

Cloud Based Patient Referral System with RFID Based Clinical Information Retrieval In Emergency Cases

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Abstract - In today's era, often the patients and their medical help is located remotely which involves the patients to invest sufficient amount of time and money. As a result, there is a need to smoothen these human efforts due to the fast-paced life. In this paper, we have described an integrated system that focuses on the referral workflow and retrieval of the patients' medical records in emergency cases. The referral system allows the patients to directly communicate with healthcare professionals located remotely, thereby saving both time and money. Here, the RFID technology has been integrated in healthcare for the emergency situations, that involves unconscious and unaccompanied patients. The use of RFID will provide the doctors with patient's accurate medical history in order to make the emergency case as efficient and risk-free as possible, thereby promoting patient safety and optimizing hospital workflow.

Key Words: Patient Referral System(PRS), Cloud , Electronic Medical Records, RFID, Emergency Care.

1.INTRODUCTION

Improving the efficiency of health care infrastructures is one of the most challenging goals of the modern-day society. In fact, delivering quality care to patients while reducing the healthcare costs is the primary need of today's fast paced life. In the medical field, the physicians often refer to and consult one another to compete the patients' treatment. The transfer of a patient from one physician to another is termed as Referral. A **referral** can also be defined as a process in which a patient at a one level of the health system, having insufficient resources (Knowledge, medications, equipment, skills) to manage a clinical condition, seeks the assistance of a better or differently resourced facility(healthcare professional) at the higher level to assist in. 46% of faxed referrals never result in a scheduled appointment, 55% of specialist visits are unnecessary and 50% of referring physicians do not know whether their patients actually see the specialist or no. These above mentioned statistics that show the need of the referral system. The referral management solution can provide widespread benefits and can help to address some of the problems that are outlined above.

When a certain disorder is diagnosed, the patient first consults his primary healthcare physician. If the physician is able to treat that particular disease/disorder then the patient has no need to consult another specialist. But if the patient requires a specialist treatment, and if the

specialist is located elsewhere then getting to the second stage, that is moving from his primary physician to the suggested specialist doctor can take a very long time. The patient may also have to travel to the place where the specialist is located. If the patient has any heart disease or any other physical disability then it would not be possible for him to travel long distances. To this purpose, we have designed a system where the patients scan and upload their reports and can themselves select a medical professional based upon the doctors profile. The healthcare professional can then view all medical data of a patient from the cloud and the patient can have a chat with the doctor regarding the same, thereby saving both the time and money that would be otherwise required in case the patient needed to travel physically.

Although the hospitals have been slow to adopt the Electronic Medical Records, their potential benefits cannot be disregarded. Traditionally the patients have their medical records in the form of a hardcopy, may it be prescriptions, reports, X-rays, etc which they have to carry with them each time they consult a doctor. But in emergency cases where the patient may be unconscious or unaccompanied, the medical history of the patient is not known for diagnosis. Instant access to patient information is the key to life-saving in emergencies where delays may mean the difference between life and death. Hence, we have integrated the RFID technology which can be used for instant retrieval of the patients' medical history in case of emergencies.

Thus, we can evaluate the quality of medical care and provide faster consultations to the patients and promote efficient medical diagnosis by integrating different technologies.

2. Literature Survey

Various systems for the above mentioned domain have been proposed to enhance the efficiency, effectiveness and advancement of information technology.

In [1], the authors have proposed a web-based personal health record (PHR) that can be used by patients to collect and manage their health information (e.g., medical history, past surgeries, medications, and allergies), to request self-referrals, and to store a record of their consultations.

The authors in [2] present a data exchange system for e-referral system in Thailand, in order to access data exchange

problem and improve the effectiveness of the e-referral system. This paper presents a data exchange service by using a cloud based platform. It proposes to use the concept of platform as a service (PAAS) to provide a service for health institutes. Cloud computing has been used. This system can be used by referral patients having similar health conditions between different institutes. Moreover this system uses less bandwidth than other systems. It also defines a set of standards for exchange of e-health information.

[3] describes the online referral system for emergency medical service support system using Smartphone devices and cloud computing technology. The referral system architecture consists of three different technologies, namely the referral system in the hospital will use cloud computing technology, where Graphics user interface is web based, so that the hospital can freely control the availability of places to service emergency, as well as to monitor the movement of ambulances that will come from the health centre requesting referral to the hospital using the map. The information obtained by the proposed model looks much faster than conventional models. However, the location of the place makes it impossible to get a good internet network. Thus usage of SMS technology in hospitals and health centres would be a better solution.

[4] proposes a personal health record (PHR) system that is patient centered. Cloud computing has been used extensively so that patients can get access to their records anywhere and at anytime. This system combines personal health records from different sources which includes the records measured by patients (blood pressure, diet, exercise habits), doctors records (allergies, medical history) hospitals records (ECG, medical advises) and other records from medical stores. This system can survive equation attack, external attack and reverse attack perfectly in cloud computing environment. This system also has a set of disadvantages like vulnerability to cyber-attacks. Users having their own personal data on the cloud propose a serious risk of the data being stolen elsewhere stored or hacked. These vulnerabilities lead to serious and grave consequences if their security is compromised.

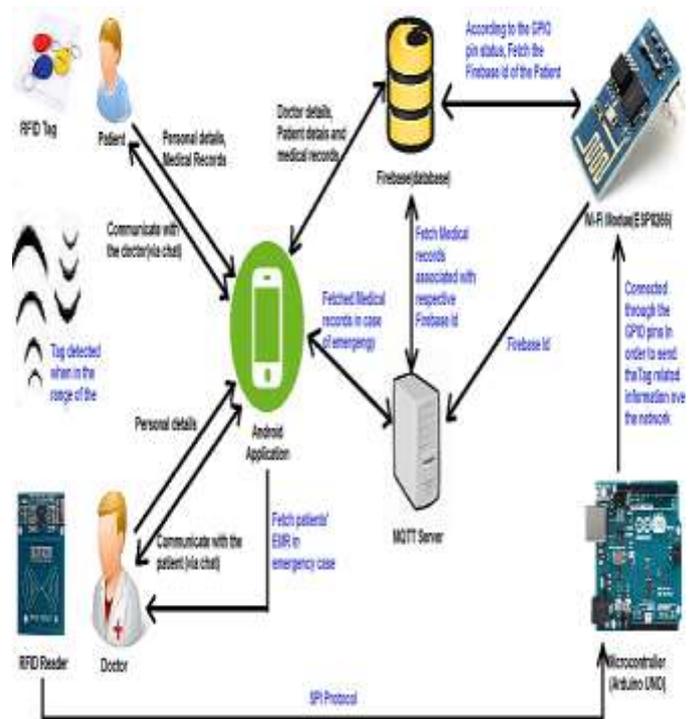
[5] proposes an e-healthcare management system is implemented where all the patient information is required to be archived in a central database. The system is based on service oriented architecture (SOA) and cloud services. SOA displays important advantages through presenting free conjugation stage impartiality standards based execution and solid deals for variant statehood.

Management System for electronic referral documents and healthcare information exchanging has been developed in [6]. The system is based on ShizuokaEMR with healthcare information exchanging standard of HL7 (Health Level 7) and DICOM (Digital imaging and Communication in Medicine).

[7] implements an RFID-based system, named SIMOPAC, that integrate RFID technology in health care in order to make patient emergency care as efficient and risk-free as possible. The great advantage of SIMOPAC is represented by the availability of vital medical information through patient cards and the usage of health information standards (such as HL7) to store, transfer and retrieve users' health records.

The Authors in [8] have proposed a electronic patient referral system by adding a fingerprint patient identification service to work with a data exchange service that identifies patients using only fingerprints and citizen IDs. This system has two advantages: (1) it supports faster and more convenient requests from medical staffs for patient data from other hospitals using only patient fingerprints, and (2) the referred patients receive better health care.

3. System Architecture



The proposed system consists of 5 modules. The modules are explained further in detail.

3.1 Android Application

The proposed system has an Android Application where the patients and the doctor can enter their data and register to avail the benefits of the system. If already registered, they can simply login using their respective credentials provided while signing up.

- **Patient:** Once the patient registers himself, After logging in, the patient can upload his/her medical data (reports, prescriptions, x-rays, etc) by simply scanning them

through camera scanner. this data is then stored in the database i.e. the Cloud. The patient can then select a doctor from the particular category based upon the doctors profile.

- **Doctor:** The doctor too has to register himself for the system. When a patient selects a particular doctor, the doctor will be notified about the same. He can then view the past medical records of the patient which have been stored on the could to study the patients' case. Both the entities can then discuss the case over a chat as to what further treatment should be taken up by the patient.

3.2 Cloud (Firebase)

The Firebase Real-time Database is a cloud-hosted database. Data is stored as JSON and synchronized in real time to every connected client. When a patient registers for the system, he is issued a unique firebase Id. In our system, the patients' medical data is stored on the cloud as soon as he uploads it by scanning and the doctor can thereby view the stored medical records. Thus the medical records are accessible anytime, anywhere to patient as we.

3.3 RFID Reader and RFID Tags

In our system, each patient has his own RFID tag which has an associated Firebase Id. In emergency situations, where the doctor needs the medical history of the patient for further diagnosis, this RFID tag which the patient owns can be used to retrieve his medical information using a RFID reader(MFRC-522) which will be available at the doctors' end. Here, we are using a passive RFID tag which collect energy from the nearby RFID reader's interrogating radios waves. RFID uses electromagnetic field to automatically identify and track the RFID tags. The reader transmits a radio signal to interrogate the tag and the RFID tag, when in the range of the reader, responds with its identification or other information.

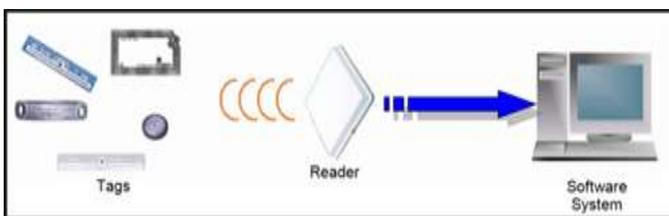


Fig -2: Basic RFID System

3.4 Arduino UNO

Arduino UNO is an open-source microcontroller board based on ATmega328P microcontroller. it is programmable with the Arduino IDE via a type B USB cable. In our system, the Arduino UNO board is integrated with an RFID Reader in order to process the data or information

retrieved from the RFID Tag. The RFID Reader is connected to the Arduino as shown in the figure below.

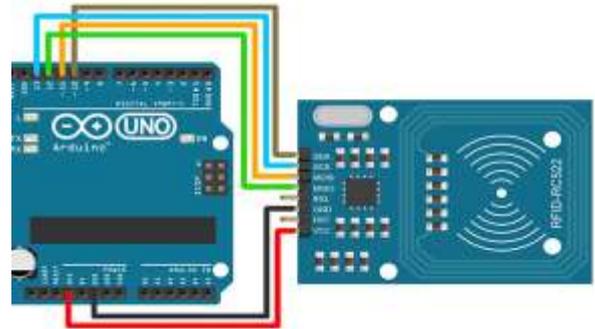


Fig -3:Arduino and RFID Reader Connections

3.5 ESP8266 Wi-Fi Module

After the RFID tag is detected , this information needs to be sent to the android application in order to access the medical records. To send this information over the network, we require a Esp8266 Wi-Fi module. ESP8266 Wi-Fi module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller, here Arduino UNO, access to the Wi-Fi network. The GPIO pins 3 and 4 of Arduino are connected to the GPIO0 and GPIO2 pins of ESP8266 respectively. As per the status of the GPIO pins, the Wi-Fi module will start sending data to the MQTT(Message Queue Transmit Telemetry) server. Wi-Fi will get paired to the module initially and when the status of GPIO is having low transition or low value, module will send respective firebase Id to MQTT topic. In this way the medical records can be fetched by the doctor.

4. CONCLUSION

The proposed system is thus helpful in scenarios where expert medical help is not available to patients locally. The medical care is tailored according to the patient. The system is beneficial for the people who are unable to travel physically to seek the consultations, especially the senior citizens. In the emergency situations, where the patients' past medical records are necessary for the further diagnosis, proposed system provides the doctors immediately with the medical records which makes the emergency case as efficient and risk-free as possible. Thereby promoting patient safety and also optimizing the hospital workflow. All the above mentioned details are the advantages of the proposed system. the disadvantages of the system include: Availability of a smart phone and access to a high speed network. In future the system can be configured to incorporate large number of users to implement it globally, also the In-app payments can be included which currently have not been incorporated in the system.

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