

QREAM: QR-code Emergency Assistant Model

Abdullah A Sheikh

Computer Science Department College of Computers and Information Technology, Taif University,
Taif, Kingdom of Saudi Arabia.

ABSTRACT: Using a Quick Response (QR) code has been spread over most applications, such as registration, commercial, and verification purposes. Emergency situations need a quick and effective action plan including communication, identification, and full data access to provide urgent assistant. In Saudi Arabia, the Hajj event similar cases might occur. As a result of that, a quick response plan is needed to provide assistant in emergency situations for pilgrims.

The aim of this paper is to introduce and to describe an emergency assistant model based on using QR-Code (QREAM). In addition, this paper will discuss the model design and analyse the results of using the QREAM.

KEYWORDS: QR-code, Model, Quick Response, Identification, Hajj Applications.

INTRODUCTION

The use of the Quick Response (QR) code has been widely spread in most applications, such as the enrolment process, commercial advertising, and for verification purposes [4].

Security and identification are vital uses for the QR code, as it provides more information when required with more accurate data than other technologies such as barcodes [4] [14].

In light with Saudi vision 2030, All services in Kingdom of Saudi Arabia must be provided with a very high expectations of accuracy, speed, and secure. A very special service provided in Hajj is a combination of all sectors work together for this aim. Hajj and Umrah seasons required different types of services such as transportation, health management, information guidance, location of accommodation and places, and identification. As a result, the Saudi Arabian government has published many authorised applications for different sectors to facilitate the Hajj and Umrah seasons [9] [16].

The gathering of pilgrims in Hajj is extremely concerning to the Saudi government, especially the Ministry of Hajj. This needs different ways to apply to control the crowd and monitor or follow a very large number of pilgrims in Hajj.

Health is a vital issue that is also a huge concern for the Saudi government, and the Ministry of Health has developed several strategies and technologies to serve pilgrims while they are in Makkah doing Hajj and Umrah [18] [13].

This paper introduces the QR code Emergency Assistant Model (QREAM) that will provide an assistant to help monitor pilgrims during the Hajj using a unique QR code for each pilgrim.

The paper is organised as follows. Section II gives an overview of the QR code.

Next, Section III serves as a review of the research literature to present the impact of using QR code, then Section IV explains the research methodology for the new model. Then, Section V discusses the research results and research finding. Finally, it concludes with an explanation of the need to develop the QREAM.

BACKGROUND

This section serves as a background and provides a general view of QR code and includes types of QR code and QR code structure and all features that are involved in the use of QR code technology.

The version of the QR code symbol has versions ranging from version 1 to version 40 [7]. In addition, QR code technology can store different types of data such as personal information, web page address, bank accounts, and very important data [8]. The size and capacity of the information that can be retrieved are different from one QR Code version to another [17]. In addition, using QR code technology makes retrieving data and information faster than other similar technologies due to the number of modules used in the QR code symbol [19].

TYPE OF QR CODE

The QR code technology has been categorised into five categories that help to decide the main purpose of using the QR code, these categories are listed as follows [11]:

- 1) QR code Model 1 and Model 2: which decides the version of QR code used.
- 2) Micro QR code: for using a single detection pattern to reduce the size of QR code.
- 3) iQR code: used to store more information using 2D matrix code.
- 4) Secure QR code (SQRC): To use a QR code with security features that are needed for sensitive information.
- 5) Frame QR: its developed as two dimensional (2D) code with a blank canvas area to keep the design and data.

QR code is defined as a set of black and white dots that stores a lot of information that can be accessed quickly using the QR code reader using the camera of a smart device, then it can retrieve the required information accurately. see the QR code structure [6] in Figure 1. as the following:

- 1) Version Information
- 2) Separation
- 3) Timing Pattern
- 4) Format Information
- 5) Data and Error Correction
- 6) Quiet Zone
- 7) Alignment Pattern
- 8) Position Detection Pattern

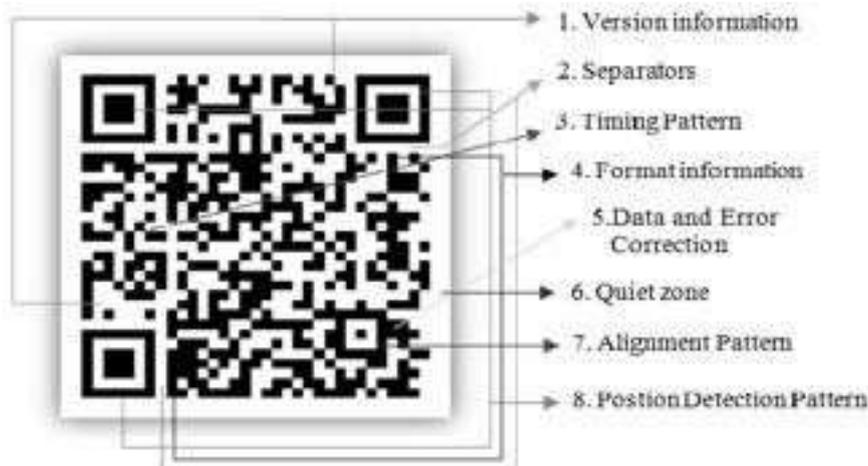


Figure 1. QR code Structure

RELATED WORK

This section discusses the related work of using the QR code. In addition, it presents some technologies and most common applications that are used in Saudi Arabia in Hajj.

Hajj is the fifth pillar of Islam and Muslims are obliged to do once in their life if it is affordable [12], Saudi government put a lot of efforts to make the Hajj season comfortable, safe, and secure with all services needed such as health services and transportation services.

So, it is not about worshipping, it is about whole sectors working together to reach a satisfactory level for all the people involved in all hajj services. As a result, many services have been introduced from one year to another, and several developments to all Ministries sectors are working in hajj. These sectors are including Security Ministry, Health Ministry, Transportation Ministry, etc [20]. it's a big challenge [21].

Hajj applications bring great importance in helping pilgrims in the event of any health issues or being lost. Therefore, any users or employees can scan their code and identify pilgrims' information to provide assistant to them quickly.

SUMMARY OF THE MOST COMMON HAJJ APPLICATIONS

There are many hajj applications that have been developed, and each application has a different technology to manage pilgrim travel, pilgrim identification, and health observation.

The following is a brief description of some of these applications.

- **QR Codes in Religious Tourism:**
QR reader has been effectively used in developing a website as a tourist guide to help pilgrims in Makkah Saudi Arabia. The website helps to provide the user with all the information and steps for the pilgrim, in addition to explaining how to navigate between several sites by capturing QR codes [2].
- **Hajj Guide:**
Hajj Application is an application that provides essential services to pilgrims and employees during the Hajj. It works by scanning QR codes to give different types of service location, and to display information about pilgrims. Moreover, it allows many features, such as chatting with pilgrims. Moreover, it helps pilgrims in emergency situations and if an accident occurs [15].
- **Hajj Application:**
Hajj Application is an application that provides essential services to pilgrims and employees during the Hajj. It works by scanning QR codes to give different types of service location, and to display information about pilgrims. Moreover, it allows many features, such as chatting with pilgrims. Moreover, it helps pilgrims in emergency situations and if an accident occurs [9].
- **Manasikana:**
Manasikana applications is one of the applications that have been provided by the Ministry of Hajj. This application is used to read the QR code in the electronic bracelet to get pilgrim information in hospitals [18].
- **Mobile App QR detector for pilgrims suffering in Hajj:**
This mobile app is designed to generate a QR code for each pilgrim, but can only be read by an authorised person via the mobile app in emergency situations [1].
- **HajjLocator:**
The Hajj crowd tracking system in a widespread environment uses an SOS mechanism to track and monitor pilgrims during Hajj, but this app can only detect if any pilgrim is missing from the Hajj compound [10].
- **Wireless Sensor Networks for Pilgrims Tracking:**
This system is based on tracking pilgrims using a network sensor using Wi-Fi technology [5]. In case of emergency, the pilgrim can turn on an alarm using the mobile application to request help. Then the system will locate the pilgrim location through the app.
- **Pilgrims "Hajj" Tracking System (e-Mutawwif):**
This system uses GPS locator to guide pilgrims during their trip to do Hajj. But in an emergency situation, the supervisor must have the observation to locate a lost pilgrim [3].

Most of the technology used in Hajj is to help pilgrims, such as directions, specify the location, Hajj guide, monitoring, and tracking pilgrims.

However, the QREAM adds a service to help pilgrims identify their identity or find their supervisor or medical assistant in case of emergency in a medical situation or if they get lost. That will allow people around them from employees or other pilgrims to provide assistant using the QR code.

In terms of availability, the technologies used in Hajj may have some problems in providing precise data or location. Due to some issues such as connecting or poor signals or coverage.

As a result, the use of the QR code to provide data or information will be faster and more secure than other technologies.

THE QREAM

This section presents the QR code Emergency Assistant Model QREAM and its components. Also, it explains how the model system and the system flowchart to show how all processes work start with the registration stage to the identification stage. After that, it shows the criteria that were considered for this model.

QREAM divides into two main stages, the registration stage and the identification stage, each stage including some required steps. Then, it explains the QREAM steps needed for each QREAM stages.

A. QREAM Stages:

The QREAM model consists of two stages, the first stage is the registration stage and the second stage is the identification stage, see Figure 2. Each stage has been divided into different steps as the following:

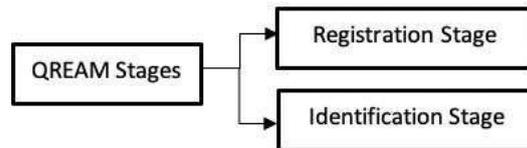


Figure 2. QREAM Stages

1. Registration stage:

First, the registration stage starts when the authorities gather all participant data after their arrival in Saudi Arabia, then they finish by generating the QR code and providing the source of the QR code such as image, tags, bracelets, or any digital forms for each participant. For this stage, see Figure 3. includes the following steps with more details:

- 1.1. Gathering Information: the authorities take responsibilities to get information of all participants and register their data in the system.
- 1.2. Generate QR Code: After gathering information, authorities will generate the QR code using QR code generators to ensure that each participant has a unique QR code linked to his personal data.
- 1.3. Link Information: After that, they link the generated QR code with the participant record with tags, images, bracelets with the QR code, or any digital forms.
- 1.4. Provide QR Code: Finally, they provide all participants with their personal QR code in any form such as tags, images, bracelets, or digital forms.

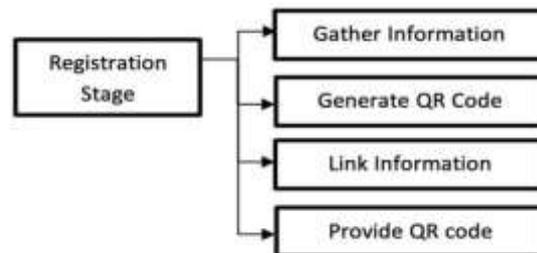


Figure 3. Registration Stage

2. Identification stage:

After the registration stage, there will be some steps involved in the identification stage of using the QREAM, and as required for any incidents that could occur, see Figure 4. These steps will be as follows:

- 2.1. Scan QR code: Scan the QR code of a particular participant using a camera on a smart device.
- 2.2. Compare: The QREAM compares and processes the QR code and finds the linked information.
- 2.3. Retrieve: The QREAM retrieves data required to help and identify the participant.

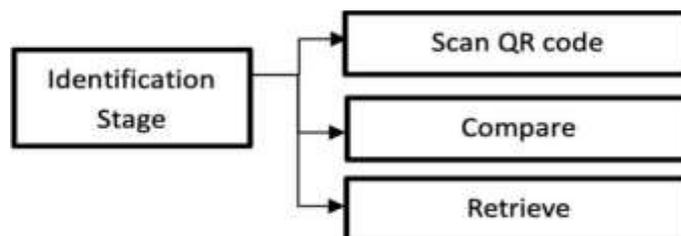


Figure 4. Identification Stage

B. QREAM Criteria:

This section provides QREAM criteria and comparisons between similar technology used in the same fields. The QREAM model has considered the following six main criteria to ensure better reliability of the technology used, see Figure 5. These six criteria are comparable between the different technologies that are used for the same purpose.

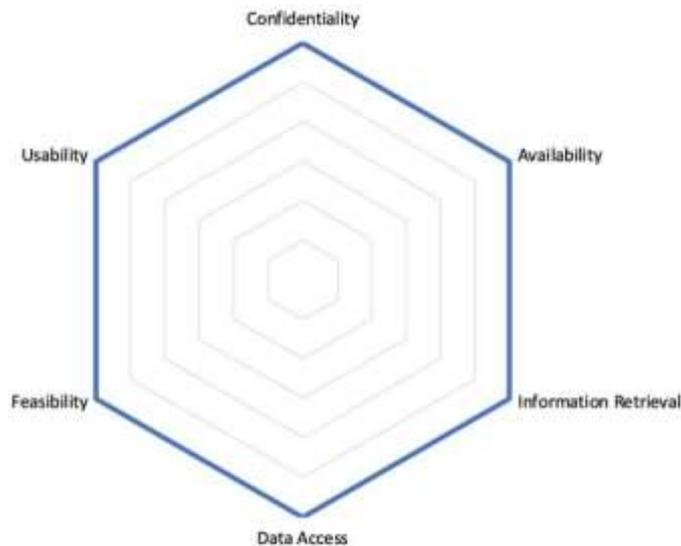


Figure 5. QREAM Criteria

- 1) Confidentiality: means that most viral information, such as very private participant's data, should only be visible to an authorised person who scans the QR code.
This feature is implemented in the system by creating a password for each user's account to prevent anyone else from seeing their private data without authorisations.
- 2) Availability: means that the information is available every time the QR code has been scanned.
- 3) Tracking information: means that the way and the source of retrieving participants data is verified and reliable.
- 4) Feasibility: means that the operational and technical cost of using the QR code is very low. It depends on implementing for reading or scanning the QR code feature in any smart device. Then it requires authorisation method to access to all participant's data or it just how retrieves general information that is needed to help the participants in the specific situation.
- 5) Usability: means that the user ability to understand and scan the QR code is very easy. This feature is implemented in the system by designing simple and understandable interfaces.

Table 1. Technologies Criteria Features Comparisons

Features	SnapTags	Image Recognition	Bluetooth Beacons	QREAM
Confidentiality	No	No	No	Yes
Availability	Yes	Yes	No	Yes
Information Retrieval	Tags	Images	Bluetooth signals	QR code
Data Access	Yes	No	No	Yes
Feasibility	Low	High	High	Low
Usability	Easy	Medium	Medium,	Easy

Table 1. shows the most common comparison criteria between QREAM and other technologies that have similarities and are used to retrieve customer information. Some features are related to security issues, and others are related to the time to retrieve the



information and the amount of data it can access. These features are Confidentiality, Availability, Information Retrieval, Data Access, Feasibility, and Usability [11].

From Table 1. the QR-Code technology used in the QREAM is the most secure technology for obtaining and accessing sensitive information, as it tracks information without errors, thus obtaining comprehensive data on user behaviour and knowledge of the services they need.

Also, this QR code technology is available at any time and place and users can rely on it to meet their different needs. In addition to being easy to use and a well-known technology for a large number of users and giving accuracy in the results of identifying the details of users such as their location or the diseases they suffer from, and thus helping them quickly and in the real time.

In addition, the use of QREAM allows access to different types of data with different classifications, such as general data or private and links to web pages to authenticate the reach of the required data.

RESULTS AND ANALYSIS

This section presents the results and analysis of using the QREAM.

The number of users that scan the QR code has increased in recent years [15] due to the growth of the number of applications developed using the QR code and using the QR code is the easiest way for pilgrims to use.

Most of the work shows that technology is used, but in different ways. This model works on the pilgrim side to help them identify their fastest way to guide them or to provide an assistant to pilgrims.

In Hajj, services with QR code technology get a better review rate compared to similar services, see Figure 6.

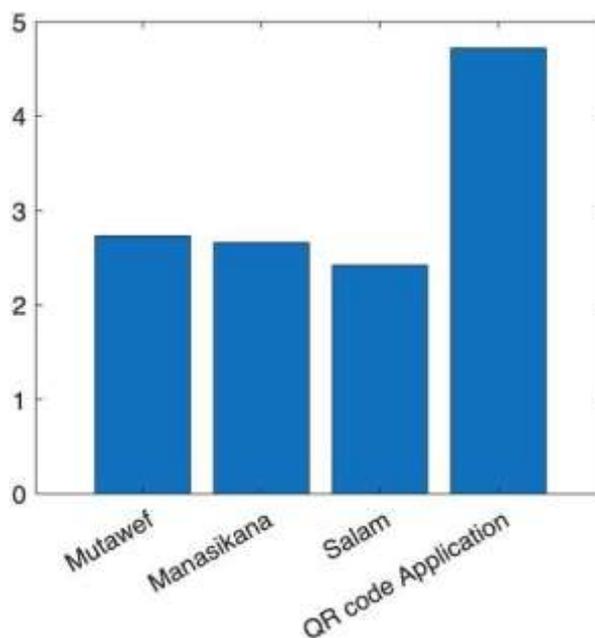


Figure 6. QR code application Review Rate compared to other applications adapted from [15]

Approaches with QREAM show highest rate of (4.72) that the QR code could provide the service to old pilgrims and children easily, because they just need to scan the QR code or anyone can scan it to help them. In addition, adding the QREAM to current application will help maximise the benefits of the services in both sides pilgrims and authorities. For pilgrims, they can scan the QR code to get assistant in any situation including emergency. For the authorities, they can track pilgrims anywhere using their QR code records or for employees in Hajj to provide help to pilgrims.



CONCLUSION

This paper has described the Quick Response Emergency Assistant Model (QREAM). It has presented an overview of QREAM each step in each stage. In addition, it presented the six main criteria of the QREAM. In addition, it showed how the QREAM will work after submitting the participants' data and linking them with the generated QR code.

Then it explained how the data will be identified using a simple example of real life use in services such as using the QR code during hajj season in Saudi Arabia. Finally, it has shown how important it is to use. The QREAM as a service to provide emergency assistants to participants, such as children and elderly people, and especially for those with a medical condition.

Identification is an important use of the QR code, as it allows more information to be read and is faster and more accurate than other technologies. This paper has introduced QREAM and its two stages and the six criteria considered by the model.

Analysing the results of using QREAM with approaches that use QR code technology provides better services, including availability and security.

ACKNOWLEDGMENT

The researcher would like to acknowledge the Deanship of Scientific Research, Taif University for funding and supporting this work.

REFERENCES

1. Al-Naima, Fawzi. (2021) Managing the Status of Suffering Pilgrims in Makkah via Mobile Application. MEST Journal. MESTE NGO.
2. Alshattnawi, Sawsan. (2012). Effective use of QR codes in religious tourism. International Conference on Advanced Computer Science Applications and Technologies (ACSAT). IEEE. pp 497–501.
3. Amro, Aladdein and Nijem, Q. (2012). Pilgrims' Hajj Tracking System (e-Mutawwif) Contemporary Engineering Sciences. vol5. No. 9. pp 437 – 446.
4. aSutheebanjard, Phaisarn and Premchaiswadi, Wichian. (2010). QR-code generator. Eighth International Conference on ICT and Knowledge Engineering. IEEE. pp 89–92.
5. Deriche, Mohamed. (2012). Wireless Sensor Networks for Pilgrims Tracking. IEEE Embedded Systems Letters. Institute of Electrical and Electronics Engineers IEEE.
6. Hoy Matthew B. (2011). An introduction to QR codes: linking libraries and mobile patrons. Medical Reference Services Quarterly. (Taylor & Francis). vol 30. No. 3. pp 295–300. <http://www.thonky.com/qr-code-tutorial/>
7. Ji, Qianyu. (2014). Exploring the concept of QR Code and the benefits of using QR Code for companies. Lapin ammattikorkeakoulu.
8. Khan, Esam Ali and Shambour, Mohd Khaled Yousef. (2018). An analytical study of mobile applications for Hajj and Umrah services. Elsevier. vol 14. No. 1. pp 37-47.
9. Mantoro, Teddy. (2012). Hajj Crowd Tracking System in a Pervasive Environment.
10. Mishra, Aayushi and Mathuria, Manish. (2017). A review on QR code. International Journal of Computer Application. vol 164. No. 9. pp 17-19.
11. Mohamed, Mamdouh N. (1996). Hajj & Umrah from A to Z, IslamKotob.
12. Mohammed, Alaa and Al-Naima, Fawzi. (2021). MANAGING THE STATUS OF SUFFERING PILGRIMS IN MAKKAH VIA MOBILE APPLICATION, MEST Journal. vol 9. No 2. pp 54-60.
13. Narayanan, A Sankara. (2012). QR codes and security solutions. International Journal of Computer Science and Telecommunications. vol 3. No. 3. pp 69 – 72.
14. Noor Talal H and Atlam, El-Sayed and Malki, Zohair S and Alzighaibi, Ahmad Reda and Hashim, Hasan and El- Agaimy, Rasha. (2020). Android/iPhone Mobile Application for Quick Response Pilgrims Campaign Locator. Journal of Computer and Communications. Scientific Research Publishing. vol 8. No. 5. pp 1-13.
15. Shaout, Adnan and Osman, Malak. (2017). Towards developing an intelligent HAJJ guide system. 8th International Conference on Information Technology (ICIT). IEEE. pp 280-285.



16. Shin, Dong-Hee and Jung, Jaemin and Chang, Byeng-Hee. (2012). The psychology behind QR codes: User experience perspective. Elsevier. vol 28. No. 4. pp 1417 – 1426.
17. Stanton, Andrea L. (2020). Saudi Arabia's ministry of Hajj apps: Managing the operations and piety of the Hajj. Journal of Religion. Media and Digital Culture. Brill. vol 9. No. 2. pp 228 -246.
18. Tiwari Sumit. (2016). An introduction to QR code technology. International Conference on Information Technology (ICIT). IEEE . pp 39-44.
19. Parker, Ann and Neal, Avon. (2009). Hajj paintings: Folk art of the great pilgrimage. American Univ in Cairo Press.
20. Rahman, Juma and Thu, Min and Arshad, Neelam and Van der Putten, Marc. (2017). Mass gatherings and public health: case studies from the Hajj to Mecca. Annals of global health. Elsevier. vol 83. No. 2. pp 386-393.