Personal Health Record And Emergency Medical Services

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Abstract— **in today's fast pace life it's very crucial to take care of one's health, this can be made easy by maintaining a Personal Health Record (PHR). PHR is collection of all the health related data of a person. One can maintain his PHR from his childhood and can use it anytime. Emergency Medical Systems (EMS) are services which can be provided in various emergency situations. These services may include calling an Ambulance service till patient gets discharge from the hospital. The culmination of EMS and PHR can tremendously help in making health management efficient. We are going to develop a system that maintains PHR and provide EMS using cloud environment. It provides asynchronous notification using Google Cloud Messaging (GCM) which is a lightweight mechanism that uses push messaging technology for notification.**

Keywords—Personal Health Record, Emergency Medical Services, Android, Google Cloud Messaging, Push Mechanism, Web Services

I. INTRODUCTION

Today most people are aware of benefits of maintaining PHR. It is not only beneficial for patients but also healthcare providers may benefit from PHR in both economic and quality way. Due to high mobility and busy work schedule of professionals in healthcare it's more important for them to have ubiquitous access to the critical health information in order to take the necessary and timely healthcare decisions. For patients also it will be of much use because they won't have to carry anything with them while going to hospitals. As well as they will be able to get timely notifications about their health and some important suggestions in order to have better health. Cloud computing provides storage and manipulation of data at secure, cost effective way. As android enabled devices are very common in everyday life, it can empower the user's mobile experience. The information can be accessed from android application while data is stored on cloud server.

Mobile Cloud Computing (MCC) allows capabilities of applications to exposed as sophisticated service which user will be able to access like a normal service.MCC provides the efficient health record management that can helps in managing the complete information. This paper is concerned with development of an android application that will save Personal Health Records of registered users and provides Emergency Medical Services to users in emergency cases like accidents. Application will also serve user in non-emergency cases by allowing ubiquitous access to the user.

To successfully implement above application GCM plays a vital role. GCM is a push messaging technology provided by Google to send asynchronous notifications across android devices and server. The push technology is a data distribution technology in which selected data is automatically delivered into user's device as a notification. The push technology can be use to make information more accessible for the user. The push technology was created to overcome to some problems facing users of the Internet, e.g. information overload and low bandwidth. Information overload is the main driver for the development of push services. So it is required to solve the problem with amount of information available on the internet. The push technology can be augmented by filtering, indexing, and directory services to help manage information overload.

The application which interfaces with a PHR and can be accessed by almost any device enables immediate access to critical medical information by authorized ambulance center personnel on site of incident and during patient transfer to a hospital. Then the hospital authorities can check patient medical histories, patient allergies and much more to ensure that the treatment provided is the safest and most effective choice for the patient. Ambulance service and hospital emergency departments can automate their operations by making information available where and when needed and by providing an infrastructure for the integration of pre-hospital and in-hospital emergency healthcare.

II. RELATED WORK

Recently technologies like Android, cloud computing and PHR have been used extensively. Many approaches have been applied to bring them together to build many applications of special purpose. Many of them have been related to healthcare issues. Storing PHR and using them to define logic for solving health issues has been the prime approach. One of them was to provide medical documentation to the user using cloud. This approach uses Hospital Availability Exchange(HAVE), Emergency Data Exchange Language(EDXL) technologies to locate hospital and For exchanging operational data with hospitals and incorporates an intelligent module that supports help selecting the most appropriate ambulances and hospitals for each case. Here the problem was about locating the resources properly. Getting the location of patient in emergency situation is most important thing when we want to provide EMS.

Another approach was using Google's Android operating system and Pull Messaging Model. This stores the patient data and images on cloud server. This is effective method when there are frequent updates in the patient data. But it usually proves to be inefficient when we need to make number of request without any substantial data update. This

leads to large number of unnecessary requests to the server hence higher connection establishment frequency. It causes inefficient bandwidth utilization and higher power consumption by the device. However, we can use the most recent technologies like Google Cloud Messaging (GCM) to overcome all these problems. These technologies helps in sharing data immediately and effectively, therefore required data is available at each required location, which adds to the quality of care.

III. MOTIVATING SCENARIOS

Earlier we used to have manual health records, but with these records we had various problems such as limitations on access as well as modifying the PHR. Upsurge of current leading edge technologies could help in automating many a thing and thus add to the ease with which we can reach to the maximum people.

Handling medical data digitally allows us to deploy various logical algorithms to provide automated services to the patients. This approach makes everything easy for the user and even illiterate people can use it to effectiveness. Thus we thought of the possible ways to bring few new technologies together to simplify the management of health related issues. With Client – Server models already present, we can implement push messaging model to notify various stations involved in these issues. So we are using GCM service to push the messages to the users.

In emergency case it is important to locate the patient's location and inform nearest ambulance service as well as the relatives of the victim. Along with this user needs a common application to manage all his health issues including diet, allergies etc. Thus we came up with an idea of an Android application to do these entire things via single platform. Now one issue still remains, what about people without android phone. So to overcome this problem we brought back the classic web application platform. Now user can access all the features through both mobile application or through internet.

IV. APPLICATION OVERVIEW

This application is intended to simplify the management of patient's health. We have tried to cover every possibility to make it simple for use so that maximum number of people will be able to use it in their daily life. On the whole it provides the common platform to address the daily health issues including common things like diet and notifications for medicines. Primarily we have focused on providing the emergency service to the user. User is registered on the application with his ADHAAR number as his sole identity. So the registered people will always be recognized using their ADHAAR number and further services are provided according to the information we get from his PHR.

In emergency situation, assuming victim to be unconsciousness, third person will come into the picture to notify the incident to the system. He will enter his and if possible victim's ADHAAR number. Along with this he will also enter the brief description of situation so as to prioritize the simultaneous calls to the ambulance service in the same area. Now application will prepare a module including the location and will send it to the server. If user is registered then his PHR will be retrieved from server database (MySQL) using the web services, and a brief notifying message will sent to the contacts given in PHR. Through web services nearest ambulance service will be searched and will be notified with appropriate message and address including the brief accidental description we have obtained. Even if the victim is not registered he will get the emergency service. Only difference will be that his PHR won't be available, so his relative will not be notified.

Along with emergency service this application will generate the notifications for the registered user. With help of standard values for the given age. If certain value falls out of the normal range by certain predefined margin then a notification module will be prepared by web services and will be forwarded to the GCM server along with target device identification number.

User's diet will be tracked on day basis. User is able to set the notification time for reminder. And at that time user will be able to insert his diet of the day. Same procedure can be followed for reminders of appointments and reminders. This makes it easy for user to remember the medicines.

User will have the real time chat option. He will be able to chat with the doctor. Doctor can send the prescription to the user via message. This message will be preceded by certain hash tag. This will make it easy to store this message permanently in user's PHR.

When user needs to share the information to someone, he will be able to select the fields to share and then the selected data will be shared with target email id.

All these features needs strong underlying platform for support. Figure 1 diagram represents the infrastructure we have used to support above features. As we can see we are using hybrid cloud, Public and private cloud.

PHR data and web services reside on Private cloud. GCM provides public cloud features by enabling notifications to the android devices. Data centers and server gives storage and computational capacities and forms infrastructure of the application. This infrastructure can be build using our own computer. We can simply make provisions to make the server online 24 hours.

This Infrastructure then supports PHR base which includes storage and retrieval of PHR data by the web services running on the server. This infrastructure also acts as a base
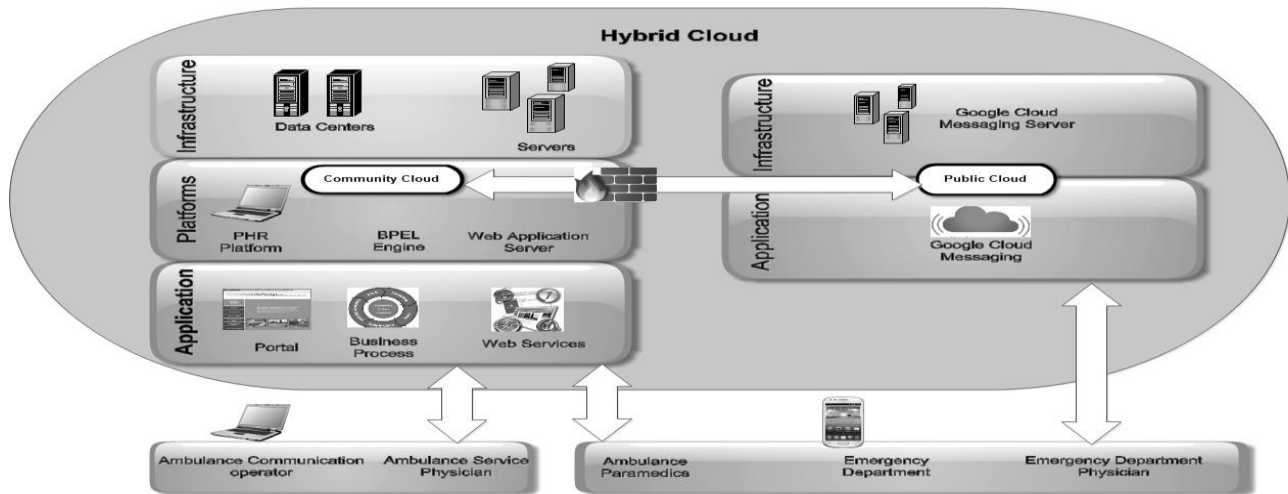
Figure 1. Hybrid Cloud

For application server and Business processes Execution Language Engine (BPELE). BPEL helps in running the web services.

This platform now supports the actual application features.

V. SYSTEM ARCHITECTURE

This EMS System uses the 4 basic components.

A) *Server*:

This is a GCM enabled server application being hosted on private cloud. We can also host this service on a normal server; just we need to make sure that it is online for 24 hours. Server hosts PHR base and Web services to process the data and ensure the service to the accidental situations.

PHR base helps taking decisions in many obvious situations. Along with medical data, various other information like diet and reminders helps user to manage his daily life smoothly.

Web services running on the server processes all this data and generates the notifications if there are any. BPEL supports all the web services running on the server.

We are using the Java based server as an application server. This supports SOAP protocol and thus enables various options to be open for us. This includes calling the GCM service.

B) B) Google cloud messaging service:

This service works in coordination with the main application server. These are not actual physical servers but are the templates to be added to the server pages. This is a Google's freely available service which is used to push the notification to the user's android device. And on 17 Jun 2013 it was also released for the chrome browsers. Its working is quite simple. It takes the Notification bundle from main server and send it to the targeted device.

With Hyper Text Transfer Protocol (HTTP) only downstream pushing is possible i.e. messages are sent from main server to the device. But with Extensible Messaging and Presence Protocol (XMPP), both ways transmission is possible i.e. we can push the notifications from the device back to the server whenever needed. Here we need bidirectional messaging so we will go with XMPP.

There is one slight problem with the GCM service. It can't push the Notification message of size greater than 4kb. So there arise two cases:

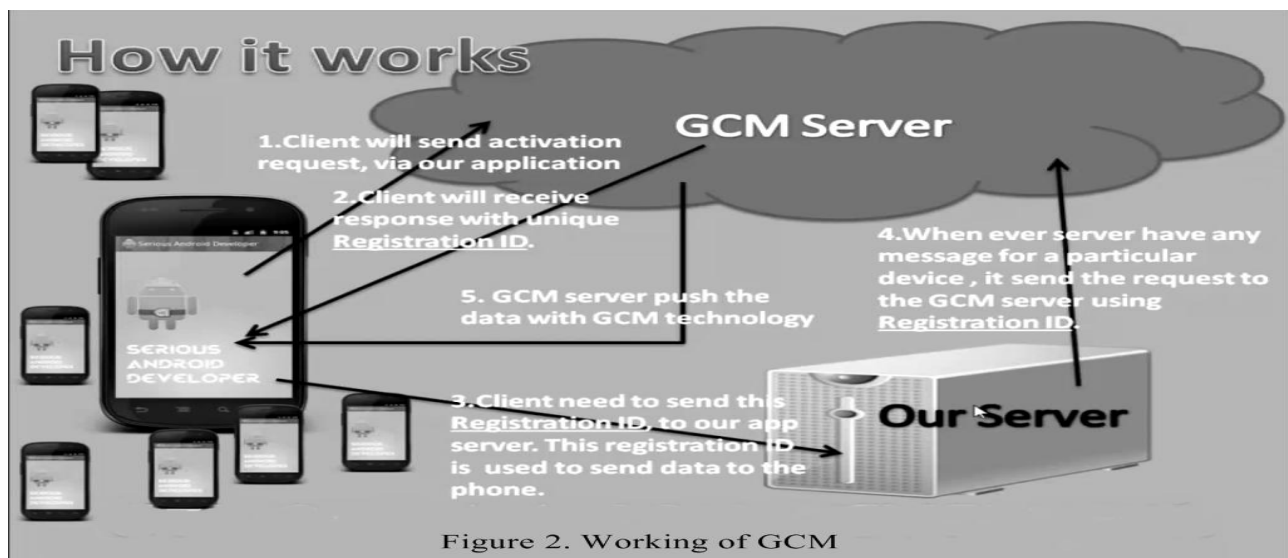Message with size less than 4kb: Here the message will be

Figure 2. Working of GCM

directly sent to the device.

Message with size greater than 4kb: Here we need a two step *a.* approach. First we create the notifying message which is smaller than 4kb and send it to the device. Now device will call the Synchronization service to sync all the changed data.

C) *Android client application*:

Being the most common mobile operating system across the world, android is the best option to start with. Later we can extend it to the other devices like Windows and Apple. Android application consists of four basic parts.

Broadcast receiver: This elements acts as data receiving and data sending interface. It receives the message sent from the server, hands it over to the Services. It also broadcasts the Intent to the server.

Services: This element consists of various algorithms to process the message and invoke various services. These services decide whether to show the notification to the user as it is or store it to the local repository.

Content providers: This component acts as a local repository to store the data locally, i.e. on client device itself. Various kinds of data like images, text files and tables many need to be accessed very frequently. Downloading this data frequently could prove inefficient, so local repositories can store this data into client device. SQLite libraries on android device can act as small database system.

Activities:

This element is concern with the visuals being provided to the user. We need to provide simplified and easily learnable User Interface (UI).Activity component simplifies the message and presents it to the user. If notification arrived is of high priority then it will be presented to the user without much processing.

D) *Chrome browser:*

Since GCM service is available for Google Chrome browser we can use it to act as client. Small Chrome add-on service will allow user to get the notification on browser. This will nullify the dependency over android devices and hence we could reach to maximum people. Basic tasks like Registration and data modification are very easy and fast through Chrome browser.

VI. IMPLEMENTATION ISSUES

SQLite, the database platform supported by Android, has been used for storing patient's data locally on Android devices. In emergency situation if the victim is not conscious then presence of third person is mandatory to notify the system.

GCM service can't handle the message of size greater than four kilobytes. This restricts the messages containing multimedia information. This service is available only for Android and Google Chrome. So we are not able to extend this service to other platforms like Microsoft Windows and Apple's iOS. In emergency situation, to send the message to the server we need the device to be online.
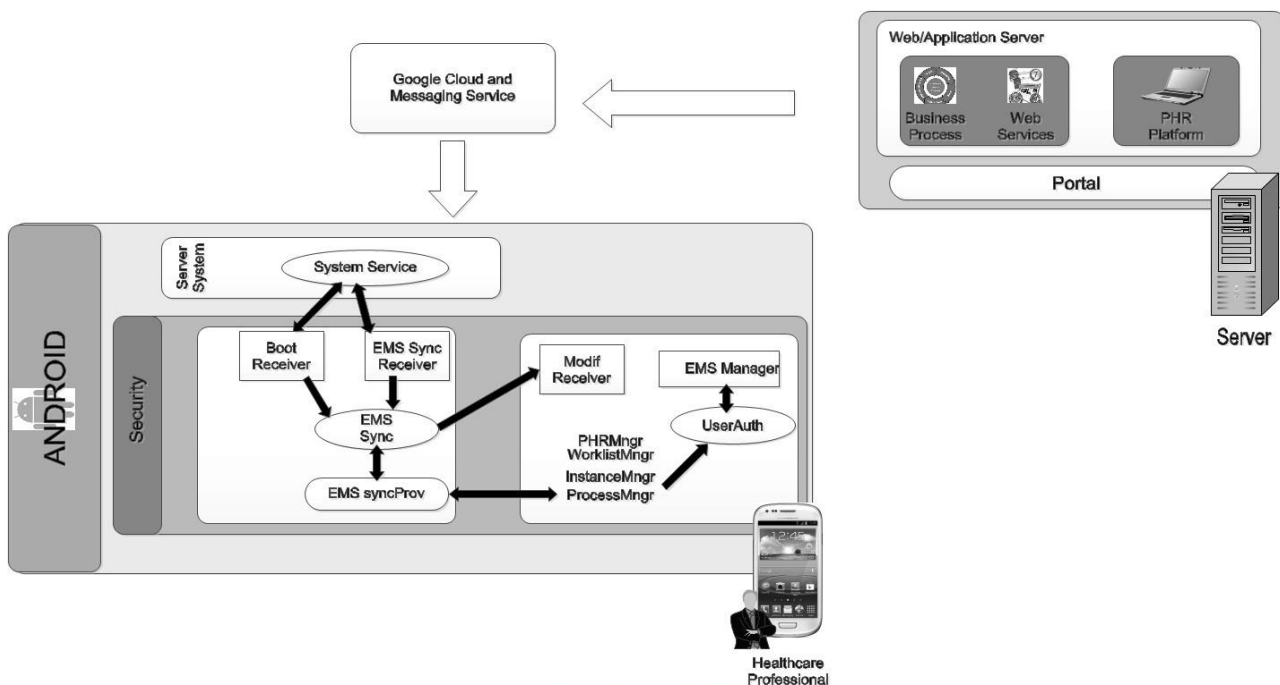

Figure 3. System Architecture

VII. CONCLUSION

In early days people have faced the challenge to maintain Health records. PHR can be very beneficial in this scenario as it reduces lots of human efforts and worries about their health records. Implementation of PHR along with EMS can lead to better delivery in emergency situations. Services like ambulance and hospital emergency departments can use this application to provide pre-hospital and in-hospital emergency care activities.

Cloud computing and mobile technology convergence has led to the emergence of Mobile Cloud Computing (MCC). It can be used to meet the increased collaboration and coordination requirements between EMS users by facilitating relevant information access by authorized people ubiquitously. This paper presents a PHR-based EMS in a cloud computing environment and places special focus on an Android application, which provides mobile access to the proposed EMS. EMS can be deployed by using Google's push messaging technology. It allows user to receive critical data by asynchronous notifications so that they can take proper actions immediately.

VIII. ABBREVATIONS

EMS-Emergency Medical Services
PHR-Personal Health Record
GCM-Google Cloud Messaging
HTTP-Hyper Text Transfer Protocol

XMPP-Extensible Message passing Protocol
BPEL-Business Processes Execution Language

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