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AN INVESTIGATION OF IOT IMPORTANCE AND VIABILITY OF HEALTH RECORDS RETRIEVAL USING ELECTRONIC TAGS IN PILGRIMAGE

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

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Abstract- Health care services is one of the most important domains in the world. One of most important goals of healthcare services is the need of make accurate healthcare decisions in the right time. Retrieving useful historical health records of patients in real-time is necessary to provide accurate healthcare decisions. Traditional health record systems like paper-based system require time and efforts to collect, manage, and retrieve patients' records. Electronic health record systems were adopted to allow health staff to retrieve useful health records in real-time and consequently improve and speed up healthcare services. EHR is effective to serve patients in their local countries. Although EHR is effective for local healthcare services (i.e. hospitals within patient country), the implementations of EHR for global purposes is still an issue. EHR is not applicable for the persons who travel to other countries. One of the most important travelling purposes for Muslims is the pilgrimage journey. Each year millions of Muslims travel to KSA to complete pilgrimage rites. Pilgrims may need healthcare services and these services should be accomplished accurately in real-time which requires historical health records based electronic approaches. This study aims to investigate the importance and viability of IoT implementations to support EHR retrieving of pilgrims 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 show that EHR supporting tags reading is a promising solution to enhance healthcare services and avoid the challenges of EHR implementations in pilgrimage.

Keywords: EHR, 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 (Hibbard & Peters, 2003). Patient's health records represent important source that support healthcare decisions (Bose, 2003). None-the-less, the traditional retrieving systems of health records such as paper based system are still face many problems such as probability of damage or harm the health records, and time requirement of health records collecting, managing, and retrieving (Tang et al., 2006).

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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 risk (Cossar and Reid, 1989). 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 (Ahmed, Arabi, & Memish, 2006). 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 (Cossar et al., 1990; Page, Clift, & Clark, 1994).

Pilgrims need healthcare services and these services should be accomplished accurately in real-time which required historical health records based electronic approaches (Ahmed, Q. & Balaban, V., 2013). EHR encompasses all health information in all media forms regarding an individual and is primary source for recording and documenting client health data (Bickford and Hunter, 2006). EHRs combine 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 (Carter, 2008). Internet of Things (IoT) technology could be effective solution to retrieve health records of pilgrims from their original countries and pass it to health staff in pilgrimage health centres. This research focuses on importance and viability of deploy IoT to retrieving EHR of pilgrims using electronic tags 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 aimed to investigate the challenges of current health records approaches and the importance of EHR.

II. PROPOSED FRAMEWORK

Outdoor services like pilgrims' healthcare services require two main IoT Layers which are (Agrawal & Das, 2011): 1) lower layer, and 2) upper layer. Lower layer (RFID) consists of electronic tags and wireless sensors. Sensors read data of tags and transfer it to

upper layer (Al-Turjman et al., 2013; Zhu et al., 2010). Upper layer (WSN) consists of super nodes and base station. Super nodes handle data from lower layer and transfer it to base station (Al-Turjman et al., 2013; Zhu et al., 2010). Hence, data stored in base station is managed and processed automatically connecting with central web servers.

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

- *Connectivity Layer:* The electronic tags should be in very short distance of wireless sensors (i.e. 3 meters) (Jia et al., 2012). Data 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 (Tao et al., 2014).
- *Abstraction Layer:* This layer is responsible for transfer of data from base station to central web servers through open gateway such as internet infrastructures (Atzori et al., 2011).
- *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 (Da et al., 2014). 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 case of need for healthcare services, healthcare centre contains 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 pilgrim EHR via internet network to base station. Base station display outputs on monitor that is connected with the sensor that sends tag data.

III. MATERIALS AND METHODS

Data was collected from health staff in Kingdom 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 centres. According to Yount (2006), 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 tags reading to support pilgrimage healthcare services.

IV. RESULTS

a) Demographic Data

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

Regarding to 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 long experience years 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 were 22% of respondents that 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 situation of pilgrimage healthcare activities.

b) Availability of Pilgrims' Health Records

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 is 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 format i.e. images and texts	0	0	0	8	52	4.86	Very High

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 healthcare methods. Therefore, they are not sure about the privacy effectiveness of electronic healthcare approach.

Table 2: Challenge of Health Records Retrieval

Item No.	Item	SD	D	N	A	SA	Mean	Agreement Level
8	There are not enough staffs to manage the electronic health care systems	55	5	0	0	0	1.08	Very Low
9	The staffs do not have enough computer skills to manage the electronic healthcare 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 the electronic health-care systems	59	1	0	0	0	1.01	Very Low
12	Privacy of health data limit the use of the electronic healthcare systems	0	5	49	6	0	3.01	Medium
13	The traditional healthcare approaches (i.e. paper-based) delay the health 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 understand the non-Arabic pilgrims in the context of healthcare services	0	0	0	1	59	4.98	Very High

d) Importance of Electronic Health Records Retrieval

Table 3: Importance of Electronic Health Records Retrieval

Item No.	Item	SD	D	N	A	SA	Mean	Agreement Level
17	The EHR speeds up the health care services	55	4	1	0	0	4.80	Very High
18	The EHR supports the accuracy of healthcare services	56	4	0	0	0	4.86	Very High
19	The EHR based on Arabic language increases the usefulness of healthcare services	55	3	2	0	0	4.88	Very High
20	The EHR based on Arabic language makes the healthcare services easier	56	3	1	0	0	4.93	Very High
21	EHR can increase the performance of 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

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.

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.

V. FINDINGS SUMMARY

The current healthcare services in pilgrimage are not supportive 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

VI. CONCLUSION AND FUTURE WORKS

Retrieving health records using electronic systems is important to improve the accuracy and speed up health services of patients. EHR retrieving using IoT considered as 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 request through IoT layer (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 according to perspective of pilgrims' courtiers. On other hand technical framework of proposed ideas would be developed to clarify overall aspects of EHR retrieving using IoT. This requires empirical case study of specific country of pilgrims such as Malaysia.

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