

# **An Electronic and Computer System for Guidance and Counseling in Hajj**

Saleh Alshehri<sup>+</sup>

Computer Science & Engineering Department, Jubail University College, Jubail Industrial City 31961, Saudi Arabia

**Abstract.** Hajj is a great season for Muslims. This religious event is accompanied by some of the problems and challenges to those who are responsible for the organization of the pilgrimage season, the government of the Kingdom of Saudi Arabia. One of the most frequent problems is lost pilgrims. Other challenges are related to the guidance and counseling of the pilgrims. In this paper, we offer an electronic and software system which works effectively to help in guiding the lost pilgrims as well as enabling various government regulators to provide direction and guidance to the pilgrims in different languages. This system relies on RFID TAGS distributed to pilgrims and RFID readers and GSM devices distributed in different places of the holy sites. These devices read RFID TAGS and then send SMS messages via GSM technology to a computer. This computer contains a database of the pilgrimage groups, which in turn sends the information required for the lost pilgrims to their campaigns. This system can also help the hajj regulators such as the Ministry of Hajj, civil defense, SMD and protection of the environment, traffic and others to send information and guidance on general pilgrimage, the traffic situation, places of hustle, locations of danger, information about weather clock to Hajj campaigns and officials.

**Keywords:** RFID, GSM, Hajj, Pilgrimage, Lost Pilgrims.

## **1. Introduction**

The presence of about 3 million pilgrims in one place for a period of approximately twenty days creates a lot of challenges and difficulties. These challenges relate to the pilgrims themselves and others like the organizers of Hajj. One of the most important problems facing the pilgrims and campaigns is lost pilgrims during the performance of Hajj practices. Studies show that 50% of the pilgrims fear becoming lost [1]. This phenomenon may lead to many complications not only for the pilgrims themselves, but also the organizers and campaigns. This is because the campaigns are linked to specific dates to navigate between different locations and the loss of one or more of the pilgrims may upset these appointments.

Although the statistics say that the average age of the pilgrims is 36 or more years old and the percentage of pilgrims who pilgrimaged before is about 50%, the pilgrims come from multiple countries with different languages and different cultures and levels of education and thus the traditional solutions to the mentioned problem may not be practical [2,3].

Various government agencies which participate in the Hajj, such as civil defense, traffic, and the Ministry of Hajj, and SMD, environmental protection and others, encounter problems and challenges for the delivery of instruction and guidance to campaigns and then to the pilgrims. Language and culture differences may be among the most important causes of the challenges.

There are several studies conducted to deal with these difficulties, but the solutions were not up to the required expectation or were difficult to implement in many ways [4, 5]. Of the most important aspects of this is that a large proportion of the lost pilgrims are children with whom it is difficult to use GPS devices [6].

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<sup>+</sup> Corresponding author. Tel.: + 966133426960; fax: +966133426961  
E-mail address: shehri@ucj.edu.sa

For example, we can say the GPS system or special devices such as smart phones can be used but there are two major problems. The first is that it is difficult to follow three million pilgrims at the same time using GPS. The second is the negative reaction of the pilgrims when they know that they are being observed around the clock [5]. To the best of our knowledge, there has been no study to overcome those two problems at once. Therefore, we propose a system that relies on sending SMS messages using GSM and RFID technologies which it is believed it could be more appropriate than other solutions [7].

## 2. Research Methodology

RFID is a technology of identification using radio waves and can be included in the construction of a simplified system that is used in many applications, and usually consists of RFID TAG, a silicon chip and an antenna, and an RFID reader [8]. The use of RFID technology to track people is not new. In the past there were many existing methods to use of this technique. However, it used to be either expensive or hard to implement [5].

We have built an integrated model. The details of the design and system components will be presented. The role of each part of the system components and its relationship to key tasks will be discussed. Simplicity in design, affordability, installation and training of the system were also put into consideration. Figure 1 shows the general layout of the system.

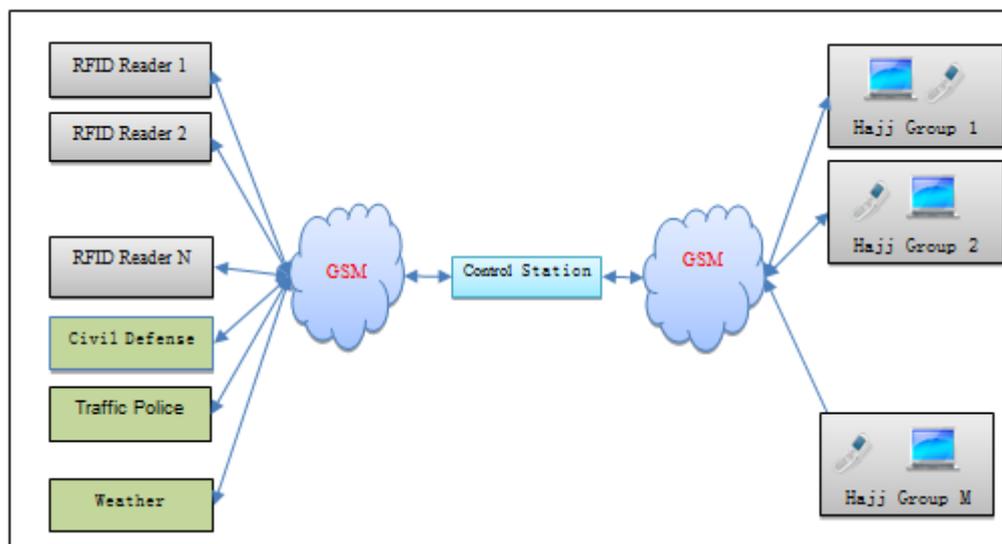


Fig. 1: General layout of the system.

### 2.1. Subsystem (RFID) Reader



Fig. 2: RFID reader with GSM module.

This part consists of the RFID reader is linked to a GSM device and contains integrated Arduino microcontroller to run the program that reads RFID TAGs. The function of this part is to read the RFID TAG and send a message to the control station. This message contains the RFID reader number, the TAG number as well as the transmission time. Figure 2 illustrates the RFID reader with a GSM module.

## 2.2. The Console

The control unit consists of

- A computer with a dedicated database.
- GSM module for receiving incoming messages from the RFID reader, as in Figure 3.
- The database contains:
  1. information of all RFID readers such as the number and location of each device,
  2. the SIM numbers dedicated to these RFIDs
  3. the Hajj campaigns SIM numbers,
  4. TAG numbers for each specific campaign,
  5. any other SIM numbers which are required to communicate with the organizers and authorities of the Hajj.

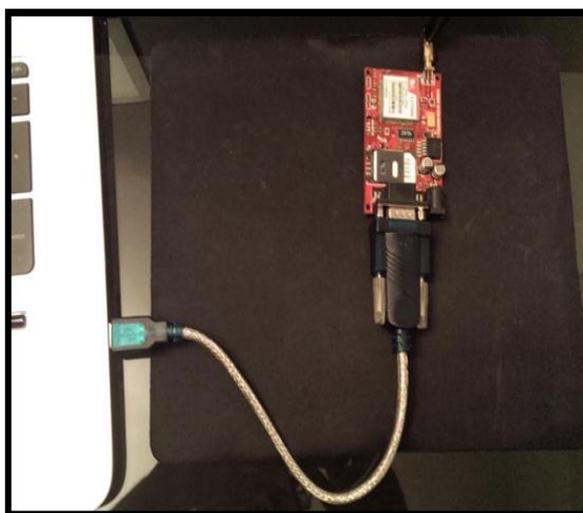


Fig. 3: The GSM device is plugged into a computer console.

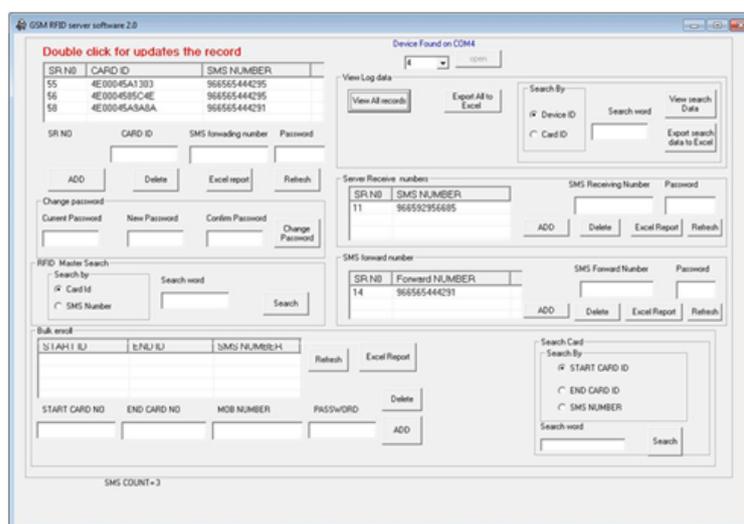


Fig. 4: The database in the computer console program.

Identification and processing of this information and the installation of these devices must be prepared in advance before the Hajj season. Figure 4 contains a picture on the computer screen showing the database.

### 2.3. Receiver Module Campaigns

This unit is installed in all of the Hajj campaigns, consisting of any number of devices containing the SIM, such as iPad, iPhone and other devices connected to a computer attached with a GSM module. The main task of this unit is receiving SMS messages from the console which is then displayed on the appropriate hardware such as LCD TV and acts as the situation requires.

### 2.4. Method of Operation

There are three possible ways to install RFID reader devices:

- Portable devices manually delivered to the members of the Boy Scouts, police and others. Location coordinates can be sent through SMS messages to the console and then to the pilgrimage groups.
- Installing the machines in the Boy Scouts, police and other centers so as to accompany the lost pilgrim to these centers and send an SMS message from there.
- Reader devices in well-known and predetermined places and be inside columns with specific colors which can be easily discerned.

Whatever the preferred method, which can be a combination of two or more methods, installing these devices in the places specified should be done before the start of the pilgrimage season. The SIM numbers and the RFID TAGs should also be prepared. Each director of a campaign is given a GSM with specific SIM number. The campaign's mobile phone numbers that will be used by managers in the pilgrimage are requested. Further, the contact numbers of the parties participating in the Hajj, which will be used to communicate with the system, are acquired.

A special team enters this information into the database in the console. Then each TAG number becomes linked to the campaign to which it belongs. Also, the contact numbers for each campaign and the contact numbers for the organizations, as well as those of the participants in the approaching Hajj become known. The campaign managers should explain to his pilgrims that when a pilgrim is lost, he or she should pass his or her hand next to the device located on of the green phosphor columns and wait next to the column until someone from the campaign comes to escort him.

When the pilgrim passes his/her hand which carries the TAG, the RFID reader reads the TAG number and then sends the message to the console, including the number and TAG reader device number and the date and time of the message. When the control station receives the SMS message, the program extracts the information from the message. It then sends the TAG number to the Hajj campaign in which this pilgrim belongs. Therefore the organizers of the campaign will be able to know where the lost pilgrim is and then go to get him. Figure 5 shows an example of receiving a message on a mobile campaign organizer's device and its place in the database.

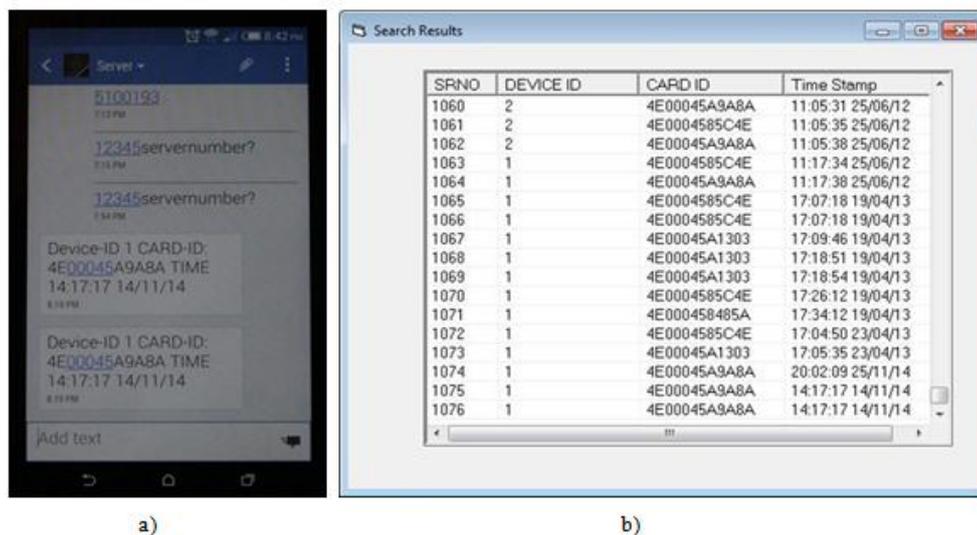


Fig. 4: a) Received message by group1 mobile phone coming from reader 1, b) SMS log in the database.

The console can receive private, warning, guidelines and awareness messages from several organizations participating in the pilgrimage season. For example, the traffic police can send a message to all campaigns through this system to inform them of serious overcrowding in a tunnel or intersections and thus campaign managers can change directions and take alternative routes. Also weather agents are able to send warnings to all campaigns predicting bad weather. Also civil defense can send warnings of a fire in specific locations so pilgrims do not go there. A Hajj campaign can have a SIM installed in a GSM module which is linked to a computer to display important information to pilgrims on a large screen. It may be appropriate to provide an automated translator of several languages in order to do the translation of these guidelines and the warning before sending these messages to the appropriate campaign. All can be done automatically in the control unit which may need to be provided with a backup device if necessary.

### 3. Other Uses

Some simple modifications can be done to the developed program (database) to get reports on the performance of campaigns in terms of speed of response and dealing with cases of loss. This can be done together with installing a RFID reader for each campaign and upon the arrival of the lost pilgrim he/she passes the TAG beside the RFID reader which in turn sends an SMS message to the console. This way the

number of lost pilgrims in each campaign and the time it takes the organizers in each campaign to deal with cases of loss can be analyzed.

There is another use for this system, which is the possibility to identify the pilgrims who have fallen behind in the Hajj and what campaigns they belong to. This can be achieved through insisting that the pilgrim continues to carry the TAG until the entry halls of the departure port. This way the departed pilgrims and their departure time are recorded for further analysis.

#### **4. Discussion**

It can now be seen what distinguish this system from those described above in [5]. These distinguishing features are as follows:

- Ease of use, where the lost pilgrim needs only to recognize the RFID reader column and pass the TAG next to it.
- Ease of installation of the hardware. It is required to install the column for the reader as well as the reader only once and each year only the SIM cards need to be installed. The devices can be powered using solar cells.
- The RFID reader device and the TAG are cheap.
- Only one computer is required.
- The required GSM devices are inexpensive.
- Complex and expensive systems such as computer networks with/without optical fiber are not needed.

The following are some difficulties that are raised from implementing such a system:

- The need to write an ad hoc database program.
- TAGs preparations and distribution is needed in each pilgrimage season.
- Taking note of the campaigns organizers contact numbers.
- Education and awareness of pilgrims regarding this system and its benefits.

#### **5. Conclusion**

This proposal presented a system to help alleviate the problem of the loss of the pilgrims as well as directing and guiding awareness and educational messages to pilgrims. These messages come from regulators and participants in the pilgrimage season such as the Presidency of Meteorology and Environment (PME), traffic, civil defense and others.

This system is based mainly on the principle of providing a known RFID TAG number, linked to a particular pilgrimage campaign. When the lost pilgrim passes a RFID TAG next to a distributed RFID reader device at various places in the pilgrimage site, the reader sends a private message to the organizers of the campaign on the Hajj to come to the place of the reader. This system can be used to send messages to campaigns through a controlling computer which receives SMS messages and then re-sends them in several languages to the campaigns.

Although the main interest of the system is in a period of pilgrimage, the benefit may also be in the visiting seasons, especially in the holy month of Ramadan, where the system can be applied in the vicinity of the Two Holy Mosques in Mecca and Medina.

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