LOCATION AND SITUATION BASED HEALTHCARE RECOMMENDATION SYSTEM USING AI

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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 "**Location and Situation Based Healthcare Recommendation System**", submitted by **Nahidujjaman**, **Gm Zulkar Nine** and **Syed Muhayminul Islam** 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 and approved as to its style and contents. The presentation has been held on 31st May 2021.

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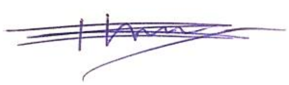

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Dr. Sheak Rashed Haider Noori, Associate professor & Associate Head, Department of CSE** Daffodil International University. 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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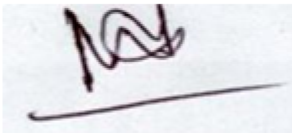

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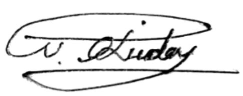

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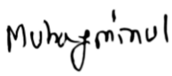

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

In this twenty-first century, the health problem is still significant in developing countries such as Bangladesh. Many people die every year due to unfair treatment as well as miss-guessing their disease. Many lives can be saved if the action had been taken earlier before getting sick. People tend to get disoriented at the time of the disease and get confused about which doctor needs to be consulted for the disease. Our proposed system takes several parameters from the user (manually or from IoT devices) and detects the disease. Also, recommend hospitals based on the detection and location of the user.

Keywords: Hospital Recommendation System, Disease Detection System, IoT devices to detect disease, health monitoring system using IoT devices

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CHAPTER 1
INTRODUCTION

1.1 Project Overview

In this twenty-first century, the health problem is still prominent in developing countries such as Bangladesh. Every year, many people die as a result of incorrect medication or misdiagnosis. They might have spared many lives if they had taken action before being ill. When people are sick, they also get disoriented and unsure about which doctor they can see. According to the health ministry's health bulletin, for every 10,000 people in our country, there are six physicians, nurses, and midwives. According to the World Health Organization, Bangladesh's doctor-to-patient ratio is 5.26 to 10000 people, putting the country in the second-to-last place [1]. Our country has a massive population, but there aren't enough doctors to go around. Since fewer doctors, some patients have to wait an unnecessary period to see a doctor. And it could get even worse.

Wearable sensor-based devices can effectively control a variety of life-threatening diseases. Cardiovascular disease (CVD) is a common disease that accounts for the bulk of deaths worldwide. Smartphone-based health monitoring services are becoming more popular as the information and technology revolution progresses. Allowing each person to evaluate their health and urging them to obtain urgent medical care Will save a life in an emergency.

The two most significant markers of human health are heart rate and body temperature. The heart rhythm, also known as the pulse rate, is the number of heartbeats per minute. Calculating the pulses may calculate the heart rate by measuring the rise in blood flow volume. For healthy individuals, a typical heart rhythm is between 60 and 100 beats per minute. Adult males' resting heart rates are around 70 bpm, while adult females' resting heart rates are around 75 bpm [2]. Electrocardiography (ECG) has been a more widely used service in recent years. An ECG can reliably calculate the heart's functioning by recognizing the slight change in voltage produced by the cardiac muscle. Doctors and patients may use a mobile tracker to constantly monitor the heart rate, collect critical data, and take reasonable measures to avoid serious injury [3].

Our proposed method detects the user's disease by collecting multiple parameters (manually or via Wearable devices). Using intelligent health tracking systems, assess the health status, such as heart rate, body temperature, respiratory rate, blood glucose rate, ECG, EEG, glucose levels, and other variables. Detect patient condition and inform medical staff and family members.

1.2 Objective

The objective of our proposed work is given below:

i. Detect health condition in real-time with high accuracy
ii. Generate quick response to reduce unusual death
iii. Emergency response from the system.
iv. Send information to concerned parties in minimum time.
v. Lightweight wearable devices.

1.3 Research Framework

We are proposing our framework, which is given below:

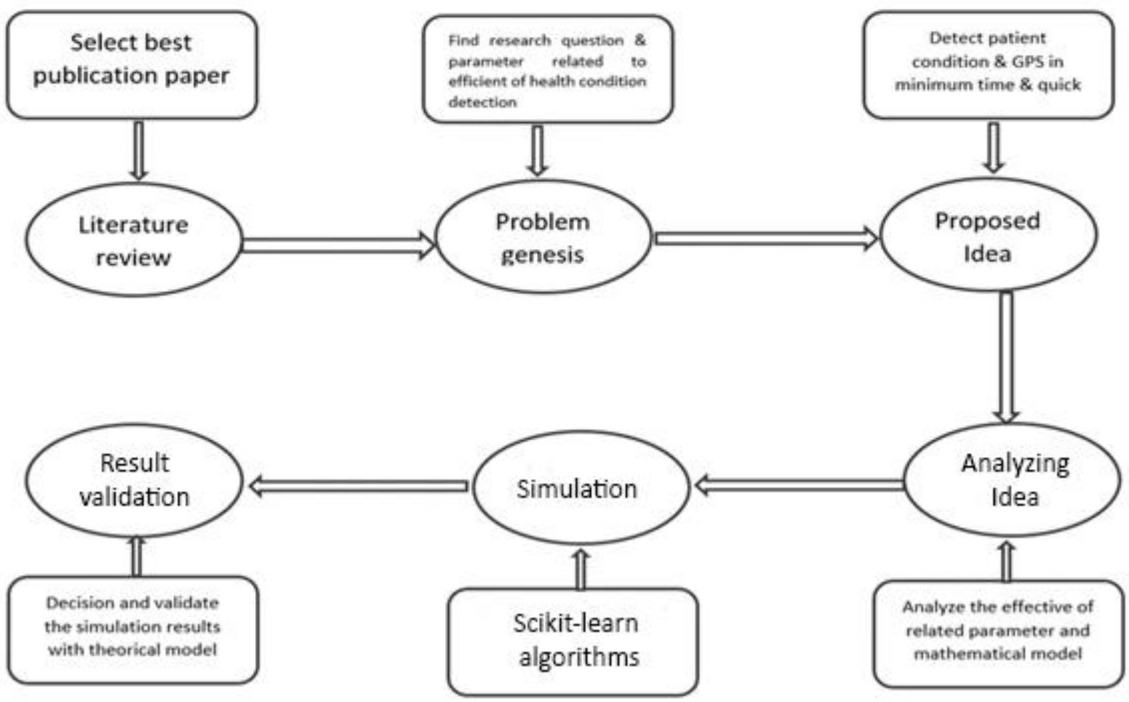

Figure 1.3.1: Research Framework

1.4 Methodology

Our mission is to come up with research questions and criteria for effective health identification in monitoring systems. We want to use wearable devices to diagnose a patient's health problem in the shortest time possible and respond quickly. The health tracking systems keep track of the user's physical measurements and send them to the user's smartphone. The mobile analyzes and correlates the sequences of measurements received from various instruments, documents the result, and shows the result to the user. As required, it recommends the nearest hospital or diagnostic center and informs the user's family in an emergency.

Required Device

- Body Temperature sensor
- Heart Rate sensor
- Blood pressure sensor
- pulse oximeter
- Weight Scale
- Electrocardiograph

Three types of data will be collected

- Objective data
    - Age
    - Weight
    - Height
    - Gender
- Subjective data
    - Smoking
    - Alcohol
    - Physical Activity
- Examination data

- Blood pressure
- Heart rate
- Body Temperature
- Cholesterol

1.5 Related Work

In medical research, some significant work has been performed using IoT to track patient health. The following is a list of works related to this area.

IoT Based Health Monitoring System [4], In an IoT network, Tamilselvi et al. created a health-tracking system that can track a patient's primary symptoms such as heart rate, percentage of oxygen saturation, body temperature, and eye activity. Heartbeat, SpO2, Temperature, and Eye Twitch sensors are using as recording components, and an Arduino-UNO is used as a processing unit.

IoT-based health care monitoring kit [5] In the IoT world, Acharya et al. introduced a healthcare monitoring kit. Heartbeat, ECG, body temperature, and respiration were among the established method's critical health parameters. Pulse sensor, temperature sensor, blood pressure sensor, ECG sensor, and Raspberry Pi are the primary hardware modules used here. Sensor data was gathered and sent to a Raspberry Pi for analysis before being sent back to the IoT network. The system's biggest flaw is that no data visualization interfaces have been developed.

Design of a photoplethysmography-based pulse rate detector [6] Banerjee and colleagues proposed a noninvasive technique for detecting pulse rate. The proposed machine employed the plethysmography method and digitally showed the results, making it a real-time tracking unit. In comparison to other invasive techniques, the procedure has proven to be as safe for the patient. Gregoski and colleagues.

Android-based health parameter monitoring [7] Trivedi et al. proposed a health parameter monitoring system controlled by a mobile device and focused on Arduino. The analog data obtained by the sensors is sent to the Arduino Uno board. The analog values registered are converted into digital data by the integrated analog to digital converter. The physical qualities of the developed system were transmitted through Bluetooth.

Table 1.5.1: Summary of the reviewed smart health monitoring systems

Paper Title	**Author**	**Year**	**Feedback Device**	**Major Hardware Components**	**Uses**	**Cost**
Personal health monitoring using a smartphone.	Moser and Melliar-Smith [18]	2015	Smartphone	Blood pressure sensor, body weight sensor, pulse oximeter, glucometer, accelerometer	Chronic disease progression	Cost-effective
Design on mobile health service system based on Android platform.	Kong et al. [19]	2016	Mobile phone	Wi-Fi module, Bluetooth, RFID, ECG, blood pressure	Chronic disease	Low cost
Continuous heart rate monitoring using smartphone.	Turner et al. [3]	2017	Smartphone	Heart rate sensor, Bluetooth, microcontroller, electrode pads, display	Cardiovascular disease	Costly

Smart health monitoring system patient through IoT	Kumar et al. [20]	2017	Monitor	Arduino Uno, temperature sensor, heart rate sensor, body position sensor, Wi-Fi module,	Heart problem, noise detection	High cost
Smart detectionand transmission of abnormalitie s in ECG via Bluetooth.	Penmatsa and Reddy [21]	2016	Smartphon e, laptop, VGA display	ECG, Bluetooth, temperature sensor, heart rate sensor, Arduino, bio-sensor	Detecting abnormalitie s in heart	Low cost
An IoT based patient monitoring system using raspberry Pi.	Kumar and Rajaseka ran [22]	2016	Monitor	Raspberry pi, heartbeat sensor, temperature sensor, respiration sensor, accelerometer	Respiration rate monitoring	Expensi ve
A smart sensor interface for smart homes and heart beat monitoring using WSN in IoT environment.	Desai and Toravi [23]	2017	LCD display	CPLD,ARM7T DMI-S, temperature sensor, gas sensor, heartbeat sensor, raspberry pi	Pulse, temperature and smoke detection	Expensi ve

Design andimplementation of a wearable sensor network system for IoT-connected safety and health applications.	Wu et al. [24]	2019	Smartphone	Raspberry pi, Lo-Ra module, temperature sensor, humidity sensor, pulse sensor, WSN, WDM, UV, CO2 sensor	Hearing loss, headache, rapid pulse rate detection	Costly
Smart and pervasive ICU based-IoT for improving intensive health care.	Ahouandjinou et al. [25]	2016	Monitor	ECG, pulse sensor, temperature, camera, environmental sensor, Bluetooth, ZigBee, RFID	Heart problem, fever detection	Costly

1.6 Project Outcome

The proposed system will detect users' health conditions, and based on the need; it will recommend the nearest hospital. High accuracy of detecting disease and responding accordingly can save a life.

CHAPTER 2
BACKGROUND

2.1 Recommendation System

Data is in every place. According to the American business magazine Forbes, about 2.5 quintillion bytes of data are being generated each day (Marr, 2019) [8]. By the research from Statista (2021), this amount is expected to reach 149 zettabytes by the year 2024 from 2010 [9]. The human brain cannot manage this vast amount of data. Psychologist George Armitage Miller says that because of data overloading, people get confused and are likely to make more flawed decisions instead of making informed ones (Wikipedia contributors, 2021) [10]. A recommendation system helps people to make decisions by calculating these enormous amounts of data. In short, a recommendation system is a decision-making tool that takes decisions for the user by an information filtering approach. The recommendation systems give the user a decision by taking some information from him then calculate them to help him choose from a larger space of possible options.

2.2 Types of Recommendation System

The recommendation System can mainly be divided into six categories:

- Collaborative Recommendation System
- Content-Based Recommendation System
- Demographic Based Recommendation System
- Utility-Based Recommendation System
- Knowledge-Based Recommendation System
- Hybrid Recommendation System

1. **Collaborative Recommendation System:** The Collaborative recommendation system is the most widely used and most mature recommendation system. It works by using similarities between users and their interests in any particular item. It searches between a large group of people and finds a small group of people with similar tastes. Then based on the interest of one user, it suggests items to another user. It requires users' historical data to calculate and recommend. The Collaborative recommender system calculates ratings or recommendations by the users of objects and generates new recommendations based on those ratings. The Collaborative recommendation system is based on the assumption that similar people will most likely like them if one person liked the items in the past.
2. **Content-Based Recommendation System:** Content-based recommendation systems need users' previous data to recommend new items to them. This system works by the user's data such as rating, clicking on a link, and suggesting a similar product to him. The content-based recommendation system is a keyword-specific recommendation system. When a user rates or clicks on an item, the system recommends similar items based on the item's keyword.
3. **Demographic Based Recommendation System:** The demographic-based recommendation system recommends items to a user based on some attributes and makes recommendations based on demographic analysis. The demographic analysis is based on factors like age, sex, race, country, etcetera. The demographic-based recommendation system recommends items without any past rating from the user. It can recommend without any knowledge; thus, any new user of any system can also get recommendations. This recommender system is not that complex and easy to use.
4. **Utility-Based Recommendation System:** The Utility-based recommendation system makes suggestions based on the computation of each object's utility to the user. This recommender system's main advantage is that it can factor in non-product attributes, such as vendor reliability and product availability.

5. **Knowledge-Based Recommendation System:** The knowledge-based recommendation system makes recommendations when a user enters specific queries. This recommendation system attempts to suggest items based on inference about a user's needs. This system might ask the user to fill in some questions to know what the user might like. The system then searches and recommends similar items that match with users' given data. This recommender system's main advantage is that it does not need any previous ratings or keywords to make suggestions.
6. **Hybrid Recommendation System:** The Hybrid recommendation system uses multiple recommendation systems to overcome one recommendation system's limitation. Every recommendation system is excellent. They follow different approaches when recommending items to a user. However, every method has some limitations of its own. The hybrid recommendation system is used to reduce or overcome these limitations.

CHAPTER 3

PROJECT DESIGN

3.1 Problem Definition

In a developing country like Bangladesh, where medical service is not broadly available, people tend to suffer in emergency medical situations. These include not understanding the actual problem and miss treating the disease. A vast majority of the population is living under a meager income in this country. To understand the disease, doctors give various kinds of diagnostic tests to patients, by which they need to spend a vast amount of money; also, there are other factors like medication costs and hospital fees. To get better and proper treatment, people need a massive amount of money. Which, in most cases, they cannot bear. That is why in most cases, people take medicines without properly testing their bodies. As a result, many people die every year.

Another problem is that the poor and uneducated or poorly educated people who live in the rural areas where quality treatment is not available; suffer much. Because of the scarcity of quality hospitals, they cannot perform tests to find their diseases. As a result, they get disoriented at choosing the right doctor for their treatment. They do not know which doctor needs to consult for which disease.

3.2 Idea Generation

By looking at the problem definitions, we can categorize the problem into two different categories:

a. Not understanding the disease
b. Consulting the wrong doctor for the wrong disease

To solve these two problems to help the poor people in Bangladesh, we need to develop an idea to help them understand their disease and know which doctor needs to consult for that particular disease. Also, understanding the disease before getting sick is better than understanding it after getting sick. So, that people can take the required steps to prevent catastrophes.

3.3 Vision

Our research goal is to find a solution to the problems that people will use every day with trust. The human body is a susceptible subject. Any misinformation about it can cause severe or sometimes fatal damage. That is why some educated people do not want to trust any information from any non-medical sources. This is not the case for uneducated or poorly educated persons. They tend to learn about various medical terms from non-medical persons without knowing that it might cause serious injury. However, nowadays, many people search through the internet for medical terms. According to research, in the USA, almost 35% of adults have gone through the internet to figure out the health condition that they or someone else has. And from them, only 41% confirm that the health professionals agree with the diagnostics that they have gone through online (Fox & Duggan, 2013) [11]. This is not a great success rate when it is the case of human health. In Italy, 84% of young people use the internet for health information (Sbaffi, 2011) [12]. And in Bangladesh, the number of people who search through the internet for health information is almost 74%. Most of them use popular social media like Facebook and Twitter to gather these pieces of information (Gundlapalli et al., 2017, pp. 122–125) [13]. So, the number of miss-information gathering rates increases significantly. And that is why we want to create a long-term and dependable way for people to acquire information about their health and hospital referrals based on their health status and location.

3.4 Information Gathering

Information is power. Gathering information for any research is a very crucial part. There are many miss-informations available here and there. That is the reason we need to be careful while gathering information. The most reliable sources of information are various kinds of journal papers and books. Also, articles of popular magazines like Forbes are reliable sources for information too. Some other methods of information gathering include interviews, questioning, questionnaires, observation, etcetera. However, interviews and questioning are considered the only choice for the initial phase while gathering information.

3.5 Concept Solution

Recommendation system has now become an essential part of the internet. The recommendation system is being used in social media like Facebook, Twitter, Youtube for better ad recommendation. Youtube uses this system to recommend better videos for the user. E-commerce websites like Alibaba, Amazon etcetera have a robust product recommendation system.

Our mission is to design a system that will help users understand their disease and recommend a hospital according to their disease.

Almost 60% of the world population use the internet; from this, almost 93% of internet users accessed the internet by the mobile device (Statista, 2021b) [14]. According to DataReportal, in Bangladesh, 47.61 million people, which is close to 29% of the total population, use the internet. This number has increased by 7.7 million between 2020 and 2021 (Kemp, 2021) [15]. So, it is clear that the number of internet users is increasing drastically every year. According to Google, 5% of total internet searches are health-related

(Ramaswami, 2015) [16]. They spend much time searching through the internet to know about their health conditions. However, this number of people get their health information from unreliable sources of the internet. Sometimes which leads to dangerous situations.

So, a perfect solution is needed for this massive number of internet users. People will enter their information about how they are feeling, and based on that information; our system will try to predict the result of his health condition. This will save their time as well as the chances of getting false information which could lead to fatal danger, would be reduced. And based on the predicted result, which is predicted based on the user's information, the nearest hospital will be recommended. That will save them a lot of time. When it comes to an emergency, time is of the essence.

CHAPTER 4
IMPLEMENTATION

4.1 Data Collection

Data collection is a systematic approach to gather information. While dealing with sensitive subjects like human health, we need to search for a perfect dataset because any wrong information about it can lead to fatal danger. For testing purposes, we are going to implement our system to detect one disease only. After searching for data for a while, we found a dataset containing health information as feature data and cardiovascular disease data as target data from Kaggle[1]. This dataset contains eleven feature data and one target data to detect cardiovascular disease. This dataset contains 70000 patients' data. All of these data are collected during the medical examination of each patient. Age, gender, height, weight, systolic blood pressure, diastolic blood pressure, blood cholesterol, blood glucose, smoking habits, alcohol intake, and physical activity of the patient are the feature data. These data are being used to calculate the result if the patient has cardiovascular disease or not.

Table 4.1.1: Cardiovascular Disease dataset

id	age	gender	height	weight	ap_hi	ap_lo	cholesterol	gluc	smoke	alco	active	cardio
0	18393	2	168	62	110	80	1	1	0	0	1	0
1	20228	1	156	85	140	90	3	1	0	0	1	1
2	18857	1	165	64	130	70	3	1	0	0	0	1
3	17623	2	169	82	150	100	1	1	0	0	1	1
4	17474	1	156	56	100	60	1	1	0	0	0	0
8	21914	1	151	67	120	80	2	2	0	0	0	0
9	22113	1	157	93	130	80	3	1	0	0	1	0
12	22584	2	178	95	130	90	3	3	0	0	1	1
13	17668	1	158	71	110	70	1	1	0	0	1	0
14	19834	1	164	68	110	60	1	1	0	0	0	0
15	22530	1	169	80	120	80	1	1	0	0	1	0
16	18815	2	173	60	120	80	1	1	0	0	1	0

[1] Cardiovascular Disease dataset | Kaggle - https://www.kaggle.com/sulianova/cardiovascular-disease-dataset

In this dataset, the age column is presented as days of patients; gender column is represented as 1 for Female and 2 for Male; height column is in centimeters; weight column is in kilogram; ap_hi is systolic blood pressure; ap_lo is diastolic blood pressure; cholesterol is represented as 1 for normal, 2 for above normal and 3 for well above normal; gluc is represented as 1 for normal, 2 for above normal and 3 for well above normal; smoke is represented as 0 for a non-smoker and 1 for a smoker; alco is represented as 0 for non-alcoholic, and 1 for an alcoholic; active is represented as 0 for non-active, and 1 for active and the cardio column is represented as 0 for no cardiovascular disease and 1 for cardiovascular disease.

At first, the system will take users' data and analyze them to detect if they have any chance of getting affected by disease or not. If our system found any chance for them to get sick, then it will recommend some hospital based on the location and the user's predicted disease. Also, as a result, we will need some hospital details as well. We have collected hospitals' information manually. The hospital dataset has parameters such as Hospital Name, Speciality, District, Short Address, Full Address, Co-Ordinates, and Contact Details.

4.2 Parameter Analysis

In the cardiovascular disease detection dataset, there are three types of input features.

a. **Objective:** This is the factual information of the patient. This includes age, height, weight, and gender.
b. **Examination:** Result of medical Examination of the patient. These are systolic blood pressure, diastolic blood pressure, cholesterol, and glucose.
c. **Subjective:** Information that the patient gives. This includes smoking habits, alcohol intake, and physical activity.

The age column is in days format, which we will transform into years by using a simple formula:

$$Y = \frac{D}{d}$$

Here, Y is the year value that we will get, D is the day's values from the dataset, and d = 365.2425. After that, to keep things precise, we can round the Y value to get a real number and get the actual age.

After finishing converting the age from days to years, we will look into the dataset deeply.

Table 4.2.1: Describing the Cardiovascular disease dataset

	gender	height	weight	ap_hi	ap_lo	cholesterol	gluc	smoke	alco	active	cardio	years
count	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000
mean	1.3496	164.3592	74.2057	128.8173	96.6304	1.3669	1.2265	0.0881	0.0538	0.8037	0.4997	53.3387
std	0.4768	8.2101	14.3958	154.0114	188.4725	0.6803	0.5723	0.2835	0.2256	0.3972	0.5000	6.7653
min	1	55	10	-150	-70	1	1	0	0	0	0	30
25%	1	159	65	120	80	1	1	0	0	1	0	48
50%	1	165	72	120	80	1	1	0	0	1	0	54
75%	2	170	82	140	90	2	1	0	0	1	1	58
max	2	250	200	16020	11000	3	3	1	1	1	1	65

From table 4.2.1, we can see that there might be some outliner data in the ap_hi and ap_lo columns. So, we need to drop those columns from the dataset to increase the accuracy. Once dropping those faulty columns, our data has become cleaner.

Table 4.2.2: Describing the Cardiovascular disease dataset after removing the faulty rows

	gender	height	weight	ap_hi	ap_lo	cholesterol	gluc	smoke	alco	active	cardio	years
count	69007	69007	69007	69007	69007	69007	69007	69007	69007	69007	69007	69007
mean	1.3487	164.3596	74.1178	126.2958	81.3315	1.3644	1.2258	0.0879	0.0536	0.8033	0.4949	53.3249
std	0.4766	8.2040	14.3285	17.8871	9.8894	0.6787	0.5718	0.2831	0.2252	0.3975	0.5000	6.7684
min	1	55	11	-150	-70	1	1	0	0	0	0	30
25%	1	159	65	120	80	1	1	0	0	1	0	48
50%	1	165	72	120	80	1	1	0	0	1	0	54
75%	2	170	82	140	90	1	1	0	0	1	1	58
max	2	250	200	240	190	3	3	1	1	1	1	65

4.3 Data Analysis

After dropping the faulty columns from the dataset, we have 69007 data left. Of which 34857 are for cardio patients and 34150 for non-cardio patients.

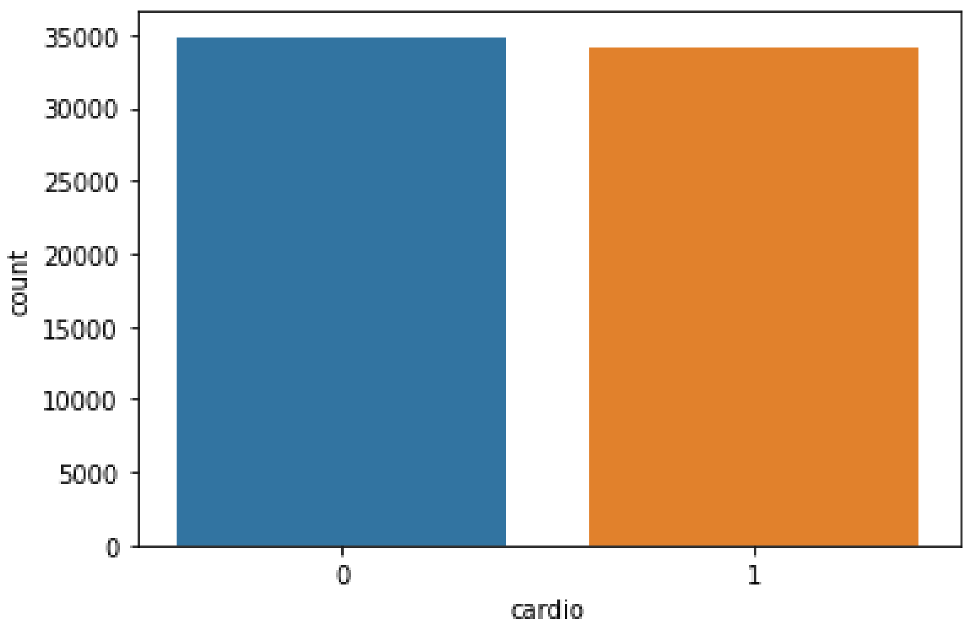

Figure 4.3.1: Cardio and Non-Cardio Visual

We will now calculate the dataset based on different parameters such as age and patient weight.

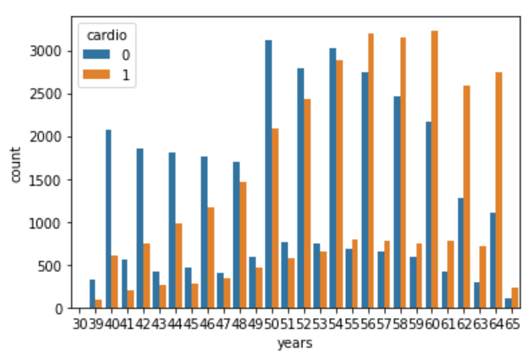

Figure 4.3.2: Cardio and Non-Cardio Visual Based on Age

Analyzing figure 4.3.2, we can see that the chance of getting affected by cardiovascular disease has increased from the age of 55. And the chances of getting affected have increased drastically with age. From this figure, we understand that age is a factor for getting affected by cardiovascular disease.

Now we will see if there any effect of weight in case of affected by cardiovascular disease.

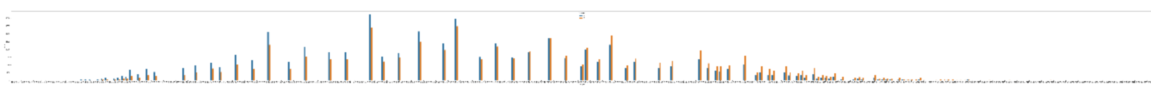

Figure 4.3.3: Cardio and Non-Cardio Visual Based on Weight

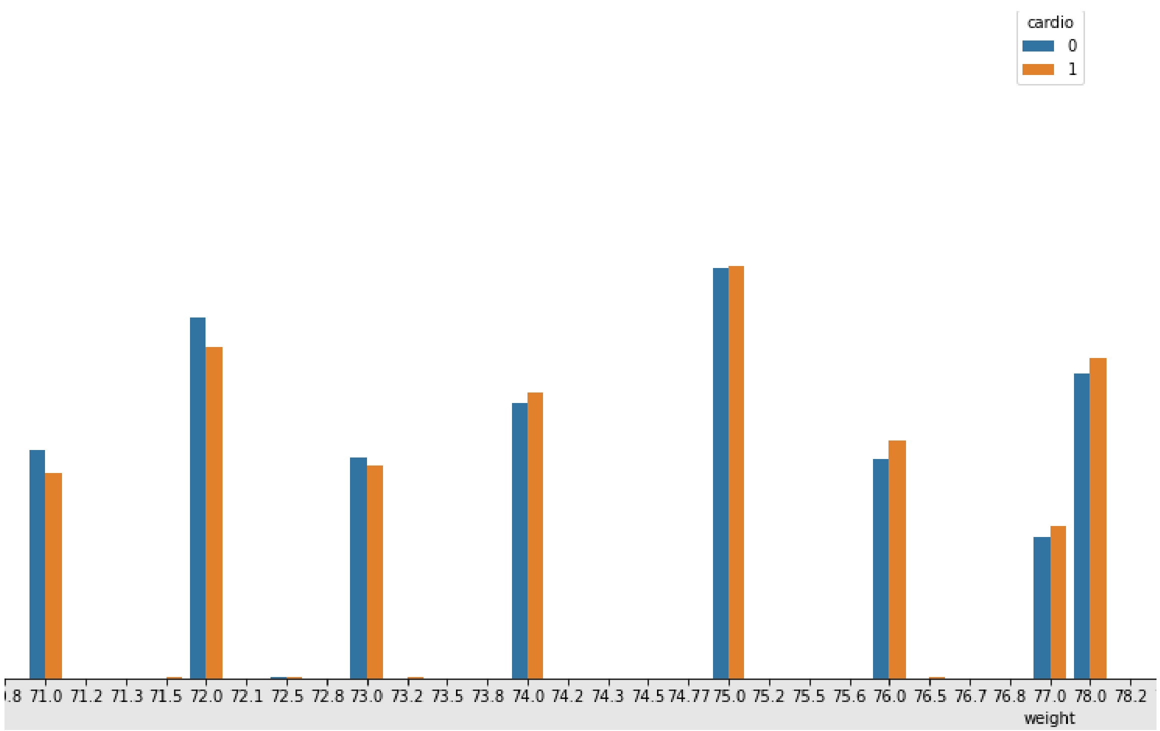

Figure 4.3.4: Cardio and Non-Cardio Visual Based on Weight (Zoomed)

In figure 4.3.3, we have the data of cardiovascular disease-affected people based on their weight. Let us look at a particular portion of it in figure 4.3.4. We can see that the chances of getting affected by cardiovascular disease also increase from the weight of 74 Kilograms respectively. So, from both figure 4.3.2 and figure 4.3.4, we can see that age and weight are both has factors for getting affected. However, since the weight may vary from user to user based on their height, we can measure the BMI to see if it impacts the likelihood of being sick. That way, we will get a new feature in our dataset, which will increase our result's accuracy. To get the BMI from the dataset,

$$BMI = \frac{weight}{(\frac{height}{100})^2}$$

Here, we divide the height column by 100 because our height data is centimeters, but we need it in meter format.

After getting the BMI feature from the existing weight and height column, we can analyze it.

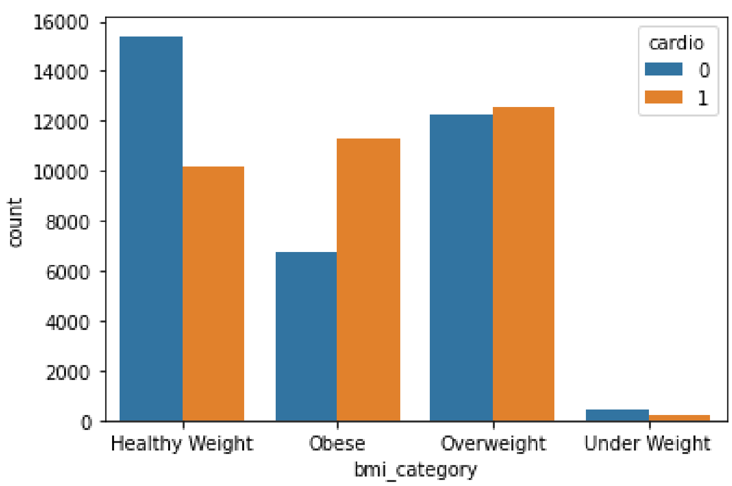

Figure 4.3.5: Cardio and Non-Cardio Visual Based on BMI

From figure 4.3.5, we can see that people with overweight and obese have more chance of getting cardiovascular disease.

4.4 Correlation

We have seen multiple features and their effects for getting affected by the cardiovascular disease so far. However, we must look at each feature's association to see which one has the most significant influence on cardiovascular disease.

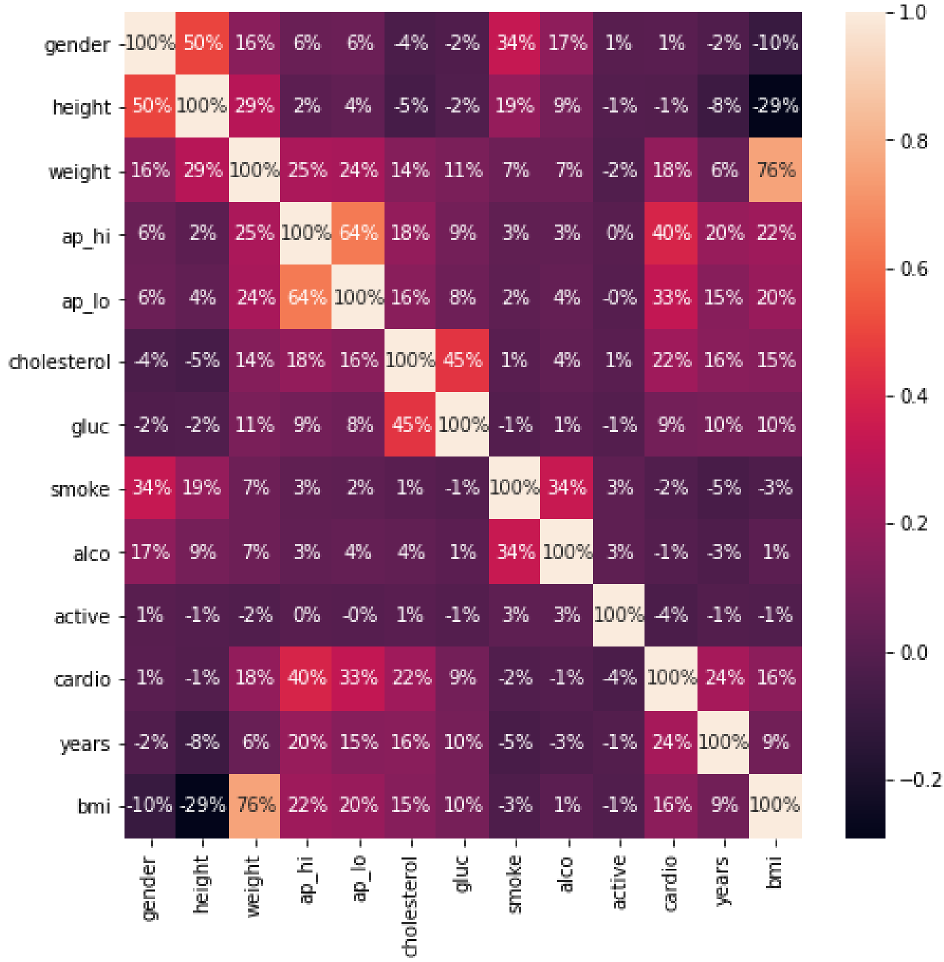

Figure 4.4.1: Correlation between each feature

We can see from figure 4.4 that ap hi and ap lo, which are systolic and diastolic blood pressure, respectively, are mainly responsible for cardiovascular disease. They have 40% and 33% influence on cardiovascular disease.

Other features such as years of the user, cholesterol, weight, BMI, and glucose are 24%, 22%, 18%, 16%, and 9% liable for cardiovascular disease.

However, some features like height, smoking behavior, alcohol intake, and physical activeness have negative correlations with cardiovascular disease.

4.5 Frontend Design

Building a sound system is not enough if the users of the system can not interact with it easily and efficiently. The frontend design of any system is the central part for the user to interact and take advantage of the system. Streamlit is an excellent tool in python to use and visualize as a frontend tool for data science. We used streamlit with python to users' data. The user will enter their health data and get the output on the same page. The benefit of streamlit for the developer is that it is easy to learn and easier to implement. Also, the apps developed with streamlit is pre-responsive. That is why the user can use it on any device, from smartphones to personal computers.

Figure 4.5.1: User Interface Design with streamlit

4.6 User Input

The system must first take the users' inputs before processing and measuring their data in order to provide them with predictions about their health status. In the input section, the users will provide their health info which are gender, height, weight, systolic blood pressure, diastolic blood pressure, cholesterol, glucose, smoking habit, alcohol intake, and physical activeness that will help the system to do the calculation and give them feedback. These data can be collected through the smart devices that collect users' health data, for example, a fitness tracker. These devices then send the required info to the system. The system will also need some objective and subjective data. These data are stored for the user's account when they register for the first time. Those who do not own any smart device that can get their health data will be given options to enter their data manually.

Also, our system will give the user hospital recommendations based on their health condition and location. That is why the users need to provide their location info as well. The location info will be taken through the GPS module of the users' device. If it fails to get the GPS data, then the users can enter their location info in the input field.

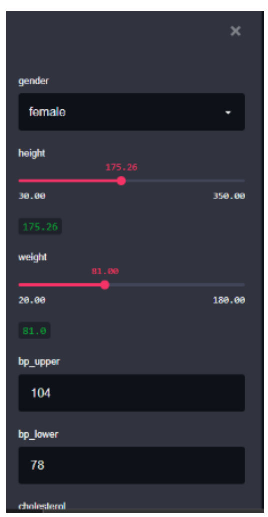

Figure 4.6.1: User Input

4.7 Detect Location

Detecting users' location can be done variously.

- Using Users IP Address
- Using Users GPS Address
- Manual Input

1. **Using Users IP Adress:** When someone uses the internet, he leaves his IP. We can easily get users' locations with their IP addresses and use them to recommend hospitals. However, tracking a user's IP has a limitation. Most of the people in our country use a public IP address. The internet providers give the same IP to most of their customers to reduce cost. That way, every one of those customers uses the same IP address. If we look for the location using that IP address, we will find the internet service provider's location, not the users. Also, an IP address can be easily changed with a Virtual Private Network or VPN. That is why getting the location from the user's IP is not a suitable solution.
2. **Using Users GPS Address:** Almost every intelligent device nowadays, like smartphones, smartwatches come with a built-in GPS module, which can be used to detect users' location. The benefit of using GPS is that it can give the precise location of the user. However, the drawback of using GPS is most of the computers do not have a GPS module built in. If the system asks for GPS permission from the browser on a computer, it will give the IP address location that is not suitable, which we have discussed earlier. But, for mobile devices, GPS is beneficial while getting precise location.
3. **Manual Input:** Since IP address does not give a precise location, and GPS can not give location information for all devices, that is why manual location input is suitable in many cases. Users can store their location for the first time during their registration process. Alternatively, they can input it manually every time they check for their health condition. The location given by the users can be converted using

various mapping API such as Google Map, Bing Map, Here Map, MapBox etcetera. The limitation of using manual input from the user to get location is that different mapping API can give different results. It does not give precise location all the time. But this method gives closer to a precise location.

4.8 Calculating Distance

After getting the latitude and longitude from the user's provided address, the system calculates its distance with the hospitals' latitudes and longitudes from the hospital dataset. For calculating the distance, the system uses the distance method from the geopy module. The distance method uses the geodesic distance algorithm provided by Karney (2012, p. 47). [18]

4.9 Recommend Hospital

Recommending hospital or healthcare service to the user based on their location and disease is one of our system's primary goals. After detecting the users' health condition and location, our system gives them the top five hospitals from their location and based on their disease. It will save the user a lot of time searching for the right hospital. In figure 4.9.1 is the list of hospital and their contact information based on the users' condition and location. In figure 4.9.2 is the map view of the hospitals along with users' location for user convenience.

	Hospital Name	Speciality	District	Address	Full Address	Co-Ordinates	Contact Details	Distance
0	National Center for Contr…	Heart Hospital	Dhaka	Dhaka 1207, Bangladesh	Shaheed Suhrawardy Medica…	23.770037773196396, 90.37…	88029115481	3.681
1	National Institute of Car…	Heart Hospital	Dhaka	Dhaka 1207, Bangladesh	Shaheed Suhrawardy Medica…	23.770713019551447, 90.36…	http://nicvd.gov.bd/	3.762
2	Saaol Heart Center (BD) L…	Heart Hospital	Dhaka	nan	H.No 26, Eskaton Garden R…	23.74569544293002, 90.396…	8801777780851	4.354
3	জাতীয় হৃদরোগ ফাউন্ডেশন হা…	Heart Hospital	Dhaka	nan	Plot-7/2, Dhaka 1216, Ban…	23.80380191847623, 90.361…	+880 2-9033442	4.734
4	National Heart Foundation…	Heart Hospital	Dhaka	26 দারুস সালাম রোড, ঢাকা …	26 Darus Salam Rd, Dhaka …	23.788843219182674, 90.35…	http://www.nhf.org.bd/	4.935

Figure 4.9.1: Recommended Hospitals based on the disease and location

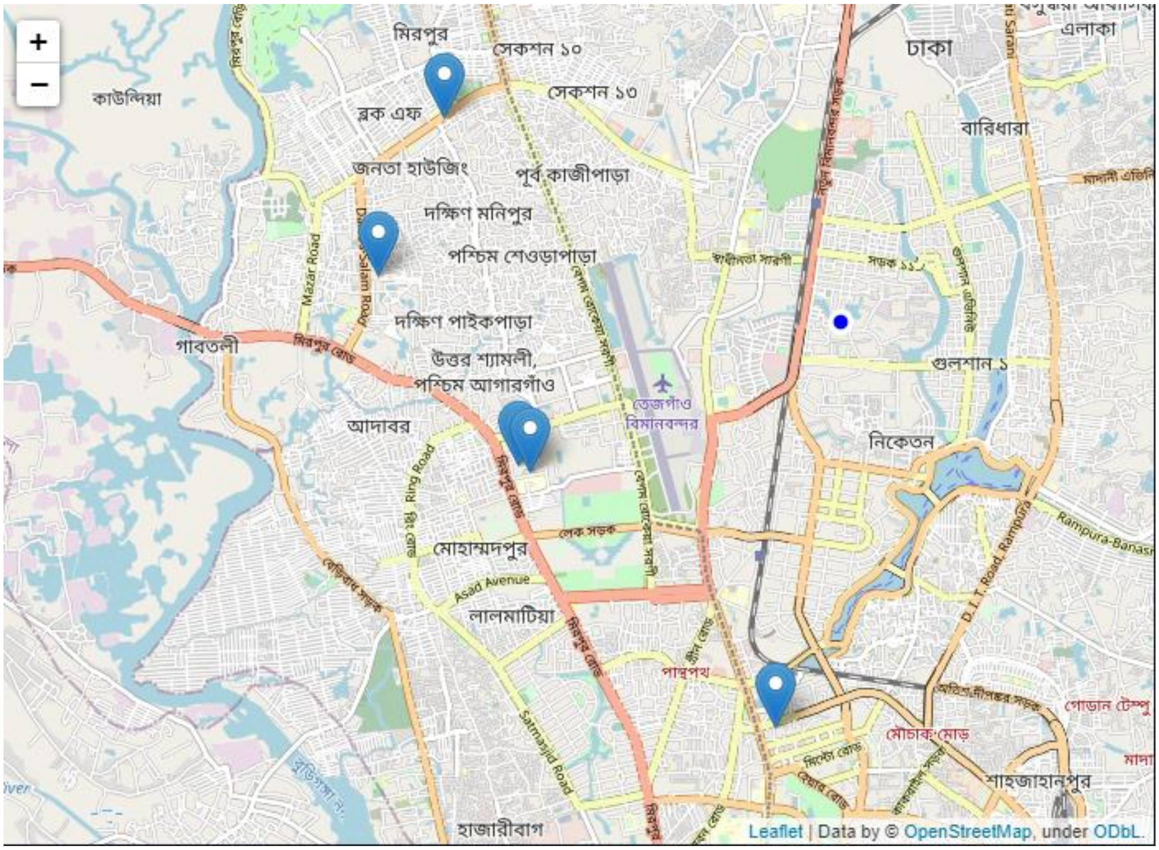

Figure 4.9.2: Recommended Hospitals based on the disease and location in Map

Sometimes a specialized hospital may not be available from the users' location. In that case, our system will recommend hospitals based on the users' location only. In figure 4.9.3 is the list of available hospitals based on the users' location. In figure 4.9.4 shows the map view of the hospitals closer to the users' location.

	Hospital Name	Speciality	District	Address	Full Address	Co-Ordinates	Contact Details	Distance
0	ICDDRB Dhaka Hospital	Genaral Hospital	Dhaka	nan	Shaheed Tajuddin Ahmed Ave,…	23.78424097204507, 90.40157…	8809666771100	0.1892
1	Universal Medical College H…	Genaral Hospital	Dhaka	nan	74G/75, Pea-cock Square, Ne…	23.783594406201274, 90.3959…	8801841480000	0.7701
2	Impulse Hospital	Genaral Hospital	Dhaka	nan	Behind Channel I office, 30…	23.773790464643636, 90.3986…	8801715016727	1.2819
3	Badda General Hospital Pvt.…	Genaral Hospital	Dhaka	nan	107/2, Uttar Badda, Progoti…	23.795376960042947, 90.4237…	8801790776722	2.3973
4	CPHD General Hospital Ltd.	Genaral Hospital	Dhaka	nan	24 Shaheed Tajuddin Ahmed A…	23.76055469820749, 90.39924…	8801704741633	2.6865

Figure 4.9.3: Recommended Hospitals based on the location

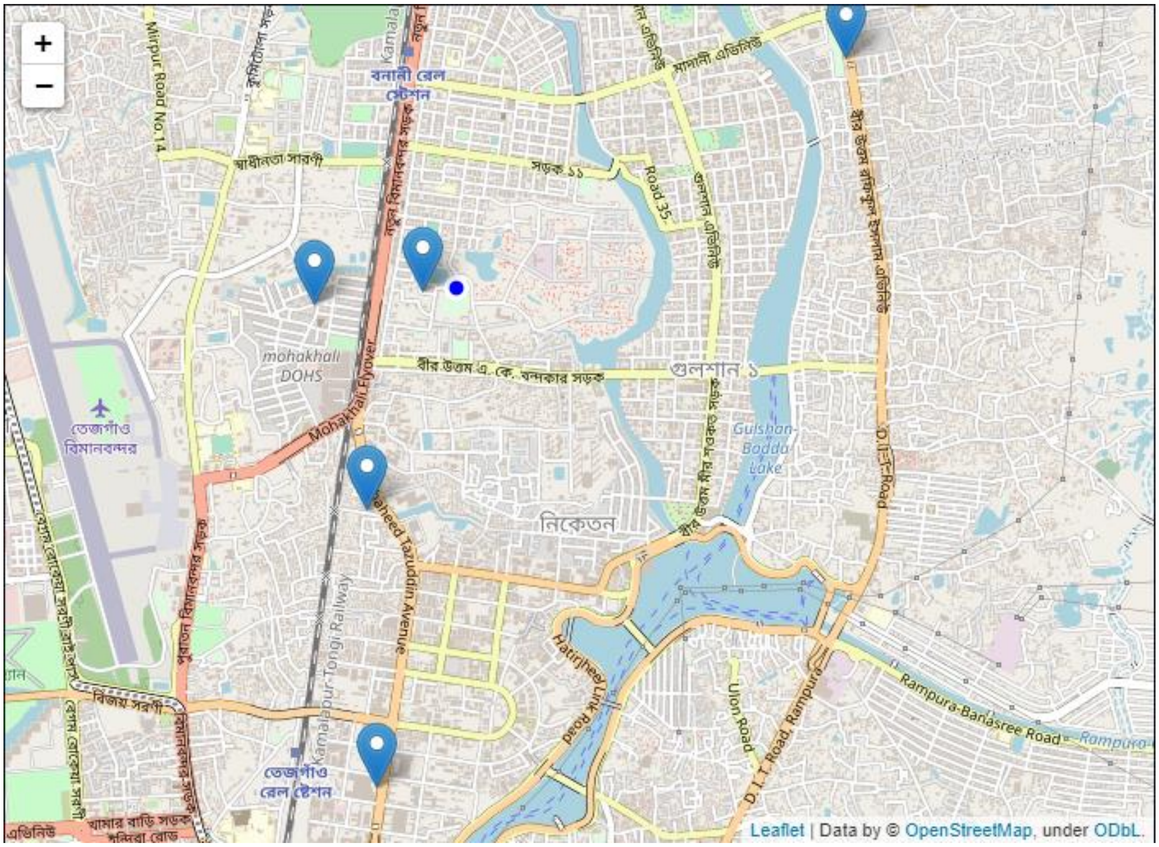

Figure 4.9.4: Recommended Hospitals based on location in Map

CHAPTER 5
RESULT

5.1 Different Approach and Results

For training and testing the cardiovascular disease dataset, we have used the scikit-learn model and tried its different classifiers. Those classifiers are:

- AdaBoostClassifier from ensemble
- MLPClassifier from neural_network
- SVC from SVM
- KNeighborsClassifier from neighbors
- DecisionTreeClassifier from tree
- RandomForestClassifier from ensemble
- GaussianNB from naïve_bayes
- QuadraticDiscriminantAnalysis from discriminant_analysis

We have tested every one of the classifiers above to measure the maximum accuracy of our dataset. We have used 85% of the total dataset for training purposes, and 15% is for testing. After testing these 15% data, we have got different results for different classifiers. We have got a maximum accuracy of about 72.5%.

From table 5.1, we can observe the different accuracy scores of different classifiers. Some of them have slightly different accuracy score from another. However, we are considering the maximum accuracy from them. That is why we are using the AdaBoostClassifier since it gives the maximum accuracy score.

Table 5.1.1: Accuracy Scores of different classifiers

Classifiers	**Score**
AdaBoostClassifier	0.725464
MLPClassifier	0.723628
SVM	0.719571
KNeighborsClassifier	0.716094
RandomForestClassifier	0.701990
GaussianNB	0.700927
QuadraticDiscriminantAnalysis	0.685471
DecisionTreeClassifier	0.632921

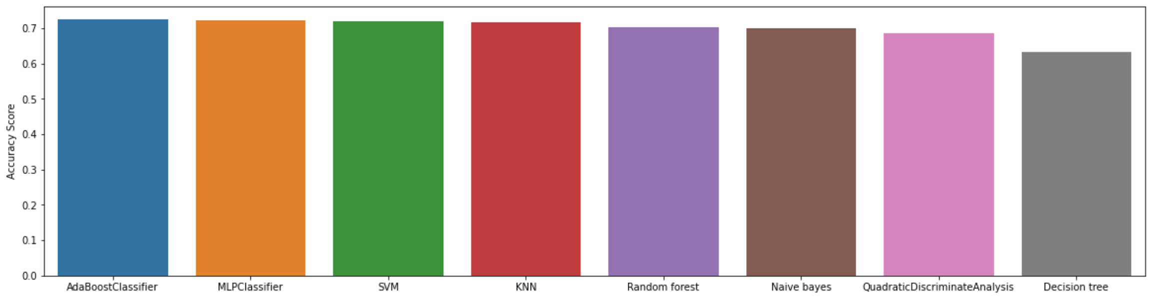

Figure 5.1.1: Accuracy Score of different classifiers

CHAPTER 6
CONCLUSION & FUTURE WORK

6.1 Conclusion

The suggested approach examines the values of various health parameters obtained from a wearable smart tracker. Sometimes people get sick all of a sudden. In this situation, the victim requires immediate medical attention. That's why we proposed a Health care recommendation system which will detect patient health condition and suggest the nearest hospital for urgent need.

In this project, we looked at different algorithms and how they could be used in a disease detection system. From the scikit-learn model, we have used eight different algorithms to gain maximum disease detection accuracy from the dataset. User data will be collected using a smart tracking device such as a smartwatch, and few static data will be collected from the user. The smart tracking system can constantly gather data and communicate with a smartphone, as well as store data in the cloud. The system also collects GPS location, and for urgent needs, the system will recommend the nearest hospitals. Therefore, nearby hospitals will be recommended to the user that can save the victim's life.

6.2 Limitation

As a growing nation, our national system doesn't have centralized patient data. We cannot track patient's previous data or comparing them with current data. Also, if the sensor doesn't work fine, it can produce the incorrect parameter value, resulting in an incorrect prediction. Sometimes Machine Learning algorithm cannot detect with a hundred percent accuracy, so it may cause faulty prediction.

6.3 Future Work

In our future work, we want to implement our work in real life. In just a few years, technology has advanced tremendously. We can see a system that can distinguish several parameters from users and can be used more accurately to provide more precise results when tracking the users' health conditions. We can also add the facility recommending specialized doctors along with the hospital. Based on the patient situation system can also call an ambulance, informing relatives.

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