



Inspiring Excellence

BRAC University

TELEMEDICINE PORTAL

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Certificate of Approval

Declaration: This is to certify that this thesis report is submitted by Md.Tauhidul Islam (ID:13101132), Mayesha Samiha Oishee (ID:14101124), Sabira Roshid Toma (ID:13301149) and Mashrur Ahmed Khan (13101240) for the degree of Bachelor of Science in Computer Science and Engineering to the Department of Computer Science and Engineering, School of Engineering and Computer Science, BRAC University. We hereby declare that this thesis is based on the results found by ourselves and the materials of work found by other researchers are mentioned by reference. The contents of this thesis, neither in whole nor in part have been previously submitted to any other Institute or University for any degree.

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“The greatest challenge to any thinker is stating the problem in a way that will allow a solution”

Bertrand Russell

Abstract

Telemedicine is a platform for monitoring the patients remotely which can be evolved by all kinds of digital platform. As 75.396million^[1] of total population of Bangladesh are currently getting the benefits of internet via smart phones, we are focusing on mobile platform especially android because of its ease of access. By targeting API level 15 and later, our app will run on 97.4% devices that are all active on Google play store. By simply getting the mobile app which has been built up for two user interfaces (doctors and patients) within the same app, it will allow to acquaint with each other. For ensuring better performance, scalability, security we are using MYSQL database which is placed in web hosting server. All the data of patients and doctors will be stored in MYSQL database. The main features of our system are video conferencing, online prescription, medical history, basic health tips and question/answer section. As video conferencing is our most vital feature, we are using Open Tok, WebRTC platform for video and voice to make sure that there would be no compromise regarding the quality. The Tokbox native SDK for video consists of an SDK and a set of APIs to access Tokbox's real time network to enjoy quality video calls. With Tokbox's globally-deployed SD-RTNTM (Software Defined Real-Time Network) and end to end network technology, the Tokbox Native SDK for Video providers ensure superior video call quality with minimum latency and low packet loss. Patients will get the benefits of asking any health related question by selecting the proper medical field. The questions which has been asked by patients, will be answered by that specific field's specialist doctor. We have designed the structure of our app from scratch to UX and UI. As the state language of our country is Bangla, we implemented our app in Bangla for making it more user friendly.

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Table of Contents

CERTIFICATE OF APPROVAL	I
ABSTRACT	III
ACKNOWLEDGEMENT	IV
LIST OF FIGURES.....	VIII
LIST OF TABLES	X
LIST OF ABBREVIATIONS	XI
1 INTRODUCTION	1-1
1.1 BACKGROUND AND MOTIVATION	1-1
1.2 SCOPE, RESEARCH AND LIMITATIONS.....	1-2
1.3 SUMMARY OF GOALS	1-2
1.4 METHODS.....	1-3
1.5 SIGNIFICANCE AND CONTRIBUTION	1-3
2 METHODS AND MATERIALS	2-4
2.1 APP-DEVELOPMENT-LIFECYCLE	2-4
2.2 MATERIALS	2-6
2.3 DATA COLLECTION AND EXPERIMENTAL METHODS	2-6
2.3.1 <i>Literature review</i>	2-6
2.3.2 <i>Discussion with experts</i>	2-9
2.3.3 <i>Brainstorming with supervisor</i>	2-9
3 REQUIREMENTS SPECIFICATION	3-10
3.1 FUNCTIONAL REQUIREMENTS	3-10
3.2 NON-FUNCTIONAL REQUIREMENTS	3-11
4 DESIGN	4-13
4.1 UML USE CASE DIAGRAM	4-13
4.2 SPLASH SCREEN	4-14
4.3 STARTUP SCREEN	4-14
4.4 PATIENTS INTERFACE.....	4-15
4.4.1 <i>Login page</i>	4-15
4.4.2 <i>Signup page</i>	4-16
4.4.3 <i>Home page fragment</i>	4-16
4.4.3.1 Health tips fragment	4-17
4.4.3.2 previously asked questions fragment	4-17
4.4.4 <i>Doctors selection page by category</i>	4-18
4.4.4.1 Online doctors' list	4-18
4.4.4.2 Doctors' info page.....	4-19
4.4.4.3 Video calling interface	4-20
4.4.5 <i>All question answer section</i>	4-20
4.4.6 <i>Inquiry section</i>	4-21
4.4.7 <i>My asked question</i>	4-21
4.4.8 <i>View patient profile</i>	4-22
4.4.8.1 Patient basic information.....	4-22

4.4.8.1.1	Update patient basic information.....	4-23
4.4.8.2	Patient medical history	4-23
4.4.8.2.1	Update patient medical history	4-24
4.5	DOCTORS INTERFACE	4-25
4.5.1	Login page.....	4-25
4.5.2	Signup page	4-25
4.5.3	Homepage fragment.....	4-25
4.5.4	All question answer section	4-26
4.5.4.1	Question details	4-26
4.5.5	Unanswered questions.....	4-27
4.5.5.1	Response to the asked question	4-27
4.5.6	My answers.....	4-28
4.5.7	View doctor profile.....	4-28
4.6	ONLINE PRESCRIPTION INTERFACE	4-29
4.6.1	Welcome page	4-29
4.6.2	Login and Registration	4-29
4.6.3	Homepage.....	4-30
4.6.4	Create new patient information	4-30
4.6.5	Patient ID confirmation.....	4-31
4.6.6	Write patient ID	4-31
4.6.7	Write prescription	4-32
4.6.8	Search prescription	4-32
4.6.9	Expand patient prescriptions	4-33
4.6.10	View prescription	4-33
5	IMPLEMENTATION.....	5-34
5.1	ANDROID AS A DEVELOPMENT PLATFORM.....	5-34
5.2	ANDROID SYSTEM ARCHITECTURE.....	5-34
5.3	ANDROID STUDIO	5-35
5.4	PROJECT DESCRIPTION	5-39
5.5	PATIENT AND DOCTOR INTERFACE IMPLEMENTATION	5-39
5.5.1	Login and signup interface.....	5-39
5.5.2	Homepage.....	5-41
5.5.3	Find a doctor.....	5-42
5.5.4	All asked questions.....	5-43
5.5.5	Ask a question.....	5-43
5.5.6	Navigation drawer	5-43
5.5.7	View profile	5-43
5.5.8	My questions.....	5-43
5.5.9	Video calling implementation	5-44
5.6	ONLINE PRESCRIPTION IMPLEMENTATION	5-46
6	TEST AND RESULTS	6-48
6.1	TESTING PROCEDURE AND RESULT	6-48
6.2	LIMITATION.....	6-48
7	CONCLUDING REMARKS AND FUTURE WORKS	7-50
7.1	CONCLUSION.....	7-50
7.2	FUTURE WORK	7-51
	REFERENCES.....	7-52

List of figures

Figure 1: Splash Screen	4-14
Figure 2: Startup Screen.....	4-14
Figure 3: Login page.....	4-15
Figure 4: Signup page	4-16
Figure 5: Homepage fragment	4-16
Figure 6: Homepage overview.....	4-16
Figure 7: Health tips fragment	4-17
Figure 8: Previously asked question fragment.....	4-17
Figure 9: Doctors selection page by category.....	4-18
Figure 10: Online doctors' list	4-18
Figure 11: Doctors' info page.....	4-19
Figure 12: Video calling interface	4-20
Figure 13: All question answer section.....	4-20
Figure 14: Inquiry section.....	4-21
Figure 15: My asked question.....	4-21
Figure 16: View patient profile.....	4-22
Figure 17: Patient basic information.....	4-22
Figure 18: Update patient basic information	4-23
Figure 19: Patient medical history	4-23
Figure 20: Update patient medical history	4-24
Figure 21: Question details	4-26
Figure 22: Unanswered questions	4-27
Figure 23: Response to the asked question	4-27
Figure 24: My answers.....	4-28
Figure 25: View doctor profile	4-28
Figure 26: Welcome page	4-29
Figure 27: Login and registration	4-29
Figure 28: Homepage.....	4-30
Figure 29: Create new patient information	4-30
Figure 30: Patient ID confirmation	4-31
Figure 31: Write patient ID.....	4-31
Figure 32: Write prescription.....	4-32
Figure 33: Search prescription	4-32
Figure 34: Expand patient prescriptions	4-33
Figure 35: View prescription	4-33
Figure 36: Android studio.....	5-35
Figure 37: kotlin vs Java	5-36
Figure 38: Android studio SDK tools information	5-37
Figure 39: Android build gradle info	5-37
Figure 40: Android build (Module App) info	5-38
Figure 41: ADV	5-38
Figure 42: XML file.....	5-40

Figure 43: Java file.....	5-40
Figure 44: PHP file	5-41
Figure 45: ListView	5-42
Figure 46: Video calling - 1	5-44
Figure 47: Video calling - 2	5-45
Figure 48: Video calling - 3	5-45
Figure 49: Video calling - 4	5-46

List of tables

Table 1: Different apps and its features in Bangladesh.....2-8
Table 1: Different apps and its features in Bangladesh.....2-9

List of Abbreviations

API	Application program interface
AVD	Android Virtual Device
DAB	Diabetic Affiliation of Bangladesh
GTC	Grameen Telecom
ICT	Information and communication technologies
IDE	Integrated development environment
JSON	JavaScript Object Notation
PHP	Hypertext Preprocessor
RX	Recipe
SDK	Software development kit
SDLC	The systems development life cycle
SSL	Secure Sockets Layer
URL	Uniform Resource Locator

*We dedicate this thesis to our parents for nursing us with affections and
love and their dedicated partnership for success in our life*

Chapter 1

Introduction

1.1 Background and Motivation

In general sense, medical care relies on the face to face communication between the patients and the doctors but consequent upon telemedicine, patients can communicate with doctors anytime anywhere. Many developing countries cannot provide basic health care facilities to its people because of insufficient number of physicians and medical services. While clinic and diagnostic centers are essentially developing around the urban areas, people living at the rural areas are facing more problems. The poor infrastructure of the govt. hospitals in rural areas are making peoples' lives more difficult as they have to rush to the cities for any kind of health problem or diagnosis. Telemedicine can be considered as a gift of ICT and is conceivably the most noticeable of e-business benefit that can have a noteworthy obvious impact on the advancement of society.

The concept of telemedicine was first introduced in 1959, when a two-way video conferencing link was established using microwaves between University of Nebraska Medical School and state mental hospital. Bangladesh is a densely populated developing country where most of the people live in rural areas which are often ill-equipped for proper medical treatment. Moreover, after being selected as a cadre of Bangladesh Civil Service, doctors usually get employment to the rural health centers, though most of them tend to come to cities for getting more social benefits. Besides, people living in the cities are also facing a lot of problems in getting the doctor's appointment such as waiting 2-3 hours for seeing the doctor. Another 1-2 hours waiting in the queue for getting done with proper diagnosis tests. Though usually we get to see lots of hospitals, diagnostic centers around us, but it is still not enough for this huge number of people of Bangladesh ^[8]. In past years, telemedicine implementation was not very easy because of the poor infrastructure of telecommunication. As the situation nowadays has changed a bit, we are focusing on building an app which will build a bridge for both patients and doctors where anybody will be able to share their problems by 24/7.

1.2 Scope, Research and Limitations

Initially, we addressed the problems which are mentioned above regarding the difficulties people are facing to meet a physician. Now, we aimed to develop an android based mobile app especially for the remote patients as well as the people all over the country. The app is expected to provide a doctor 24/7 to the patients for health advices via video conferencing and other features too. Despite of very short time, we are facing problems in ensuring the high quality video conferencing for the rural areas. Recently, our country has entered into fourth generation internet era though people find difficulties to get 4G service outside Dhaka city. There are many places in Bangladesh where customers actually struggle to get 2G and 3G services and hence it becomes quite inconvenient to get connected with a video call.

As our system will store patients' medical history and personal information, we have to ensure the security of each and every bit of data. Moreover, we should keep in mind the fact that a significant number of our population are not familiar with new technologies so we need to make it much more user friendly and make people understand the concept of telemedicine. Besides, billing method would be a serious issue in terms of security, authenticity otherwise we will fail to build trust among people.

1.3 Summary of Goals

The purpose of this project is to ensure low cost medical support throughout the country. As it is a medical related application, we have to maintain standard procedures to ensure the credibility and security of the information that are stored in our database. To accomplish our goal, we must investigate the previous work in this field and also the ongoing projects in order to understand how we can reshape the system for our country.

The thesis should show how to use real data for the application. Also, the process of designing and implementing a user friendly and easy to adapt application by different age groups, will be a difficult part for us.

Again, most importantly, the implementation of video calling should be the most priority as it is a unique feature according to our country. Every patient must get a unique Id which will be auto generated by the system and thus we will have to ensure the fact that doctors get that Id of the patient. By getting the unique Id of that patient, doctor will able to check the previous patient's medical history. There will be another feature called 'online

prescription' where doctors can create prescription on our web application which is connected with our medicine database.

Besides, the design of the database and also the process of showing the patient's medical history would be clearly discussed further. Moreover, billing methods should be easier for the user and most importantly those should be affordable as well.

Therefore, another main feature of our application is online prescription system where doctors can write prescription through either app or web. On top of that, doctors can check patients' previous health records which have been stored in patients' database. Every time when a doctor will write prescription, it will automatically be saved on database.

1.4 Methods

At the very beginning, we studied different academic literatures relevant for our thesis for understanding the field and future prospects. Also, different research papers and applications were very effective for us to design the application features. Furthermore, many forums like stack overflow and GitHub which is recommended by associates also helped us to solve identified problems in order to build an application prototype. Before sketching the application prototype, we discussed with experts and colleagues and subsequently made further modifications. After making all the improvements in design prototype, we finally built the skeleton of our android based app.

1.5 Significance and Contribution

After carrying out lots of research on telemedicine which has been discussed earlier in literature review, we could finally identify the features of our app which we want to implement. Moreover, we considered the features which were not previously evolved in our country. Despite of a very short time testing period, we were successful in seeing the desired result. Therefore, research results of ours can be helpful for future work in this medical platform.

Chapter 2

Methods and Materials

In response to different changes in the number of patients in our country especially in rural areas, it is high time for us to bring a paradigm shift in this health care sector. If we talk about the technology, then we can see it is expanding day by day. Due to this expanding technology, we should also keep in mind some important facts like patients are way more informed about the disease and more actively involved in health care decisions^[12]. While developing the app we followed some development processes such as:

- state requirements
- state specification
- design and implement in the system
- test the system

2.1 App-Development-Lifecycle

For making a successful mobile app, we went through a lot of research and pre planning. In a competitive market of app development, we had kept in mind some important facts. For example, not only building an app but also we had to design the app in such a way that it attracts users' attention.

To understand it further – we tried to develop our app through software development lifecycle (SDLC). We went through eight phases of development which are listed below^[13].

Phase 1: Pre-planning and research

This is the first and most important phase for developing app as during this phase, we got the exact idea what we actually want to build. Apparently we did a lot of research about medical field, health facilities those people are currently getting etc. Also, we have talked with experts about the phases of development we should have followed and what should have been the next phase etc.

Phase 2: Mental prototyping

In the second phase of development, we brainstormed our ideas in the form of sketches on a paper and tried to find out the most efficient features of the app. Once we had all the features we were willing to add in our app, we tried to get the idea of time it would take to build up. In this phase, we also took feed from experts to get a clear idea of what they thought about our ideas.

Phase 3: Assessment of technical feasibility

Now, in this phase we analyzed if the system would support the app's functionality or not. Moreover, we researched about the available technical resources like API, libraries which are the most vital resources for our app. Therefore, we tried to make the app most responsive for all devices. As most smartphone owners are android users, we chose android as a developing platform.

Phase 4: Building a prototype

In this phase, we used a set of rough wireframes. Apparently, we implemented touch experience to check how it works. While doing so, we faced a lot of errors which were auspiciously solved later on.

Phase 5: Designing and development of app

Designing and developing is the fifth phase of the development where we designed our app. We focused on making it the most efficient and user friendly one.

Phase 6: Building the app Using Agile methodologies

Once the design was ready, we focused on the methodology we should be following. As Agile methodology is the best approach for an app development, we tried to follow that. The advantage of this methodology is that it allows the developers to make changes, adds new features and permits further improvement etc.

Phase 7: Testing the app

It is the second last phase of the development when the app is already built. Now, at this stage we gave the beta version of the app in hands of some of our friends and then collected their feedback.

Phase 8: The launch

This is the last phase, the app is fully complete and ready to submit it to the app store.

2.2 Materials

While building the app, we started from sketching the design. After that, several tools were applied. We have used JAVA, XML, JSON, PHP as programming language and mysql server for database which is located at remote server. Therefore, **API** (Tokbox) has been used to implement the main feature of our app which is video calling. These are the libraries we have used so far:

- de.hdodenhof for circularimageview
- recyclerview
- cardview
- daimajia.slider
- weiwangcn.betterspinner
- nineoldandroids
- Picasso

2.3 Data Collection and Experimental Methods

2.3.1 Literature review

Countries like Bangladesh having inadequate healthcare opportunities must incorporate telemedicine into their healthcare system through volunteer efforts of doctors. Telemedicine, the effective tool of providing health care services to the rural people started its journey in late 1999. As we know a developing south Asian country like Bangladesh still is not capable of providing proper health care facilities to its huge population. However, the first telemedicine link was established by Swinfen Chairtable in 1999 ^[1]. Apparently, they used to take still images which were being transmitted by email. As it was a very low cost system, it had become a reference model for many developing countries ^[1]. Telemedicine pilot mission Diabetic affiliation of Bangladesh (DAB) and Grameen Telecom (GTC) became an actual-time tele medical consulting telemedicine project where full-duplex video transmission was used ^[2]. The achievement rate of this project turned into not so pleasant because of limitations of market merchandising and other elements ^[2]. Banglalink, The telecom company of Bangladesh has launched “Healthlink” as one of the first digital Health care services in the

country back in 2008^[3]. 'Health Center 16263' is an official call center on health related information and advice which officially has started their journey on April 24, 2016. The MICE division of Health Department under the Ministry of Health and Family Welfare operates the call center. People can call the number '16263' for any advice related to health issues directly to the doctor and for that 2 taka 45 paisa per minute charge will be applicable^[4]. Furthermore, a digital health service named "Tonic" has been launched by Grameenphone and Telenor Health on 5th June, 2016^[5].

The main feature of 'Health link' by Banglalink are mobile audio call service around 24/7hrs. Besides they do not have any mobile app, Govt. hospitals information or any live chat option. Now, if it is about a mobile app or live chat, then we should talk about "TONIC" by Grameenphone where they are providing that is a mobile app featuring audio call by dialing 789, health tips, live chat, user account as well as the doctor's appointment.

Later on, in February 2015, the Maya Apa android app has been launched which is perhaps one of the biggest initiatives undertaken to create a virtual safe space for people from all walks of life in Bangladesh^[6]. Before that in 2014, Maya Apa partnered with world renowned NGO, BRAC, through its Gender Justice and Diversity department^[6]. The app has been a blessing for many, especially women who often had questions and problems that no one else was willing to discuss in a conservative society.

Maya Apa is an anonymous messaging platform that connects users with expert advice, available on web, wap and android. In simpler terms they digitally connect subject matter experts to user queries with their platform. It is a platform where user signs in, creates an anonymous profile and ask any question through voice, text, image. Later on, within 48 hours, experts' response to queries.^[7]

Many developed nations, including the United States, have made it a need to consolidate telemedicine into their medicinal services frameworks. Around the world, this idea has been embraced by nations in push to give better human services to those in provincial territories where hospital facilities might be at a distance and specialist doctors are not available. Apparently, there are many telemedicine apps called LiveMD, TeleDoc, and Doctoron Demand, HealthTop and MDLive in many developed countries around the world. Moreover, the main feature of all these apps are Video calling and Audio calling. They all are also providing Doctor's profile in their app except TeleDoc. LiveMD and MDLive also have an unique feature called look up symptoms where system will automatically generate some questions regarding patients' problems and thus will make a presume of the disease. Teledoc

and MDLive also have the previous record patient medical history. We have organized different apps and its features which is given below:

In Bangladesh:

Features	স্বাস্থ্যবাতায়ন (by DGHS.Govt) Dial 16263	TONIC (by Grameenphone) Dial 789	Health Link (by Banglalink) Dial 789	Maya Apa
Mobile audio Call Service (without internet)	✓	✓	✓	✗
Live Chat	✗	✓	✗	✗
Booking doctor's appointment	✗	✓	✗	✗
Ambulance info	✓	✗	✗	✗
Govt. Hospitals' info	✓	✗	✗	✗
User Account	✗	✓	✗	✓
Health Tips	✓	✓	✗	✓
24/7 hrs. health support	✓	✓	✓	✓
Mobile app	✗	✓	✗	✓
Anonymous queries	✗	✗	✗	✓

In Abroad:

Features	LiveMD	TeleDoc	Doctor On Demand	HealthTop	MDLive
Audio call service(without internet)	✓	✓	✓	✓	✓
Video calling	✓	✓	✓	✓	✓
Meet the Doctors(Doctor's profile)	✓	✗	✓	✓	✓
Lookup symptoms	✓	✗	✗	✗	✓
Patient Medical History	✗	✓	✗	✗	✓

2.3.2 Discussion with experts

As we have faced many problems while implementing each feature in our proposed application, we therefore tried to consult many android developers, faculties and students based on our requirement. These discussions with them came out to be fruitful in terms of solving those difficulties. We tried to reach out in every possible way to get the best of our app.

2.3.3 Brainstorming with supervisor

This period of thesis project was in fact one of the most enthralling ones, as in here, we got to know a lot about the ongoing projects related to telemedicine portal. We had to study the previous projects along with their features and this research had actually helped us in finding some new combination of features which we had implemented in our android app. One of such features is the 'Bangla' version. We have converted the whole outlook of our app in Bengali so that most of the people in this country would be able to comprehend as it is our native language.

Chapter 3

Requirements Specification

In this chapter, we will discuss functional and nonfunctional requirements for the application. At the very beginning of our app, we did a lot of research for a mobile app requirement documents from where we got a clear idea of technical specification of our app.

3.1 Functional Requirements

Requirements can be defined as a thing that is compulsory for building an effective app. There are two types of requirements, one is functional another is nonfunctional.

Functional requirements are the combination of technical details, data manipulation, process the data and proper calculation while building an app. It defines a function of a system or its components where a function is described as a specification of behavior between input and output^[14]. Moreover. The application architecture of a system is a functional requirement.

Hereby, the functional requirements of our application are given below:

1. System should be able to create new account for each user
2. System should be able to verify user information while creating account
3. System should allow an authentic user to login
4. System should be able to store patients' data and retrieve data from the database
5. Doctors should be able to check patients' previous data through the system
6. System should be able to take questions from patients and publish those to all users
7. System should able to filter questions by different health categories
8. System should effectively give the answer for the asked questions
9. System should show proper online and offline status
10. System should get health tips with images from the external URL
11. Patients should check their asked questions through the system in a separate field
12. Patients should be able to check their basic health information through the system
13. Patients should able to update their basic health information anytime through the system
14. System should display patients' health history

15. Patients should be able to update their health history anytime by clicking on the checkbox through the system
16. System should be able to maintain the security of the personal information of a patient
17. System should be able to show the unanswered question segment to the doctors so that they can respond and after responding to the questions, answers should be displayed for those questions
18. System should be able to establish a video call between a patient and a doctor
19. System should be able to redirect online prescription profile for each user
20. Doctors should be able to create a prescription for a specific user by the system
21. Doctors should be able to monitor each patient's previous prescriptions and reports through the system
22. System should have a logout option
23. System should properly close the app

3.2 Non-Functional Requirements

Security

Security is considered as the non-functional requirement of our system. As our app will deal with a patient's personal information like previous health records so this type of data should be highly secured. In addition to that, prescribed drugs are very sensitive for a patient, so it should neither be disclosed to others nor be changed by others.

Reliability

We need to focus on the reliability of the app so that people can trust us as the whole concept is very new to them. We must ensure a stable connection for video calling otherwise people will not rely on it. Moreover, billing method can play an important role in building up trust amongst the users. Besides, it should be affordable and easily payable.

Usability

Though most of the people in the cities are technologically advanced, it will be easier for them to use the app rather than the people who live in the rural areas. Apparently, we should design our app in such a way that it will be user friendly to all aged groups of people all over the country.

Efficiency

As our app is for the people of all age types, we tried to design and implement our app in the most efficient manner.

Legality

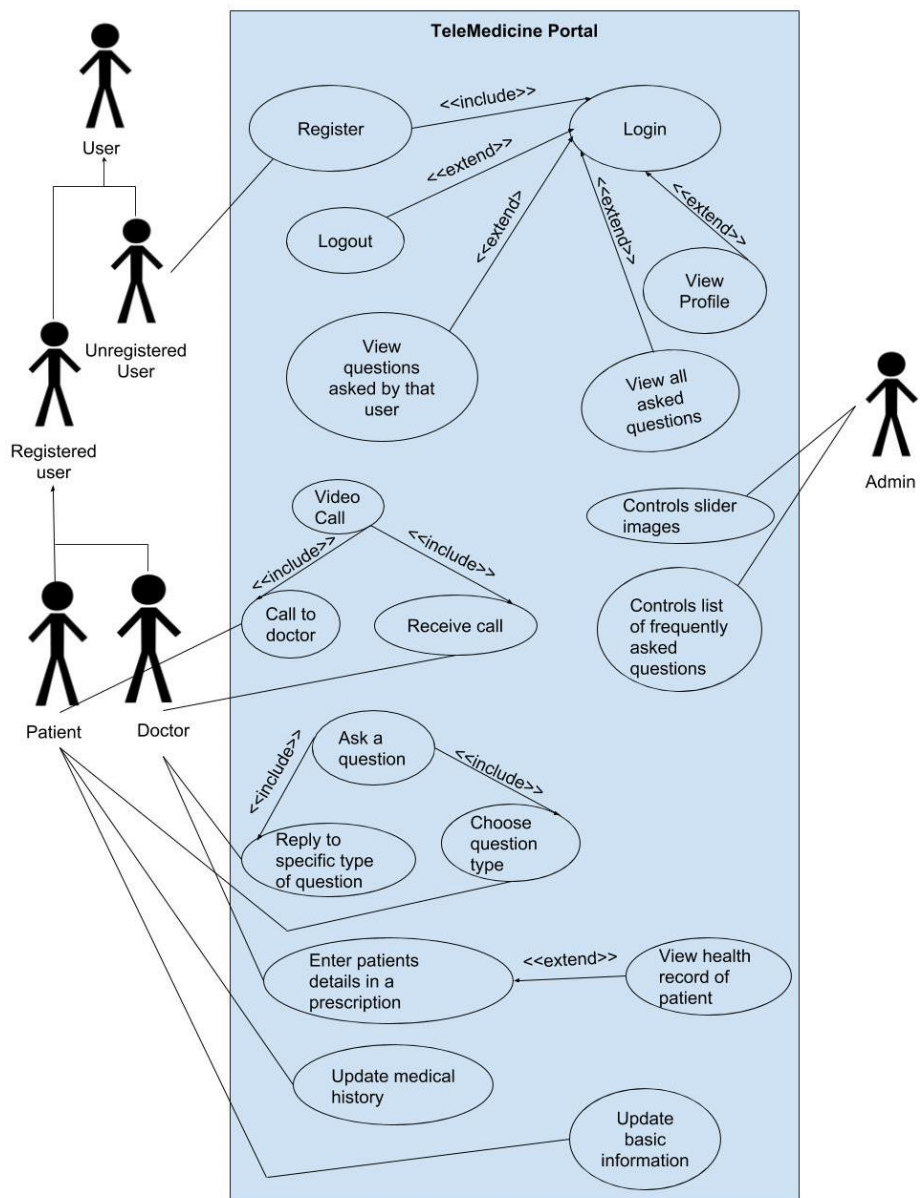
Legal issue is a very important issue as a nonfunctional requirement for our app. We should keep in mind the fact that the data we are dealing with can be very sensitive for the patients.

Chapter 4

Design

In this chapter, the application design processes and the implementation of those designs will be briefly discussed. Apparently, we designed our app into two separate interface, one is for patient and another is for doctor.

4.1 UML Use Case Diagram



4.2 Splash Screen

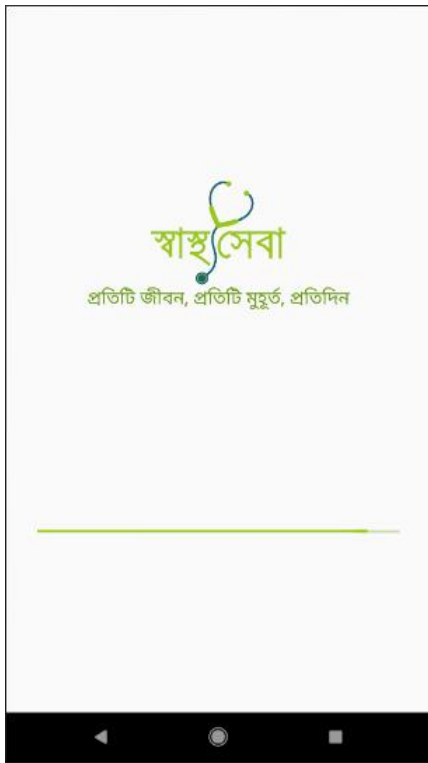


Figure 1: Splash Screen

This is the startup screen where there are two buttons, one is for doctors and another is for patients. Anyone can log in by clicking on the buttons according to their type.

4.3 Startup Screen

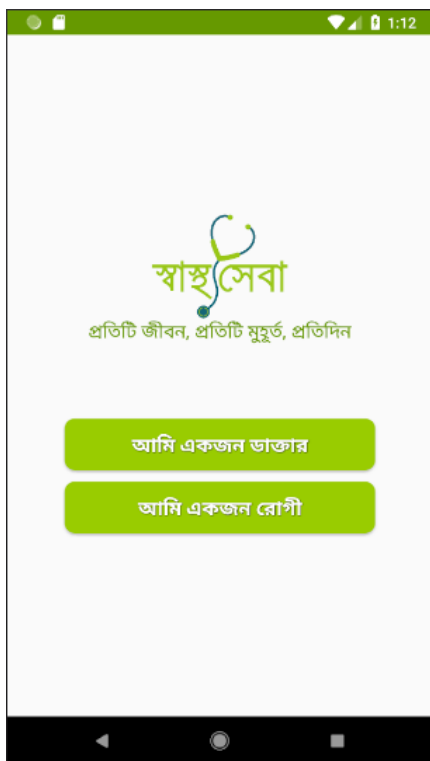


Figure 2: Startup Screen

This is the startup screen where there are two buttons, one is for doctors and another is for patients. Anyone can log in by clicking on the buttons according to their type.

4.4 Patients Interface

Patients interface is designed for only patients where they will sign up for creating new account providing all their basic information. Along with that, they can check their info after log into their account.

4.4.1 Login page

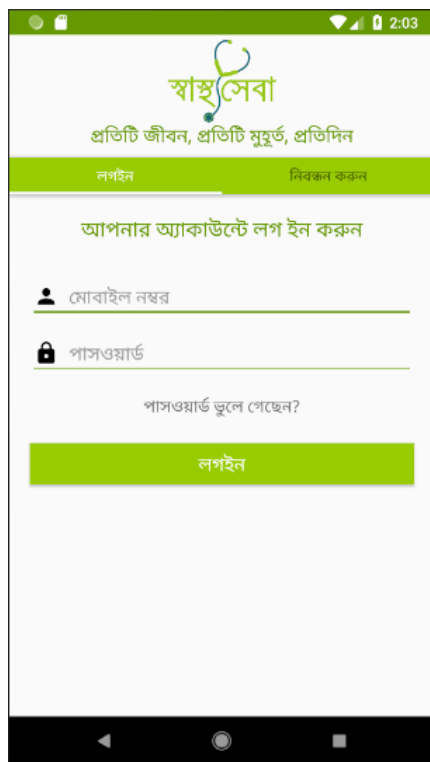


Figure 3: Login page

In this activity there is tab view section which contains two fragments for login and sign up. In the login section, there are another two sections for providing username and password and thus anyone can login to his/her account which has been created previously. Moreover, for logging in, user has to go through validation check for ensuring better security and anyone who gives any invalid username, will not be allowed to login.

4.4.2 Signup page

স্বাস্থ্যসেবা
প্রতিটি জীবন, প্রতিটি মুহূর্ত, প্রতিদিন

লগইন নিবন্ধন করুন

একটি অ্যাকাউন্ট তৈরি করুন

নামের প্রথম অংশ

নামের শেষাংশ

জন্ম তারিখ (দিন / মাস / বছর)

লিঙ্গ

পুরুষ মহিলা

মোবাইল নম্বর

ই-মেইল

পাসওয়ার্ড

পাসওয়ার্ড নিশ্চিত করুন

নিবন্ধন করুন

Sign up section is used for creating a new account with proper validation check where user will have to provide his/her basic information.

Figure 4: Signup page

4.4.3 Home page fragment



Figure 5: Homepage fragment

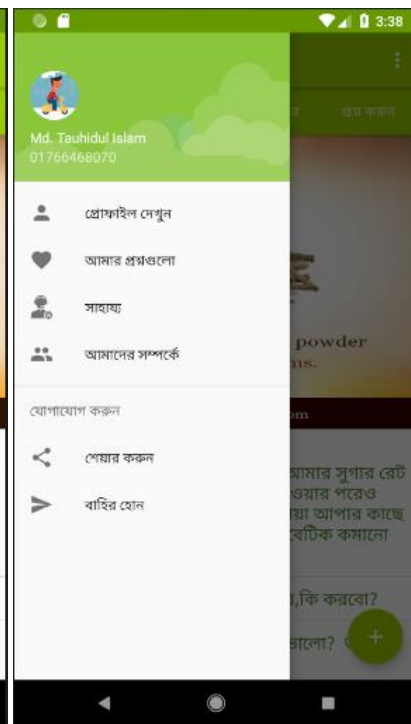


Figure 6: Homepage overview

After the user can successfully login, a home page will appear as the main page from where the user can move to another page according to their query. On the top left corner of the homepage, there is navigation drawer. For asking any question, there is a floating button on the bottom

right corner of the page. Homepage is divided into two parts, one is for health tips and another is for displaying recent top asked questions by different users.

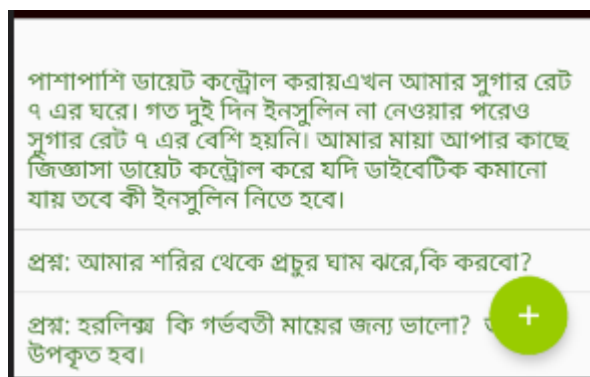
4.4.3.1 Health tips fragment



Necessary health tips for user with images

Figure 7: Health tips fragment

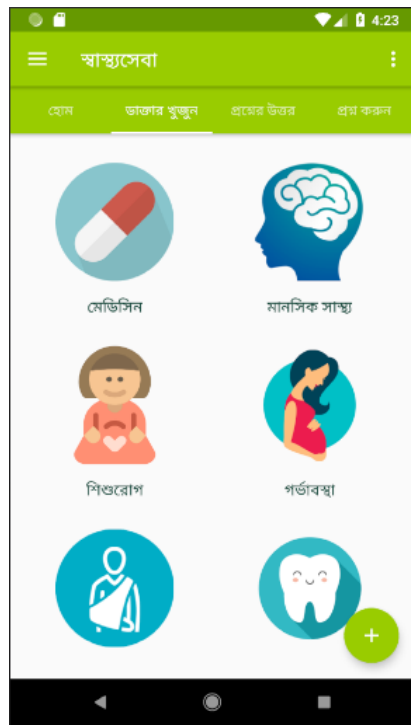
4.4.3.2 previously asked questions fragment



This section is displaying recently asked questions by patients.

Figure 8: Previously asked question fragment

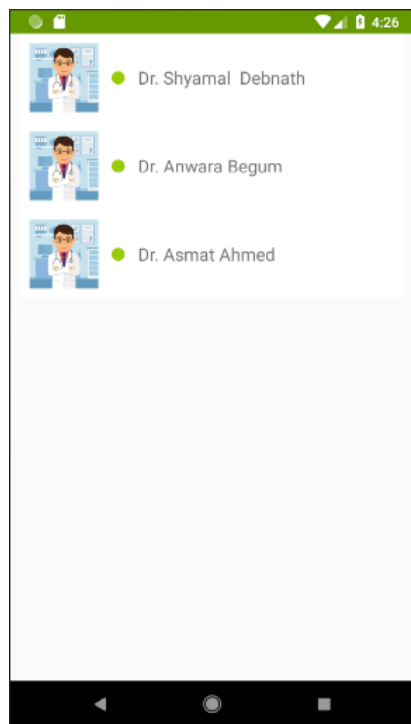
4.4.4 Doctors selection page by category



In the doctors' selection page, there are different doctors' categories where a user can select a particular category based on their problem or disease

Figure 9: Doctors selection page by category

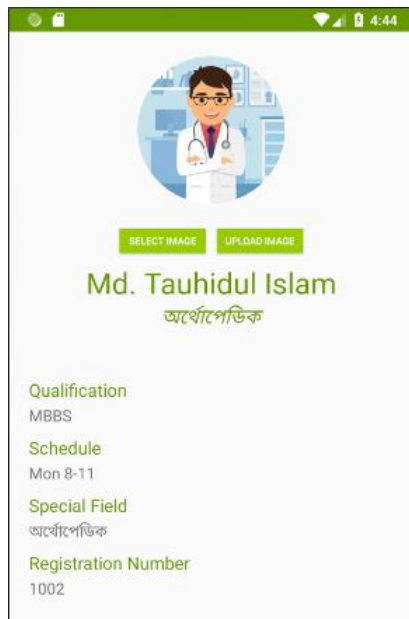
4.4.4.1 Online doctors' list



After selecting the doctor from the 'Doctor selection page', this Online doctors list will appear which will show the list of doctors who are currently available. After that, patients can choose any doctor from the available doctor list and can call them to discuss about their health issue. Also, there is a green dot which is the indication of availability of a Doctor.

Figure 10: Online doctors' list

4.4.4.2 Doctors' info page



This page is named as doctors' information page where all the basic information of a doctor will appear. When a doctor log into their account they can check their information and can update their information anytime. Moreover, the basic information includes a picture of doctor, name, qualification, schedule, Special field of treatment, registration number etc. of the doctor. Also, patient can also check doctor profile from their interface.

Figure 11: Doctors' info page

4.4.4.3 Video calling interface

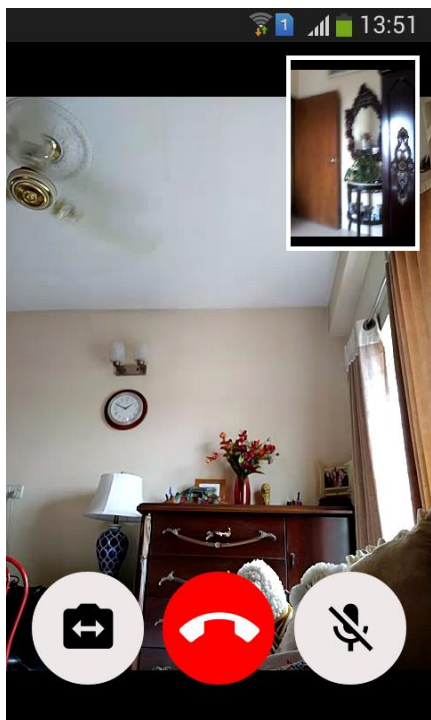


Figure 12: Video calling interface

In the video calling interface, there are three buttons at the bottom of the page. Left button works for switching the camera between the front and back end. Middle button is for ending up the call and the right button is for muting/unmuting the microphone.

4.4.5 All question answer section

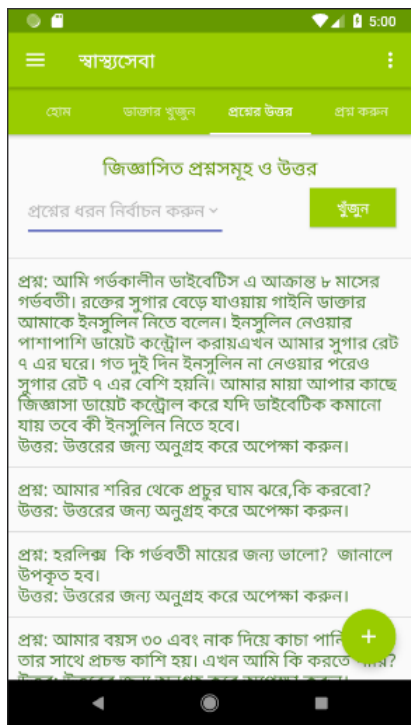


Figure 13: All question answer section

There is another section for question and answer where there is a filter button which will help to filter asked questions according to the type of the question. This section will also show the recently asked questions.

4.4.6 Inquiry section

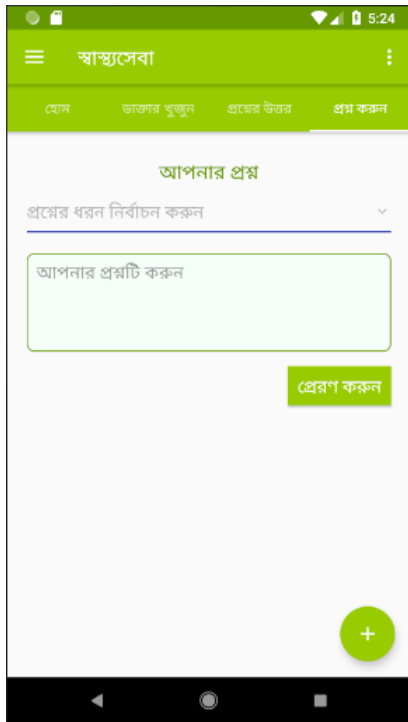


Figure 14: Inquiry section

In the inquiry section, by selecting a type from the drop-down list containing different medical categories, one can ask their question accordingly.

4.4.7 My asked question

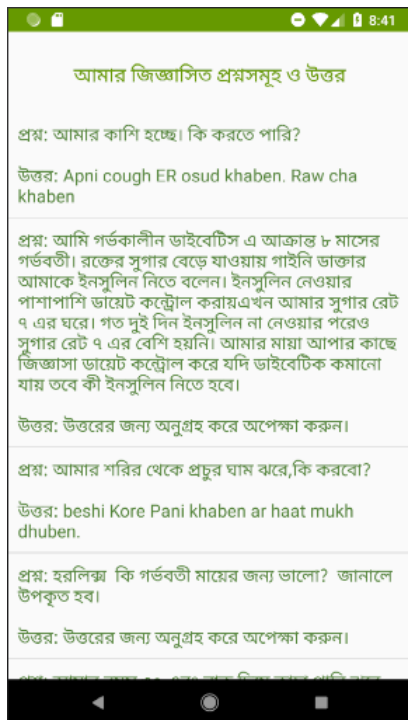


Figure 15: My asked question

When a patient want to check the question he/she asked previously, he/she can check by clicking on the field “Amar Proshnogulo” from the navigation drawer menu. Prior to that, they can check all the answers of the questions the asked which was replied from the doctor.

4.4.8 View patient profile

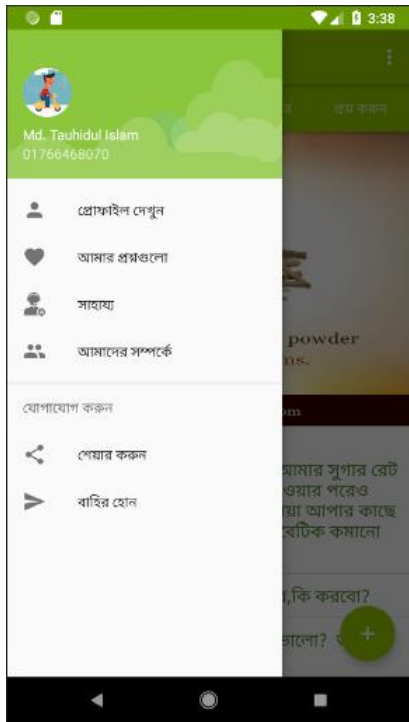


Figure 16: View patient profile

By clicking the navigation drawer on top left corner, user can check navigation drawer menu that consists of different items like View Profile, My Questions, Discussions, Helpline, About Us. There is also an option for sharing the app with others and the log out items from the account.

4.4.8.1 Patient basic information

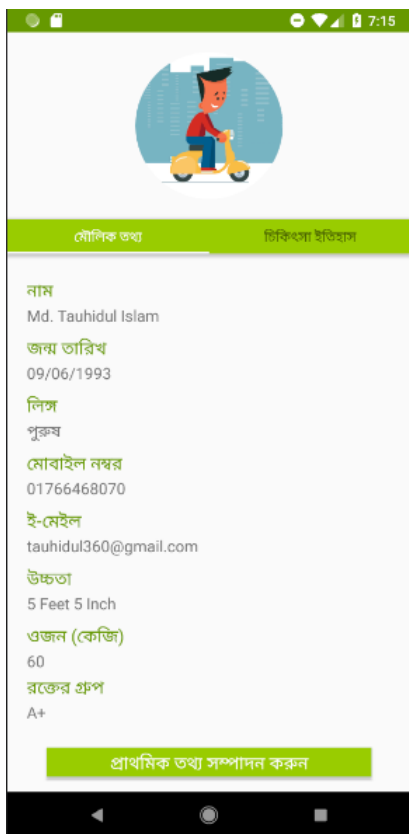
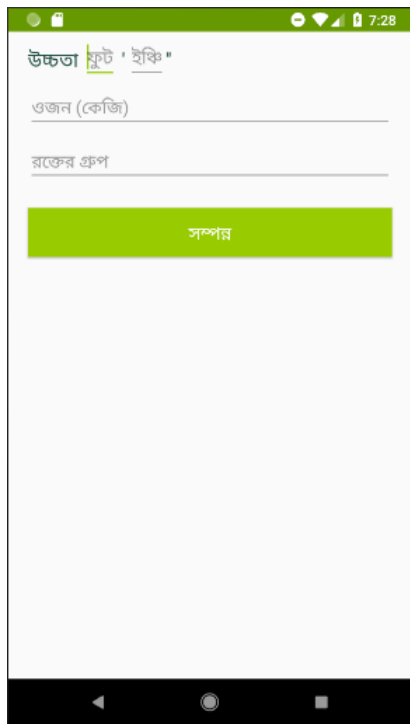


Figure 17: Patient basic information

Basic information which will be found in the navigation drawer menu, is another fragment which contains basic information of the user like name, birthdate, gender, contact number, e-mail, height, weight, blood group.

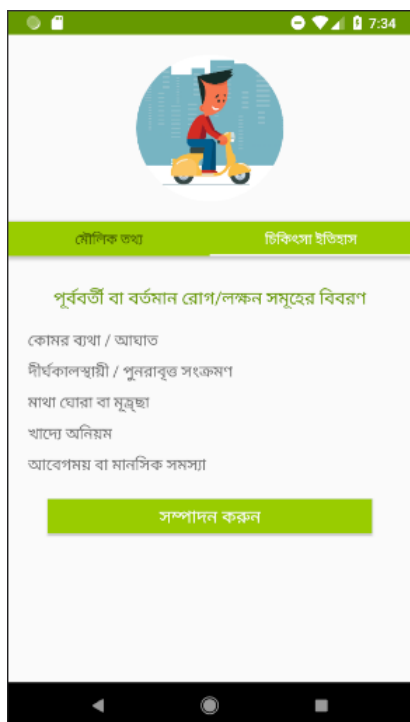
4.4.8.1.1 Update patient basic information



User can update their information any time if they want to do so.

Figure 18: Update patient basic information

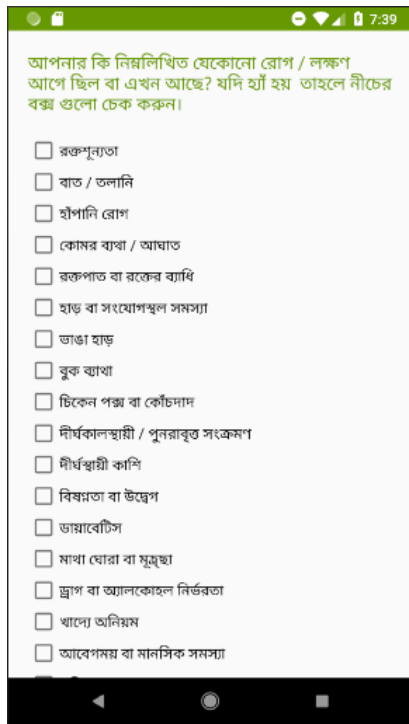
4.4.8.2 Patient medical history



There is another fragment named medical history where user can check the summary of their previous medical history. Given that, our online prescription system is synced with this fragment, it would be much easier for both patient and doctors to track the previous records.

Figure 19: Patient medical history

4.4.8.2.1 Update patient medical history



আপনার কি নিম্নলিখিত যেকোনো রোগ / লক্ষণ
আপে ছিল বা এখন আছে? যদি হ্যাঁ হয় তাহলে নীচের
বক্স গুলো চেক করুন।

- রক্তশূন্যতা
- বাত / তলানি
- হাঁপানি রোগ
- কোমর ব্যথা / আঘাত
- রক্তপাত বা রক্তের ব্যাধি
- হাড় বা সংযোগস্থল সমস্যা
- ভাঙা হাড়
- বুক ব্যথা
- চিকেন পল্ল বা কোঁচদাদ
- দীর্ঘকালস্থায়ী / পুনরাবৃত্ত সংক্রমণ
- দীর্ঘস্থায়ী কশি
- বিষন্নতা বা উদ্বেগ
- ডায়াবেটিস
- মাথা ঘোরা বা মূহুচ্ছা
- দ্বাগ বা অ্যালকোহল নির্ভরতা
- খাবো অনিয়ম
- আবেগময় বা মানসিক সমস্যা

User can update the information in the database by clicking on the check boxes.

Figure 20: Update patient medical history

4.5 Doctors Interface

4.5.1 Login page

This activity having a tab view section contains two fragments for login and sign up. In the login section, there are another two sections for providing username and password and thus doctor can login to his/her account which has been created previously. Moreover, for logging in, user has to go through validation check for ensuring better security and anyone who gives any invalid username, will not be allowed to login.

4.5.2 Signup page

Sign up section is used for creating a new account with proper validation check where doctor will have to provide his/her basic information.

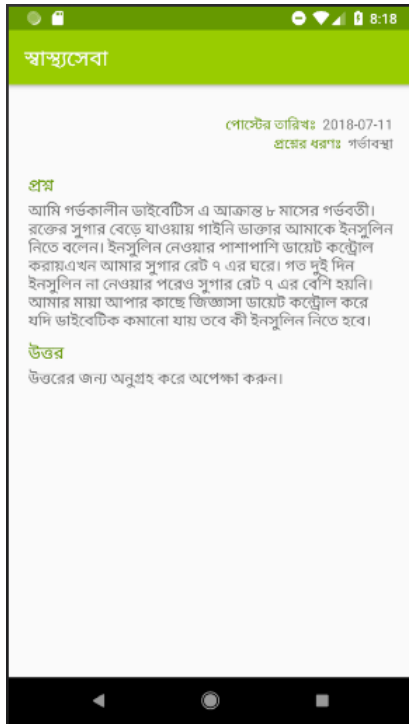
4.5.3 Homepage fragment

Home page fragment is similar as the patients interface home page fragment. After the user can successfully login, a home page will appear as the main page from where the user can move to another page according to their query. on the bottom right corner of the On the top left corner of the homepage, there is navigation drawer. For asking any question, there is a floating button page. Homepage is divided into two parts, one is for health tips and another is for displaying recent top asked questions by different users.

4.5.4 All question answer section

This is the section where all the questions and answers will appear.

4.5.4.1 Question details



Doctor can check the question details from this section where patient type will appear. Also, the time and date when the question has been asked will appear at the right top corner of the page. Along with that, question type will be shown.

Figure 21: Question details

4.5.5 Unanswered questions

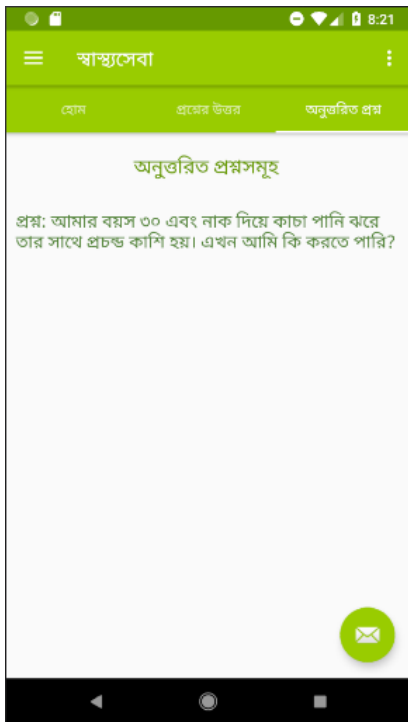


Figure 22: Unanswered questions

Doctors can check unanswered questions from the unanswered section and if they want they can answer according to the patient question.

4.5.5.1 Response to the asked question

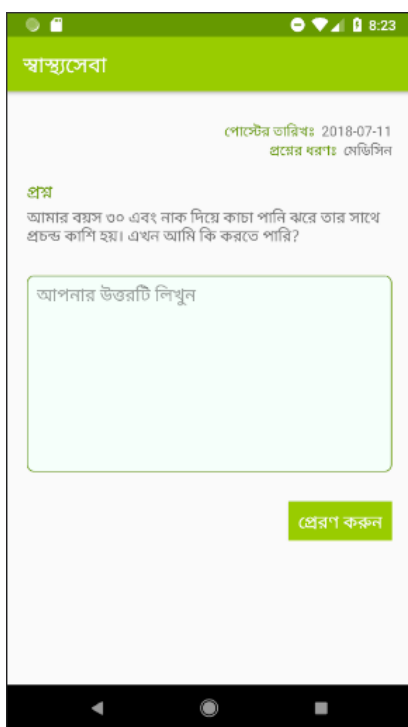


Figure 23: Response to the asked question

Here, doctor will reply to the patients asked question.

4.5.6 My answers

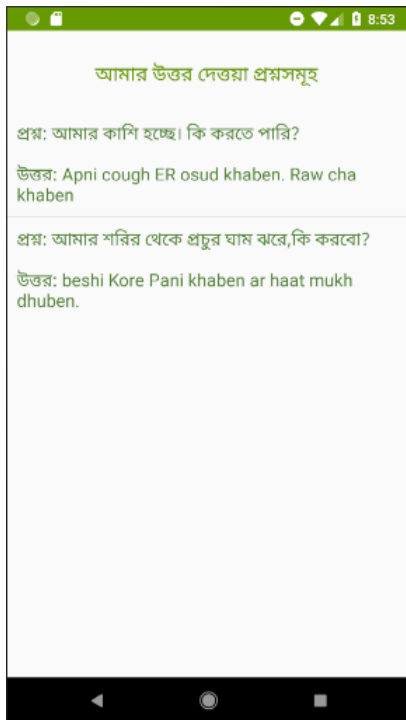


Figure 24: My answers

This page will show all the questions and answers which has been replied by the doctor. In brief, Doctor can manually check their answers to the patients which was only replied by them not by other doctors.

4.5.7 View doctor profile

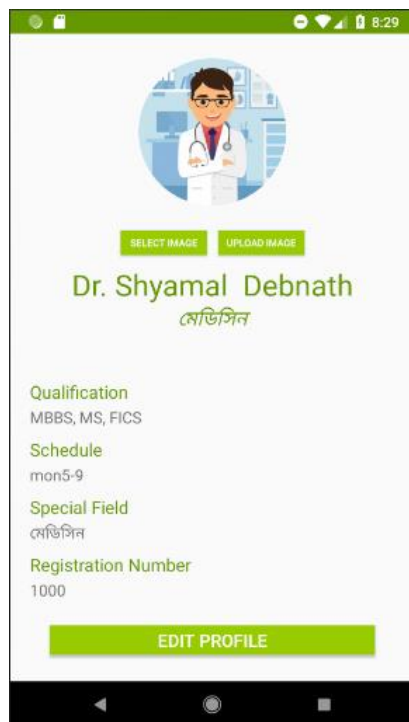


Figure 25: View doctor profile

This page is named as “View doctor profile” page where all the basic information of a doctor will appear. When a doctor log into their account they can check their information and can update their information anytime. Moreover, the basic information includes a picture of doctor, name, qualification, schedule, Special field of treatment, registration number etc. of the doctor.

4.6 Online Prescription Interface

4.6.1 Welcome page

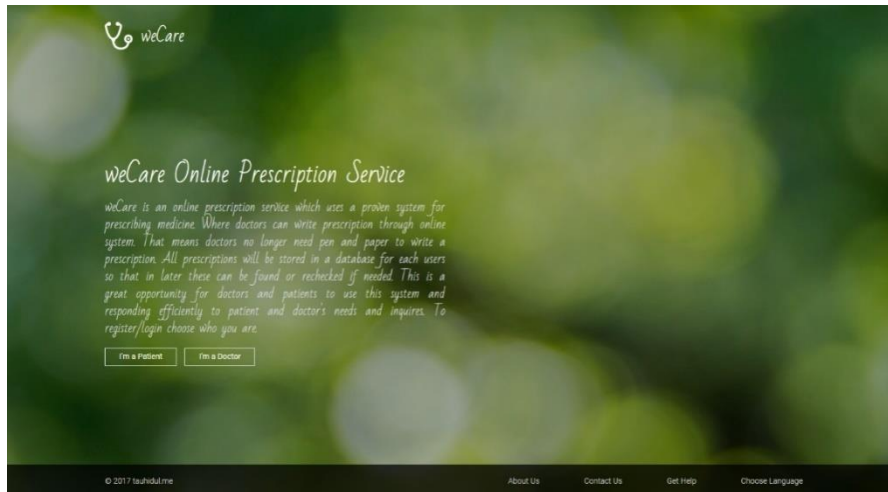


Figure 26: Welcome page

This is the welcome page of online prescription service which has been titled as “weCare”. In the middle, a brief description about the system is given and below that there are two buttons, one is for doctor and another is for patient. After that, there is a footer at the bottom of the page containing four sections such as About Us, Contact Us, Get Help, Choose language.

4.6.2 Login and Registration

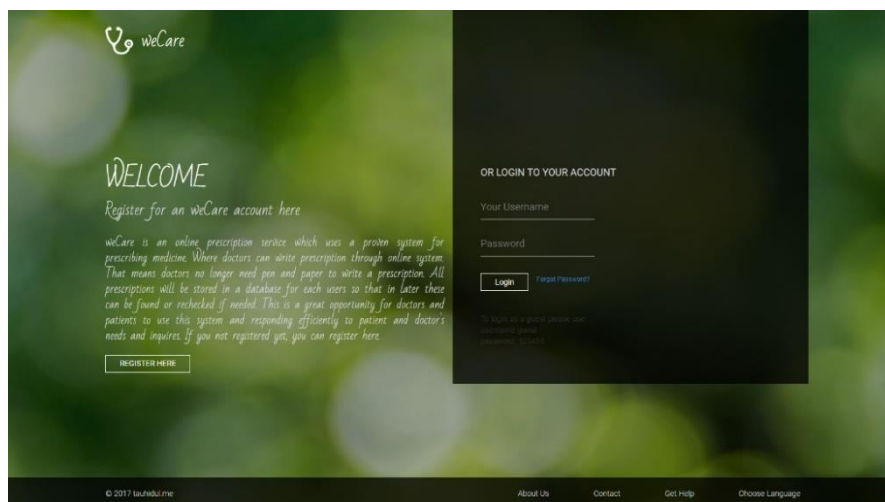


Figure 27: Login and registration

User having an account in our system can login providing username and password and for those who do not have any account can create an account in the registration section by providing basic information. For both the sections, user have to go through validation check.

4.6.3 Homepage

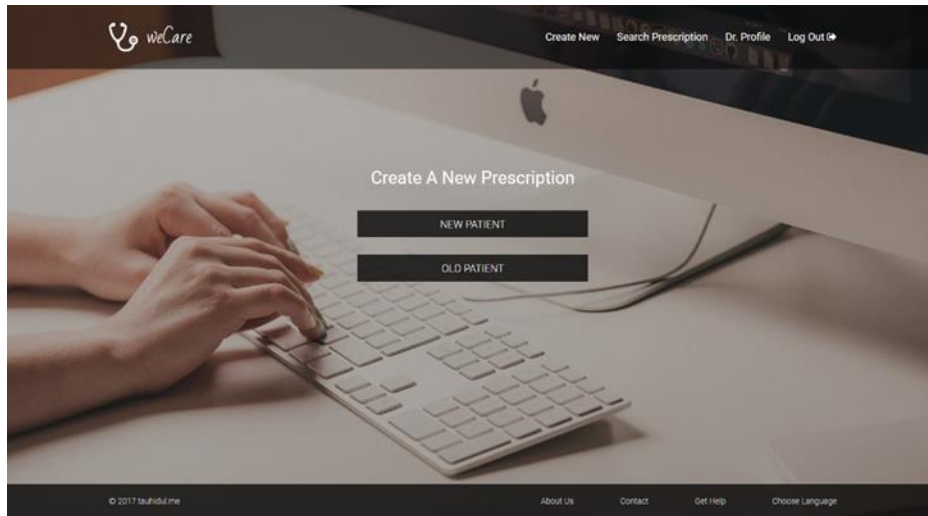


Figure 28: Homepage

This homepage appears as main page when a doctor successfully logs in. There is a header section on the top and a footer at bottom. In the header section there are four sections like create new prescription, Search prescription, Dr. profile, log out. There are two buttons, one is for new patient and another for old patient. Doctor have to select the patient type and another page will appear accordingly.

4.6.4 Create new patient information

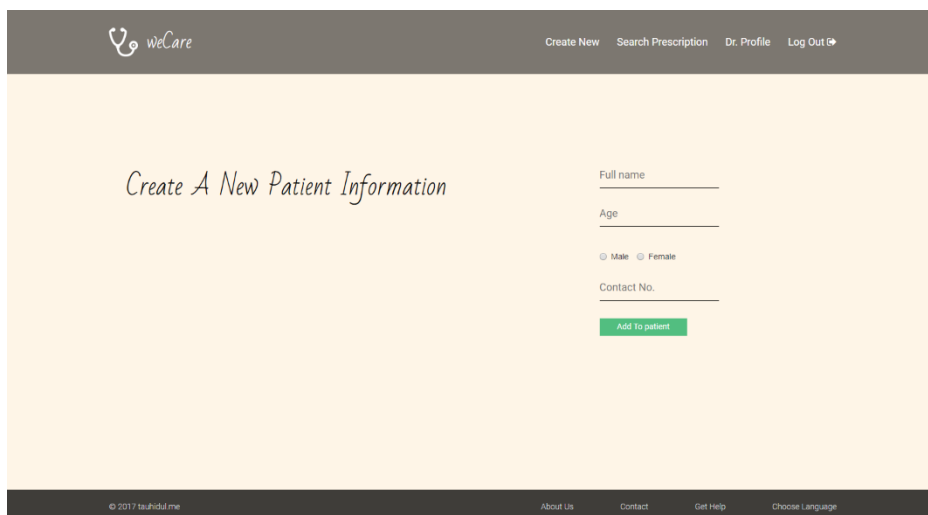


Figure 29: Create new patient information

After selection in the new patient section, create new patient information page will appear where patient's necessary information will be taken for creating an account for that patient.

4.6.5 Patient ID confirmation

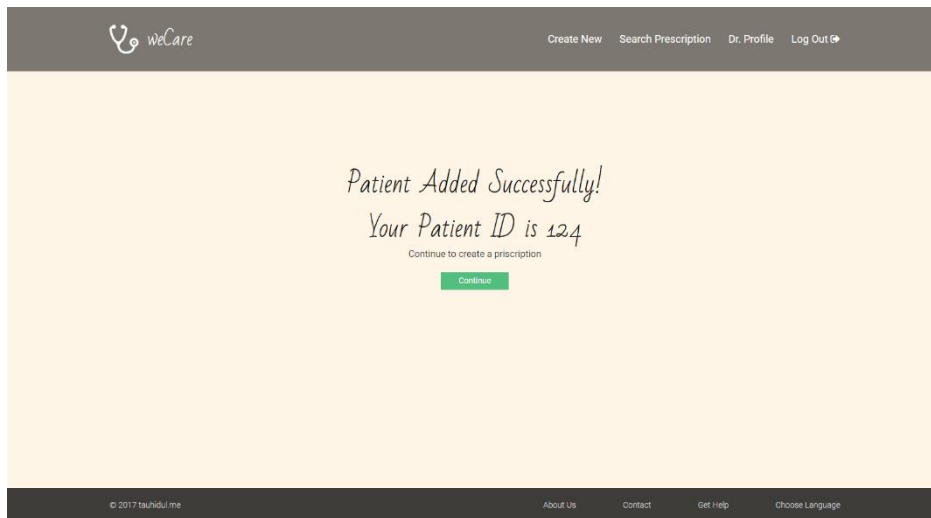


Figure 30: Patient ID confirmation

A unique patient ID will be automatically generated by the system for uniquely identifying the patient.

4.6.6 Write patient ID



Figure 31: Write patient ID

Moreover, if the prescription is for old patient then the only thing the doctor has to type is the patient Id which has been created earlier.

4.6.7 Write prescription

Patient ID : 123 Prescription No : 133 Visit No : 01 Date : 2018-06-30
Patient Name : Anika Nur Age : 15 Sex : Male Contact : 9177777777

Diagnosed with/Symptoms
Fever

General Examination
103 Drg C

Examination to be done

Rx.

No.	Type	Drug	Dosage	Usages	Comment
1	Tab	Napa	100mg	1.1.1	After meal

Advice

Next visit date: 18/09/2011

DECAID PROCEED

Figure 32: Write prescription

This page will appear after clicking the continue button where doctor will write the prescription. It exactly looks like a handwritten prescription. After writing down everything, one click on the proceed button and it will automatically save everything into the database from where patient would be able to print it anywhere anytime.

4.6.8 Search prescription

Search by [] Search

Patient Name	Patient ID	Age	Gender	Contact No.	Create	Expand
Md. Tauhidul Islam	119	24	Male	01700000000	Create	Expand
Sabira Roshid Toma	120	24	Female	01700000000	Create	Expand
Yasin Ahmed	121	24	Male	01600000000	Create	Expand
Mk. Ornaab	122	24	Male	01700000000	Create	Expand
Anika Nur	123	15	Male	01777777777	Create	Expand
Habibur Rahman	124	45	Male	01666666666	Create	Expand

Figure 33: Search prescription

Doctors can search for any prescription by typing the unique patient ID.

4.6.9 Expand patient prescriptions

The screenshot shows the weCare interface for a doctor's profile. At the top, there are navigation links: 'Create New', 'Search Prescription', 'Dr. Profile', and 'Log Out'. Below this is a search bar with a dropdown menu labeled 'Search by' and a 'Search' button. The main content area displays the doctor's name 'Md. Tauhidul Islam' and a list of patient information: Patient ID: 119, Age: 24, Gender: Male, and Contact No.: 01700000000. To the right, there is a table of prescriptions:

Visit No.	Prescription ID	Date	Action
1	125	2017-10-10	View Prescription
2	127	2017-10-10	View Prescription
3	132	2017-10-11	View Prescription
4	133	2017-10-11	View Prescription
5	136	2018-06-30	View Prescription

At the bottom of the page, there is a footer with copyright information '© 2017 tauhidulrme' and navigation links: 'About Us', 'Contact', 'Get Help', and 'Choose Language'.

Figure 34: Expand patient prescriptions

By clicking on the expand button, doctor can get to know the patient's information and previous prescriptions and their dates.

4.6.10 View prescription

The screenshot shows the detailed view of a prescription in the weCare interface. At the top, there are navigation links: 'Create New', 'Search Prescription', 'Dr. Profile', and 'Log Out'. Below this is a search bar with a dropdown menu labeled 'Search by' and a 'Search' button. The main content area displays the doctor's name 'Asst. Prof. Dr. Md. Tauhidul Islam' and a list of patient information: Patient Name: Md. Tauhidul Islam, Age: 24, Sex: Male, and Contact No.: 01700000000. The prescription details are as follows:

Diagnosed with/Symptoms: Fever

General Examination: 104 Degree F

Examination to be done: Blood Test

ADVICE: Take bed rest

Next visit date:

No.	Type	Drug	Dosage	Usage	Comment
1	Tab	Napa	100mg	1-0-1	if temp more than 100 D.F
2	Cap	Xyz	100mg	0-0-1	7 days

At the bottom of the page, there is a footer with copyright information '© 2017 tauhidulrme' and navigation links: 'About Us', 'Contact', 'Get Help', and 'Choose Language'.

Figure 35: View prescription

By clicking on the view prescription button, doctor will get this exact prescription for each patient.

Chapter 5

Implementation

In this chapter, the implementation processes of those designed pages will be described. We will discuss the target platform which has been used for the implementation of the application. There were a lot of tools accessible amongst those some had been used to create that significant structure of our features. Then, all those have been explained giving different code examples.

5.1 Android as a Development Platform

We have chosen Android as a development platform because an android application has access to a large pool of customers. Hence, it makes sense to choose android for its ease of installation, compatibility with more devices etc. Besides, it has a very lower development cost. Moreover, it has an open source where developers can easily recompile and make different changes according to the variety of devices.

5.2 Android System Architecture

Android operating system is a software which includes a combination of an operating system, middleware and core application. This system is roughly divided into five sections and four main layers. Android platform can be used for building applications where Android SDK provides powerful tools and APIs those are essential. Java is used as programming language. Let us talk about different sections of the system-

Linux kernel: Android is basically built on linux kernel which is being used for memory management. Besides, kernel handles all the things such as networking and a vast array of device drivers ^{[9][10]}.

Libraries: On the top of Linux kernel there is a set of libraries open-source web browser engine webkit. SQLite is a database which is used for storage and sharing data. Moreover, SSL libraries ensure internet security. Libraries are also used to play and record audio and video ^{[9][10]}.

Android Runtime: This section provides a key component called Dalvik Virtual Machine which enables each android application to run in its own process with its own instance^{[9][10]}.

Application framework: This layer provides many higher level services to application in the form of Java classes. Also, this framework includes the following key services-

- Activity Manager
- Content Providers
- Resource Manager
- Notifications Manager
- View System

Application: Android application will be found at the top layer. Developers will write their application on this layer only^{[9][10]}.

5.3 Android Studio

In this project, we are using Android Studio v3.0. Android Studio is the official Integrated Development Environment (IDE) for Android app development based on IntelliJ IDEA. It is a unified environment for all android devices, offers more features which enhance our productivity when building android app providing a fast and feature-rich emulator^[11].

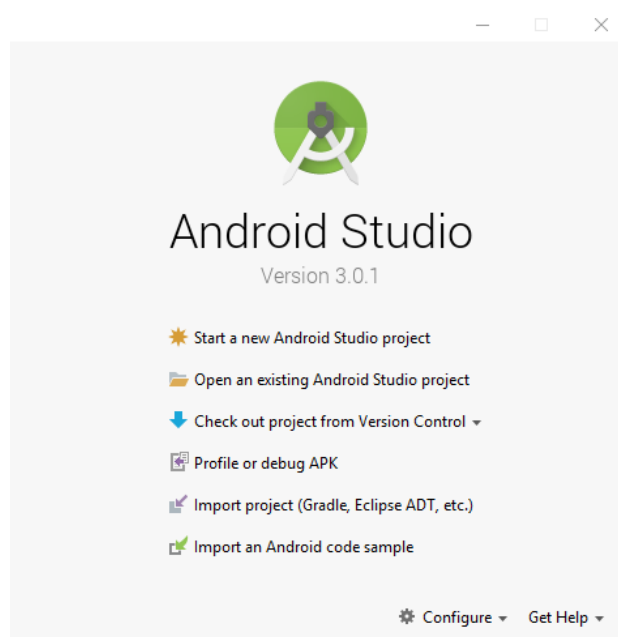


Figure 36: Android studio

For implementing android app in android studio, there are two types of programming languages named java and kotlin. Though kotlin is more expressive than java, we did not choose it because of its limited resources in the developers' forum. Besides, we chose Java as it is a very powerful and well developed language and in addition to that, we can get proper utilization because of their huge resources.



Figure 37: kotlin vs Java

Android SDK Tools is a component for the Android SDK which includes complete set of development and debugging tools. In our project, we used Android SDK tools v26.1.1. The Android Support Library is a collection of libraries, some of which inter-depend on each other and here we installed constraint Layout for android, solver for constraint Layout, Android support repository v47.0.0 and Google repository v58. We are using Sdk Version 26 by targeting API 15 and which are approximately used by 100% of devices.

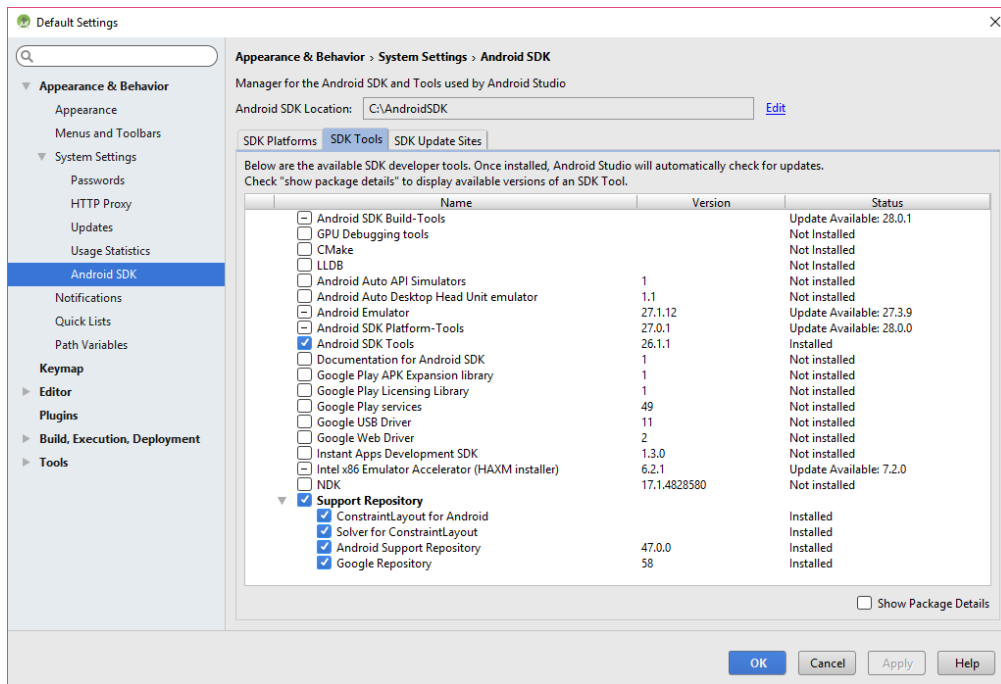


Figure 38: Android studio SDK tools information

For a successful build, the files in the project need to sync with gradle. Here 'com.android.tools.build:gradle:3.0.1' has been used.

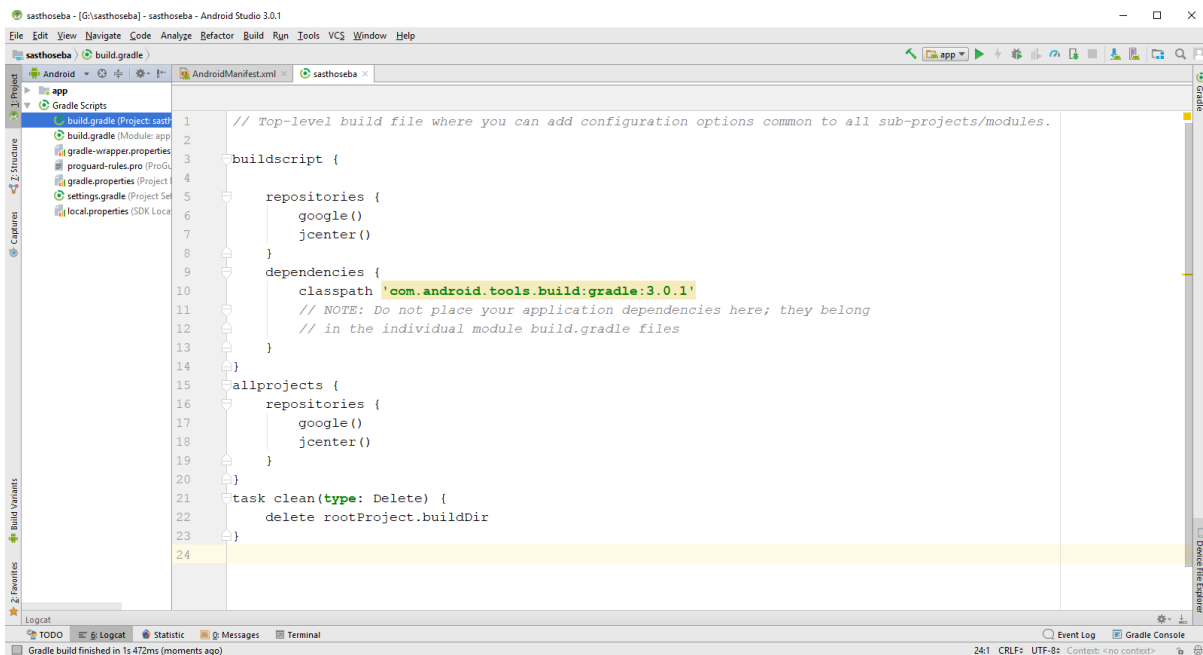


Figure 39: Android build gradle info

In the build.gradle(Module: app) file we need to specify compileSdkVersion, minSdkVersion, targetSdkVersion and dependencies for a successful gradle build. Here are the versions we have used:

compileSdkVersion 26

minSdkVersion 15

targetSdkVersion 26

versionName "1.0"

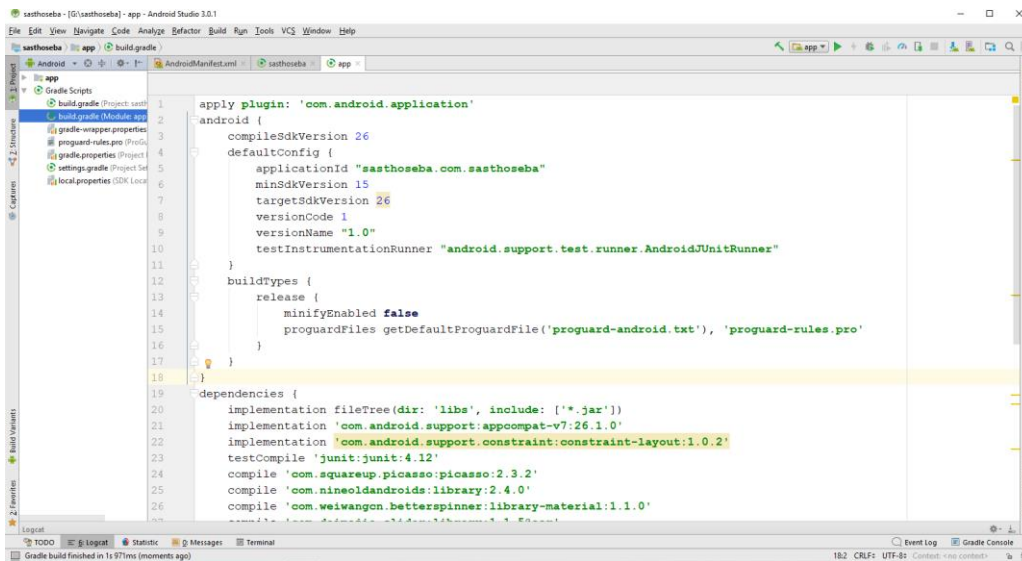


Figure 40: Android build (Module App) info

An Android Virtual Device (AVD) is an emulator configuration that modify an actual device by defining hardware and software options to be emulated by the Android Emulator. We are using Nexus 5X as device, API : 27 and resulation:1080*1920; 420dpi.

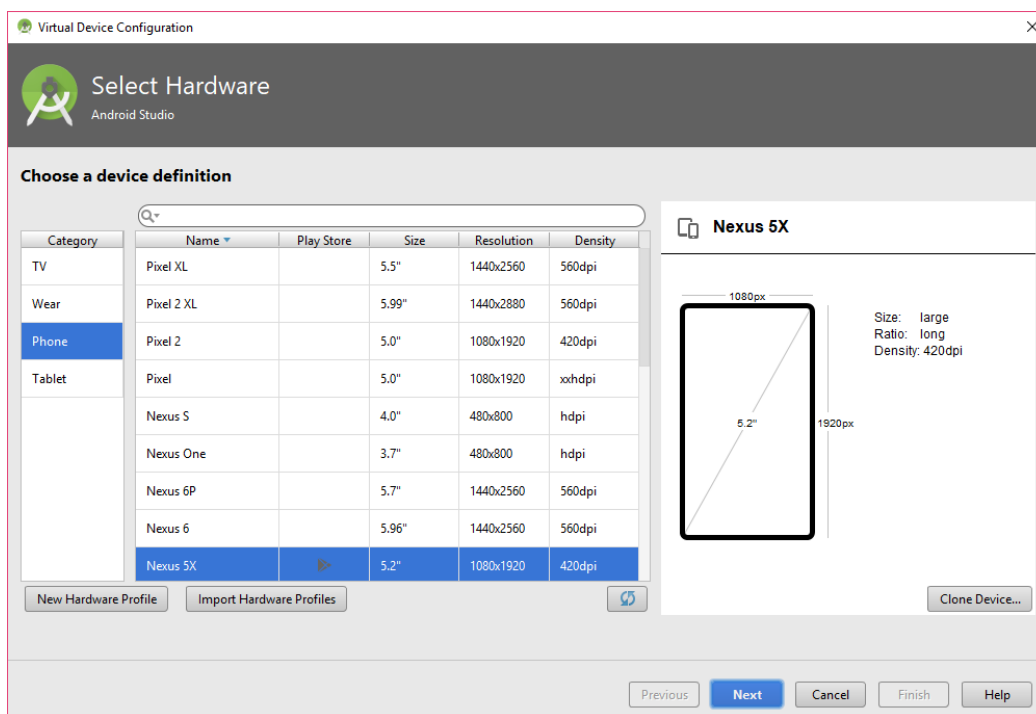


Figure 41: ADV

5.4 Project Description

We have used Android Studio version 3.0.0 for building our app. This app mainly contains two types of user interfaces. One is doctor and another one is patient. For connecting all the activities together, the Manifest.xml file automatically integrated the newly made activities within itself. We have used 'Splash Screen' activity as the first screen of our app. It shows loading screen with a progress bar of 100 milliseconds. The progress bar gets updated after every 15milliseconds. The next activity shows two buttons for two different user interfaces.

5.5 Patient and Doctor Interface Implementation

5.5.1 Login and signup interface

For a patient/doctor, the user will be first shown an activity with two fragments (tabs), namely Login and Signup. Login page has two edit text fields, one of those takes valid mobile number and another one takes a password of minimum 6 characters as input. Validation code was put for each edit text input in the .java file of each fragment. If all inputs are valid then on clicking the 'LOGIN' button the user is directed to the homepage. On the contrary, in the Signup fragment, there are seven edit text fields, according to the patient's requirement such as name, mobile number, email, password etc. A radio button was used for selecting gender of the patient. By 'onClick' method (inbuilt method in .xml file), user gets access to the homepage.

From login and sign up page a patient's information is sent and retrieved using String request as GET and POST method (along with server URL). URL address contains PHP code which processes data and communicate with MySQL server by sending and retrieving data.

When a user tries to sign up, PHP file checks whether the provided information already exists in MySQL database or not. The user must provide a unique email, phone, registration number otherwise the system will cease that individual to create an account through validation check.

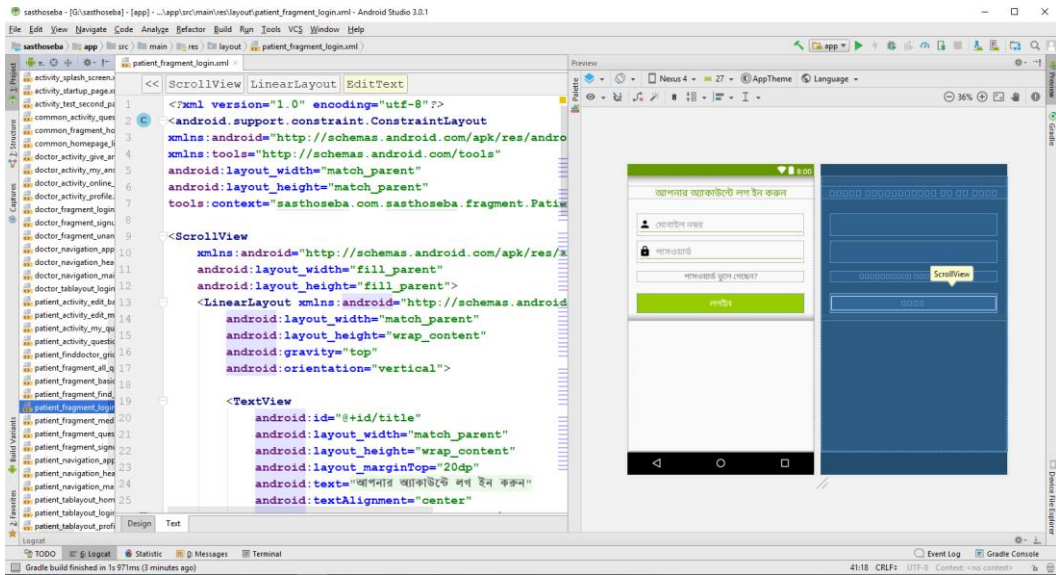


Figure 42: XML file

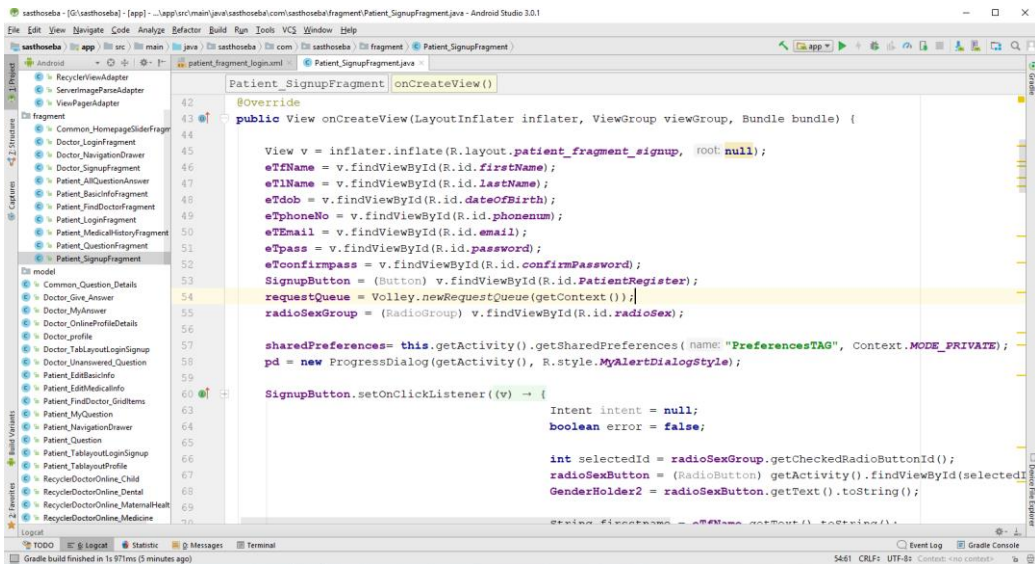


Figure 43: Java file

```
Editing: /home/mdtaowlo/eHealth Encoding: utf-8 Re-open
Keyboard shortcuts
17 $email = $_POST[ 'Email' ];
18 $confirmPassword = $_POST[ 'Password' ];
19
20 $checkPhonesQL = "SELECT Id FROM Doctor WHERE Phone='$phonenum'";
21 $checkPhone = mysqli_fetch_array(mysqli_query($con,$checkPhonesQL));
22
23 $checkEmailsQL = "SELECT Id FROM Doctor WHERE Email='$email'";
24 $checkEmail = mysqli_fetch_array(mysqli_query($con,$checkEmailsQL));
25
26 if(isset($checkPhone)){
27     echo "PhoneExist";
28 }
29 elseif(isset($checkEmail)){
30     echo "EmailExist";
31 }
32 else {
33     $Sql_Query = "insert into Patient(`Id`, `FirstName`, `LastName`
34
35     if(mysqli_query($con,$Sql_Query)){
36         echo 'Done';
37     }
38     else{
39         echo 'Try Again';
40     }
41 }
42 mysqli_close($con);
43 ?>
```

Figure 44: PHP file

5.5.2 Homepage

From Login/Signup page if a user completes every step appropriately then by ‘onClick’ method (inbuilt method in .xml file), user gets access to the homepage where it contains four fragments, an Action Bar at the top, a Navigation Drawer on the top left part and a floating button at the bottom right corner. In the homepage, the first fragment namely ‘Home’ shows ‘Slider View’ with a title of different images which are implemented by using ‘BaseSliderView.OnSlideClickListener’ and ‘ViewPagerEx.OnPageChangeListener’. Next obtainable slide is observed if a currently showing slide is clicked. The images are loaded directly from the internet as the urls of different images are set on .java files. The slider changes its image after every 5000 milliseconds.

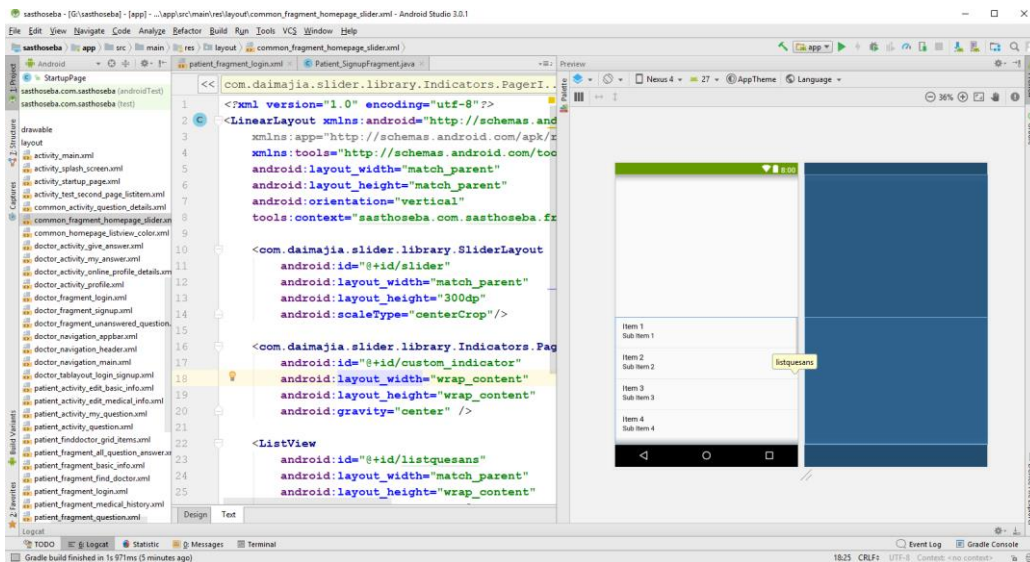


Figure 45: ListView

On the lower part, frequently asked questions by patients are shown on the database in 'List View' format. The questions asked will appear in a descending order which means most recently asked question will appear first. Here, we are using `JSONArrayRequest(Request.Method.GET, GET_URL, new Response.Listener<JSONArray>())` which gets `getJSONObject` from server JSON file.

5.5.3 Find a doctor

On the next tab, patients will be able to search for doctors where the doctors' list is categorized in 'Grid View' format by taking the grid items in an 'Array List' and then notifying the 'Grid Item Array Adapter'. 'On Item Click' method is used to intent from one grid item to an activity. A method namely 'set Data' is called to set the names of each grid item which are eventually added to the Array List. After clicking on each item, the patient will be able to see a list of doctors who are online. Online and offline status will appear from the moment the app starts. The time when user logs out from the app, he/she will automatically be set on the offline status.

'Recycler view' was used here so that the data loaded from 'End Point Link' could be shown just as each doctor's name along with his/her image being an item appears on the page.

By clicking on each recycler view item, the selected doctor's profile is shown. Here, it is done by extracting the JSON object (the clicked item) from JSON array and passing it to another activity using 'putExtra' method. The next activity receives the object and shows doctor's details in Text View. Doctor's image is shown in recycler view by converting the

blob values to bitmap format. Bitmap is a format used to show images of items in recycler view.

5.5.4 All asked questions

On the this fragment, the patient/doctor can see a list of all the asked questions by patients in a List View format. Here, the patient/doctor can filter the question type by selecting an item from the Drop Down Menu at the top.

5.5.5 Ask a question

Similarly, in this fragment, the patient can ask question in a ‘text Multi Line’ format on the edit text field. The background color of the edit text field is changed in such a way so that the user can easily identify the question field. A significant Hex code of color was used from the color library in order to change its background look.

5.5.6 Navigation drawer

The user’s name and mobile number is loaded after the ‘Navigation Drawer’ is clicked. When any navigation menu item is clicked, the patient is directed to another activity according to the item being clicked.

5.5.7 View profile

When “View Profile” is clicked, the patient/doctor gets to see his/her profile where the patient/doctor can also edit any information if the individual wants to do so. The user can update his/her weight, height, blood group etc. by filling in the necessary edit text fields available. On the other tab, the patient can update predictable health problems by selecting the check boxes on that activity. The check boxes being selected are directly updated in the database after clicking on the button.

5.5.8 My questions

If the user clicks on ‘My Questions’ navigation menu, then it directs to an activity by ‘Intent’ method where only his/her asked questions are shown from MySQL database through JSON file. The past history of asked questions are shown in ‘List View’ format.

5.5.9 Video calling implementation

For implementing video call connection in our mobile based application, we have used the OpenTok API library which is also known as TokBox. We had to sign up on its account in order to use its Token, Session ID and API key. We had to put the api project secret and api project key in the Heroku cloud server (provided by TokBox) so that our project could be deployed in it. After deploying successfully, the server provided a session id, token and api key. Everytime a patient clicks on the video call button, then a JSON object request is sent to the Heroku server and eventually a new session id, token and api key is generated for each call and then these are saved as string values on the back end, ready to be used for establishing a video connection.

We compiled 'com.opentok.android:opentok-android-sdk:2.14.0' and 'pub.devrel:easypermissions:0.4.0' on build.gradle(Module:app) to import the libraries to be used. The .java file implements Session.SessionListener and PublisherKit.PublisherListener. In the onCreate method, a method called 'requestPermissions()' is used to ask the user to allow camera access, internet access and record audio to start the video chat. The response of the user is stored in a String array. If the user allows access to all of these, then a secured video chat opens on the phone in which the user can see his/her video.

```
@AfterPermissionGranted(RC_VIDEO_APP_PERM)
private void requestPermissions() {
    String[] perms = {Manifest.permission.INTERNET, Manifest.permission.CAMERA, Manifest.permission.RECORD_AUDIO};
    if (EasyPermissions.hasPermissions( context: this, perms)) {
        // initialize view objects from your layout
        mPublisherViewContainer = (FrameLayout) findViewById(R.id.publisher_container);
        mSubscriberViewContainer = (FrameLayout) findViewById(R.id.subscriber_container);

        // initialize and connect to the session
        mSession = new Session.Builder( context: this, API_KEY, SESSION_ID).build();
        mSession.setSessionListener(this);
        mSession.connect(TOKEN);
    } else {
        EasyPermissions.requestPermissions( host: this, rationale: "This app needs access to your camera and mic to make video call.
    }
}
```

Figure 46: Video calling - 1

The onConnected method allows the publisher to create a video stream.

```

@Override
public void onConnected(Session session) {
    Log.i(LOG_TAG, msg: "Session Connected");

    mPublisher = new Publisher.Builder( context: this).build();
    mPublisher.setPublisherListener(this);

    mPublisherViewContainer.addView(mPublisher.getView());
    mSession.publish(mPublisher);
}

```

Figure 47: Video calling - 2

The `onStreamReceived` method creates a connection between the publisher and the subscriber.

```

@Override
public void onStreamReceived(Session session, Stream stream) {
    Log.i(LOG_TAG, msg: "Stream Received");

    if (mSubscriber == null) {
        mSubscriber = new Subscriber.Builder( context: this, stream).build();
        mSession.subscribe(mSubscriber);
        mSubscriberViewContainer.addView(mSubscriber.getView());
    }
}

```

Figure 48: Video calling - 3

Each of these methods work accordingly. The first one is for mute button. If it is clicked once, the microphone of publisher is muted. If clicked twice the microphone turns on and vice versa. Similarly, for the swap camera button, if it is clicked once, camera of publisher is swapped. If clicked more than once, it moves to the previous direction. The 'end' method is mainly for closing the video conversation. If it is clicked once, the video and audio both will be turned off.

```

int clickcount=0;

public void mutemethod(View view) {
    clickcount=clickcount+1;
    if (clickcount%2!=0) {
        mPublisher.setPublishAudio(false);
    }
    else if (clickcount%2==0){
        mPublisher.setPublishAudio(true);
    }
}

public void swapcameramethod(View view) { mPublisher.swapCamera(); }

public void end(View view) {
    mPublisher.setPublishVideo(false);
    mPublisher.setPublishAudio(false);
}
}

```

Figure 49: Video calling - 4

In the .xml file, Frame Layout was used as a whole because of its comfortability. Different Frame Layouts of varying dimensions were placed one within another to fit in the viewed layout. The whole Layout consists of subscriber's view within which the publisher's view was placed on the top right part. Three circle buttons were placed at the bottom to make it more visible with Each button having a different functionality. The 'com.github.markushi:circlebutton:1.1' library was compiled to use the circle shaped buttons in the Layout.

5.6 Online Prescription Implementation

Online prescription is the another one of the main features of our app where a doctor can write prescription and they can check a patient's previous health history. When a patient signs up, online prescription system will automatically generate a unique ID for each patient. It is basically a separate website which can be used externally without even using our app by simply typing a web URL for the site on the browser. Therefore, we tried to sync that separate website with our app. A link in a button will be placed in our app which will redirect to online prescription website.

When a doctor desires to make a prescription, he/she would mostly need a patient ID which will be mentioned in the app. After that, the system will search for that patient from the database by matching the given patient ID. If the user exists, the system will generate a

unique prescription ID so that in future, that particular prescription can be found by that prescription ID. The main prescription interface is divided into some parts which are a patient's basic info, RX, diagnosed with/Symptoms, General Examination, Examination to be done, Advice and Next visit date. There are a multiple text fields in RX which help to clarify the uses and Dosage of each drug properly. Doctors will be able to prescribe as many drugs as needed by clicking the done button after filling in the necessary information. Besides, each drug list can be edited or removed if the doctor wants.

On the other hand, other text fields will work while doctor confirms by clicking done button separately. On the input field of next visit date, we have used a calendar view which would give a comfort feeling to pick up a date. After all the requirements are done, the doctor can proceed to the next page by clicking on the proceed button. Anyhow, a doctor can discard a prescription at any time if he/she thinks it's going wrong or maybe if it's not needed anymore.

We have used MySQL database to store and retrieve information. There are some tables which associates with each other to organize data in a proper way. When a prescription is written, it passes through several PHP & MySQL queries which help to communicate with remote MySQL database to be stored in a proper destination. Later on, all the data those are retrieved from database are organized in such a mannered way that looks like a paper printed physical prescription. We have added a print button on each final prescription so that a patient can print it anytime whenever feasible.

Another feature of our online prescription system is the searching option. Doctor can search for any patient's prescription by simply providing the patient's ID. After searching, an expand button will appear. By clicking on the expand button, a doctor will be able to see all the visits that patient had made previously. Moreover, a doctor is allowed to monitor each prescription as it is necessary to check previous health records to ensure better understanding on the health condition of the patient.

Chapter 6

Test and Results

6.1 Testing Procedure and Result

While testing this app in different stages of its development, we had encountered software bug on many activities. Sometimes, the app used to crash after we attempted to explore through it. We tried to debug the whole application by trying to figure out the problems in Logcat of Android Studio and also by searching for errors in PHP files.

One of such difficulties is that the ‘offline’ and ‘online’ statuses of doctors were not getting updated in the database after the user went online or offline. We had to fix it by writing the correct piece of code in PHP file. For getting the database information of logged in users then showing them on our app, we had to search through different documentations and online tutorials and afterwards we could find a solution for this. We had shown our built up activities to random people for evaluation. Their feedback as users had brought us an assertive feeling about the tasks we had done and also the mistakes those should have been contributed more attention.

For video call, the session id and token which were used had been set a time limit of 6 hours only and the aftermath of this time limit was an improper connection between the two user interfaces. For each such bugs, we had to simultaneously fix and run to view whether the desired output could be attained or not. After creating a few numbers of activities, we have showed these to ten random people and tested on them as users so they could suggest a better idea if they had any. After a number of trial and error processes, we could finally achieve a full set of working activities and later on, we compiled all of these in one application.

6.2 Limitation

Although we have tried to implement a peer to peer connection of video call in this application, due to lack of time and efficiency, we could only establish a secured connection between two interfaces i.e. across connection takes place whenever any user simultaneously opens the app. This could have been made possible if the token and session id could be generated through the machine whenever a user tried to connect to another particular user. The auto generated ids would have remained unique in between themselves. Another item of

limitation is the poor network connection of internet while one is using it. It has been observed that whenever the network connection is slow, the app takes time to load data from database, proceed to another activity and eventually cannot connect to a video call. After a certain time limit, the app stops loading data which means that it has crossed the time duration to get data that was set on .java file of our application.

Chapter 7

Concluding Remarks and Future Works

7.1 Conclusion

The main problem that was raised at the beginning of the project was to develop an app that would help most of the patients living all over the country and especially for those who are living in rural areas of Bangladesh. Along with a lot of infrastructure problems of health sector, those people are not getting proper health services. Our main purpose was to contribute to our health sector though we know these problems would not be solved in one day. The major goal of the project was to develop an app that would help people to reach a doctor in every possible way. Therefore, an android based app was the easiest way for us to make a bridge between a doctor and a patient as we all know that more than 140 million people, out of Bangladesh's population of 160 million, use mobile phones. According to telecom regulators around 80 million people access the internet. We had started designing our application based on different initial research we carried out. Now, combining the whole project that we have constructed so far, we can conclude that our goals were accomplished in many aspects. This app can let the patients ask questions to the respected doctors through which they can get help for their medical related issues as well as they can video call those doctors who are online and also search for suitable doctors available when they need.

We took a leap of faith and had a lot of aspiration before starting to work on this mobile based application and here we are, finally being able to achieve our goals in a very decent manner. Our app was tested in the final stage of the procedure and the response we got from the participants was quite stately. Based on their opinions, we could eventually conclude that this app was successful in being user-friendly and also being able to perform it's required job.

7.2 Future Work

In future, our application can be modified by working on some optimization issues which includes "Auto or customizable video quality". In "Auto or customizable video quality" people can choose video quality depending on the bandwidth. Besides, optimization also includes fixing some security issues and fixing some bugs. Billing method will get the most priority in our future work as people have to pay money for the treatment. Moreover, it has to very secure and easy for building up the trust between the people.

Moreover, 'push notification' feature via firebase can be added to make it even more user friendly so that patients can know if their questions have been answered yet or not. Again, offline data storage feature will be implemented. In our online prescription system, all medicines of different company in our country will be added in the medicine database so that it can automatically suggest the drug name when doctor will write drugs name.

All of these important features mentioned above could have been applied if we could get much time in implementing those during thesis period. Our system is generally for helping the people of Bangladesh. But we will work further in future to make it more versatile to use for almost all countries over the world.

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