AN ADVANCED HEALTHCARE ANDROID APPLICATION WITH MACHINE LEARNING

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Declaration

We hereby declare that this thesis is completely based on the results obtained from our own work. Proper acknowledgment has been made in this paper while using all other material. This thesis, neither in whole or in part, has been previously submitted to any other University or Institute for the award of any Degree or diploma.

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List of Abbreviation

ML	Machine Learning
SMS	Short Message Service (SMS)
COPD	Chronic Obstructive Pulmonary Disease
UCLH	University College London Hospital
AI	Artificial Intelligence (AI)
ECG	Electrocardiogram
IDE	Integrated Development Environment
SDK	Software Development Kit
API	Application Programming Interface
DBMS	Database Management System
RDMS	Relational Database Management System
SQL	Structured Query Language
SVM	Support Vector Machine

Abstract

In this thesis, an advanced healthcare application on android platform is proposed and demonstrated using machine learning techniques. This advance healthcare application allows the user to conduct critical prognosis based on their proved information. This application is composed of (1) predicting health risk of the user, (2) providing the users with necessary suggestions depending on their health conditions and (3) helping the users by connecting them with blood bank and hospitals nearby. As a further development of service, the application will enable the user to make an appointment with doctors. In our thesis project, we have run this prognosis system for heart diseases based on the information those we have collected and have gotten an accuracy level of 0.71 out of 1.

Chapter 1: Introduction

Healthcare quality in Bangladesh has not been up to the mark due to several factors. One of the major reasons of that we have not been able to establish a reliable pre-diagnosis method also referred to as prognosis, which would allow us to have a very early forecast of upcoming health danger. Besides these, we are also lagging behind in terms of providing emergency medical support. These problems can be solved by the implementation of Machine Learning (ML) techniques as usage of ML in healthcare has increased significantly in recent years [41]. Bangladesh is a place which has huge market of smartphones [18, 20]. Keeping that in mind we are submitting this paper which proposes a model to develop a mobile application which will be acting as a healthcare support to reduce the risks created by fatal diseases. The Android-based application will have the feature of predicting health dangers with the help of Machine Learning (ML) techniques so that the user can take precautionary steps before any massive damage. But it should be noted that the system will not determine the disease directly without the consultation of the doctor. Rather it will predict the possible health dangers and suggest the user visit to a doctor or hospital if needed. In our work, we have conducted research in this field and also come up with a model to implement all the things mentioned well. A prototype of the application has also be developed. After the next phases of the development, the application will suggest the user the nearest place to consult with the doctor and will also help in emergency cases like- finding out ambulance and blood on time.

1.1Motivation

ML provides methods, techniques, and tools that can help in solving diagnostic and prognostic problems in a variety of medical domains. At present, ML is using widely for determining the clinical parameters and prognosis. The literal meaning of prognosis is ‘knowledge beforehand.' It is a medical term for predicting the likelihood of a person's survival and finding out the health-related risks that a person is encountering right now. Implementation of ML can make the prognosis much easier. The proposed application will act as a prognosis tool as the system will learn from patient/user data and develop itself in an efficient way to predict after analyzing it.

Learning from patient data is not a new term as it is being used to develop highly functional medial applications. For example, in the work of Hau and Coiera (Hau and Coiera, 1997) an intelligent system, which takes real-time patient data obtained during cardiac bypass surgery and then creates models of normal and abnormal cardiac physiology, for detection of changes in a patient's condition is described [1]. This sort of intelligent system can play a vital role to reduce the health danger of people encountering several health problems. However, the existing system is expensive and beyond the reach of almost all of the people. So, it is absolutely necessary to come up with a system which will be made available to all and will not be expensive to be used. We thought a mobile-based application based on ML techniques can serve as a great solution in this regard.

1.2 Thesis Outline

The rest of the thesis is organized as follows:

- Chapter 02 includes background analysis and related works.
- Chapter 03 presents our proposed model and its implementation
- Chapter 04 demonstrates the experimental results and outcomes.
- Chapter 05 concludes the thesis and states the future research directions.

Chapter 2: Background Analysis and Related Works

2.1 Background

Smartphone nowadays is not limited to a phone, rather it has been a miniature version of a personal computer. With no doubt, it has revolutionized our lives in many ways. This ‘always on', a flexible and on-demand device at present serves mankind in terms of communication, entertainment, learning, managing the social life and what not. With an increasing speed, the ability to provide data related services, and computing power, the smartphone touched almost all the sector of our lives. [15]. Likewise, for every other place in the world, Smartphone has become a part and parcel of our daily life. People from teenager to senior citizens, everyone uses a smartphone which runs mostly in android platform. Many companies are producing the smartphone at such a less price, that people of all class can afford it. Smartphone with the integration of the latest technology has made our life so easy and comfortable. We are able to communicate with our dear ones with from anywhere in the world with the help of social media like Facebook, Tweeter, What's App, Skype, Google Duo etc. With the help of google map and other maps, we can visit and move around easily in an unknown place without even worrying about getting lost. With the help of Uber and other ride-sharing applications, we always get a ride waiting for us anywhere we go. The news about around the world is always in our pocket. Even we don't have to join any class or academy to develop skills. With the blessing of technology, we can develop our skills by sitting at home on various sections, from cooking to programming, robotics and any aspect of science. We always carry movies and other multimedia stuff on our phone and also use it to track our daily schedule.

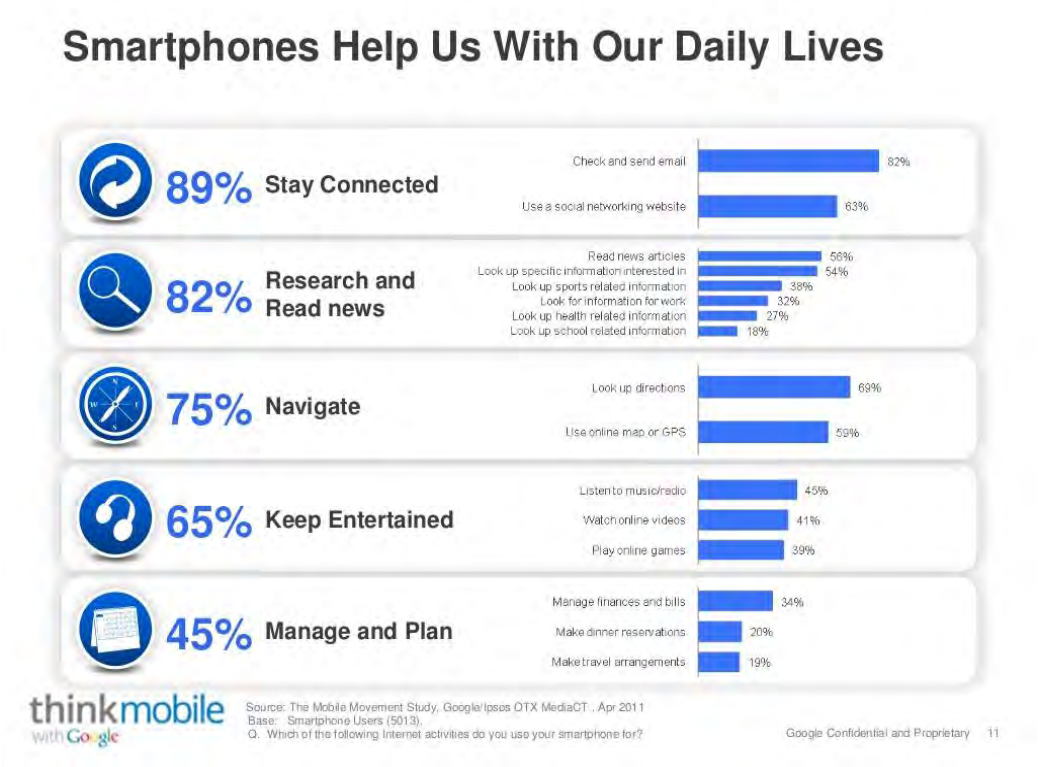

Figure 01: The Mobile Movement Study of Google

Figure 01 gives us a rough idea of the role of the smartphone in our daily life [17]. According to "The Mobile Movement Study" on Google, 89% smartphone users use their devices throughout the day. 82% of them do research and news reading, 65% use the devices for entertainment purposes while 45% use these to manage and plan such as- paying bills, making reservations and so on. These statistics clearly prove that people do spend a significant amount of time on their smartphones.

According to an article published in "The Financial Express", 30% people of a total population of Bangladesh use smartphones on daily basis [16]. Which means about 30 million people out of 100 million mobile phone users use smartphones. Bangladesh currently has a mobile market of TK 100 billion [16]. Many events are being organized by the government to motivate people to use smartphones. The mobile handset market is one of the fastest growing markets in Bangladesh. In February 2017, it was noticed that more than 73% of internet users use mobile as the medium [20]. After 1 year, the 4G network was launched in Bangladesh on 19th February 2018 [18]. After that, the demand for smartphones has increased at a very satisfactory rate. Most of the smartphones in

the market that falls within the price range of TK 10,000 supports 4G [19]. So people are being more interested to use smartphones.

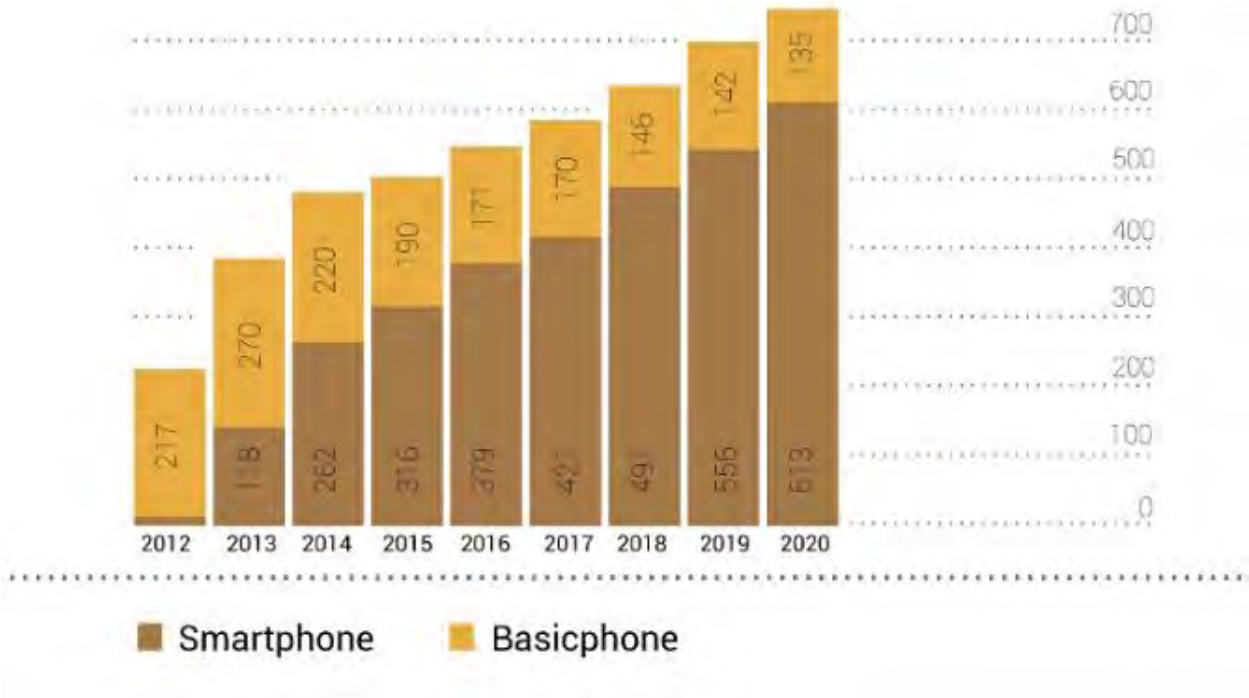

Figure 02: Usage of Smartphones in Bangladesh

Figure 2 shows us the increasing rate of usage of smartphones [21]. From 2013 to 2014 the rate increased became more than double of the previous. From 2014 to 2015 it increased 58.77%. Although after 2016 the rate is increasing at a lower rate but yet, the demand of smartphone is increasing.

2.2 Smartphone in Healthcare

The importance of smartphones in healthcare has become a serious issue at present. In recent years, many studies have been done and several processes were taken to develop applications which will be used in a great deal in healthcare [22]. Some studies proved that the usage of mobile phones in telemedicine and remote healthcare brought about significant changes in developing nations [23]. Health applications have been developed for the HIV treatment in the rural areas and these play extraordinary roles in terms of offset diagnosis and providing necessary information to the workers [10, 24]. In addition to that, studies assessing specific functionalities

of smartphones have recently featured in the literature as well, including an examination of the use of onboard digital diaries in symptom research [25], usages of short message service (SMS) text when it comes to management of behavior change [26], in sexual health education [27], and to improve patients' adherence to antiretroviral treatment [28]. Comparison of the use of mobile phone records against traditional paper-based records in controlled drug trials is also done in one study [29].

Some patient-centered applications are also developed and these are capable of doing multiple functions. The applications are managing chronical diseases and even self-diagnosis [30]. There are applications developed for lifestyle management, diabetics, smoking cessation and alcohol addiction. There are several smoking cessation apps available on iPhone [31]. In the Android platform alone, numbers of Android apps are available with verities of functionalities, including self-monitoring blood glucose recording, medication or insulin logs, and prandial insulin dose calculators [32]. Most number of the apps belongs to exercise and weight loss category. Users make a diary of his daily diet, weight, height etc. as the parameter in these apps. By analyzing those data the app predicts whether he is living a healthy life, what type of diet he should follow, what kinds of exercise he should do and related suggestions. [33, 34].

Mobile applications are also available when it comes to mental health and psychological aspects of human. There is an application that randomly prompts the patient to self-report psychotic symptoms multiple times throughout the day and helps psychiatric patients to improve his/ her overall condition [43, 15]. Another app is made for the patients who suffer from sickle cell disease to make a dairy so that they can keep track of their pain and other syndromes [44, 15]. There is also an app developed for monitoring the patients affected with COPD (chronic obstructive pulmonary disease) [45, 15].

2.3 Applications of Machine Learning in Healthcare

There are a number of healthcare applications and systems in which the techniques of Machine Learning have been used. ML has been an efficient process which can be used to come up with almost accurate predictions. One of the core intentions of developing the Machine Learning technique is to do diseases prediction and diagnosis successfully.

ML has been used as a strong tool in pharma and medicine as usage of ML includes diagnosis, behavioral modification, drug discovery, clinical trial research, radiology and what not [36]. Googles DeepMind Health along with the partnership with some hospitals and other institutions is trying to develop technology with the implementation of ML and other techniques to address macular degeneration in aging eyes [37, 38].

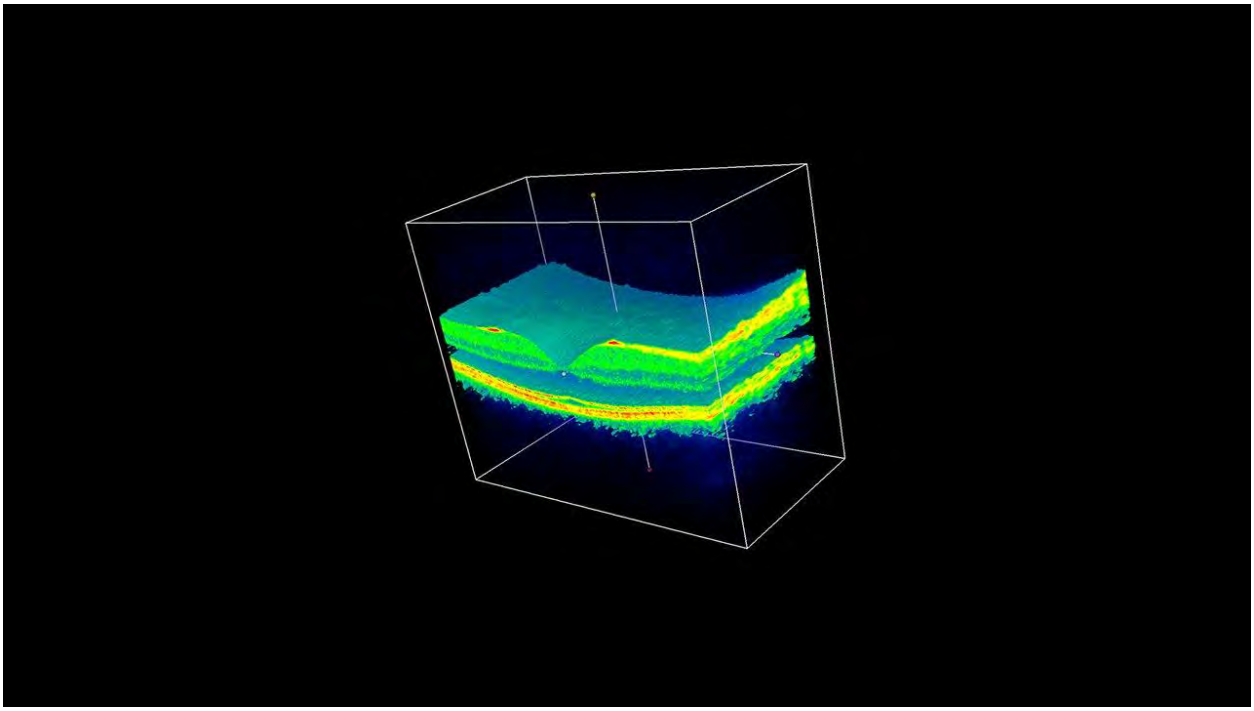

Figure 03: Google DeepMind Health-An OCT scan of one DeepMind Health team's eyes

A data-analytics B2B2C software platform company named Somatix has developed ML-based app uses "recognition of hand-to-mouth gestures" with a view to helping people to understand their own behavior, so that they can bring positive changes in their lives [39]. Google's DeepMind Health is working with University College London Hospital (UCLH) to develop machine learning algorithms that will be capable of differences between healthy and cancer affected tissues to help improve radiation treatments [36, 38]. One of their prime focuses is to apply ML to help speed up the segmentation process and increase accuracy in radiotherapy planning.

The MIT Clinical Machine Learning Group is leading the development of next-generation intelligent electronic health records, which will incorporate built-in ML/AI to help with things like diagnostics, clinical decisions, and personalized treatment suggestions [40].

Project InnerEye, which is a research project based on Machine Learning and computer vision leading by the Microsoft. [41, 42]. This project will automatically portrait the tumor inside a human body along with the anatomy in a 3D radiological image.

From keeping all these facts in mind, we have come up with the idea to develop an application which will help people to predict their basic diseases with the help of certain parameters and provide a necessary suggestion.

2.4 Related Works

Detecting a health problem through technology or any other way is really a challenging and complex matter. Many research works are being taken place to develop these techniques. They have tried to propose different types of diagnosis system, health applications based on machine learning, big data. Data mining and other latest methods.

In [6], authors tried to give us ideas about how we can use the latest technologies in terms of healthcare. They have said that all the data are useless by themselves until the proper analysis is done with it. If the data is passed through some machine learning approach, we will be able to get the most accurate outcome possible.

In [7], the authors, in their work, have tried to find out the cause of heart disease by analyzing different parameters (age, gender, chest pain etc.) using decision tree algorithm.

In [8], the authors evaluated real-life data collected from "World Health Organization" and using the state of Machine Learning they obtained a precision value of equal 0.770 and a recall equal to 0.775 using the Hoeffding Tree algorithm.

In [2], the authors present an acquisition and management system for 12-lead electrocardiogram (ECG) diagnosis. The system improves its initial knowledge base interacting with them. Special machine learning techniques were used in it.

In [4], authors proposed a model of machine learning in medical imaging in which they have discussed the implementation of machine learning to help advance the scientific research in medical imaging.

On the other hand, in [9], the authors have evaluated several data using Machine Learning Algorithms and Big Data analysis and received accuracy level of 94.8%.

In [12], authors analyzed some data of patients to find out their health problem using both Machine Learning and Classical Statical method to find out which one is more convenient [12].

In [10], authors have developed a mobile learning platform, so that the doctor and HIV/AIDS work who are currently working in the rural area can easily communicate with each other and other doctors.

In [11], authors have developed a mobile platform combining web-based and mobile technologies to keep track of malaria-affected people in a village [11].

In [13], the authors have developed a system for elderly people. When the system identifies a health problem, it automatically notifies a physician and provides an explanation of the automatic diagnosis. If they find anything unusual, it automatically notifies a doctor or physician. They have achieved 100% accuracy in their first run.

In [14], authors have developed and evaluate machine-learning-based approaches to extracting clinical entities including medical problems, tests, and Treatments, as well as their asserted status from hospital discharge summaries written using natural language.
These papers, analysis, and algorithms will help to attain our goal to develop the healthcare application.

Chapter 3: Proposed Model and Work Procedure

3.1 Application Features

Our proposed application has several features based on that. To be more precise, there are in total five different services that the application will provide. These are- Prognosis, Search Hospital (nearest), Appointment, Blood Bank, and Emergency (contacts).

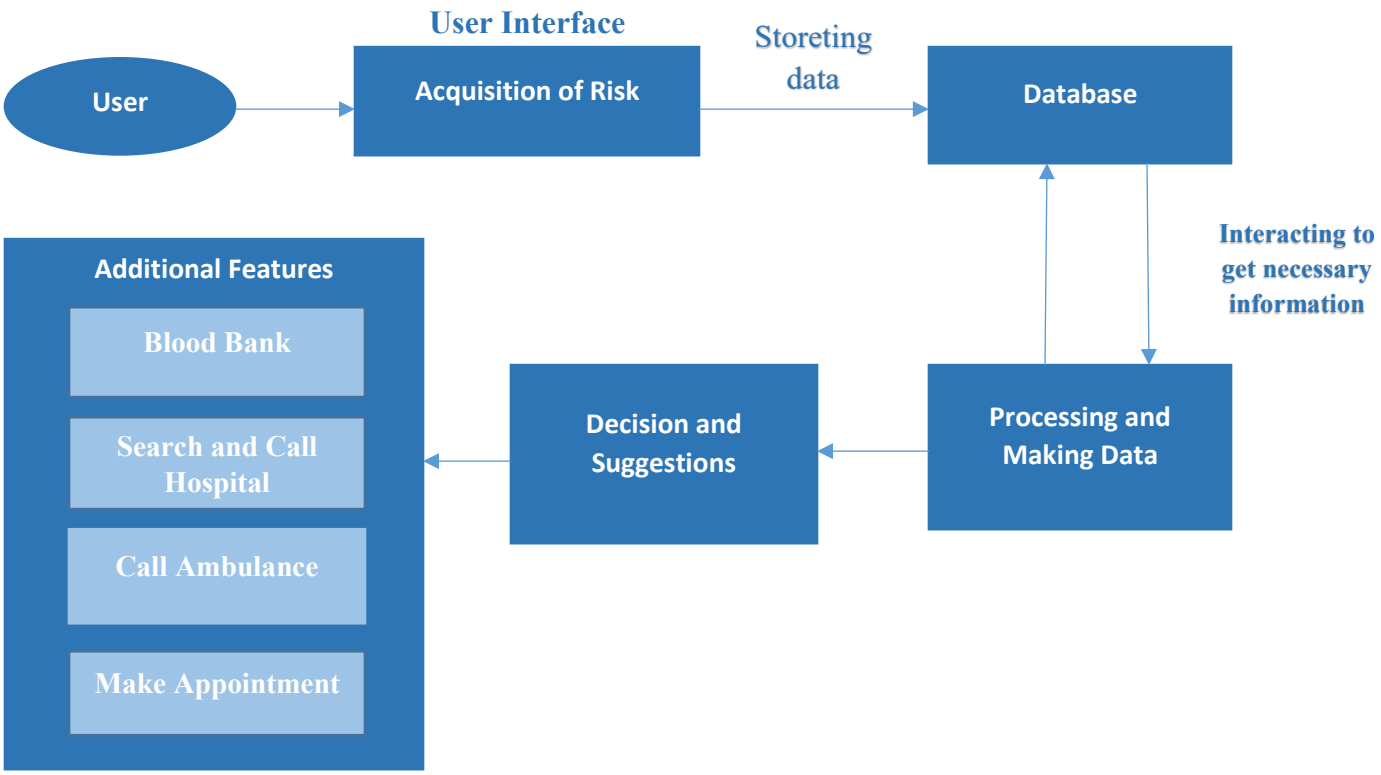

Figure 04: Features of the Application

Figure 04 is the block diagram of the complete system which also covers the overall features of the application.

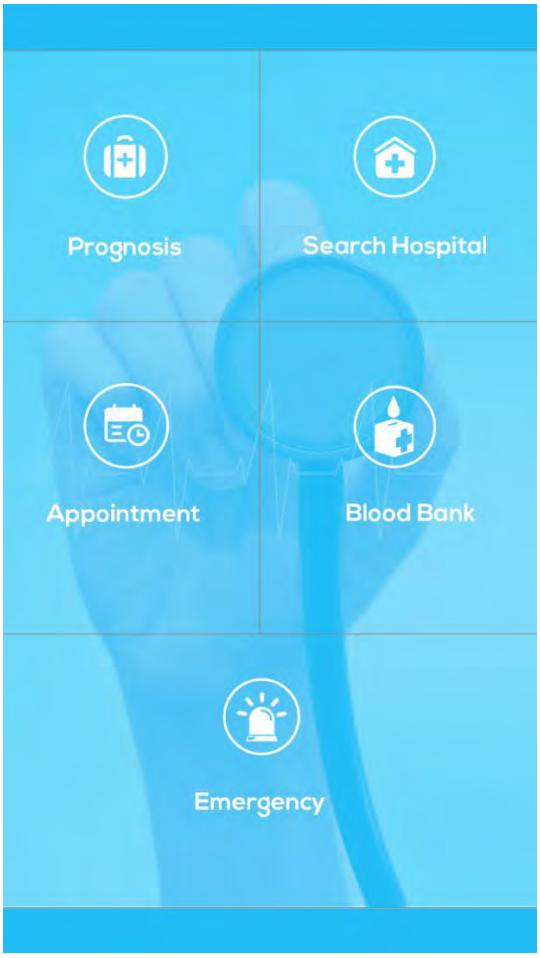

Figure 05: User Interface of Application Features

Figure 05 is the user interface designed for this particular application. There is in total five sections or menus and each of them represents one of the features of the application. Details of each feature have been demonstrated in the latter part of the chapter

3.2 Development Tools

Several technologies and platforms have been used to develop the overall system. The system is developed in a form of an Android application which has a specific server to communicate with. Details of platforms, libraries, programming languages and ML algorithms have been described in the latter part of the chapter.

3.2.1 Platform and IDE

Android is a widely used platform made by Google for mobile devices using a modified Linux Kernel. The platform was first introduced in November of 2017, by the Open Handset Alliance which is an alliance of renowned companies including Google, HTC, Motorola etc. At present, Android is considered one of the best-selling OS in the world and it has over two billion active users. Android applications nowadays are available in most of the devices and the storehouse of these apps is known as 'Google Play' which has more than 3.3 million apps as of June 2018 according to Wikipedia.

Android is an open development platform which enables the developers to contribute while any version is under development process. To create an application in Android, a developer needs to have Android Software Development Kit (SDK) which has related tools and Application Programming Interfaces (APIs). The official Integrated Development Environment (IDE) of the Android operating system is 'Android Studio' which has needed tools integrated with it. In our development of the Android application, we have used Android Studio as the IDE.

3.2.2 Programming Language: Java

Java is a widely programming language and it was first released by Sun Microsystems back in 1995. A number of applications and websites use Java and many more are creating every day. Java is fast, secure and most importantly reliable. For these sort of characteristics, Java is used in laptops, supercomputers, gaming consoles, phones, internet, in short- Java is everywhere!

Almost all of the applications that run on the Android platform are written in Java, one of the most popular programming languages of the present world. It is a general-purpose class-based and object-oriented programming language. "Write once, run anywhere" is the main feature of Java code which depicts that a compiled Java code can run on all platform. This actually distinguishes it from almost all other programming languages. We have also used Java as the programming language to write the codes to develop the mobile application.

3.2.3 Network Library: Retrofit

Retrofit is a type-safe HTTP client for Android and Java. In a simpler way, it can be said that Retrofit is used as a network library which can be used to simplify the process of parsing an API response. The library or framework provides a wide range of advantages. Firstly, it is an easier media which can be used to connect to web-services by translating the API into Java or Kotlin language. It is very much customizable and can add Gson, Jackson, XML and any other converters. In addition to that, it is very much easier to add Headers and request HTTP using Retrofit. Additional functionalities of this library include file uploads, custom headers, testing, downloads and so on. In our application, we have used Retrofit as the medium of communication and also to run the process of parsing an API response.

3.2.4 Server Side Programming Language: Python

Python is an object-oriented high-level programming language with the feature of dynamic semantics. It is written with data structures which are combined with dynamic typing and dynamic binding. It is very helpful for Rapid application development. The language is widely used as a glue language to connect existing components together. Python is highly popular for developing machine learning based applications. The positive side of the language is the syntax is simple and easy to learn. It also supports modules and packages. So, we can program with modularity and reuse code.

Usually, programmers love to code with Python because of the increased productivity it offers. As Python is a less hassle language it does not need any compilation. For that, the edit-test-debug cycle is extremely fast. Beside these debugging Python programs is very easy, because a bug or bad input will never cause segmentation. When the program cannot catch any exception, the interpreter prints a stack trace.

In our application, we have used Python to train the system with the given dataset. Based on the learning the system will predict the disease of the user. As we have implemented machine learning in our application and Python goes with our requirements well and it is simple, so we have chosen Python over others.

3.2.5 Machine Learning Framework: Scikit Learn

Scikit Learn is a Python framework for machine learning. As Python is widely used for machine learning there are lots of frameworks available for it. The frameworks make our work much easier. We do not have to worry about writing machine learning algorithm. We can use different frameworks to get the work done easily. Scikit Learn is one of those frameworks available for Python.

Among other options, we have chosen Scikit Learn framework for our Android app. Scikit learn is simple and most importantly efficient for data mining and data analysis. It is accessible for everybody and reusable in various contexts. The framework is built on NumPy, SciPy, and Matplotlib. Also, Scikit learn is an open source and commercially usable framework which is very much reliable to use.

3.2.6 Database Management System: MySQL

MySQL is an open source Database Management System (DBMS). It is basically a relational database. In that case, we can call it Relational Database Management System or RDBMS. The SQL part of the MySQL means "Structured Query Language" which is one of the most used and standard languages used to access a database. Because of its reliability, performance and easy to use nature, It is one of world's most popular open source DBMS. As it is a form of relational database, it stores data in separate tables, unlike other databases which put all data together. Some of the advantages of using MySQL includes data security, high performance, flexibility, scalability and so on.

3.3 Application Feature: Prognosis

Prognosis, also known as foreseeing or for-knowing, is a medical term which is used in terms of predicting the likeliness of a particular disease in the human body. The concept of prognosis in medical science is very specific. It depicts the process of predicting the progression and probable outcome of a health danger or attack which is caused by any disease. By conducting prognosis in a patient's body it can be judged whether the signs and symptoms will lead to any disease and how it will react over time. Moreover, analyzing the prognosis report, it can be estimated whether the condition of the patient will improve or worsen. A complete prognosis

covers several factors which are very much important to determine the overall health condition of any individual. For example, the outcome of prognosis includes a description of the course of the disease, unpredictable crisis, quality of one's life- such as the ability to carry out daily works, life expectancy and so on. In addition to that, it also works as an alarm for those who are in severe health dangers and need an immediate consultation with doctors.

Conducting a prognosis, based on the user data, is one of the prime features in our application and it is also the focus area of our research. In this section, our main goal is to come up with a process which can be used effectively to provide prognosis report to the user so that he/ she can find it easier when it comes to dealing with any sort of health danger. It should be noted that prognosis reports made in this application should not be used as medical prescriptions and it will not be able to predict and solve the overall health danger completely. Prognosis is basically the process of forecasting based on qualified grounds. It estimates the subjective probability and formulates an overall result considering a single case. As a result of that, it can not be used as a completely effective tool for a particular patient or disease. However, it can be vital to get an early forecast of the disease and also to take immediate steps.

3.3.1 Interface of Prognosis

In our proposed model we have included prognosis for Heart Diseases and Diabetes. A similar process can be used in terms of predicting health dangers in other diseases.

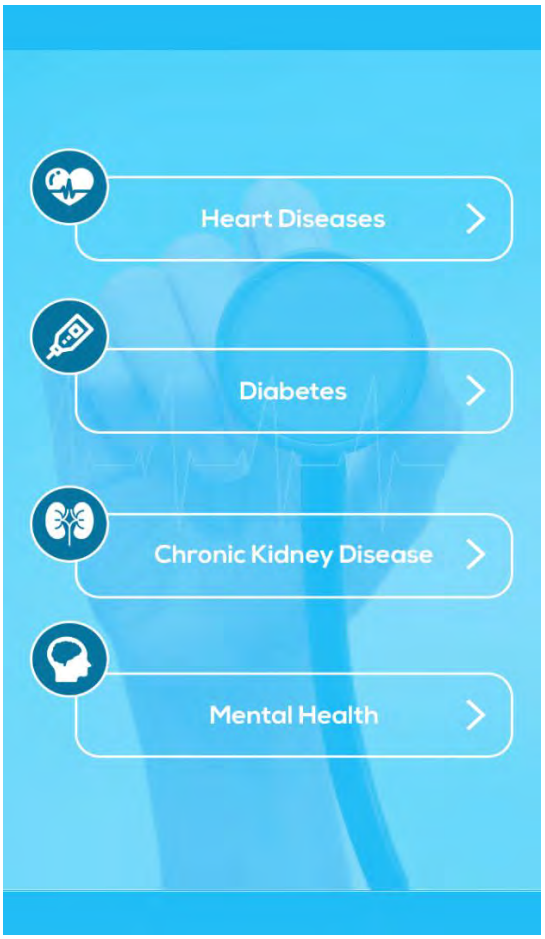

Figure 06: Interface of Prognosis

The figure 06 given above is the interface whenever a user clicks to Prognosis menu in our application. In our application, we have run prognosis for heart disease.

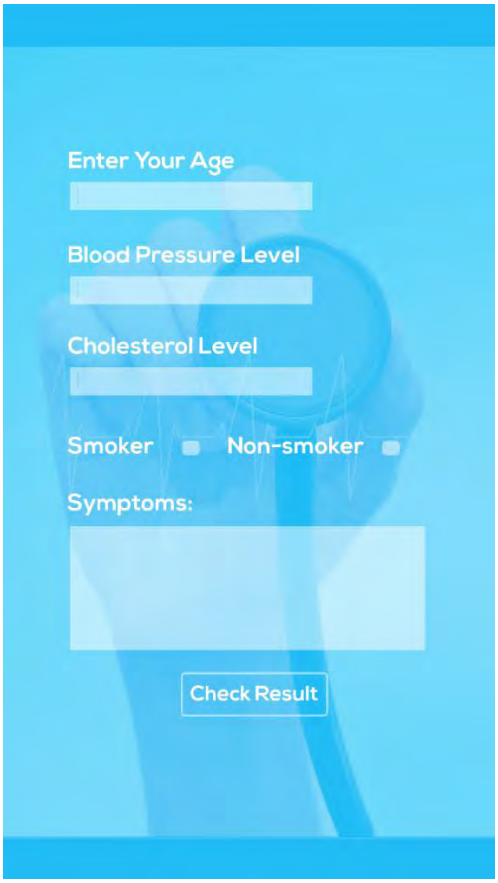

Figure 07: Prognosis Interface (demo)

Figure 07 shows the demo interface when the user taps heart disease option to run prognosis. The user will be asked to provide necessary information such as- blood pressure and cholesterol level, symptoms and so on so that the system can use these data to make the prediction.

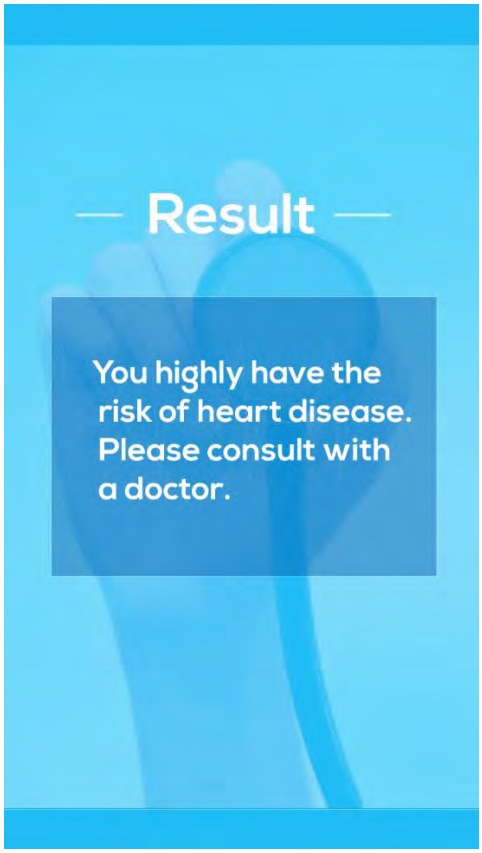

Figure 08: Prognosis Result (demo)

Figure 08 is a demonstration of the result found from the prognosis. It will appear when the user taps check result option from the earlier interface. This can be termed as a prognosis report which just predicts the probability of health danger in a patient body. Again, it should be noted that our proposed system will display the result based on the dataset and algorithm we are working on and it should not be used as a medical diagnosis report or prescription. The system is basically giving a probable update and further consultation with medical personnel is needed in case of diagnosing a disease and rooting out it.

3.3.2 Workflow and Implementation of Prognosis

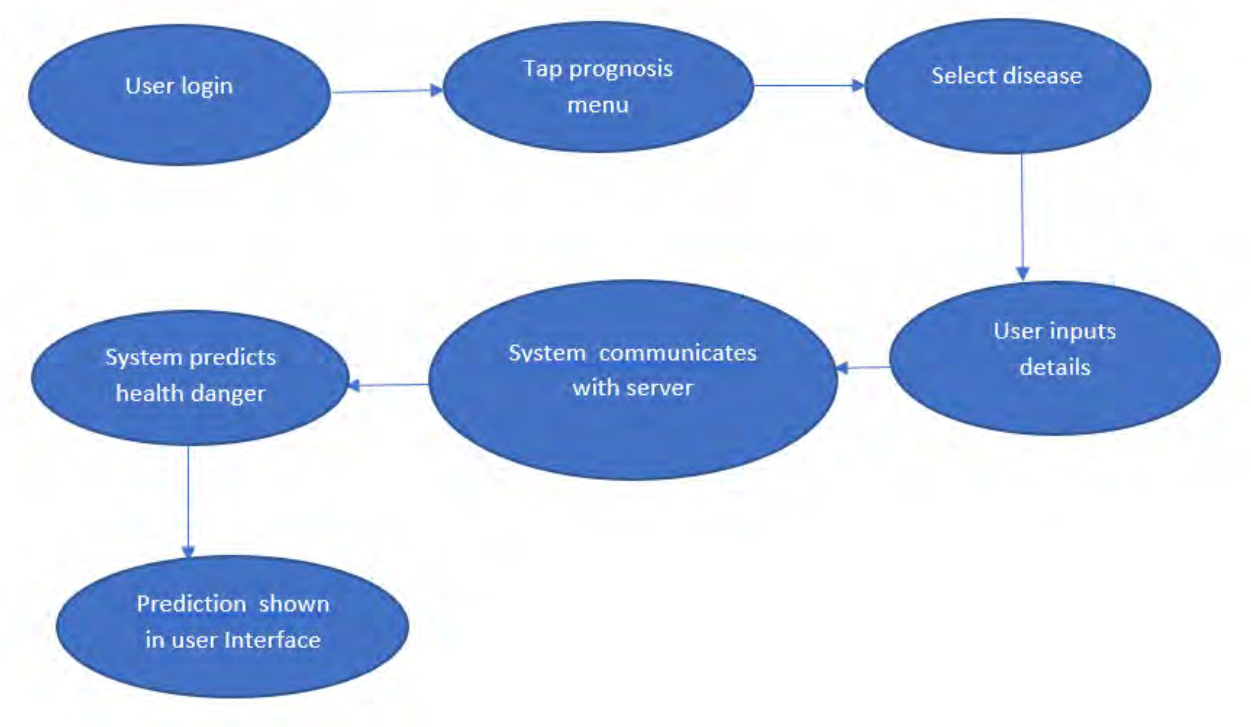

Figure 09: Workflow of Prognosis/ Health Danger Prediction

Figure 09 shows the workflow of the prognosis to show how the process will work in the application. At first user logs into the application. To run prognosis user need to select the prognosis tab and select any disease of which he/ she wants to get Prognosis report. The user needs to input some details specific to that particular disease. For example, if it is for heart diseases, information related to several major factors such as- blood pressure, cholesterol level, heart rate etc need to be provided. After getting the data from the user, the system will now communicate with the server and try to match inputs with the data trained in the database of the server using ML techniques. After that, a prediction will be made based on the user data and it will be shown in the user interface.

3.3.3 Dataset

In our practical implementation, we have developed ML techniques to predict the possibility of heart disease in a person's body. For that we have used a dataset. The Dataset was collected from

'UCI Machine Learning Repository'. In the same repository there were four different datasets depending on four different places. Among Cleveland, Hungary, Switzerland and VA Long Beach we choose to continue our research with Cleveland based dataset. In a normal form, this dataset is also known as Cleveland database. There were 303 instances, 75 attributes in total. Out of the 75 attributes given here, not all of them are major attributes. Therefore, we did not use all the attributes given here as we choose most relevant ones to conduct our research and implementation. This is a disperse dataset meaning so many data are there which are kept null for data unavailability. For the ease of our purpose we have taken the average point in between maxima and minima to get an optimized result from our Machine Learning Algorithm. Though this dataset carries 75 attributes in total we have used 14 majors of them in our process. The main goal of using this database is to find the possible presence of heart disease in a human body. The values of the attributes vary from 0 to 4 to measure the presence of heart disease. Where 0 carries absence of data and 1,2,3,4 means the severity level of the attributes. The name and social security number has been replaced by dummy data just to ensure personal data protection. The list of used attributes of the dataset have been listed below:

Attribute Name	Attribute Number in Dataset	Attribute Documentation
age	3	age in years
sex	4	1 = male; 0= female
cp	9	Chest pain type -- Value 1: typical angina -- Value 2: atypical angina -- Value 3: non-anginal pain -- Value 4: asymptomatic

Trestbps	10	trestbps: resting blood pressure (in mm Hg on admission to the hospital)
Chol	12	serum cholestoral in mg/dl
Fbs	16	fasting blood sugar > 120 mg/dl (1 = true; 0 = false)
Restecg	19	
Thalach	32	Maximum heart rate achieved
Exang	38	exercise induced angina (1 = yes; 0 = no)
Oldpeak	40	ST depression induced by exercise relative to rest
slope	41	the slope of the peak exercise ST segment -- Value 1: upsloping -- Value 2: flat; Value 3: downsloping
Ca	44	number of major vessels (0-3) colored by flourosopy
Thal	51	3 = normal; 6 = fixed defect; 7 = reversable defect
Num	58	diagnosis of heart disease (angiographic disease status) -- Value 0: < 50% diameter narrowing -- Value 1: > 50% diameter narrowing (in any major vessel: attributes 59 through 68 are vessels)

Table 01: List of use Attributes of the dataset

3.3.4 Algorithm

So far, we have used Support Vector Algorithm Support Vector Machines (SVM) is an algorithm which is widely used as a machine learning algorithm to solve multiclass classification problem.

Support Vector Machine, commonly known as SVM, is a machine learning algorithm which has the especially to be used for the purpose of classification or regression sort of challenges. In most cases, the algorithm is used to sort out the problem related to classification. Set of examples are given in one or two classes and the SVM algorithm builds model that assign each new example of the dataset to one of those classes. In this process, data items have to be plotted as points in n-

dimensional space where n is the number of features you have. The value of each feature is used as the value of a particular coordinate. Then, classification should be carried out. For that, we need to find the hyperplane that differentiates multiple classes from each other.

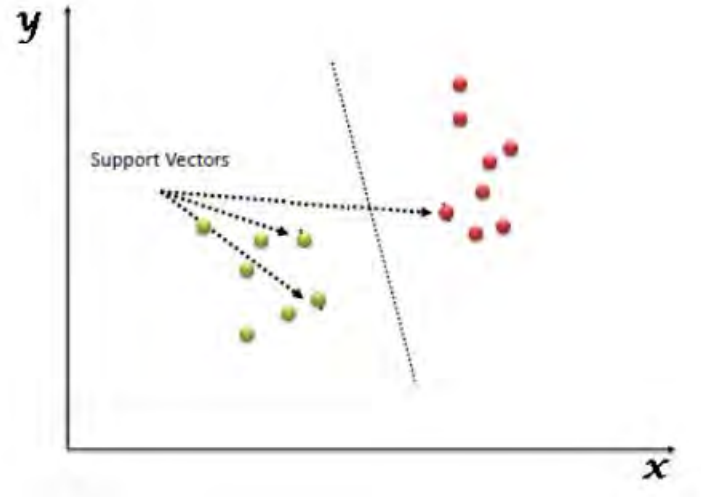

Figure 10: Example of SVM

In figure 10 the SVM algorithm is used to differentiate two classes from each other. Further prediction can be done from here.

3.3.5 Methods and Approach

Methods and processes used in this system have been mentioned below:

Dimensionality Reduction Using PCA Method: PCA is a method which is used to convert the data from high dimensional space to a lower dimensional space. It is a statistical method in which the observed raw data set, which might be correlated in nature, is converted into linearly uncorrelated variables.

Centering the data and performing an SVD on it is the process of computing PCA. Here first few columns of the V matrix produced by SVD as the principal components. The equation that is used in this process is:

X=U^VT

Here, X is the data matrix, is the diagonal eigenvalue matrix and U and V are unitary matrices.

RBF kernel SVM: RBF kernel is used in SVM for non-linearly separable problem. It is a non-linear kernel function as no hyperplane is sufficient enough to accurately classify data in this case.
Our target was to test different classifier and compare which one is working better in terms of heart disease prediction. We have compared Linear SVM and RBF Non-linear SVM on the given vector representation of Cleveland dataset. For the purpose of experiment, we run the classifiers for 80/20 splits while we used 80% for training our classifiers and 20% for testing their predictions.

With the presence of 303 instances and 14 attributes, we have implemented Principal Component Analysis (PCA) on the original X value where X is the feature set. Our feature set is then reduced to X_new which is a vector representation of 303 samples. Then we tried 80/20 split of X_new where 80% of X_new is used to train the SVM classifier and 20% of X_new is used to test.

3.4 Application Feature: Search Hospital

In emergency cases, it is absolutely necessary to take the patients to the nearest hospital. Often we see that the patient's condition deteriorates if he/ she is not taken to the hospital on time. But in many cases, people find it difficult to go to the nearest hospital especially in remote arrears or in arrears which are unknown to the people. Our system proposes a solution to this as we have included a feature in our application which will help the user to find the nearest hospital.

3.4.1 Interface of Search Hospital

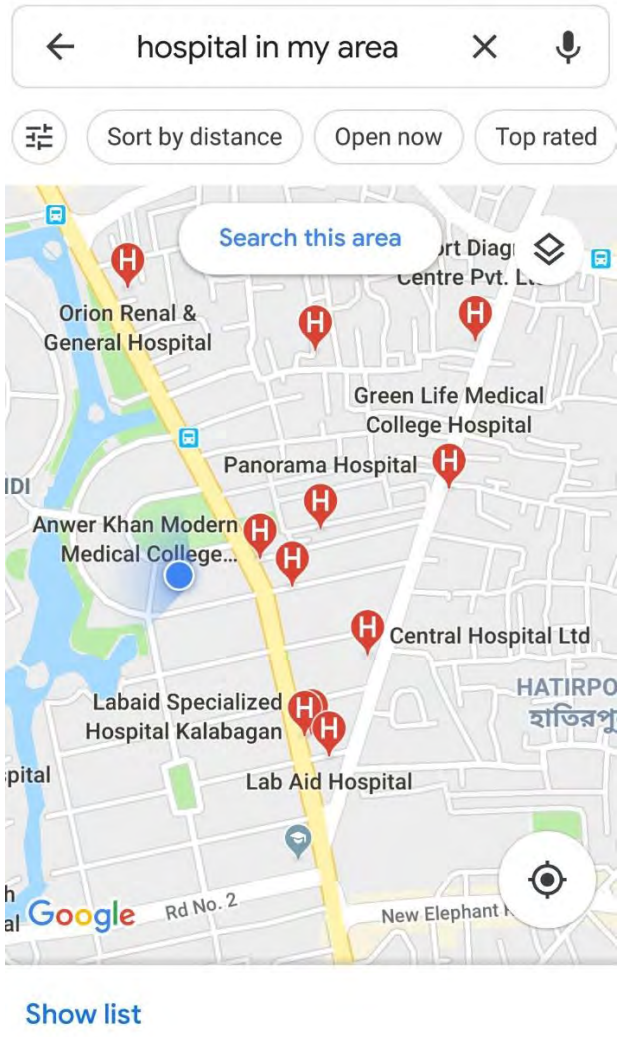

Figure 11: Interface of Search Hospital

In figure 11, a demonstration of the app interface, when Search Hospital, is tapped is given.

3.4.2 Workflow and Implementation of Search Hospital

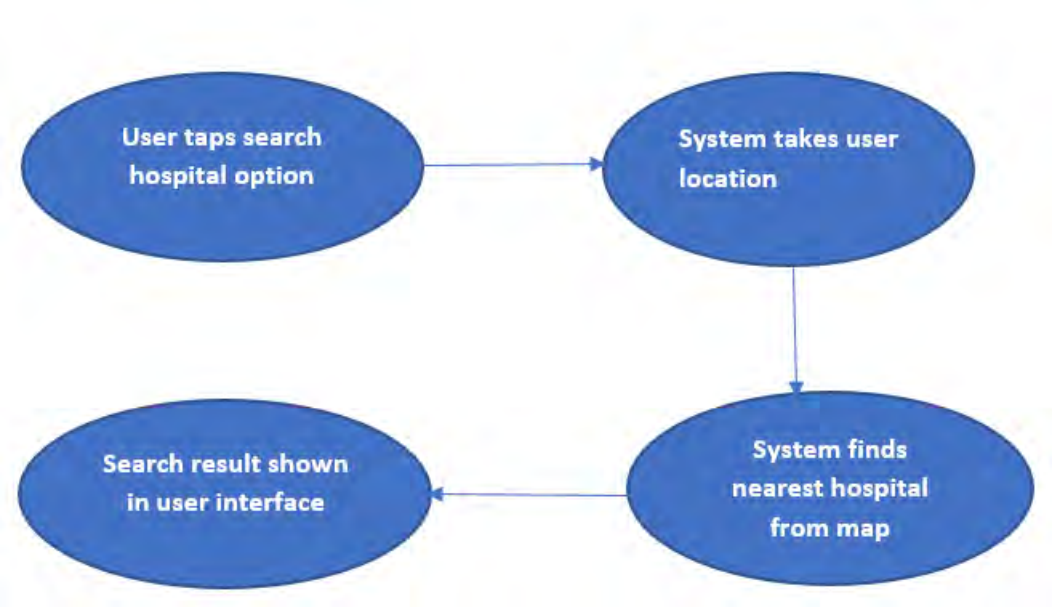

Figure 12: Workflow of Search Hospital

Figure 12 shows how this feature works in real life. By tapping the Search Hospital option from the app interface, the user will be able to get the map marking the nearest hospitals based on the user's current location.

In our application, the process is done with the help of Google Maps API. Google Maps is basically the web mapping service provided by Google and it offers a real-time 360-degree view of streets. The map also shows the nearest places and can be categorized in terms of types. The search in our application will be done from the app on the google map. On any specific event when user will try to know the nearest hospital then they might click on the option, the Google Maps will open and the nearest hospital will be shown. We will handle and control google map application through internal intent from our application. User's location will be taken from the GPS enabled in his/ her phone. So, the location or GPS should on in the user's phone while using the service in our application.

3.5 Application Feature: Appointment

In our proposed model, we have also included the option of booking appointments with the doctor chosen by a user. This feature will enable the user to make quick appointments from the application.

3.5.1 Interface of Appointment

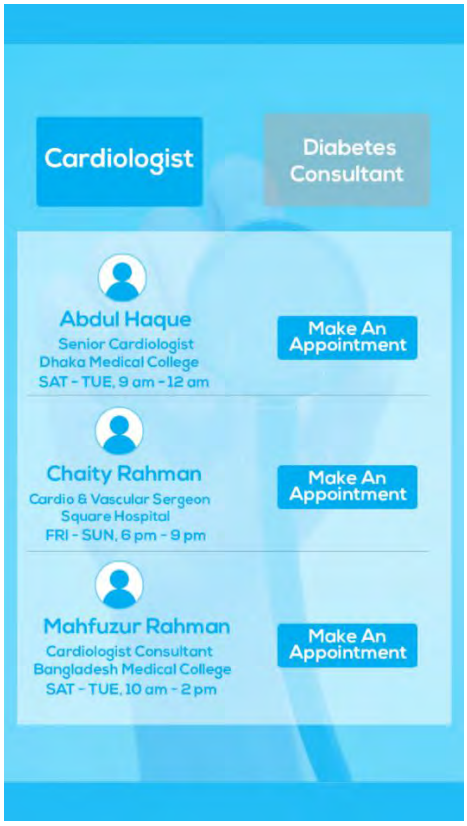

Figure 13: Interface of Appointment

Figure 13 shows the sample interface when appointment feature is tapped from the application. The users will see the classified list of the doctor so that they can make appointments.

3.5.2 Workflow and Implementation of Making Appointment

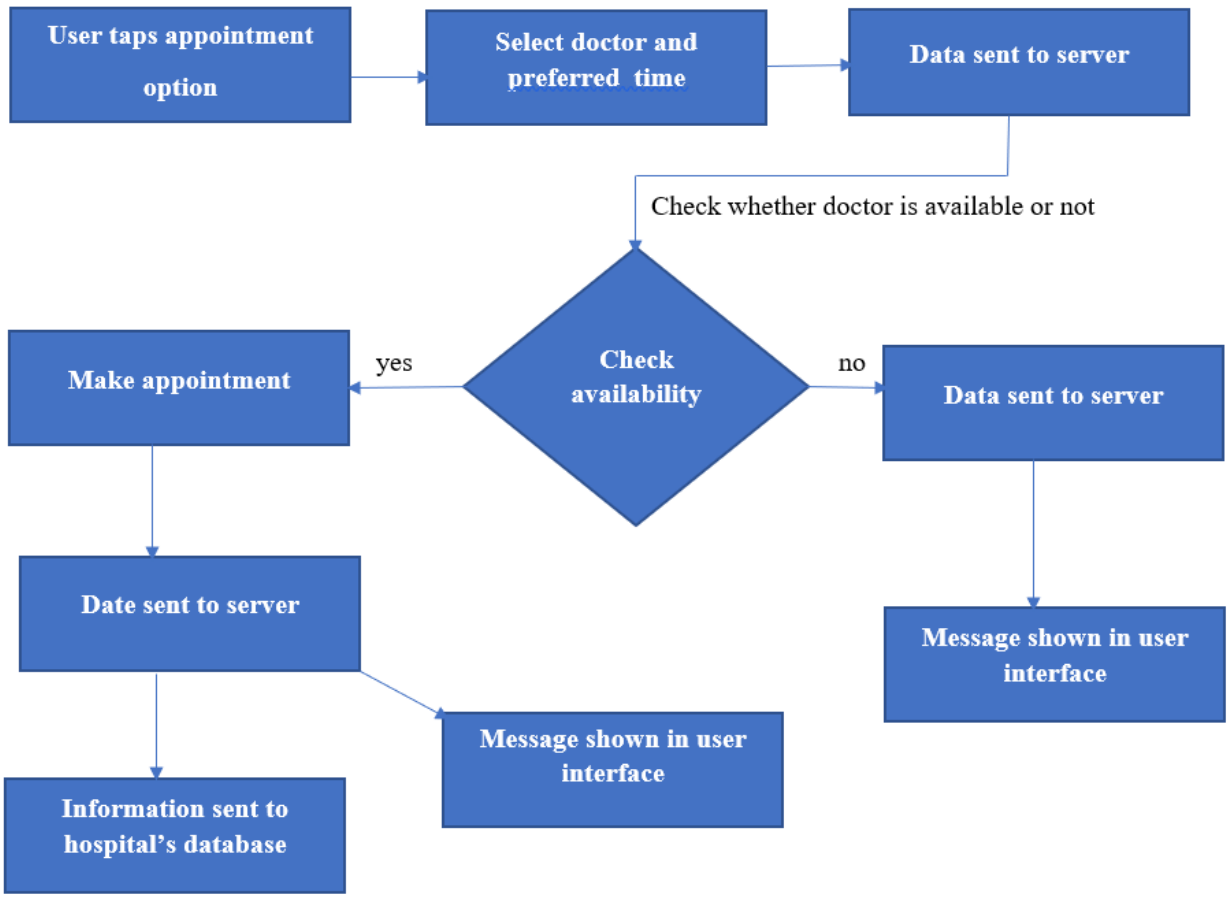

Figure 14: Workflow of Making an Appointment

Figure 14 shows the process and workflow while a user makes an appointment by the application. IThe list of doctors and patients, along with their addresses and schedules, will be saved in the database. The information and schedule regarding doctors will be received from the authority concerned of the hospitals who will be eager to use this service. In fact, this app will also be used

From the application, the user will be given the facility of making appointments with the doctors from enlisted hospitals. From the categorized list of the doctors, the user will have to select one with preferred timing. The data will be sent to the server and the availability of the doctor will be checked. If the doctor is available, an appointment will be done and confirmed. The data will be sent to the database allocated for the hospital so that the authority concerned there can manage

the schedule. If the doctor is not available, the user will be informed from the message appeared on the screen.

3.6 Application Feature: Blood Bank

Blood is something which undeniably one of the most crucial necessities when it comes to medical cases. We often run in short of blood and a number of patients suffer as a result of that. In our proposed model, we have set up a blood bank which will enlist the name and contact addresses and it will be categorized by different blood groups. Fig shows the interface of the blood bank which is included in our system.

3.6.1 Interface of Blood Bank

Figure 15: Interface of Blood Bank

Figure 15 shows the interface of the Blood Bank where address and contact information of donors have been given for each category.

3.6.2 Implementation of Blood Bank

The user will select the blood group and contact information enlisted donor will be shown to him/ her so that quick contact can be made with the person.

We have used Android tab layout to create the list of Blood Bank in our application. Android tab layout is a feature of Android design support library. This feature basically creates a horizontal layout of android tabs on the display which can be both swapping and non-swapping. In one

word, this features can project more than one screen on a single screen the tabs can be both sliding and non-sliding. To create a non-sliding tab, we have to replace the layout with the fragment on tab selected listener event and to add slides, we have to use View page. To create a layout at first we have to open a new project and select the device. Then we have to select the "select empty tab". After completing now we have to complete the main and most important task. We have to add features, design in the layout and to do so, we have to create some .java, .xml and .gradel files and modify them with the language specified by them.

3.7 Application Feature: Emergency

Saving time is one of the prime concerns in terms of a medical emergency. We have included a section entitled ‘Emergency’ in our application and it will help the user to go for quick communication with any hospital authority in case of an emergency.

3.7.1 Interface of Emergency

Figure 16: Interface of Emergency Feature

Figure 16 is a demonstration of the interface of the emergency section of the application. There will be several tabs based on the different location in Dhaka city. Address, emergency number, quick dial and so on will be found here.

3.7.2 Implementation of Emergency

In this section, we have included the dial-up services of several hospitals so that the user can make an emergency call for the ambulance and medical support. For that, he/ she will have to select the hospital from the list and contact information will be shown to him/ her with the option of a quick call to the hospital. Likewise, previous section we have used Android tab layout to create

the list of Emergency information in our application. Android tab layout is a feature of Android design support library. This feature basically creates a horizontal layout of android tabs on the display which can be both swapping and non-swapping. In one word, this feature can project more than one screen on a single screen. This feature will make the user more comfortable while finding out the emergency contact information with nearest hospitals in terms of any emergency.

Chapter 4: Result Analysis and Discussion

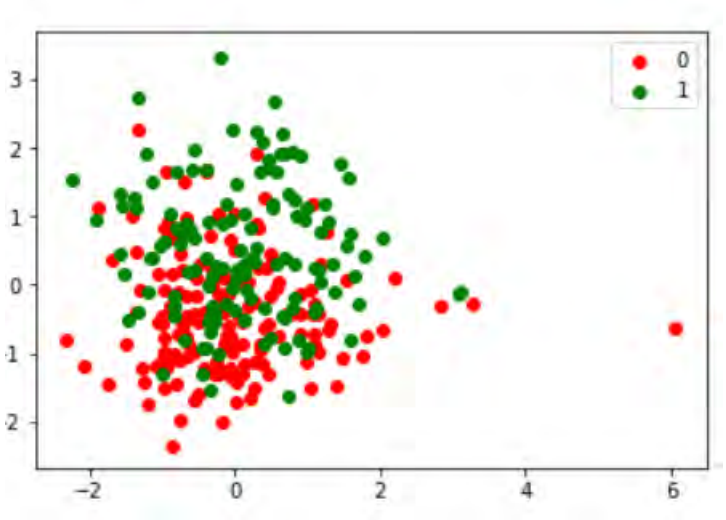

Figure 17: Result Analysis

Fig 17 shows the outcome of the prediction so far. The result and efficiency level has been summarized below:

Prognosis	Health Disease Prediction
Outcome	So far, differentiated into two classes. 1 indicates presence of heart disease while 0 nullifies the existence of it.
Accuracy	So far, the accuracy was measured 0.71 on the scale of 1.

Table 02: Result Analysis of Heart Disease Prediction

In a generalize form, the result can be classified into two types, represented by 0 and 1. Analyzing the presence of various factors such as- blood pressure, cholesterol level, heart bit and so on the result has been derived in the form of presence or absence of the disease. However, our aim was to classify the existence of disease in four values from 1 to 4. So far, we have simplified the process and reduced the outcome range to 0 and 1 for now.

Chapter 5: Conclusion and Future Work

5.1 Conclusion

In this work, we have developed a system as a form of an Android application. As a core feature of the system, prognosis or pre-diagnosis of medical conditions (so far, heart disease) has been made to find out the possible outcome of health dangers in a human body. So far, we are able to predict the presence of health danger in two different criteria in term of heart disease. SVM algorithm has been used as a Machine Learning technique and several technologies have been used to run it in Android platform. The system also has a few features including emergency support. The main goal of the work is to develop a system which can act as a tool in healthcare especially when it comes to predicting the possibility of a disease. So far, the work is almost done and we are working on upgrading the efficiency of the system.

5.2 Future Work

As our next tasks, at first, we to improve the efficiency of our model so that it can play an advanced role in healthcare in Bangladesh. We will try to make the predictions more accurate. One of our prime focuses will be to make the system as reliable as possible. In addition to that, we will try to develop an improved appointment feature which will operate from both end and doctors will also have a version of the application. Also, we have the plans to add more features including- doctors rating, a process by which user can rate their doctors whom they visited. Also, we have future plans to build desktop and mobile version of our software for mass use.

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