

Infant Monitoring aid and Managing Application (iMAMA)

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DECLARATION OF ORIGINALITY

I declare that this report entitled “**Infant Monitoring aid and Managing Application (iMAMA)**” is my own work except as cited in the references. The report has not been accepted for any degree and is not being submitted concurrently in candidature for any degree or other award.

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ACKNOWLEDGEMENTS

I would like to express my sincere thanks and appreciation to my supervisor, Soong Hong Cheng who has given me this bright opportunity to engage in this project. A million thanks to you.

ABSTRACT

The proposed project is a mobile application that integrates with Cloud based medical information system with purpose to provide helps on parenting for infants in Malaysia. The functionalities of the proposed system includes, tracking vaccine schedule of an infant, tracking of infant health details, schedule a vaccination appointment using mobile application for each doctor. One of the features of the system is using Google GPS api to track down clinic. The Google GPS api library is included in the writing of an Android application using Java programming language and cloud database Firebase which is the main development platform. The development methodology that used to develop for this project is Throwaway Prototyping. At the end of the project, the system will help the parent in resolving their problems in parenting their infant health issue and help the doctor gain more control and information on the patient health.

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List of abbreviation

IMAMA - Infant Monitoring aid and Managing Application.

API - Application Programming Interface

OS - Operating System

MBaaS - Mobile Backend as a service

RDMS - Relational Database Management System

SDK-Software Development Kit

UI - User Interface

1 Introduction

1.1 Problem statement

Becoming a new parent is both exhilarating and overwhelming. Being into a new world of responsibility for an infant can leave new parents feeling unprepared for the task. These responsibilities include vaccination, providing a safe environment.

When infants were born, doctor will provide a schedule for the infant to have vaccination. The schedule consists of a chart of monthly view about the date of vaccination which depends on the age of the infant. However, the schedule is paper based, parent tends to lost it or lost track of the schedule. According to (BabyCenter Malaysia Medical Advisory Board 2014), there are more than 10 different injections. This brings a negative effect to the infant as the infant may be harm by various infectious diseases. When cases of missing out vaccination happen it could affect overall health level of a country. According to (Ministry of Health Malaysia, Health Fact 2012), Malaysia childhood immunization coverage for 2011 is average about 98.032% which means there is still some of the children is Malaysia are not protected from various harmful diseases. Most of the vaccinations that not taken are those vaccines that needed to be inject during late infant stage and early childhood stages. And also, when parent wanted to make an appointment to vaccination doctor are often not available. This causes them to giving up vaccination to their infant because of the inconvenience.

Another problem is the daily routine of activities of infants, when parent have limited knowledge about treating some conditions happens to the infant such as fever, rashes or any other medical related conditions, parent have to contact a doctor to some advice for some serious case parents have to bring the infant to see the doctor. When it comes to bringing the infant to see a doctor, the parent might not know where the nearest clinic or a suitable clinic is located.

1.2 Project Objective

Main objectives of the Infant Managing aid and Monitoring Application are:

Objectives	Problems
To provide parent with an apps of user interface to enhanced parenting of newborn infants	Parents find it hard to taking care of infant especially having first born infant as they does not having enough knowledge about the care taking about infant
To provide an easy access for parent to find out where is the nearest clinic when medication attention is needed for their infant.	When condition of infant is too serious the infant need to visit a doctor, the parent might not know where the nearest clinic or a suitable clinic is located.
To provide a reminder of vaccination using mobile application	Most of the vaccinations that not taken are those vaccines that needed to be inject during late infant stage and early childhood stages according to Health Fact 2012 which Ministry of Health Malaysia.
To provide a platform for parents to keep track of their infant health details.	Doctors need infant health conditions to make more accurate decision. Parent often did not record that.
To provide a platform for parents to make appointment with doctor in a clinic	Parent wanted to make an appointment to vaccination doctor are often not available. This causes them to giving up vaccination to their infant because of the inconvenience.

1.3 Project scope

The scope of the project is the development of a mobile application that integrate with cloud based database which allow user to make store health data , make appointment with doctor , find nearby clinics when needed.

1.4 Project Background

When an infant is born, the first concern for being a parent has the ability to take good care of the infant. Malaysia as a multicultural country, different races have different ways to take care of their infant but the way they concerning about the health of the infant is practically the same. This project will start off by provide aid for monitoring the health of an infant while integrating health detail with a medical information system. Mobile application is software develop for mobile device like smartphones, tablet or any other mobile devices. Mobile application allows user to process some simple and basic some task is a very portable way.

The proposed title of this project is “Infants Managing aid and Monitoring Application (iMAMA)” which is a mobile application that integrated with medical information systems that provide aid to monitoring health of an infant for parent.

2 Literature Reviews

2.1 Healthcare

The definition of health care is a series of diagnosis, treatment and prevention of disease for human beings. There are many type of health care specialist such as **dentistry**, medicine, nursing, optometry, pharmacy, midwifery and other health professions. There are three tier of health care primary health care, secondary tier and tertiary care:

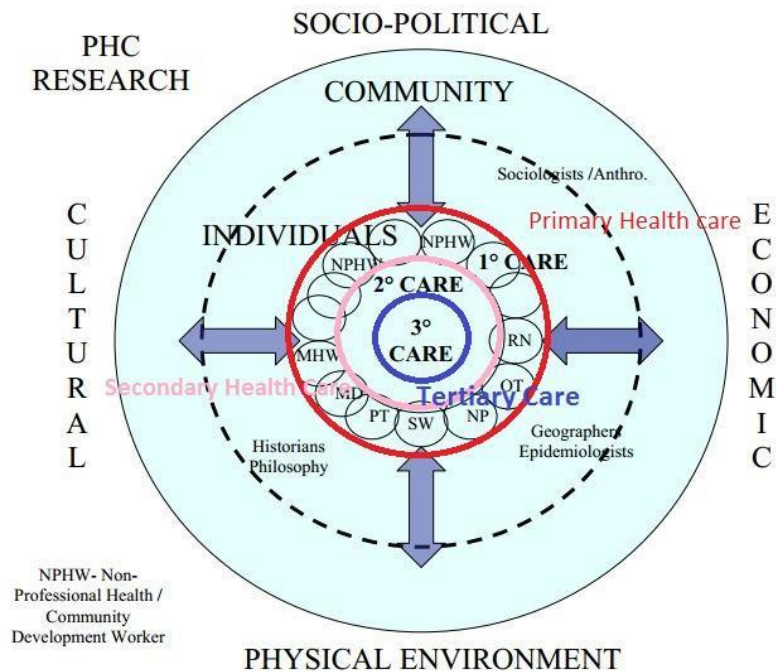


Figure 2.1 Tiers of health care

2.1.1 Primary Health Care

Primary Health Care is a conceptual model that consists of process and beliefs about the method health care is structured. Health promotion, population health, and disease prevention are all example of Primary Health Care. (Calnan, R. and Rodger, GL, 2002)

2.1.2 Secondary Health Care

Secondary Health Care is medical that provide by a specialist or facility that has more specialized knowledge, equipment and skills compare to primary care physician. This includes acute cares which is treatment for short period for serious injury or other health condition. Some examples of secondary health care practitioner are [Cardiologist](#), Pediatrician, and Obstetricians

2.1.3 Tertiary Health Care

Tertiary health care are more specialized consultative health care compared to secondary health care. Usually applied on inpatient person and has referral from primary or secondary health care professional. Examples of tertiary health care services are cancer management, neurosurgery, and cardiac surgery.

2.2 Development of infants

From helpless newborn to children stage, it took 3 years and the stage in between is called the infant stages or in some cases is called toddler stage. Babies grow and change at an astounding pace.

2.2.1 Helpless newborn to active toddler stages (newborn to 12month)

2.2.1.1 Newborn to 3 months

The first development stage of new born baby, baby body and brain is learning to live in the outside world.

Motor

infant will have basic hand movement and head movement.

Sensory

Infant track objects visually with eyes while able to respond to noise and voice.

Health status

Weakest states of infant as infant is just new born and still fully rely on parents. Vaccination and monitoring is needed from parent.

2.2.1.2 4 months to 6 months

During this duration, infant are learning to reach out and gain control the outside world around them.

Motor

infants have better control on their hands and can roll over their back to front and sit up with support and having greater head control.

Sensory

Able to respond to noise/voice while get used to everyday noise and sounds.

Health status

stronger compare to previous stages as infant already take some vaccination but still need health protection from parent.

2.2.1.3 7 months to 12 months

During this duration of development, infant will transition to toddler stages and infant will action like a toddler

Motor

infants start to crawl and picking out object with hands

Sensory

Able to explore object with finger and mouth and have conscious on every object

Health status

stronger compare to previous stages as infant already take some vaccination but still need health protection from parent.

2.3 Vaccination for babies

Childhood immunization is an attempt to replace the anticipated natural primary contact between the human body and a hostile organism, with a safer artificial contract, so that any subsequent natural contact takes place in a state of heightened immunity. (Zimmerman, 1987)

Age	Vaccine	Hepatitis B Vaccine**	
		Scheme A	Scheme B
Birth	BCG, OPV 0	HB1	
6 weeks	DPT 1, OPV 1	HB 2	HB 1
10 weeks	DPT 2, OPV 2		HB 2
14 weeks	DPT 3, OPV 3	HB 3	HB 3
9 months	Measles, Yellow fever*		

Table: EPI schedule

Scheme A is recommended for countries where perinatal transmission of hepatitis B virus is frequent (e.g South Asia), while Scheme B is for those with less frequent perinatal transmission (e.g Sub-Saharan Africa).

The table above shows that no immunization schedule is ideal and therefore EPI recommends that each country determine its own schedule that is suitable. This immunization program must ensure that protection must be achieved before any infant are at high risk of a disease. In most developing countries, infants are at high risk of this disease including within the EPI strike early in life, therefore it is important to protect the children through immunization as early as possible. As people always say, “prevention is better than cure.”

Immunisation	Age (months)									Age (years)	
	0	1	2	3	4	5	6	12	18	6	
BCG	■										No scar
Hep B	■	■					■				
DPT			■	■	■		■				DT
OPV			■	■	■						
HIB			■	■	■		■				
Measles*								■			
MMR									■		

Table: New immunization schedule

The immunization program in Malaysia commenced about 40 years ago with the DPT vaccine following the BCG vaccine in 1961 and OPV vaccine in 1972. The Measles immunization was added to the program in 1984 with the immunization against rubella being introduced in 1988 and against hepatitis B in 1989 (Pathmanathan, 1990).

In Malaysia, the immunization of BCG has the highest percentage of 99.97%, DPT of 95.3%, OPV of 95.4%, measles of 88.4% and hepatitis B of 93.5% in 2000.

2.4 Comparison of Existing system

In this section, similar system that has been developed in the past will be studied and compared.

2.4.1 An Efficient Emergency, Healthcare, and Medical Information System

The authors stated that current Malaysian emergency, healthcare and medical information systems shows that they have several weakness such as lack of sharing between hospitals, no integration between emergency, healthcare and medical information systems, lack of utilizing real-time and mobility technologies, still some parts are paper-based and standalone systems. They proposed a system that incorporate the real-time and mobility technologies with medical emergency systems (SHIHAB, AISHA, SHAHINA, VLADIMIR, OTHMAN, 2008).

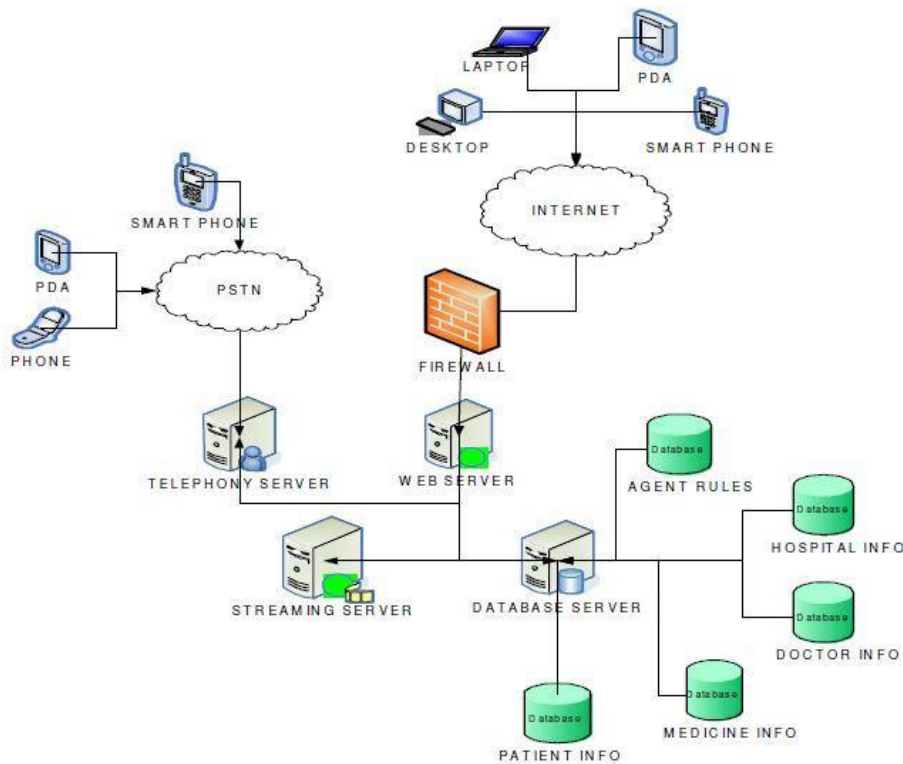


Figure1: Overall IEHMS architecture

Strength:

I found that the strength of this system is they provide very details information regarding their work. They also provide a very strong framework for a medical information system.

Weaknesses:

In the online environment, security is very important especially dealing with patient medical records. The system have only one firewall which may cause the system vulnerable to cyber-attacks. When the attacker get through the one and only firewall, the database system that contain sensitive information about the patient could be potentially access by the attacker. Another weakness are the system provide very limited interaction between patient and doctor.

Solution to the Weaknesses:

Install another firewall on the boundary of the database server. This could decrease the vulnerabilities of attacker. Since the system already include some mobile application functionality, they can develop another module that include communication between doctor and patients.

2.4.2 Android-Based Application to Assist Doctor with Alzheimer’s patient

In this paper, Android-based application called Alzheimer’s Patients Medical Care System (APMS) is proposed. APMS is aimed to assist doctors to monitor their Alzheimer’s patients, especially for the medication. During medication time, APMS sends notification messages to remind a patient about the medicine that he or she has to take according to the schedule provided by the doctor. The doctor can also monitor the condition of a patient according to the feedback provided by the patient’s caregiver through APMS. Based on the feedback, a doctor may change the medication schedule and refer the patient for further treatment (Zaid, Wan, Mohd, 2013).

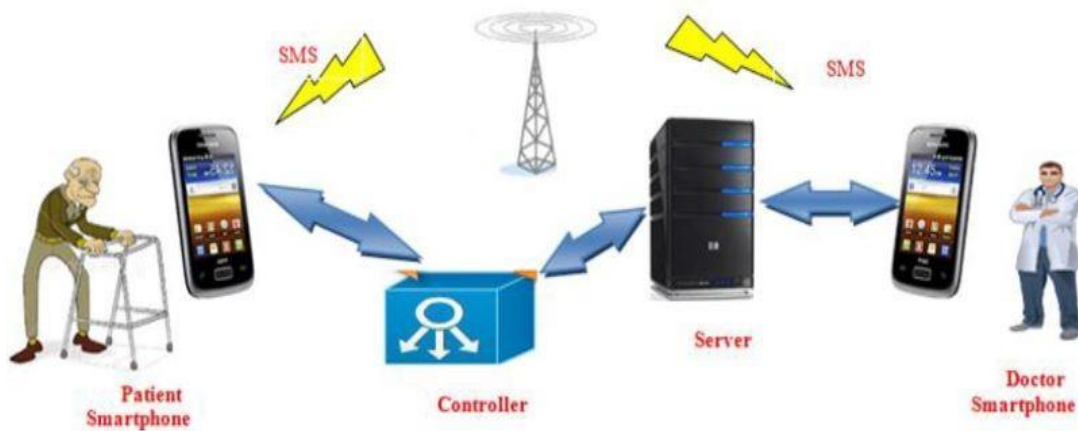


Figure 2.2 APMS design process

Strength:

This mobile application provide a very convenient way to let patient’s caregiver and doctor communication with each other.

Weaknesses:

The feedback from patient’s caregiver isn’t accurate as what them seen is not the patient or doctor perspective. This could cause inaccurate or wrong diagnosis that may lead to unnecessary treatment or very harmful consequences to the patient.

Solution to the Weaknesses

The weakness can be resolved by understanding what normally would happen Alzheimer's patients to predict the outcome of diagnosis. The developer can develop a video conference module on the mobile application.

2.4.3 Mobile Healthcare Information Management utilizing Cloud Computing and Android OS

This article is about providing availability of e-health applications and medical information anywhere and anytime and the invisibility of computing by addressing Cloud Computing concept in electronic healthcare systems. (Charalampos Doukas, Thomas Pliakas,, 2010)

Strength:

Solve physical data storage problem which happens on most of the mobile device by using cloud computing concept. Image and information is processed on a server and the result where send back to user.

Weakness:

Image the process is having a big in size most of them took too much time to load and it depends on the speed of the internet.

Solution to the Weaknesses:

Image can be compressed into smaller size or different format when more detail image is needed another more detail image can be resend to increase the performance of the system.

2.5 Comparison of Mobile backend as a Service model

Firestore

Firestore is use Mobile backend as a service (MBaaS) as model to provide services to their client which often are developers. It provide real time storing and retrieving data that allow user to instantly see changes without reloading the same activity. It also provides Query function that to get information from the server. It uses a fermium model as business model which means to get bigger size or more simultaneous real time connections user will have to paid for the services. Not only database, Firestore also provides User Authentication services for developer to implement in their projects Platform supported by this services are Android,IOS.JavaScript.(Firestore,2015)

Pubnub

Pubnub is Chat server backend as a service it allow user to push message to different device through native mobile application. It allows developers to implement chat services into their mobile application with Pubnub chat backend services. It also allow user to send one to one notification using the services. It use a freemium model as business model which the user that using the chat service exceed certain limits the developer has to paid for the services to maintain the chat services. Platform supported by this services are Android,IOS.(Pubnub,2015)

Parse

Parse is cloud based database which launched by Facebook. It provides data storing capabilities and mass push notification to mobile device. It allow user to set backend logic verification using java script to the server. It also use a freemium model as business model which data stored exceed certain level the developer will have to paid for the server. Unfortunately, Parse will be discontinued in year 2017. It gives away its source code for those developers that using the service which allow them to be setup the service themselves. Platform supported by this services are Android,IOS.(Parse,2015)

Batch

Batch provide mass push notification to mobile device through native mobile application. Using Big Data it allows developer to segmental the user of mobile application to push different notification to the user. This helps developer of application to increase sales send more personalizes notification to their user. Platform supported by this services are Android,IOS.

Comparison table of Mobile backend as a Service model

	Firestore	Pubnub	Parse	Batch
Store Data	✓			
Real time data change	✓			
Push notification		✓	✓	✓
User to user notification		✓		
Back end server logic	✓ (partial)		✓	

3 System Design

3.1 Requirement Specifications

3.1.1 Functional Requirement

For patient mobile application module:

- A module that tracks infant health details such as body temperature, weight, heart rate. If there is any of the value out of the safety range an alert will be shown.
- A module that use the user current location to find the nearest clinic
- A module that tracks vaccination schedule and provide the detail of each type of vaccine.
- A module that can make appointments with the doctor to have vaccination for the infant

For medical information database module:

- A module that accept appointment and schedule them between doctors.
- A module that store clinic location.
- A module that store patient detail.

For doctor mobile application module:

- A module that accept appointment from the patient .

3.1.2 3.1.2 Non-functional Requirement

- User data should synchronize with the database in real-time.
- All data will be dynamically added / store into database.
- All data will be retrievable when needed.

3.2 System Design

3.2.1 Use case Diagram

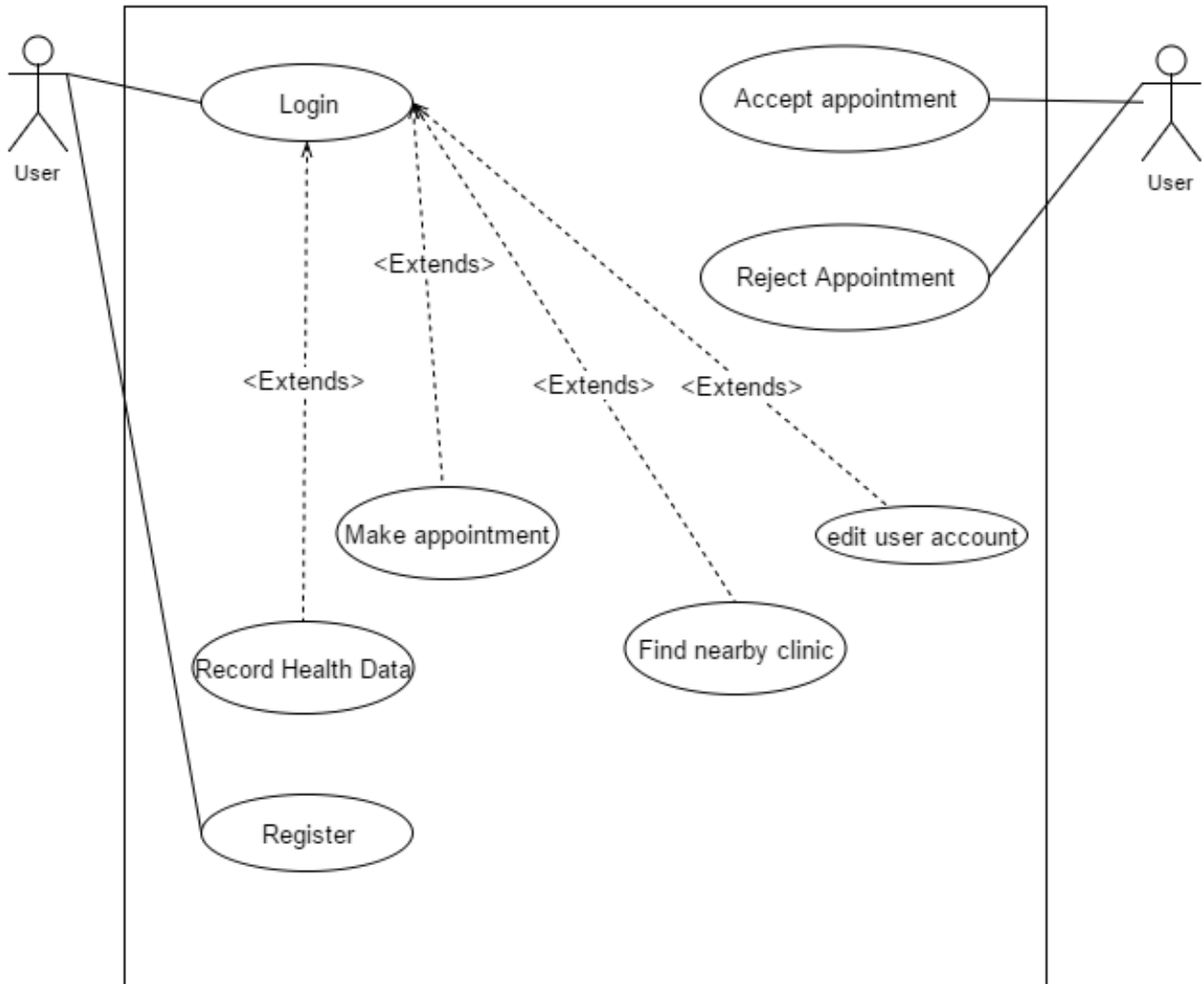


Figure 3.1 Use Case Diagram of IMAMA mobile application

Login - Enable user to login to system

Register - Enable user to register to the system

Record Health Data – Enable user to record their baby body weight and body temperature

Make appointment– Enable parent make appointment with doctor

Accept appointment – After appointment is made doctor need to accept the appointment.

Reject appointment - After appointment is made doctor need to reject the appointment.

Edit User Account - Edit user account after register.

3.2.2 System flow Diagram

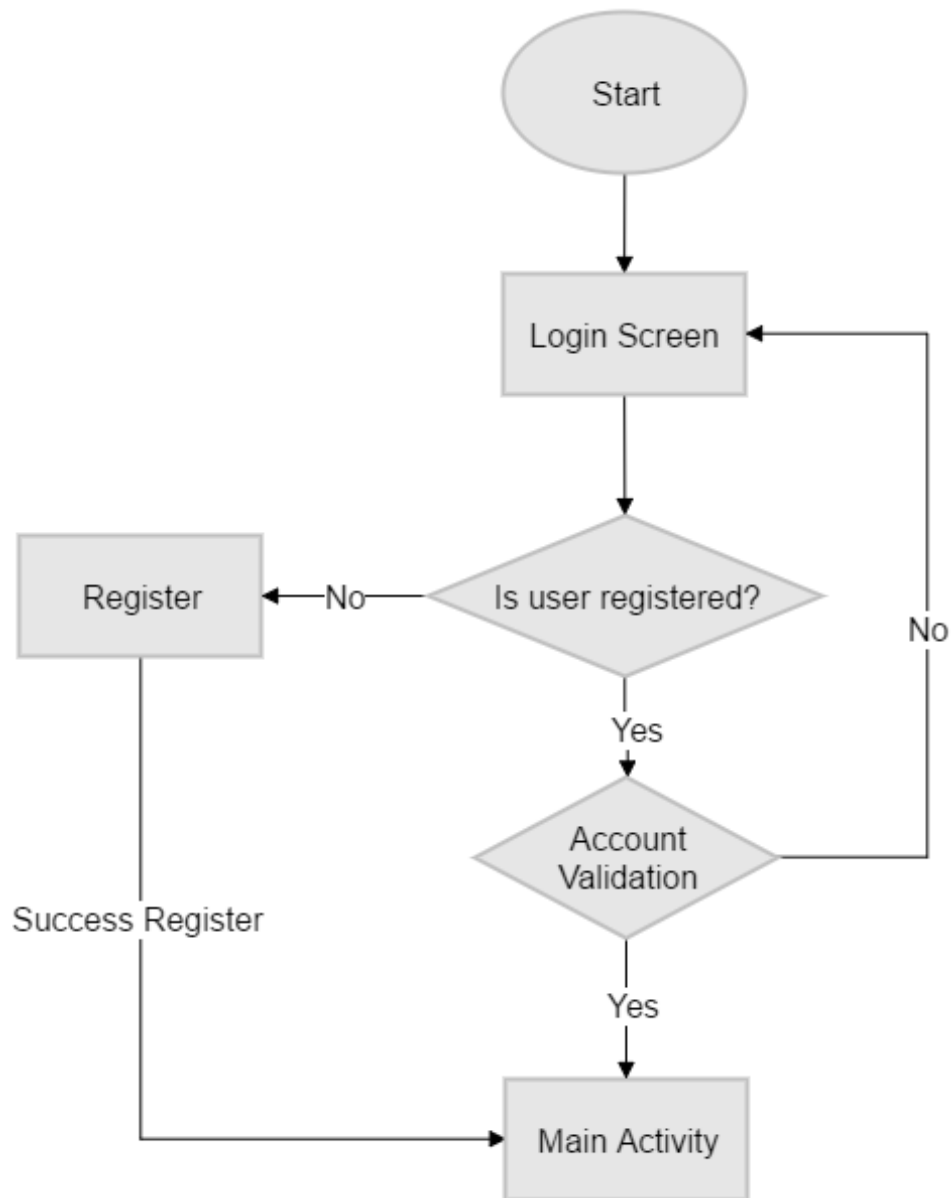


Figure 3.2 System flow chart of IMAMA mobile application(Part1)

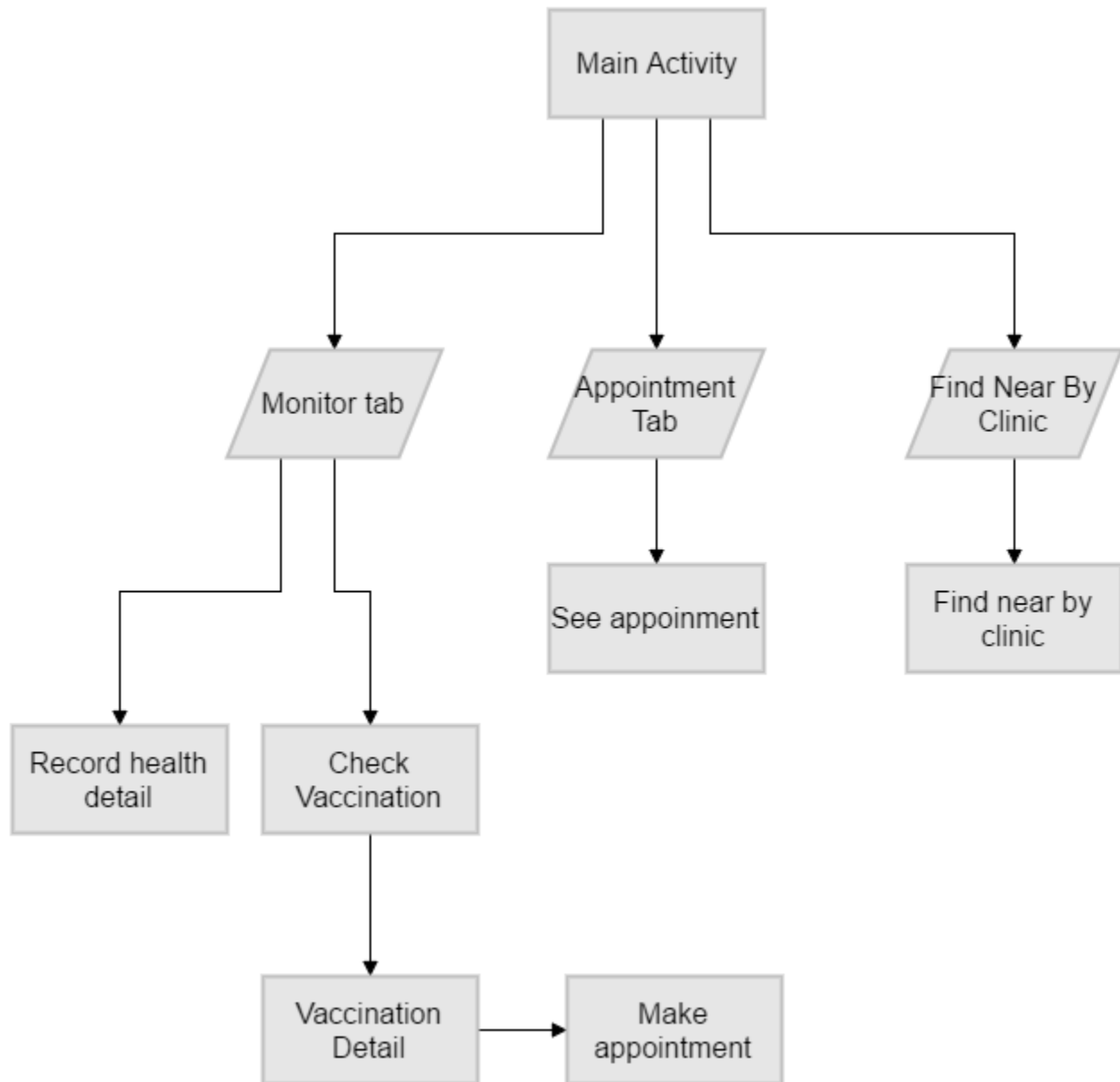


Figure 3.3 System flow chart of IMAMA mobile application(Part2)

3.2.3 Sequence diagram

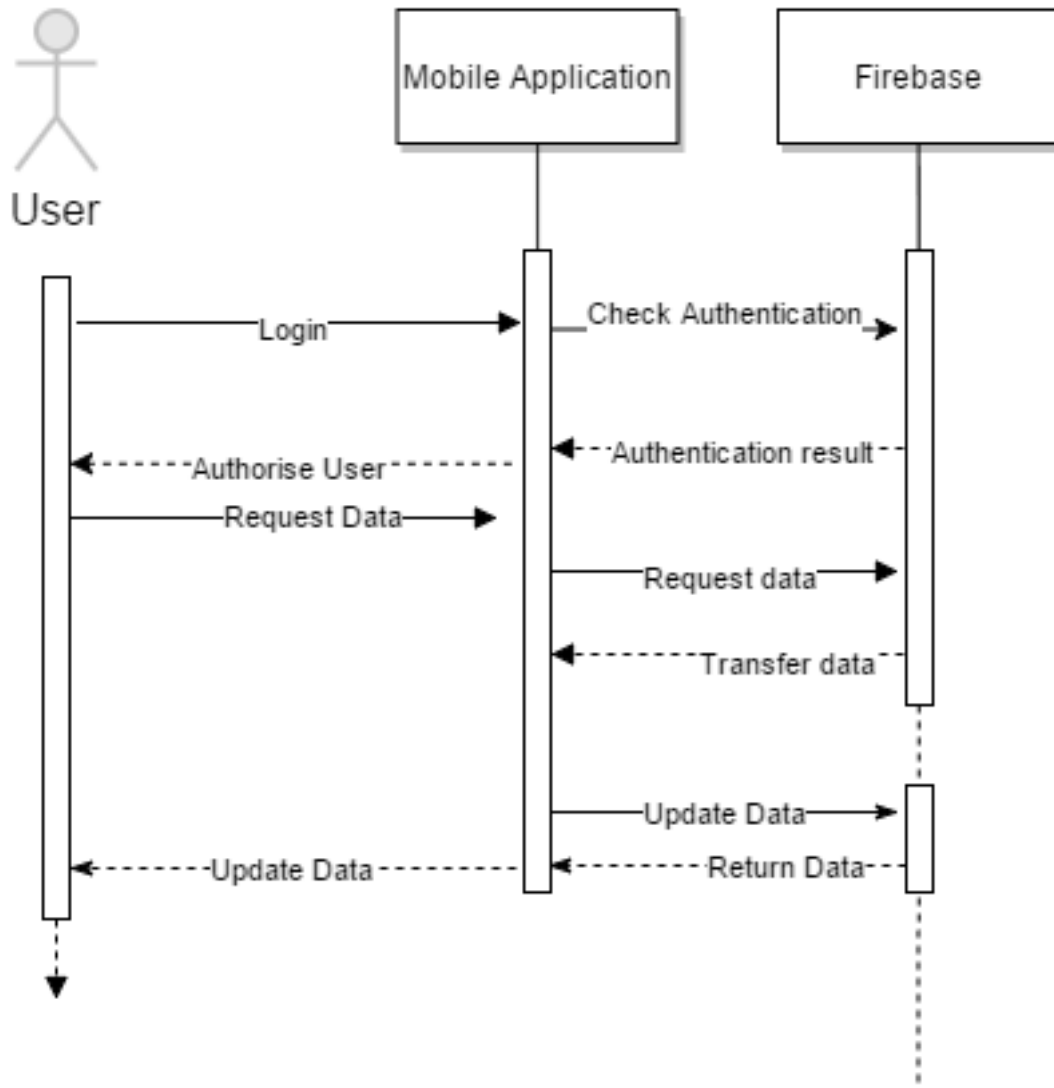


Figure 3.4 Sequence diagram of IMAMA mobile application

3.2.4 Entity Relationship Diagram

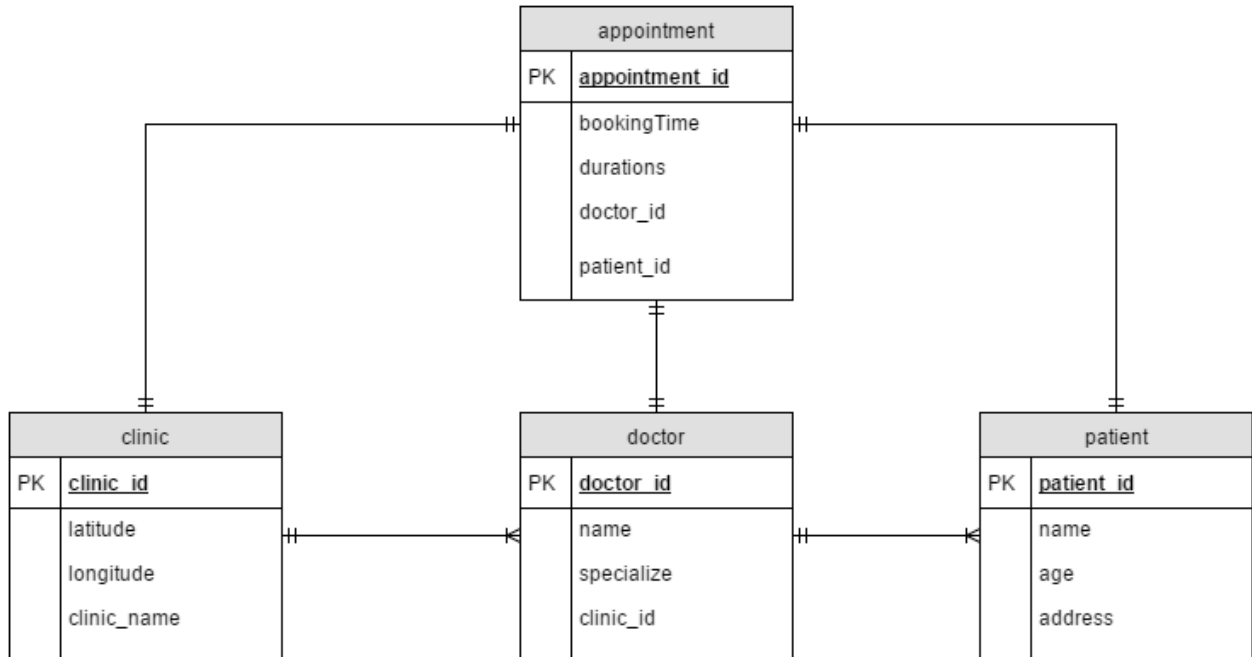


Figure 3.5 Entity Relationship Diagram of IMAMA mobile application

3.3 User Interface Design

3.3.1 Login Screen and Appointment List

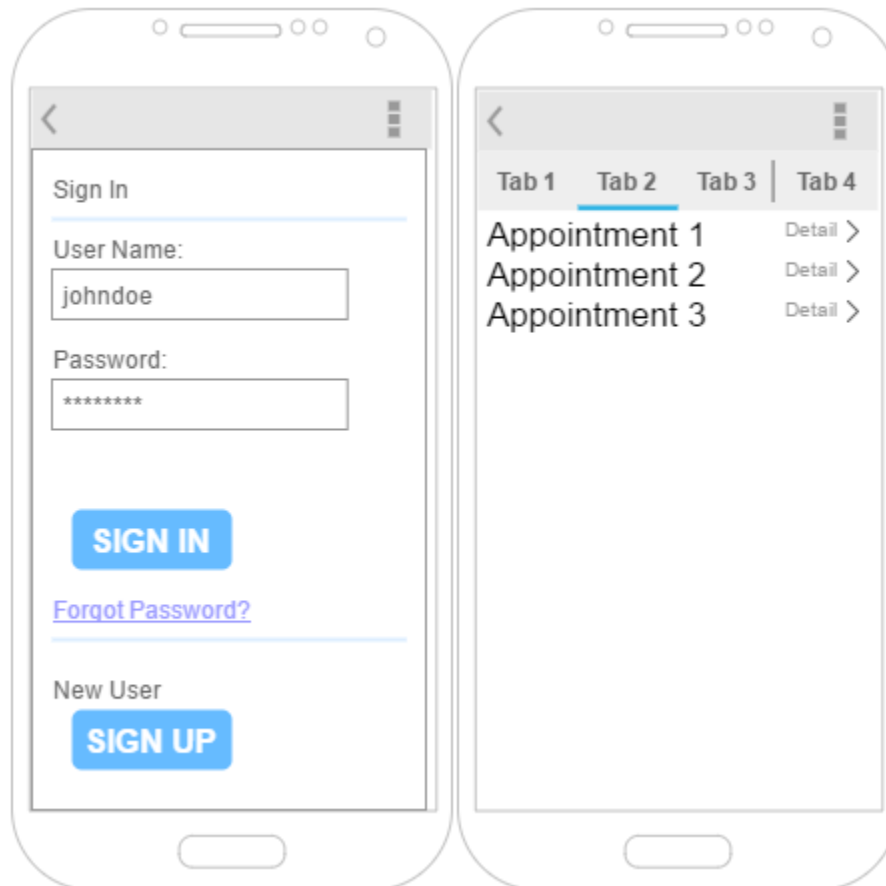


Figure 3.6 User Interface Design of IMAMA login screen and Appointment list

Above are the mockup of the user interface design of login screen of the mobile application which consist of two edit text for user email as user id and password, additional two more button is for register and login button.

For the appointment list fragment, the fragment will be using recyclerView of CardView which recycle CardView as template to make a list.

3.3.2 Monitor Health Data Module



Figure 3.7 User Interface Design of IMAMA Monitor Health Data Module

Health Data Module consist of three button which two of them serve similar function which is record the temperature and weight to the system. These activity consist of one edit text which allow user to enter the data and a graphview to keep track of the health history.

3.3.3 Find Nearby Clinic Module

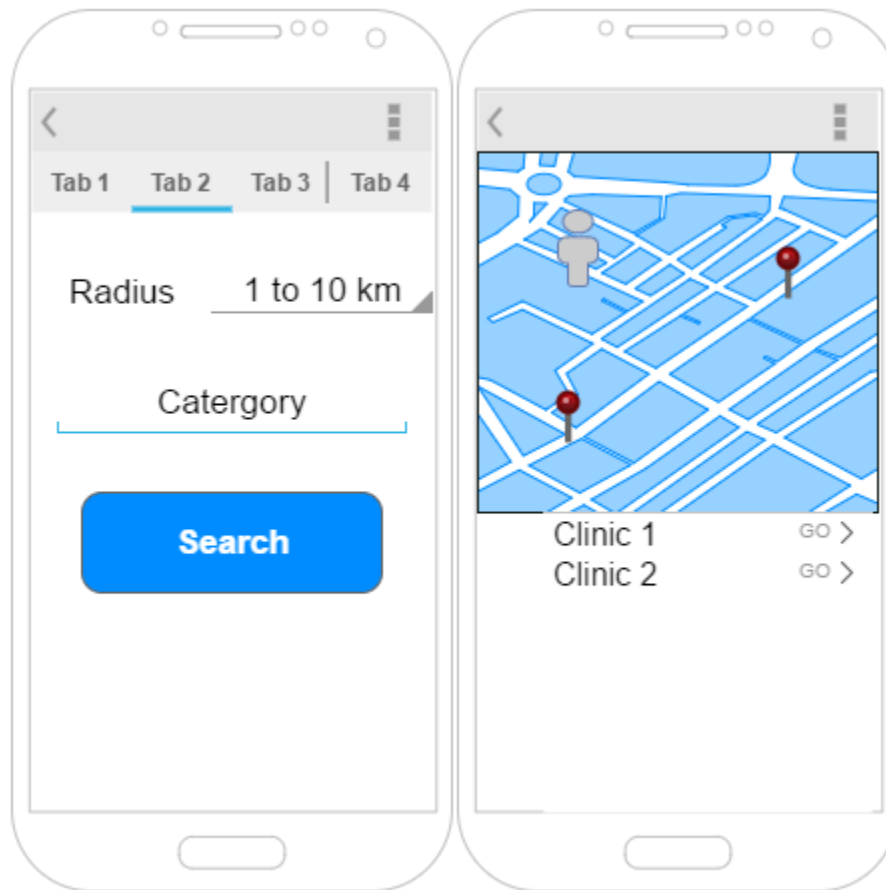


Figure 3.8 User Interface Design of IMAMA Find Nearby Clinic Module

This module consist of two activity which user will choose the radius of searching at the first activity and proceed when pressed the search button the application will show the map with other clinic location. When other clinic location is shown the user can press go to navigate to the location.

3.3.4 Vaccination Details and Make Appointment

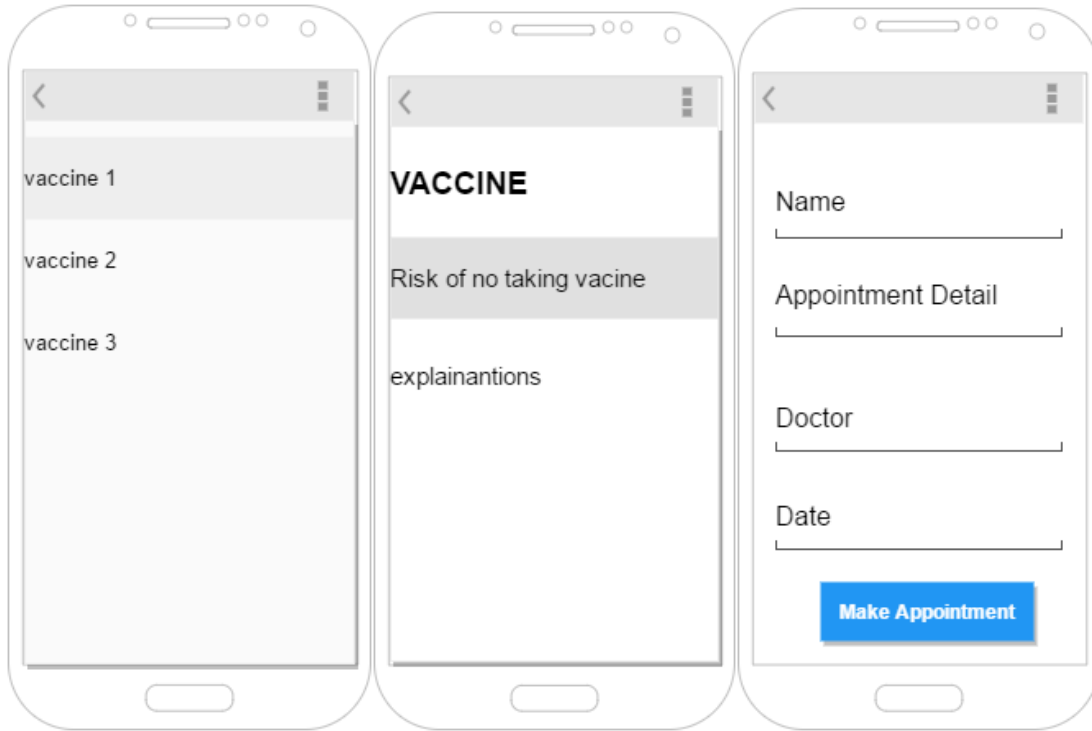


Figure 3.9 User Interface Design of Vaccination Details and Make Appointment

In this module, User will have a list of vaccine to selected, when particular vaccine is selected user can see the detail of vaccine and the disease of the vaccine prevent as well as the risk when the vaccine is not taken then below the vaccine details is a make appointment button it will proceed user to make appointment. User will enter name appointment detail ,select doctor from drop down list then select a date to make a valid appointment.

3.3.5 Firebase User authentication & database

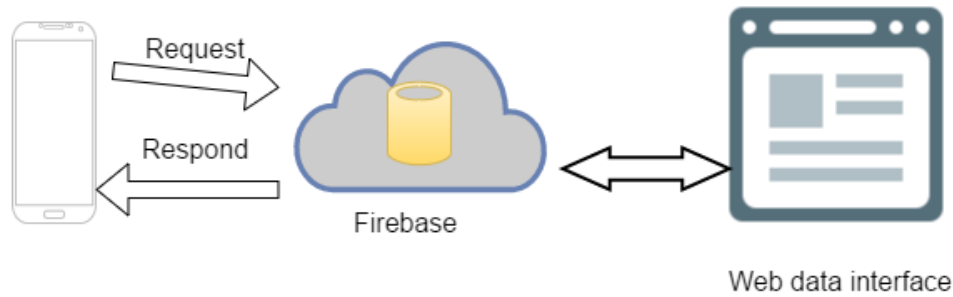


Figure 3.10 Firebase System Architecture

Above shows an overview of the system architecture of this project and the relationship between its major components. This project used Firebase as the backend server .Firebase is a cloud based database services, the service allow directly store java objects into database which makes development easier.

To develop using Firebase, first developer must register an account , then an app needs to be create in the Firebase dashboard (<https://www.firebase.com/account/#/>). When creating the app the Firebase will required to create Firebase URL which are the database reference that allow the mobile application to connect to the database. In order to connect the database with the mobile application the Firebase url will needed to add into Android Studio SDK. Before developer can use the Firebase API the library must be included in the SDK .In order to allow the library to installed in the project, the project file Gradle.build must include dependencies that compile the library from internets

```
dependencies {  
    compile 'com.firebase:firebase-client-android:2.5.1'
```

Since the same database will be used, a constant class will be used to store the Firebase URL as a string. Beside that internet permission are need to added into the AndroidManifest.xml to allow the mobile application to connect to the internet. After allowing the internet permission the

context must be set before using the Firebase APIs.(`Firebase.setContext(this);`) will be added into the activity that needed to use Firebase APIs

```
1. @Override
2. public void onCreate() {
3.     super.onCreate();
4.     Firebase.setAndroidContext(this);
5.     // other setup code
6. }
```

Figure 3.11 Example of setup of firebase

4 Methods / Technologies Involved

4.1 Software Development Methodology

The software methodology that is selected for the project is throwaway prototyping. The figure below shows the classifications of the software development approaches that include prototyping of some kind.

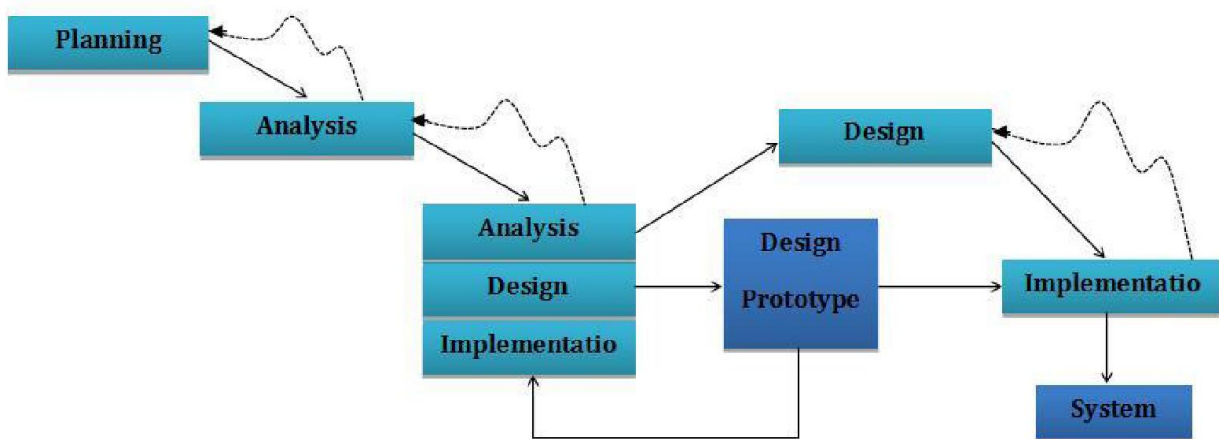


Figure 4.1 Throw-away Prototyping Phases

With 'throw-away' prototyping a small part of the system is developed and then given to the end user to try out and evaluate. In this project, the end user will be the doctor who treats infant-pediatrician that provides feedback which can quickly be incorporated into the development of the main system. A prototype developed as part of a throw-away approach will not form part of the final solution. It is likely to inform the final solution, but the prototype itself will not become part of the final solution. Throwaway prototypes are a useful way of exploring ideas, and gaining feedback from the end-user. They tend to be used to answer questions.

The advantages of this throwaway prototyping approach are:-

- It focuses the user on only one aspect of the system so keeping their feedback precise.
- It also provides a useful and meaningful way for a developer to walk the end-user through the system requirements as interpreted by the developer.
- Feedback from the client and/or end-user should aid in allowing misinterpretations or unnecessary complexities to be picked up and addressed at an early stage.
- Rapid throwaway prototyping explores completeness of specifications and the spiral model attempts management of risk using prototypes in the software development process.

The methodology contains several phases, below will be discussing at each phase what task will be conducted:

4.1.1 4.1.1 Planning phase

In the planning phase, we will collect the requirement from doctor and conduct analysis to identify possible to build the system or not. Next, a Gantt chart is made and task is assigned into every phase. The, developer will make appointment with the end user to understand the requirement of the end user. After gathered the requirement the development will proceed to Analysis phase.

4.1.2 Analysis phase

In the analysis phase, a system proposal is written and proposed to the end user. The system proposals are include requirements of user, business model and system concept. In this phase, analyst will analyze existing system and find out the other new solution to propose a new system. After completing analyze the system then will go to Design phase

4.1.3 Design phase

In this phase, I will design all the alternative diagrams such as Use –Case diagram,ERD diagram as well as including the user interface diagram. After completing all the diagrams, company will send a presentation of the part of the system, like the flow of part of the system and the functionality of part of the system. If end user will approve the design of part of the system, then we will throw-away the prototyping and redesigns the system in analysis and design phase to make sure it is errorless and proceed to implementation phase.

4.1.4 Implementation phase

In the last phase, all the accepted prototype is combine and uses as one system.

4.2 Development Technologies and Tools

4.2.1 Software

Android Studio

This development tool is used to develop the android app part of the system. It also provides sample projects with source code, development tools, mobile phone emulator and required libraries to build android applications.

Firestore Database service

This is a cloud-based database service which allows patient, doctor data to be stored into a cloud server which is virtualized on the internet.

Material Design Library

This library allows the project to have a material design look on the UI while it also provides dynamic animation for those UIs.

Google Play Services Map API

This API allows the project to launch MapActivity within an android mobile application.

Google Play Services Location API

This API allows the project to get location from the user within an android mobile application.

Android GraphView

This UI allows the user to draw a graph within an android mobile application.

Draw.io

This is used to draw all the diagrams and mockups of this project.

4.2.2 Hardware

Computer

Type: Laptop

Model: Lenovo Y410p

Processor :Intel core i7 4800QM

Installed Memory: 4 Gb

Mobile Devices 1

Redmi note 2 with android 5.0.2 along MIUI 7

Motorola Moto-G with stock android 5.0.3

4.3 Project Planning

4.3.1 Ghant Chart

ID	Task Description	Start Date	Planned End Date	Actual End Date	Work Days Planned	Work Days Elapsed	Work Days Remain	Work Days Overrun	02-FEB	09-FEB	16-FEB	23-FEB	02-MAR	09-MAR	16-MAR	23-MAR	30-MAR	06-APR	13-APR
1	Review Final Year Project 1	01-Feb-15	08-Feb-15	08-Feb-15	5	0	0	0	█										
2	Planning	09-Feb-15	23-Feb-15	23-Feb-15	11	0	0	0		█									
3	Requirement analysis	24-Feb-15	02-Mar-15	03-Mar-15	5	0	0	1				█							
4	System Design	03-Mar-15	10-Mar-15	10-Mar-15	6	0	0	0					█						
5	System Development	11-Mar-15	01-Apr-15	01-Apr-15	16	0	0	0						█					
6	Report	02-Apr-15	09-Apr-15	10-Apr-15	6	0	0	1											█

Figure 4.2 Gantt chart

5 Implementation

5.1 Mobile Application Implementation (Patient)

5.1.1 Login and Register Module

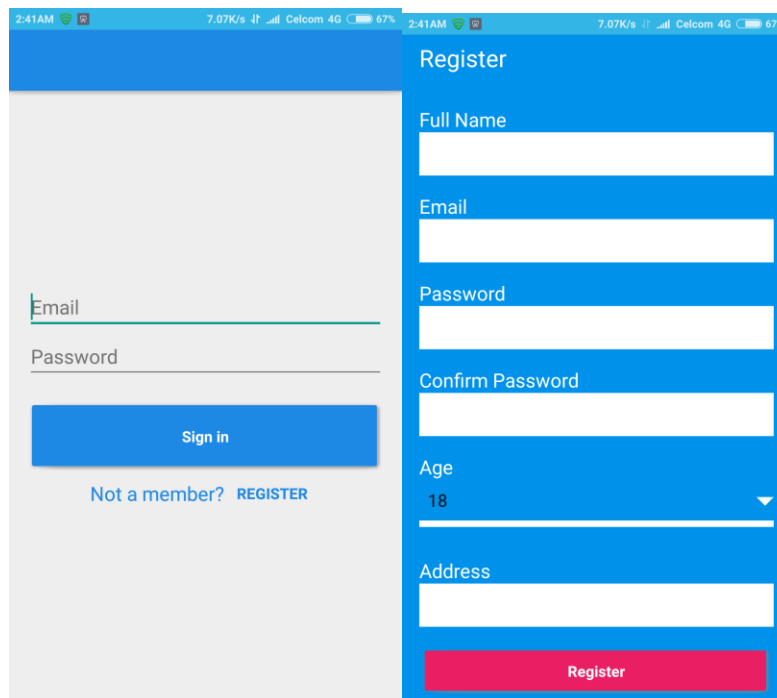


Figure 5.1 Screenshot of Login and Register Screen

Login Screen

The login screen allow user to perform login action using Email and password registered earlier. The login screen is implemented with Material Design Library Rectangle Button which has a ripple visual effect when pressed. EditText UI component is used for email and Password text field. All of these UI component are arranged using Linear Layout which allow UI to arranged without collide with each other. When Sign in button is pressed with Email and password entered, the mobile application will authenticate the Email and password with the server with Bcrypt encryption. With Bcrypt encryption, the user data and password will be secured when passing through the internet.

Register Screen

If the user doesn't have an account he/she can press the Register Button below the Sign in Button. When pressed, user will be guided to Register Screen which allow user to register their account. In the Register screen, multiple EditText UI component to allow user to key in the register data and TextView that indicate the information they need to entered. When register button is pressed, the data is validated within the mobile application by checking the textfield is correctly entered the data will send to server to validate the availability of Email. If the Email is available the account is registered, else the user will be prompt to choose another email.

5.1.2 Main Screen

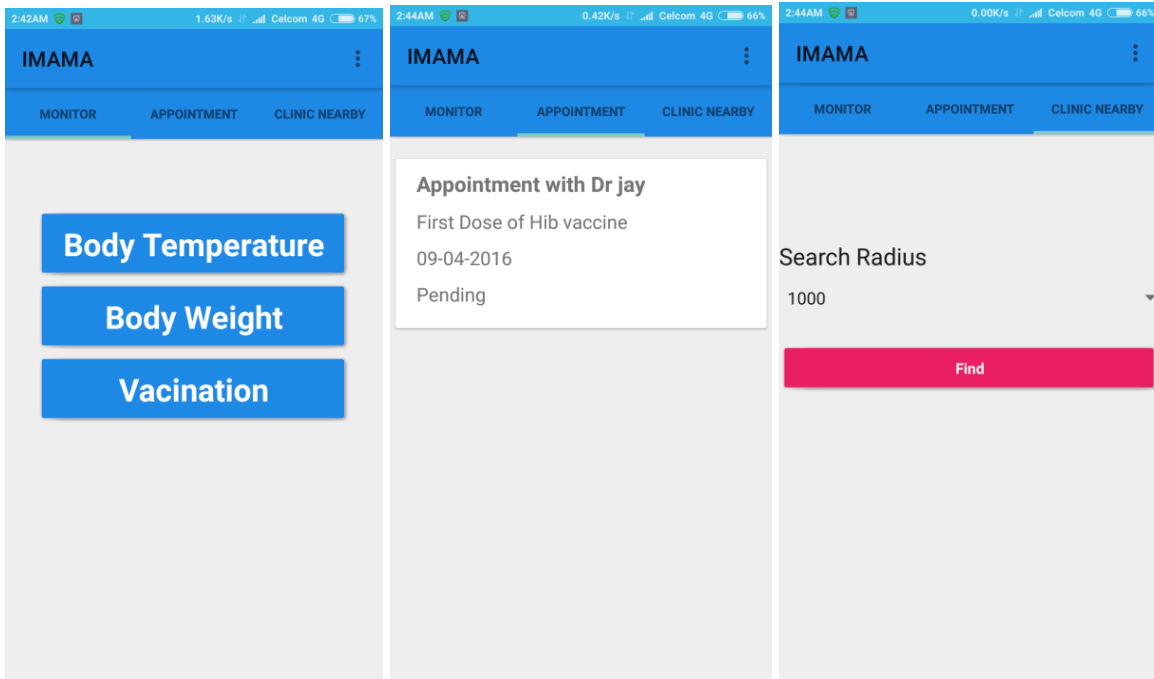


Figure 5.2 Screenshot of Main Screen

Above are the user main screen after login, It three Fragment that show as tab with monitor, appointment and clinic nearby. Each of these Fragment are plugged into TabFragmentManager which is an UI component that allow fragment to be displayed in tabs.

5.1.3 Menu Item and User Account

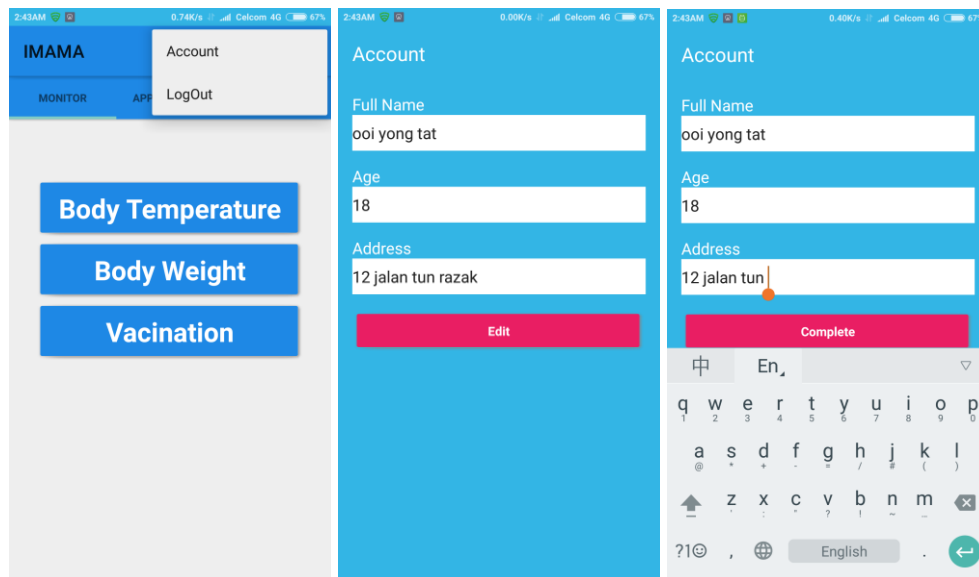


Figure 5.3 Screenshot of Menu Item and User Account.

In the main screen, there is a menu item that allow user to logout the app and access to their user account. When the Account button is pressed, the user will proceed to account page which information of the user will be retrieved from Firebase. By pressing the Edit button the user will allow to Edit their information. After editing the data will stored into database and renew the old data.

5.1.4 Monitoring and Health Data

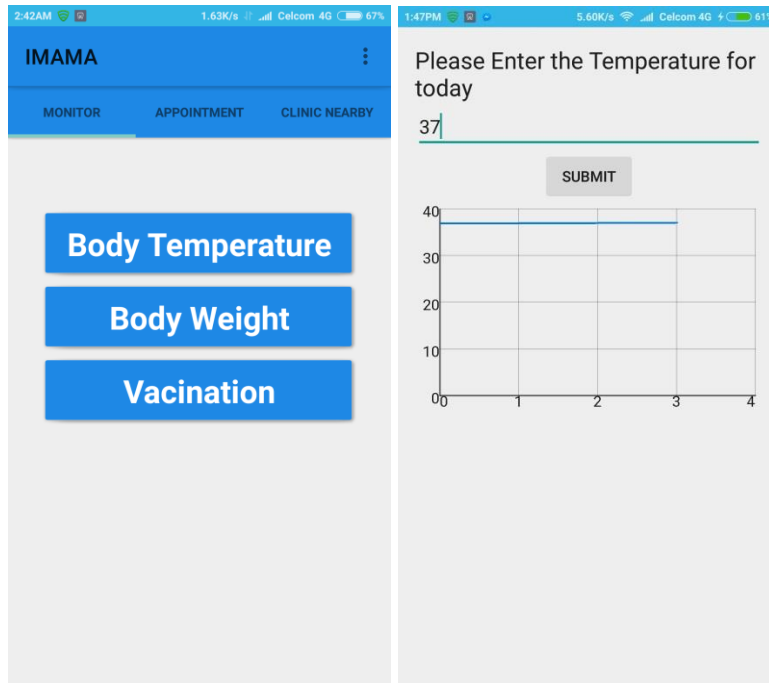


Figure 5.4 Screenshot of Monitoring and Health Data.

Monitoring tab has three button each of these button is arranged in LinearLayout to avoid the UI component colliding with each other. When user pressed body temperature or body weight button they will proceed to the health data recording screen which consist of one EditText one submit and one GraphView. When user enter the health data , the data will be saved into server then the GraphView will plot a graph of the health data recorded.

5.1.5 Vaccination List

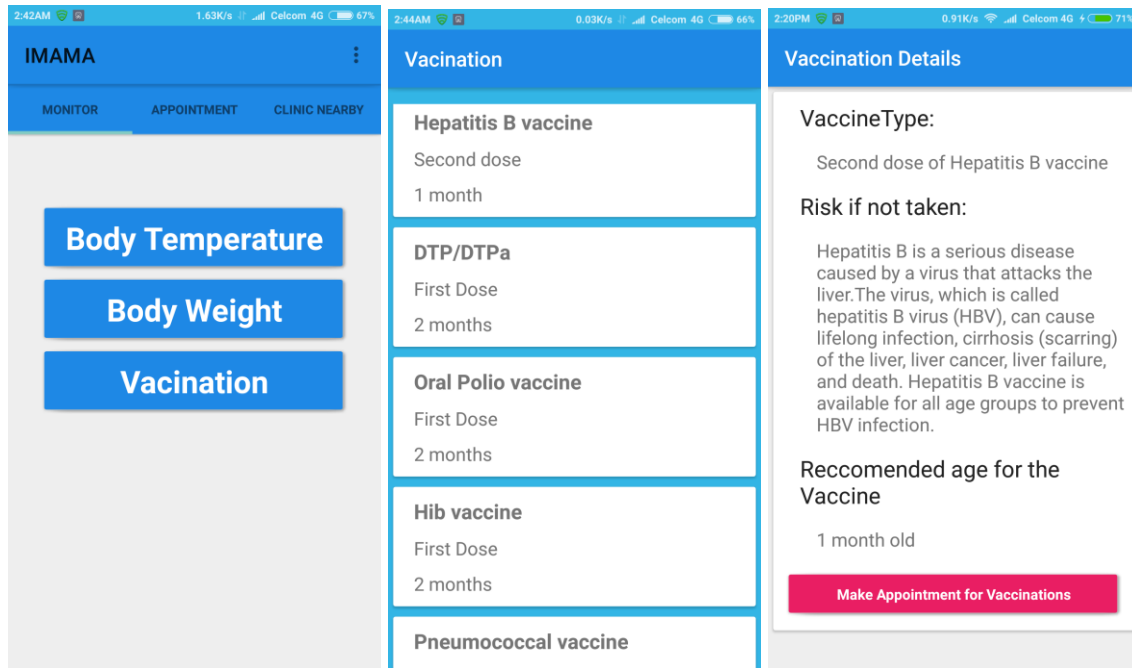


Figure 5.5 Screenshot of Vaccination List and Vaccination Details.

Vaccination list is used recyclerView that containing Cardview which recycle the Cardview for repetitive use to make a list. The Cardview contains the Vaccination type and the recommended age for taking the vaccine. Vaccination Details contains the detailed vaccine information like “Risk if not taken” and recommended age for taking the vaccine. The Vaccination Detail also allow user to make appointment about that particular vaccination.

5.1.6 Appointment module

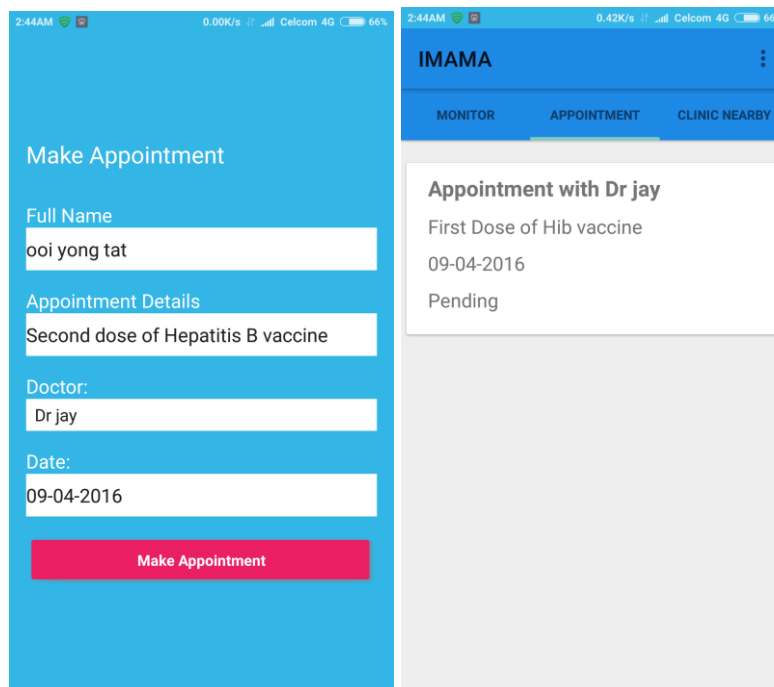


Figure 5.6 Screenshot of Make Appointment and Appointment List.

In this module, user can make appointment with the doctor using the mobile user can choose the appointment detail such as vaccination or other user defined reasons, then user get to choose their doctor in a dropdown list and user choose the date. Then press the Make appointment button the system will send the appointment to the doctor for approval. The applied appointment is listed on the Appointment List.

5.1.7 Find Nearby Clinic

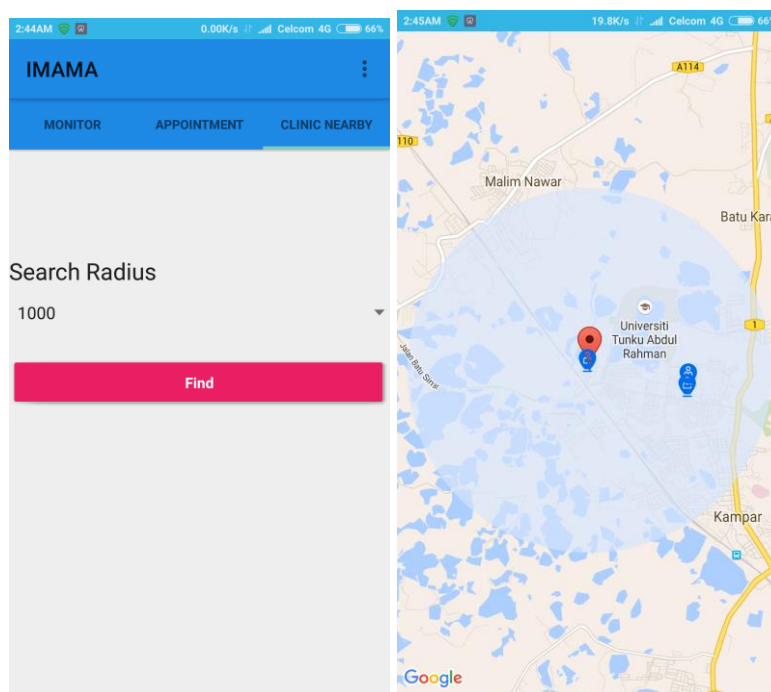


Figure 5.7 Screenshot of Make Appointment and Appointment List.

This module is the third tab of the main Activity , it allows the user to find the nearby saved clinic in the firebase database. It use Google map api also known as Google map activity to pinpoint user and the clinic location. Using an algorithm called Haversine formula, it allow user to specify the range of search with the user to locate the clinic. The algorithm use the radius of Earth , longitude and latitude of both user and clinic to find the distance .Since we have the distance we can group the clinic based on the distance and display accordingly. Below are the Haversine formula and the class I have implemented the Haversine Algorithm.

$$a = \sin^2(\Delta\phi/2) + \cos \phi_1 \cdot \cos \phi_2 \cdot \sin^2(\Delta\lambda/2)$$

$$c = 2 \cdot \text{atan2}(\sqrt{a}, \sqrt{1-a})$$

$$d = R \cdot c$$

```
package tats.imama.classDir;

/**
 * Created by Tat on 4/7/2016.
 */
public class Haversine {
    private static final int EARTH_RADIUS = 6371; // Approx Earth radius in KM

    public static double distance(double startLat, double startLong,
                                  double endLat, double endLong) {

        double dLat = Math.toRadians((endLat - startLat));
        double dLong = Math.toRadians((endLong - startLong));

        startLat = Math.toRadians(startLat);
        endLat = Math.toRadians(endLat);

        double a = haversin(dLat) + Math.cos(startLat) * Math.cos(endLat) * haversin(dLong);
        double c = 2 * Math.atan2(Math.sqrt(a), Math.sqrt(1 - a));

        return EARTH_RADIUS * c; // <-- d
    }

    public static double haversin(double val) { return Math.pow(Math.sin(val / 2), 2); }
}
```

Figure 5.8 Screenshot of Haversine algorithm.

5.2 Mobile Application Implementation (Doctor)

5.2.1 Login Module

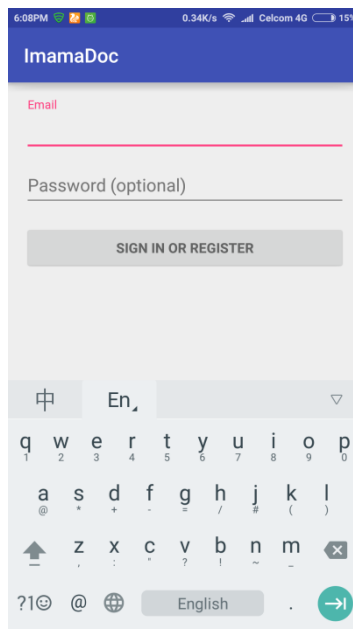


Figure 5.9 Screenshot of Register Screen In Imama Doctor Mobile Application

Similar to the Patient Mobile Application, the login screen allow user to perform login action using Email and password registered earlier. The login screen is implemented with Material Design Library Rectangle Button which has a ripple visual effect when pressed. EditText UI component is used for email and Password text field. All of these UI component are arranged using Linear Layout which allow UI to arranged without collide with each other. When Sign in button is pressed with Email and password entered, the mobile application will authenticate the Email and password with the server with Bcrypt encryption. With Bcrypt encryption, the user data and password will be secured when passing through the internet. In this module user (doctor) uses their username and password to log in to the mobile application.

5.2.2 Appointment List and Appointment Details

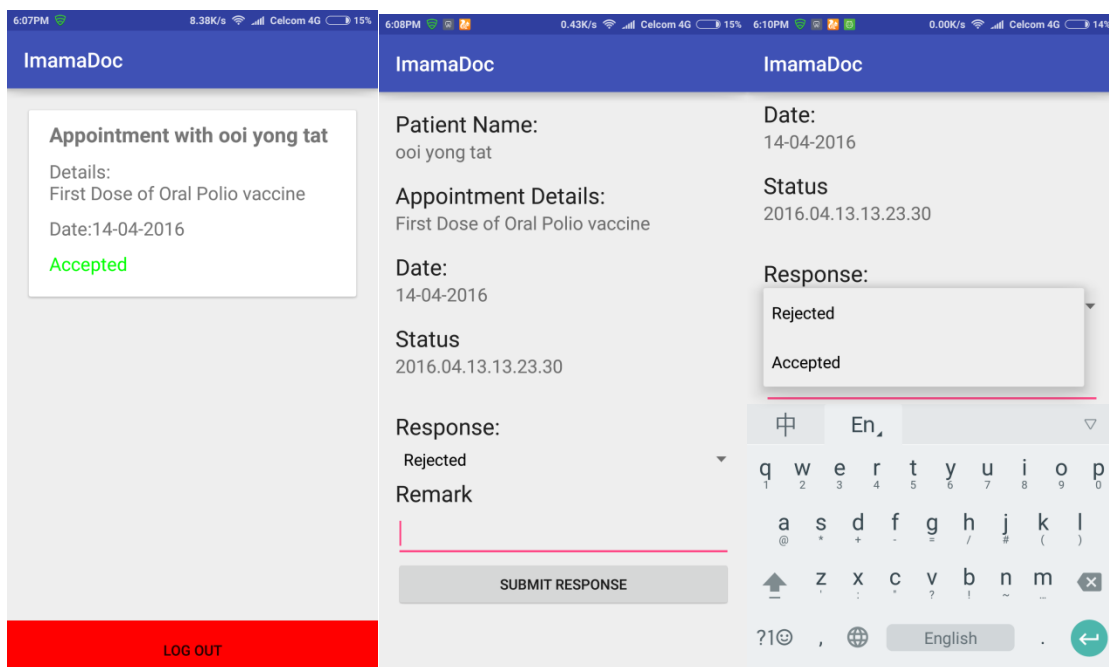


Figure 5.10 Screenshot of Register Screen In Imama Doctor Mobile Application

In this module, CardView binded in recyclerView is used to list each appointment dynamically. When user(Doctor) press the CardView the user will be proceed to Appointment Details activity which allow the doctor to gives respond to the patient whether to reject or to accept the appointment.

5.2.3 E-mail notification

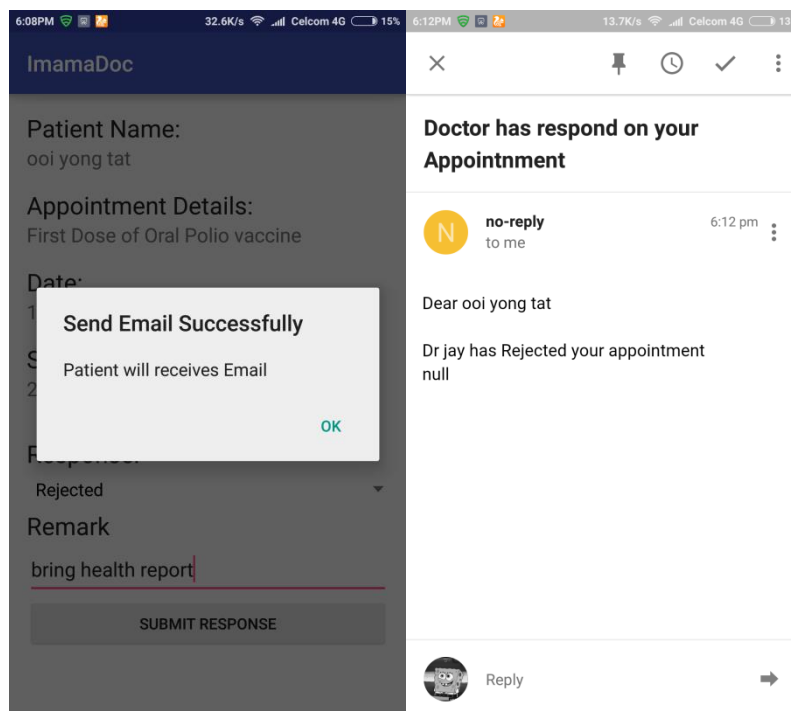


Figure 5.11 Screenshot of Email Notification In Imama Doctor Mobile Application

After doctor posted a respond the doctor will send an email notification to the user (Patient). The email is send using Mailgun.com using SMTP message with Javamail plugin. Since javamail doesn't fully support gradle and android studio, the library is imported independently and implemented in an independent runnable Thread to send the email notification. Below are the thread of code that implemented in this project.

```

Thread thread = new Thread(new Runnable() {
    @Override
    public void run() {

        try {
            Properties props = System.getProperties();
            props.put("mail.smtps.host", "smtp.mailgun.org");
            props.put("mail.smtps.auth", "true");
            Session session = Session.getInstance(props, null);
            Message msg = new MimeMessage(session);
            msg.setFrom(new InternetAddress("no-reply@sandboxcbcbce74d686940e98c55bae25d970572.mailgun.org"));
            msg.setRecipients(Message.RecipientType.TO,
                InternetAddress.parse(patInfo.getEmail(), false));
            msg.setSubject("Doctor has respond on your Appointment");

            msg.setText("Dear " + GlobalClass.appSelected.getPatientName() + "\n\n" +
                GlobalClass.appSelected.getDoctorName() +
                " has " + spinner.getSelectedItem().toString() + " your appointment" + "\n" + remarkDetail);

            msg.setSentDate(new Date());
            SMTPTransport t =
                (SMTPTransport)session.getTransport("smtps");
            t.connect("smtp.mailgun.com", "postmaster@sandboxcbcbce74d686940e98c55bae25d970572.mailgun.org", "0123836519");
            t.sendMessage(msg, msg.getAllRecipients());
            System.out.println("Response: " + t.getLastServerResponse());
            t.close();

        } catch (Exception e) {

        }

    }
});
thread.start();

```

Figure 5.12 Screenshot of Email notification Java Code In Imama Doctor Mobile Application

The E-mail is composed using Message Class in javamail then a Session is activated with the Mailgun.com server. After connected to the Mailgun server, the E-mail is pushed using the mail gun server. In this project, a sandbox domain is used which only allow to send to authorized E-mail. To send to every kind of email, A public domain name is needed.

5.3 Firebase Implementation

5.3.1 Patient data

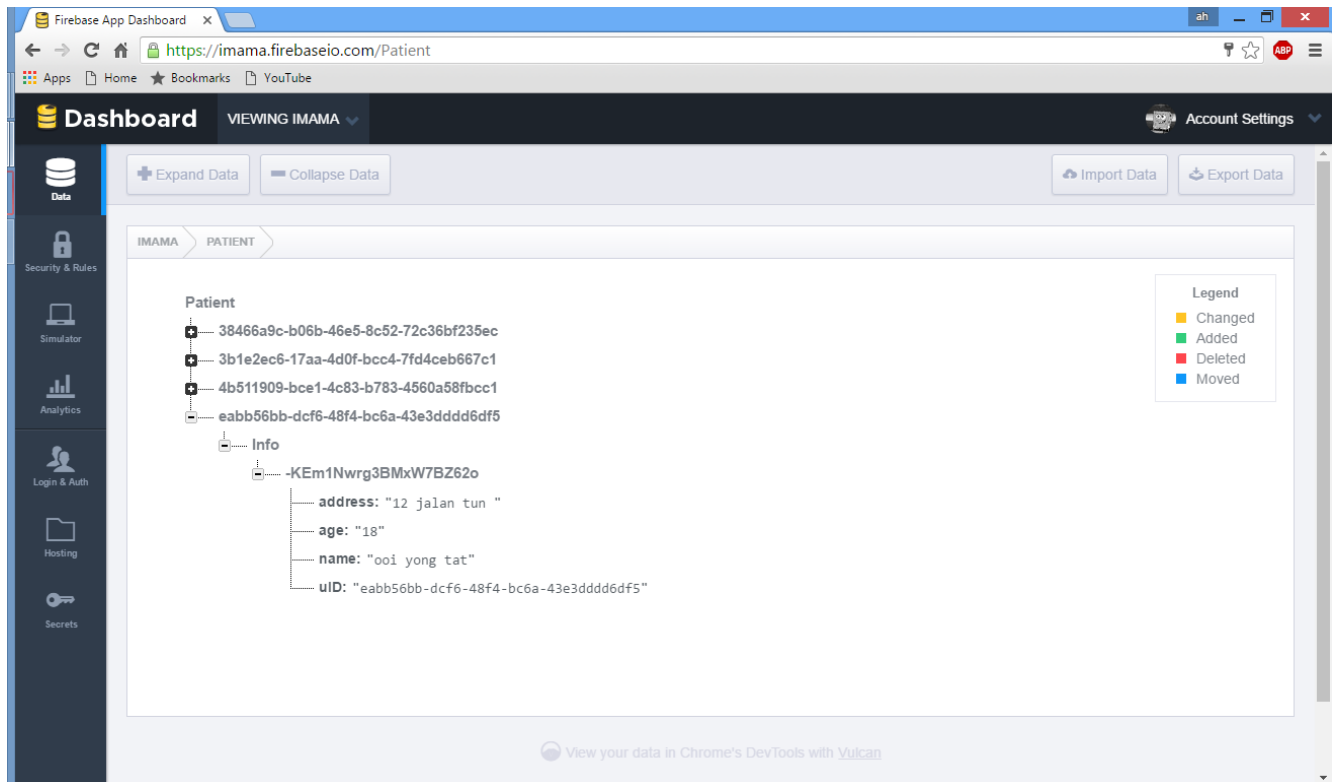


Figure 5.13 Patient data stored in Firebase.

Data will be stored as JSON object the identification of the object will be the Userid generated by Firebase which is unique in the whole database. Followed by the patient information with address, age, name and UserID.

5.3.2 Doctor data

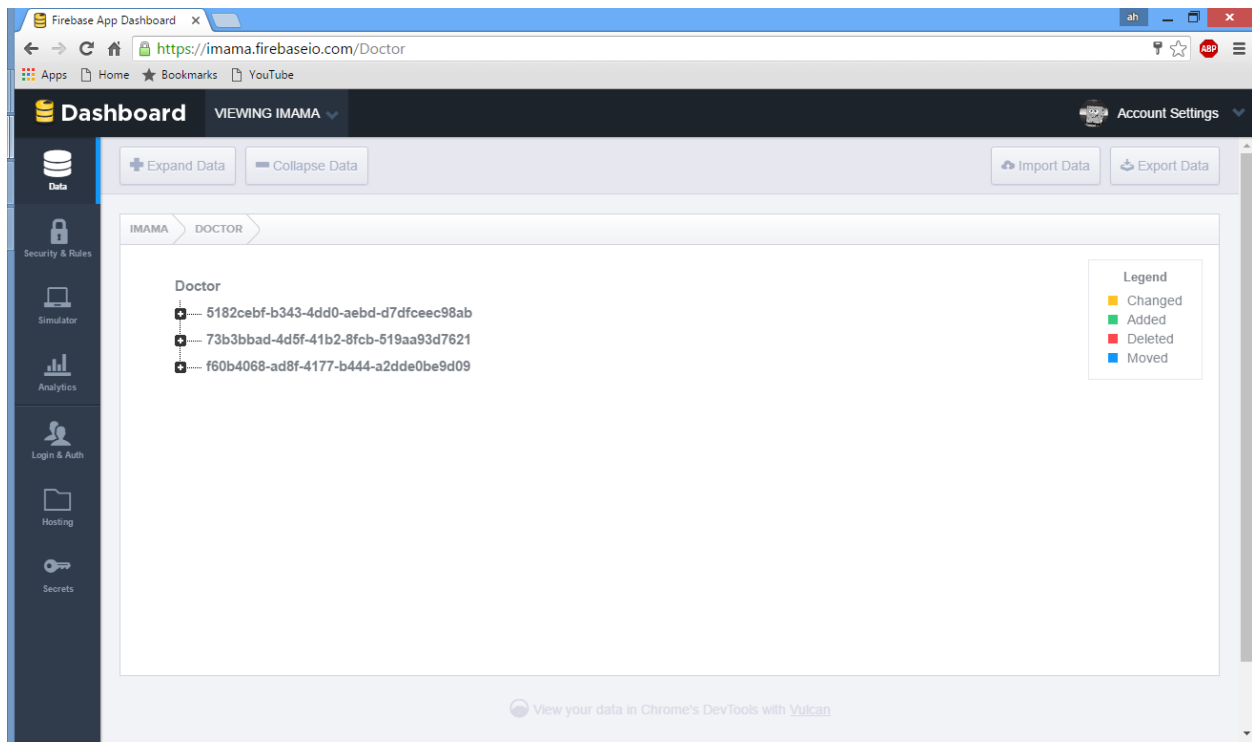


Figure 5.14 Doctor data stored in Firebase.

Data will be stored as JSON object the identification of the object will be the Userid generated by Firebase which is unique in whole database. Follow by the doctor information with address, age, name and UserID. For doctor storage latitude and longitude of the clinic will be added to allow user to use gps to find the clinic.

5.3.3 Appointment Data

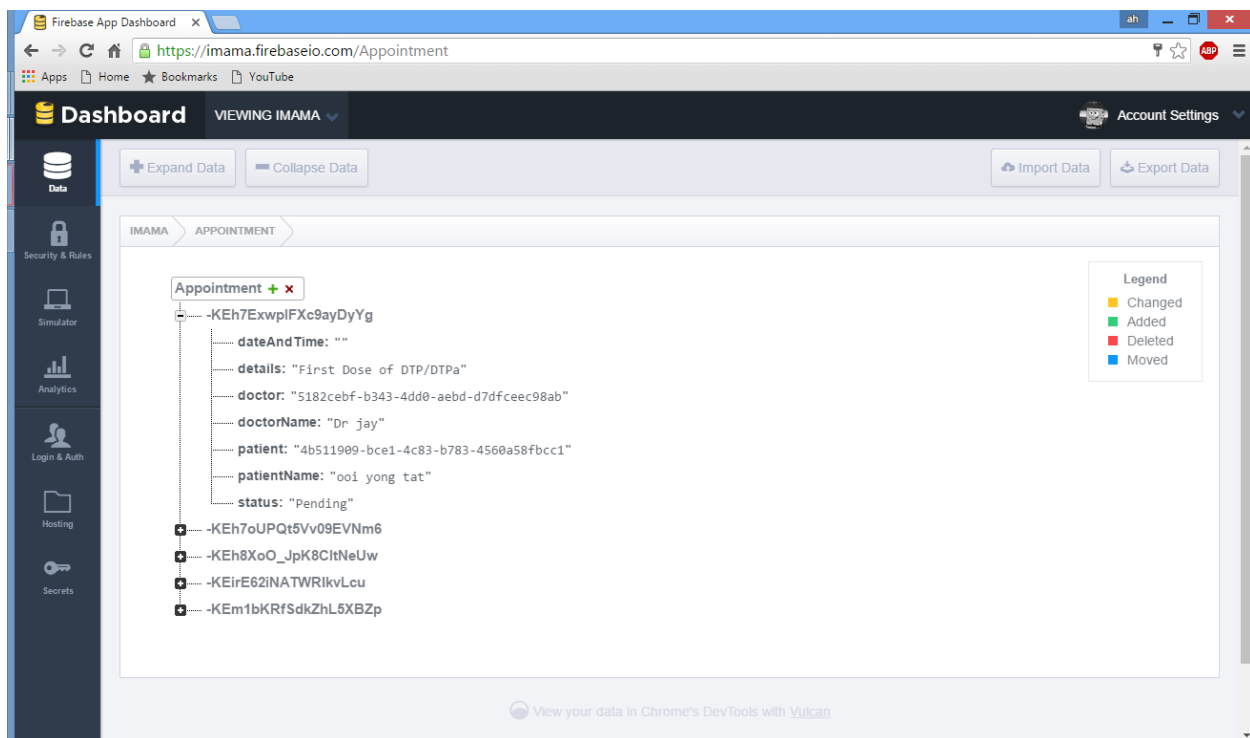


Figure 5.15 Appointment data stored in Firebase.

Appointment data will be stored as JSON object the identification of the object will be the pushID which generated by Firebase which is unique in whole database. Each appointment consist of the UserID of the doctor and UserID of the patient as well as the time and details of the appointment.

5.3.4 Security

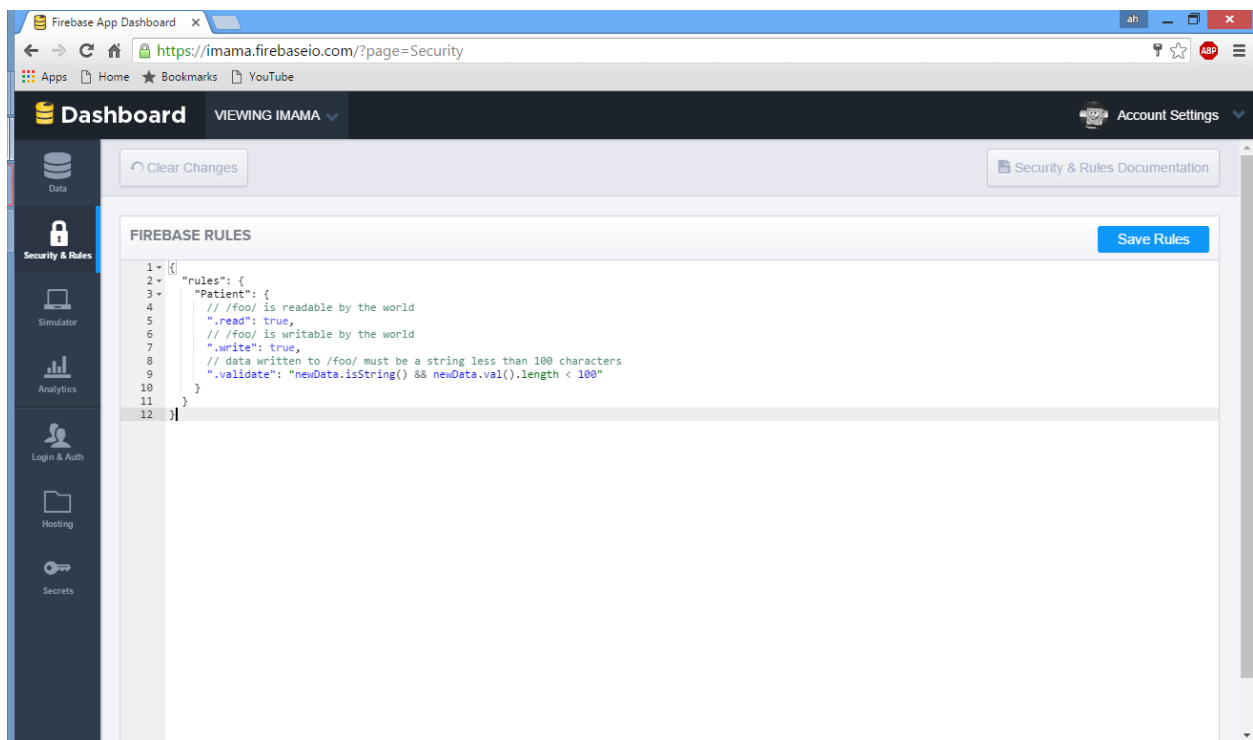


Figure 5.16 Firebase Security.

Firestore has this security measure that allow user to preset the data validation and read right authority allow some data to be only be write or read.

5.3.5 User Authentication

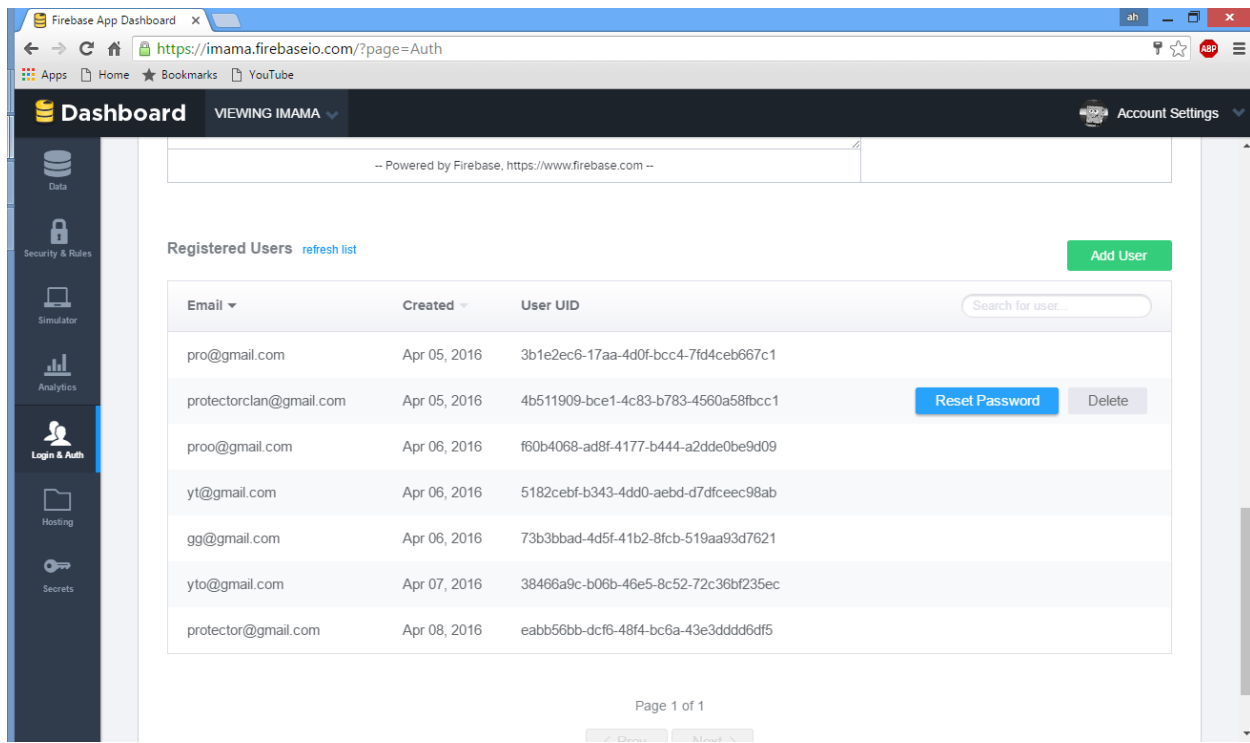


Figure 5.17 Firebase User Authentication

This interface shows all user and UserID stored in the database. User can be manually added into the server or remove at this interface as well as reset password. When password is reset an Email will be send to the user to renew the new password

6 CONCLUSION

6.1 Project Review

This project is mainly about making developing an appointment for doctor and patient. The motivation to develop this project is due to current clinic appointment system are still depending on the phone line and paperwork which are not efficient to be processed. The Imama project has taken the first step to make appointment through mobile application. The traditional appointment method is hard to be arrange as is still done in paper work. With the mobile application user can make appointment easier and doctor can sort the appointment accordingly.

6.2 Future Work

Ambulance Tracking Module

Since the Firebase is chosen as the backend of this system which has real-time reading feature it allows location to be real-time sync. With this feature, an ambulance tracking module can be use when user used the emergency hotline to request dispatch of ambulance. The ambulance might need some sort of GPS tracking device. For example Mobile Phone. The device will allow the ambulance to be tracked in real time to allow user to react with the distance left of he/she location.

Wearable Device

The application also consist of recording health data such as weight and temperature. In the future, Wearable device might have the module allow user to record health data which can sync with the mobile application for more accurate and more accessible reading of health data.

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Appendix

Appendix A: User Manual

Requirements

1. Android 5.0 or above device
2. Android file manager apps (e.g: Solid Explorer Classic)
3. GPS Enabled in Android devices
4. Internet Enabled in Android devices
5. At least 1GB ram and above android Device

Installation Step:

1. Enable the unknown sources from the Security section of setting in the device
(Setting>Security>Unknown Source)
2. Copy the apk file into device using Window Explorer
3. Run the apk using File Explorer app in android.
4. The mobile application is installed into the devices