A FRAMEWORK FOR IMPROVED HAJJ MANAGEMENT AND RESEARCH

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ABSTRACT

Hajj is a unique gathering of its kind and poses a challenge to its organisers. Recently many types of identification and sensor devices, including RFID tags, have been developed. Such technologies, together with the use of database systems, can be extremely useful in improving the Hajj management. Sensor devices can be used to track movements of individuals during the Hajj period. Various types of scanners such as palm, fingers, eye-lid, retina and face scanners can also be used to correctly identify individuals who are lost or dead in some unfortunate circumstances. The data provided by the pilgrims can be organised in the Hajj database and can be used to effectively identify individuals. There are many other aspects of Hajj which might be worth researching. The aim of this paper is to provide a framework for improved management of Hajj and set the agenda for research in the future.

Keywords: Hajj, Pilgrim, Munazzam, Ameer, Sensor Network Systems, RFID tags.

INTRODUCTION

Management of the annual pilgrimage to Mecca known as Hajj is a very complex task. In order to improve the Hajj management, there are many aspects which present opportunities for in-depth study and research. In this paper, certain aspects of pilgrim identification problems are discussed and a framework for resolving these problems is presented. In doing so, use of certain recent technological tools is advocated. This paper also outlines other potential areas for future research.

Many sensor and scanning devices including of Radio Frequency Identification (RFID) devices available today are very useful in effectively managing large crowded events. A full description of various types of RFID devices and step-by-step process to build them for different purposes can be found in [1], [2], [3] and [4]. RFID tags, to be referred as tags, are already in use to manage many businesses and social activities. Tags come in many shapes and sizes as can be seen in [1]. There are tiny RFID chips, as small as 2x12mm glass tags, known as VeryChip, which can be implanted under the skin of human body parts. VeryChips are approved for human implantation by the Food and Drug Administration (FDA) of the United States of America. For details, see [1]. By implanting a tag, a human can be turned into a Spime, as described in [2], which can be tracked in its location and the time when it was detected at that location. By doing so, a missing person can be found easily by means of processing signals from the tag sensors or codes. However, the author does not advocate the use of VeryChips for the Hajj pilgrims for social and cultural reasons. Instead, ordinary RFID tag, carrying a code to the pilgrim record in the backend database, can be put in an arm or wrist by linking it to a sensor network and hence providing a mechanism for information retrieval. In this way the tag can help provide vital medical data to paramedics to assist in treatment of patients in emergencies. Human lives are often lost in disasters such as tsunami, earthquakes, stampedes and fires. By using traditional means, it is very difficult to accurately identify badly mutilated bodies. Like VeryChip, the DNA technology is also very effective and easy to use, but can only be administered amongst the consented pilgrims due to privacy and confidentiality concerns. The use of other scanning devices, in many situations, can also very useful in identifying a person, dead or alive. For example, biometric scans of fingers, palms, eye-lids, retina or face are very effective.

In large congregations, many people go missing, and in some cases die in instances such as stampedes, fires and collapse of buildings. For example, during 1997 and 2005, several hundred Hajj pilgrims died of fire or stampede. Some accounts of Hajj can be found in [4], [5], [6] and [7]. It is very difficult to identify badly mutilated and charred bodies due to lack of information. Hence, there is a need to make use of the available technology to find solutions. Similar problems also exist in organising other events like Kumbh Mela in India, a gathering of tens of millions of pilgrims in India. Details on Kumbh Mela, referred to be as Kumbh,
can be found in [8], [9], [10] and [11].

Wireless and the other modern technologies can play a vital role in effectively managing very large congregations like in Hajj and Kumbh. With relatively simple application of these technologies, loss of several precious lives can be saved. As certain rituals of Hajj and Kumbh are performed in very large congregations, the organisers are faced with many challenges of crowd management, especially when hundreds of linguistic and ethnic backgrounds are involved.

In the remainder of this paper, a case study on identification of Hajj pilgrims is presented. In this case study, only specific problems are identified and their solutions based on technology are suggested.

SOME PROBLEMS FACED BY THE HAJJ MANAGERS AND PILGRIMS

A. On arrival, some pilgrims have to wait for several hours at the airport (usually the Hajj terminal) before their immigration and other formalities can be completed.

B. There are a number of activities where overcrowding can not be contained. Each year, due to overcrowding, thousands of pilgrims go missing for days or weeks (and some of them may never be found). Reuniting the pilgrims with their groups may take considerable time due to various reasons. Most of the pilgrims do not remember the details of their places of stay, and hence cannot return to their places of stay on their own. At present, the Hajj managers (Munazzam) provide every pilgrim with a wrist band which has an identification number. The identification number is linked only to some limited data in the Munazzam office. These details are not readily accessible by the police and other agencies, and so they are not in a position to reunit the pilgrims unless they contact the Munazzam office, which is usually done only in emergencies and may take considerable time.

D. The health requirements for granting a Hajj visa are very basic. For example, there is nothing to prevent an HIV carrier from performing Hajj. Also the Hajj organisers provide visa for the disabled and aged. If it continues to happen, pilgrims should be provided with adequate facilities and be properly monitored.

E. Each year, some people may not return back to their countries and hence become illegal immigrants in Saudi Arabia (and later may illegally migrate to the neighbouring countries). There is always a problem of finding accurate details of such illegal migrants even if they are caught.

![Diagram of Hajj management process](image)

All of the above issues or problems are due to the lack of information at the right place and right time. Discussed below are some ways of addressing these issues.

TECHNOLOGY-BASED SOLUTIONS FOR PILGRIM IDENTIFICATION PROBLEMS

Combination of wireless and database technologies seems to be unavoidable if the solutions for many Hajj management problems are to be provided. In making a case for technology based solutions, there is no suggestion to alter the way in which the Hajj is performed, nor is a suggestion to alter the current roles of
any of its stakeholders including those of Hajj Munazzams.

1. Collecting pilgrim information and providing them with RFID tags
At the time of visa application, detailed pilgrim information including the health information should be collected into a (distributed) database system, to be referred as the Hajj database. With the grant of visa, each pilgrim should be provided with a tag. The Hajj database should be linked to the immigration processes at the airports and other strategic locations, and be accessible to the important stakeholders.

2. Pilgrim Processing and Collection of Additional Matching Information
Upon the arrival of pilgrims at the Hajj terminal, immigration officials should use the pilgrim tag along with the passport to retrieve and validate the pilgrim data. At this point, pilgrims should be required to undergo biometric scans of one or more of their identifiable limbs. The scanned information should automatically be entered into the Hajj database.

3. Installation of Sensors, Processors and Display Screens
In order to receive and transmit information, tag readers, sensors and processors would be required to be installed in sufficient numbers at all strategic location. Mobile tag readers and scanners should be provided to key stakeholders including the Ameers and Munazzam. Large display screens can also be installed at some of these locations to display warnings, and other important information. These measures, once in place, will provide solutions to many problems associated with the identification of pilgrims. An overview of the framework for management of Hajj with these tools and technologies is given in Fig 2.

**BENEFITS OF THESE TECHNOLOGIES**

A. Reduction of the waiting periods at airport
Scanning the pilgrim tag at the Hajj terminal and retrieving the matched information from the Hajj database would eliminate the use of paper forms and speed up the pilgrim processing. This will also eliminate the need for the custody of pilgrim passports by Munazzam. This would result into considerable reduction in the waiting period at the airport and other check points.

B. Tracking the movements of individuals
With the help of the tag sensors and monitors, movements of pilgrims can be tracked on a regular basis and the information can be collected in the Hajj database. In case of a missing pilgrim, the organisers and help agencies can track the movements of pilgrims. The information collected from the sensor networks into the Hajj database would provide the place and time of the sightings of the pilgrims. In this manner, the search can be refined to a considerably small domain. If a pilgrim is unable to reach his/her destination, police officers can retrieve the accommodation information using the pilgrim’s tag, and hence unite the pilgrim. Similarly, in the case of an unfortunate death of a pilgrim, the tag can be used to gain complete information from the Hajj database. If for some reason, tag was not found with the deceased body, information can be retrieved on the basis of his/her biometric scans stored in the database. In cases of badly mutilated or burnt
bodies, biometric scans of some of the limbs might still be helpful to identify the persons. In the worst case scenario, where the body is mutilated or burnt to the extent where biometric scans are not possible, the suggested system would be inadequate.

C. Well being of pilgrims and check on the spread of diseases
As the health data is collected into the Hajj database, the organisers can better manage pilgrims posing potential health risks to fellow pilgrims. In cases of emergencies and other medical needs, data on the pilgrim health would provide vital information to the paramedics.

D. Better planning of future pilgrimages
Data collected during a pilgrimage would be a useful resource for better planning of the future pilgrimages. By mining the historical data, many other problems can be solved. For example, it would be easier to enforce a restriction on the number of pilgrimages for individuals. Such a restriction is desirable as the holy cites of the Hajj have only limited areas.

E. Tracking Illegal Migrants
It is a daunting task for any government to track and identify illegal immigrants. The data in the Hajj database would be very useful in tracking and identifying the illegal migrants once they are caught.

FUTURE RESEARCH
There is scope for research in other aspects of Hajj, some of which are listed below:
1. Pilgrim Health
   At the moment, the Saudi authorities provide health facilities for the pilgrims. This makes it difficult for the local population of Mecca and the surrounding regions to get medical help. Some countries also bring their health experts and medicines for their pilgrims. Research may look into the possibilities of better organisation of the health facilities, including an option of introducing health insurance and allowing private health organisations to participate in the scheme.

2. Hajj Communication
   With pilgrims coming from different ethnic backgrounds with hundreds of different languages, research may look into the need for sign language and other means of communication.

3. Hajj Security
   At the moment there seem to be no issues with pilgrim and infrastructure security. However, research may look into the details of technological tools, mechanisms and the measures to prevent the occurrence of any mischievous and harmful acts.

4. Hajj Infrastructure
   The Saudi government has continuously been improving the Hajj facilities. Research could look into future infrastructural needs, including the need for expansion of accommodation in Mina.

5. Hajj Travel
   Movement in and around Mecca is very time consuming. Future research may suggest some better ways of transportation to overcome the long delays, and facilitate smooth transition of pilgrims.

6. Local Pilgrims
   Thousands of people from Mecca and the surrounding regions make up their mind for Hajj at the last moment, often without any intimation to the Hajj organisers. This poses serious difficulties in managing the Hajj. How could these pilgrims be managed in a better way?

CONCLUSIONS
Tracking and identifying individuals in large congregations is a very complex problem. It becomes even more complex when hundreds of languages, ethnicities and beliefs are involved. Although modern technologies offer remedies to such problems, but may not provide all the answers. The use of more advanced, efficient and effective technologies, which may provide all the answers, may not be applicable due to social and cultural sensitivities. The use of technologies mentioned in this paper is perceived to be
acceptable to the pilgrims and the managers of Hajj. The framework for addressing these issues and problems is also applicable to problems of the other congregations such as Kumbh.

The major problems the Hajj organisation is associated with the crowding of events, which have roots in ignorance or pilgrims’ sectarian perceptions. Until these perceptions change, problems would continue to persist.

The current version of the system is a prototype and needs to be tested in a real world scenario. It would be suitable for deployment after acceptability tests are successfully conducted. A project team at the University of Canberra has been working on the analysis, design, implementation and testing/evaluation.

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