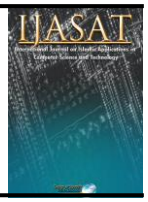

Requirements Model For Hajj and Umrah Mobile Healthcare System (HUMHS)

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ABSTRACT

Millions of Muslims embark on a religious pilgrimages "Hajj and Umrah" to Saudi Arabia every year. Saudi Hajj and Health authorities provide health facilities, services, and medical help during Hajj and Umrah seasons for the pilgrims. Due to pilgrims mobility in different religious places, proper healthcare procedures become a major concern. Providing proper and accurate patients' healthcare during religious pilgrims "Hajj and Umrah" is a big challenge especially for elder people. Many people do not know how to convey their medical history or even their current medication. A mobile healthcare informatics system, where patients can have the details of their medical history, can be an adequate solution. The objective of the study is to develop the requirements for healthcare mobile cloud application that can improve healthcare procedures during Hajj and Umrah.

***Keywords*: Mobile cloud, mobile healthcare, requirements model, Hajj and Umrah pilgrims.**

1. INTRODUCTION

Hajj is a hard journey and requires great effort. The Hajj is an Islamic event once every year, while Umrah is continues during a year. Muslim from all over the world arrive to KSA for the purpose of Hajj or Umrah or for seasonal work surrounding the holy cities and visiting the historical sites (Ministry of Health (MOH), 2016), ministry of health established hospitals, health centers and employ qualified medical staff to provide all levels of healthcare to pilgrims such as emergencies for adults, women and children (MOH, 2016). To obtain entry visa for 2016/1437h Hajj and Umrah, it is necessary to get health requirements such as vaccination certificate for Yellow fever, Meningococcal meningitis, Poliomyelitis, Seasonal influenza and Zika virus disease and Dengue (Jaffar A, et.al, 2014). In addition health education is required to protect pilgrims against infectious and communicable diseases, such as chronic diseases, hygiene and general cleanliness, shaving and haircutting, protection against food poisoning, heat exhaustion, managing with the crowds (Farouk Haffejee, 2011). In addition, the health requirements for granting a Hajj visa needs to be improved (Malak Osman and Adnan Shaout, 2014). This paper proposes a requirements model of Hajj and Umrah Mobile Healthcare (HUMH) system, system maintains the medical history records aim to assist medical staff to aid pilgrims' access by accessing their Electronic Health Records to provide accurate and quality services.

1.1 Research Questions and Contribution

The proposed requirements model assumes the cooperation between health ministry and hajj ministry exists to share information based on cloud health provider for patients during Hajj and Umrah and the system intended to answer the following questions:

1) What are the suitable requirements for proposed system?
2) How can pilgrims convey their medical history to health care providers?
3) How can health care providers retrieve and update medical information on pilgrims?

1.2 Research Organization

The paper is organized as follows. Section 2 describes a background of essential electronic health and mobile technology for health services over cloud. Section 3 summarizes related work. Section 4 presents the proposed methodology. Section 5 presents the requirements model and discusses the functional, nonfunctional requirements. Finally, section 6 presents the conclusions and future work.

2. LITERATURE REVIEW

Healthcare requires continuous and systematic innovation in order to remain cost effective, efficient and to provide high quality services. Professionals predict that cloud can improve healthcare services, due to the benefits many desktop applications have been migrated into the cloud (Jaffar et.al, 2014). Currently, several healthcare providers have adopted the electronic medical records systems to create, store, maintain and move medical records of patients depend basically on DICOM to rise up utilization, eliminated hospital finances and improve quality of healthcare services.

2.1 Electronic Health Records

Electronic Health Record (EHR) is defined as “a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting". Included patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. Another definition “the set of components that form the mechanism by which EHRs are created, used, stored, and retrieved”, allow sharing health information between different systems in different Care Delivery Organizations (Ahmed E. Youssef, 2014). The key benefit, as shown in Figure 1, with the access of medical information that will improve patient safety, enhanced accuracy health Information, decrease cost and medical errors, more thorough documentation and increased quality of care and better patient notification.

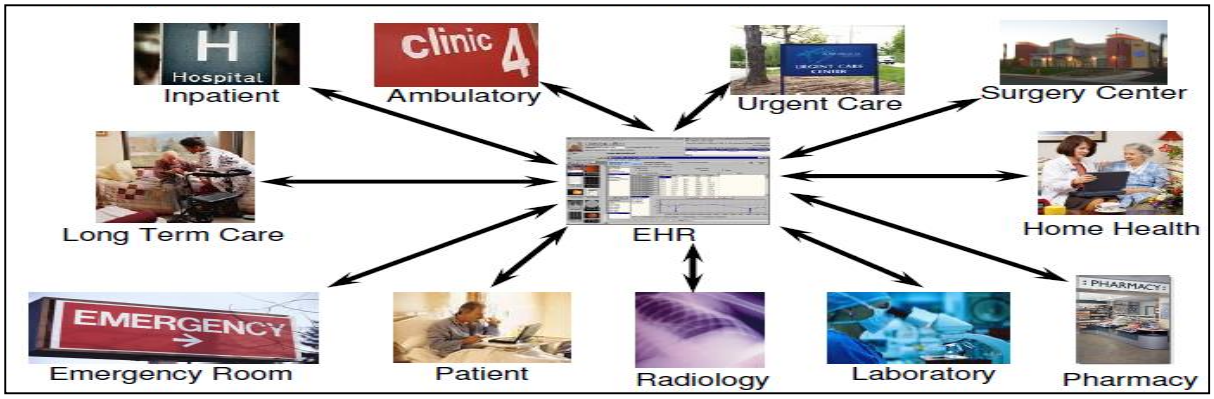

Figure 1: The important of the electronic health record (EHR), that integrated information from multiple resources (IMB, 2007).

2.2 Mobile Healthcare

Mobile Device is a generic term used to refer to a variety of devices that allow people to access data and information from wherever they are (Vikas Kottari et al., 2013). Mobile phones present applications that have been developed to provide various services and facilities to assist healthcare professionals such as: information and time management; health record maintenance and access; patient management and monitoring; clinical decision-making; and medical education and training. In addition mobile technology provides a number of important benefits to healthcare such as improving geographic coverage by providing patients care through information exchange and better connectivity to healthcare professionals anywhere and anytime (C. Lee Ventola, MS, 2014), communication capabilities, information sharing facilitate faster diagnoses and treatment and reducing paper consumption for both hospitals and healthcare professionals (GSMA and MNO, 2010).

2.3 Mobile Cloud Computing

Mobile Cloud Computing (MCC) refer to infrastructure where both the data storage and data processing services happen in clouds, via a computer, without having to be connected to a fixed physical link. Mobile Cloud Computing has many advantages such as improving data storage capacity and processing power, improving reliability and availability, scaled to meet unpredictable user demands and integrated different services from different providers easily to meet the users' demands.

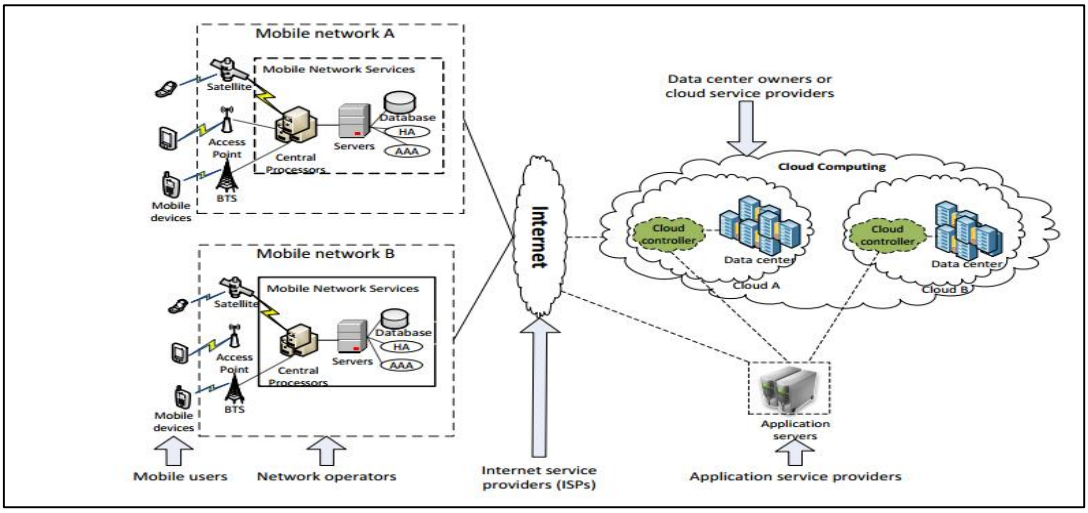

Figure 2: Mobile Cloud Computing Architecture (Lo'ai A. et.al., 2016).

The combination of cloud computing and mobile networks to bring benefits for mobile users, network operators and cloud providers.

2.4 Mobile Cloud Healthcare

The existing health information systems suffer from many challenges to developing such as standards for information sharing, high cost of creating independent systems, management problems, updating and maintenance issues. Solutions depend on the adoption of cloud computing technology in healthcare (Sougand Setareh, et. al., 2014) to analyze and provide patients' information from multiple EHR repositories accurately, securely and fast as shown in figure 3.

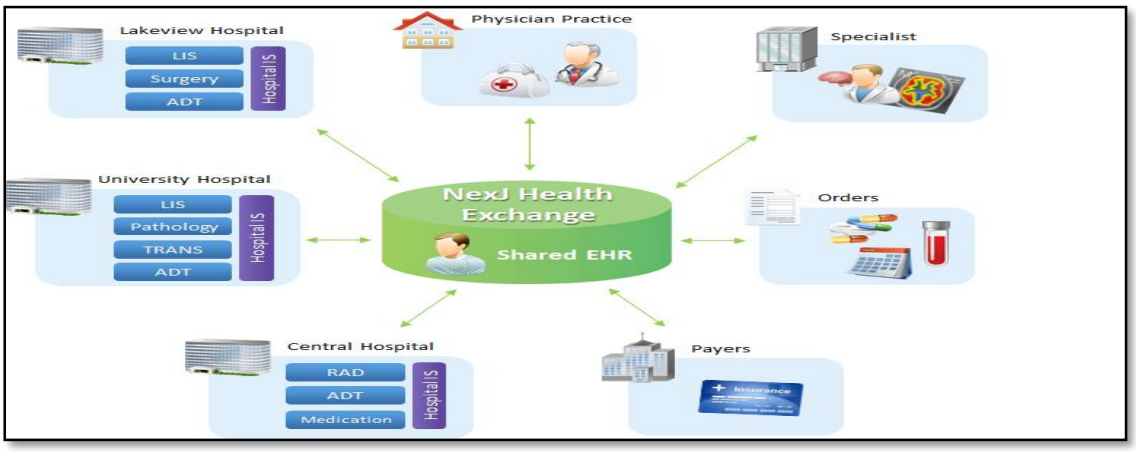

Figure 3: Cloud Health Exchange (www.healthworkscollective.com , 2016).

2.5 Related Work

Some Islamic applications focus primarily on health, followed by hajj systems for surveillance and monitoring and the use of the electronic medical records to monitor the blood glucose levels of Muslim patients who fast during the month of Ramadan. In this section, we discuss existing related work which aims towards Hajj and Umrah healthcare principles.

- **Jaffar A, et.al.** described key features for the 2014 Hajj and Umrah, reviewed the recent impact of emerging viruses such as Ebola in West Africa and the Middle East respiratory syndrome corona virus (MERS-CoV) in affected countries, and highlight the updated

requirements and the required vaccines. In addition to update the immunization status of pilgrims against vaccine-preventable diseases.

- **Eric Beck, et.al.** discuss challenges to support new issue for mobile cloud health care, such as a reliable and affordable Hajj pilgrimage to find missing patients without the need to check at the hospitals. In addition discussed interoperability and data migration processing to cloud.
- **Nafea, et.al.** proposed a new mechanism to prevent any health problem during Hajj period. Based on Electronic Health Record and tracking device enhances patient access to comprehensive health information and knowledge that related to Hajj. Moreover, mechanism monitor and tracking patients based on the proposed special device that can prevent patient loosing without the need to check at the hospitals.
- **Mantoro, et al.** proposed Hajj Locator framework for cases of missing Hajj pilgrims during Hajj, tracking based on mobile phone environments as it is reasonably affordable and is extensively used by people.
- **Abdulfattah I. Sindy, et.al.** present study to assess the pattern of patients and illnesses encountered at one health facility at Arafat on the 2nd day of Hajj, the objective was to provide input for future improvement of health care during this mass transit, such as use of Influenza vaccine should be mandatory. More emphasis is required on pre-Hajj education of pilgrims.
- **Malak Osman & Adnan Shaout** presented solutions to pilgrim identification problems, explores the solution using available technology to enhance the accuracy and tracking time of the pilgrims and provide them with location based services, also set the agenda for future research. However, all of related work does not benefit from cloud services especially for pilgrims healthcare for quick served interact with mobile device benefits.

3. PROPOSED METHODOLOGY

Our methodology based on Ahmed E. Youssef model shown in Figure 4, this mobile healthcare model enables patients and medical staff to interact access electronic health records. We proposed a requirements model for developing Mobile Cloud Application solution to Hajj and Umrah Healthcare organizations to facilitate pilgrims' healthcare services during period of Hajj and Umrah. The proposed method aims to achieve the following goals:-

- To handle and retrieval of Pilgrims data profiles, that facilitate Hajjis data processing needs for healthcare services.
- Provide better communication and access to different types of information resources Systems.
- Used EHR for sharing platform to keep pilgrims health records on cloud environment and increase collection of health information.
- To provide better overall care outcomes for patients during Hajj and Umrah, in addition to reduce the time for healthcare delivery (Eric Beck, e.tal. , 2012).

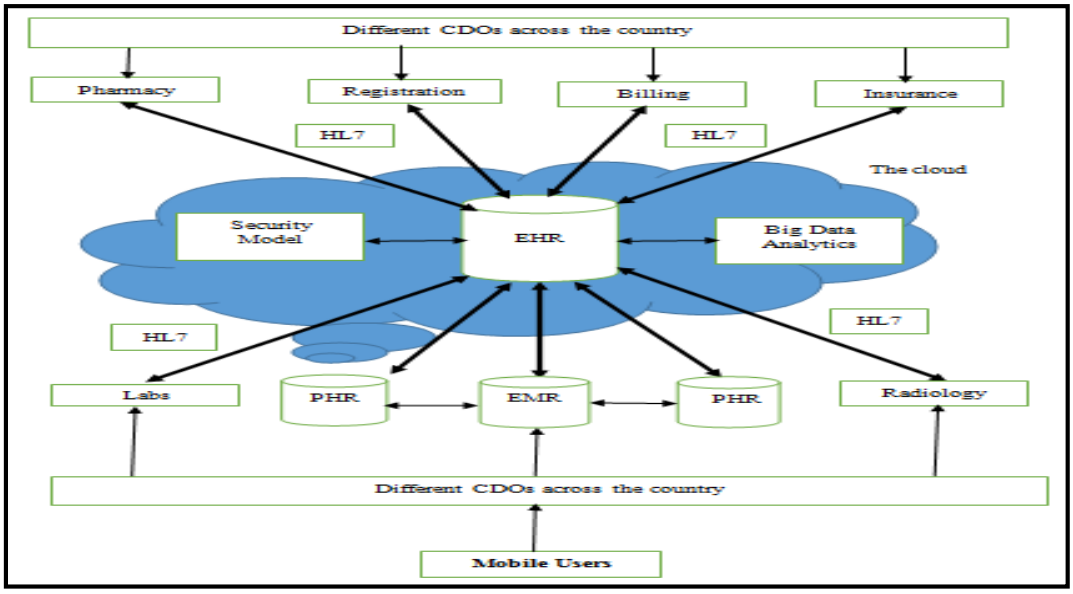

Figure 4: Mobile Cloud Healthcare Model based on HER (Ahmed E. Youssef, 2014), mobile healthcare model enables patients and medical staff to interact access EHRs.

4. REQUIREMENTS MODEL

We propose the requirements model using unified modeling language (UML) concepts for model driven software development to explain how requirements components work with each others, we defined a behavior models to allow features of mobile cloud application to access and transform portable data based on electronic health records. Requirements are divided into functional and non-functional requirements component for cloud health services powered by mobile device as follows:

4.1 The Functional Requirements

Contains requirements and features that represent functional behavior and features that the system under development must support.

4.1.1 Mobile User (MU) Requirements Component

Is a pilgrim or medical staff user who moves in the holy cities and sites uses a mobile device?.

a) **Patients:** Need to access mobile application provided by operators to health cloud environment to follow up basic health information, also to view doctors feedback on mobile application.
b) **Medical Staff:** Need to access to all patients Information, view EHR with privacy protection, track patients' health conditions or treatments, access for feedback from patient history, updated patients records with patient case and recommend or suggest changes in the treatment that patient is taking.
c) **Environment Operators:** should be able to maintain the data base for all patients Information, generate a new access for each patient, mange and update cloud services.

4.1.2 Cloud Computing Environment (CC) Requirements Component

Represent cloud with service models, required to host patient information and provides different type of services, storing and accessing data and programs. In addition provides authorized users in cloud environment with all services need.

4.1.3 Service Directory (SD)/Provider Requirements Component

Need to host Medical services and coordinate service delivery by multiple providers (Ahmed E. Youssef, 2014). Service handle process communication to perform running operations. Basic services need are :-

a) EHR services are a directory for all health services offered in cloud. Services need to link patients to their electronic health record and integrated from different units and region to store in cloud environment.
b) Security Service (SS).
c) Communication Service (CS).
d) Resource Management Information System (RMIS) handle data and data base management issues.

4.1.4 User Agent (UA) DICOM Standard Interface

Based on Digital Imaging and Communications in Medicine (DICOM) protocol, is embedded device that receives service request from the user and sends it to service directory (SD). Another definition DICOM is an interface for communication between mobile users and cloud environment's components (Ahmed E. Youssef, 2014).

4.1.5 Mobile Device (MD) Requirements Component

Mobile Device based on three major requirements:-

a) Hardware: need to have a powerful configuration (e.g. CPU speed, memory capacity etc) to be performed in the cloud.
b) Software: to provide interface and application for cloud health services; mange health information and keep health record activities; store follow up information of all patients based on access to central cloud data base.
c) Communication: consist of:-
    - Broadcast receivers: handle communication between mobile owners and applications.
    - Mobile infrastructure: networks, protocols and data delivery.
    - Wireless connectivity with heterogeneous network.
    - Internet access to remotely stored application in the cloud.

4.2 Non-functional Requirements

Contains the following:-

4.2.1 Interface Requirements

User Interface for interacting between mobile users and cloud, three levels of user interface they are patient interface, medical staff interface and operators interface.

4.2.2 *Software & Hardware Requirements:* represent in:-

a) Operating System: such as Android or Mac operating system.
b) Web Server: for cloud service providers to manage central data base.
c) Libraries: APIs to access mobile services and knowledge of underlying network technologies.

Operational Requirements : to modify and maintain the system.

4.2.3 *Quality attributes:* the overall application design ensured:

a) Availability: mobile health system must be available for use 24hours per day.
b) Reliability: data, as entered, must be stored in cloud database.

c) Reusability: for current functionalities in applications.
d) Security and Privacy: secure access to patient data from existing system to make more informed decisions anywhere.
e) Integration of patient setup and security mechanism into provided services.

4.3 Use Case and Scenario Diagram

The following subsections will discuss requirements of the proposed model with the help of UML diagram.

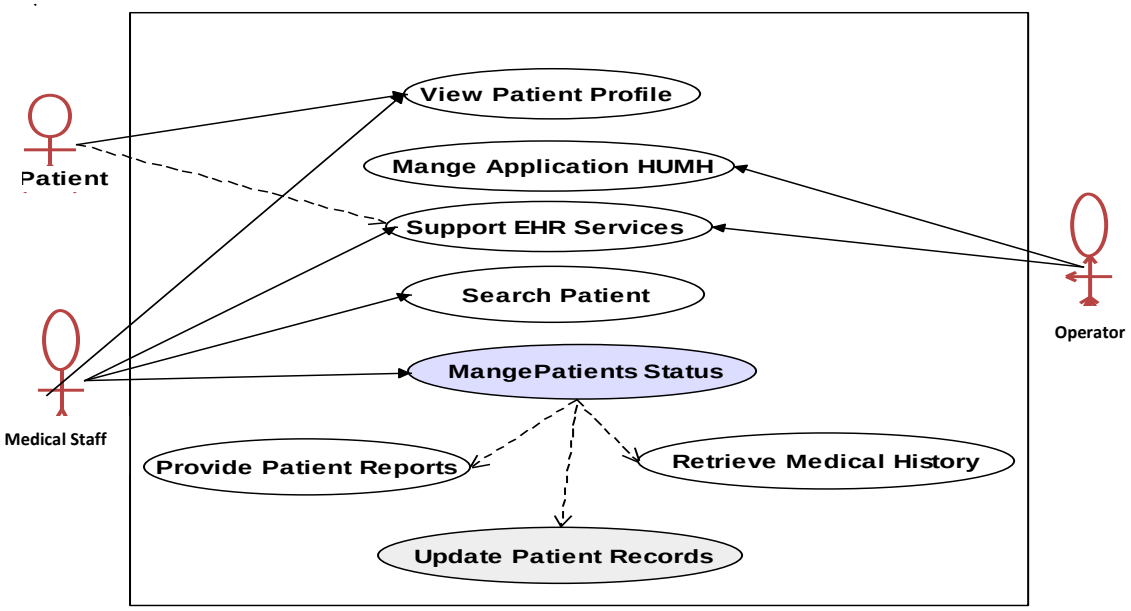

Figure 5: HUMH system Use case Diagram.

Use case for Hajj and Umrah healthcare system consist of following:-

- **View patient profile**: patient mange and edit his account login password, initial information includes (trip visa information, hosting agency, location address Hajji will be transported to, hosting agency and medical record information).
- **Mange Application:** used to maintain the records and provide off premises repository for health information.
- **Support EHR Services:** when a service used, the request firstly goes to a service gateway to meet the requirements and then sends the result to the user.
- **Mange Patient Status :** include all or part of retrieve medical history for what a patient is suffering from, provide patient reports for diagnostic tests result and update patient statues, statues can be:-
  - Diagnose the problem to give the patient the proper treatment.
  - Approve: add or edit new patient status.
  - Review: current patient status.

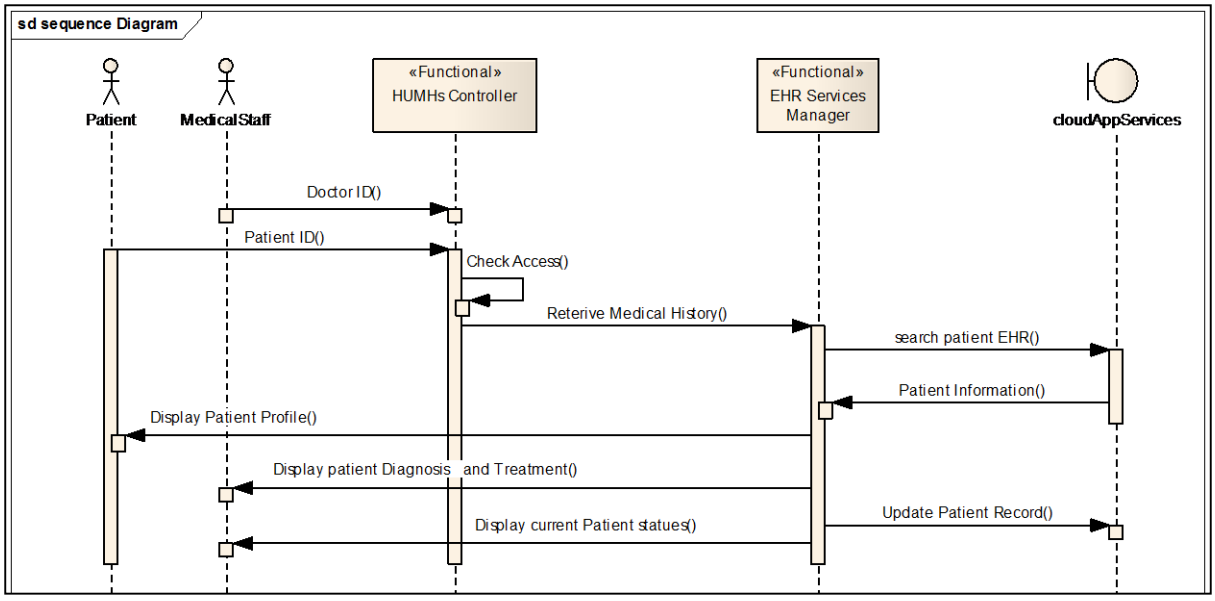

Figure 6: Sequence diagram for the retrieve medical history use case.

5. CONCLUSION & FUTURE WORK

Mobile technology and cloud computing are augmented to utilize mobile devices to perform different tasks, healthcare is a main concern. Several techniques and approaches have been presented in this study to compromise the problem of pilgrim's healthcare during Hajj and Umrah. In this paper we proposed requirements model for Hajj and Umrah mobile health system (HUMH), model specify the context of the system requirements as two category functional and non functional requirements logical components, model enable cloud developers to describe hardware and software requirements of their applications, in addition UML scenarios presents to maintain electronic health records for pilgrims, also assist medical staff to retrieve and update patient health informatics during Hajj and Umrah periods based on the digital imaging and communications in medicine (DICOM) standard.

The work in this paper was focused in specifying the requirements for developing mobile health system for pilgrims. As future work we plan to develop HUMHS process based on current cloud design patterns to implement tools which are required to deploy on cloud. In addition manage traditional healthcare system in KSA to adapting mobile cloud, accelerate developing and add patient side to accommodate healthcare needs.

6. ACKNOWLEDGEMENTS

This work was made possible by NPRP grant # [7-662-2-247] from Qatar Research Fund (a member of Qatar Foundation). The findings achieved here are solely the responsibility of the authors.

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