at a longitude of 44.40 degrees and latitude of 33.31 degrees. It has an expanse of 5034 km<sup>2</sup>, which characterizes 1.14% of Iraq's region (438317) km<sup>2</sup>.

Three areas were selected in Karbala province; the first is a rural area, the second is an urban area and the third is an industrialized area (Al-Salman et al, 2021). Figure 1, show Karbala municipality relative to Iraq.

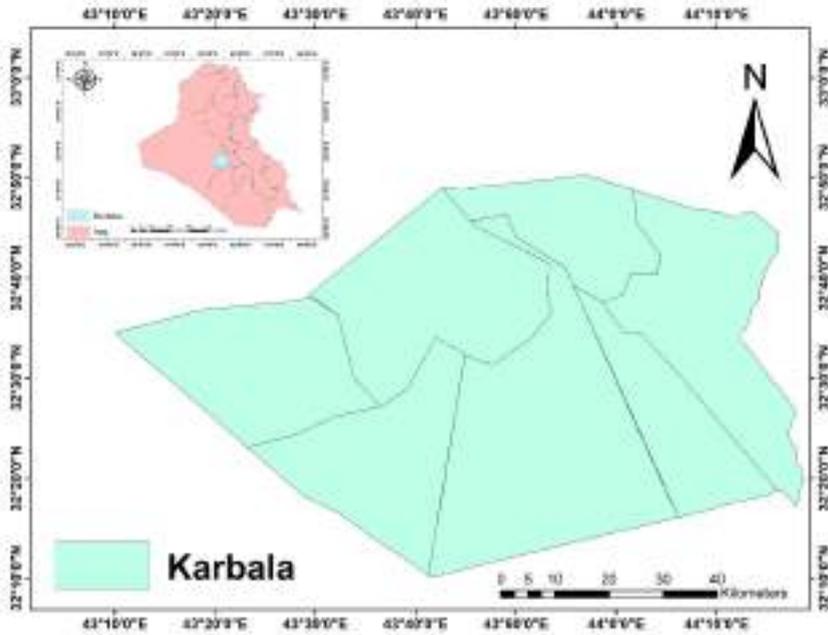


Figure 1: location Iraq and Holy City of Karbala

### 3. Data

After accumulating the data (Hourly, Daily, Monthly), from the Meteorological Organization and Seismology IMOS for wind speed and visibility, which are the most significant two elements to consider when studying the WMO arrangement of dust storms, we also gained rainfall data since several studies linked the decline of dust storms with rainfall and wind speed. In this study, a historic high of mainly dust storms data, containing monthly wind speed,

prevailing wind, rainfall, and number of dust storms, adjoined and rising dust were attained from the Iraq Meteorological Organization and Seismology (IMOS) for a 40-year period (1980-2022). Therefore, the interval of the investigation was chosen to be as lengthy as possible, dependent on the obtainability of recording data.

#### 4. Dust Storms Classification

Dust storms will be classified and categorized into three groups[16] [9] [10]:

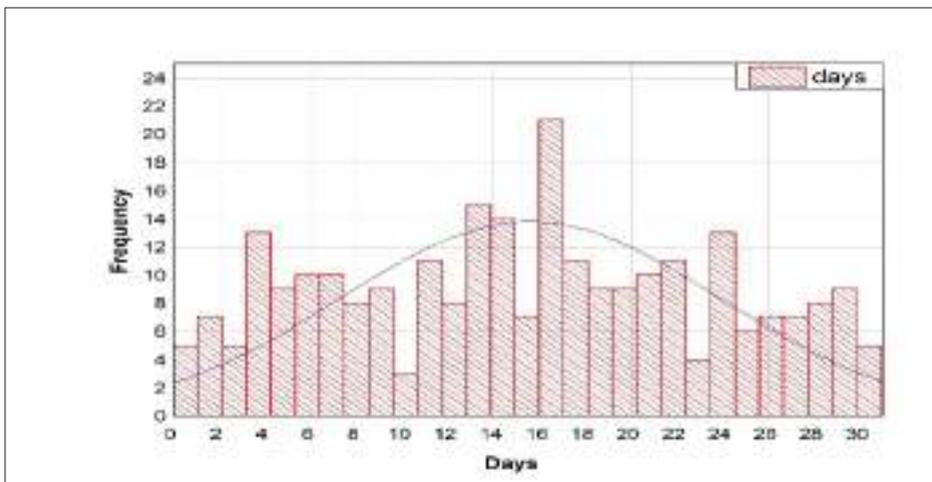
1. Light Dust Storm illustrated as a storm with distinguishability ( $0.5 < \text{visibility} < 1$ ) km, and speed of wind ( $8 < \text{wind speed} \leq 10$ ) m/s.
2. Moderate Dust Storm illustrated as a storm with discernibility ( $0.2 < \text{visibility} \leq 0.5$ ) km, and speed of wind ( $8 < \text{wind speed} \leq 12$ ) m/s.
3. Severe Dust Storm considered as a storm with visibility ( $0 \leq \text{visibility} \leq 0.2$ ) km, and speed of wind ( $8 < \text{wind speed} \leq 18$ ) m/s.

#### 5. Result and discussion

##### 5-1 Dust Storm frequency

The recurrence of dust storms in a specific area is considered one of the most important indicators of a change in the atmospheric system or in the topographic layer of the Earth's surface. In this study, an analysis of the frequency of occurrence of dust storms in Karbala Governorate was conducted, which was recorded through the weather station of the General Authority for Meteorology and

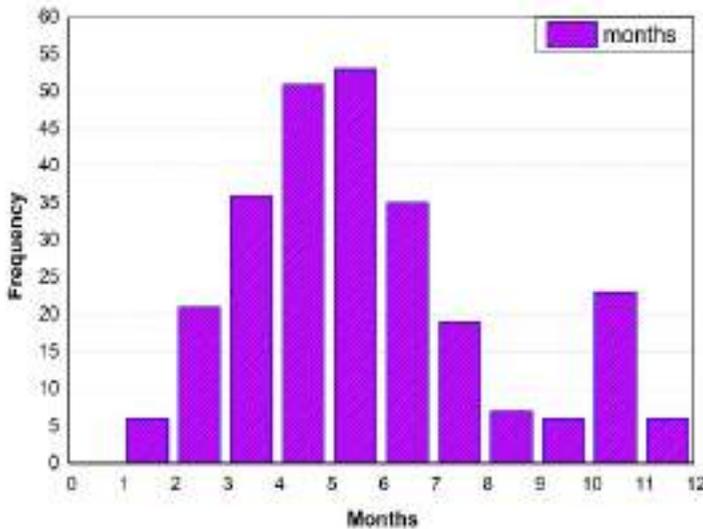
Seismic Monitoring. As a case of examining the behaviour of dust storms, a period of more than 20 years was initially taken, which included hourly, monthly, and annual data for the occurrence of dust storms. In addition to testing the conditions of the dust storm, its intensity, and the hours of its stay, start, and end, the second paragraph of the analysis took a longer period of time, more than 40 years, to study the monthly behaviour of dust storm recurrence and compare it with some weather factors such as rain and recorded wind speeds. Figure No. 2 shows the frequency of dust storms during the sequence of a full month of 30 days for a period of 22 years for the Holy Karbala station, as the number of days in the month on average is 30 days. From the figure we notice that the most frequent occurrence of dust storms during that period was limited to the sequence of days in the middle of the month, especially Day 17, while the sequence of days 10 and 23 are the least frequent days for the occurrence of dust storms, and this may be because the middle of the months is the real period



**Figure 2: Daily frequency of occurrence dust storm through period 2000-2022 in holy Karbala**

that shows the nature of the prevailing and dominant weather current and that the days at the ends of the months are a transitional state. Figure 3 shows the monthly distribution of the frequency of dust storms, where it was noted that the highest monthly frequencies were in the months of April and May, while the lowest frequency of dust storms was in the months of December and January. This is due to the state of drought and the extreme increase in temperatures in addition to wind activity during this period causes erosion and an increase in the amounts of suspended dust particles. The case of an increase in the activity of recurring dust storms can be due to the synoptic conditions associated with the prevailing atmospheric pressure systems, in addition to the formation of air fronts, and these accompanying conditions have been confirmed in their existence, through studies of weather conditions by many researchers.

Figure 4 shows the annual frequency of dust storms, where it was found that the years from 2008 to 2010 had very high frequencies of dust storms and much higher than the general average. The change in the frequency of occurrence of dust storms on an annual basis cannot be due to seasonal changes as a result of the Earth’s rotation around the sun, but it can be due to the occurrence of decadal dry seasons associated with lack of rain due to the global circulation of the atmosphere, such as increasing surface temperatures of sea



**Figure 3: Monthly frequency of occurrence through period 2000-2022- in holy Karbala**

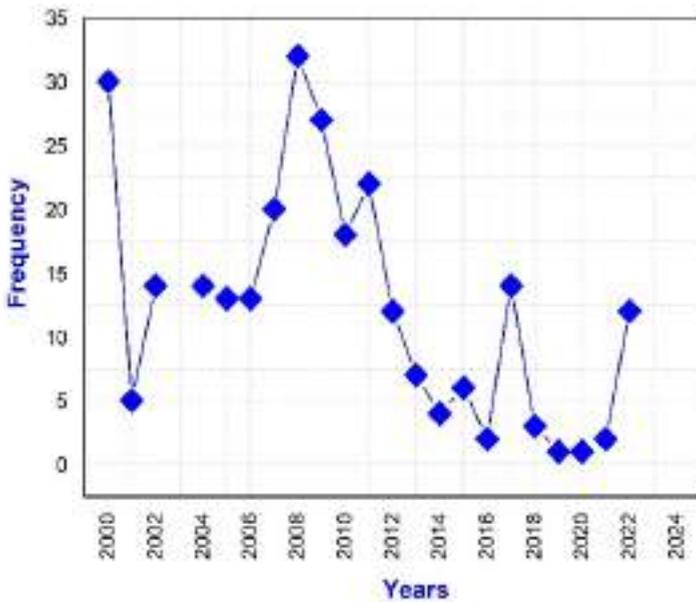


Figure 4: Yearly frequency of occurrence through period 2000-2022- in holy Karbala

water or oceans in certain areas and their decrease in other areas, which is known as the El Niño and La Niña phenomenon. These phenomena work to redistribute the amounts of rain and evaporation from the seas and oceans.

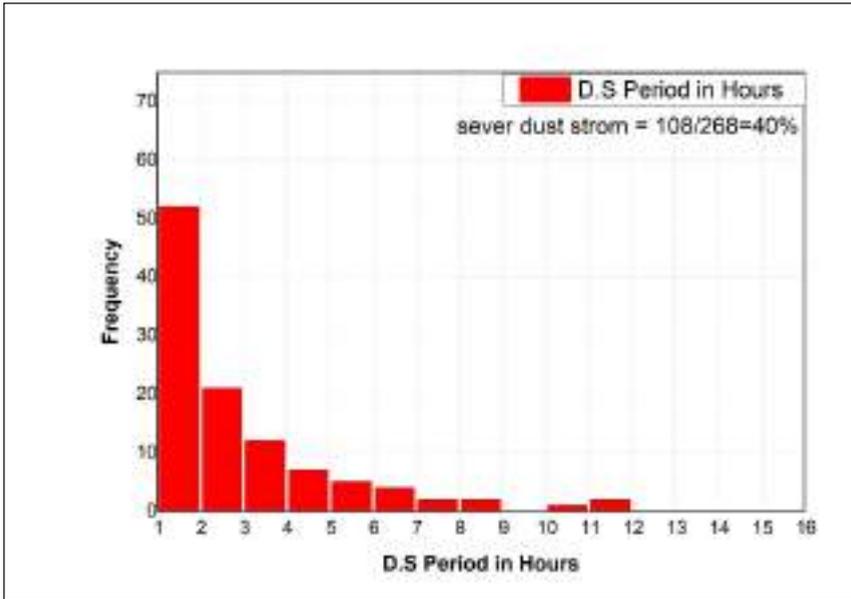
### 5-2 Light and Sever dust storm

In addition to the recurrence of dust storms during certain periods, they also vary in intensity and according to many factors operating within the atmosphere and its interaction with the Earth’s cover. During the current study, cases of dust storms recorded at

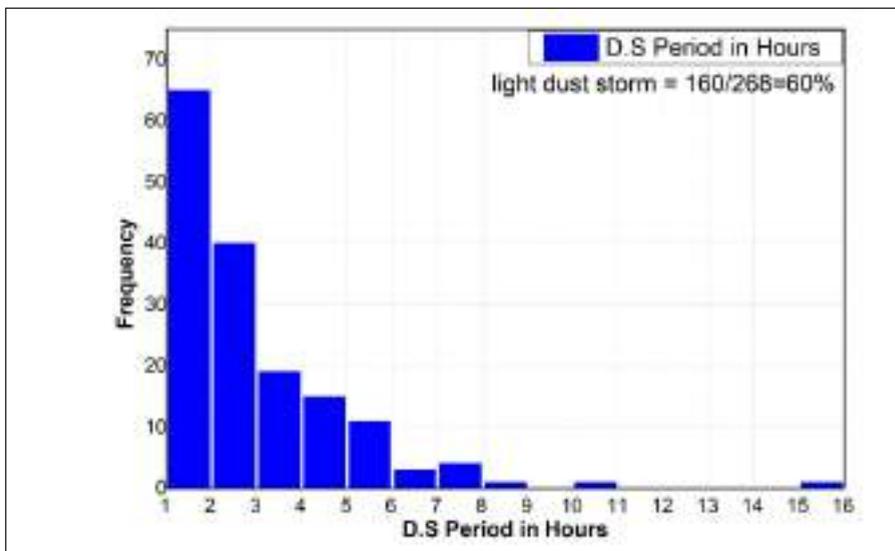
the Holy Karbala station were classified into light or moderate dust storms and severe dust storms, and the classification criterion used here relied primarily on two factors: the concentration and spread of dense dust particles, which is expressed by the range of vision and is inversely proportional to the dust concentration. The second factor is the observed wind speed. It is possible to review paragraph 4 in the theoretical part and view it. Figures (5) and (6) show the frequency of the duration of hours of survival of severe and moderate dust storms, as it was noted that about 40% of the dust storms that strike Karbala Governorate are severe dust storms whose duration of stay exceeds about 12 hours, although their frequency is very small. However, they have fairly good and certain rates and last up to 9 hours. See Figures 5 and 6 and compare them in terms of values and frequency. We note that mild ones have fewer hours of survival compared to severe ones. Severe dust storms are mostly not of local origin. They arise within large areas of the world and move over long distances, but they intensify or weaken according to the topography of the region and the weather condition. Figure 7 shows the recommended hours for severe and moderate dust storms to occur within a 24-hour period within Karbala Governorate, as most of the light and severe dust storms occur more often at the beginning of the day at sunrise hours and the increase in thermal heating of the Earth's surface, as this heating works to fuel the dust storm. Through the formation of the local convective boundary layer, the early morning hours have the highest growth speed of the convective boundary layer,

according to the source (Kareem and Hassoon, 2023).

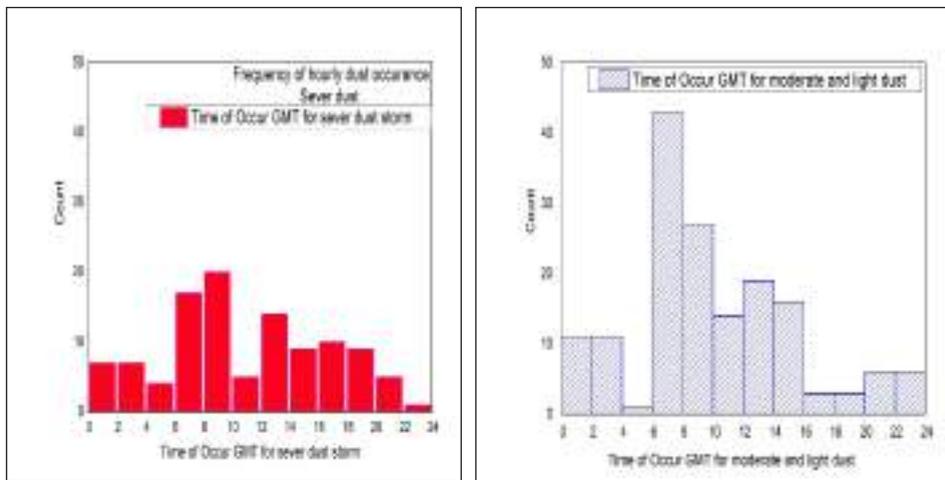
Therefore, we expect the activity of dust storms to intensify during the daylight hours, while the activity and frequency of their occurrence at night hours will be weak due to the formation of the nocturnal limiting layer close to the Earth's surface, which works to reduce the movement of air bands, (Hassoon and Roomi, 2023) and thus the dust storm does not have the possibility of feeding and reactivating, and thus resuspension of dust particles, but rather there will be downward movement and deposition of dust particles due to atmospheric stability during these hours.



**Figure 5: Frequency of Occurrence hourly period for severe dust storm for Karbala station during period 2000-2022-**



**Figure 6: Frequency of Occurrence hourly period for light and moderate dust storms for Karbala station during period 20002022-**



**Figure 7: Frequency of Occurrence daily period for (a)light and moderate and (b) severe dust storm for Karbala station at period 20002022-**

### 4-3 Effect of Atmospheric Element on Dust Storm

Weather factors affect the behaviour of dust storms fundamentally, and any change in the behaviour of atmospheric systems often has an impact in increasing or decreasing the frequency of severe and light dust storms recorded at weather monitoring stations. This fact has been proven in many solid scientific research. The current paragraph deals with comparing the rate of behaviour of recurrence of dust storms over long periods extending up to four decades with the rate behaviour of some important atmospheric parameters in relation to the emergence and development of dust storms, which are falling rain and the prevailing wind speed, see Figure 8. The observed values of atmospheric parameters are not significantly

related to the current atmosphere. For Karbala Governorate, where most of the weather conditions accompanying dust storms are directly related to the synoptic condition prevailing over Iraq and the region in general, but there is some specificity to the local climate of the governorate. Most of the increase in the frequency of dust storms, as we saw in Figure 4, occurred in the years 2008 and 2010 in Iraq in general and in Karbala in particular, in contrast to what was in previous years before 2003, in which the frequency of dust storms was relatively low. And this is also the case in the last years of 2020, Figure 4 and also Figure (8a) show the frequency distribution rates of dust storms recorded during a period of 40 years from 1980 to 2022. These large time periods were divided into small decadal periods in order to study the recurrence behaviour of dust storms every ten

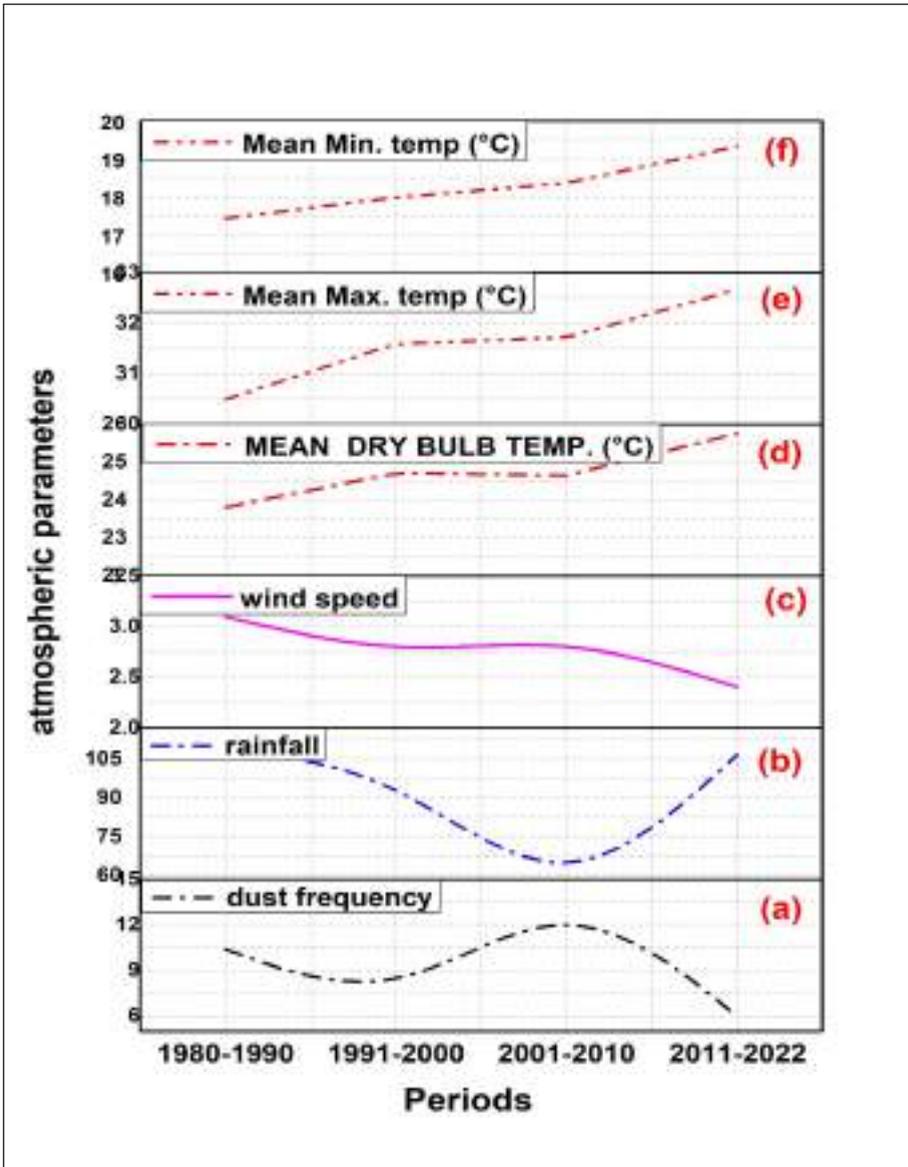


Figure 8: show the trends average of (a) trend frequency of dust storms, (b) average tends of rainfall (c) average trends of wind speed

consecutive years separately. The frequency rate of dust storms in the first period was higher than the overall average by only one value. In the second period, the second decade, there was a decrease in the values of recorded recurrent storms by about 0.69 percent of the general average. Figure 8. The third decade from 2000 - 2010. It was recorded that there was a significant increase in the number of dust storm recurrences, reaching 160% of the general average for the four decades, while it was There is a decrease in dust storms recorded during the last decade from 2010-2020, reaching 64.8% of the general average. The general tendency for dust storms to recur during the past 42 years witnessed a decrease in the frequency of dust storms by a rate of up to 9%, with an overall average frequency of dust storms of about 9.5 times during that period.

### 4-3-1 Rainfall

Drought greatly affects the frequency of occurrence of dust storms due to the lack of rainfall. The current study took it upon itself to divide the study periods into decadal periods, where rain rates were dealt with over a period of ten years and compared with the frequency of dust storms. The average amount of rain falling on the Karbala station over a period of more than 40 years was 95 millimetres, and this amount is considered a general average rainfall, which is the amount of rain collected on a monthly basis within the five rainy months of the winter, spring, and fall seasons. During the first decade, 1980-1990, there was an increase in the amount of rain above the general average by about 16 mm, while

there was a decrease of 2 mm in the amount of rain in the second decade, 1990-2000. The size of the decrease was relatively large in the period 2000-2010 and amounted to About 29 mm. This period witnessed a significant and noticeable increase in the frequency of dust storms. Also note Figure 4 and Figure 8 b, that the last period extending from 2010 - 2020 witnessed a noticeable improvement in the volume of precipitation, reaching 13 mm.

### 4-3-2 Wind speed

The prevailing winds in Iraq are north-westerly, as wind speed is considered an important factor in the formation of dust storms, as the increase in wind speed causes dust particles to rise and form a dust storm. In the same way that was used in analysing rates of rainfall amounts and comparing them with the frequency of occurrence of dust storms, wind speed rates were calculated in each of the four decades and the result of the increase and decrease in wind speed rates was compared with the rates of storm recurrence every ten years separately. The relationship between them is shown in Figure 8c, which indicates that wind speeds in the first decade 1980-1990 increased above the general average by about 0.4 meters per second, and when comparing wind data and data on the frequency of dust storms, we also notice an increase in the frequency of dust storms to about 0.9 meters per second above the general average. The resulting condition matches the physical behaviour of the causes of the emergence of dust storms, in that the formation of dust storms requires the presence of relatively high

speeds that sometimes reach, according to references, 8 meters per second. In the second and third periods, wind speeds remained slightly higher than the general average, at 0.1 meters per second. In contrast, in the third period, there was a significant increase in the frequency of dust storms during that period to more than 6 times the frequency of the general average. The latter case cannot be explained based on an increase in wind speeds, but there is another factor that may have a more obvious effect, which is the decrease in rain rates, rainfall records were relatively few during this period, and this period is considered a dry season. Also, the human factor can have a role in explaining it, that being the significant increase in dust storms recorded due to military operations after 2003. In the last decade, there has been a decrease in dust storms, accompanied by an increase in recorded rainfall amounts above the working average.

#### **4-3-3 Maximum and Minimum Air Temperature**

Increasing the temperature leads to an increase in the amounts of surface evaporation and thus increases the conditions of prevailing drought conditions, and thus the surface soil loses proportions and an important factor for its cohesion, which is moisture. By analysing the minimum and maximum surface temperatures and average air temperatures recorded at the Karbala station during the past four decades, we noticed an increase in the recorded temperature values, as the highest values of increase were in the last decade 2011 - 2022 from 24.7 to 25.7 for the average and from 31.7 to 32.7 for

the temperature. The maximum temperature increased from 18.4 to 19.3 from the minimum temperature. The increase in surface air temperatures in Karbala Governorate is considered part of the general rise in the planet's temperature due to global warming. The increase in maximum and minimum air temperatures recorded in the governorate, especially during the last decade, did not lead to an increase in the frequency of recorded dust storms, despite the importance of the temperature factor in increasing droughts and increasing evaporation rates. This is due to the fact that the last ten years were a harvest season of sufficient proportions of rain, and drawings 8a, 8b, and 8d, e, and f can be compared to obtain the above result. We can conclude that the temperature factor is not essential in determining and predicting the increased frequency of dust storms in Karbala Governorate, but rather it is an auxiliary factor and works to influence the presence and frequency of dust storms with other factors such as amounts of rain, winds, and the synoptic weather condition.

## 5. Conclusion

1- The average daily frequency of dust storms recorded for more than 20 years, showing that most of the frequency of dust storms is concentrated in the middle of the days of the months during the period from 2000-2020. This result will be useful for visitors to the city of Karbala, as it is preferable for visiting times to be during the end and beginning periods of work.

2- The monthly frequency of dust storms was limited to the months of April and summer due to drought during that period and high temperatures. Therefore, it is preferable to take masks and resources of protection from dust, as the times of the Arba' in visit to Imam Hussein (peace be upon him) were in the summer and spring months.

Most of the high frequencies of dust storms occur in the first hours of the day due to the conditions of convection and atmospheric stability prevailing during the day and night.

From the current results, we concluded that the frequency of dust storms in Karbala province is affected by the boundaries of the local governorate, and there are other factors that play a role in the statistical behaviour of the frequency of occurrence of dust storms, which may be regional or global. The results can be used to give warnings to visitors heading to Karbala to take necessary precautions and prepare for the occurrence of dust storms in seasons of drought and lack of rain.

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**EXPLORING THE INFLUENCE OF THE NEW MEDIA  
COVERAGE ON PUBLIC OPINION IN THE CASE OF  
IMAM HUSSEIN**

Ph D NUL WIDAYA BINTI MOHAMED NAWI  
UPM University

[nul\\_widaya@yahoo.com](mailto:nul_widaya@yahoo.com)

SHAHIRAH BINTI SULAIMAN  
(Individual Researcher)



## INTRODUCTION: NEW MEDIA OVERVIEW

New media refers to digital communication platforms and technologies that have emerged in the late 20th and early 21st centuries. In this paper, we highlight the literature and studies on the influence of the new media coverage on public opinion in the case of Imam Hussein, as well as related concepts that influence new media among the public. Nowadays, the increasing application of technology, especially in new media, has inspired researchers to conduct a study on the impact of new media communications. Unfortunately, the most worrying issue is how the communication systems solve these problems (Sánchez-Casado, Artal-Tur, & Tomaseti-Solano, 2019).

There are several theme approaches related to this study such as the influence of new media coverage related with public opinion and its focus on the case of Imam Hussein. For the convenience of the reader, the we have compiled a highlight of this literature based on the objectives of this study. In general, the literature will assist researchers in getting some ideas and direction of the study conducted. According to Chua (2014), literature can be broken down into various sub-topics based on one's interest and research values. New media is a platform for social interaction that entails a new branch of communication that emerges from communication contexts. This medium is made up of online sites, services, and activities that all involve some sort of process. Collaboration, sharing, and democratisation of new media users are among the processes involved (Ho, Chung, Kingshott, & Chiu, 2020).

In today's world, new media is used for three primary purposes: as a means of communication, inquiring about the latest information and doing business online. As a result, this strategy is quite useful in people's daily lives. The new media communication technique,

according to Rothschild (2011), comprises online forums, social blogs, microblogging, photographs, videos, user ratings, and social bookmarks. The new media branch offers several mechanisms that allow new media users to communicate with other new media users in a variety of ways. Furthermore, through communication, outreach, and community reorganisation, new media has an immense ability to assist corporations, specialising in product branding (AlKhalifa & Farello, 2020). Several studies have found that many new media platform users are already addicted to utilising social networking sites, and that their use of new media sites on a daily and continuous basis is strongly dependent on the individual's position. People who are very addicted to Facebook, he says, are unaware of the impending crisis (Katz & Cohen, 2020) while many children are at risk due to social isolation and reduced social services. Objective: Examine child protection in Israel during COVID-19, as portrayed in mainstream news media and government policy documents. Participants and setting: The study analyzed all policy documents and mainstream media reports published in Israel from March to May 2020, during the initial mandatory nationwide quarantine. Methods: (1).

## THE INFLUENCE OF NEW MEDIA COVERAGE ON PUBLIC OPINION

The influence of media coverage on public opinion regarding the case of Imam Hussein (a.s), a revered figure in Islam and a central personality in the event of Ashura has not been specifically addressed in the provided sources. However, the general impact of media representations of Islam and Muslims can provide some context. Research has shown that media depictions of Islam and Muslims can greatly influence public opinion and contribute to phenomena such as Islamophobia (Rane et al., 2014). The way media frames stories and the narratives it chooses

to focus on can shape the public's perceptions, sometimes leading to negative stereotypes and biases (Baker et al., 2013). In the context of the portrayal of figures such as Imam Hussein (a.s), media coverage that is not sensitive to the cultural and religious significance of such a personality could potentially contribute to misunderstandings and reinforce existing prejudices. Conversely, media that provides well-researched, respectful, and nuanced reporting can enhance understanding and appreciation of different cultural and religious narratives.

It is important to critically assess media sources for their credibility, such as considering different viewpoints and the reputation of the outlet. For instance, viewers who find specific networks like Al-Jazeera credible may be influenced by their coverage of such topics (Johnson & Fahmy, 2008). Therefore, the new media coverage, depending on its quality and orientation, can significantly affect public opinion concerning historical and religious figures like Imam Hussein (a.s).

## RESEARCH QUESTIONS

This paper is related to understanding the influence of new media coverage on public opinion in the case of Imam Hussein (a.s), which can vary depending on the context and the goals of the research. Based on the research problem, the purpose of this paper is to find out the dependency of new media coverage on public opinion. Specific research questions are:

1. **How does the new media shape the portrayal and perception of religious figures like Imam Hussein (a.s)?**
2. How does the content and discourse surrounding Imam Hussein (a.s) in new media spaces influence public attitudes, beliefs, and interpreta-

tions of his legacy?

3. How do the patterns and trends in the coverage of Imam Hussein (a.s) across different types of new media platforms impact public opinion over time?

4. How does new media contribute to assessing the nature of discussions, interactions, and engagement related to Imam Hussein (a.s) in online spaces and in shaping public opinion?

5. How do the mechanisms through which new media cover topics about Imam Hussein (a.s) influence the formation and dissemination of narratives, including factors such as virality, algorithmic amplification, and user engagement?

6. How do new media representations of Imam Hussein reflect broader cultural narratives, ideologies, and power dynamics, and how do they impact public perceptions within specific socio-political contexts?

7. How can we provide insights that can inform media literacy efforts and communication strategies aimed at promoting critical thinking, cultural understanding, and constructive dialogue in digital media environments?

Overall, this paper is concerned with gaining a nuanced understanding of how new media coverage shapes public opinion regarding Imam Hussein (a.s), and seeks to draw implications for media practices, religious discourse, and societal dynamics.

## SIGNIFICANCE OF THE STUDY

This research seeks to enhance understanding of the complex interplay between new media, religion, and public opinion formation,

with implications for religious pluralism, interfaith dialogue, and social cohesion in multicultural societies. By examining the case of Imam Hussein (a.s), it contributes to broader discussions on the role of media in shaping collective memory, cultural heritage, and identity construction in the digital age.

## **QUALITATIVE RESEARCH METHODOLOGY: FOCUS GROUP DISCUSSION**

Focus group is a method of group interview. This focus group in this study is applied to new media users consisting of people who depend on new media. Besides, the selected informants are those who always use the new media for their daily activities. Usually, focus groups are used to obtain a deeper understanding on a topic or to get a better understanding of a study such as treatment, attitudes, strategies, and the views of a group (Liamputtong, 2014). Focus groups are preferable and applicable in this study. Focus groups conversations are often used as a qualitative tool to gain an in-depth interpretation of social issues. This method aims to gather data from a precisely selected group of people, not from a statistically representative sample of a wider population.

For this study, we chose to use focus groups. Focus groups have been conducted face to face but online and online focus group is a research method that involves gathering a selected group of informants in a virtual setting to engage in interactive discussions and provide qualitative insights. Focus group discussions are an intense method of qualitative research that entail conducting five (5) groups with six (6) persons in each group. This small sample of informants will be used to examine the perspectives of the informants on a specific concept, plan, or circumstance.

## FOCUS GROUP NEW MEDIA USERS

Several parameters have been identified specifically in the selection of informant’s new media. The number of new media user informants in this study is as many as six (6) persons for every group, totalling five (5) groups with experience in using new media. This is shown in Table 1.1. The purpose of the selection of this group is to see an understanding of the influence of new media coverage on public opinion involving people directly via online in Karbala, Iraq.

**Table 1.1 Sampling of New media User Informants**

Title	Description	Fraction	Total
New Media User	Youth	30 people	30 people
Age	Youth	15 to 30 years old	
Gender	Man	22 people	
	Woman	8 people	
	Indian		
Area	Karbala, Iraq	6 people in 1 group from each state (16 states)	

Several parameters have been identified especially in the selection of informants within new media users. As much as 30 people who are new media users, with experience in the new media were recruited as informants in this study. Based on Table above, new media users 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 new media coverage influence on public opinion among people.

## DATA COLLECTION

Data collection process is crucial in providing information reports from informants on the conducted studies. Therefore, it does need serious attention. This section explains the data collection based on three methods of study used in the focus groups. In this study, a focus group was conducted on new media users who consist of youths in Karbala, Iraq. This method is suitable to gain and understand the influence of new media users and their social engagement. In addition, through this focus group, we are able to explore experiences and the influence of new media on social engagement among youth. This process takes between 1 to 1 ½ hours. Focus group implementation information is as follows in Table 1.2 below and the total number of focus group informants is 30 people, and one group consists of 6 informants. Table 1.2 shows the information of the focus group informants.

**Table 1.2 Focus Group Implementation Informant**

Informant Category	Method	Month	Informant Number
Youth	Focus Group 1-5	August 2023	30 people

In the implementation process, there are five steps for this focus group. The first is group formation. In this study the focus group consisted of six people new media users in a group, around the city of Karbala, Iraq which includes various races and backgrounds. It is carried out in the form of five (5) inner group closed via online session. The second step is the appointment of a moderator. Inside this study the researcher himself became a moderator. Ahmad Sunawari Long (2011) argues that it is preferable that moderators are not recognized by the group members in order to avoid shyness or lack of seriousness among members. The

main task of the moderator in this study is to be the chairman of the group discussion; to note, record, and ensure the discussion session runs smoothly. The third step is to hold a brief familiarization session. It is run before the start of the session discussion. This is because members or informants are made up of various backgrounds and they do not know each other. Therefore, informants are asked to introduce themselves, state their home address and other basic information. This step will take approximately 10 minutes and will help us ascertain who is a shy character and who is more vocal and outspoken. The fourth step is a discussion session on the study conducted. This part is very important because it helps to get the results of the study. The moderator asks a few questions to the informant and wait for their answers. In this focus group, informants have been exposed to some examples of posters and videos of social involvement among peoples in Karbala, Iraq. However, it is all done after obtaining permission and consent from the informant. All recordings have been presented in text form transcription. As a last step the researcher thanks the informants for participating and their willingness to spend time in this research.

## DATA ANALYSIS

Data analysis comes next in a study once the informant has provided the data. The information gathered through MP4 recording has been transformed into text transcription for focus group and interview procedures. Following completion of the informant interview, data analysis was carried out. This makes it possible to compare one group to other groups and make notes about them. To gather correct results, data were further examined using NVIVO 12 software. In addition, each informant in the focus group was given a label to make it simpler to

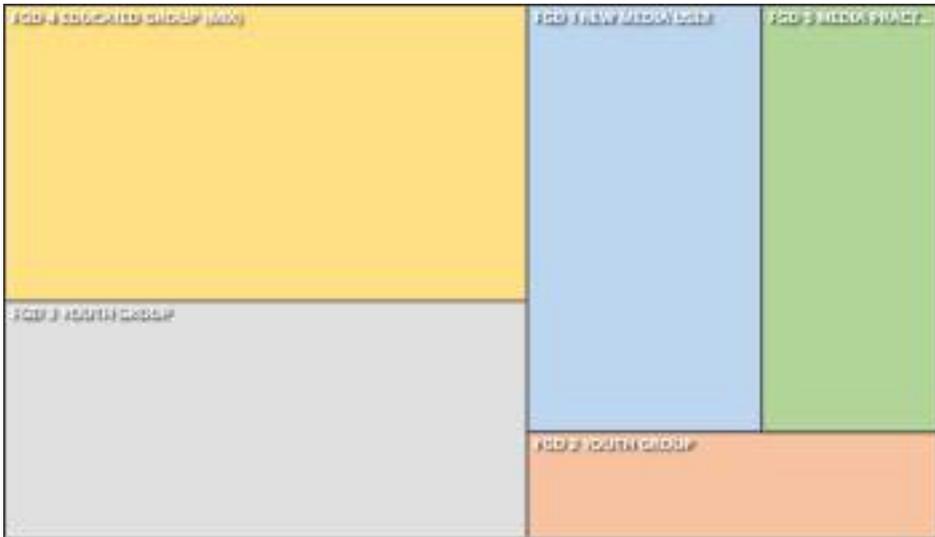
handle creating or determining the themes in this study and safeguard the secrecy of the study informants. This made it easier to write the study’s findings. The labelling of focus group informants is shown in Table 1.3 below:

**Table 1.3 Focus Group Informant Labelling (KF)**

Focus Group	Informant Number	Informant Labelling
1-5	30	FG1-FG5

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**



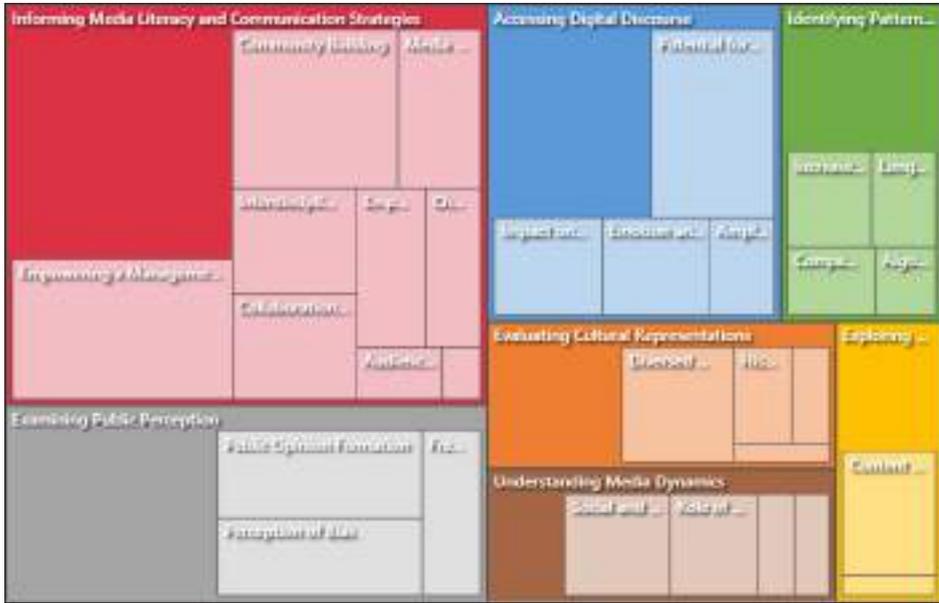
**Table 1.4 Compared by number of coding references**

Files	Number of coding references	Number of nodes coding
Files\\INTERVIEWS\\FGD 1	18	46
Files\\INTERVIEWS\\FGD 2	10	20
Files\\INTERVIEWS\\FGD 3	18	57
Files\\INTERVIEWS\\FGD 4	28	71
Files\\INTERVIEWS\\FGD 5	14	35

**RESULTS AND DISCUSSION**

An important part of the new media coverage and its influence on public social engagement is affected by the publics’ new media networking. A big risk factor for many issues and problems is said to be online community social interactions. The idealised self-shows that are shared on new media are a constant issue. Public are at risk of coming out as superficial as a result, although the terrible outcome may depend on how they interact on new media. Problems include and are not limited to, social isolation and online conflict. These are the possible risks for those who interact with different posts, and so creating new media for safer and better online interaction is important.

**Figure 1.2 Compared by Number of Coding References for Exploring the Influence of the New Media Coverage on Public Opinion in the Case of Imam Hussein (a.s).**



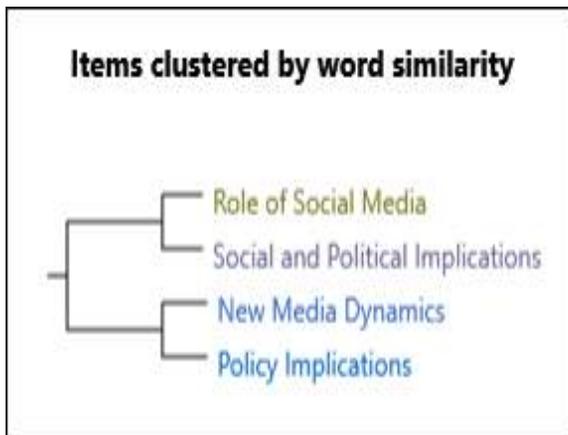
The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.2 Findings Themes and Categories shows seven (7) Themes and 30 Categories. Figures 1.2 hierarchy charts shows compared by number of coding reference by informants mostly have opinion related to understanding media dynamics (coding reference:4 Direct,19 Aggregated,Items Coded: 2 Direct, 5 Aggregated) , informing media literacy and communication (coding reference:23 Direct,79 Aggregated,Items Coded: 5 Direct, 5 Aggregated) , identifying patterns and trends (coding reference:9 Direct,21 Aggregated,Items Coded: 3 Direct, 3 Aggregated), exploring influence mechanism (coding reference:5 Direct,12 Aggregated,Items Coded: 3

Direct, 3 Aggregated), examining public perception (coding reference:17 Direct,39 Aggregated,Items Coded: 5 Direct, 5 Aggregated), evaluating cultural representations (coding reference:8 Direct,21 Aggregated,Items Coded: 2 Direct, 3 Aggregated) and accessing digital discourse (coding reference:14 Direct,38 Aggregated,Items Coded: 4 Direct, 5 Aggregated) .

## KEY THEME 1: UNDERSTANDING MEDIA DYNAMICS

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.3 Findings Categories of Understanding Media Dynamics shows four (4) Categories.

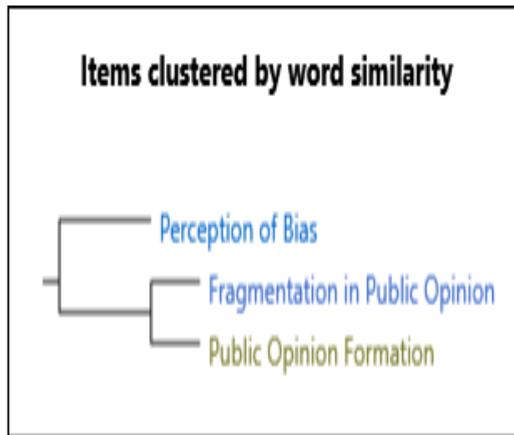
**Figure 1.3: Findings Categories of Understanding Media Dynamics**



## KEY THEME 2: EXAMINING PUBLIC PERCEPTION

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.4 Findings Categories of Examining Public Perception shows three (3) Categories.

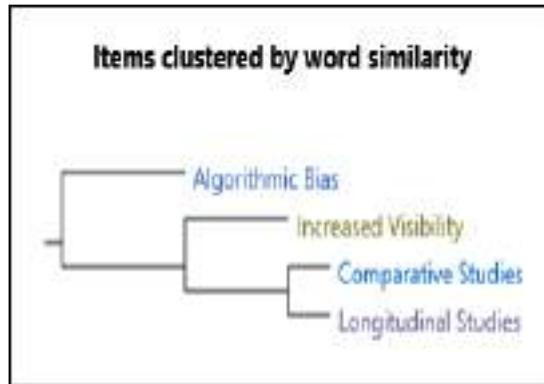
**Figure 1.4 Findings Categories of Examining Public Perception**



## KEY THEME 3: IDENTIFYING PATTERNS AND TRENDS

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.5 Findings Categories of Identifying Patterns and Trends shows four (4) Categories.

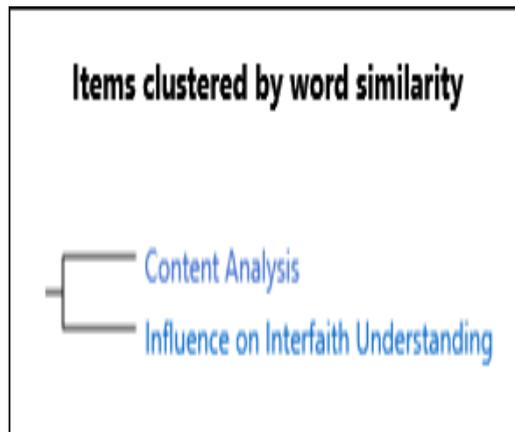
**Figure 1.5 Findings Categories of Identifying Patterns and Trends**



**KEY THEME 4: EXPLORING INFLUENCE MECHANISMS**

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.6 Findings Categories of Exploring Influence Mechanism shows two (2) Categories.

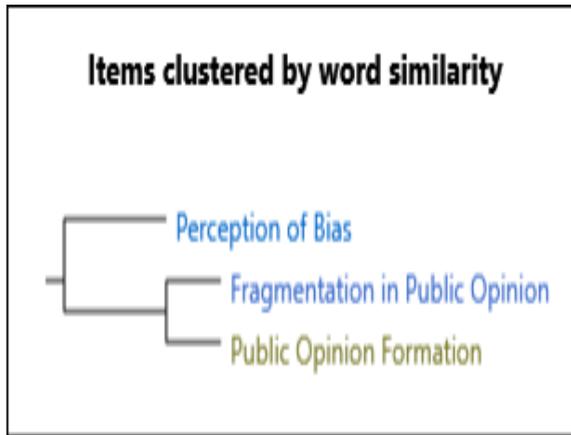
**Figure 1.6 Findings Categories of Exploring Influence Mechanism**



## KEY THEME 5: EXAMINING PUBLIC PERCEPTION

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.7 Findings Categories of Examining Public Perception shows three (3) Categories.

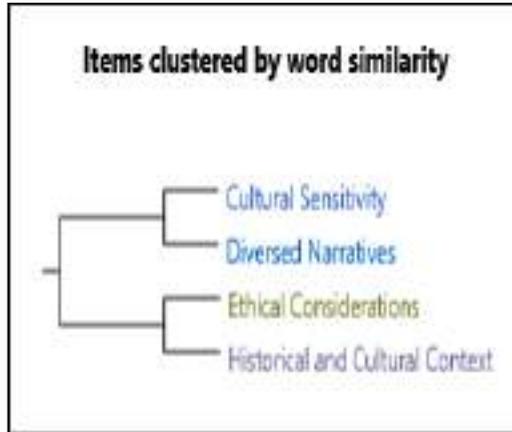
**Figure 1.7 Findings Categories of Examining Public Perception**



## KEY THEME 6: EVALUATING CULTURAL REPRESENTATIONS

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.8 Findings Categories of Evaluating Cultural Representations shows four (4) Categories.

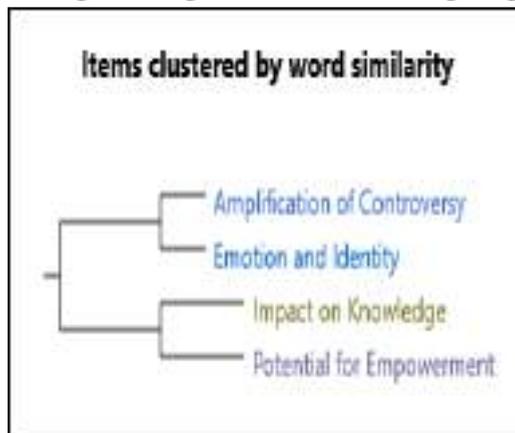
**Figure 1.8 Findings Categories of Evaluating Cultural Representations**



**KEY THEME 7: ACCESSING DIGITAL DISCOURSE**

The findings of the Focus Group Discussion transcripts support the statistical result obtained in answer to the first research question. The findings of the thematic analysis of the focus group discussion transcriptions by NVIVO12 are presented. Figure 1.9 Findings Categories of Accessing Digital Discourse shows four (4) Categories.

**Figure 1.9 Findings Categories of Accessing Digital Discourse**



## RESULT AND DICSUSSION

The findings for exploring the influence of new media coverage on public opinion in the case of Imam Hussein (a.s) can vary based on the specific research methods, contexts, and objectives of the study. However, findings include (i)Increased Visibility: New media platforms have expanded the reach and visibility of discussions related to Imam Hussein (a.s), allowing for a broader audience to engage with his legacy beyond traditional media outlets.(ii)Diverse Narratives: New media coverage of Imam Hussein (a.s) reflects a diverse range of narratives and interpretations, influenced by factors such as religious beliefs, cultural backgrounds, political affiliations, and personal perspectives of content creators and users.(iii)Amplification of Controversy: New media platforms may amplify controversial or polarizing perspectives on Imam Hussein (a.s), leading to heightened debates and discussions among online users with varying viewpoints.(iv)Community Building:Online communities and networks centered around Imam Hussein (a.s) have emerged on social media platforms, fostering solidarity, religious expression, and commemorative practices among followers and enthusiasts.(v)Influence on Public Perception: New media coverage can significantly shape public perception of Imam Hussein (a.s), impacting attitudes, beliefs, and interpretations of his legacy among diverse audiences, both within and outside of religious communities.(vi)Algorithmic Bias: Algorithms and platform dynamics may influence the visibility and prominence of certain narratives or content related to Imam Hussein (a.s), potentially reinforcing existing biases or privileging specific viewpoints over others. (vii)Challenges of Misinformation: New media environments present challenges related to the spread of misinformation, misinterpretation, and manipulation of information about Imam Hussein (a.s), requiring critical media literacy skills among users to discern credible sources

and accurate representations.(viii)Potential for Empowerment:Despite challenges, new media platforms offer opportunities for marginalized voices and alternative perspectives on Imam Hussein to gain visibility, challenge dominant narratives, and contribute to more inclusive and diverse discussions.

Overall, the findings highlight the multifaceted nature of the influence of new media coverage on public opinion regarding Imam Hussein, underscoring the importance of critically engaging with digital media content and understanding its implications for religious discourse and cultural representation.

## **SUMMARY, CONCLUSION, IMPLICATION AND RECOMMENDATION**

Over the last few decades, the development agenda has paid more attention to social engagement at all levels. There has been a growing recognition of the importance of engagement in both public and wider development, as well as formal recognition of the need to actively address the many challenges that a growing population face.

Empowering community building through a system that integrates with new media can indeed foster a positive perception of the Imam Hussein (a.s) case. By leveraging social media platforms, such a system can disseminate accurate information, facilitate constructive discussions, and encourage engagement among individuals interested in the case. Features like real-time updates, educational content, interactive forums, and user-generated content can help cultivate a sense of community and solidarity among those who share an interest or belief in the significance of Imam Hussein’s legacy. Additionally, the system could promote values

such as compassion, justice, and unity, aligning with the principles associated with Imam Hussein and his message. Through strategic use of social media and technology, this system can play a vital role in shaping positive public opinion surrounding the Imam Hussein case while fostering a connected and empowered community.

Empowering a management organization system by integrating it with social media can be highly beneficial for shaping a positive perception of the Imam Hussein (a.s) case. Systems that could work include (i) Real-time Engagement: The system can link with social media platforms to provide real-time updates on events, discussions, and developments related to the Imam Hussein (a.s) case. This ensures that the management organisation stays informed and can respond promptly to public opinions and concerns. (ii) Community Building: By leveraging social media, the system can facilitate the creation of online communities where individuals interested in the Imam Hussein (a.s) case can connect, share information, and engage in constructive dialogue. This fosters a sense of belonging and solidarity among supporters. (iii) Educational Content: The system can disseminate educational content about the historical significance of Imam Hussein, his principles, and his contributions to Islamic history. This helps to enhance public understanding and appreciation of the case. (iv) Dialogue Facilitation: Through social media integration, the system can host virtual forums, webinars, and Q&A sessions where experts and community members can discuss various aspects of the Imam Hussein (a.s) case. This promotes open dialogue and allows for the exchange of diverse perspectives. (v) Monitoring Public Opinion: The system can monitor social media channels to gauge public sentiment and identify any misconceptions or misinformation circulating about the Imam Hussein case. This enables the management organisation

to address concerns and correct inaccuracies effectively. (vi)Positive Messaging Campaigns: The system can launch targeted social media campaigns aimed at promoting positive messages and narratives about the Imam Hussein (a.s) case. This helps to counter negative perceptions and cultivate a more favourable public opinion.

By leveraging social media integration, the management organisation can effectively harness the power of digital platforms to shape a positive perception of the Imam Hussein case, foster community engagement, and advance its objectives.

For exploring the influence of new media coverage on public opinion in the case of Imam Hussein (a.s), several recommendations can be made such as (i)Interdisciplinary Research Approach: Encourage interdisciplinary collaboration between scholars from fields such as media studies, religious studies, communication, sociology, and cultural studies to provide diverse perspectives and insights into the complex dynamics of new media coverage and public opinion regarding Imam Hussein (a.s). (ii)Longitudinal Studies: Conduct longitudinal studies to track changes and trends in new media coverage and public opinion over time, allowing for a more comprehensive understanding of evolving narratives, patterns, and influences. (iii)Audience Analysis: Conduct audience analysis to better understand the demographics, motivations, and engagement patterns of individuals consuming and participating in discussions related to Imam Hussein (a.s) on new media platforms, helping to tailor communication strategies and interventions effectively. (iv)Content Analysis: Utilize content analysis techniques to examine the tone, framing, and thematic content of new media coverage related to Imam Hussein (a.s), identifying prevalent narratives, representations, and discursive strategies employed by media producers and users.(v)

Comparative Studies: Compare new media coverage and public opinion regarding Imam Hussein (a.s) across different cultural, linguistic, and geopolitical contexts to identify commonalities, differences, and factors shaping variations in narratives and perceptions. (vi) Ethical Considerations: Address ethical considerations related to the portrayal of religious figures in new media environments, including issues of respect, sensitivity, cultural appropriation, and the potential for misinformation or manipulation. (vii) Media Literacy Education: Promote media literacy education initiatives aimed at empowering users to critically evaluate, analyze, and engage with new media content related to Imam Hussein (a.s), equipping them with the skills to navigate complex digital information landscapes responsibly. (viii) Collaboration with Community Stakeholders: Collaborate with religious leaders, community organizations, and digital media influencers within Shia Muslim communities and beyond to co-create research agendas, disseminate findings, and develop community-driven initiatives for fostering informed dialogue and understanding. (ix) Policy Implications: Inform policy discussions and interventions related to digital media regulation, religious representation, and cultural diversity by providing evidence-based recommendations grounded in empirical research on the influence of new media coverage on public opinion regarding Imam Hussein (a.s).

By implementing these recommendations, researchers can contribute to a more nuanced understanding of the influence of new media coverage on public opinion regarding Imam Hussein (a.s), fostering dialogue, empathy, and cultural exchange in digital media spaces.

In conclusion, for a paper exploring the influence of new media coverage on public opinion in the case of Imam Hussein (a.s), we

might want to summarize the findings regarding the role new media played in shaping perceptions about Imam Hussein (a.s). The interplay between new media narratives and public opinion, and acknowledging the complexity of this relationship, highlights both the extent and limits of new media's influence, as well as any changes in public perception that were noted during the period of study. Finally, researchers suggest areas for further research to understand the evolving influence of new media on public opinion in historical and contemporary contexts. It involves empirical studies or content analysis.

This paper reiterates the significance of new media in appropriately presenting Imam Hussein's (a.s) story and the broader Islamic message in a manner resonant with moderation and historical context, highlighting the necessity for Iraqi media to align their representations with the religious significance and ritualistic nature of Imam Hussein's (a.s) cause, especially given the contemporary challenges and ideological complexities across the region. To sum up, the methodological approach of using Focus Group Discussions to gain qualitative insights and consolidate the findings demonstrates new media's dependency and influence on public perception regarding Imam Hussein (a.s).

We must therefore emphasise the originality and value of this research in providing a critical analysis of the intersection between new media and the public's understanding of religious events. Furthermore, the management and policy implications might offer for communication experts and media practitioners seeking to leverage new media to disseminate balanced and educational content. To conclude, by noting the potential positive impact that informed and sensitive new media coverage can have on public opinion and the understanding of Islam and its historical figures like Imam Hussein (a.s), ensures that the essence

and core values of the message are conveyed effectively to both Muslim and global audiences.

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**Detect weapons in crowds of people using  
artificial intelligence**

**Dr. Qasim Jaleel**

**A teacher in the Karbala Education Directorate**

**[qasim.jaleel1984@itnet.uobabylon.edu.iq](mailto:qasim.jaleel1984@itnet.uobabylon.edu.iq)**



## Abstract

Security cameras and video surveillance systems are crucial infrastructures for ensuring the safety and security of the general population. Nevertheless, the identification of high-risk scenarios using these methods is still predominantly carried out manually in several places, particularly in Karbala. Insufficient personnel in the security industry and restricted human capabilities might result in unnoticed dangers or delays in identifying potential threats, so endangering the public during crucial events. As a reaction, many entities have created robotic and automated methods to detect potential dangers by analyzing CCTV footage. The objective of this project is to create an affordable and efficient artificial intelligence (AI) system that can accurately recognize and identify weapons in real-time surveillance films, even in various situations. The system consists of a training phase for the Convolutional Neural Networks (CNNs) using a data set containing images of weapons. The second stage is testing the system, which demonstrated its high ability to detect weapons with high accuracy compared to previous research, the accuracy of the proposed method reached 93%.

**Keywords:** artificial intelligence, CNN, deep learning, machine learning.

## Introduction

Artificial intellect) AI (is the replication of human intellect in computers, which are programmed to imitate cognitive abilities including learning, problem-solving, perception, reasoning, and decision-making(Saxena et al., 2020). Artificial intelligence empowers robots to carry out jobs that have historically relied on human intelligence, including

anything from basic activities such as voice and picture recognition to intricate endeavors like operating self-driving cars, engaging in strategic games, and producing innovative material(Prongnuch & Sitjongsataporn, 2021).

AI comprises a wide array of approaches, algorithms, and procedures with the goal of developing intelligent systems that can comprehend and engage with the environment in a way that resembles human behavior(Ni et al., 2023). AI encompasses several essential elements and specialized areas, such as:

Machine Learning, Deep Learning: Deep learning is a distinct subfield of machine learning that use artificial neural networks with several layers (known as deep neural networks) to acquire intricate patterns from vast quantities of data(Teuwen et al., 2023)since facial landmarks can provide precise AU locations to facilitate the extraction of meaningful local features for AU detection. However, most existing AU detection works handle the two tasks independently by treating face alignment as a preprocessing, and often use landmarks to predefine a fixed region or attention for each AU. In this paper, we propose a novel end-to-end deep learning framework for joint AU detection and face alignment, which has not been explored before. In particular, multi-scale shared feature is learned firstly, and high-level feature of face alignment is fed into AU detection. Moreover, to extract precise local features, we propose an adaptive attention learning module to refine the attention map of each AU adaptively. Finally, the assembled local features are integrated with face alignment feature and global feature for AU detection. Extensive experiments demonstrate that our framework (i.

Deep learning has demonstrated exceptional accomplishments in tasks like as picture and audio recognition, natural language processing, and game playing(Jaleel & Ali, 2022b). Natural Language Processing (NLP) is a specialized branch of Artificial Intelligence (AI) that specifically aims to facilitate computers in comprehending, deciphering, and producing human language(Jaleel & Ali, 2022a). Natural Language Processing (NLP) approaches find use in several domains, including language translation, sentiment analysis, chatbots, and information retrieval(Jaleel & Hadi, 2022). Computer Vision refers to the field of study that focuses on enabling machines to analyze and comprehend visual data, such as photos and videos, by interpreting the information they contain(Wang et al., 2020). Computer vision techniques are employed in several applications, including object identification, facial recognition, medical image analysis, and autonomous driving(Sahu & Dash, 2021).

Convolutional Neural Networks (CNNs) are a type of advanced neural networks specifically developed to handle and examine visual input, such as photos and movies(Teuwen et al., 2023)since facial landmarks can provide precise AU locations to facilitate the extraction of meaningful local features for AU detection. However, most existing AU detection works handle the two tasks independently by treating face alignment as a preprocessing, and often use landmarks to predefine a fixed region or attention for each AU. In this paper, we propose a novel end-to-end deep learning framework for joint AU detection and face alignment, which has not been explored before. In particular, multi-scale shared feature is learned firstly, and high-level feature of face alignment is fed into AU detection. Moreover, to extract precise local features, we propose an adaptive attention learning module to refine the attention map of each

AU adaptively. Finally, the assembled local features are integrated with face alignment feature and global feature for AU detection. Extensive experiments demonstrate that our framework (i. Convolutional Neural Networks (CNNs) have emerged as the most advanced method for a range of computer vision applications, such as picture classification, object identification, segmentation, and others(Milosevic, 2020).

Robotics is the integration of artificial intelligence and mechanical engineering to create and construct intelligent devices, commonly known as robots, that can carry out activities independently or with minimal human intervention. Robotics is used in several fields, including industrial automation, manufacturing, service robots, and autonomous drones(Kim et al., 2023)to defeat their opponents, players need to choose and implement the correct sequential actions. Because RTS games like StarCraft II are real-time, players have a very limited time to choose how to develop their strategy. In addition, players can only partially observe the parts of the map that they have explored. Therefore, unlike Chess or Go, players do not know what their opponents are doing. For these reasons, applying generally used artificial intelligence models to forecast sequential actions in RTS games is a challenge. To address this, we propose depthwise separable convolution-based multimodal deep learning (DESEM).

Video surveillance systems employ cameras and software to observe and document activity inside a specified region. These systems serve several functions, such as ensuring security, promoting safety, and facilitating monitoring. Here is a concise explanation of the functioning of video surveillance systems, Cameras: Video surveillance systems

include of one or more strategically positioned cameras to gather footage of the monitored area(Bhatti et al., 2021)it must ensure a safe and secure environment for investors and tourists. Having said that, Closed Circuit Television (CCTV. Cameras can differ in their kind, such as being fixed or pan-tilt-zoom, as well as in their resolution and capabilities, such as having night vision or infrared imaging(Q. Yang et al., 2020).

**Video Recording:** Cameras collect video footage of the monitored area, which is then saved on a digital video recorder (DVR), network video recorder (NVR), or cloud storage system. The captured video can be retrieved and examined at a later time for the purpose of analysis or as proof(Dolhansky et al., 2020).

**Real-Time Monitoring:** Video surveillance systems not only record but also offer real-time monitoring features, enabling security personnel or operators to observe live video feeds from the cameras. Real-time monitoring allows for prompt action to be taken in response to security risks or incidents as they happen(Albiero et al., 2021).

**Motion Detection and Analytics:** Numerous video surveillance systems are furnished with motion detection technology, which activates recording or notifications when movement is detected inside the camera’s visual range. Advanced systems can employ video analytics algorithms to automatically analyze film and identify certain events or behaviors, such as object detection, facial recognition, and aberrant behavior detection(T. Y. Yang et al., 2019)we employ the soft stagewise regression scheme. Existing feature aggregation methods treat inputs as a bag of features and thus ignore their spatial relationship in a feature map. We propose to learn a fine-grained structure mapping for spatially grouping features before

aggregation. The fine-grained structure provides part-based information and pooled values. By utilizing learnable and non-learnable importance over the spatial location, different model variants can be generated and form a complementary ensemble. Experiments show that our method outperforms the state-of-the-art methods including both the landmark-free ones and the ones based on landmark or depth estimation. With only a single RGB frame as input, our method even outperforms methods utilizing multi-modality information (RGB-D, RGB-Time).

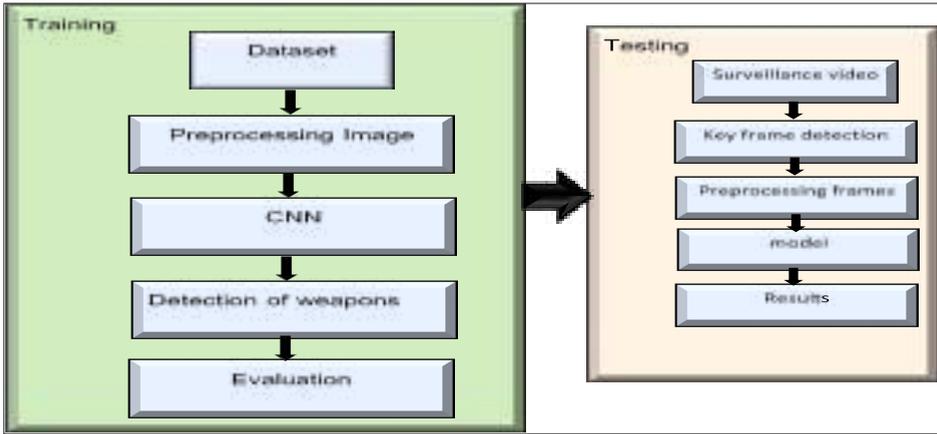
Remote Access: Contemporary video surveillance systems frequently have remote access functionality, enabling authorized users to remotely examine live or recorded video feeds from any location with an internet connection. Remote access allows for the surveillance systems to be monitored and managed from cellphones, tablets, or PCs (Truong et al., 2023). In this paper, modify CNN for detection weapons. Then the CNN network is trained by dataset. And then test the videos by extracting the frames and inserting it into the network for detecting weapons.

## methodology

The system consists of two stages, as shown in the figure (1). The first stage is the stage of building the model and training it on various types of weapons. In the first stage, the image containing various types of weapons is read. The image data is then pre-processed to suit the requirements of the CNN network. After that, the results obtained during the training process are evaluated. The second stage is the testing stage, where the accuracy of the system in the process of detecting weapons is tested. In the second stage, which is the testing stage, the system is tested with new image data that is not included in the training process. This

stage is important because it demonstrates the ability of the proposed system to detect weapons in crowds of people. In addition, the system provides high accuracy in detecting weapons compared to previous methods.

**Figure (1): general structure of the detection model weapons.**



## Dataset

The COCO Dataset, also known as Common Objects in Context, is a widely used dataset in computer vision research. The COCO dataset is a highly popular dataset that is extensively utilized for applications like as object detection, segmentation, and captioning. Its main emphasis is on commonplace things and settings, as shown in figure (2).

## Preprocessing Image

This preprocessing procedure effectively prepares the image dataset for training CNN models. Preprocessing is essential for ensuring that the input data is correctly prepared and standardized, hence enhancing the training process and optimizing the performance of the CNN model.

Figure (2) part of dataset.



## Convolutional Neural Network (CNN) model

To detect weapons, Model CNN was used. This model has the ability to deal with images and videos. In addition to the ability to detect objects such as people, cars, weapons, etc. The number of layers in a Convolutional Neural Network (CNN) for weapon identification can be flexible and influenced by factors like as the complexity of the

detection task, the quantity and variety of the dataset, and the specific architecture being employed.

In the proposed system, the CNN network consists of the following layers: The term “Feature Extraction Layers” refers to a set of layers in a neural network that are responsible for extracting relevant features from input data. The earliest layers of the CNN architecture usually comprise convolutional and pooling layers that are responsible for extracting features from the input pictures.

The phrase “Intermediate Layers” refers to the layers that exist between the input and output layers of a neural network. The intermediate layers in the CNN architecture serve to enhance the retrieved features and capture more intricate representations of the input data. These layers frequently include of supplementary convolutional and pooling layers.

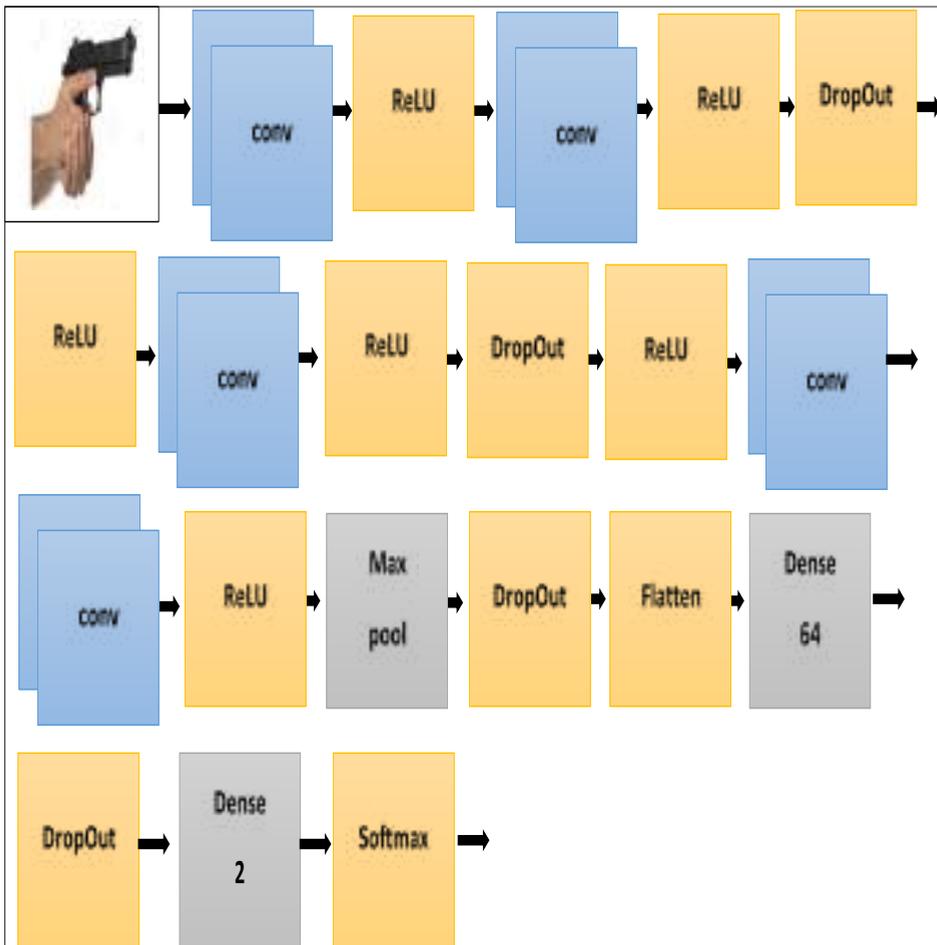
The Localization and Classification Layers are. At the later stages of the CNN architecture, there are usually layers that have the task of identifying the location and category of weapon in the images. The architecture typically consists of convolutional layers, which are then followed by fully connected layers. This design is used to make predictions about the bounding box coordinates and class probabilities for identified weapon.

The output layer is the final layer of a neural network that produces the network’s output or prediction. The output layer of the Convolutional Neural Network (CNN) architecture generates the ultimate predictions for tasks related to weapon detection. The output layer for weapon detection may have neurons that correspond to several categories of weapons, such as firearms and knives, as well as the background.

Figure (3) below illustrates the architecture that it employed for

modify CNN model. Some of the model's hyperparameters include the filter size, which should be 256 for the first convolution layer, 128 for the second, 64 for the third, 32 for the fourth layer, and 16 for final the layer. also using in model, the operation of the pooling layer, whose stride is always set to 1 for both the pooling and convolution layers. It also explained how used ReLU in CNN after each convolution layer. It is using decided to use Max Pooling with a filter size of  $2 \times 2$ .

Figure (3) CNN model.



## Detection of weapons

In the weapons detection phase, the network is trained on various types of weapons. The data set is divided into 70% training data and 30% test data. In the training phase, the data set designated for training is used, which contains various positions, sizes, and shapes of weapons. This stage is considered very important because it is essential for learning about weapons, and the more pictures of weapons there are, the more accurate the system will be.

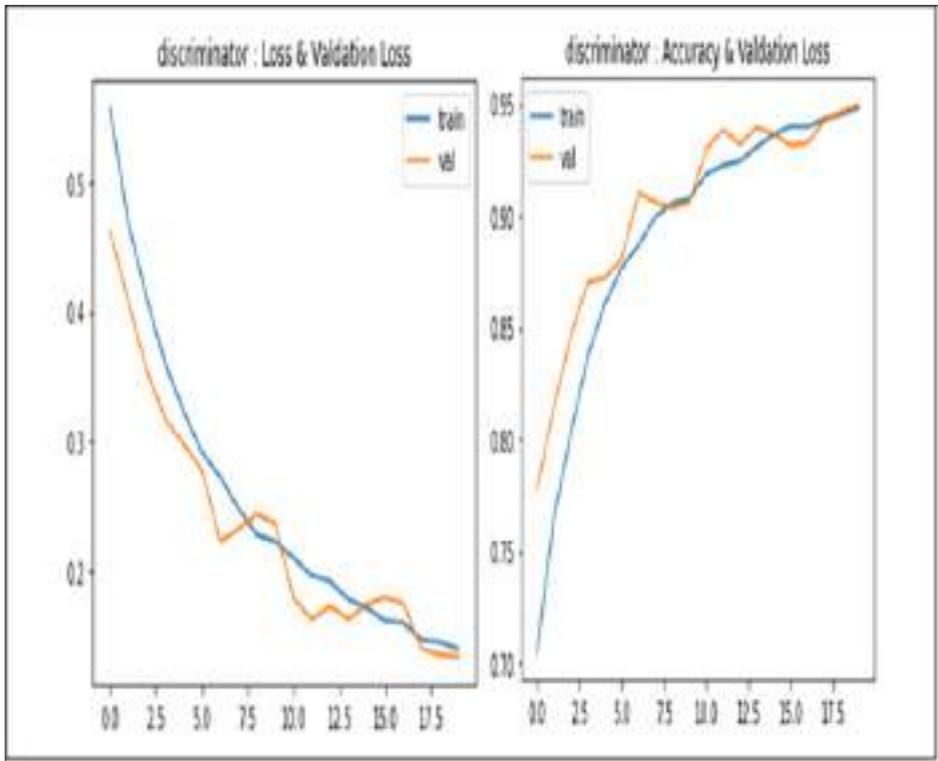
## Evaluation

Evaluating the system is an important stage, whether it is in the training stage or the testing stage. The measure used in the proposed system is accuracy, which is considered one of the most important measures for the Neural network. The figure (4) shows the connection between lost training data and evaluation data, as well as the connection between model loss and accuracy. The figure (5) depicts the confusion matrix for the discrimination model, which shows the distribution of number ratios between weapons and not weapons. The proposed system proved an accuracy of 97% in the training phase, while the accuracy reached 93% in the testing phase.

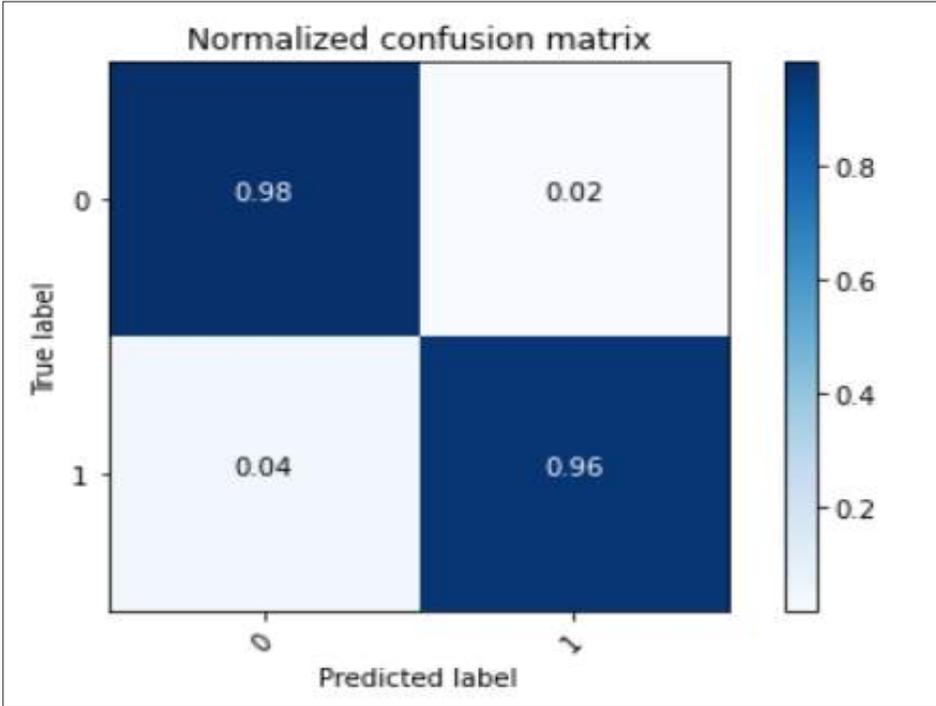
In the testing phase, the mechanism will be different because it will depend on new data that the proposed system was not trained on. The first step is to take the monitored videos, where the videos are divided into frames. Not all frames that enter into the testing process are useful, so a processing is used to extract the frames, which is the Key frame detection. In video processing and analysis, key frame identification is a technique used to pinpoint representative frames within a video stream. These frames are important or representative because they provide important details about the video's content. Applications such as video

summarizing, video indexing, and video browsing can benefit from key frame detection. The calculated similarity scores are used to determine which key frames to use. Key frames are sometimes defined as frames that show notable variances or changes in comparison to their nearby frames. As an alternative, key frames might be chosen on a regular basis to guarantee that the whole video sequence is covered.

**Figure (4)The relationship between the loss, accuracy between train, and validation.**



**Figure (5) Predicted label of the proposal model.**



### Conclusion

The proposed model has proven its ability to detect various types of weapons in a crowd of people. The model was trained on the Coco data set, which contains various types of weapons and is divided into training data and test data. When compared with previous research, we find that the proposed model has the highest detection rate, as in table (1). When using the Model Yolo 4, the accuracy of the system is 91%. Faster R-CNN achieves an average Accuracy of 88%. UZI Model achieves an average Accuracy of 88%. The accuracy of the proposed model in the training phase reached 97%, while in the testing phase it was 93%.

The accuracy of the system depends greatly on the accuracy of the weapons images on which the proposed model is trained. In addition

to the types of weapons presents in the training data set. It is possible to develop the proposed model using other deep learning networks that may increase the accuracy of the proposed model

**Table 1 Comparison Between the Results of The Traditional Methods and The Proposed Method.**

Method type	Accuracy
Yolov4(Bhatti et al., 2021)it must ensure a safe and secure environment for investors and tourists. Having said that, Closed Circuit Television (CCTV	91%
Faster RCNN(Jain et al., 2020)	91%
UZI Model(Jain et al., 2020)	88%
The propose method	93%

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**Bridging Faith and Borders: Unravelling the  
Transformative Role of Women in the Arbaeen Pilgrimage**

**Professor Azra Abidi**

Department of Sociology, Jamia Millia Islamia  
Central University



## Abstract

The Arbaeen pilgrimage stands as one of the most significant and largest annual gatherings in the world, yet its understanding and recognition outside of Shia Islam remains limited. This paper delves into the multifaceted dimensions of the Arbaeen pilgrimage, tracing its origins, evolution, and contemporary significance within the context of Shia Islam. Arbaeen marks the fortieth day after the martyrdom of Husain ibn Ali (a.s), grandson of the Prophet Muhammad (pbuh), in the Battle of Karbala, symbolising the eternal struggle between good and evil and serving as a pinnacle of self-sacrifice in Shia tradition.

Drawing upon historical narratives and religious texts, this research explores the sacred significance of the Arbaeen in Islam and its association with the commemoration of Imam Husain (a.s). It examines the institutionalization of the Arbaeen pilgrimage by Shia Imams, particularly during the post-Umayyad period, and its transformation into a large-scale public gathering despite initial suppression under regimes like that of Saddam Hussein.

The principal aim of this paper is to situate the participation of women in this pilgrimage, who through their participation inverse the logic of patriarchal structures which allegedly prevent them from being at the forefront. They not only participate in this pilgrimage but play a pivotal role in assisting their fellow pilgrims in the completion of the pilgrimage. In doing so, the paper also investigates the logistical aspects of the Arbaeen pilgrimage, such as the routes taken by pilgrims, the provision of free services and accommodations, and the security measures implemented to ensure safety amidst potential sectarian violence. Moreover, it analyses the political dimensions of the pilgrimage,

including its revival after the fall of Saddam Hussein and its role in symbolizing Shia defiance against terrorist oppression and extremism.

Furthermore, this research examines the Arbaeen pilgrimage as a site of solidarity and contention within the Shia community, reflecting both unity against external threats and internal rivalries. By synthesizing historical accounts, contemporary reports, and scholarly analysis, this paper contributes to a deeper understanding of the Arbaeen pilgrimage as a religious, cultural, and socio-political phenomenon with global implications within the Islamic world.

Keywords-Arbaeen pilgrimage, Sacred Significance, Solidarity, Women participation, Socio-political Phenomenon.

## Introduction

The martyrdom of Imam Hussain (a.s) remains a poignant and timeless symbol of the struggle for righteousness and justice. In the face of Yazeed's tyranny, Hussain Ibn Ali (a.s) emerged as a beacon of humanity, championing the cause of the oppressed and embodying the principles of truth and integrity. Even though centuries have passed, the legacy of the seventy-two martyrs of Karbala endures, inspiring people around the world to uphold Hussain's (a.s) teachings and defend the oppressed.

The Arbaeen pilgrimage holds profound significance within Shia culture, serving as a sacred journey of devotion and love to honour Imam Hussain's (a.s) sacrifice. Pilgrims from diverse backgrounds and beliefs converge on Karbala, united in their reverence for Hussain (a.s) and his message. This pilgrimage transcends boundaries of nationality, religion, and sect, symbolizing the universal appeal of Hussain's (a.s) legacy as a unifying force

for humanity.

People of all ages and walks of life participate in the Arbaeen pilgrimage, demonstrating the inclusive nature of Hussain's (a.s) message. Women, children, the elderly, and those with physical challenges make the journey to Imam Hussain's (a.s) shrine, highlighting the universal significance of his sacrifice.

The Arbaeen pilgrimage is not merely a religious ritual but a manifestation of deeply rooted Shia values, reflecting the teachings of the Imams and the principles of compassion, justice, and solidarity. Through their pilgrimage, participants become witnesses and protectors of Hussain's (a.s) martyrdom, embodying the spirit of Hussainiyat - a school of thought that advocates for justice and opposes oppression.

In essence, the Arbaeen pilgrimage serves as a powerful expression of faith, unity, and devotion, reaffirming the enduring legacy of Imam Hussain (a.s) and his companions. It is a testament to the timeless resonance of Hussain's message and his unwavering commitment to truth and righteousness in the face of adversity.

## Significance of Ziyarat in Shia Islam

Ziyarat, rooted in Arabic, encompasses a profound spiritual journey that extends beyond mere physical travel. At its core, it involves visiting sacred sites, particularly the shrines of revered religious figures like prophets, saints, and martyrs. However, Ziyarat is not just about reaching a destination; it's about connecting with the divine presence associated with these sites.

For Shia Muslims, Ziyarat holds deep significance as a spiritual pilgrimage to the shrines of the Holy Prophet and his Ahlul-Bayt

(the family of the Prophet). It symbolizes a journey of faith where believers seek inspiration, purification, and guidance from these revered personalities of Islam. Through Ziyarat, individuals aim to cleanse themselves physically and spiritually, reflecting on their lives and seeking forgiveness for their shortcomings.

The rewards for undertaking Ziyarat, especially visiting the shrine of Imam Hussain (a.s), are believed to be immense, with promises of paradise for those who embark on this pilgrimage. During the sacred month of Rajab, believers are encouraged to undertake this blessed journey, drawing closer to the divine and seeking blessings from the holy shrines.

Ziyarat goes beyond a mere physical journey; it's a transformative experience that touches the soul of the pilgrim. It serves as a reminder of the eternal connection between believers and the divine presence of the Prophet and his Ahlul-Bayt. As individuals embark on this sacred journey, they seek spiritual nourishment, guidance, and blessings, enriching their faith and strengthening their connection with God.

In the company of these holy personalities, believers find solace, inspiration, and a renewed sense of purpose, reaffirming their commitment to the path of righteousness. Thus, Ziyarat is not just a ritual but a deeply meaningful practice that deepens one's faith and spirituality.

### **Significance of Arbaeen Ziyarat**

Arbaeen Ziyarat holds profound significance within Shia Islam, particularly among followers of the Ahlul-Bayt. Arbaeen marks the end of the 40-day mourning period following the martyrdom of Imam Hussain (a.s), the grandson of the Prophet Muhammad (pbuh), at the Battle of Karbala. The pilgrimage to Imam Hussain's (a.s) shrine in Karbala on Arbaeen is one of the largest annual gatherings in the world,

drawing millions of pilgrims from various parts of the globe.

## **The significance of Arbaeen Ziyarat lies in several aspects:**

**Commemoration and Remembrance:** Arbaeen Ziyarat is a solemn occasion to honour and remember the sacrifice of Imam Hussain (a.s) and his companions, who stood against tyranny and injustice. It serves as a powerful reminder of the values of justice, righteousness, and selflessness upheld by Imam Hussain (a.s), inspiring believers to emulate his virtues in their own lives.

**Spiritual Renewal and Reflection:** The pilgrimage to Karbala on Arbaeen provides a unique opportunity for spiritual renewal and reflection. Pilgrims engage in acts of worship, recitation of prayers, and reflection on the teachings of the Ahlul-Bayt. The journey fosters a deep connection with the spiritual legacy of Imam Hussain (a.s) and encourages believers to recommit themselves to the path of righteousness and piety.

**Unity and Solidarity:** Arbaeen Ziyarat is a symbol of unity and solidarity among Shia Muslims and beyond. Regardless of nationality, ethnicity, or social status, millions of pilgrims come together in a display of solidarity, demonstrating the universal appeal of Imam Hussain's message of justice and compassion. The pilgrimage fosters a sense of community and brotherhood, transcending geographical and cultural boundaries.

**Witness to Resistance:** Arbaeen Ziyarat also serves as a powerful expression of resistance against oppression and tyranny. The sheer magnitude of the pilgrimage, despite challenges and obstacles, reaffirms the enduring relevance of Imam Hussain's struggle and the continued

demand for justice and freedom in the face of adversity.

Overall, Arbaeen Ziyarat is a deeply significant and spiritually enriching event that reinforces the enduring legacy of Imam Hussain (a.s) and the principles for which he sacrificed his life. It is a testament to the resilience, devotion, and unwavering commitment of believers to uphold the values of justice, compassion, and righteousness.

#### Importance of Arbaeen Pilgrimage in Shia Imams Hadiths

The significance of visiting the shrine of Imam Hussain (a.s) and the rewards associated with it are emphasized in numerous hadiths narrated by Shia Imams. These hadiths highlight the spiritual benefits and blessings bestowed upon pilgrims who undertake the journey to Imam Hussain's (a.s) shrine, particularly during the Arbaeen pilgrimage.

Imam Baqir (a.s) underscores the abundance of rewards granted by Allah (swt) to the pilgrims of Imam Hussain (a.s), suggesting that if people truly understood the magnitude of these rewards, they would be overwhelmed with excitement and enthusiasm. Imam Sadiq (a.s) further emphasizes the divine blessings bestowed upon those who visit the shrine of Imam Hussain (a.s), equating the rewards to those performing both Hajj and Umrah, two significant pilgrimages to the Kaaba.

Moreover, Imam Sadiq (a.s) stresses the importance of visiting the grave of the oppressed, referring to Imam Hussain (a.s), and highlights the significance of this act for those seeking paradise as their ultimate abode. The hadith attributed to Imam Hassan al-Askari (a.s) identifies visiting the shrine of Imam Hussain (a.s) on Arbaeen as one of the signs of faith, alongside other religious practices. This underscores the importance of the Arbaeen pilgrimage in Shia Islam, drawing millions of devotees from various faith backgrounds to pay homage to Imam Hussain (a.s).

The Arbaeen pilgrimage serves as a manifestation of the teachings and values upheld by Imam Hussain (a.s), particularly the principles of help, dedication, and resistance against oppression and tyranny. The generosity and communal spirit displayed by the Iraqi people during this pilgrimage exemplify the ideals of Imam Hussain's message, fostering a society characterized by unity, compassion, and solidarity.

Imam Hussain's (a.s) sacrifice serves as a powerful example for humanity, highlighting the importance of standing against injustice and oppression, regardless of one's background or status. His legacy inspires individuals to strive for a world characterized by peace, justice, and compassion, where every individual is valued and respected.

Ultimately, the lessons derived from Imam Hussain's sacrifice and the Arbaeen pilgrimage transcend religious and cultural boundaries, offering a universal message of hope, resilience, and the pursuit of righteousness.

## The History of Arbaeen

The historical significance of the Arbaeen pilgrimage, particularly in Shia culture, is deeply rooted in the commemoration of Imam Hussain's (a.s) sacrifice at the Battle of Karbala. The journey to Karbala to pay homage to Imam Hussain (a.s) and his companions has evolved into a cornerstone of Shia faith and a manifestation of profound devotion and love.

Jabir Ibn Abdullah Ansari, a companion of Prophet Muhammad (pbuh), is believed to be one of the earliest pilgrims to visit the grave of Imam Hussain (a.s). His pilgrimage symbolizes the enduring reverence and devotion shown by followers of the Ahlul-Bayt towards Imam Hussain (a.s) and his legacy.

The Arbaeen pilgrimage draws devotees from diverse backgrounds, including men, women, children, the elderly, and the physically challenged, transcending boundaries of nationality, religion, and sect. It serves as a unifying force, bringing together people from different ideologies under the banner of Imam Hussain's (a.s) message of justice and compassion.

Many pilgrims undertake the journey to Karbala on foot, walking long distances from cities like Najaf to reach the shrine of Imam Hussain (a.s). This physical exertion is seen as a testament to their love and devotion, guided by the spiritual pull of "Ishq Hussain," the love for Imam Hussain (a.s).

The hospitality extended by the people of Iraq towards pilgrims during the Arbaeen pilgrimage is noteworthy. Iraqi families open their homes and provide food, shelter, and other necessities to the visitors, considering it an honour to serve the pilgrims of Imam Hussain. This generosity reflects the spirit of selflessness and compassion embodied by Imam Hussain himself.

Women play a significant role in the Arbaeen pilgrimage, actively participating in providing services to pilgrims alongside men and children. Their involvement challenges societal norms and promotes the assimilation of women into communal activities, breaking barriers of gender inequality.

Overall, the Arbaeen pilgrimage is not just a physical journey but a spiritual experience filled with devotion, love, and solidarity. It symbolizes the timeless legacy of Imam Hussain and his eternal message of standing against oppression and injustice, inspiring millions of believers worldwide to uphold the values of compassion, unity, and selflessness.

## Lady Zeinab (AS) as a Beacon of Arbaeen Tradition

Hazrat Zainab (a.s) indeed transcends her familial roles to become a symbol of resilience, courage, and empowerment for all women. Her unwavering commitment to justice and truth, even in the face of adversity, serves as a timeless inspiration.

Following her release from captivity by Yazid, Zainab (a.s) returned to Karbala on the day of Arbaeen, hoping to find some trace of her beloved brother Imam Hussain (a.s) and his companions. Despite the devastation of the battlefield, Zainab (a.s) carried with her the belief that one day a shrine would be erected in honour of Hussain and his followers, a place where people could pay homage to their sacrifice.

Over time, despite attempts by rulers to suppress the memory of Hussain and destroy his shrine, the number of pilgrims visiting Karbala continued to grow. Zainab's (a.s) faith and perseverance, coupled with the enduring love and devotion of Hussain's (a.s) Shia followers, ensured that his legacy would not be forgotten.

The pilgrimage to Imam Hussain's (a.s) shrine on Arbaeen is a testament to Zainab's (a.s) enduring influence and the universal appeal of Hussain's (a.s) message of justice and compassion. It is a reminder that the sacrifices made by Hussain and his companions continue to resonate across generations, inspiring people from all walks of life to stand against oppression and uphold the values of truth, righteousness, and humanity.

### Review of Literature:

Manveer Singh, "Arbaeen - Heaven on Earth (Arbaeen Ziyarat)" (2020): Singh's book provides a firsthand account of the author's

experience during the Arbaeen pilgrimage in 2019, documenting the journey from Najaf to Karbala. Through vivid imagery and personal reflections, Singh captures the spiritual essence of the pilgrimage, emphasizing acts of service and solidarity among pilgrims. The book serves as a testament to the transformative power of the pilgrimage experience and the profound impact it has on participants.

Umme Salma Mujtaba Husein, “A phenomenological study of Arbaeen foot pilgrimage in Iraq” (2018): Husein’s study explores the motivations and experiences of foot pilgrims during the Arbaeen pilgrimage, employing a phenomenological approach. The findings highlight the significance of perpetual rituals and societal concerns as driving factors for participants. The study underscores the religious, bodily, and humanitarian aspects of the pilgrimage experience, offering insights for future planning and policy development.

Ian Reader, “Pilgrimage growth in the modern world: Meanings and implications” (2007): Reader’s article examines the contemporary growth of pilgrimages worldwide, with a focus on examples from diverse religious traditions. The article highlights the modern factors contributing to pilgrimage growth, including the emergence of new pilgrimage sites and the repudiation of organized religion by some modern pilgrims. The reader’s analysis sheds light on the evolving nature of pilgrimage practices in the modern era.

Soodeh Mansouri, “Arbaeen Walk: From Sectarian Ritual to Global Pilgrimage Modification in Interpretation & Function” (2024): Mansouri’s text explores the evolution of the Arbaeen pilgrimage from a sectarian ritual to a global phenomenon with cultural, socio-political, and religious significance. The text traces the historical context of the pilgrimage and its transformation following the US invasion of Iraq in 2003. Mansouri argues that the pilgrimage’s immense scale and inclusivity reflect its

broader cultural, social, and political dimensions.

Tahereh Khazaei, Mohammadtaghi Karami Ghahi, “From De Ritualization to Ritualization: The Arbaeen Walk Based on the Experience of Female Iranian Pilgrims” (2024): Khazaei and Ghahi’s paper examines the Arbaeen pilgrimage from the perspective of female Iranian pilgrims, employing thematic analysis of semi-structured interviews. The study identifies key themes, including the pilgrim’s body, identification with historical suffering, and the feeling of sin. The paper highlights the ritualization of the Arbaeen pilgrimage and its significance for participants.

Alex Shams, “The Politics of Arbaeen: Transcending Militarized Urbanism in Iraq’s Shrine Cities” (2023): Shams’ article explores the political dimensions of the Arbaeen pilgrimage in post-invasion Iraq, emphasizing its role as a space of solidarity and resistance. The article contrasts the militarized urbanism imposed by external forces with the inclusive ethos of the pilgrimage. Shams argues that Arbaeen offers a vision of alternative urbanism grounded in equality and communal care.

Sophia Rose Arjana, “Pilgrimage in Islam: Traditional and Modern Practices” (2017): Arjana’s work expands the discourse on Islamic pilgrimage beyond the traditional focus on Hajj, highlighting the significance of lesser-known pilgrimages like Arbaeen. By exploring diverse pilgrimage practices within Islam, Arjana challenges common assumptions and promotes inclusivity in scholarly discourse. Her work enriches our understanding of the diverse religious expressions within Islam.

Overall, the reviewed literature offers valuable insights into the Arbaeen pilgrimage, spanning from personal narratives to scholarly analyses. These works collectively contribute to a deeper understanding of the pilgrimage’s significance, its evolution over time, and its broader

socio-political implications.

## Research Methodology

The research methodology employed in this study aimed to comprehensively investigate the participation of women in the Arbaeen pilgrimage, focusing on their roles, experiences, and the broader significance of their involvement. The principal aim was to challenge patriarchal structures by highlighting the active participation of women in this religious journey and to understand the dynamics of their engagement. The study utilized qualitative methods, primarily through in-depth interviews with 50 Shia Muslim women who had undertaken the Arbaeen pilgrimage on foot from Najaf to Karbala.

**Sampling Strategy:** Purposive sampling was employed to gather information from women aged between 20 and 55, belonging to the middle class, and who had participated in the Arbaeen pilgrimage at least once or at most four times. The selection criteria aimed to capture diverse perspectives while ensuring a focus on women with direct experience of the pilgrimage.

**Data Collection:** Data was collected through semi-structured interviews conducted in Lucknow and Delhi, focusing on participants' motivations, challenges, roles during the pilgrimage, experiences of assisting fellow pilgrims, interactions with other female pilgrims, and reflections on the significance of the journey. The qualitative approach allowed for a detailed exploration of participants' narratives and perspectives, enriching the understanding of their lived experiences.

## Analysis and Key Findings of Research

The following section presents a detailed examination of the data gathered during the research study, aiming to identify and uncover insights and trends relevant to my research question that shed light on my research objectives. These are-

### 1-Why did you go on the Arbaeen pilgrimage?

Response-Shia women participate in the Arbaeen pilgrimage, alongside men, due to its profound religious, cultural, and spiritual significance in Shia Islam. Honouring the martyrdom of Imam Hussein (a.s), the pilgrimage serves as a devout expression of faith and a commemoration of his sacrifice. Additionally, it fosters a sense of community and solidarity among Shia Muslims, providing women with a platform to connect with fellow believers and strengthen their bonds within the faith. Beyond communal unity, the pilgrimage offers an opportunity for spiritual purification, reflection, and the seeking of blessings and intercession, aligning with the core tenets of Shia belief and practice. Therefore, women partake in the Arbaeen pilgrimage to engage deeply with their religious heritage, nurture their spiritual growth, and reaffirm their devotion to Imam Hussein (a.s) and the Shia tradition.

### 2-Did you face any kind of difficulty while doing the Arbaeen pilgrimage?

Response: The spiritual significance of the pilgrimage, and the devotion of participants often serve as sources of strength, enabling women to overcome obstacles and fully engage in this deeply meaningful religious journey.

### **3-What was your role as a woman in this pilgrimage?**

Response: The role of women in the Arbaeen pilgrimage is multifaceted and significant. While the specific roles may vary depending on cultural and personal circumstances, women play essential roles in various aspects of the pilgrimage. Overall, women play diverse and integral roles in the Arbaeen pilgrimage, contributing to its spiritual, cultural, and social dimensions while embodying the values of faith, compassion, and solidarity.

### **4-How many old women or physically weak women did you help in this pilgrimage?**

Response: It is common for volunteers and fellow pilgrims to offer assistance to those in need, including older individuals and those with physical limitations. This assistance may range from providing physical support, such as helping them walk or navigate crowded areas, to offering emotional support and ensuring their well-being throughout the journey. The spirit of communal support and solidarity during the Arbaeen pilgrimage often results in many women, regardless of age or physical condition, receiving the help they need to participate in this significant religious event.

### **5-How did you feel about helping women?**

Response: Women pilgrims who assist others during the Arbaeen pilgrimage likely experience a sense of fulfilment, empathy, and solidarity. By offering support to fellow pilgrims, especially women who may be older or physically weak, they embody the values of compassion and community central to the pilgrimage experience. This act

of service allows them to connect with others on a deeper level, fostering bonds of empathy and understanding across diverse backgrounds and circumstances. Additionally, assisting others may strengthen their sense of purpose and spirituality, as they actively embody the teachings of compassion and selflessness inherent in the pilgrimage journey. Overall, helping women during the Arbaeen pilgrimage is likely to evoke feelings of empathy, solidarity, and spiritual fulfilment among women pilgrims, enriching their own experience of the pilgrimage.

### **6-Would you like to give some message to the upcoming pilgrims?**

Response: The message from women who have participated in the Arbaeen pilgrimage have emphasizes the importance of embracing the journey with compassion, resilience, and a commitment to spreading peace and unity. Top of Form

### **7-Did you interact with female pilgrims from another country?**

Response: Yes, women pilgrims often interact with female pilgrims from other countries during the Arbaeen walk. The pilgrimage to Karbala for Arbaeen attracts millions of Shia Muslims from around the world, creating a diverse and vibrant community of pilgrims. Women from different countries may come together during the journey, sharing stories, experiences, and prayers as they walk towards the holy city of Karbala. These interactions foster a sense of camaraderie, unity, and solidarity among female pilgrims, transcending geographical boundaries and cultural differences. Such exchanges can be deeply enriching, allowing

women to connect with others who share their faith and devotion to Imam Hussein, strengthening their bonds as members of the global Shia Muslim **community**.

### **8-Do you think Hazrat Zainab (a.s) had any contribution for this form of Arbaeen?**

Response: Women pilgrims of Arbaeen often recognize Hazrat Zainab’s (a.s) significant contribution to the commemoration and preservation of the tragedy of Karbala, which plays a crucial role in the observance of Arbaeen. Hazrat Zainab (a.s), the sister of Imam Hussein (a.s), played a pivotal role in conveying the message of Karbala to the wider Muslim community through her eloquent sermons and steadfastness in the face of adversity. Her courage, resilience, and unwavering commitment to justice have inspired generations of Shia Muslims, including women pilgrims participating in the Arbaeen pilgrimage. Many women pilgrims see Hazrat Zainab (a.s) as a symbol of female empowerment and leadership, whose actions and teachings continue to resonate profoundly during the Arbaeen pilgrimage and beyond. Therefore, they acknowledge her enduring influence on the commemoration of Arbaeen and the perpetuation of the values of truth, justice, and devotion to the Ahl al-Bayt (the family of the Prophet Muhammad).

### **9-Did you feel excluded from any front in the Arbaeen pilgrimage being a woman?**

Response: While women pilgrims play significant roles in the Arbaeen pilgrimage, there may be instances where they feel excluded or face challenges due to their gender. In some contexts, cultural norms or logistical limitations may result in women having less visibility or

access to certain areas during the pilgrimage. For example, crowded spaces or limited facilities could present challenges for women in terms of safety, comfort, or accessibility. Additionally, there may be instances where women's voices and perspectives are not fully represented or heard within the broader pilgrimage community. Despite these challenges, many women pilgrims actively participate in the Arbaeen pilgrimage, finding ways to navigate and overcome obstacles while contributing meaningfully to the commemoration of Imam Hussein's martyrdom. Efforts to address gender inclusivity and ensure the full participation of women in all aspects of the pilgrimage experience are ongoing and important for fostering a more equitable and inclusive environment for all pilgrims.

## 10-How many kilometres did you walk in a day?

Response: The distance women walk each day during the Arbaeen pilgrimage from Najaf to Karbala can vary depending on various factors, including their physical condition, pace, and rest stops. The distance between Najaf and Karbala is approximately 80 kilo meters (about 50 miles), and the pilgrimage typically takes several days to complete on foot. Some women may walk shorter distances each day, while others may cover longer distances, depending on their circumstances and preferences. Additionally, factors such as weather conditions and crowd density along the route can also influence the pace of the pilgrimage. Overall, women pilgrims often undertake a challenging journey, walking significant distances each day to reach their destination in Karbala and participate in the commemoration of Arbaeen.

## 11-Did you help each other in the Mowkib?

Response: Yes, women pilgrims often help each other in Mowkib (rest areas) during the Arbaeen pilgrimage. Mowkibs are temporary camps or facilities set up along the pilgrimage route where pilgrims can rest, eat, and receive various services. In these communal spaces, women pilgrims may offer assistance to one another in various ways, such as sharing food and water, providing emotional support, helping with basic needs, and looking out for each other's well-being. The spirit of solidarity and mutual support is an integral part of the Arbaeen pilgrimage experience, and women pilgrims frequently engage in acts of kindness and cooperation within the Mowkib as they journey together towards Karbala.

## 12-What message does Arbaeen give you?

1. **Response:** Arbaeen carries several powerful messages for women participating in the pilgrimage:
2. **Strength in adversity:** Arbaeen commemorates the resilience and steadfastness of Imam Hussein (a.s) and his companions in the face of oppression and injustice. For women, this serves as a reminder of their strength and resilience in overcoming challenges and standing firm in the face of adversity.
3. **Community and solidarity:** The massive turnout for Arbaeen demonstrates the power of communal unity and solidarity. Women participating in the pilgrimage are reminded of the strength that comes from coming together with fellow believers, supporting one another, and fostering a sense of community.

**4. Empowerment and agency:** Arbaeen celebrates the legacy of figures like Hazrat Zainab (a.s), who played a crucial role in preserving and propagating the message of Karbala. Women are inspired to embrace their own agency and leadership roles, recognizing their ability to make meaningful contributions to their communities and society at large.

**5. Spiritual devotion:** Arbaeen is a deeply spiritual experience for participants, offering an opportunity for reflection, prayer, and connection with the Divine. Women are encouraged to deepen their spiritual practice and devotion, drawing inspiration from the teachings and sacrifices of Imam Hussein (a.s) and his family.

**6. Social justice and compassion:** The message of Arbaeen extends beyond religious boundaries to encompass themes of social justice, compassion, and empathy. Women pilgrims are called to embody these values in their interactions with others, advocating for justice and compassion in their communities and the wider world.

**7. Overall,** Arbaeen provides women with a powerful platform for spiritual growth, communal solidarity, and empowerment, while also imparting timeless lessons of resilience, compassion, and social justice. Top of Form Bottom of Form

### **13-What is the social, cultural, and political significance of the Arbaeen pilgrimage for women in the contemporary era?**

**1. Response:** In the contemporary era, the Arbaeen pilgrimage continues to hold significant social, cultural, and political significance

**for women. I have gathered the responses from women as follows:**

**2. Social significance:** Arbaeen serves as a powerful platform for women to connect, bond, and express their religious devotion in a communal setting. In an increasingly interconnected world, the pilgrimage offers women the opportunity to form diverse networks, share experiences, and build solidarity across cultural and geographical boundaries. It provides a space for women to assert their agency, voice their concerns, and advocate for issues that are important to them within the context of their faith community.

**3. Cultural significance:** Arbaeen remains deeply ingrained in Shia Islamic culture and tradition, serving as a means of preserving and transmitting religious and cultural heritage to future generations. In the contemporary era, women play an active role in shaping and evolving the cultural practices associated with the pilgrimage, incorporating new forms of expression, technology, and communication into the tradition. The pilgrimage serves as a dynamic cultural phenomenon that continues to evolve and adapt to changing social and technological landscapes while retaining its core spiritual and historical significance.

**4. Political significance:** In the contemporary era, the Arbaeen pilgrimage has become increasingly politicized, with participants using the event as a platform for political expression and activism. Women, like men, engage in political discourse and advocacy during the pilgrimage, raising awareness about social justice issues, human rights violations, and political oppression affecting their communities. The sheer scale and visibility of the Arbaeen pilgrimage make it a potent tool for political mobiliza-

tion and protest, challenging existing power structures and advocating for change.

**5. Overall, in the contemporary era,** the Arbaeen pilgrimage continues to serve as a multifaceted phenomenon with profound social, cultural, and political significance for women. It provides a space for women to assert their identities, express their beliefs, and advocate for their rights within the context of their religious community, while also contributing to broader social and political movements for change.

#### **14-What aspect of the Arbaeen pilgrimage would you like to explore further?**

Response: One intriguing aspect of the Arbaeen pilgrimage is the diverse participation of people from various backgrounds, religions, and cultures. It's fascinating to explore how individuals from different parts of the world come together to pay homage to Imam Hussain (a.s) and participate in this deeply spiritual journey. Additionally, the logistical aspects of organizing such a massive pilgrimage, including accommodation, transportation, and crowd management, offer insights into the dedication and effort put forth by both pilgrims and local communities.

## Significance of present Research:

The research methodology and analysis offer valuable insights into the participation of women in the Arbaeen pilgrimage, shedding light on their roles, experiences, and the broader significance of their involvement. By citing the narratives of women pilgrims, the study enriches our understanding of their contributions to this religious tradition and underscores the need for gender-inclusive approaches in religious practices and rituals.

The research underscores the importance of recognizing and amplifying the voices and experiences of women in religious practices traditionally dominated by patriarchal structures. By challenging gender norms and actively participating in the Arbaeen pilgrimage, women assert their agency, resilience, and commitment to their faith. Moreover, the study highlights the broader social, cultural, and political significance of the pilgrimage for women in the contemporary era, serving as a platform for cultural expression, solidarity, and activism.

## Conclusion

The Arbaeen pilgrimage represents more than a mere religious journey; it symbolizes a profound testament to the enduring legacy of Imam Hussain (a.s) and the timeless values he embodied. As Shia Muslims converge on Karbala to honour his sacrifice, they also manifest the principles of unity, compassion, and resistance against oppression that Imam Hussain exemplified.

Women, in particular, play a crucial role in perpetuating these values during the pilgrimage. Their acts of solidarity and compassion transcend cultural and geographical boundaries, reflecting the universal message

of Imam Hussain's sacrifice. Through their selfless assistance to fellow pilgrims, irrespective of differences, women embody the essence of the pilgrimage—an embodiment of unity and communal support.

Central to the pilgrimage narrative is the defiance against oppression, epitomized by Imam Hussain's (a.s) stand at Karbala. His message resonates universally, inspiring individuals to confront injustice and uphold the sanctity of human life. This ethos of resistance against tyranny is not confined to history but reverberates through contemporary struggles for justice and equality worldwide.

Lady Zeinab (a.s), Imam Hussain's (a.s) sister, emerges as a timeless symbol of resilience and activism. Her unwavering courage in the face of adversity serves as a beacon for women, reminding them of their potential to effect societal change and uphold principles of justice and enlightenment.

In conclusion, the Arbaeen pilgrimage transcends religious boundaries to embody universal values of compassion, unity, and resistance against oppression. It stands as a testament to the enduring legacy of Imam Hussain and the timeless message he imparted—an ethos that continues to inspire individuals worldwide to strive for a more just, compassionate, and united world.

## Labbaik Ya Hussain

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