# Pilgrim Smart Identification Using RFID Technology (PSI)

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**Abstract.** Yearly, from all around the world, different nations millions of pilgrims gather for Hajj season in holy Makkah to perform Hajj rituals, so Saudi government and Hajj institutions facing a big challenge and a lot of problems summarized in losing the official identification documents, language barrier in communicating with the authority especially in emergency cases (need guidance when missing directions, and medical problems) and determining the identity of dead pilgrims.

The aim of Pilgrim's Smart Identification (PSI) system is to improve the current identification method by using RFID (Radio Frequency Identification) technology.

**Keywords:** RFID Technology, Hajj, Hajj Campaign, Smart Identification.

## 1 Introduction

Yearly, from all around the world, different nations and cultures millions of pilgrims are gathered for Hajj season in one spot in holy Makkah to perform Hajj rituals, doing the same things at the same time. The Hajj is held in the second week of the last month of the year in Hejri calendar (Thul' Hijjah).

Hajj is the fifth pillars of Islam. Every Muslim has a good health and enough money must perform Hajj once at his life time. The Hajj season is the most crowded event that is repeated every year and the number of pilgrims is rapidly increasing year after year. That means the Saudi government in collaboration with Hajj institutions must do their best to make it the most beautiful and comfortable journey for every pilgrim. However, Saudi government and Hajj institutions facing a big challenge and a lot of problems due to the huge number of pilgrims summarized in language barrier, pilgrim identification in case of losing etc. So, they try to solve these problems especially lost problem by nominating a worker for every group of pilgrims to look for and guide the pilgrims by checking their names' lists and passports many times to make sure that none of them are lost. This process is a waste of time and effort.

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## 2 Problem Definition

During Hajj season many of the Saudi ministries, government's sectors and other committees who are responsible for managing and coordinating the pilgrims' services face hard time in organizing the Hajj process. The difficulties in organizing the Hajj process come from many issues dealing with the rite of the pilgrimage, because it is a unique gathering of an extensive number of Muslims who came from various countries to join processions of hundreds of thousands of people, who simultaneously converge restricted area on Mecca for the second week of the Hajj, and perform a series of rituals.

The large gathering of people raised many critical issues for the organizations and committees who have a full responsibility to take care of them. Some of these issues are summaries in:

- Losing the pilgrims' identification documents.
- Lacking of knowing the direction to re-join their campaign.
- Communicating with the guidance and authorities in case of missing or losing properties.
- Knowing the health medical record of the pilgrims.

For instance, if a pilgrim does speak neither Arabic nor English language, his\her doctor will not be able to get any information about his\her medical history. In emergency situations, the patients might come to the hospital in a coma, stroke or any critical state when the doctors have to find out the reason as soon as possible so the proper action can be taken immediately to save their lives. In presence of language barrier the situation will be more difficult to manage. The technology has made things easier for doctors in term of patient's life saving. Validity of patient's data in a special (card or tag) including chronic illnesses, current medications, previous surgeries and allergy to some food, material or drugs can help the emergency team to act rapidly and therefore saving the patient's life. For example, the patient who comes with coma due to overdose or side effect of his/her own medicines can be treated and improve dramatically if the specific Antidote given after identifying the drug that caused this coma, in this case the patient is unconscious and presence of his/her current drugs list will be enough to save life. This is a simple data that has significant benefit so how if a proper health record is available.

Last ten years ago, the Ministry of Hajj has provided nine computerized centers which operated by a total of 350 manpower. The ministry has also established 21 guidance centers to assist and help pilgrims in the holy places under their supervision [1].

According to the data that the Saudi government has shown that "18 percent of the second proportion of pilgrims suffered from being lost; that percentage represent 200 thousand pilgrims a year, and 84 percent of the lost pilgrims agree that this problem discomfort and confuse their Hajj journey" [1]. Arafa, Mena, Mozdalefa and also the holly Mosque are a very wide area that pilgrims go to and gather in during the Hajj season.

It is obvious that the language barrier is considered one of the main difficulties in communication. According to the reported interview done with one of the hiring guidance, worked as a guide man on one of the past Hajj seasons, who pointed to the difficulties that happened due to the lack of having a way to find the location of each pilgrim professionally. This guidance mentioned that he had communicated with pilgrims who spoke different languages daily using an information card carried by each pilgrim. However, he emphasized that the process in this case required walking with each pilgrim to his camp for a simple reason because of the language barrier and the lack of understanding. He said: "I am having a big difficulty with pilgrims who missed their cards that indicate the position of their camps, which means that I have to contact with all the Hajj campaigns, one after the other and tell them the description of the lost pilgrim until I find the right campaign"[2]. Furthermore, the Ministry of Hajj recruited many multilingual translators to facilitate the communication with the pilgrims from non-Arab nationalities; additionally it requested all owners and investors of residential units and hotels to provide identification cards and distributed them to all pilgrims [1].

The other problem is raised during the pilgrims' transportation, when the responsible workers for the Hajj campaign check out each pilgrim's passport, in order to ensure that they are carrying the same group of pilgrims. The process of checking the pilgrim's identity during the transportation consumes a lot of time and it is obvious to lose some of them.

To avoid all the mentioned problems, we decided to implement "Pilgrims Smart Identification" (PSI) system using RFID technology. PSI is aimed to identify the lost, die, sick pilgrims and guide the lost pilgrims to their camps and overcome the language barrier.

Radio-frequency identification (RFID) is a technology that uses the radio waves to exchange the data between the RFID reader and the electronic tag attached to an object, for identification purposes. RFID makes it possible to give each pilgrim its own unique identity number [3]. In other words, it does not require line of sight to "see" an RFID tag, the tag can be read even if it is a few meters away, and unlike barcodes RFID tags can be read hundreds of tags at time.

## 3 Objectives

The main objectives of PSI are including the following:

1. Make Hajj journey easier for pilgrims and reduce the problems that possible occurs.
2. Save Hajj authorities time and efforts in identifying pilgrims.
3. Overcome the language barrier obstacle between the pilgrims and Hajj authorities in case of losing or missing.
4. Identify the lost, died, and sick pilgrims.
5. Know the health medical record of the pilgrims.

## 4 Automatic Identification Related Work

RFID-Based Pilgrim Identification System proposed by Mohandas which a prototype for identifying pilgrims to facilitate the declaration of the pilgrims in case of dying or missing. He used RFID passive technology for the performance of the prototype, and he concentrate on storing pilgrims' information such as personal information, medical information and contact information of the pilgrim's Hajj campaign. [4].

Additionally, [5] proposed RFID Based Library Management System (LMS). The library management system is used to save the time to the members who work on the library, fast access to the book in searching, and decrease errors that for example happen in put book in shelf etc. RFID used here rather than barcode because it can be re-used tags many times, to speed up self-check in/out processes, to make the library secure from the theft, tags cannot be visible like put it in cardboard cover of book, and can store data such as stack number, book number, author information but barcode just store identification number. It used RFID technology with two readers: Work-about Pro Ultra High Frequency (UHF) RFID handheld reader that has Windows Embedded CE 5.0 and full Video Graphics Array (VGA) that use for searching, and Mercury4 RFID reader used to transfer data to a remote computer over a network, EPC global Generation2 UHF passive RFID tags. In LMS the RFID has three integration modules: Searching module for fast searching of books, transaction module provided transaction forms, and monitoring module to monitor the incoming and outgoing things [5].

Furthermore, RFID has been used to manage the patient in the hospital [6]. Hospitals always used paper to save information of the patient during registration and updated by nurse. This is inaccurate because it written by hand. Nurse takes care for inpatient and outpatient. The Hospital Patient Management System (HPMS) provides low cost of health care, easy automate and simple patient identification processes in hospitals and use mobile device for design a health care management system. The system used RFID technology, to update information Wi-Fi connection using mobile devices such as PDA. RFID tag is put on wristband and has an identification number with password to protect it, and can store patient data such as name, patient ID, drug allergies, drugs that the patient is on today, blood group. Each patient wear wristband and contains an antenna and a tiny microchip. The data can read from the tag even the patient was sleep without disturbing them. The data can enter/update by HPMS application developed by Agile System Development Methodology (ASDM) using C# in Microsoft Visual Studio.net 2003 environment [6].

## 5 PSI Methodology

The first step the developers need to decide in order to produce the desired system is the instruments and tools used for the data collection. Thus, PSI developers decided to use interviews and questionnaire instruments to help them understand the Hajj campaign mechanisms in dealing with their pilgrims' identification in case of getting lost and treating them when they have health problems. Also, through the interviews with the Hajj campaigns, the PSI developers investigated about the different ways to organize work for the Hajj campaigns' workers. The other instrument in the data

collection is the distribution of the questionnaire to recognize the users' characteristics and the most important tasks that need to be included in the PSI project.

The PSI developers realize that, in order to facilitate storing and retrieving the information, they need to build a database.

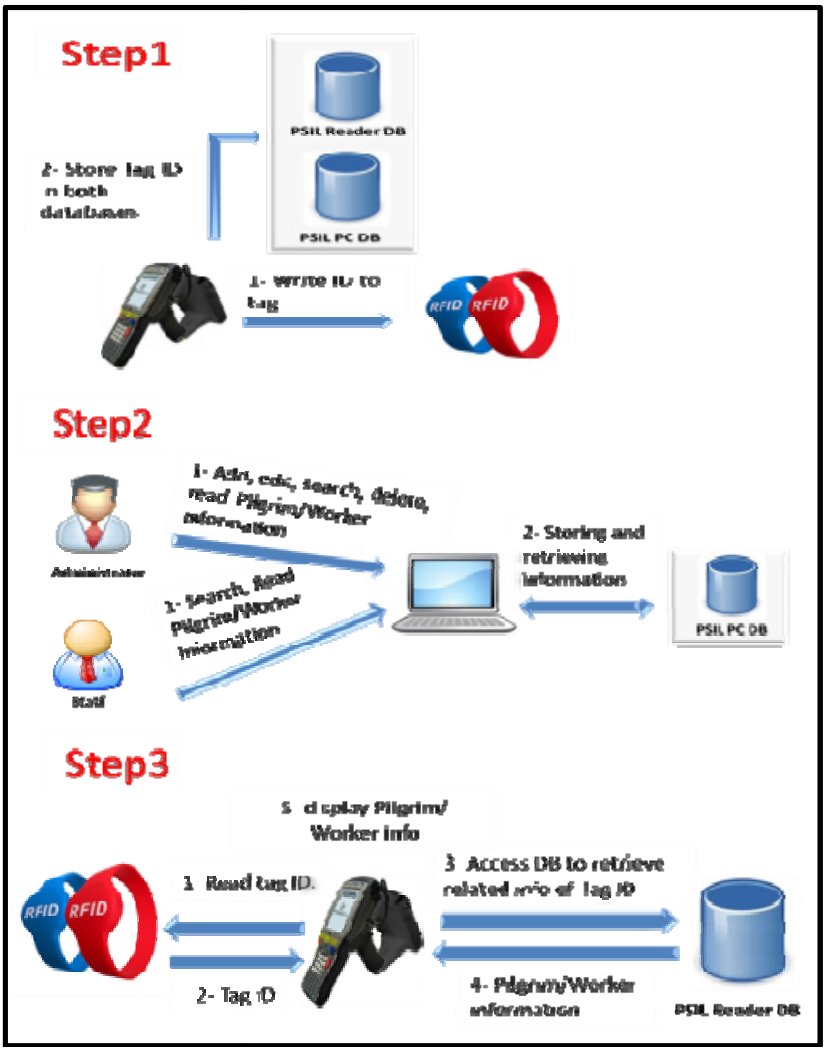


**Fig. 1.** PSI Architecture

## 6 PSI Architecture

PSI system is based on utilizing the RFID technology, and it consists of four components, which are RFID wristbands, end terminal PC, the database, RFID reader. Figure -3 shows the PSI components and architecture.

The RFID wristband is a basic component in PSI system which plays a major role in saving the pilgrim's or worker's information. The wristband is distributed to each pilgrim and worker. It's used as an identifier; it has a unique tag id stored in it.

The stored information will include the following:

- Personal information like the name, telephone number and address in Saudi Arabia and in Home country, nationality, etc.
- Medical condition information
- Contact information of his Hajj campaign.
- Picture of the pilgrim or worker.

PSI system consists of two applications; the first one is on the PC and the other is on the RFID handheld reader. Both have a graphical user interface which is developed by Visual Studio 2008 and C# to facilitate the data entry as shown in figure -2 and figure -3 respectively. Every application has its own independent database. So, PSI system has two databases which are used to store pilgrims, workers and login data, one of them stored in the PC which is developed by SQL server 2005 and the other one is in the RFID reader (CSL CS101-2 EPC Class 1 Gen 2) which is developed by SQL compact edition 3.5. The replication is used between the two databases.

RFID reader sends periodic signals to inquire about any tag in the surrounded area. The tag is represented in PSI system as a wristband.

The passive tag draws the power from RF field of the reader to operate its micro-processor that strengths the data, then the RFID tag reflects the signals which contains the tag ID that's stored in the manufacture. These tags will be reassigning them with a new tag id by the hajj campaign based on their rules by using the function (Write Tag ID) at the reader application.


**Fig. 2.** PSI PC's Application

Through PSI PC's system the administrator assigns pilgrim/worker information to these tag ids. PSI PC's application has two types of accounts; one for administrator with the ability to add new pilgrim or worker, edit pilgrim or worker information, read pilgrim's or worker's information, delete pilgrim or worker, search for pilgrim or worker information, add new administrator, add new staff, delete staff and change password. Staff account also interacts with PSI system by read pilgrims or workers information, search for pilgrim or worker information and change his password. The adding and deleting on the PC's application will be stopped at a specific time after insuring that every pilgrim and worker in the campaign has been registered to the system. The PSI reader's application is also standalone, its main functionality is to read the stored Tag Id on the wristband's tag, retrieve the related information of the pilgrim or worker and display it in the RFID reader screen, only if the tag is assigned to a pilgrim or worker in the database. Also this application has the ability to add and delete pilgrim's or worker's information in case of emergency.

The entire previous scenario is done to achieve PSI system's objectives and goals.


**Fig. 3.** PSI Reader's Application

## 7 Conclusion

PSI system is developed to facilitate most important Hajj obstacles from different aspects. Mainly, from Hajj authority perspective, it saves Hajj authority's time and efforts by facilitating pilgrims' and workers' information registry. Additionally, PSI system helps guiding lost pilgrims to their campaigns by using RFID reader to read campaign information (campaign name, address and phone). Also the stored information helps to contact with pilgrims' family in their countries in emergency cases.

In addition to making Hajj journey comfortable for every pilgrim by avoiding big troubles due to lack of communication and understanding because of the language barrier that appears in different areas. From the medical side, PSI helps doctors to

know the health medical records of pilgrims by correctly diagnosing the emergency cases. Also it helps in identifying lost, sick and deceased pilgrims.

PSI system is composed of PC application and RFID reader application both are developed using C# and .Net farmworker. In PC application, PSIL is used to register pilgrims' and workers' information and modify operations to the SQL server database which makes them easier and faster than manual registration. Also it enables the person responsible to view the list of all pilgrims and workers and to search about a specific pilgrim and worker.

While the reader application provides different functionalities. for example, programming the wristband with a given tag id, which reads multiple tags at one time then displays pilgrim or worker information in the reader screen related to the selected tag from SQL compact Edition database. In unusual cases, there is an ability to perform add and delete operations from the reader application.

Finally, both applications are user-friendly and have simple interfaces, the developers hope PSI system will have a good impact on social services and help Hajj authorities to manage Hajj problems in an efficient way.

## 8 Future Work

PSI system is developed to help Hajj authorities in identifying pilgrims and workers. It consists of two parts: the first part is a PC application which is used to facilitate entering pilgrims' and workers' information (add, edit and delete) operations and the second part is Reader Application which is considered as the core of the system. In addition to pilgrims' and workers' information entry process, it is used to write id tags, read tag id and retrieve the related information from the database.

1. Implementing GPS to determining the pilgrim's position
2. Help request feature: possibility of guiding the pilgrims to their camps in case of losing direction.
3. Encryption the stored information in the database.
4. Generalize the RFID technology to all the Hajj sectors to minimize the common problems that occur during Hajj season.

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