

Technical Services for Organizing Crowds, Provided to Pilgrims, During Hajj Season

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Abstract: The study aims to Identify Technical Services (Expert Systems, Neural Networks, Genetic Algorithms) in Provided to Pilgrims, During Hajj Season, and to measure the impact of Technical Services in Organizing Crowds on developing services Provided to Pilgrims, during Hajj season, the study based on qualitative method depending on questionnaire that was applied on 103 administrative workers in Administration of the affairs of the Grand Mosque in Makkah. The study concluded that there is a high degree of estimation for artificial intelligence in the Administration of the Affairs of the Grand Mosque in Makkah, where it was found through the study that expert systems was in the first rank, followed by genetic algorithms, then neural networks, where all of these dimensions had a high degree of assessment, depending on results the study came up with recommendations the most important of which employing artificial intelligence to organize crowds more in the Administration of the Affairs of the Grand Mosque in Makkah the study shows that the application of artificial intelligence has an important impact on the organization and management of crowds.

Keywords: Technical – Services – Organizing – Crowds – Pilgrims – Hajj.

الخدمات الفنية لتنظيم الحشود المقدمة للحجاج خلال موسم الحج

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المستخلص: تهدف هذه الدراسة إلى التعرف على الخدمات الفنية (الأنظمة الخبيرة، والشبكات العصبية، والخوارزميات الجينية) المقدمة للحجاج خلال موسم الحج، وقياس أثر الخدمات الفنية في تنظيم الحشود على تطوير الخدمات المقدمة للحجاج خلال موسم الحج. اعتمدت الدراسة على المنهج النوعي بالاعتماد على الاستبيان الذي تم تطبيقه على 103 من العاملين الإداريين في إدارة شؤون المسجد الحرام بمكة المكرمة، وخلصت الدراسة إلى وجود درجة عالية من التقدير للذكاء الاصطناعي في إدارة شؤون المسجد الحرام بمكة المكرمة، حيث تبين من خلال الدراسة أن النظم الخبيرة جاءت في المرتبة الأولى، تلتها نظم الخوارزميات الجينية، ثم الشبكات العصبية، حيث كانت كل هذه الأبعاد تتمتع بدرجة عالية من التقييم، واعتماداً على النتائج خرجت الدراسة بعدة توصيات، أهمها توظيف الذكاء الاصطناعي لتنظيم الحشود بشكل أكبر في إدارة شؤون المسجد الحرام بمكة المكرمة، كما بينت الدراسة أن تطبيق الذكاء الاصطناعي له تأثير مهم على تنظيم وإدارة الحشود.

الكلمات المفتاحية: فنية - خدمات - تنظيم - حشود - حجاج - حج.

Introduction

{وَأَذِّنْ فِي النَّاسِ بِالْحَجِّ يَأْتُوكَ رِجَالًا وَعَلَى كُلِّ ضَامِرٍ يَأْتِينَ مِنْ كُلِّ فَجٍّ عَمِيقٍ} [الحج: ٢٧]

Hajj is the fifth pillar of Islam, and its reward is great, as the Messenger, may God's prayers and peace be upon him, told us. Whoever makes a pilgrimage to God and does not spoil his return without sins. Therefore, the service of pilgrims and immigrants is one of the finest services that the Kingdom is proud to provide, and it makes every effort to ensure that the needs of pilgrims are covered and providing them with facilities.

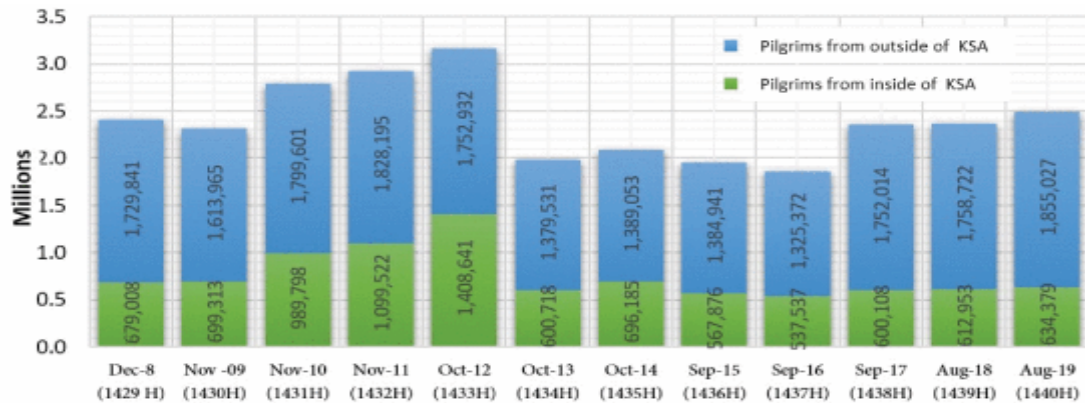


Figure (1) figure 1 illustrates the number pilgrims during (2008 - 2019) in Kingdom of Saudi Arabia

Each year, only about 2 million Muslims out of 1.8 billion people (0.11%) are able to perform a pilgrimage, mainly due to cost, physical capacity and time constraints. Over the past 10 years, Saudi Arabia has hosted 23.97 million pilgrims from all over the world. Figure 1 shows the number of pilgrims for this period, with the blue part of the bars showing the local pilgrims and the green part showing the international pilgrims (Ahmed, 2020, p. 19).

Development and evaluation of considered crowd management plans in sacred emotions after each pilgrimage season, use of previous crowd management studies and extensive use of available techniques to reach effective and distinctive solutions. The aim of the research is to provide a spiritual transformative experience for Rahman's guests by facilitating and facilitating the process of hosting more pilgrims, setting up sites in a way that ensures that the religious experience of pilgrims is not crowded and enriching the religious experience of pilgrims (Vrontis & Pereira, 2022, p. 44).

During the event of Hajj, masses of pilgrims gather in Makkah making it one of the largest gatherings in the world. Several challenges arise while managing such a huge number of people. Hajj is the most crowded gathering of Muslims on earth. It has unique characteristics with regard to the people who attend it pilgrims, the place they meet in, and the kind of rituals they perform. These characteristics result in a set of challenges in controlling the crowd, and identifying the personalities. This matter requires those in charge of managing the affairs of the Grand Mosque in Makkah Al-Mukarramah to pay more attention to the increase in the number of pilgrims and what follows in order to secure all their various requirements and needs related to the safety and security of the crowds, providing a safe environment for them, and other requirements (Ahmed & Saleh, 2018, p. 37).

The Problem Statement:

It is noticeable that, despite the modern technology and its introduction and development, there is a dearth of studies that deal with this, the problem of the current study lies in identifying Technical Services for Organizing Crowds, Provided to Pilgrims, During Hajj Season (Mahdi, 2019, p. 35). The problem of the study is determined in answering the following questions:

- 1- What is the extent of reliance on Technical Services (Expert Systems, Neural Networks, Genetic Algorithms) in Provided to Pilgrims, During Hajj Season?
- 2- What is the impact of Technical Services for Organizing Crowds on developing services Provided to Pilgrims, during Hajj season?

Objectives of the study:

The study seeks to achieve the following objectives:

- 1- To Identify Technical Services (Expert Systems, Neural Networks, Genetic Algorithms) in Provided to Pilgrims, During Hajj Season

- 2- To measure the impact of Technical Services in Organizing Crowds on developing services Provided to Pilgrims, during Hajj season?

Hypotheses of the study:

- 1- There is a statistically significant effect at the significance level (α 0.05) of artificial intelligence in its combined dimensions on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah.
- 2- There is a statistically significant effect at the significance level ($\alpha \leq 0.05$) of artificial intelligence in terms of expert systems on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah.
- 3- There is no statistically significant effect at the significance level (α 0.05) of artificial intelligence in terms of neural networks on the development of crowd management services in the Administration of the Grand Mosque in Makkah.
- 4- There is no statistically significant effect at the significance level (α 0.05) of artificial intelligence in terms of genetic algorithms on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah.

The Significant of the study:

The study has theoretical and apply Significant, as follows:

Theoretical Significant:

The theoretical importance of research stems from:

- 1- The scarcity of studies that dealt with the topic of the current research despite its importance.
- 2- From the current research, the researcher hopes to enrich the local and Arabic scientific library with a study concerned with services provided to Pilgrims, during Hajj season, through theoretical literature and field studies.

1-3-2 Practical significance:

The applied research importance stems from:

1. The Kingdom's orientation towards developing services provided to Pilgrims, during Hajj season, in a modern, distinguished and modern way to achieve the desired development.
2. The study would benefit those in charge of Hajj and its organization in finding one of the important ways to develop their services in crowd management.

Previous Studies:

Mohaneds et al. 2018, developed a system for tracking and identifying pilgrims during Hajj season by using mobile phones. It uses mobile phones that equipped with a Global Positioning System (GPS), which is available with pilgrims. In addition, the authors developed a second system, which is a small mobile sensor unit that could be given to each pilgrim and to be attached on his/her Hajj clothes. This sensor includes a GPS chip, a microcontroller, battery and antenna. In both ways, the mobile phone or the mobile sensor sends its ID number, latitude, longitude and time. Therefore, these are location information of the pilgrims will be revealed on a Google map or a similar geographical information system by using map server.

Mohamed et al. 2019, proposed an IoT based framework that is smart and efficient in terms of crowd time management. It allows users to interact through mobile devices. The interface layer of the proposed framework captures users' sensory data from their mobile devices, followed by a management layer, which extracts the information from the collected data and serves users with vital information about open roads and passages, locating non-crowded areas their groups and friends. An expert crowd monitoring and management IoT-based framework was presented by Nasser et al. which is designed to predict possible problems by monitoring the paths leading to the location of the rituals.

Islam et al. 2019, presented an IoT-based Crowd congestion and stampede avoidance approach that uses a combination of different sensors and machine learning-based WEMOS D1. E-writes belts were proposed to collect data from pilgrims in real-time and predict the possible risk of a stampede.

Haase et al. 2019, presented an operational research-based decision support system for crowd management. This system provided a scheduling tool and a real-time video tracking system (video-based counting system VBCS), to ensure an uncongested and

smooth flow of pilgrims and provide real-time statistics for an early warning system. The system was proved to be effective in stopping the tragic loss of human lives and there was no massive disaster reported from 2007 to 2014.

Felemban et al. 2021, presented a scheduling process to facilitate pilgrims' movement between holy sites, i.e., Mina, Muzdalifah and Arafat using trains. The optimized scheduling technique considers train movement plans, train capacity, train stations' capacity, roads allowed to/from camps-stations, road capacity, and pilgrims' camp locations at source and destination sites. The algorithm has been used in Hajj 2019.

During Hajj, sometimes, due to unavoidable conditions or external environmental factors, such as heavy rain, authorities need immediate solutions to reschedule pilgrims' movement.

Al-Qarni et al. 2021, presented a framework designed for crowd control and management system aiming to manage and prevent stampedes and catastrophes. The proposed framework presents an algorithm for stampede prediction with proof and deployment simulation. There are several IoT companies which have launched many innovative products and solutions using LTE-M (Long Term Evolution (4G), category M1) or NB-IoT (Narrowband Internet of Things) connectivity that enables them to easily deploy numerous devices in crowded areas without impacting their performance.

Rehman and Felemban, 2022, developed an interactive tool that reads the change requests submitted by the authorities and efficiently provides updated schedules by accommodating all the new constraints. The tool allows stakeholders to reschedule the groups based on the pilgrims' temporal preferences to perform the stoning ritual in accordance with the safety parameters. The safety parameters make sure that rescheduling of the group does not violate the capacity of the road and the Jamarat. The tool has been used in Hajj 2019 by the Ministry of Hajj and Umrah to reschedule the pilgrims' movement before and during the Hajj event.

Aljuwaiber&Elnagar (2022) that dealt with the impact of an electronic application on the organization of Umrah visits, which does not include Technical Services, and is not related to During the Hajj season, which requires a lot of management and precision, given the large number of pilgrims, which reach 2 million pilgrims per season.

Literature of Study:

Al-Qarni in his thesis entitled "A Future Perspective to Achieve the Security of Pilgrims and Umrah Performers According to Vision 2030 in the Kingdom of Saudi Arabia," posed the question of how to develop a future perspective to enable the security of pilgrims and Umrah performers in accordance with Vision 2030. The researcher used content analysis and interviewing to collect data to address the study question in an intentional sample that included 15 experts and strategists in the field of Hajj and Umrah services (Al-Thubaiti, 2019, p. 14).

The study ascertained the need to complete, develop, and design plans involving available technologies, in line with the needs of pilgrims and to achieve Vision 2030. It indicated the need to raise the capacity of the Holy Sites, especially Mina and the circumambulation court, as they are currently insufficient to accommodate the target numbers to achieve Vision 2030, which envisions an annual 5 million pilgrims and 30 million Umrah performers by 2030. The study also noted the need for a comprehensive plan focusing on potential risks, taking into account security and safety standards by ensuring good organization and accurate statistics for pilgrims and Umrah performers, their classifications, and measurement of the performance of the provided services level, their efficiency, and the achievement of the objectives of the vision. It stressed that awareness efforts would not achieve their goal if the pilgrims and Umrah performers are not enlightened. (Altalhi, 2021, p. 47).

Idris noted that every year an operational plan is prepared in which all relevant parties participate, and this becomes the main basis for dealing with the crowds of pilgrims. He stated that the responsible authorities experience great difficulty with regard to control of the flows in carrying out their tasks and achieving these goals during Ramadan and Hajj, especially Masjid Al-haram and its surrounding squares owing to the severe overcrowding around Al-haram. Those responsible for this face great difficulties in dealing with those crowds. Direct monitoring showed high rates of flow and density, reaching more than five people per square meter at peak times in the circumambulation court and other Haram courts (Abi Sen & Alhaboob, 2021, p. 17).

The study also suggested that a crowd management plan be developed, especially for the Hajj and Ramadan seasons, including the presentation of several proposals that can contribute to the reduction in crowding based on field study data and direct monitoring. Felemban discussed the use of the digital revolution to manage Hajj crowds and indicated the most crowded places during the Hajj period, such as the circumambulation of the Kaaba; camping in Mina, Arafat, and Muzdalifah; and stoning of the Jamarat,

which is a very crowded area. The diverse nature of the crowd in terms of race, age, language, and culture also poses many challenges for the organizers, who are responsible for ensuring the smooth organization of the event (Felemban& Majid, 2020, p. 56).

The emergence of modern digital technology helps researchers explore and suggest modern methods of crowd management to develop strategies for organizing these gatherings. This study presented a classification that summarizes the survey conducted in this study on the use of technical areas to provide the necessary services and improve crowd management during the Hajj season. These would include wireless technologies, computer-assisted vision, spatial computing, data analytics, mobile applications, modeling, and simulation. The study indicated that one dimension of this classification involves understanding the variety of possible crowd management techniques, and another dimension involves understanding the impact of technologies in dealing with this massive crowd. The study also tackled a multi-dimensional technical approach, the results of which may help researchers better deal with future gatherings (Shambour, 2022, p. 49).

The study suggested the integration of effective technologies, such as data analysis, which can help in discovering useful information with the help of data mining, text analytics, and data visualization, which supports the decision-making process.

Abi Sen performed a study to design a smart street for crowd management during the Hajj. They showed that the crowd management seen during the Hajj is typical and that Hajj management has made many large improvements in the infrastructure of Hajj facilities, which have helped reduce overcrowding in the Holy Sites. However, the problem of crowd control and congestion remains a real one (Basahel&Yamin, 2021, p. 31).

This study therefore proposed the design of digital smart streets based on LED light screens and wireless network sensors, computing, and main management servers, which can facilitate crowd management and control, easing crowd management by providing a rapid response to alerts by the central administration and by using and employing techniques to discover crowd problems and identify places of interest. A prototype of the proposed system has been simulated to show its feasibility and ease of application, as well as determining the benefits and advantages that can be achieved if it is implemented in crowded areas during the Hajj. This study turned the crowd into a smart area that could be managed and controlled through quick responses to people and quick intervention in emergencies by turning the ground into a smart deck. Colors can also be used to make observation easier so that it is understood by all people of different cultures, which is especially valuable during the Hajj, which is attended by millions of people who come from all over the earth. (Felemban&Biabani, 2020, p. 24).

Shambour and Gutub studied the recent progress in the study of technologies and applications of the Internet of Things that serve Hajj and Umrah in an analytical study conducted over 5 years (2016–2020). The papers reviewed were classified into four main groups, which include studies of the two holy mosques and the Holy Sites, pre-arrival studies, housing and services studies, and transportation and crowd management studies. The analysis showed that a plurality of the research reviewed (34.2%) was published in 2018, and artificial intelligence was the most targeted area (24.2%). Real application was the most widely used tool among researchers (42.3%) (Shambour, 2022, p. 18).

The results also showed that most researchers relied on the use of descriptive statistics in analyzing and interpreting data and most of the data collection methods used by researchers depend on the use of official reports and data, followed by virtual data, software, technology, and cameras. The results showed relative weakness in studies related to the two holy mosques and the Holy Sites relative to other research branches. Finally, some research ideas and practical suggestions were provided to serve pilgrims, visitors, and service providers, such as the use of smart mobile screens distributed in certain places in the Holy Sites to enable people to discover their place of residence in case one is lost. The researcher suggested a monitoring system, a smart parking system, and smart building system (Shambour, 2022, p. 23).

Basahel et al. addressed the management of Hajj and Umrah during COVID-19. Their study indicated that thousands of crowded gatherings are being held all over the world, and most of them have a religious component. Holding events such as this represents a great challenge, especially during the COVID-19 pandemic. To control the spread of infection, many restrictions were put in place, including mandatory face masks, maintaining social distancing, and a commitment to regular cleaning and sterilization. That study investigated many crowded events held during the pandemic and investigated their impact and contributions regarding the spread or containment of COVID-19. Most countries consider that containing the pandemic globally is difficult, and ensuring that people have access to safe drinking water is a vital step in reducing the spread of the virus among the population (Hussein & Salman, 2022, p. 16).

Methodology

Study Method:

This study based on qualitative method. the study will use descriptive and analytical approach to describe Technical Services for Organizing Crowds, Provided to Pilgrims, During Hajj Season.

Population and Sample:

The study population includes all administrative workers in Administration of the affairs of the Grand Mosque in Makkah, The study tool was distributed to (110) individuals of the study sample. A total of 103 analyzable questionnaires were retrieved.

The participants in the questionnaire were chosen randomly from among the administrative workers in the Department of the Affairs of the Grand Mosque.

Study sample characteristics

The frequencies and percentages of the characteristics of the study sample were found as follows:

1- Age

Table No. (1-3) shows the distribution of the study sample members by age:

Table No. (1-3) Distribution of the study sample according to age

Age	Frequency	Percentage %
20-30 years	36	35.0
31-40 years	25	24.3
41-50 years	34	33.0
Over 50 years old	8	7.8
Total	103	100.0%

Table No. (3-1) indicates that the age group (20-30 years) was the highest category for the study sample in Administration of the affairs of the Grand Mosque in Makkah, as their percentage reached (35%) of the total sample of the study, followed by the age group (41-50 years). At a rate of (33%), followed by the age group (31-40 years) with a percentage of (24.3%), and finally the percentage of the age group (more than 50 years) reached (7.8%) of the study sample.

2- Gender:

Table No. (3-2) shows the distribution of study sample members by gender.

Table No. (3-2) shows the distribution of study sample members by gender

Gender	Frequency	Percentage %
Male	92	89.3
Female	11	10.7
Total	103	%100

Table No. (3-2) shows that 89.3% of the study sample members are males e.g., more than half of the study sample members, and 10.7% of the females working in the Administration of the affairs of the Grand Mosque in Makkah.

3- Educational level

Table No. (3-3) shows the distribution of study sample members by educational level.

Table No. (3-3) Distribution of study sample members according to educational level

Education level	Frequency	Percentage %
High School	15	14.6
Intermediate Diploma	4	3.9
Higher Diploma	28	27.2
Bachelor	53	51.5
Master	3	2.9

Education level	Frequency	Percentage %
PhD	15	14.6
Total	103	100.0

It is noted that the highest percentage of academic qualifications for the study sample was in favor of the bachelor's degree holders by (51.5%) of the sample members, followed by the higher diploma holders with a percentage of (27.2%), while the percentage of high school holders and PhD holders was 14.6% equally. This was followed by the percentage in favor of the intermediate diploma holders with a percentage of (3.9%), and finally the percentage of the master's holders reached (2.9%) of the total study sample.

4- Number of years of experience

Table No. 3-4 shows the distribution of study sample members according to the number of years of experience.

Table No. (3-4) Distribution of the study sample according to the number of years of experience

Education level	Frequency	Percentage %
1-3 years	31	30.1
More than 3-5 years	13	12.6
More than 5-10 years	5	4.9
11-12 years	4	3.9
More than 12 years	47	45.6
Total	100	97.1
Unanswered	3	2.9

It is noted that the largest percentage of the practical experience of the study sample members in the Administration of the affairs of the Grand Mosque in Makkah was in favor of experience (more than 12 years) at a rate of (45.6%), while experience (1-3 years) amounted to (30.1%) of the study sample, followed by Experience category (more than 3-5 years) at a rate of (12.6%), followed by the percentage of experience (more than 5-10 years) at a rate of (4.9%), and the percentage of experience (11-12 years) came in last place at a rate of (3.9%).) of the study sample members in the Administration of the affairs of the Grand Mosque in Makkah.

Data collection:

The study relied on two types of data: primary and secondary data, whereas secondary data will be represented by the theoretical and field previous studies, as well as books and research on the subject under study in order to develop the theoretical framework and the goal of dimensions that measure "Technical Services for Organizing Crowds, Provided to Pilgrims, During Hajj Season".

The primary data were represented by the development of a questionnaire to measure the variables and dimensions and study hypotheses.

Questionnaire Design:

A five-point likert scale questionnaire will be used as a tool to measure the dimensions of study variables based on the following values:

- Strongly Agree: (5) points
- Agree: (4) points
- Neutral: (3) points
- Disagree: (2) points.
- Strongly Disagree: (1) point.

Reliability Test:

The Reliability Test, which is the calculation of the Cronbach-Alpha coefficient, has been tested to verify the internal consistency of the fields included in the questionnaire as a measuring tool, where a value ranges between (1-0) and its value is acceptable at (60%) and above. (Sekaran & Bougie, 2014), table No. 3-5 indicates the test results as follows:

Table No. (3-5) reliability test

	Variable	Variable number of paragraphs	Cronbach's Alpha
1	expert systems	5	0.852
2	neural networks	5	0.833
3	genetic algorithms	4	0.859
Development of crowd management services		7	0.921

Table No. (3-5) indicates a high reliability of all study variables and the tool in general, where the value of (Cronbach's Alpha) was higher than the value (60%) for each variable and for all variables of the study scale.

Regression results:

Table No. (3-6) Regression Results

R Square	0.273
F Value	49.177
F (Significance)	0.000
Beta of expert systems	0.246
Beta of neural networks	0.393
Beta of genetic algorithms	0.584
VIF factor	1.187

In order to find out the relationship between developing services provided to pilgrims and technical services (expert systems, neural networks, genetic algorithms), a multiple linear regression model was used in which expert systems, neural networks and genetic algorithms were considered as explanatory variables and developing services as dependent variable. The results of the regression model demonstrated that there was a significant relationship between developing services provided to pilgrims and the explanatory variables. This can be inferred from the t value and its associated p value. The explanatory variables explain 24.8% of variations in developing services showing that the strength of relationship between developing services and the explanatory variables are moderate. By referring the F value and its p value, it may be concluded that the model is valid and there is a correlation between developing services provided to pilgrims and the explanatory variables. To verify the existence of the mentioned relationship, a multicollinearity test was carried out. The result revealed the VIF factor of the model was ($1.187 < 3$) indicating the nonexistence of multicollinearity problem.

Data analysis and results:

"SPSS" software will be used with the aim of analysis, including:

- 1- Cronbach's alpha Test.
- 2- Descriptive Statistics.
- 3- Regression.

Discuss And recommendations

Discussion:

The study concluded that there is a high degree of estimation for artificial intelligence in the Administration of the Affairs of the Grand Mosque in Makkah, where it was found through the study that the dimension of expert systems was in the first rank, with a mean of (4.194), and in the second rank was after genetic algorithms with an average of My arithmetic (4.068), followed by the third and last rank after neural networks, with an arithmetic average of (4.025), where all of these dimensions had a high degree of assessment, and results indicate a high degree of artificial intelligence in the Administration of the Affairs of the Grand Mosque in Makkah(Khunji, 2017, p. 61).

Below is a breakdown of those results:

Expert systems: The results of the study indicated that expert systems were at a high level in the Administration of the affairs of the Grand Mosque in Makkah.

It was found that the human experience is modeled in finding appropriate solutions in organizing crowds during the Hajj season. The results also reached the presence of advanced expert systems that develop solutions to various problems in organizing crowds during the Hajj season. To use expert systems as an expert consultant to improve the decision-making process in organizing crowds in the Hajj season. The presence of advanced expert systems capable of acquiring knowledge in several areas that support the management's capabilities in organizing crowds during the Hajj season (Mahdi, 2019, p. 35).

Neural networks: The results of the study indicated that neural networks were at a high level in the Administration of the Affairs of the Grand Mosque in Makkah, and it was found that the existence of artificial neural networks systems provide multiple options as a result of their high ability to analyze information in managing crowds during the Hajj season.. The existence of artificial neural networks systems is characterized by the ability to derive information from complex data to organize crowds during the Hajj season. The existence of artificial neural networks systems helps in obtaining large amounts of information to create certain characteristics and situations that contribute to the creative organization of crowds during the Hajj season. The existence of artificial neural networks systems reality and different assumptions (Ahmed & Saleh, 2018, p. 37).

Genetic Algorithms: The results of the study indicated that genetic algorithms were at a high level in the Administration of the Affairs of the Grand Mosque in Makkah, and it was found that genetic algorithms are an excellent way to assist the Administration of the Affairs of the Grand Mosque in Makkah in reaching quick results. When there are many and diverse inputs, the results also showed that the genetic algorithms themselves were developed and adapted to the Administration of the Affairs of the Grand Mosque in Makkah to keep pace with regulatory developments (Vrontis & Pereira, 2022, p. 45).

Dependent variable, development of crowd management services: The results indicated that the development of crowd management services was at a high level in the Administration of the Affairs of the Grand Mosque in Makkah, and it was found that artificial intelligence was developed and updated in line with the development requirements in the Administration of the Affairs of the Grand Mosque in Makkah,

The results also showed that the process of simplifying and developing procedures through artificial intelligence contributed to the rapid completion of work in the Administration of the Affairs of the Grand Mosque in Makkah.

The study also found the following:

- There is a statistically significant effect at the significance level ($\alpha 0.05$) of artificial intelligence in its combined dimensions on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah, from which the results indicated the following:
- There is a statistically significant effect at the significance level ($\alpha \leq 0.05$) of artificial intelligence in terms of expert systems on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah. This conclusion is consistent with the findings of Rehman and Felemban, 2022.
- There is no statistically significant effect at the significance level ($\alpha 0.05$) of artificial intelligence in terms of neural networks on the development of crowd management services in the Administration of the Grand Mosque in Makkah. This conclusion is consistent with the findings of Al-Qarni et al. 2021.
- There is no statistically significant effect at the significance level ($\alpha 0.05$) of artificial intelligence in terms of genetic algorithms on the development of crowd management services in the Administration of the Affairs of the Grand Mosque in Makkah. This conclusion is consistent with the findings of Islam et al. 2019.

Recommendations:

Through the results, the study reached the following recommendations:

- 1- The study recommends employing artificial intelligence to organize crowds more in the Administration of the Affairs of the Grand Mosque in Makkah the study shows that the application of artificial intelligence has an important impact on the organization and management of crowds.

- 2- The necessity of develop Expert systems because of its great role in assisting Administration of the affairs of the Grand Mosque in Makkah in the thinking process and not only providing them with information in the.
- 3- The necessity of develop artificial neural network systems in the Administration of the Affairs of the Grand Mosque in Makkah and linking them to the feature of learning as in human cases.
- 4- The necessity of following up on the development of genetic algorithms on their own and adapting them to the environment of the Administration of the affairs of the Grand Mosque in Makkah.
- 5- The study recommends generalizing its findings and recommendations, and suggests conducting research and studies based on the results and recommendations of the current study.

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