m-Health : A Complete Healthcare Solution

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***Abstract*—In today's Modern world mobile phones have become a necessity in everyone's lives. The number of mobile users have increased by manifold. People may not own their own laptops but everyone now-a-days has A smart phone equipped with a internet connection. A smart phone can be used to solve various issues related to Healthcare. The awareness among people regarding proper health and fitness has now increased. This Paper presents our idea of a smart android application which can be used by people to solve various healthcare issues. The system which we have developed is a Smart Android application through which one can Track their fitness ,Schedule appointments with a Doctor ,Set a reminder for themselves to Take medicines on time and Can request blood from a nearby donor in case of Emergency and they can inform their relatives about current location.**

***Keywords*—m-Health,Android,Healthcare.**

I. Introduction

The importance of healthcare has greatly increased in our society. With the recent advancements in technology better quality of mobiles are coming into the market Every single day.People have now become tech-savvy and demand better services from their smart phones The mobile phones now-a-days are equipped with a variety of sensors[1] like location sensor , temperature sensor , Heart-rate sensor , gyroscope , Step-counter and so on. Because of such features the number of users using mobile phones has shown an unprecedented growth. It is estimated that in India alone there are more than 1 billion smart phone users[2]. The Google's Android Operating system has become one of the most popular operating systems in the world. In India it is estimated that Among all smart phone users ninety seven percent of users own Android phones[3].

We have successfully developed a working prototype of a smart Android application which has many features which can be useful to the user depending on his needs.The following are the five modules of this application:
1)Fitness Module:
The user can know the number of calories he has burnt in a day while doing various activities like Walking,Running,Cycling etc. The user can keep a track of the number of foot steps he has taken. He can keep a track of his distance , speed and pace while running.
2)Doctor-Patient Module:
Through this application patients can find doctors. Doctors can connect with patients. Doctors can prescribe medicine to the patient through the application.
3)Medicine Reminder Module:
Very often people forget to take medicines on time which can lead to serious complications in health. The mobile application has been developed so that it reminds the patient to take medicines from time to time.
4)Emergency Module:
Sometimes a person is trapped in an emergency situation where he may not have the time to call his emergency contact. In such cases it is necessary that the relatives of patient are informed about his location at a Click of a single button.
5)Blood-Request Module:
Sometimes during a situation of accident a person may require blood of a particular blood group which may not be available in the blood bank.In such cases a patient can find near by blood donors of same blood group in the vicinity.

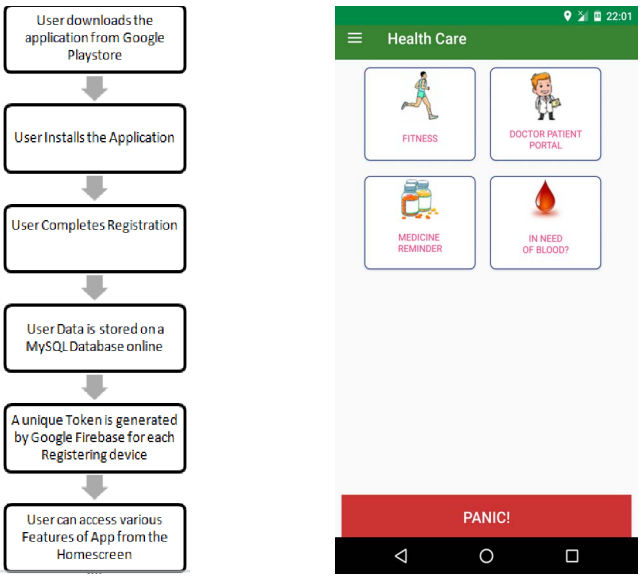
We have organized our paper as follows: Section II highlights some similar work done by others in field of mobile healthcare . Section III describes the Design of our application. Section IV describes the implementation of above five modules in detail. Finally section V gives the conclusions.

II. Related Works

A large number applications have been developed in the field of Mobile healthcare. We studied various solutions developed in mobile-Health.
Among those Yuanyuan Du et al[4] have developed an android application which can trigger or send an alert to the users relatives depending on his actions. A background service(An Android application component) running in the application continuosly monitors the activities of user and fires an alarm accordingly.It also has a feature where it can remind the patient to take medicines which are prescribed by the doctor to take on time.
Fletcher Lu and Manon Lemonde(2014) have presented their unique idea of an android application which motivates people to do excercise. This application has used social media to encourage fitness among people and to reduce obesity. The use of social media creates a competitive spirit among people when the see others using the application and becoming Fit

and encourages them to keep themselves fit.
Jon Blancou et al[6] have developed an Android based application which can automatically detect a road accident. In their application an android device which is running their pre-installed application is fixed on a car. Whenever a road accident takes place it is detected by their application. On detection of accident a Message is sent to the emergency services informing them about the place of accident. Another message is sent to the vehicles which are in the vicinity of the victim. A SMS is sent to the predefined contacts of the victim. Also their application has a feature of live video streaming , in which the android devices fitted on the nearby vehicles can send a live video stream of the accident spot to the emergency services.
An Android application developed by Ran Wei and Zhimin Yang(2012) enables doctor-patient interaction. In one of the features developed by them, patients who have mild symptoms can access the hospital database using the android application. Based on their symptoms , they will be recomended the solutions. Thus the patients can self Diagnose and it will not waste time of doctor. The application also enables non-Real time communication between doctors and patients. It is not feasible for the doctors to be online always to answer the queries of patients. The patients can leave a message and doctor can answer them later through the system platform.

III. Application Design



(a) (b)

Fig. 1: Flowchart And Homescreen of The application

Fig.1 shows the flowchart of application and its Homescreen after installing it. Once the user has installed the application on his phone he is asked to provide some registration details like Name ,Mobile number ,Email id ,Weight. The weight is required because the application calculates the amount of calories burnt by the user while performing his day to day activities. After the user clicks on the submit button , their details get stored on a MySQL Database. We have used Hostinger which is a free web hosting service inorder to host our remote database and to run various PHP Scripts. Once the application has been registered with the server , the application does many tasks in background. It continuosly tracks the location of user and updates it on the remote database. It calculates the amount of calories burnt by the user while he is doing his day to day activities like traveling to work ,cycling ,running etc.

A. Software

To design this application we have used various technologies. The various technologies used in this application are:

1) Android:

Android is an operating system which was introduced by Google. Android was founded in Palo Alto , California by Andy Rubin ,Rich Miner ,Nick Sears and Cris White in 2003[8]. In the year of 2005 android was acquired by Google. From then onwards it has become very popular and it powers most of the mobile devices. Android powers hardware which is mostly based on ARM Architecture. The android operating system is based on a modified version of the linux kernel. Due to the huge popularity of the android operating system there are a lot of developers which develop application programs for android based devices which are popularly called as apps. Android applications are written in JAVA programming language. Due to a vast developer community a number of Libraries and API(Application Programming Interface) have been developed. Android is not only limited to mobiles but it also powers various other devices like Television set ,Home-security systems ,watches ,cameras ,Refregirators,Car navigation systems ,Smart watches etc.

2) Firebase:

Firebase is an application platform which helps the developers to develop high quality Web and mobile applications. Firebase was founded in 2011 by Andrew Lee and James Tamplin[9]. It provides various features like Realtime database , Firebase cloud messaging(FCM) and Firebase storage. We have utilized Firebase Cloud Messaging(FCM) feature in our application. Firebase cloud messaging provides a cross platform solution to deliver messages between two devices through the internet. The messages are delivered at no cost. Before using the FCM Service a device must be registered with the Firebase server. After the device has registered , Firebase creates a token which uniquely identifies each device registering with firebase. A token is nothing but a string of characters and numbers. The token generated by firebase can be used by the developer to identify each device and to communicate with it.

3) PHP:

PHP is the acronym for Hypertext Pre-processor. It is called so because the libraries which PHP Uses are already

compiled. Whenever someone requests for a PHP page from his web-browser ,that request is sent to the server ,interpreted by it and the response is received in the form of HTML. PHP is a widely used server-side scripting language. It is an open source programming language used in web development. A scripting language is a type of programming language which is not compiled but is directly interpreted. PHP was created in the year 1994 by Rasmus Lerdorf[10],[15]. It is widely used for web development. PHP Script can be embedded in between HTML script to do a particular task. The PHP Script can be used in HTML by embedding it between the <?php and ?> tags. As it is a server side scripting language it is executed by the server and the HTML code is sent to the client. PHP Enhances the security of the application as it never displays the source code to the client.

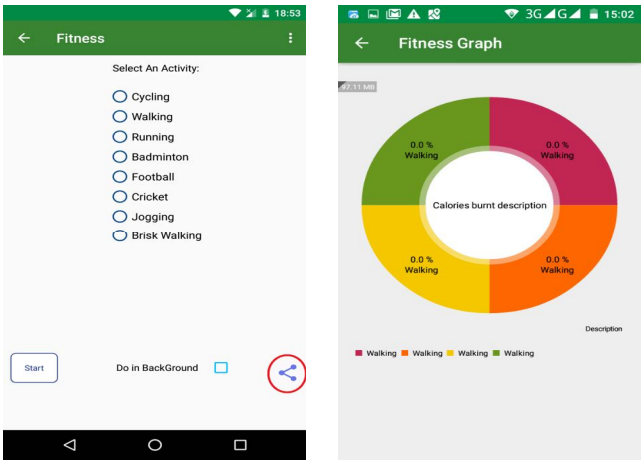
4) MySQL:

MySQL is an open-source Relational Database Managment System(RDBMS). It was founded by Michael Widenius[11]. It is a structured Query language. It is written in C and C++. It is widely used for accessing and managing a database. It is designed such that it can easily handle even large data-sets. It is very friendly to PHP and is widely used for development of Web applications. It is widely used in the world because it is free to use. It is cross platform in nature [14].

IV. Implementation

There are five modules in our application which perform different functions. They are as follows:

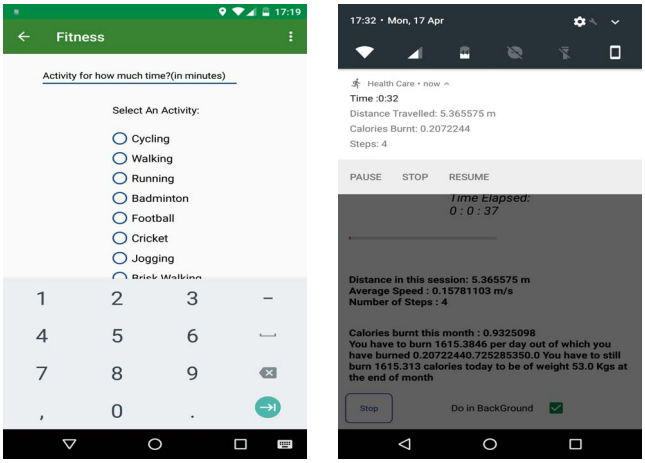
A. Fitness Module



(a) (b)

Fig. 2: Screenshots of Fitness Module

This module helps the user to keep a track of his fitness parameters. When the user starts the application for the first time ,he can see the homescreen of the application as shown in Fig.1(b). In order to use the fitness feature of application, the user must click on the fitness button. The screenshots of the fitness activity(A single screen with user interface) are as



(a) (b)

Fig. 3: Screenshots of Fitness Module

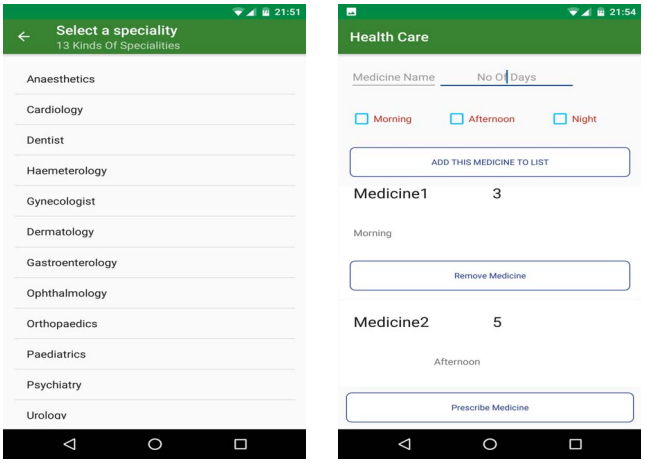
shown in Fig.2 and Fig.3. As shown in the Fig.3(a) the user is presented with various activities like cycling ,running ,walking ,badminton etc.He must select any one activity of them. The user must also specify for how much time he is going to do the particular selected activity Fig.3(a). After the user clicks on start button ,as shown in Fig.2 the application starts measuring his speed and distance using the mobile's geo-location sensor as shown in Fig.2(a). It calculates the number of steps the user has walked by using the sensor called as step counter. The application also shows the amount of calories burnt. If the user wishes to see a graphical analysis of the amount of calories burnt while doing various activities then as shown in Fig.2(b) they can see a pie chart. The user can also share the details of his daily workouts on social media sites like facebook by pressing on the button circled in red as shown in Fig.2(a). Regular sharing of workout details with others on social media promotes others to do excercise. The user may not necessarily keep this application open while it is measuring various parameters ,as shown in Fig.3(b) the application can be in background while it is measuring these parameters. For calculating calories burnt while running the following equation adapted from the work of Cameron et al(2004) is used: [12]

$$CaloriesBurnt = 0.63 * Weight * DistanceTravelled \quad (1)$$

Where weight is expressed in pounds and Distance in miles.

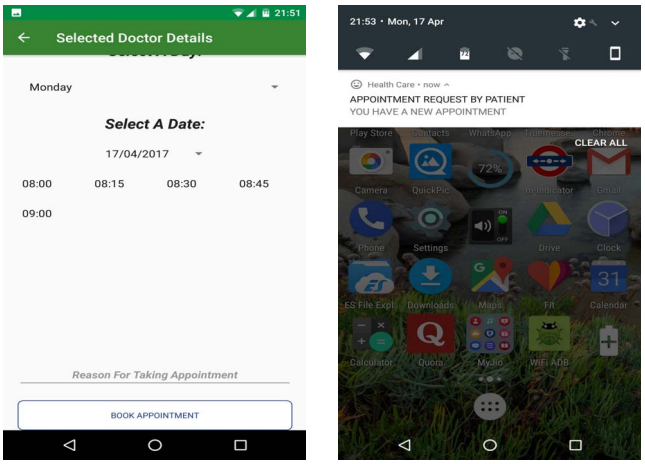
B. Doctor-Patient Module

This module enables Doctor-patient interaction using the android application. If a patient wants to take appointment of the doctor ,then they can take using this application. To take appointment of a doctor the user must click on button "Doctor Patient Portal" as in Fig.1(b). After clicking the user is presented with different types of Doctor specialities like Cardiology ,Dentistry,Urology etc as shown in Fig.4(a). When user selects on particular speciality ,they are shown a list of available doctors of that speciality.



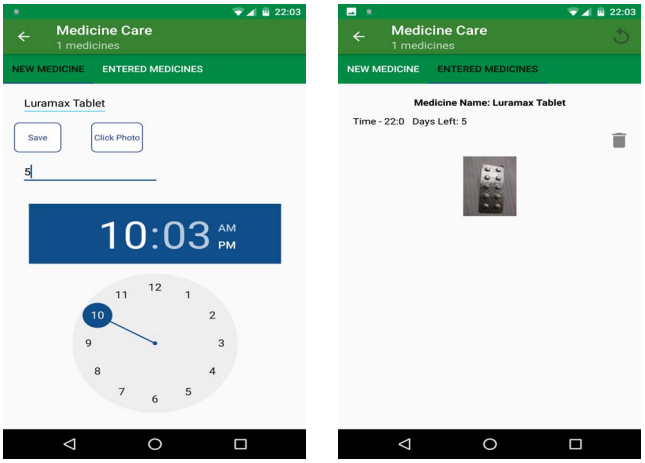
(a) (b)

Fig. 4: Screenshots of Doctor-Patient Module



(a) (b)

Fig. 5: Screenshots of Doctor-Patient Module



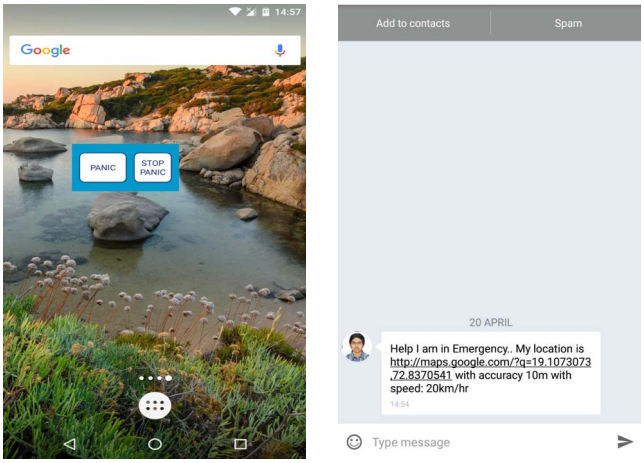
(a) (b)

Fig. 6: Screenshots of Medicine Reminder Module

When the user selects a particular doctor ,the user has to select the time and place of consultation as per convenience as in Fig.5(a). On Taking an appointment the doctor receives a notification on his mobile as shown in Fig.(b). After the appointmment of doctor with the patient is complete the doctor can also prescribe medicines directly to the patient from his mobile. The medicines prescribed by the doctor get pushed directly to the mobile of patient. In order to send the medicine prescription, the application uses Google's Firebase cloud messaging. The application first send the data in the form of a string to a PHP file on our free hosting service. The PHP file sends that data to the cloud messaging server which in turn sends the medicine data to the patients mobile phone. Now traditionally the doctors prescribe medicines on a hand-written prescription on a paper. Thus the question that would arise is why to prescribe medicines using an application. The reason is that a hand-written prescription can often be mis-understood by the chemist which may lead to taking of wrong medicines by the patient. Other reason is that the patient can loose a hand-written prescription but can never loose a digitized prescription. Our application has integrated the Doctor-patient module with the medicine reminder module. Any medicines prescribed to the patient are received by the medicine reminder module. The medicine reminder module reminds the user to take medicines prescribed by the doctor on time by regurlarly sending him a notification.

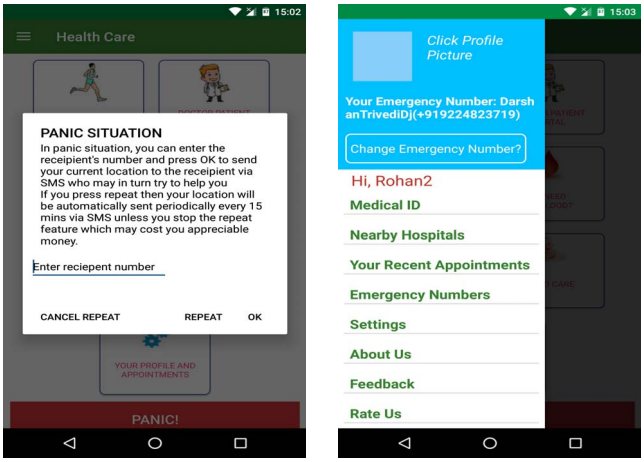
C. Medicine Reminder Module

This module enables the user to set reminder to take medicines on time. To set a reminder the user must click on the Medicine Reminder button on the homescreen of the application as shown in Fig.1(b). The user can set reminders for multiple medicines. To set a reminder for a particular medicine the user types the name of the medicine in the application as shown in Fig.6(a). Then they have to set the number of days and the time at which he wants to be reminded. To make it easier for the users to recognize the medicine which they have to take, the user is asked to to click a picture of medicine by clicking on the Click Photo button as shown in Fig.6(a). The entered medicines can be seen in the Entered medicines tab on the screen as shown in Fig.6(b). Here the user can see the details of all his medicines along with their picture. When the application reminds the user to take a particular medicine ,the user is also shown the picture of medicine which he had clicked while setting the reminder. Looking at the picture of medicine makes it easy for the user to recognize the medicine which is to be taken. The medicine reminder module is also integrated with the Doctor-Patient module ,wherein a reminder is automatically set for the user for any medicines which are prescribed by the doctor.



(a) (b)

Fig. 7: Screenshots of Emergency Module



(a) (b)

Fig. 8: Screenshots of Emergency Module

D. Emergency Module

In times of emergency ,it becomes necessary for the user to inform their relatives about their whereabouts. In such cases it may not be possible for the user to make a phone call. To deal with emergency situations ,this application provides a Red button as shown in Fig.1(b) , on pressing of which a message is sent to the emergency contact of the user. If the user has not yet set an Emergency number they can set it as shown in Fig.9(a) and Fig.9(b). The user can send an emergency message even without opening the application. The application provides a widget(An application extension offered as a part of a larger application already installed on the device) as shown in Fig.7(a). A widget can be placed on the Homescreen of the user's phone. If the user clicks on the Panic button then an emergency message is sent to the pre-defined emergency contact of the user. The format of this message is as shown in Fig.7(b). This message contains the current location of the user along with the speed at which the user is moving. This message is sent to the emergency contact after every 10 minutes. To stop the emergency module the user must click on the Stop Panic button as shown in Fig.7(a). If the emergency contact of the user gives two Missed calls to the user then the current location of the user will be sent to the emergency contact. This feature can be useful in times when the user is not able to use their phone but the emergency contact wishes to know the current location of the user.

E. Blood Request Module

```
SELECT id, deviceid,Token,name,
       Latitude, Longitude, BloodGroup
  FROM (
 SELECT z.id,
        z.deviceid,
        z.Token, z.name,z.Latitude,z.Longitude,z.BloodGroup,
        p.radius,
        p.distance_unit
                * DEGREES(ACOS(COS(RADIANS(p.latpoint))
                * COS(RADIANS(z.Latitude))
                * COS(RADIANS(p.longpoint - z.Longitude))
                + SIN(RADIANS(p.latpoint))
                * SIN(RADIANS(z.Latitude)))) AS distance
  FROM UserDetails AS z
  JOIN (   /* these are the query parameters */
       SELECT  19.031892  AS latpoint,  72.845186 AS longpoint,
               3.0 AS radius,      111.045 AS distance_unit
    ) AS p ON 1=1
  WHERE z.Latitude
     BETWEEN p.latpoint  - (p.radius / p.distance_unit)
         AND p.latpoint  + (p.radius / p.distance_unit)
    AND z.Longitude
     BETWEEN p.longpoint - (p.radius / (p.distance_unit * COS(RADIANS(p.latpoint))))
         AND p.longpoint + (p.radius / (p.distance_unit * COS(RADIANS(p.latpoint))))
) AS d
WHERE distance <= radius
ORDER BY distance
LIMIT 15
```

(a)

Fig. 9: Screenshot of SQL Query

The purpose of this module is to help the user find an appropriate blood donor in case of emergency. This application helps to connect the person in need of blood with the blood donor. When a user is need of blood ,the user clicks on the In Need Of Blood Button on the Homescreen of the application as shown in Fig.1(b). When the user clicks on this button ,the current location and the blood group of the user is sent to a PHP Script on the free hosting server. The PHP Script runs an SQL query on the remote database which is as shown in Fig.9(a). The remote database contains the location and blood groups of all the users who are using the application. This query returns the firebase tokens of users of the application who are eligible to donate blood to the user requesting blood and are located within a raduis of 3 kilometers from the current location of the requesting user. To calculate the distance between two latitude/longitude points the SQL query applies the havershine formula. The PHP script then passes these received tokens to the Firebase server which inturn sends a notification to the eligible donors. The notification received by the donor contains the location and the phone number of the user requesting blood donation. The blood donor can thus contact the user.

V. Conclusion

In this paper we have designed an Android based healthcare application. The Android application developed is able to provide many useful features to the user. It provides many features to the user bundled in a single Application. The application can help the user to keep a track of his fitness and also manage appointments with doctors very easily. The application can also be helpful to the user in case of an emergency.

There are many improvments possible in the application in the future. The future improvments of the application can contain features like integration of fitness module with fitness band. A fitness band is a wearable device which can track various parameters of a person like calories consumed, heart rate, distance travelled ,quality of sleep etc [13]. There can be an additional feature which can enable video conferencing between the doctor and patient ,which can enable the patient to have access to advice from best doctors around the world. The emergency module can have a system which detects accidents automatically using various sensors of an Android mobile phone.

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