



MANAGING THE STATUS OF SUFFERING PILGRIMS IN MAKKAH VIA MOBILE APPLICATION

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Abstract

The gathering of many people for pilgrimage in sacred places has been increasing in recent years worldwide. With the growing number of pilgrims, the difficulties facing the authorities are also expanding in the form of crowd control and accident avoidance. In such a huge gathering of people and the expected resulting stampede, many pilgrims, including young children and old people, get lost and many pilgrims die because of both natural causes and the stampede. This paper proposes a dedicated mobile solution to identify Muslim pilgrims to Makka experiencing such abnormal situations using QR Code with a mobile application called (Hajj ID). Each practicing pilgrim must wear all time an assigned QR Code containing all his/her necessary personal information, which can be retrieved to access the personal and medical information of the pilgrim in an emergency. The QR Code can only be read by authorized personnel using a mobile application specially designed for this purpose and the pilgrim status will change and be saved to the database and shown on the Hajj website.

Keywords: Hajj, pilgrim identification, QR Code, lost pilgrim, crowd control, stampede

1 INTRODUCTION

One of the biggest religious activities worldwide is the annual Muslim Pilgrimage to Makkah, (Hajj). This event is undertaken by very large number of Muslims reaching a few million people speaking different languages and come from different background cultures. Managing such an

occurrence becomes a very complicated and challenging job for the authority in Saudi Arabia.

These Hajj rituals must be held on the same number of days in the last month of each lunar year. With such a huge crowd, where people walk shoulder to shoulder, there is a high risk that many people will break from their communities and get lost. Dangerous conditions may also arise due to different factors such as traffic crashes, overcrowding, human delays, stampeding, and

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death (Osman, 2018) . The first step to assist pilgrims in such emergency is to define the "pilgrim's identity" so that the responsible authorities can properly provide assistance.

One of the modern technologies that can be used to identify pilgrims without having to talk to them is by using the QR Code with the mobile application (Hajj ID).

2 SYSTEM ARCHITECTURE

The proposed layout of the QR Code based identification system architecture is illustrated in Fig .1 .The flowchart of the working mechanism of this system is shown in Fig. 2.



Fig. 1 Identification system architecture

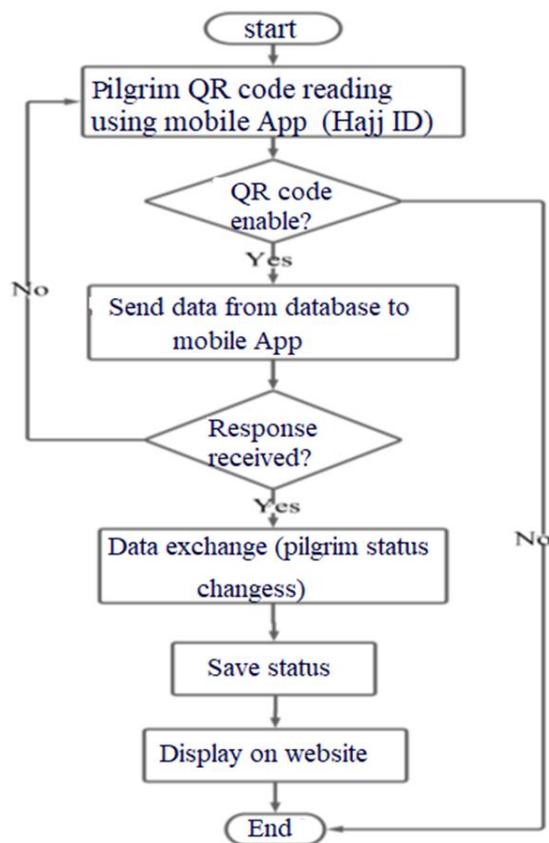


Fig. 2 System flowchart

The basic idea of the working of this system is to have the front end and the back end interfaced with each other. The front end includes the pilgrim QR Code, mobile application, and a website, while the backend includes the system database.

2.1 Pilgrims QR code

Each pilgrim wears a wrist QR Code that contains the important basic information of the pilgrim through which the authority can recognize the pilgrim to provide assistance if needed. The information in the QR Code may include the following:

- Pilgrim name
- Age
- Country
- The convoy that the pilgrim came with
- Hajj blood type
- Chronic diseases present at the pilgrim, if any
- Pilgrim passport number
- State (which is changed according to the condition of the pilgrim, whether being missing, injured or dead)

2.2 Mobile Application

The "Hajj ID" mobile application is a program that can be downloaded on the phones by the people responsible for providing assistance and protecting pilgrims, whether being security or medical authorities. This program reads the QR Code of the pilgrim to obtain the identifying and basic information of the pilgrim from the database.

"Hajj ID" is built using Flutter framework. Flutter is a Google-based mobile SDK and UI tool built based on Dart's programming language, which was publicly released in 2018 (Olsson, 2020) . Flutter is an open-source SDK for high-performance, high-fidelity mobile applications development for both Android and iOS (Madhuram, 2019) .

The mobile application icon (Hajj ID) appears on the Android system and the first interface in this application is the welcome interface as shown in Fig. 3.

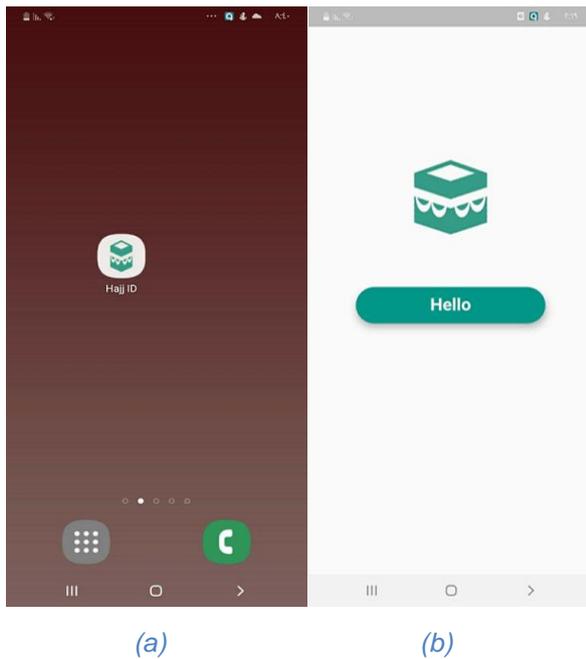


Fig. 3 (a) Hajj ID application icon, (b) Welcome interface of the application Hajj ID

The second interface that appears to the user after the welcome interface in the application is the interface that requests entering a PIN as shown in Fig. 4. The user of the application must possess the PIN of the security authorities or the PIN of the health authorities to be able to use the application because the presence of a PIN is necessary for the use of the application to be limited to certain parties.

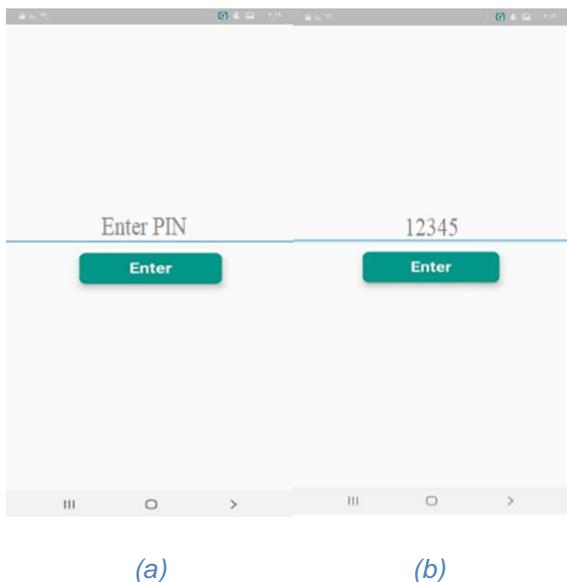


Fig. 4 (a) The application asks for a PIN, (b) Entering a PIN

After entering a PIN, it will move to an interface that enables the user to scan the QR Code for pilgrims as shown in Fig. 5, which is the third interface of the application and is considered the most important interface that will work with the database because when a QR Code scanner is made there will be a link to the database to fetch private QR Code information.

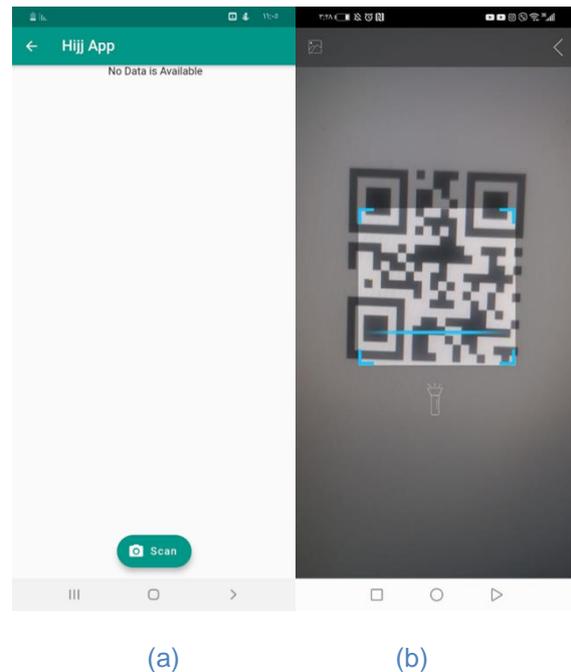


Fig. 5 (a) The third interface of the application to request a QR code scan, (b) Scanning QR code

2.3 Website

It is a site of the pilgrim identification system on which the names of missing, injured and deceased pilgrims appear so that families can verify pilgrims during the Hajj season, as well as the authorities responsible for Hajj to monitor the number of dead, injured and lost pilgrims. Updates are made to this site in the event of a new case occurring through the phone application and after saving it in the database it appears on the site. This site consists of two interfaces, the first page is the main page as in Fig. 6 to define the site and contains pictures of some emergency cases. The second page is for pilgrims and contains the names and information of pilgrims who have suffered one of the cases of loss, injury or death, as shown in Fig. 7. This website is designed using HTML, JS.



What is the Hajj ID application site? Many emergency cases are recorded during the Hajj season, such as the injury or death of the pilgrim, or even the loss of pilgrims in the holy sites, as in the pictures above. They are recognized by a mobile QR code on the wrist of the pilgrim's hand by the Hajj ID app and then displayed on this website

Fig. 6 Home page content

| NO. | name | age | country | state |
|-----|-------------------------|-----|----------------------|---------|
| 1 | Ali Ahmed Fadel | 78 | Iraq | Missing |
| 2 | Abass Mohammed Ali | 88 | Jordan | Dead |
| 3 | Enas Omar Sheban | 54 | Palestine | Missing |
| 4 | Khalil Ibrahim Abdullah | 76 | Iraq | Dead |
| 5 | Amal Abbas Mahimid | 58 | United Arab Emirates | Injured |
| 6 | Aisha Othman Ahmed | 66 | Turkey | Missing |
| 7 | Salman Mohammed Nasser | 70 | Kuwait | Dead |
| 8 | Qasim Ali Hadi | 63 | Lebanon | Missing |
| 9 | Ahmed bin Hisham | 79 | Morocco | Dead |
| 10 | Ahmed Abbas Amin | 67 | Tunisia | Injured |
| 11 | Al Hassan Salem Ahmed | 74 | Algeria | Injured |
| 12 | Bakr Saladin Ayoub | 80 | Indonesia | Dead |
| 13 | Zaid Anas Abdullah | 55 | Jordan | Injured |
| 14 | Ismail Sabah Muhammad | 65 | Palestine | Injured |

Fig. 7 Content of Pilgrims page

2.4 Database

The database is the back end of the system, and it is the pivotal and essential part of the pilgrim identification system, where data are collected for all pilgrims who enter the Kingdom of Saudi Arabia to perform the Hajj, and the database was built using Firebase. Firebase is a backend platform for Web, Android, and iOS applications. It offers a database in real-time, different APIs, multiple types of authentication, platform hosting and much more (Mehta, Madhani, & Patwardhan, 2017) .It helps developers build high-quality apps and stores data in the JavaScript Object Notation (JSON) format that does not allow the query to be used to insert, update, delete or add data to it. This is the backend of a system that is used as a database for storing data (Khawas & Shah, 2018). Firebase was launched in April 2012 and purchased in 2014 by Google to provide the backend developer solution. Google officially released Firebase in the summer of 2016 to earn revenue for developers, creating a successful application, and promoting business growth (Tram, 2019) . Several useful mobile tools are provided by the Google Firebase suite.

Developers of around 1.2 million applications were using the Firebase SDK as of May 2018 (Gonsalves, 2018). The following three characteristics can be performed in this application: develop, grow and earn. The structure of the hajj database consists of two children named (pin, user) as shown in Fig. 8.

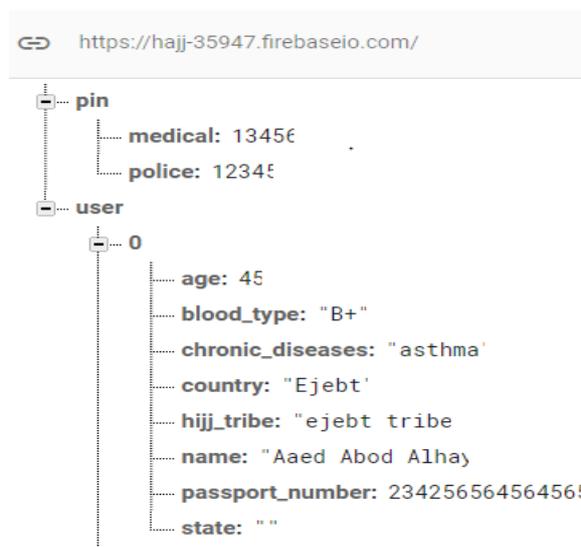


Fig. 8 Hajj database structure

3 RESULTS

The running application for a typical pilgrim identification carrying the QR Code is shown in Fig. 9.

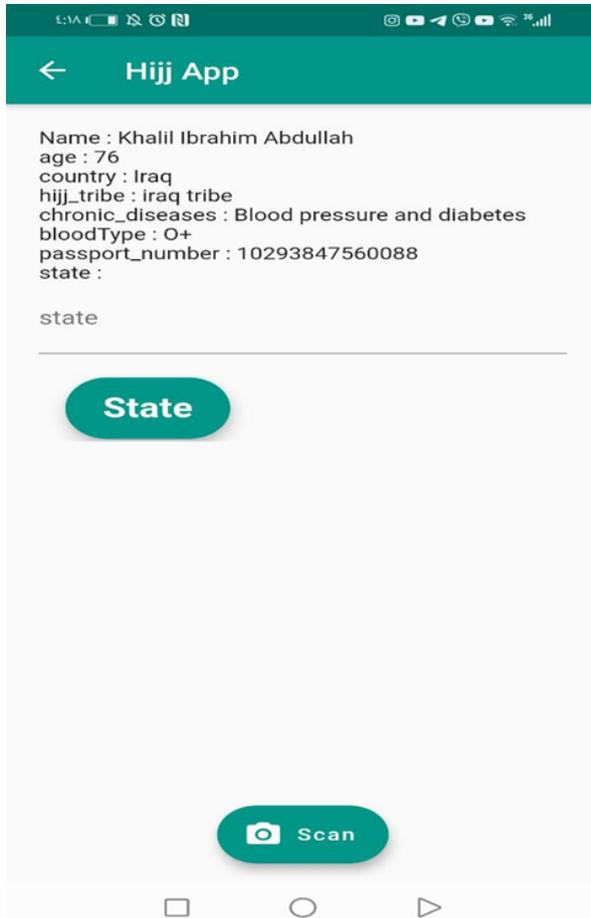


Fig. 9 After scanning the QR code, the result is the pilgrim's information

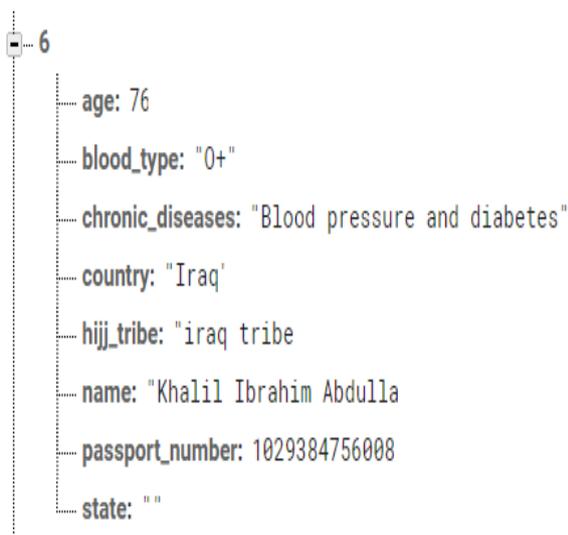


Fig. 10 Information about one of the pilgrims in the database

In the resulting interface that appears after performing a QR Code scan, there is a state which is to add the pilgrim's current situation if it is being affected, missing, or dead. In Fig. 10, the pilgrim's information in the database shows an empty state, meaning that the pilgrim was not exposed to any emergency.

Assuming that an emergency has occurred and led to the pilgrim's death, and his state changed to dead as in Fig. 11, the system will then add the word "dead" in the state in the application and send it to the database. We go back to the database to see the pilgrim status changed as in Fig. 12.

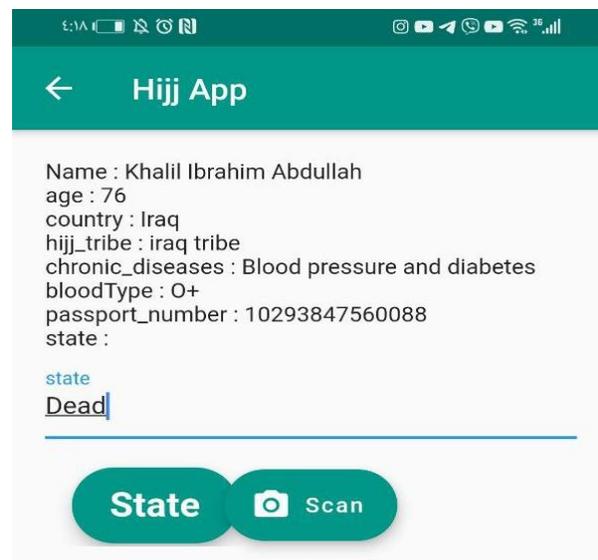


Fig. 11 Change pilgrim's State

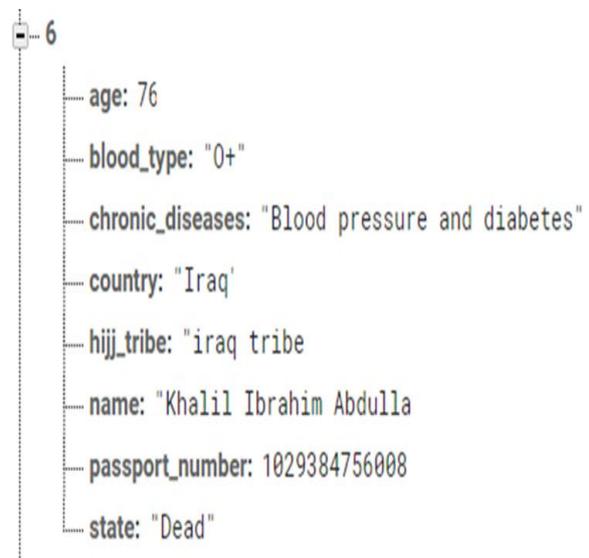


Fig. 12 State change in the database

After saving the changes in the database, the status update will appear on the web site and the pilgrim name, age and status will be displayed as in Fig. 13.



| NO. | name | age | country | state |
|-----|------------------------|-----|-----------|---------|
| 1 | Ali Ahmmed Fadel | 78 | Iraq | Missing |
| 2 | Abass Mohammed Ali | 88 | Jordan | Dead |
| 3 | Enas Omar Shaban | 54 | Palestine | Injured |
| 4 | Aisha Othman Ahmed | 66 | Turkey | Missing |
| 5 | Salman Mohammed Nasser | 70 | Kuwait | Dead |
| 6 | Qasim Ali Hadi | 63 | Lebanon | Missing |
| 7 | Ahmed bin Hisham | 79 | Morocco | Dead |
| 8 | Ahmed Abbas Amin | 67 | Tunisia | Injured |

Fig. 13 Pilgrim status update

4 CONCLUSIONS

The paper presents the application of QR code technology with a mobile application (Hajj ID) to identify pilgrims during the Hajj season in emergencies. The Hajj ID apart from being of low cost, achieved the following important goal. The design is based on the Flutter framework, which is considered currently as being one of the advanced and effective in building mobile applications because of its many advantages.

The first of which is the adoption of Dart language and behind it is a giant company that oversees its development, i.e, Google, which always provides instant updates to make it more accessible in usage and more adaptive. One other feature that made us use Flutter in this project is that you can program an application that works on the Android operating system and the iOS operating system. This is unlike other programs specialized in programming to run on either Android or iOS only but not support both.

For future enhancements, programming by Flutter is to be configured on both Android and iOS. It has been tried on Android in this paper and in the future, it will be run on iOS. Also, it is possible to apply the idea of identifying pilgrims by QR code for emergencies for both Umrah and Hajj, and not only during the Hajj.

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