HEART DISEASE RISK PREDICTION USING MACHINE LEARNING TECHNIQUES

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled **"Heart disease risk prediction using machine learning techniques"**, submitted by Md Saiful Islam and Md Jisan Ahmmed to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering (BSc) and approved as to its style and contents. The presentation has been held on September 2019.

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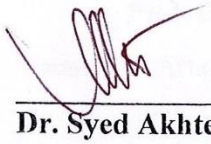

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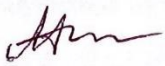

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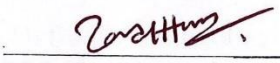

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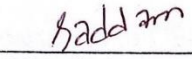

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We hereby declare that, this project has been done by us under the supervision of **Dr. Karim Mohammed Rezaul, Visiting Professor, Wrexham Glyndwr University, United Kingdom.** We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

We are living in the modern age and our daily life is undergoing multiple changes that directly have positive and negative effects on our health. Different types of diseases are greatly increased for this changing nature where heart disease has become more prevalent. As a consequence, people's lives are at risk. The changes in blood pressure, cholesterol, pulse rate, etc. can lead to heart diseases that include narrowed or blocked blood vessels. It may cause Heart failure, Congenital heart disease, Coronary artery disease, Myocardial infarction (Heart attack), Hypertrophic cardiomyopathy, Pulmonary stenosis, and even sudden cardiac arrest. Many forms of heart disease can be detected or diagnosed with different medical tests by considering the family medical history and other factors. But it is quite hard to predict heart disease without any medical exams. But "Machine Learning" is making it a little simpler nowadays. The purpose of the current study is to predict the risk of heart diseases and to make people aware of their daily routine with high accuracy. For the prediction of heart disease risk, we use five 'Machine Learning' classification algorithms such as Support Vector Machine (SVM), Decision Tree (DT), Naive Bayes (NB), Artificial Neural Network (ANN) and Random Forest (RF). Our finding demonstrates that DT with greater precision (97.83%) outperforms the SVM, NB, ANN, and RF. Finally, the research has been completed by developing an app (application system) named HeartCare which can predict the symptoms of heart disease.

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CHAPTER 1

Introduction

1.1 Introduction

The heart is our body's key organ or portion. Human life itself depends on the heart's function effectively. If the heart's capacity isn't fantastic, it will affect various parts of the human body, such as the cerebrum, kidney, and so on at that stage. In case the body's blood dissemination is wasteful, organs such as the mind and heart will suffer. Blood capture in the cerebrum is mostly called a stroke, and it is called an attack in the heart. Life is entirely subject to the ability of the heart and brain to work. Everyone needs the ability of both. Many factors increase the risk of heart disease [28]. There are a lot of factors which build the danger of heart disease [13] like a family history of coronary illness, smoking, poor eating methodology, high pulse, cholesterol, high blood cholesterol, obesity, physical inertia, overweight, high blood pressure, stress or hypertension, chest pain, taking drug etc. Heart disease (otherwise known as a coronary disease) continues the world's major cause of death for centuries. In 2015, the World Health Organization (WHO) assessed 17.7 million casualties from cardiovascular diseases worldwide [5]. An ongoing report by WHO in 2018 shows the result that 56.9 million deaths in 2016 occurred on the planet due to heart disease [29]. 17.3 million people finished as a consequence of heart disease in 2008 [26]. It is an equal open-door executioner that claims approximately one million lives each year. In 2011, the disease alone killed about 787,000 people and every year 380,000 people from coronary disease; every 30 seconds, one has a heart attack and every 60 seconds, one dies of a heart-related disease [23].

Different Machine Learning algorithms for example, Decision Tree (DT), Multi-layer perceptron (MLP), Naïve Bayes (NB), K-closest neighbor (K-NN) and Support vector machine (SVM) [6] are utilized for distinguishing and extricating valuable data from the clinical dataset with insignificant client inputs and efforts [22]. Machine Learning is essentially the disclosure of learning from an immense measure of crude information. Machine Learning is otherwise called subfield of information the executives [19]. Machine Learning has two primary models named as predictive Model and the

Descriptive Model. The predictive model is characterized as a model that is made to foresee a specific result or result by utilizing prescient displaying systems [20]. While the elucidating model is characterized as a model made to give a superior comprehend of information without focusing on a particular variable by utilizing investigation systems like factor examination and group examination and so forth [21]. Heart ailments are the main reason for death universally: a greater number of individuals die every year from heart illnesses than from some other causes. If we can anticipate the coronary illness and give cautioning previously, a bunch of deaths can be decreased.

In this research, by evaluating the dataset of heart illness, we suggested a Machine Learning (DT) to predict the risk level of heart illness based on selected symptoms. The projections of this technique will assist individuals to understand their heart's situation so that they can be conscious of it and if they encounter any problems they will go to the doctor as quickly as possible as a consequence of decreasing the death rate.

1.2 Motivation

The principle motivation of this research is to furnish a precise sickness analysis system with an increased list of capabilities. Physically, the doctor needs to perform the number of tests to analyze a specific disease that requires a great deal of time, exertion and cash. But our proposed system will foresee the risk of heart disease with high exactness bringing about time and exertion decrease.

1.3 Rationale of the Study

The opportune discovery of heart sicknesses can stop death. But in each circumstance, it is seeing at the last phases of disease or after death. So the fundamental issue is we can't distinguish or can't understand coronary illness at beginning periods. For this situation, the Machine Learning method is a great system can identify coronary illness. On the off chance that we can distinguish coronary illness at the beginning period by various data mining techniques, we can diminish the rate of sudden death.

1.4 Research Questions

There are so many illnesses that have a serious effect on us, one of which is heart disease. It is a severe disease because we often hear that most individuals die from heart disease and other comparable illnesses are heart-related [33, 34, 35].

Most medical scientists observe that many times the majority of heart patients may not survive and die with heart attacks. These following questions arise when we thought to implement our idea-

- How to predict heart disease risk with higher accuracy?
- How to make people aware of their heart health?
- How to reduce sudden death by heart disease?
- How to make people aware of their food habits?

1.5 Expected Output

There are a lot of people who are very much unconscious about their health. For this reason, they are suffering from various kinds of diseases where heart disease is very common and in the long run, deaths are knocking at the door. If people are always monitored their heart condition by using our system, they will be conscious of their heart health as a result of the death rate because of heart disease will be decreased. We can't provide any kind of medical support by our project but we can simply aware people change their lifestyle, food habit, stop smoking, etc. by showing the predictive risk level of heart disease. There are a lot of research has already done about heart disease risk prediction based on few numbers of features that's why they don't give us an accurate rate of risk of heart disease but in this research we analyze a lot of features like smoking, family history of heart disease, cholesterol, blood pressure, chest pain, age factor, gender, stress, regular exercise, taking drug or not, etc. as a result we are able to show the risk of heart disease with higher accuracy.

1.6 Report Layout

In this report, by evaluating the dataset of heart illness, we suggested a machine learning classification algorithm (DT) to predict the risk level of heart illness based on selected symptoms. The projections of this technique will assist individuals to understand their

heart's situation so that they can be conscious of it and if they encounter any problems they will go to the doctor as quickly as possible as a consequence of decreasing the death rate. This report is divided into six parts. This is the first part where we're talking about our work motivation and the anticipated result. In the second chapter (CHAPTER 2) we address associated work, range of issues. We address the process and execution of information collection in the following chapter. Chapter four is for the results and evaluation of experiments. Chapter five discusses how we implement our proposed system. Lastly, chapter six represents the conclusion and future work.

CHAPTER 2

Background

2.1 Introduction

Is heart disease a word coined to define a large amount of heart-related healthcare? Classification algorithms for machine learning make predicting the cardiovascular disease a little easier. In medical science, heart disease is the main problem. Predicting the risk of heart disease is simpler by using the classification algorithm in ' Machine Learning.' The training and testing data belonging to distinct classes were classified using multiple methods in' Machine Learning.' It seems vital to predict the risk of heart disease through machine learning techniques in the diagnosis of heart disease. The purpose of this project is to assess distinct classification methods in the prediction of heart disease. The number of exams is provided to the patient these days to find a disease. But using the method of ' Machine Learning ' can reduce this.

2.2 Related Works

Presently the primary concern in medical science is the prediction of heart disease. By using various techniques in “Machine Learning” such as SVM, DT, NB, KNN (k-nearest neighbor), RF (Random Forest) and ANN (Artificial neural network) we can easily predict the risk of heart disease. Various studies have been done and increasingly more is going on in the prediction of coronary illness to get progressively accurate outcomes. For examining and prediction of heart disease risk they have applied different data mining techniques and got various outcomes of accuracy. Table 1 shows the different data mining techniques used to predict heart disease by various studies with their accuracy. The prediction of heart disease through hazard factor classes is explained in [10]. In this work, four variables like behavior, condition, age, and sex of the patient are utilized to distinguish coronary illness. The work of Sudha et al. [17] proposed the classification techniques like Naive Bayes, Decision tree and Neural Network for anticipating/predicting the risk of heart disease. The classification techniques like Decision trees, Bayesian classifier and Back Engendering Neural System were received in this investigation.

Table 2.2: Comparison of Different Machine Learning Algorithms

Machine Learning Technique	Accuracy (%)	Objective	Year	Ref.
Support Vector Machine (SVM)	73.2	prediction and diagnosis of heart disease patients using Data Mining Technique	2019	[1]
Artificial neural network (ANN)	48			
Support Vector Machine (SVM)	86	risk prediction of heart disease at classification in data mining	2015	[7]
Decision Tree (DT)	76			
Naive Bayes (NB)	69			
Artificial neural network (ANN)	85			
Decision Tree (DT)	82.5	analysis of heart disease and Prediction of heart Attack in coal mining regions using Data Mining Techniques	2010	[24]
Support Vector Machine (SVM)	82.5			
Decision Tree (DT)	82.22	heart disease prediction Using feature selection approaches	2019	[2]
Random Forest	84.17			
Naive Bayes (NB)	84.24			

The records with unessential information were expelled from the information distribution center before the mining procedure happens. According to Paper [15] Intelligent Heart Disease Prediction System Using Data Mining Techniques, Sellappan Palaniappan et al. have utilized three data mining techniques. Extraction of concealed information from a recorded coronary illness database, building and getting to models through DMX (Data Mining Extensions) inquiry language and capacities and the preparation and approval against a test dataset. Adequacy is represented by utilizing the Lift Chart and Classification Matrix. The best model to anticipate patients with coronary illness gives off an impression of being Naïve Bayes pursued by Neural Network and Decision Trees. The work by Hlaudi Daniel Masethe [11] Prediction of Heart Disease using Classification Algorithms, an examination was performed for the expectation of heart attack and connection with find the best system for conjecture. The work by K. Sudhakar et al. [14] Study of Heart Disease Prediction using Data Mining presents the various methods that are conveyed in the ongoing years for figuring the forecast rate in coronary illness. These methods incorporate Artificial Neural Network, Naive Bayes, Decision Trees, and Classification Algorithms**.** Alagugowri et al. [9] built up an anticipating framework to predict coronary illness. Heart attack risk prediction based on a weighted fuzzy rule is explained in [18]. In this research, a hybrid algorithm involving the general mining approach, alongside the weighted credit technique is utilized to create fuzzy rules. Given the fuzzy rules, a heart attack is anticipated/predicted. Lora E. Burke et. al. [8] and a gathering of researchers checked on how mobile health can assume a significant job in cardiovascular sickness avoidance. They demonstrated numerous insights and gave some thought about how versatile wellbeing (mHealth) can counteract cardiovascular malady. They prescribe some future research, for example, versatile application for treating obesity empowering regular physical movement, smoking discontinuance, control of hypertension, and dyslipidemia; and treating diabetes mellitus. Heart Disease Prediction System proposed by AH Chen, SY Huang, PS Hong, CH Cheng, EJ Lin and is created by utilizing the Data mining method a) choice of significant qualities for the forecast of coronary illness b) artificial neural network for arranging coronary illness dependent on significant highlights. The accuracy of expectation is about 80% and builds up an easy to use HDPS (Hydroacoustic Data Processing System) and has highlights like ROC (Rate of

Change) bend show, execution show area [16]. According to Abhishek Taneja [27], Heart Disease Prediction System Using Data Mining Techniques manages the conduction of four tries by utilizing chosen order calculations on a full preparing data-set containing 7339 instances. Knowledge discovery in databases (KDD) has been utilized to build up a forecast model that can predict heart disease risk dependent on estimations done. The work by K. Srinivas et al. [25] proposed the data mining procedures, for example-Rule Based, Decision Tree, Naive Bayes, and Artificial Neural Network to a huge amount of medical consideration data to predict the risk of a heart attack. We have discovered that the existing systems depicted within the research papers have demonstrated fewer features than our proposed system, we used both public and medical datasets to these algorithms and we found the most noteworthy accuracy.

2.3 Research Summary

There are a lot of people who are very much unconscious about their health. For this reason, they are suffering from various kinds of diseases where heart disease is very common and in the long run, deaths are knocking at the door. If people are always monitored their heart condition by using our system, they will be conscious of their heart health as a result of the death rate because of heart disease will be decreased. We can't provide any kind of medical support by our project but we can simply aware people change their lifestyle, food habit, stop smoking, etc. by showing the predictive risk level of heart disease. There are a lot of research has already done about heart disease risk prediction based on few numbers of features that’s why they don’t give us an accurate rate of risk of heart disease but in this research we analyze a lot of features like smoking, family history of heart disease, cholesterol, blood pressure, chest pain, age factor, gender, stress, regular exercise, taking drug or not, etc. as a result we are able to show the risk of heart disease with higher accuracy.

2.4 Scope of the Problem

Heart disease is the leading cause of death. Many people died of heart disease just because of unhealthy daily routine and food habits. That’s why we decided to research heart disease risk prediction so that by our system we can reduce the death rate. We proposed a system that gives people the predictive value of the risk of heart disease so

that people can aware of their heart health. So the scope of the present study is heart disease.

2.5 Challenges

Everything has its dark side. That's why we faced a lot of difficulties to research and implement our system. Sometimes it was so tough to handle but by the grace of Almighty, we have passed these difficulties. These following difficulties made our research more difficult –

1. during data collection from different hospitals
2. during the selection of algorithm
3. for applying machine learning classification algorithm
4. for implementing our proposed system
5. during the selection of external factors of heart disease

CHAPTER 3
Research Methodology

3.1 Introduction

In this research, we are going to predict the risk of heart disease by using five machine learning algorithms such as Decision Tree, Naive Bayes, Artificial Neural Network, Random Forest and Support Vector Machine because of its huge accuracy compared to other algorithms. For applying these algorithms, first of all, we had to collect datasets about external attributes of heart disease symptoms. By studying research papers, we have already known that these five machine learning techniques give more accuracy. Preprocessing of data is exhibited in an understandable introduction by transforming raw information into an accessible setting for a reason. Data cleaning is a procedure where information is cleaned by eliminating missing information, copy information and settling information irregularities. Subsequently, information quality is improved bringing about the helpfulness of information. Change of information or data starting with one organization then onto the next arrangement is known as data transformation. It is typically done when a source configuration is expected to change over into the required organization for a particular reason. It is basically the transformation of numeric or alphabetic advanced data into a revised arranged and rearranged structure tentatively or experimentally. The primary idea of information decrease is to diminish innumerable measures of information into helpful data. Features selection is likewise signified as factor determination, Attribute choice or variable subset choice for model development which hinders the way toward picking a subset of appropriate highlights (variable indicators). Figure 3.1.1 demonstrates the methodological framework to carry on this research.

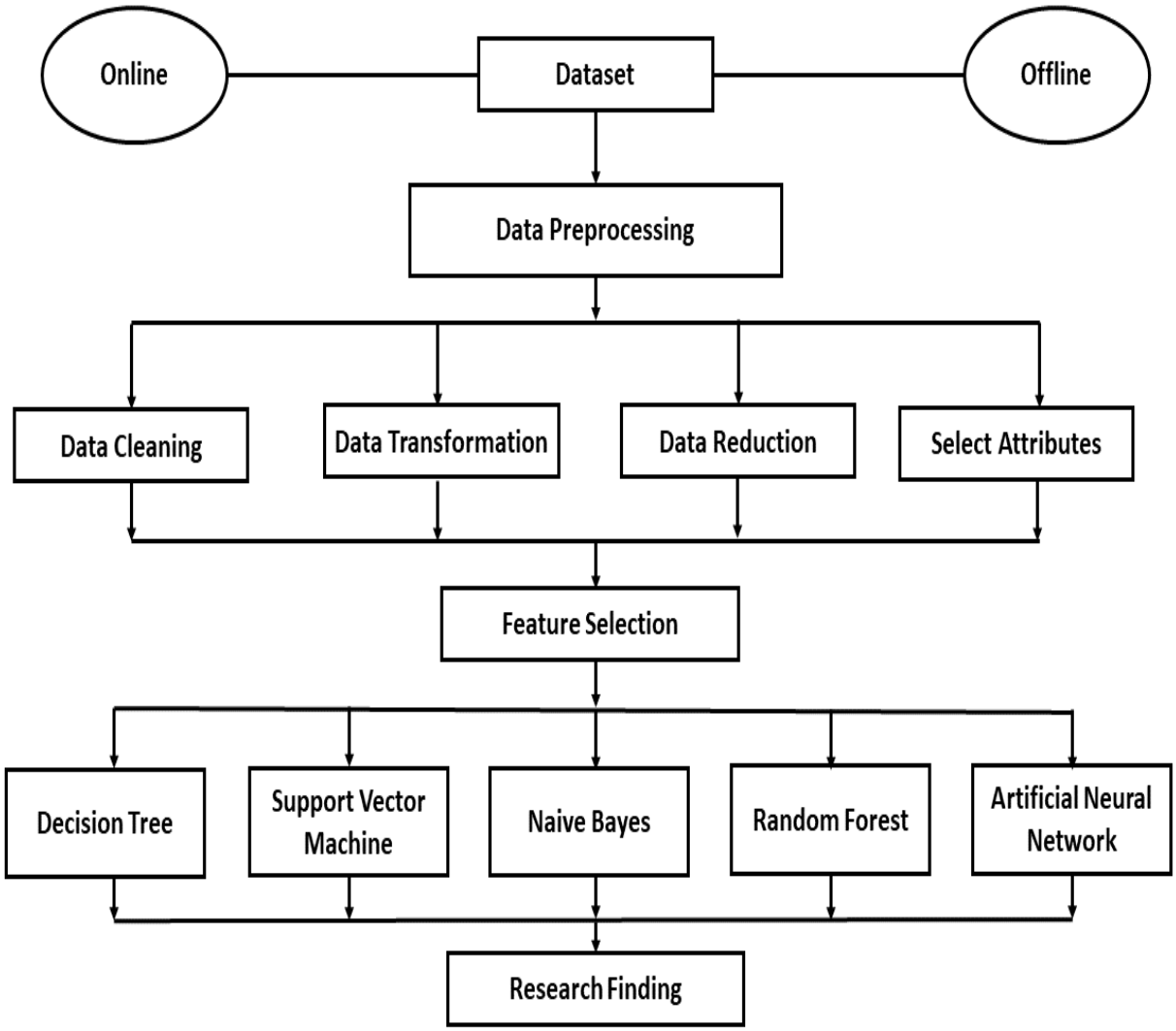


Figure 3.1.1: Methodological Framework

3.2 Research Subject and Instrumentation

We divide this section into two sub-sections so that it will be clear to all.

3.2.1 Research Subject

Heart disease is a wide word that includes many issues and conditions related to the heart, from abnormal heartbeat and organ failure. A large number of people faced heart-related diseases because of unhealthy daily routine and food habits such as smoking, taking too much oily food and doesn't maintain regular exercise, etc. That's why In this current

study we proposed a system which will give people the risk level of heart disease based on machine learning classification algorithm so that people can aware about their daily routine and food habits. We can't say that it will stop heart disease but it will reduce the death rate.

3.2.2 Research Instrumentation

For collecting data, we designed a survey paper which included three general questions and twelve yes/no question. To get the expected result we distributed these survey papers to the general people and different hospital's heart patients. We designed the survey paper that included the following questionnaires-"age?", "gender?", "people type?", "Smoker?" "Diabetes?", "Treated for high blood pressure?", "Did your mother or father have a heart attack before age 60?", "Do you take any kind of drug? ", "Do you feel any kind of stress?", "Do you feel heartburn?", "Do you feel dizzy or lightheaded?", "Do you have shortness of breath?" , "Do you take regular exercise?", "Do you feel any pain in the center of your chest?", "Do you feel any pressure, tightness, pain or squeezing in your chest that may spread to your neck, jaw or shoulder or one or both arms?". At the same time, it is assumed that the data collected from general people and heart patients are legal and authorized.

3.3 Data Collection Procedure

For completing our research we need to collect data. We collected data online and offline. We collected our necessary data from general people and heart patients of different hospitals in Dhaka city which is called offline data collection. On the other hand, we made a google form to collect data from different people by sending a link is called online data collection. We asked them our following questionnaires and we took the answers from them in the survey paper. According to this, we collected all the necessary data. Some people were unable to give their data on that case we collect their data from their relatives and their medical profile. We also collect data from past studies. For this reason, we had to gather a lot of research papers, journals, websites and report and then we combined these data and collected our necessary data to implement our idea.

3.4 Statistical Analysis

After collecting data, we analyze and process these data in various steps. First of all, we have to preprocess these data. The collected dataset for this study is 1247 out of which 57% and 43% of males and females respectively. We then transform the dataset to extract missing and irregular data. Afterward, we selected external factors (associated with heart disease) to apply our selected algorithm through the collected dataset. By distributing questionnaires, we have collected our dataset and all questions' outcome is shown in percentage in Figure 3.4.1.

The questionnaire designed for this research is shown in Table 3.4.

Table 3.4: Questionnaires of collected dataset

Let, Q1= Smoker? Q2= Treated for high blood pressure? Q3= Diabetes? Q4= Did your mother or father have a heart attack before age 60? Q5= Do you take any kind of drug? Q6= Do you feel any kind of stress? Q7= Do you feel heartburn?	Q8= Do you feel dizzy or lightheaded? Q9= Do you have shortness of breath? Q10= Do you take regular exercise? Q11= Do you feel any pain in the center of your chest? Q12= Do you feel any pressure, tightness, pain or squeezing in your chest that may spread to your neck, jaw or shoulder or one or both arms?

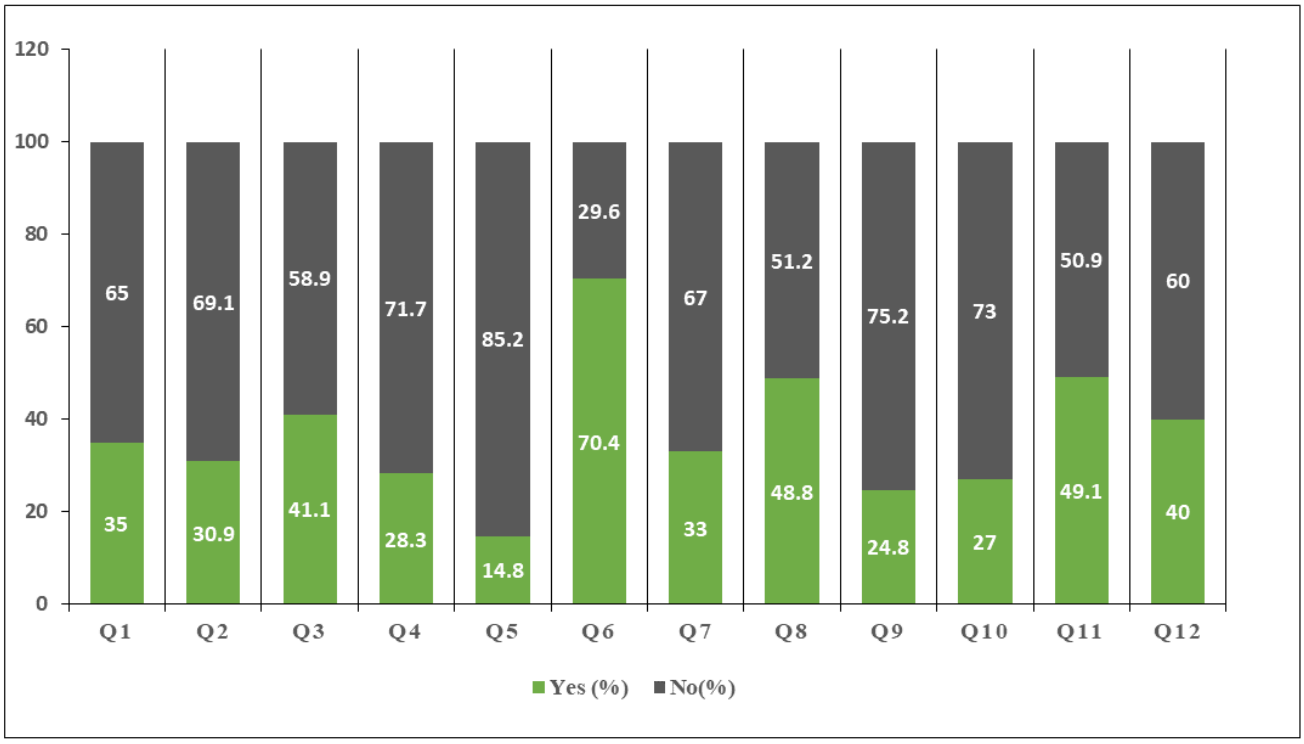


Figure 3.4.1: Statistical view of collected dataset

Figure 3.4.1 represents the frequency of data set (in %) using two colors where the color green points out 'yes' for our inquiry on the homepage and the other color which is black that indicates 'no' for the same query. The following graph demonstrates that the percentage of smoker is 35% whereas the percentage of non-smoker is 65%, treated for high blood pressure patient is 30.9%, diabetes patient is 41.1%, 14.8% people take drug, 70.6% people feel stress, 33% people feel heartburn, 27% people take regular exercise. In our collected dataset, 51.8% normal people and the rest of the percentage (48.2%) is heart patient.

3.5 Implementation Requirements

- Language: Python (Version : 3.7.0)
- IDE : PyCharm / Open source web application : Jupyter Notebook
- Library : Pandas (Data analysis)
- Library : Malplotlib (Data visualization)
- Library : Scikit learn (Machine learning)

- Fundamental package for computing : Numpy
- Microsoft Excel
- Microsoft Word
- Basic knowledge of computing
- Basic knowledge of python

CHAPTER 4

Experimental Results and Discussion

4.1 Introduction

The authors developed a technique in this article to produce frequent itemset based on the user's symptoms. It helps the people to know the risk level of heart disease from the external factors. The results will assist doctors to predict the heart patient's risk level. We used three machine learning algorithms in which we had the decision tree as the best performer to get high precision.

4.2 Experimental Results

Our suggested system's primary objective is to predict the risk of heart disease. Nowadays different machine learning approaches and data mining techniques make it simpler to predict heart disease risk levels. We need to obtain information to apply these data mining methods and then we need to pre-process this information very closely. A total of 14 characteristics has been gathered. The characteristics or symptoms analyzed for this research are age, gender, stress, diabetes, smoking, heart disease family history, substance use or not, taking regular exercise or not, chest pain or not, shortness of breath, etc. Then we used machine learning algorithms to estimate the heart disease risk level. We accomplished distinct levels of precision after implementing five machine learning classification algorithms. Table 4.2 and Figure 4.2.1 demonstrate the precision of our used algorithms.

Table 4.2: Performance Study of Machine Learning Algorithms

The Algorithms Used	Accuracy
Decision Tree (DT)	97.83%
Support Vector Machine (SVM)	92.83%
Random Forest	84.71%
Artificial neural network (ANN)	85%
Naive Bayes (NB)	89%

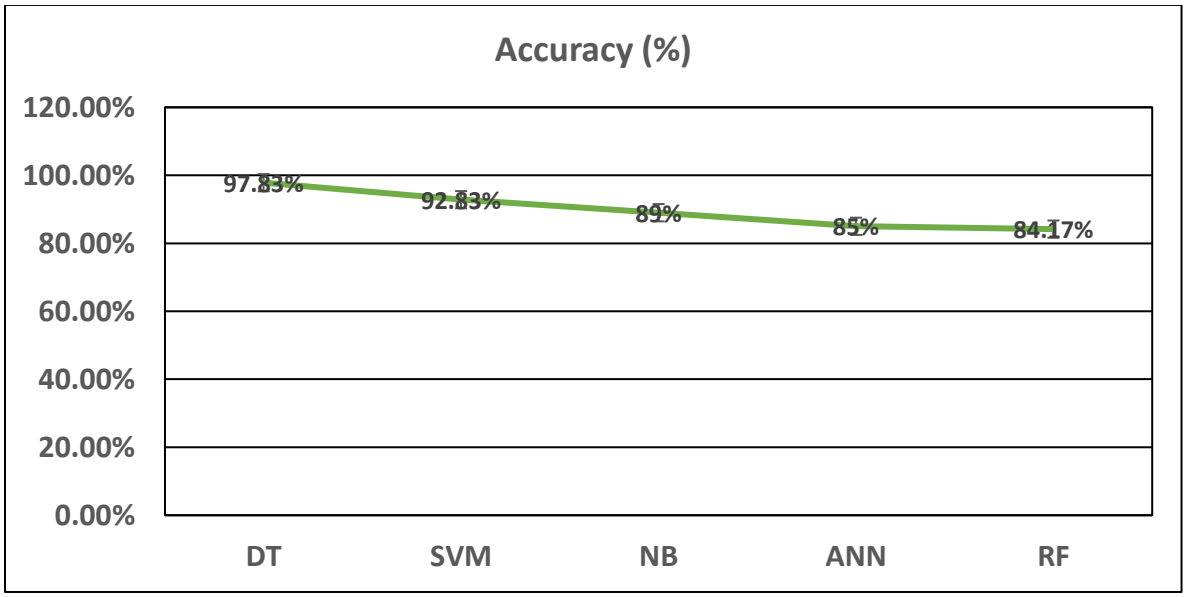


Figure 4.2.1: Performance Level of Machine Learning Algorithms

It is shown from the above Table and Graph that Decision Tree provides the greatest prec ision of 97.83%. We introduced our scheme with this algorithm because of its elevated pr ecision.

4.3 Descriptive Analysis

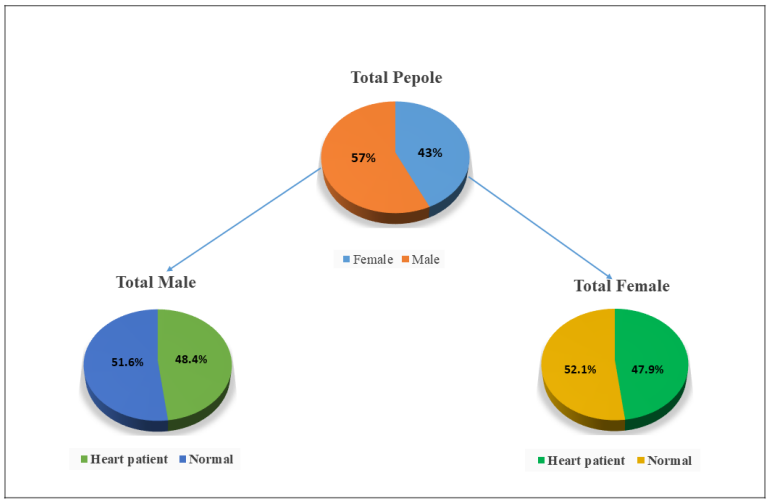


Figure 4.3.1: Heart patient percentage according to gender

For both males and females, the major cause of death is heart disease. By analyzing our dataset, it is shown that male is highly affected by heart disease as shown in Figure 4.3.1 which also demonstrates that the percentage of male (48.4%) affected by heart disease is greater than the percentage of female (47.9%) affected by heart disease. A huge number of people are dying every day by various diseases where heart disease is the dominant one. The primary cause of heart disease is causing an unhealthy life like eating too much oily food containing lots of cholesterol, not taking physical exercise, smoking, etc. That's why we suggested a system/model in this article that allows individuals to understand their level of danger for heart disease.

4.4 Summary

The primary motive of this project is to be conscious of their lifestyle by understanding the risk level of heart disease and it will partly decrease the death rate. Our project is unable to provide medical therapy of any kind. Suppose someone takes a lot of oily food every day and requires no workout whatsoever. If he/she utilizes our scheme then he/she will be able to understand the amount of danger of heart disease as a consequence he/she will be aware of the health of his / her heart that will protect individuals from heart disease. For applying machine learning algorithms, data were gathered from various

hospitals and general writing it down. The other method of gathering information was from the release summary of the separate patients. In such a way, an all-out 14 factors of about 1247 data were gathered. This gathered data were then arranged and organized efficiently in an Excel position. Utilizing this information, it tends to be exposed to various machine learning algorithms. From the data-set, fifteen features are extricated, for example, age, gender, blood pressure, and smoker and so on to anticipate the probability of patients getting heart disease. These credits are sustained into SVM, DT and Naive Bayes grouping Algorithms in which DT gave the best outcome with the highest accuracy which is shown in Table 3 Our proposed algorithms are observed to be better than the accuracy of other algorithms in the literature review. From the past research work and Table 1, it is cleared that none of the research studies has achievement rates higher than 86% for the referenced algorithms on the gathered Heart Disease Dataset. In light of the examination of the outcomes, it tends to be seen that the proposed models delivered sensible outcomes in arranging the conceivable coronary illness patients. Execution of the proposed technique is contrasted with the leaving algorithms to build up the proficiency of the proposed method.

CHAPTER 5

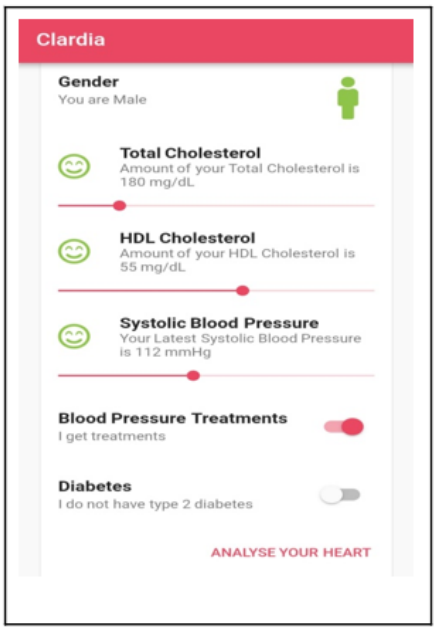
Implementation

5.1 Introduction

Using smartphones, we created an easy strategy for predicting the danger of heart disease. A prototype software based on Android was created by incorporating information from heart patients and individuals in particular. Data from 1247 heart patients and ordinary individuals have been analyzed and associated with risk variables such as hypertension, diabetes, smoking, family history, high blood pressure, stress and clinical symptoms that may suggest underlying undetected heart disease. Machine learning technology has been used to extract the information and a predictive score is produced.

5.2 Comparative studies

There are currently a few applications that can predict the danger of heart disease. Very few of them are popular and have some common characteristics at the same moment. There are also some distinctive characteristics in our apps that are distinct from other apps. At the same moment, before developing this application, a lengthy study has been performed which makes this app additional support to be as efficient as possible. This request is produced particularly for all kinds of individuals at the same time. From this perspective, this app is unique in focusing more than others on heart patients. The following screenshot demonstrates that there are few factors in these apps in where we used three general information and twelve external factors and three non-required medical information so that it will give you a better outcome than existing other apps. The following screenshot of Claudia's application which has been shown in Figure 5.2.1 and Cardiac risk calculator application which has been shown in figure 5.2.2 has only two general information and six factors. Based on this information the calculate the risk of heart disease in where we predict the risk of heart disease based on three general information and twelve external factors.



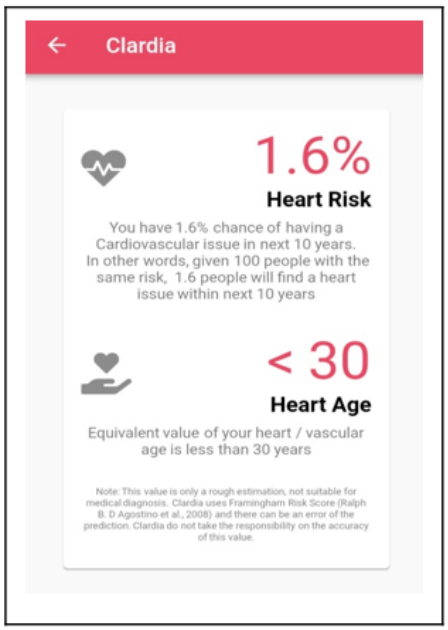
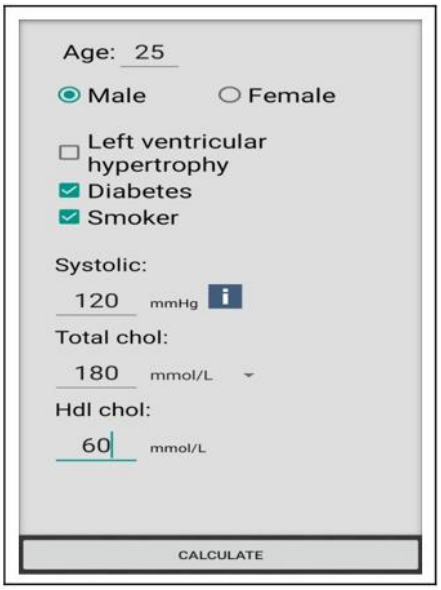


Figure 5.2.1: Screenshot of existing application



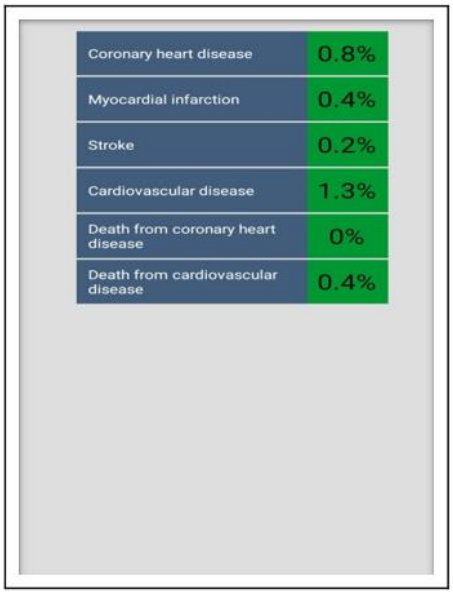


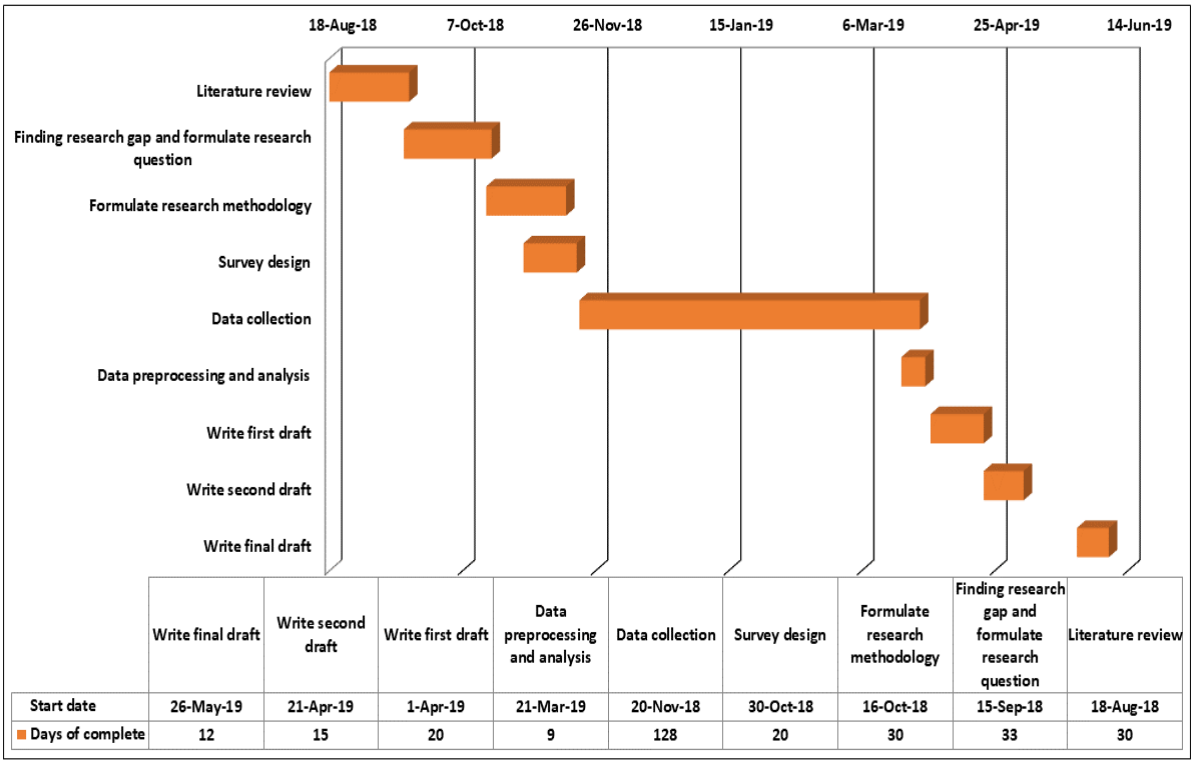
Figure 5.2.2: Screenshot of existing application

5.3 Challenges

To fulfil our purpose, we confronted several difficulties. UI and effectiveness applications are large problems for us. We confronted the following difficulties to create a user-friendly and effective implementation:

- It was a large challenge for us to make the UI user-friendly and simple to comprehend.
- For testing our application in android device

5.4 Work schedule both for research and development



	Write final draft	Write second draft	Write first draft	Data preprocessing and analysis	Data collection	Survey design	Formulate research methodology	Finding research gap and formulate research question	Literature review
Start date	26-May-19	21-Apr-19	1-Apr-19	21-Mar-19	20-Nov-18	30-Oct-18	16-Oct-18	15-Sep-18	18-Aug-18
Days of complete	12	15	20	9	128	20	30	33	30

Figure 5.4.1: Gantt chart for heart disease risk prediction system (Research Part)

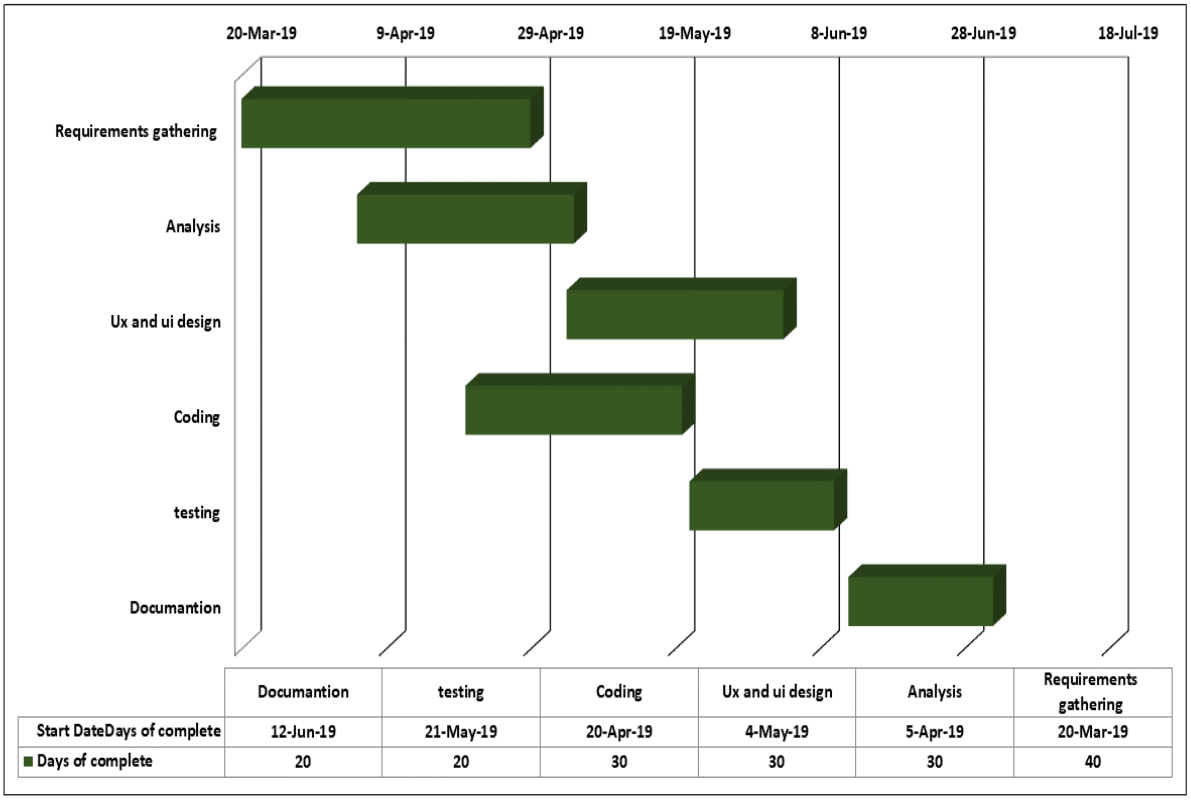


Figure 5.4.2: Gantt chart for heart disease risk prediction system (Development Part)

5.5 Business process modelling

Business process modelling (or) process modelling is an analytical depiction or merely an illustration of the company procedures of an organization. Modelling processes are a critical element for efficient leadership of business processes [4].

Figure 5.5.1 explains how user-specified information in HeartCare is calculated using an algorithm which produced the anticipated application-specific result. There will be some questionnaires provided to complete at first when the user opens our request. The system's questions are mandatory questions that a user has to fill out or otherwise the app will not allow the user to proceed to the next phase. When the customer fills the data blanks, all this data will be sent to the scheme. Now comes the primary portion where the system uses an algorithm to calculate all the user surveyed data. After that, the request will give an anticipated result based on all that data. The request will provide the user

with feedback on their heart condition at the end and where to contact to get treated as quickly as possible.

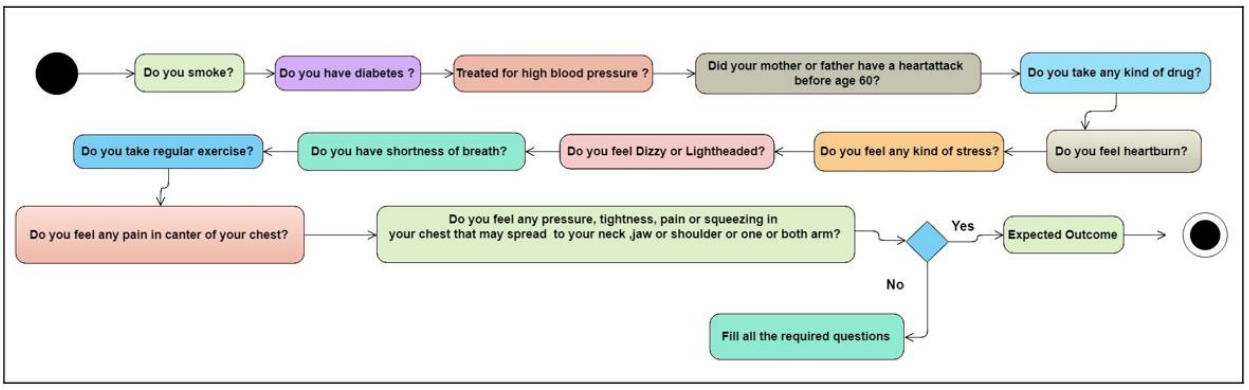


Figure 5.5.1: Business Process Model

5.6 Requirement collection and analysis

Collection and evaluation of requirements is a very important word for the creation of a system or any sort of application of android. The following conditions are required to fulfil this project's objective:

- To use the application, you need an android device
- Basic information must be provided to use the application.
- To use the application, you have to know about android application
- To use the application, you have to be loyal otherwise you will not get the accurate result

Tools requirements to develop the projects:

- Android Studio IDE to develop the project.
- Programming language: Java
- For design: Adobe XD, XML etc.
- Real time database: Firebase database.

- Offline database: SQLite
- Android devices to testing our application.

5.7 Use case modelling and Description

5.7.1 Use case modelling

The Use Case Model defines the suggested feature of the new system. A Use Case is a discrete unit of user interaction with the system (human or machine). Cases of use are typically linked to 'actors.' An actor is a human or machine entity that executes a meaningful job that interacts with the scheme. Here is the use case model for our application as shown in Figure 5.7.1.1.

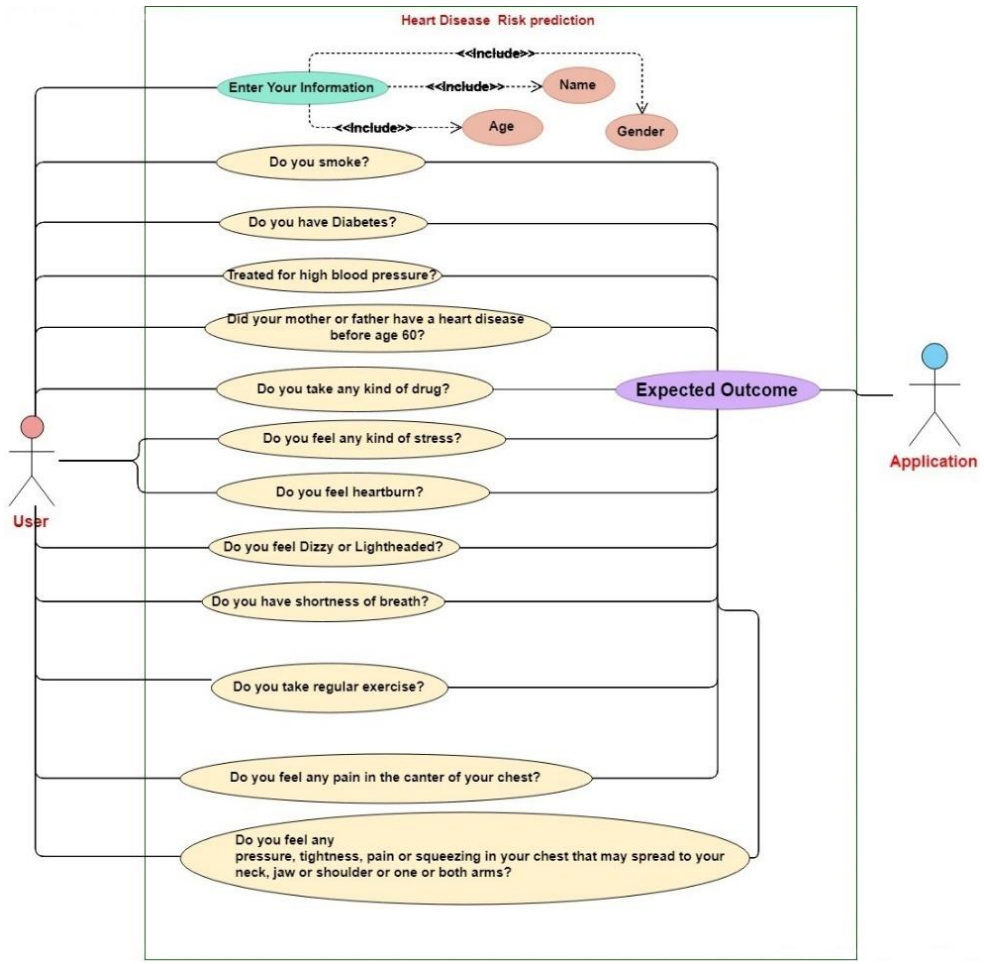


Figure 5.7.1.1: Use case modelling

5.7.2 Use case Description

Table 5.7.2.1: Use Case Description of Enter your information

Use Case ID:	01
Use Case Name:	Enter your information
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input their general information.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.2: Use Case Description of Do you smoke?

Use Case ID:	02
Use Case Name:	Do you smoke?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input their smoking status.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.3: Use Case Description of Do you have Diabetes?

Use Case ID:	03
Use Case Name:	Do you have Diabetes?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input either they have diabetes or not.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.4: Use Case Description of Treated for high blood pressure?

Use Case ID:	04
Use Case Name:	Treated for high blood pressure?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input whether they have high blood or not?
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.5: Use Case Description of Did your mother or father have heart disease before age 60?

Use Case ID:	05
Use Case Name:	Did your mother or father have heart disease before age 60?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input about their parents having heart diseases before age 60.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.6: Use Case Description of Do you take any kind of drug?

Use Case ID:	06
Use Case Name:	Do you take any kind of drug?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input whether they take any drugs or not.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.7: Use Case Description of Do you feel any kind of stress?

Use Case ID:	07
Use Case Name:	Do you feel any kind of stress?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input if they feel any stress or not.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.8: Use Case Description of Do you feel heartburn?

Use Case ID:	08
Use Case Name:	Do you feel heartburn?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input their general information.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.9: Use Case Description of Do you feel Dizzy or Lightheaded?

Use Case ID:	09
Use Case Name:	Do you feel Dizzy or Lightheaded?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input if they feel dizzy or lightheaded.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.10: Use Case Description of Do you have shortness of breath?

Use Case ID:	10
Use Case Name:	Do you have shortness of breath?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input if they have any shortness of breath.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.11: Use Case Description of Do you take regular exercise?

Use Case ID:	11
Use Case Name:	Do you take regular exercise?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input whether they exercise or not.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.12: Use Case Description of Do you feel any pain in the centre of your chest?

Use Case ID:	12
Use Case Name:	Do you feel any pain in the canter of your chest?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input if they feel any pain in the centre of their chest
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

Table 5.7.2.13: Use Case Description of Do you feel any pressure, tightness, pain or squeezing in your chest that may spread to your neck, jaw or shoulder or one or both arms?

Use Case ID:	13
Use Case Name:	Do you feel any pressure, tightness, pain or squeezing in your chest that may spread to your neck, jaw or shoulder or one or both arms?
Created by:	Md Jisan Ahmmed
Date Created:	03/08/2019
Description:	In this stage user have to input they feel any pain, pressure, squeezing in their chest or may spread to their neck, jaw, shoulder or one or both arm.
Primary Actor:	User
Secondary Actor:	None
Preconditions:	User must have to open the application

5.8 Front end Design

A project's visual portion is the front-end design. For a mobile app from Android. It is very essential as slow websites frustrate tourists in their search for options. Instant reaction to the application results in higher conversion rates. The optimized output is one of the company advantages of the front-end application.

A request must also represent the actual objective of the company. The design & graphics should not confuse the client as it interacts with the front-end portion, well-designed interfaces install confidence and confidence in the brand and assist attain communication objectives leading to greater traffic & conversion. To create a helpful user interface, we are attempting our utmost. We try to create our implementation smoother.

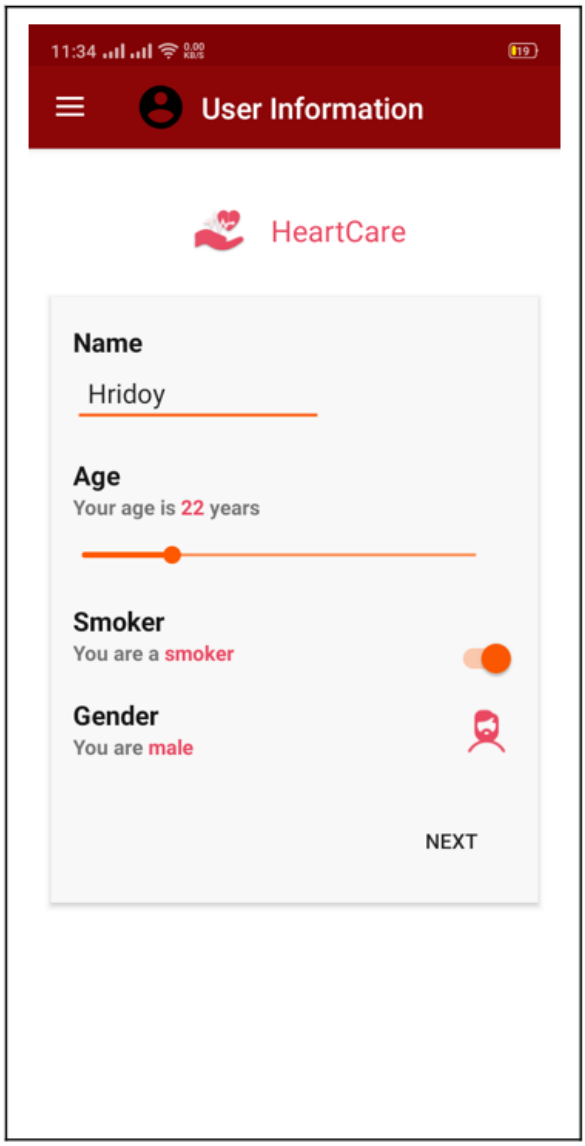


Figure 5.8.1: Application screen shot 1

Figure 5.8.1 is the homepage of our application which is the user information part. In this part, the application will ask for the user's name, age, whether the user is a smoker or not and the user's gender. After pressing next, it will continue to the next part.

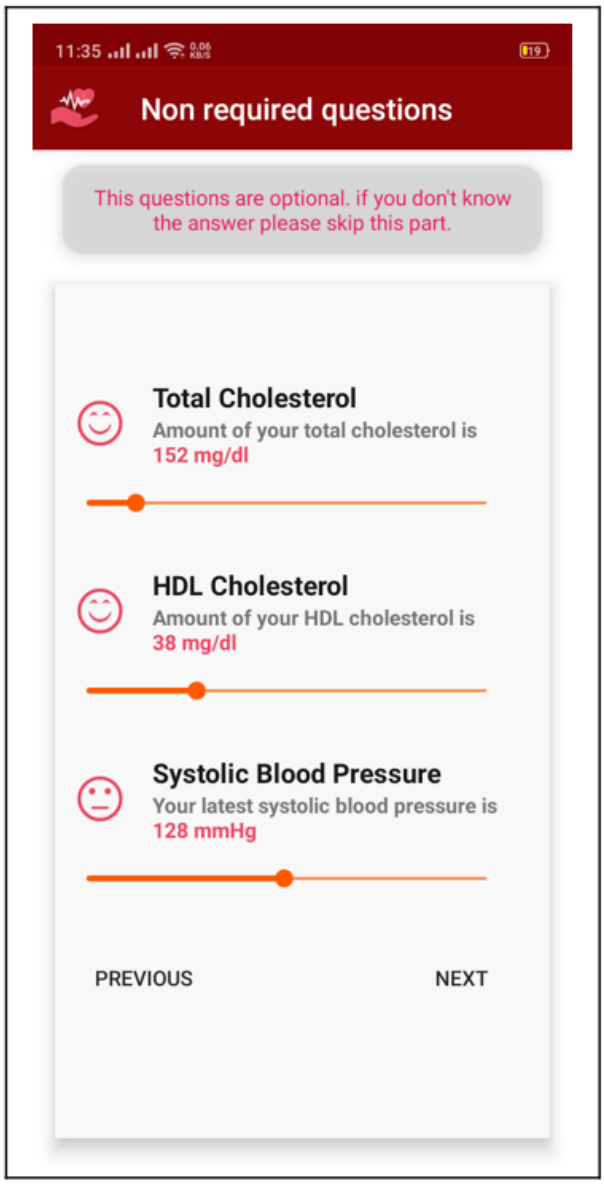


Figure 5.8.2: Application screen shot 2

Figure 5.8.2 is the 2nd part of our application, where it will ask for some non-required questions. This means if the user knows his/her total cholesterol, HDL cholesterol and systolic blood pressure he/she might put that as an input. If he/she doesn't know this information they might skip this part. But if someone knows this information and puts those as inputs our application will generate a more accurate result. By pressing the next user may continue to the next part.

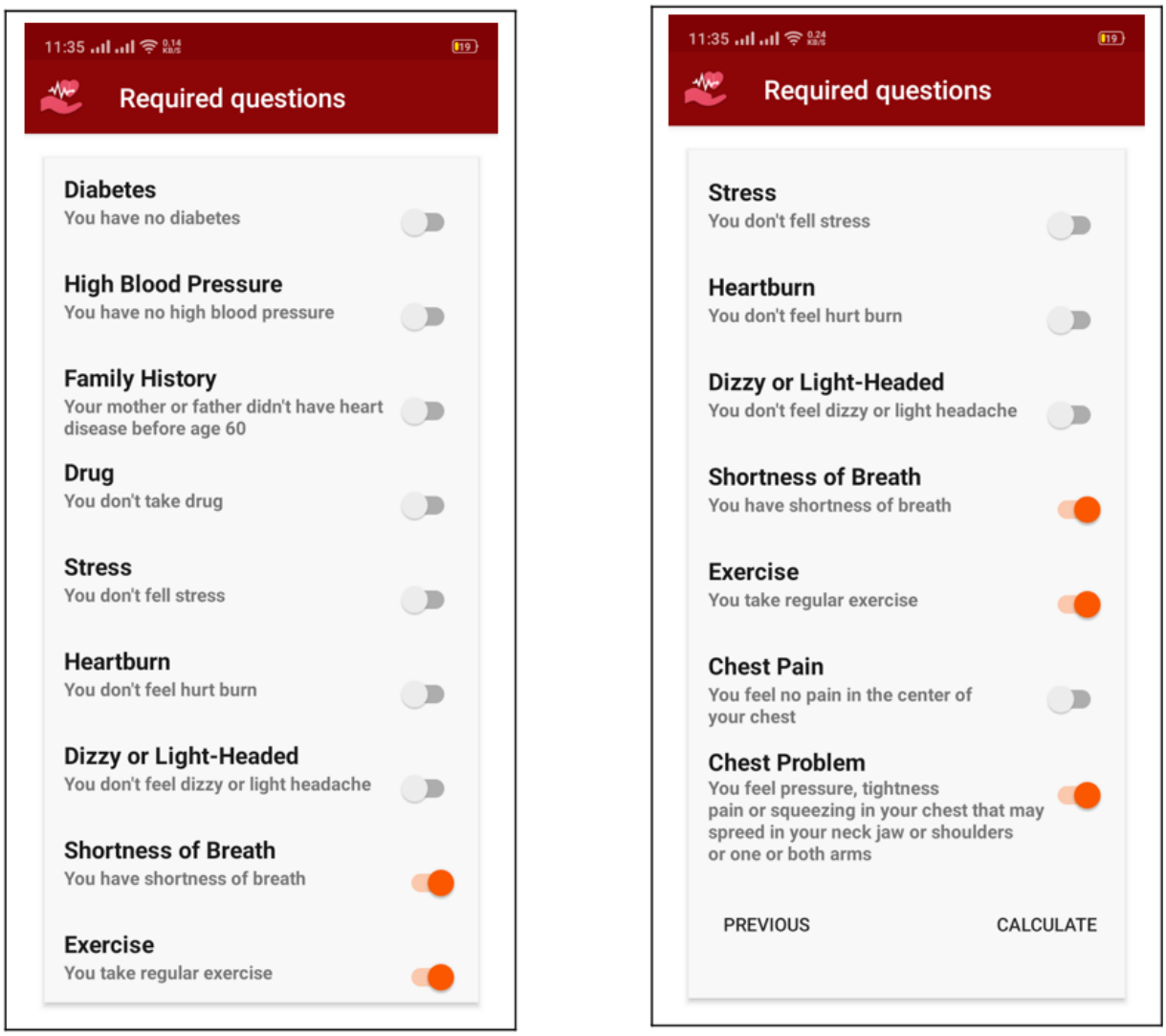


Figure 5.8.3: Application screen shot 3

Figure 5.8.3 is the 3rd part of our application where it will ask for some common attribute of the user which makes our application easy to use. These are just simple checkboxes to take those inputs. Like, whether the user has diabetes, high blood pressure, does the user have any family history regarding heart diseases, does the user take any drugs, etc. Based on these factors when the user will press calculate, our application will generate its result onto our final part of the application.

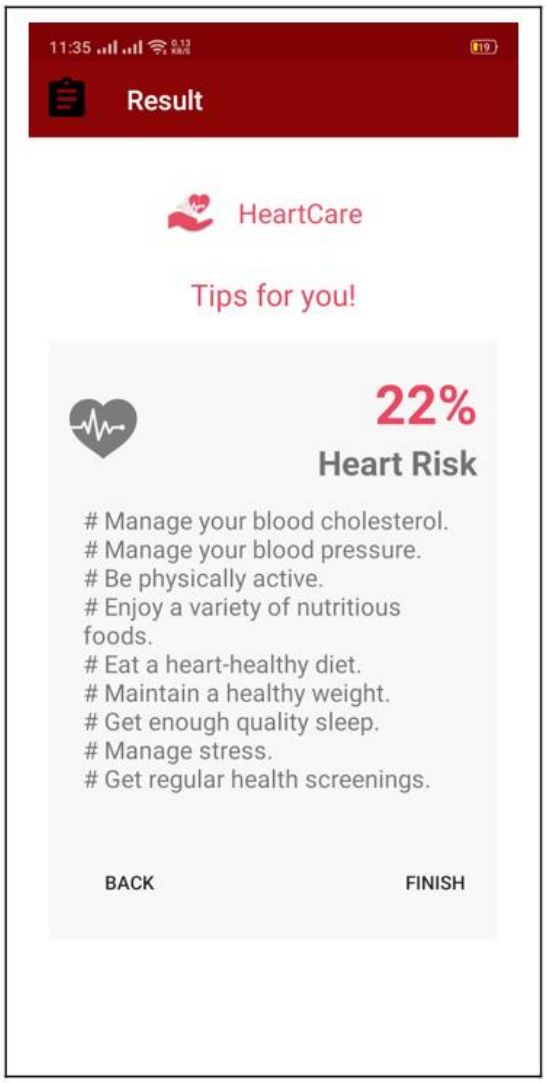


Figure 5.8.4: Application screen shot 4

Figure 5.8.4 is the final part of our application where it will produce the result based on those factors which we have discussed earlier from part 1 to part 3. By considering those factors our application will use a decision tree algorithm to generate the best result which we have already discussed in detail in this research earlier.

In this result part, our application will predict the risk of the user being in heart disease. This result will be shown in percentage value. Based on that percentage our application will suggest the user what he/she should do. Like, whether the user should go to a doctor or get admitted into a hospital etc.

5.9 Implementation Requirements

To execute the research, we use distinct types of instruments. This provides us a lot of functions for growth. We used Android Studio to implement this project and chose Java programming language and generated XML files. We can write code rapidly and easily in Android Studio. We have deployed Android's recent version 3.3.2. and, the API level for the project is API-28. We could use an emulator or any android phone as an actual device for testing [3].

5.10 Testing Implementation and Reports

A test case is a set of circumstances or variables to determine whether a test scheme meets or operates correctly. The test case development method can also assist define problems in the demands or design of an application. Here Table 5.10 shows that the Heart Disease Risk Test Case.

Table 5.10: Test case table for Heart Disease Prediction System

No	Tested Case	Test Input	Expected Outcome	Actual Outcome	Result	Tested on
1	Run the application	Tested on different real android devices- Samsung Galaxy A5 Samsung Galaxy J7	To run the apps successfully	Run the apps successfully	Passed	1 August, 2019
	Take the input	Tested on different real android	Take the input successfully	Take the input successfully	Passed	1 August, 2019

2		devices- Samsung Galaxy A5 Samsung Galaxy J7				
3	Get the result accurately	Tested on different real android devices- Samsung Galaxy A5 Samsung Galaxy J7	Get the result accurately	Get the result accurately	Passed	2 August, 2019

5.11 Future Scope

We have suggested a scheme in this present research by which we can understand the predictive value of the risk level of heart disease. We cannot provide any kind of medical assistance in this present research. But we will add a message section in the future that will produce the name of the medicine based on heart disease. We're going to add another chapter where we're generating heart specialist information so individuals can reach them and get advice from them. To evaluate diabetes, elevated blood pressure and cholesterol, we will add distinct types of sensors.

CHAPTER 6

Summary, Conclusion, and Implication for Further Research

6.1 Summary of the study

A lot of individuals are very unconscious about their health. That's why they suffer from a variety of diseases where heart disease is very prevalent and fatalities knocking at the door in the long run. If individuals are always monitored by using our system to monitor their heart condition, they will be aware of their heart health as a consequence of lowering the death rate due to heart disease. It is quite difficult for us to provide any kind of medical assistance through our project, but by demonstrating the predictive amount of danger, we can simply be conscious of individuals changing their lifestyle, food habit, stop smoking, etc. Much study has already been performed on the forecast of danger of heart disease based on a few characteristics, which is why they do not offer us a precise risk level for heart disease, but in this study we evaluate many characteristics such as smoking, family history of heart disease, cholesterol, blood pressure, chest pain, age factor, gender, stress, regular exercise, taking drug or not, etc. as a result we are able to show the risk of heart disease with higher accuracy.

6.2 Conclusions

There are so many illnesses that have a serious effect on us, one of which is heart disease. Certainly, it is a severe disease as we often hear that most individuals nowadays die from heart disease as well as other comparable illnesses are heart-related [30, 31, 32]. Heart attack remains the primary driver of death rate around the world. The World Health Organization evaluated that 17.5 million individuals died from cardiovascular sicknesses in 2012, speaking to 31% of all passing around the world; a gauge of 16 million passing younger than 70 were expected to non-transferable maladies, 82% of which are in low and middle-income nations; about 7.4 million were because of coronary illness, and 6.7 million were because of stroke [12]. So, we have to find an optimum solution for remedying this disease. However, it is not easy to stop it overnight. To identify the symptoms of heart disease, in this research, we proposed an implemented system (based

on the queries described in section 3.4) which can predict the risk level of heart disease so that people can be aware of their heart health and thereby it may partially reduce the death rate. Our findings show higher accuracy than previous studies which is shown in Table 1. In the future, the applied procedure can likewise be connected to ongoing medical data set and furthermore can be utilized with other techniques. This would bring about an increment of further accuracy and high geared. The implemented application system (HeartCare) is quite helpful to predict the risk of heart disease.

6.3 Implication for Further Study

We have suggested a scheme in this present research by which we can understand the predictive value of the risk level of heart disease. We cannot provide any kind of medical assistance in this present research. But we will add a message section in the future that will produce the name of the medicine based on heart disease. We're going to add another chapter where we're generating heart specialist information so individuals can reach them and get advice from them. To evaluate diabetes, elevated blood pressure and cholesterol, we will add distinct types of sensors.

CONTRIBUTION FROM THIS R&D PROJECT

Contribution:

1. An App based on DT has been developed.

2. International publication-1: Scopus & DBLP indexed

    Md. Saiful Islam, Md. Jisan Ahmmed and Karim Mohammed Rezaul, "Prediction of Heart Disease Risk Using Machine Learning Techniques", Submitted to *International Journal of Medical Informatics*, September 2019.

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APPENDIX

Appendix A: Field Survey

We are from Daffodil International University (Md. Saiful Islam and Md. Jisan Ahmmed)
We are conducting studies on the forecast of danger of heart disease.

HEART DISEASE RISK PREDICTION

Age: _____ **Gender:** ☐ **Male** ☐ **Female**

People Type: ☐ **Heart Patient** ☐ **Normal**

1. Smoker?	☐ Yes	☐ No
2. Diabetes?	☐ Yes	☐ No
3. Treated for high blood pressure:	☐ Yes	☐ No
4. Did your mother or father have a heart attack before age 60?	☐ Yes	☐ No
5. Do you take any kind of drug?	☐ Yes	☐ No
6. Do you feel any kind of stress?	☐ Yes	☐ No
7. Do you feel heartburn?	☐ Yes	☐ No
8. Do you feel Dizzy or Lightheaded?	☐ Yes	☐ No
9. Do you have shortness of breath?	☐ Yes	☐ No
10. Do you take regular exercise?	☐ Yes	☐ No
11. Do you feel any pain in the canter of your chest?	☐ Yes	☐ No
12. Do you feel any pressure, tightness, pain or squeezing in your chest that may spread to your neck, jaw or shoulder or one or both arms?	☐ Yes	☐ No

Appendix B: Online Survey Link

https://docs.google.com/forms/d/e/1FAIpQLSdbnbw-1_de2FP5dpq0oX3zDKv-Xcq6pDISkJWnvPgICbxJMg/viewform

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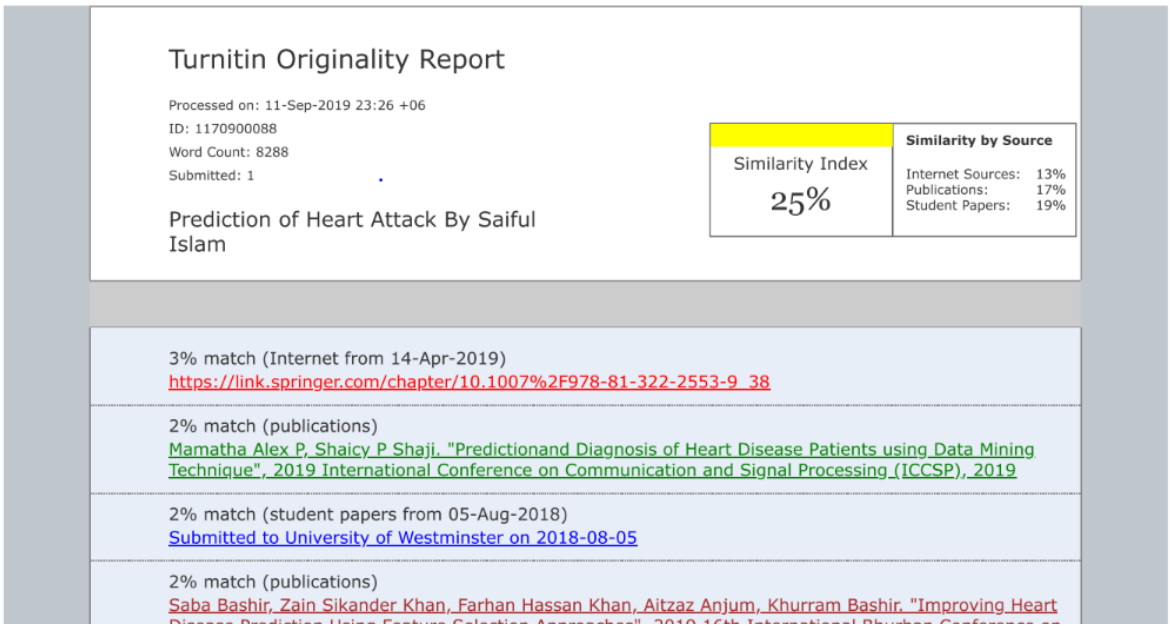

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