An Investigation of IoT Importance and Viability of Health Records Retrieval using Electronic Tags in Pilgrimage

Ali Ibrahim Latif[1], Marini Othman[1], Nor'ashikin Bte Ali[1], Azizah Suliman[1], Omar Adil Mahdi[2]
[1]*College of Information Technology, Universiti Tenaga Nasional, Kajang, Malaysia.*
[2]*Department of Computer System & Technology, Faculty of Computer Science & Information Technology Building, University of Malaya, 50603 Kuala Lumpur, Malaysia.*
ali80_82@yahoo.com

***Abstract*—Healthcare services is one of most important domains in the world. One of most crucial aspects of healthcare services is the need to make accurate healthcare decisions at the right time. Retrieving useful historical health records of patients in real-time is necessary to provide accurate healthcare decisions. Traditional health record systems such as paper-based system require time and effort to collect, manage, and retrieve patients' records. Electronic health record systems were adopted to allow healthcare staff to retrieve useful health records in real-time and consequently improve and speed up healthcare services. Although EHR is effective to serve patients in their local countries, the implementation of EHR for global purposes is still an issue and EHR is not always applicable for people who travel to other countries. One of the most important purposes for Muslims to travel is the pilgrimage journey to the Kingdom of Saudi Arabia (KSA) to perform religious rites. The millions of pilgrims converging there may need healthcare services and these services should be accomplished accurately in real-time which require electronic-based historical health records approaches. This study aims to investigate the importance and viability of IoT implementations to support retrieval of pilgrims' EHR using electronic tags. A questionnaire with 60 academic staff and interview with five experts from KSA were conducted to address the main aim of this study. The significance of the results shows that EHR supporting tag reading is a promising solution to enhance healthcare services and counter the challenges of EHR implementations in pilgrimage.**

***Index Terms*—HER; Electronic Tags; IoT; Pilgrimage; Travellers.**

I. INTRODUCTION

Health professionals need to have good vision of health cases in order to make timely and accurate decisions [1, 2]. Patient's health records represent an important source that supports healthcare decisions [3]. Nonetheless, the traditional retrieving systems of health records such as paper-based systems still face many problems such as probability of damage or harm to the health records, and time requirement of health records collecting, managing, and retrieving [4]. These challenges and more could delay or effect on the efficiency of health services.

Many people have travelled abroad to different destinations for different purposes and have been exposed to different health risks [5]. Pilgrimage is considered as the most holy and important travel for Muslims. Each year millions of Muslims travel to complete pilgrimage rites. Health risks have been documented most notably during the Hajj [6]. Moreover, travel-related somatic and psychic health problems occur more frequently but are less severe remain unreported and should be explored only in specific studies [7, 8].

Pilgrims need healthcare services and these services should be accomplished accurately in real-time which require electronic-based historical health records approaches [9].

EHR has been widely used in many studies. EHR has been defined as follows: EHR encompasses all health information in all media forms regarding an individual and is primary source for recording and documenting client health data [10]. Wager et al. in [11] provided another definition: Electronic health record: an electronic record of health-related information on an individual that conforms its nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across more than one healthcare organization.

EHR combines data from all ancillary services with other medical care components. These clinical data have different methods for sharing or importing various components, such as presentation or data integration [12]. Internet of Things (IoT) technology could be an effective solution to retrieve health records of pilgrims from their original countries and pass it to healthcare staff in pilgrimage health centers [13]. This research focuses on the importance and viability of deploying IoT to retrieve the EHR of pilgrims using electronic tag reading.

The main purpose of this study is to analyse the viability and importance of EHR using electronic tags in pilgrimage to enhance the health services of pilgrims. It also aims to investigate the challenges of current health record approaches and the importance of EHR.

II. PROPOSED FRAMEWORK

Outdoor services like pilgrims' healthcare services require two main IoT layers which are: 1) lower layer, and 2) upper layer [14]. Lower layer (RFID) consists of electronic tags and wireless sensors. Sensors read data of tags and transfer it to

upper layer. Upper layer (WSN) consists of super nodes and base station [15, 16]. Super nodes handle data from lower layer and transfer it to base station. Hence, data stored in base station is managed and processed automatically connecting with central web servers [17-19].

By reflecting the above two layers of IoT in technical implementations, there are 4 main layers of IoT environments which can be described as the following (Figure 2):

- Connectivity Layer: The electronic tags should be within very short distance of wireless sensors i.e. 3 meters [20]. Data is transferred from electronic tags through sensors to next layer (access layer).
- Access Layer: The sensors should be in short distance of super nodes i.e. 100 meters. Data is transferred to base station from sensors through super nodes [21].
- Abstraction Layer: This layer responsible for transfer the data from base station to central web servers through open gateway such as internet infrastructures [22].
- Service Layer: This layer is about providing real IoT services, the data that delivered from abstraction layer are processed and the results display on output devices such as monitors [23]. These monitors are usually connecting with the tags in connectivity layer. Thus, the results of data processing send from service layer to connectivity layer through access and abstraction layers respectively.

According to the IoT framework, pilgrims need to have an electronic tag which identifies their personality (ID). In the event of need for healthcare services, healthcare center is equipped with wireless sensors to read pilgrim tag. Data is transferred from wireless sensor to base station via super nodes. Base station sends request via internet network to the pilgrim's country of origin in order to acquire pilgrim EHR from health database in central web server. Web server sends the pilgrim's EHR via internet network to base station. Base station displays output on a monitor that is connected with the sensor that sends tag data.

III. Materials and Methods

Data was collected from healthcare staff in the Kingdom of Saudi Arabia (KSA) using a questionnaire in order to explore the current processes and challenges of healthcare services in pilgrimage and the importance of EHR to support these activities. The sample of the study is composed of 60 out of 350 healthcare staff in four healthcare centers. According to [24], the sampling percentage should be 10% at minimum for the size of population between 101-1000 workers. Thus, the sampling percentage of this research is valid (i.e. 17.1% of study population).

The questionnaire included four sections which are: (1) personal information to ensure the expertise validity of experts, (2) importance of EHR to support healthcare services in pilgrimage, (3) challenges of EHR implementation in pilgrimage healthcare services, and (4) EHR supporting tag reading to support pilgrimage healthcare services.

IV. Results

A. Demographic Data

With regards to the respondents' gender, there are 22% of female respondents and 78% male respondents. The percentage of gender variable is considered to reflect the reality of health activities in pilgrimage. The male staff members are usually more involved in the pilgrimage health activities than female staff members.

Regarding the respondents' percentages based on their age, most of respondents' ages are between 30-40 years which represent 65% of respondents (39 respondents). Thus, the presented data from the respondents will be efficient for future development i.e. the respondents will work in the health domain in KSA for a long period (i.e. 15 years).

According to the respondents' job roles, there are 29 respondents working as nurses (48% of total respondents) followed by 24 respondents working as doctors (40% of total respondents). There are also 7 respondents working as support staff (12% of total respondents). Most respondents are mainly involved in the healthcare activities (i.e. doctors and nurses).

The majority of the respondents had 4-7 years of experience (33 respondents), followed by 34% with more than 7 years of experience (22 respondents). Therefore, this segment of respondents is mature enough to provide the needed information for the study, the employees with many years of experience can provide rich data to support the questionnaire analysis usefulness. With regards to the number of pilgrimage seasons attended by respondents, 43% of total respondents attended more than 8 pilgrimage seasons (26 respondents). There are 22% of respondents total attended 4-7 pilgrimage seasons (13 respondents), followed by 20% that attended 2-4 pilgrimage seasons (12 respondents). The respondents that attended less than two pilgrimage seasons are 15% of total respondents (9 respondents). Therefore, the respondents are able to provide valid responses based on real situations of pilgrimage healthcare activities.

B. Availability of Pilgrims' Health Records

Table 1 shows the answer regarding availability. The pattern reflects lack of personal and health records that support optimum healthcare. As expected, participants endorsed questions regarding needs for health records.

C. Challenge of Health Records Retrieval

Table 2 reflects on challenges: lack of staff and infrastructures are apparently major challenges. It was also shown that the respondents are not familiar with the technical issues of electronic health care methods. Therefore, they are not sure about the privacy effectiveness of health electronic approach.

D. Importance of Electronic Health Records Retrieval

Table 3 shows consistent answers that support the importance of having EHR for timely decision-making and better services. Notably, respondents were aware that EHR would improve communication and reduce costs.

Table 1
Availability of Health Records

Item No.	Item	SD	D	N	A	SA	Mean	Agreement Level
1	Each pilgrim has his/her personal records	55	4	1	0	0	1.10	Very Low
2	Each pilgrim has his/her health records	56	4	0	0	0	1.06	Very Low
3	Health records are continuously updated	55	3	2	0	0	1.11	Very Low
4	Pilgrim can access his/her own records	56	3	1	0	0	1.08	Very Low
5	There are systematic methods to access health records of pilgrim	56	4	0	0	0	1.06	Very Low
6	The development has an electronic management for healthcare and emergencies	57	1	2	0	0	1.08	Very Low
7	There is necessity to store and retrieve the pilgrims' health records in different formats i.e. images and texts	0	0	0	8	52	4.86	Very High

Table 2
Challenge of Health Records Retrieval

Item No.	Item	SD	D	N	A	SA	Mean	Agreement Level
8	There are not enough staff to manage an EHR system	55	5	0	0	0	1.08	Very Low
9	The staff do not have enough computer skills to manage an EHR system	54	6	0	0	0	1.10	Very Low
10	There are not enough technology facilities to deploy the electronic healthcare systems	55	5	0	0	0	1.08	Very Low
11	There is budget limitation in developing and deploying an EHR system	59	1	0	0	0	1.01	Very Low
12	Privacy of health data limits the use of an EHR system	0	5	49	6	0	3.01	Medium
13	The traditional healthcare approaches (i.e. paper-based) delay the health-care services for pilgrims	0	0	0	2	58	4.96	Very High
14	The traditional healthcare approaches (i.e. paper-based) decrease the understanding of health cases	0	0	0	1	59	4.98	Very High
15	The traditional healthcare approaches (i.e. paper-based) increase the expenses of healthcare services	0	0	0	1	59	4.98	Very High
16	There are challenges in understanding non-Arabic pilgrims in the context of healthcare services	0	0	0	1	59	4.98	Very High

Table 3
Importance of Electronic Health Records Retrieval

Item No.	Item	SD	D	N	A	SA	Mean	Agreement Level
17	EHR speeds up the healthcare services	55	4	1	0	0	4.80	Very High
18	EHR supports the accuracy of healthcare services	56	4	0	0	0	4.86	Very High
19	EHR based on Arabic language increases the usefulness of healthcare services	55	3	2	0	0	4.88	Very High
20	EHR based on Arabic language makes the healthcare services easier	56	3	1	0	0	4.93	Very High
21	EHR can improve communication with the pilgrims' country (i.e. Health Ministry) to describe health cases accurately	56	4	0	0	0	4.91	Very High
22	EHR decreases the expense of traditional healthcare approaches (i.e. paper-based)	57	1	2	0	0	4.91	Very High

V. FINDINGS

The current healthcare services in pilgrimage are not supported by EHR. Usually the paper forms are used for specific purposes such as producing general reports about pilgrimage activities. The use of EHR in pilgrimage could speed up and improve the quality of healthcare services. EHR implementations in pilgrimage face many challenges such as time, effort, and financial costs. The EHR supporting tags reading is a promising solution to enhance healthcare services and avoid the challenges of EHR implementations in pilgrimage.

VI. CONCLUSION AND FUTURE WORKS

Retrieving health records using electronic systems is important to improve the accuracy and speed up healthcare services for patients. EHR retrieval using IoT is considered as an effective approach to retrieve health records of travellers. IoT facilities can be applied in pilgrimage through retrieve pilgrims' health records from central database in their countries by using electronic tags reading.

Pilgrims tags could be accessed by sensors and these sensors send health record requests through IoT layers (connectivity, access, abstraction, and service layers). Thus, health records can be retrieved in real-time to support healthcare services for pilgrims. Data collection using

questionnaire and interview show that the implementation of proposed idea of health records retrieving using electronic tags reading is important and viable.

In future, the importance and viability of proposed ideas implementation need to be investigated from the perspective of the pilgrims' countries. On other hand, technical frameworks of proposed ideas should be developed to clarify overall aspects of EHR retrieving using IoT. This requires empirical case study of a specific country of pilgrims such as Malaysia.

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