Final Year Design Project
Final Report
[EEE 400C or ECE 402C]

Project Title: Smart Biomedical Device to Predict Lung Diseases, COVID-19 And Diabetes by Using Machine Learning Algorithms.

By

Name: Ashraful Hossain
ID: 18121040
Name: Shahidul Islam Pranto
ID: 18121104
Name: MD.Nur-e-Sultan Alif
ID: 18121085
Name: Mohammad Moontasir Fahim
ID: 18121004

Date of Submission: 29/04/2022

Table of Contents

Chapter 1: Introduction

1.1 Introduction

The people of Bangladesh face a lot of issues when they have to go to diagnostic centers to diagnose their diseases. First of all, diagnosis of disease is expensive for developing countries like us which already have lots of other issues to handle like accommodation, price hike e.t.c. The poor doctor to patient ratio in Bangladesh makes our healthcare system more inaccessible. We need a good diagnosis system and also good treatment for the wellbeing of the people. Recently, many problems have arisen regarding health diagnostic centers i.e. fraudulent etc. To tackle most of the problems we need some optimization in this health diagnostic system. The solution that we bring in is a contribution from modern engineering technology. The preliminary detection of people's health related problems will reduce the chances of a bad health diagnosis experience.

1.1.1 Problem Statement

Bangladesh is a developing country. As a result its healthcare system is not up to the mark. Also the diagnosis cost is very high for the majority of the people. Many of them are deprived of expensive diagnosis facilities. In that pandemic time it's become more evident we are lacking enough diagnosis centers.

Also diabetes is one of the most common diseases in the world. In Bangladesh about 7.1 million people had diabetes, 3.7 million cases were undiagnosed. Most of the cases patients go to the hospital at later stages. So the early prediction of diabetes is a must. It is mandatory to check our medical condition regularly. As it is a time consuming process also the diagnosis centers are not cheap. As the solution to this problem we have built a smart medical system which can give us the preliminary prediction of COVID-19, lung diseases and diabetes by using our sensor device and integrated machine learning system.

1.1.2 Background Study

The Covid illness 2019 (COVID-19), a worldwide pandemic brought about by serious intense respiratory condition Covid 2 (SARS-CoV-2), has caused enormous social weight and monetary misfortunes for some locales and nations on the planet. As indicated by the most recent measurements of the World Health Organization (up to May 18, 2020), 4 589 526 cases have been tainted in more than 216 nations, zones, or domains, bringing about 310391 deaths [1]. Furthermore, the quantity of affirmed cases is as yet heightening quickly around the world, which has prompted an unprecedented challenge in front of the international community [2], [3].On the other hand ,According to the latest WHO data published in 2018 Lung Disease Deaths in Bangladesh reached 64,762 or 8.34% of total deaths. The age adjusted Death Rate is 61.82 per 100,000 of population ranks Bangladesh #7 in the world. Furthermore, Diabetes continues to be a major contribution to the worldwide illness burden[1]. Diabetes patients are more likely to develop a variety of major life-threatening micro and macro vascular problems, which result in higher medical costs, lower quality of life, and higher mortality[2]. According to the International Centre for Diarrheal Disease Research in Bangladesh in 2015, 7.1 million people had diabetes, 3.7 million cases were undiagnosed and about 129 000 deaths were

attributed to the disease . In Bangladesh, there were 8.4 million adults living with diabetes in 2019, and projected to almost double (15.0 million) by 2045.[10][11] It is also estimated that another 3.8 million people had prediabetes in Bangladesh in 2019.[5] Recent research presented in, has proposed a hybrid diabetes detection system based on mixing two common techniques from deep learning which are the Long Short-Term Memory (LSTM) method and the Convolutional Neural Network (CNN) method. The obtained results confirm the effectiveness of deep learning by reaching 95.7%. In addition, authors also have presented a deep learning approach to identify diabetes by using the Recurrent Deep Neural Network (RDNN) method. This approach was evaluated by using the public well known data set Pima Indians diabetes. The performance of the proposed approach was very good and has reached an accuracy of 81%. Moreover, authors have proposed a hybrid system composed by three common algorithms of machine learning which are the Decision Tree (DT), the Neural Network (NN) and the Random Forest (RF) methods to predict diabetes.[9] Keeping all of these in mind, We propose a model that can take data from the user. And with the help of those data , by using machine learning algorithms, the model can predict the lung related diseases like covid19 , asthma, flu etc. and diabetes. [4].We came to know about the difference among the lung related diseases based on the symptoms [5]. Moreover , Based on the symptoms, we take data on the basis of 17 parameters. MAX30102, GY906 and glucometer sensors are integrated with Arduino Uno to determine SpO2 , body temperature and heart rate and glucose level [6] We will make the dataset on our own with the help of our device and some question answers. We use some of the machine learning algorithms like K Nearest Neighbors, Decision Tree classifier, Random Forest classifier to predict the result [13][14] .We are planning to show the predicted result over a mobile phone by building an app using android studio. [12]

1.1.3 Literature Gap:

A research paper shows that to measure the oxygen saturation a sensor named Max30100 is used. By using this sensor Sp02 heart rate can also be measured. Based on these parameters they apply various machine learning algorithm to like linear regression, Support vector machine, K nearest neighbors, Random forest regression and they got the better accuracy in random forest regression to predict the Covid 19 possibilities of patients .[8] In our project we are Using Max300102 sensor which is the 3rd generation sensor ,along with this device we are also using GY906, Glucometer to measure the body temperature, heart rate , and glucose meter. By applying machine learning algorithms we are predicting not only Covid 19 possibilities but the chance of having different kinds of lung related diseases.

Another journal paper shows that they have measured Sp02 with the help of MAX30102 . Along with these parameters they worked with another four parameters to make the dataset and predict the possibilities of Covid 19 with 75% accuracy.[6] They worked with Covid 19 only. They did not focus on other diseases. Another recent research implemented a prediction model for the risk measurement of diabetes. [9]. They used a Deep Learning method and found an accuracy of 98%. There is no clear indication for the user on how to use this method on an app or website. To summarize, we can say that these jornal mentioned above have worked on one disease at a time like only covid 19 or only diabetes. They did not show any model or device

that can predict more than one disease at a time with the help of machine learning algorithms. Moreover they did not propose any website or app to show the predicted result to users . Which can be very convenient for them when they will use the model.

1.1.4 Relevance to current and future Industry:

Now a days this kind of project are done by various countries enthusiasts. For example:

1. "Patient Health Observation and Analysis With Machine Learning And IoT Based in Real Time Environment" by Arnab Dey, Pramit Brata Chanda, Subir Kumar Sarkar :

Explanation: Their project is mainly focused on- In global pandemic situations like today's, whenever doctor is unable to monitor patient then this IoT based Machine Learning model will help patients to provide proper medicine through medical staff available based on the symptoms and reports from the IoT sensors with the Machine Learning (ML) trained data set. Here the results obtained for prediction of diabetes and heart diseases, through various machine learning approaches are shown.

2. "Advanced Healthcare System using Artificial Intelligence" by Santosh Sanjeev, Gowtham Sai Ponnekanti, G. Pradeep Reddy,

Explanation: This paper proposes a resourceful, web interface which enables access of medical records to the patients and a neural network model which predicts medication for ailments. The web interface acts as a medium between doctor and patient, allowing them to access the required information. The proposed method uses custom trained speech to text models and applies Natural Language Processing (NLP) on the acquired text, to provide the patient with a prescription. The AI bot used for medication prediction has achieved an accuracy of 88%. Now their future aim is to increase the accuracy level of prediction.

1.2 Objectives, Requirements, Specification and constant

1.2.1. Objectives

- To give an early prediction of diabetes and lung related diseases like Covid19, Asthma, Flu etc.
- To collect user symptoms data as well as other health parameters in order to give predictions about the health condition of the user.
- It will be cost efficient and portable to carry around so that it is available to everyone.
- It can publish the prediction result online so that users don’t have to rely on the diagnostic centers.
- It’s a user friendly and time saving smart medical tool.

1.2.2 Functional and Nonfunctional Requirements

Functional Requirements:

- Implementing a portable smart medical device.
- Implementing a cost efficient device.
- Monitoring the patient's condition continuously by using a mobile app connected with our device through bluetooth.
- Continuous electric supply and internet connectivity
- Maintaining a hassle-free time efficient system by instantly publishing results through the website by embedded machine learning system.

Non-Functional Requirements:

- To implement the entire system using common PVC/plywood to establish the main structure.
- Adding additional warning messages or signals if any disease is detected.
- Assisting patients by providing nearby hospital location and mobile number.

1.2.2 Specifications

System	Sub-system	Requirements	Components	Specifications
Smart medical device	Sensor based parameter collection	Central Processing Unit	Arduino Uno	• Operation voltage: 5V • Input Voltage: 7-12V • Clock Speed: 16MHz • DC current per I/O pin: 20mA
	To show sensor reading	Digital Display	LCD Graphic 128	• LCD Display Type: FSTN

			X 64 Display	• 2.Module Size: 80mm x 54mm • 3. Operation Temperature Min: -20°C • 4.Operating Temperature Max: 70°C
	To measure oxygen level	Oximeter	MAX30102	• LED Peak Wavelength: 660nm/880LED Supply • Voltage:3.3~5V • Interface: I2C • Interface Operating Temperature Range: -40°C to +85°C • Dimension: 20.3 x 15.2mm
	To measure body temperature	Temperature sensor`	GY906	• VCC Range: 3.3 – 6V • Operating Current: 2mA • Object temperature: -70 to +380°C (-94 to +720°F) • Sensor temperature: -40 to 125°C • Accuracy over range of 0 to 50°C: ±0.5°C • Resolution: ±0.2°C

				• Distance: 1cm
	To measure glucose level	Glucose sensor	Glucometer	• Measuring range: 10 – 600 mg/dL with ±2% accuracy Blood Volume: not more than 1 -2 microliter. • A storage facility for not less than 300 test results with date and time should be available • Glucometer should be supplied with lancing device and universal needle set. • Strip - 500 nos. (for 1 unit) Needle - 500 nos. (for 1 unit)

Communication system	To transfer real time data to mobile app	Bluetooth module	HC-05	• frequency: 2.4GHz ISM band • Modulation: GFSK (Gaussian Frequency Shift Keying) • Emission power: ≤4dBm, Class 2 • Sensitivity: ≤−84dBm at 0.1% BER • Speed: Asynchronous communication: 2.1Mbps (Max) / 160 kbps, Synchronous communication: 1Mbps/1Mbps • Security: Authentication and encryption • Profiles: Bluetooth serial port • Supply Voltage: +3.3V to 6.0 V • Supply Current: 30mA • Working temperature: -20 ~ +75Centigrade

1.2.3 Technical and Non-technical consideration and constraint in design process

Technical Considerations:

- Convenient user interface for accessibility.
- Components availability.
- Swappable options.
- Easy components interfacing.
- Cost effective.
- Easy maintenance.

Non-technical Considerations:

- Advertising.
- Lawyer to ensure legal approval.

Constraints:

- Complicated troubleshooting.
- Overvoltage protection.
- Continuous electric supply & internet connectivity.
- Risk of leaking personal data
- For best outcomes, some of the components are not budget-friendly.

1.2.4 Applicable compliance, standards, and codes

Required Standard	**Standard Number**	**Definition**	**Comment/How does it affect our solution**
Bluetooth	IEEE 802.15. 5	provides the architectural framework enabling WPAN devices to promote interoperable, stable, and scalable wireless mesh networking. This standard is composed of two parts: low-rate WPAN mesh and high-rate WPAN mesh	This standard is used to send the real time device sensor data from the module to the android app wirelessly.

		networks. The low-rate mesh is built on IEEE 802.15.	
Continuous glucose monitoring system (CGM)	ISO/IEEE 11073	ISO/IEEE 11073 family of standards for device communication, a normative definition of the communication between continuous glucose monitor (CGM) devices and managers	It is used to get the real time glucose level of a patient.
Pulse oximeter	ISO/IEEE 11073-10404:2010	his standard establishes a normative definition of communication between personal telehealth pulse oximetry devices and compute engines	It is used to get the real time oxygen level of a patient.

Infrared temperature sensor (GY-906)	Standard IIC communication protocol.	I2C is a serial communication protocol, so data is transferred bit by bit along a single wire (the SDA line). Like SPI, I2C is synchronous, so the output of bits is synchronized to the sampling of bits by a clock signal shared between the master and the slave. The clock signal is always controlled by the master.	It is used to get the real time body temperature reading of a patient.

1.3 Systematic Overview/summary of the proposed project:

In our project there are two parts: one is hardware & the another one is the software part. 1st of all in the hardware part, we will obtain some specific parameters by using temperature, glucose meter & oximeter sensor. Through these sensors, some parameters will be collected. Then in

the software part I mean in the website there will be some question answer-based parameters where the patients will fill up the form. The question will be like Gender, Age, Type of chest pain etc. These data will go to our server and predict the disease through machine learning. Then the result will be published within a minute on the website.

1.4 Conclusion:

Bangladesh is an overpopulated country where the health diagnosis is not affordable for everyone. Moreover, lung related problems and diabetes have added more misery to people. In most cases people took the lung diseases very lightly. They come to know about the disease when it becomes Severe. In that condition they have to suffer more in every way. Same thing goes to COVID 19 and diabetes. If people are aware of their diseases they can take precautionary steps before it is too late. By using our device and website people can be aware of their heart condition and consult a doctor when necessary. Furthermore people can keep a track of their sugar level easily at home as well as they also can check the percentage of which lung diseases they have got based on their symptoms. Which helps them to avoid sudden danger caused by diabetes and lung diseases. We are hoping that In future we will be able to add some more features into this device for other diseases prediction.

Chapter 2: Project Design Approach

Introduction:

We proposed a total of four designs that fulfills our desired objectives, requirements, and constraints.Each design satisfies all of the requirements.Each design will be thoroughly discussed.To begin, we must ensure that our design encompasses all of our objectives in order to achieve the aim.Secondly,we must see all of the necessary requirements to solve our problem in order to achieve our goal. Finally,in order to achieve an efficient solution, we must ensure that it adheres to all restrictions or constraints.As a result, we will be able to meet all of the criteria.

1.1 Identify multiple design approach

Design 1: Arduino with bluetooth and separate website system
Design 2: Using MAX30100 and lm35 cheap sensors
Design 3: Arduino with wifi module and no website
Design 4: Using Raspberry Pi and integrated website and machine learning system

1.2 Describe multiple design approach

Design 1: Arduino with bluetooth and separate website system

Objective:

Here the system uses machine learning algorithms to predict the preliminary disease of the user. The system is able to collect data through some medium, thus providing the facility to predict the disease. It will collect the data through a website thus making the system easily accessible from anywhere in the world. The result will be published almost instantly on the website. The system will be a good user friendly tool for regular users. This subsystem fulfills our objectives.

Requirements:

This subsystem fulfills all the requirements as it uses four sensors for the human health parameter detection like temperature, oxygen saturation, heart beat, glucometer. Data and symptoms collection, real time sensor value monitoring by using mobile apps, disease prediction, instantaneous and auto result publication can be done by the subsystem. So the subsystem fulfills all our requirements.

Constrains:

One of our main constraints was to collect the data for the model training. But our sensors are capable enough to make the task possible. The website needs maintenance to ensure that it can handle the load of huge traffic as well as it can enable as many subscribers as possible, therefore, the constraint is mitigated. We use the most advanced sensors that are available to ourselves thus it can provide us the correct results. We will use rechargeable batteries so one battery can last for much longer.

Table 2: Criteria table for design 1

Objectives	Requirements	Constraints
✓	✓	✓

System:

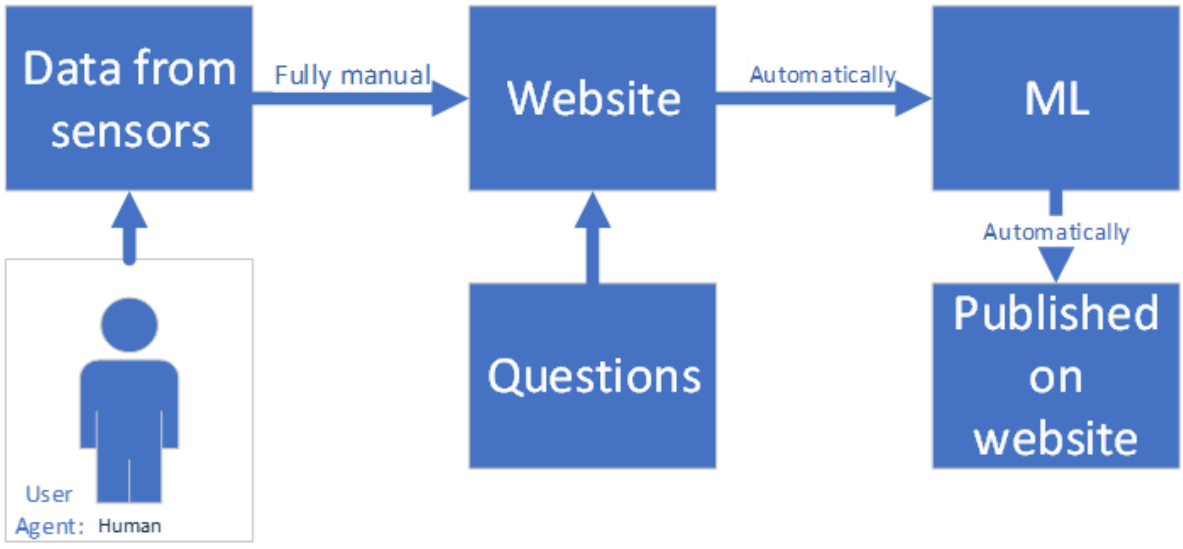
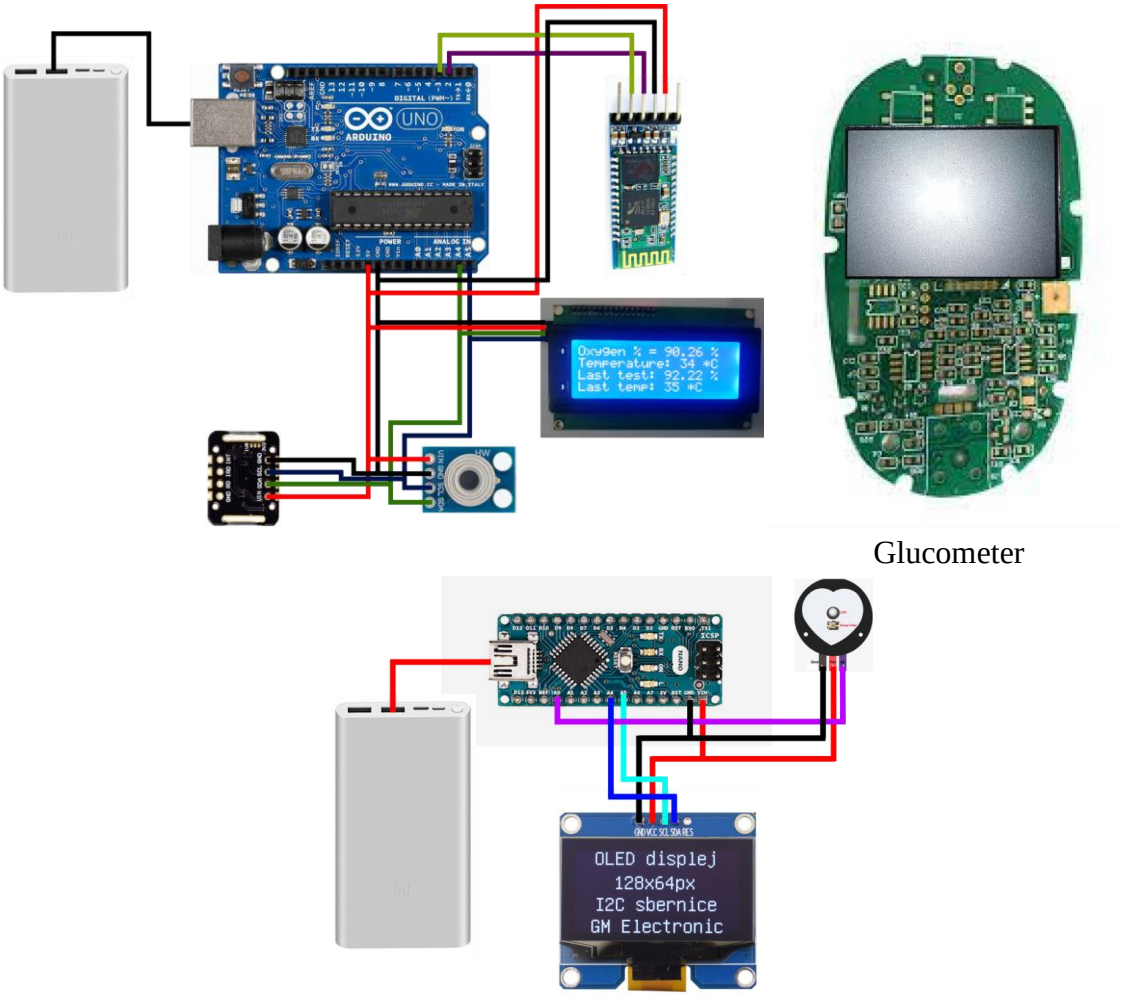


Fig 1: System for design 1

Circuit:



Glucometer

Fig 2: Device for design

Design 2: Using MAX30100 and lm35 cheap sensors

Objective:

Here the system uses machine learning algorithms to predict the preliminary disease of the user. The system is able to collect data through some medium, thus providing the facility to predict the disease. It will collect the data through a website thus making the system easily accessible from anywhere in the world. The result will be published almost instantly on the website. The system will be a good user friendly tool for regular users. This subsystem fulfills our objectives.

Requirements:

This subsystem fulfills all the requirements as it uses four sensors for the human health parameter detection like temperature, oxygen saturation, heart beat, glucometer. Data and symptoms collection, real time sensor value monitoring by using mobile apps, disease prediction, instantaneous and auto result publication can be done by the subsystem. So the subsystem fulfills all our requirements.

Constrains:

One of our main constraints is the reliability of sensors. MAX30100 (oximeter) sensor's operating voltage is 1.5v. However, Arduino Uno operates at 5v. To meet up this problem there needs a voltage divider which makes the system more complicated. This problem can be easily solved by using MAX30102 2nd generation in the design 1. There's no need for any voltage divider or modification into the circuit. On the other hand the lm35 (Temperature sensor) value is not able to give a steady and reliable value. To meet up this problem we are using more advanced infrared based contact less temperature sensor GY906 in the design 1.

Table 3: Criteria table for design 2

Objectives	Requirements	Constraints
✓	✓	**X**

System:

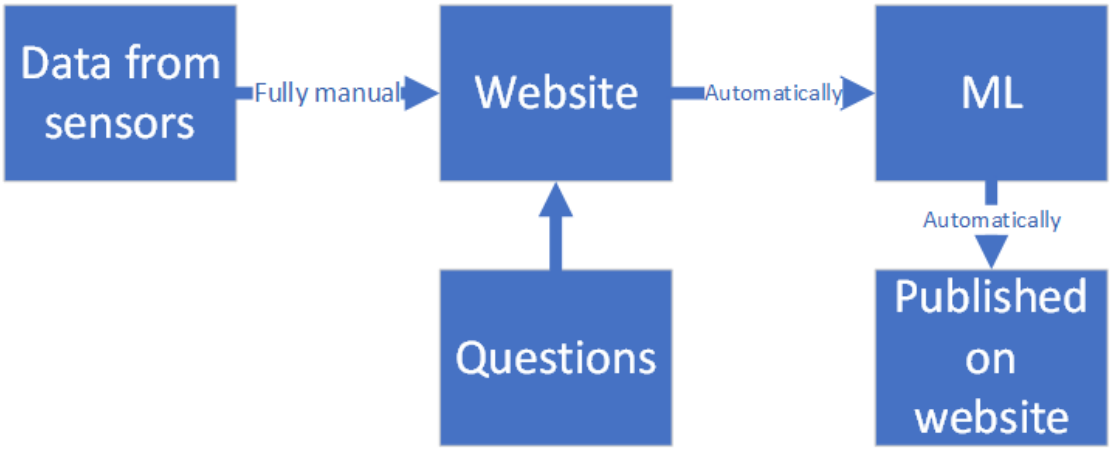


Fig 5: System for design 2

Circuit:

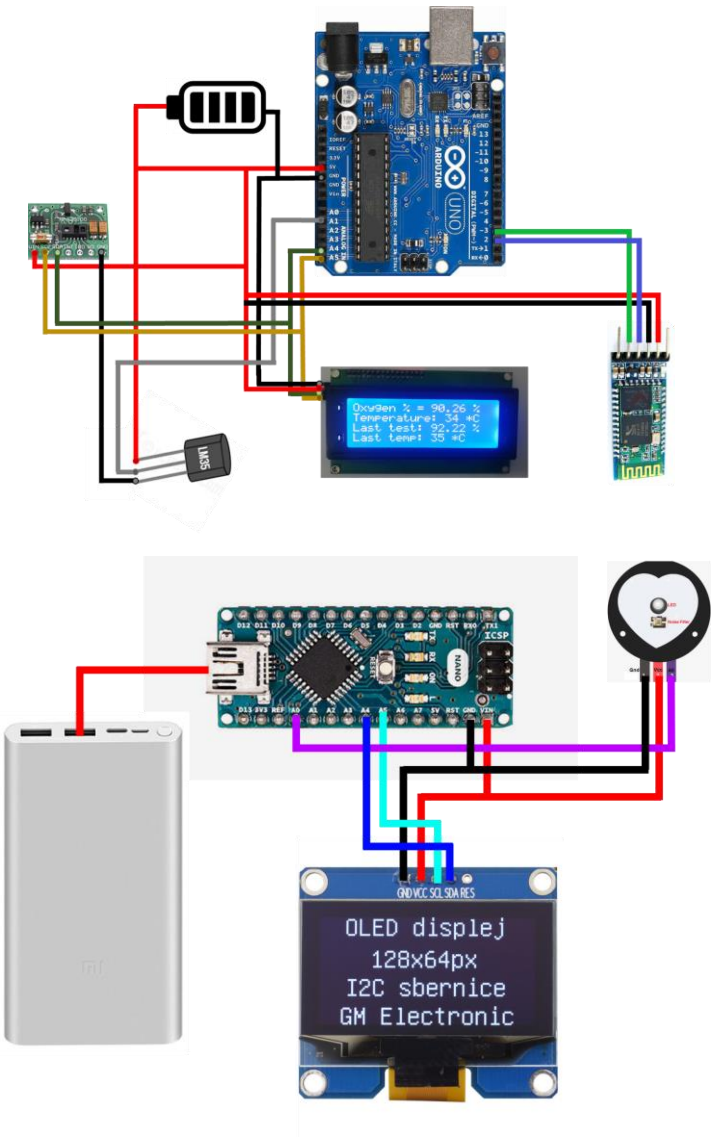


Fig 6: Device for design 2

Design 3: Arduino with wifi module and no website

Objective:

In this design , the system also uses machine learning algorithm and user data to predict the preliminary lung diseases of the user. When the user uses the sensors the data will automatically be stored in the google sheet with the help of Wifi module. On the other hand, the user will put other other parameters and email id by using Google form and the these parameters will be stored in the Google sheet. After storing, we will manually put the parameters in the software for machine learning purposes. After that the result will be sent to the user's email id. This system is easily accessible for everyone from anywhere in the world . This system fulfills our objectives also but in different ways.

Requirements:

This subsystem fulfills all the requirements as it uses four sensors for the human health parameter detection like temperature, oxygen saturation, heart beat, glucometer. Data and symptoms collection, real time sensor value monitoring by using mobile apps, disease prediction can be done by the system. The result publication is not instantaneous and automatic. So we can say that the subsystem fulfills our requirements in most cases.

Constrains:

One of our main constraints in this system is efficiency. If the sensor data is collected through a wifi module and the question answer based parameters are collected through google form it will create two separate tables on the google sheet. Which will create a huge problem to do machine learning. As the machine learning operator has to put all the parameters manually into one table. Which will delay the machine learning process. And the result will be published through an email. Which also may arise the network problem issue. To meet up this problem we are using a website mentioned in the design 1.

Table 4: Criteria table for design 3

Objectives	Requirements	Constraints
✓	✓	X

System:

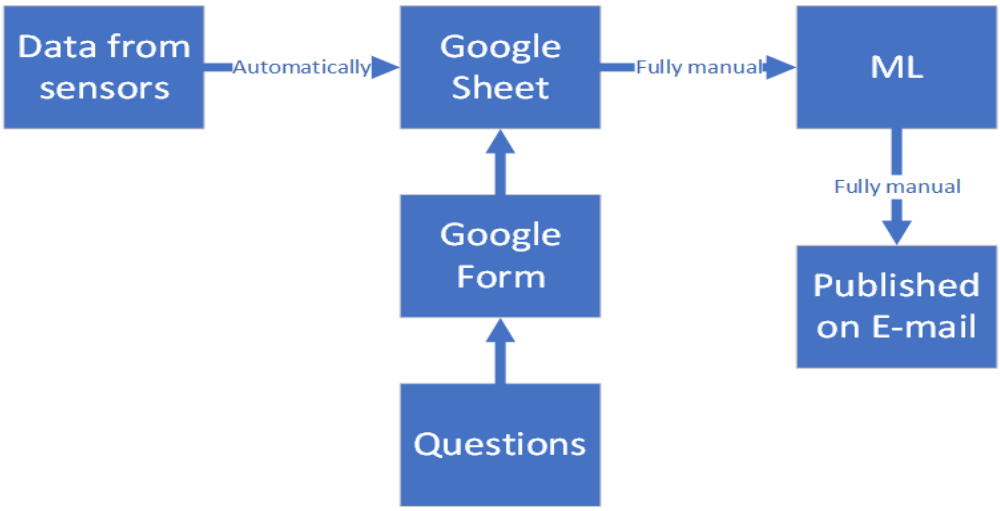
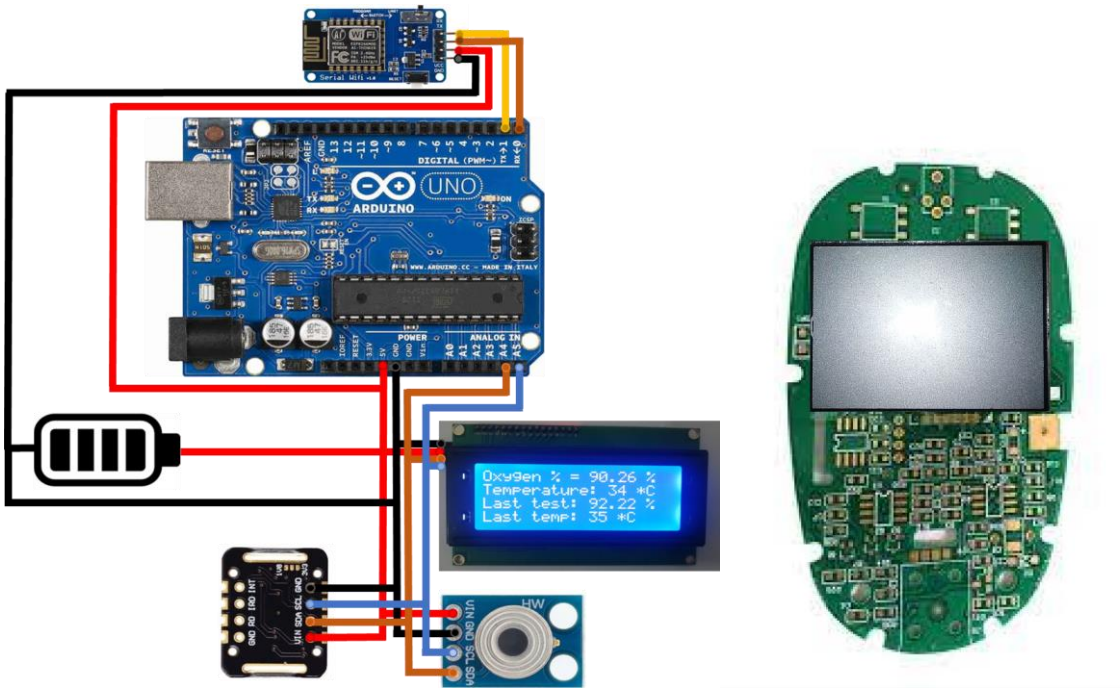


Fig 9: System for design 3

Circuit:



Glucometer

Fig 10: Device for design 3

Design 4: Using Raspberry Pi and integrated website and machine learning system

Objective:

Here the system uses machine learning algorithms to predict the preliminary disease of the user. The system is able to collect data through some medium, thus providing the facility to predict the disease. It will collect the data through a website thus making the system easily accessible from anywhere in the world. The result will be published almost instantly on the website. The system will be a good user friendly tool for regular users. This subsystem fulfills our objectives.

Requirements:

This subsystem fulfills all the requirements as it uses four sensors for the human health parameter detection like temperature, oxygen saturation, heart beat, glucometer. Data and symptoms collection, real time sensor value monitoring by using mobile apps, disease prediction, instantaneous and auto result publication can be done by the subsystem. So the subsystem fulfills all our requirements.

Constrains:

One of our main constraints in this system is efficiency. If the sensor data is collected through the GSM module and the question answer based parameters are collected through google form it will create two separate tables on the google sheet. Which will create a huge problem to do machine learning. As the machine learning operator has to put all the parameters manually into one table. Which will delay the machine learning process. And the result will be published through SMS service. Which also may arise network problem issues. To meet up this problem we are using a website mentioned in the design 1.

Table 5: Criteria table for design 4

Objectives	Requirements	Constraints
✓	✓	**X**

System

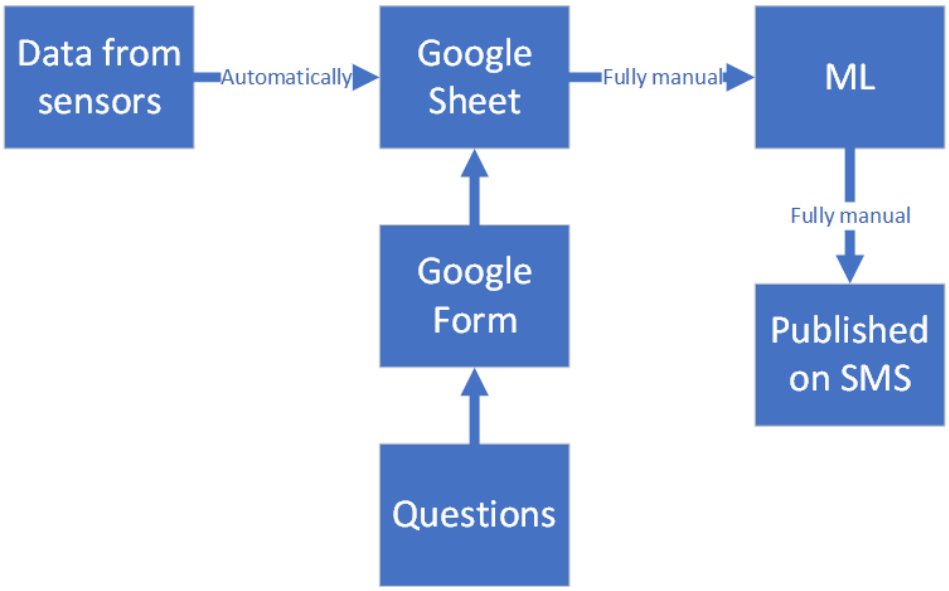


Fig 11: System for design 4

Circuit

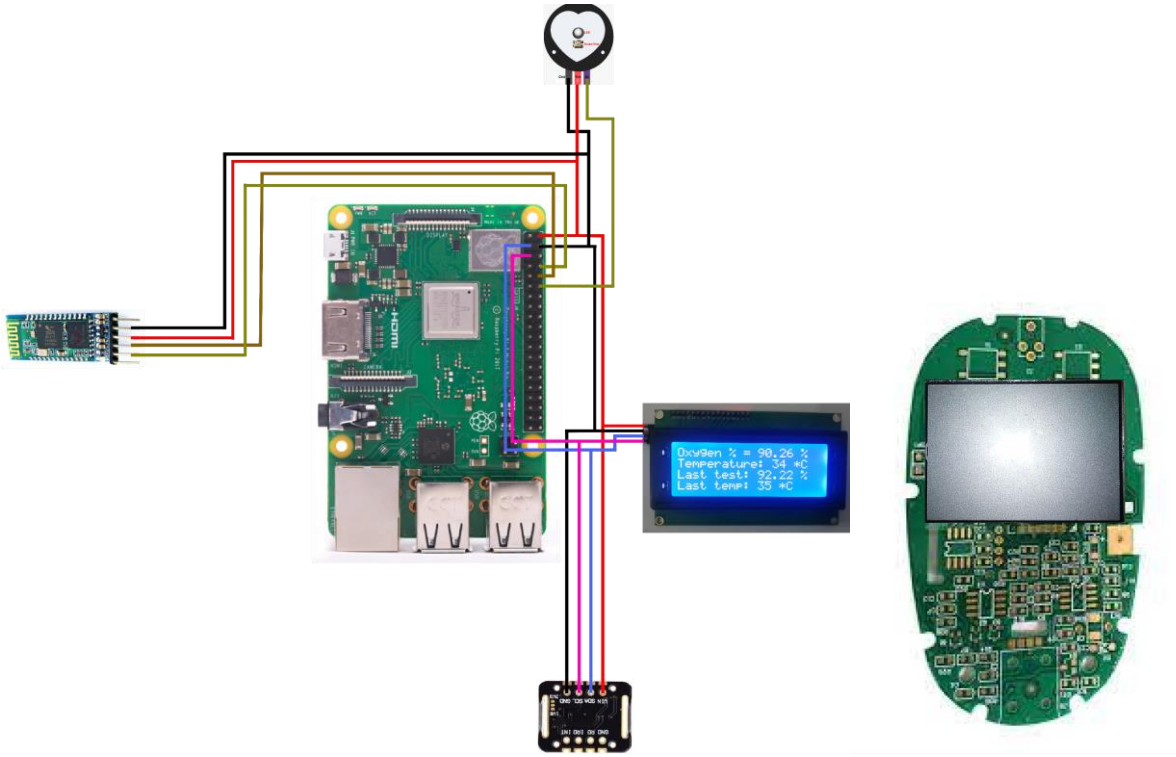


Fig 12: Device for design 4

1.3 Analysis of multiple design approach

For design 1:

For this design, we will be using MAX30102 and GY 906 to measure temperature and oxygen saturation of the users. These two modules are easily available in the market and also easy to implement on a system. These are costly compared to the similar sensors available in the market. We are using a website so that the user can provide their parameters e.g. Temperature, oxygen saturation and questions e.g. “Do you have wheezing?”, “Do you have a cough?” etc. The prediction of their diseases will be published instantly through the website. Thus this design makes the operation efficient, user friendly and sustainable.

Table 10: Analysis table for design 1

Detailed Analysis of Design 1							
Cost	**Efficiency**	**Usability**	**Manufacturability**	**Impact**	**Sustainability**	**Maintainability**	**Accessibility**
✓	✓	✓	✓	✓	✓	✓	✓

Design 2: Using MAX30100 and LM35 instead of MAX30102 and GY 906

For this design, we are using MAX30100 and LM35 for measuring temperature and oxygen saturation. These sensors provide the same parameters as design 1. These sensors have some of functional problems i.e. MAX30100 has to be modified in its circuitry to enable it to be used with another sensor within a system. On the other hand LM35 also has a functional problem i.e. it does not give a stable value of the temperature. Therefore, these sensors make the design less usable, less efficient, less sustainable than design 1. On the other hand LM35 is cheaper than GY 906 thus making the design cost effective that design 1. Other than this, the design is similar to design 1.

Table 11: Analysis table for design 2

Detailed Analysis of Design 1							
Cost	**Efficiency**	**Usability**	**Manufacturability**	**Impact**	**Sustainability**	**Maintainability**	**Accessibility**
✓	✕	✕	✓	✓	✕	✓	✓

Design 3: Data collection Using IoT & google form instead of website

For this design, the sensor based parameters will be collected by using wifi module and the question answer based parameters will be collected by using google form. As two separate methods have been used it will create multiple tabular data on google sheet which will eventually create problems in terms of machine learning. As the machine learning operator has to manually college both tables before machine learning the system will become manual. As a result the result publishing procedure will be delayed. The system will become less efficient

Table 12: Analysis table for design 3

Detailed Analysis of Design 1							
Cost	**Efficiency**	**Usability**	**Manufacturability**	**Impact**	**Sustainability**	**Maintainability**	**Accessibility**
✓	✕	✓	✓	✓	✓	✓	✓

Design 4: Data publishing using SMS service.

For this design, the sensor based parameters will use raspberry pi instead of arduino. and the whole system both machine learning and website will be integrated into the processor. And there will be a touch screen display for input parameters. As a result the system will cost more, and there will be a higher chance of system freezing. As the website is also integrated within the sensor data collection device. Which makes it harder for the normal user to repair and maintain the device if any problem arises.

Table 13: Analysis table for design 4

Detailed Analysis of Design 1							
Cost	**Efficiency**	**Usability**	**Manufacturability**	**Impact**	**Sustainability**	**Maintainability**	**Accessibility**
✕	✓	✓	✓	✓	✓	✕	✓

Finally, After going through many reference papers and with proper simulation the most optimal design is the decentralized one. The overview of the four designs and there result based on different aspect is as follows:

● **Cost:** The total cost of the first approach is around 5000 BDT. The total cost of the second, third and fourth approaches are respectively around 3500 BDT, 5500 BDT and 12000 BDT. Although the second approach cost less than the first one, in the second approach we are using cheap quality sensors. which gives us very unstable and unreliable results. Here we can say that the first approach is more cost-effective than the others approaches.

● **Criticality**: For the first and second approaches We are using a separate device for sensor data collection and a separate website integrated with machine learning for automatic disease detection and result publishing. For the third approach there is no website. The machine learning part will be done manually and the result will be published through email. and in the final approach both data collection sensor device and machine learning deployed website will be integrated in raspberry pi. Which is a very complicated process and also very complex repair. Therefore, in these criteria we can declare that, first approach will be the best option.

● **Success rate:** The success rate for the first and the fourth design approach is more time efficient and less complicated than the rest of the approaches. The 1st approach has the machine learning integrated website. which can instantly predict the disease and publish the result.

However, among the first and fourth approaches the first one is a less expensive design approach. So we are getting almost the same success rate compared with design four with less cost. So, we have chosen the 1st approach.

● **Task dependencies:** The first three approaches are decentralized, independent and sequential. However, the fourth approach is centralized and it is interrelated and integrated. So we can easily update the first three design approaches. And add more sensors on it for future work. In this criterion, the first approach will be the best option for this project.

● **Environment sustainability:** As the equipment we are using does not require any fossil fuel or any high-power consumption, or any gas leakage that will significantly affect our environment. All the approaches are environment friendly.

● **Maintainability:** Our first three multiple design approaches are easier to maintain than the fourth one. As the first three systems have simple design compared with the fourth one also they have separate sub systems. As a result systems need less power requirement and less chance to face system freezing. Where the fourth design has the higher chance of system freezing. As the website is also integrated within the sensor data collection device. Which makes it harder for the normal user to repair and maintain the device if any problem arises.

After considering all the criteria and simulation results, we have decided to choose the first approach (arduino integrated with bluetooth and a separate website system) is our optimal solution as it has the highest points.

1.4 Conclusion:

Four Multiple design approaches have been available by following the desired objective, requirements, and constraints.Each one expresses a distinct level of satisfaction in achieving those conditions and a component specification has been chosen based on further research and development to complete the comprehensive design. Later on, each design has its own set of advantages and disadvantages, and that is why they've all been scrutinized further to fulfill numerous aspects.

Chapter 3: Use of Modern Engineering and IT Tool.

3.1: Introduction: Multiple design approaches were discussed in the previous section, along with their objectives, requirements, and constraints.Now, in order to assess them, we'll need to think about some few key tools.A detailed table is provided below; as can be seen, there are two sections, one for software and the other for hardware. We'll need all of the hardware tools we'll need to complete the hardware analysis appropriately. Then there's the software tools to complete the machine learning and show the result on the website.

3.2 : **Select appropriate engineering and IT tools:**

Software part

Tools	Purpose	Validation
Arduino IDE	For writing code & compiling	All the sensor programmed and integrated with arduino
Python Django	Website development and ML Model development	Showing result based on given input by the user
Proteus Professional	Circuit Simulation	Output value of the sensor can be shown successfully
Google Co laboratory	Machine learning coding	Successfully created the machine learning model
Android Studio	App integration with device	The app displayed the output value of the device on a mobile phone

Hardware part :

Tools	Purpose	Validation
Soldering Iron	To ensure a strong connection from every sensor to the breadboard.	Successfully connected all necessary connections.
Multimeter	To measure all voltage ratings to enable safe thresholds.	Enable all correct ratings.
Bolts and Nuts	To secure all components in a complete system.	Ensuring easy swappable components.

Screw Driver	To tighten all the bolts and nuts.	To prevent over tightening.
Hot glue	To complete the infrastructure and attach permanent components.	Ensuring structural integrity.
PVC board	To develop the outer case to place our hardware components.	Easilybearable and feasible.

3.3 :Use of modern engineering and IT tools : First of all, Using Proteus Professional software we simulate all the sensors and build our circuit. After successfully simulating we move forward to hardware implementation. We use Arduino IDE for coding and programming our sensors.And we had to make sure that all the connection from arduino to sensors , LED display was accurate. After trying so many times, finally our sensors begin to work . And successfully we were able to measure the Body temperature, Heart rate,BPM ,Oxygen saturation through our sensors. We used soldering iron to connect all the sensors to the breadboard permanently and we became successful in giving a strong connection to each component. We made our device casing by using a PVC board and hot glue gun.After that, the device became easily bearable and feasible.Then comes the Software part. We use Google Colab for writing all the machine learning code and successfully built two machine learning models with 95% of accuracy. But we were planning to show the machine learning result on a website .So that a user can easily use our device and know the result. To Show the result on website and backend handling of the website we Python Django. And we were able to show the result on the website successfully.To make this thing more easy for the users we decided to show the sensor's output data on a mobile phone.Thus we built an app using Android Studio. Now, the user can see the result of his oxygen saturation, Bpm ,body temperature on mobile app when he use the sensors

3.4:Conclusion : In this chapter,We have mentioned all the modern engineering and IT tools that we are applying for the prototype of this project .And all of the tools we used for the design are IEEE-approved and suitable for building the prototype to get the intended result.

Chapter 4: Optimization of Multiple Design and Finding the Optimal Solution.

4.1 **Introduction:**

Now that we've chosen our engineering tools for implementing our design, we need to choose the best one out of several options. To accomplish so, a table is provided, which contains several conditions each with a specific point. The design that receives the most points will be

considered the best option. Following the selection of the best solution, we must run some test cases to ensure that the best design has been chosen.

4.2 Identify optimal design approach

Designs	Range of Data (Bandwidth) [Out of 30]	Usability User's Perspective [Out of 20]	Budget (Does not Exceed) [Out of 15]	Maintenance (Easy Troubleshooting) [Out of 10]	Accessibility (Compromising both users and system) [Out of 25]	Total Rating [Out of 100]
1. Arduino with bluetooth and separate website system	85 kbps At 850 – 1900 MHz	Convenient	Satisfied	Simple	Satisfied	[96]
	[29]	[18]	[15]	[10]	[24]	
2. Using MAX30100 and lm35 cheap sensors	85 kbps At 850 – 1900 MHz	Inconvenient	Satisfied	Simple	Unsatisfied	[79]
	[29]	[10]	[15]	[10]	[15]	
3. Arduino integrated with wifi module and no website	85 kbps At 850 – 1900 MHz	Inconvenient	Satisfied	Simple	Unsatisfied	[84]
	[29]	[12]	[15]	[10]	[18]	
4. Using Raspberry Pi and integrated	85 kbps At 850 – 1900 MHz	Convenient	Unsatisfied	Complex	Satisfied	[87]

website and machine learning system	[29]	[20]	[8]	[5]	[25]	

Finally, After going through many reference papers and with proper simulation the most optimal design is the decentralized one. The overview of the four designs and there result based on different aspect is as follows:

● **Cost:** The total cost of the first approach is around 5000 BDT. The total cost of the second, third and fourth approaches are respectively around 3500 BDT, 5500 BDT and 12000 BDT. Although the second approach cost less than the first one, in the second approach we are using cheap quality sensors. which gives us very unstable and unreliable result, here we can say that the first approach is more cost-effective than the others approaches.

● **Criticality**: For the first and second approaches We are using a separate device for sensor data collection and a separate website integrated with machine learning for automatic disease detection and result publishing. For the third approach there is no website. The machine learning part will be done manually and the result will be published through email. and in the final approach both data collection sensor device and machine learning deployed website will be integrated in raspberry pi. Which is a very complicated process and also very complex repair. Therefore, in these criteria we can declare that, first approach will be the best option.

● **Success rate:** The success rate for the first and the fourth design approach is more time efficient and less complicated than the rest of the approaches. The 1st approach has the machine learning integrated website. which can instantly predict the disease and publish the result. However, among the first and fourth approaches the first one is a less expensive design approach. So we are getting almost the same success rate compared with design four with less cost. So, we have chosen the 1st approach.

● **Task dependencies:** The first three approaches are decentralized, independent and sequential. However, the fourth approach is centralized and it is interrelated and integrated. So we can easily update the first three design approaches. And add more sensors on it for future work. In this criterion, the first approach will be the best option for this project.

● **Environment sustainability:** As the equipment we are using does not require any fossil fuel or any high-power consumption, or any gas leakage that will significantly affect our environment. All the approaches are environment friendly.

● **Maintainability:** Our first three multiple design approaches are easier to maintain than the fourth one. As the first three systems have simple design compared with the fourth one also they have separate sub systems. As a result systems need less power requirement and less chance to face system freezing. Where the fourth design has the higher chance of system

freezing. As the website is also integrated within the sensor data collection device. Which makes it harder for the normal user to repair and maintain the device if any problem arises.

After considering all the criteria and simulation results, we have decided to choose the first approach (arduino integrated with bluetooth and a separate website system) is our optimal solution as it has the highest points.

4.3 Performance evaluation of developed solution:

To complete the performance evaluation, we need to have desirable outcomes of our four subsystems of optimal solution.

Hardware Device: (For sensor based data collection)

After evaluating the multiple approaches we have chosen design 1 as the optimal solution. Where we are using an oximeter, heart rate sensor, infrared temperature sensor, and glucometer integrated with arduino to collect patients data. We have also used a bluetooth sensor for real time monitoring on mobile apps.

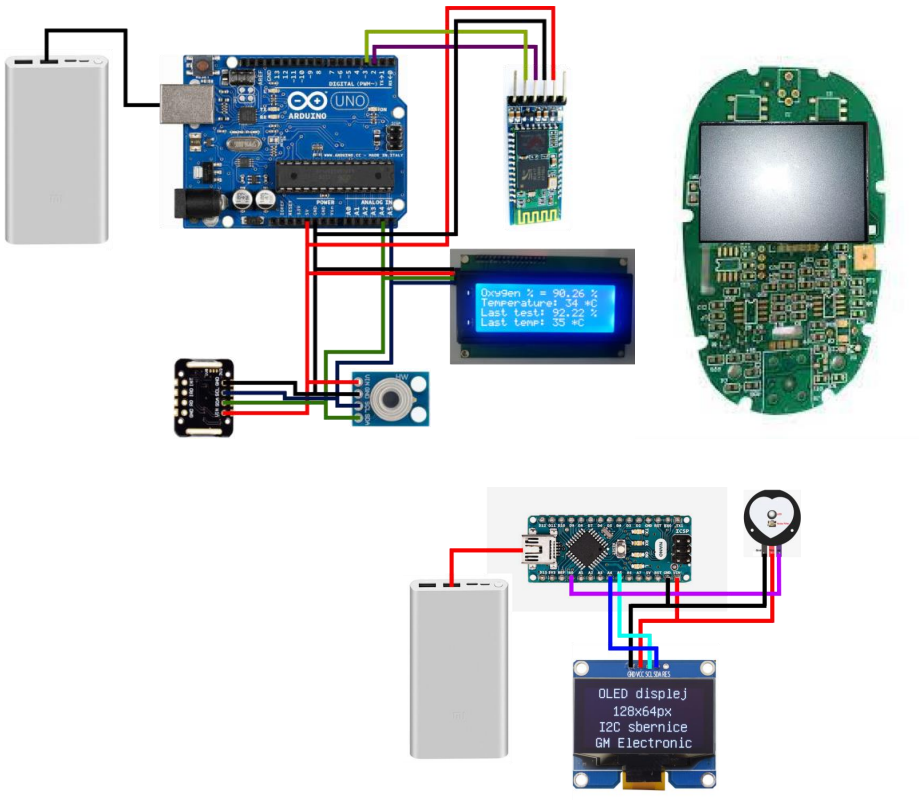


Fig: Schematic of optimal device design (Approach 1)

After finalized the design we have done our research on how to implement and run the system. Later gathering the knowledge we procedure for the software simulation of this design. We have used proteus for the software simulation of hardware. though there were few sensors

missing in the proteus software system. like oximeters (for oxygen saturation) and glucose sensors.

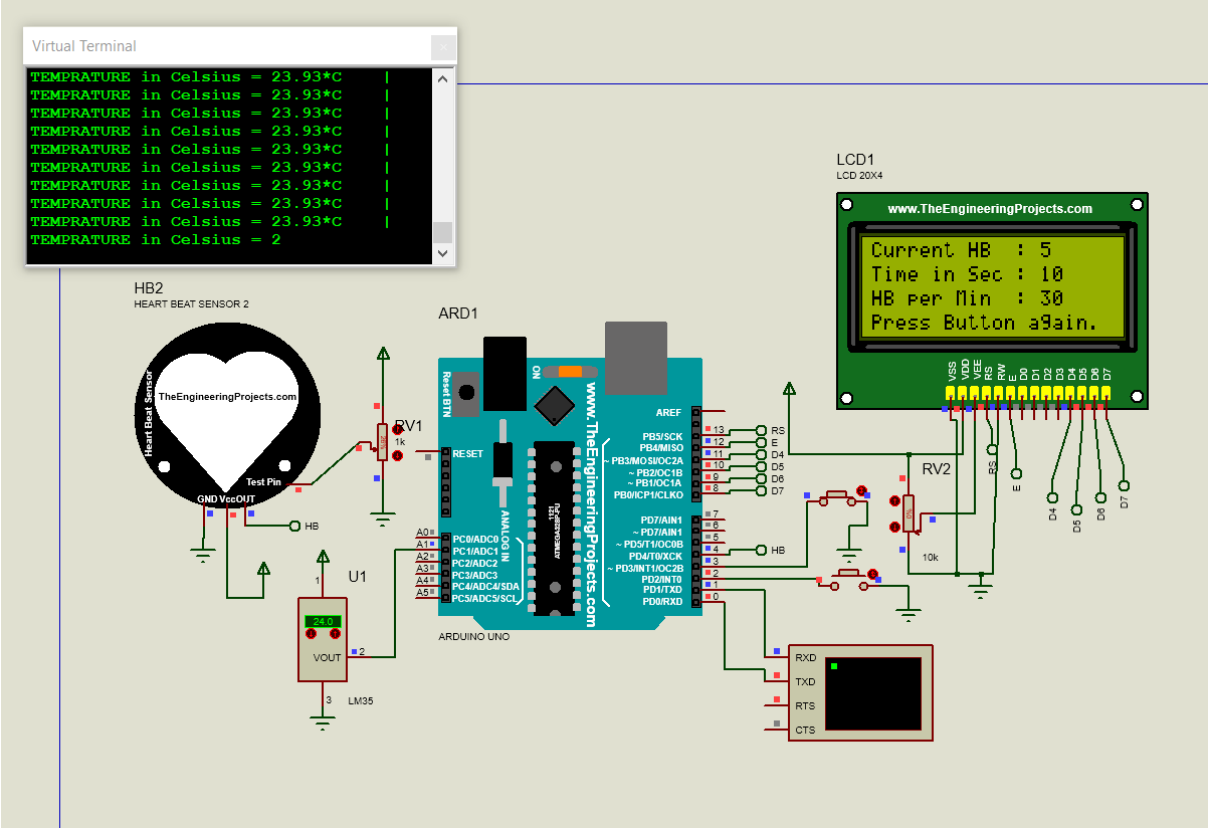


Fig: Proteus Simulation

After successfully running this system on the proteus software we proceed for the prototype building and hardware implementation. After completing the hardware part we checked our sensor for precise reading and did all the necessary measures for the most precise result. We have also added a bluetooth sensor for real time monitoring of sensor based parameters through mobile apps.

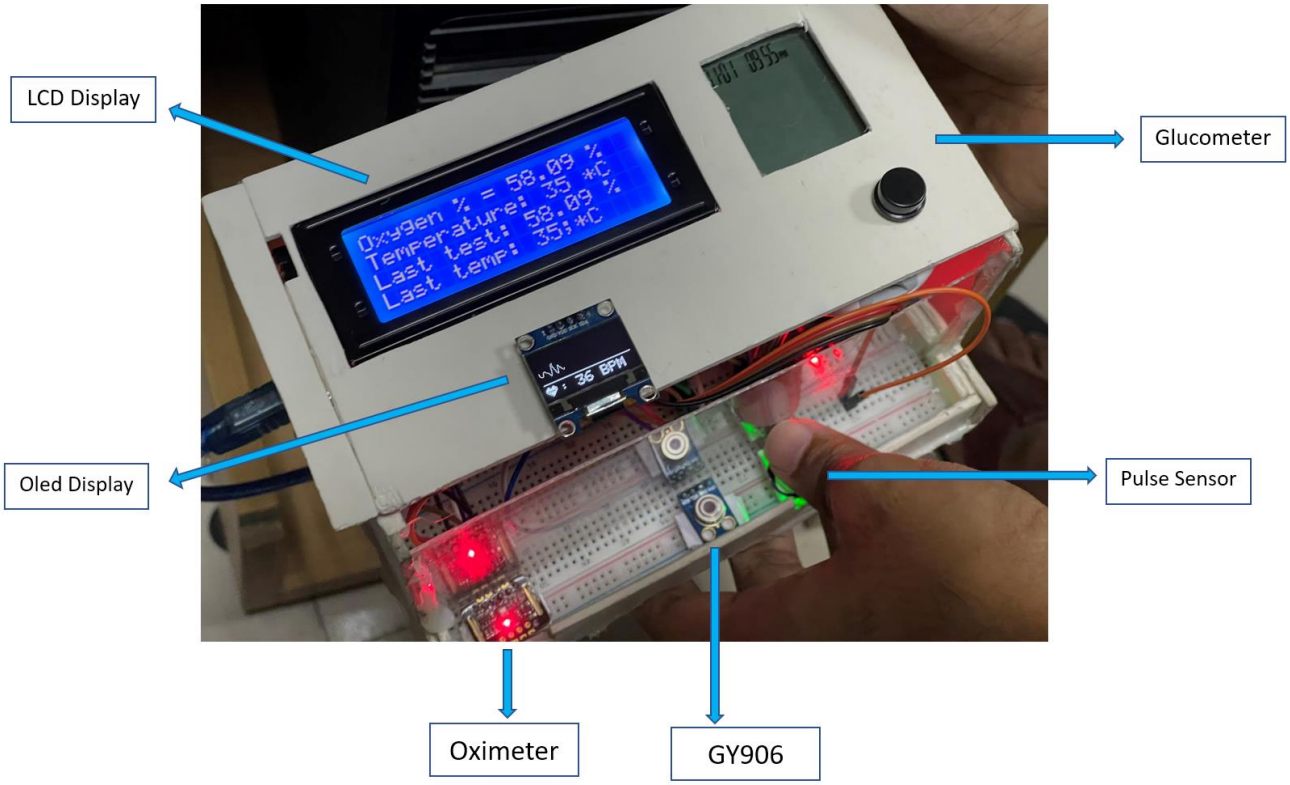


Fig: Hardware device setup

GY-906, Heart pulse sensor data verification using ThingSpeak database:

Now, one of the most important parts of our project is storing the data for machine learning. Nevertheless, before the data is stored it must be transferred through a wireless medium. For our case, we are using a wifi module as it has the maximum range of data transfer.

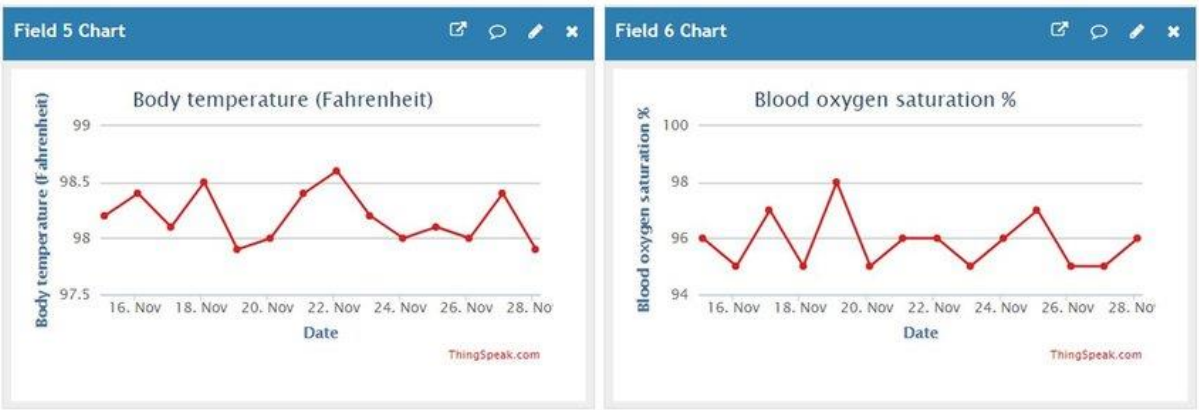


Fig: Temperature and oxygen level data visualization test on ThingSpeak

Fig: Heart rate data visualization test on ThingSpeak

Data collection:

Data collection is one of the most important requirements of our system. As without enough valid data we will fail to train and test our machine learning system. For that purpose we contacted the SMC Hospital to collect data of both diabetes and lung disease patients. We have collected over 250 patients' data through our device (Only sensor based data). And the question answer based parameters have been collected orally. Also the hospital authority helped us by providing more than 500 lung and diabetes patient’s data from their database.

Fig: Collecting data from patients using the device for machine learning

Finally after collecting all the raw data we have saved them on the google sheet. We have made necessary adjustments where any data was missing. Then we have uploaded the both diabetes and lung disease dataset on the kaggle in csv format for future development or work based on this dataset for the kaggle community.

Detail Compact Column 10 of 19 columns

About this file

This file does not have a description yet.

# Oxygen Level	# Body Temp (C)	# Heart Beat	A Length of sympto...	A Cough	# Wheezing	# Shortness c
86 99	36 41.5	44 120	more than a week 48% suddenly & for few... 23% Other (229) 29%	yes (dry) 52% no 33% Other (120) 15%	0 1	0
91	37	110	suddenly & for few hours	yes (wet)	1	1
96	36.5	100	more than a week	yes (dry)	1	1
94	37	90	suddenly & for few hours	yes (wet)	1	1
92	37	95	suddenly & for few hours	yes (dry)	0	1
92	37	110	suddenly & for few hours	yes (dry)	1	1
93	37.5	85	more than a week	yes (dry)	1	1
92	37.5	112	suddenly & for few hours	yes (wet)	1	1
93	37.5	118	suddenly & for few hours	yes (dry)	0	1

Fig: Dataset sample for lung disease

Detail Compact Column 10 of 10 columns

About this file

This file does not have a description yet.

# Fasting blood sug...	# Bedtime blood su...	# Random blood su...	# Age	# BMI	# Diastolic blood pr...	# Family histo
3.8 8.1	4.1 8.3	4.5 9.1	19 70	18.5 44	46 110	0
4.4	5.5	7.1	40	26.2	78	1
5.5	6.3	7.8	41	28	75	1
6.7	7.3	8	49	30.4	66	0
7.2	8.2	8.9	55	41	78	0
7.1	7.9	7.8	60	32.4	80	0
7	7.8	8	64	35	81	1
4.9	5.6	7.5	30	39.2	59	1
4.8	6	7.3	36	36	60	0
4.5	6.3	7.5	50	25.6	75	1
6.1	7	7.9	41	24	110	1

Fig: Dataset sample for diabetes

Machine Learning:

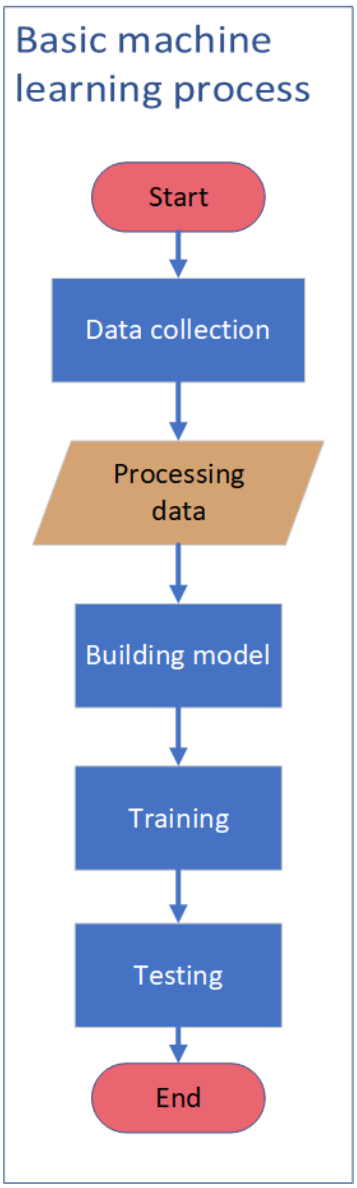


Fig: Basic machine learning flowchart

The first step toward a machine learning model building is to load the data into the environment for the further processing in a tabular format. After further inspection we have moved onto data processing which includes transforming string data into integer value. After that we started the model building using those data. We built the model using two methods, k-nearest neighbor and random forest algorithm. Further the train test method is used for the purpose of evaluating performance of those models.

String input to integer value: In this proposed system we are using some parameters that are string values. String values are used for better human readability while prompting for the data for the prediction of the model. In the form page of the website the page prompts users to input data according to their choice and the parameter displayed on the device.

Machine learning models cannot interpret string values particularly for our system. The value must be given in integer values that can be interpreted by the model. So we must convert the string values into integer values. For the proposed system, we have used one hot encoding.

The approach of transforming data to prepare it for an algorithm and improve prediction is hot encoding. With one-hot, each category value is converted into a new categorical column and given a binary value of 1 or 0. A binary vector is used to represent each integer value. The index is designated with a 1 and all of the values are zero. For data with no relationship to one another, one hot encoding is useful. The order of numbers is a significant feature for machine learning algorithms. In other words, a greater number will be perceived as better or more significant than a lower number. While this is useful in some ordinal scenarios, some input data has no ranking for category values, which can cause problems with predictions and performance.

Machine learning model: The supervised machine learning algorithm k-nearest neighbors (KNN) is a simple, easy-to-implement technique that may be used to address both classification and regression issues. As the prediction value of the new test sample, the K-NN algorithm uses neighboring classification. The distance traveled is frequently used to calculate near or near neighbors. The KNN method algorithm is relatively basic, and it determines the KNN by finding the shortest distance between the test sample and the training sample. Supervised machine learning algorithm (as opposed to an unsupervised machine learning algorithm) learns a function that gives an appropriate output when given additional unlabeled data using labeled input data.

We run the KNN algorithm numerous times with different values of K to find the K that decreases the amount of errors we encounter while retaining the algorithm's capacity to generate correct predictions when it's given data it hasn't seen before.

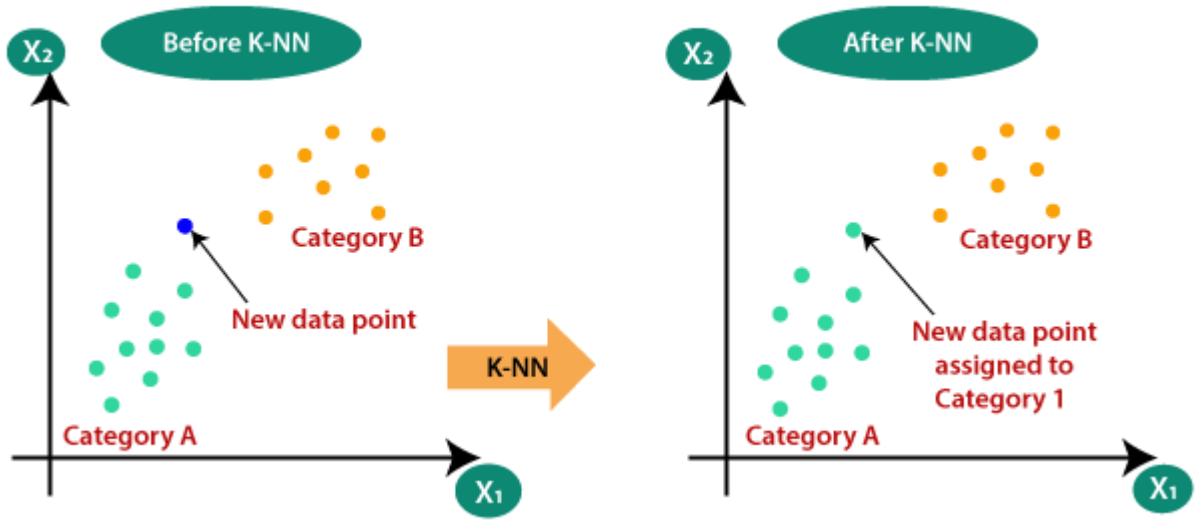


Fig: Before and after of K-NN machine learning

Train-test procedure: When machine learning algorithms are used to generate predictions on data that was not used to train the model, the train-test split process is used to measure their performance. It's a quick and simple technique that allows us to evaluate the performance of several machine learning algorithms for our predictive modeling problem.

Taking a dataset and separating it into two subgroups is the technique. The training dataset is the initial subset, which is used to fit the model. The second subset is not used to train the model; instead, the dataset's input element is given to the model, which then makes predictions and compares them to the predicted values. The second database is named test data.

Train Dataset: This is the data set that is used to fit the machine learning model.
Test Dataset: This dataset is used to assess how well a machine learning model fits.

The size of the train and test sets is the procedure's key configurable parameter. For either the train or test datasets, this is usually given as a percentage between 0 and 1. For example, a training set with a size of 0.75 (75%) is given to the test set with the remaining percentage of 0.25 (25%).

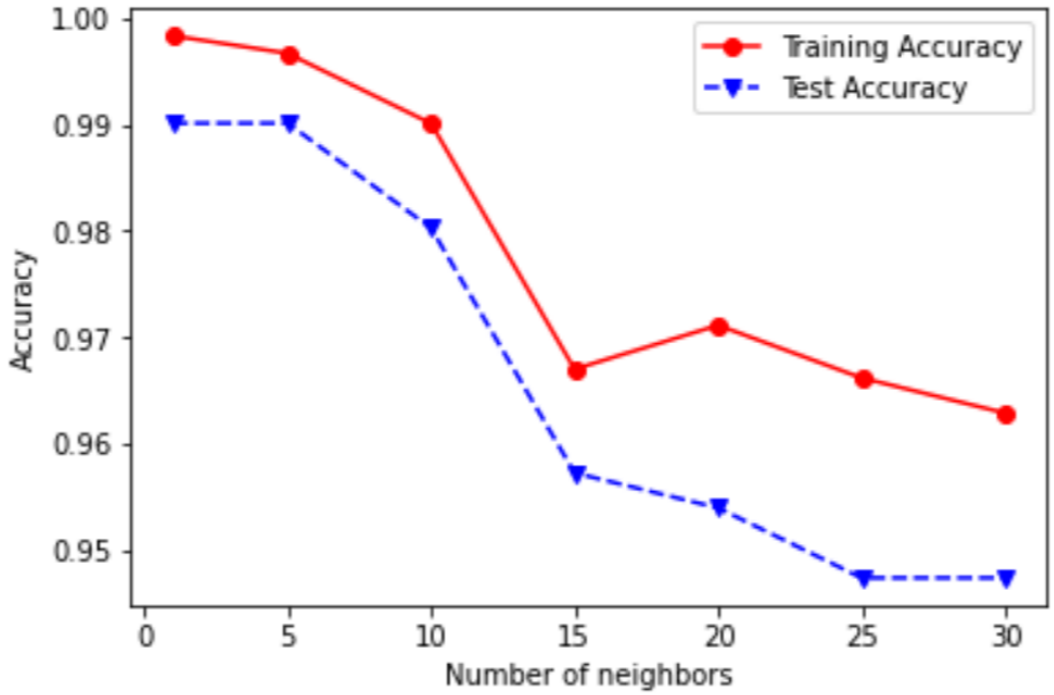


Fig: Training and test dataset comparison

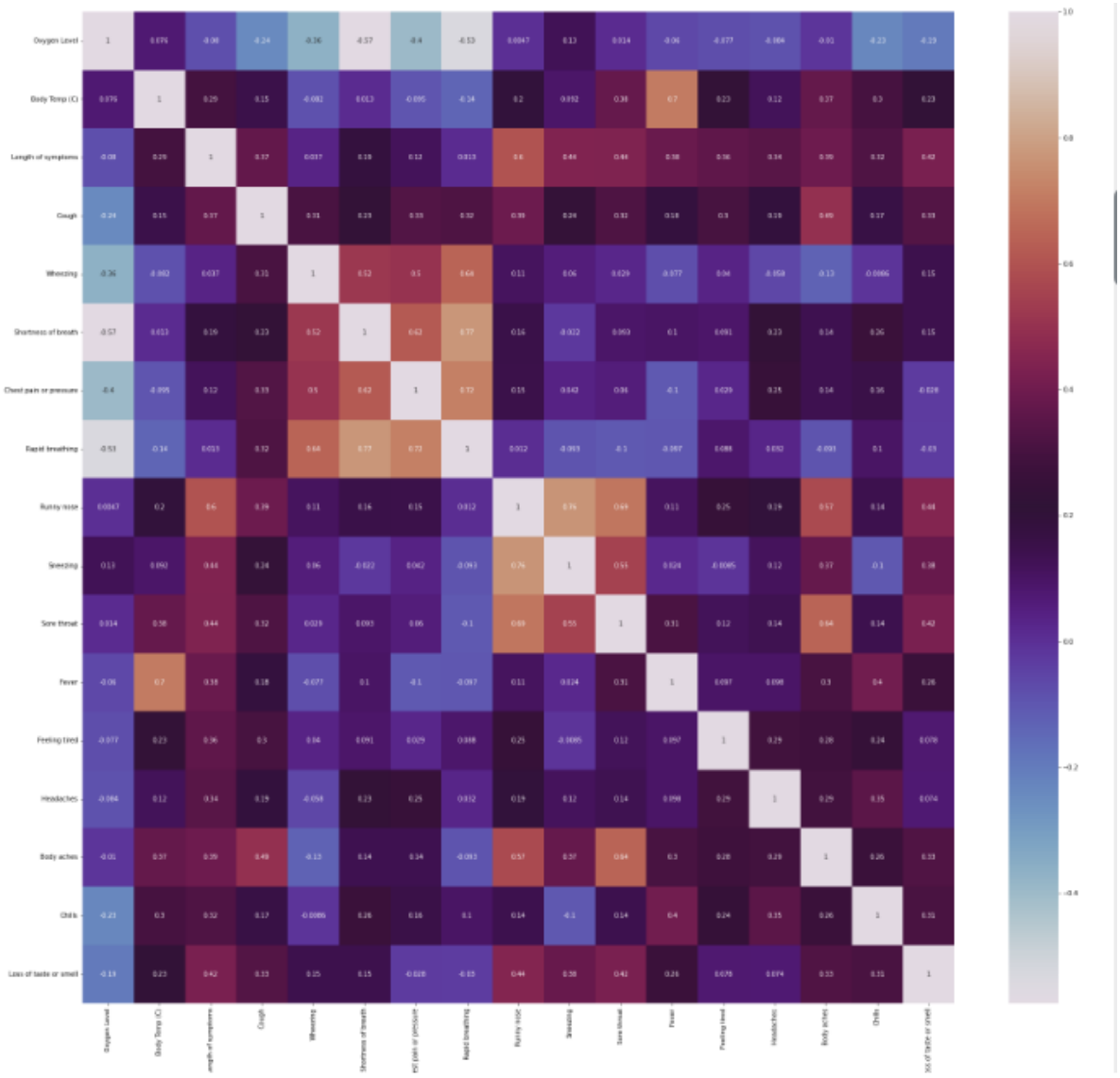
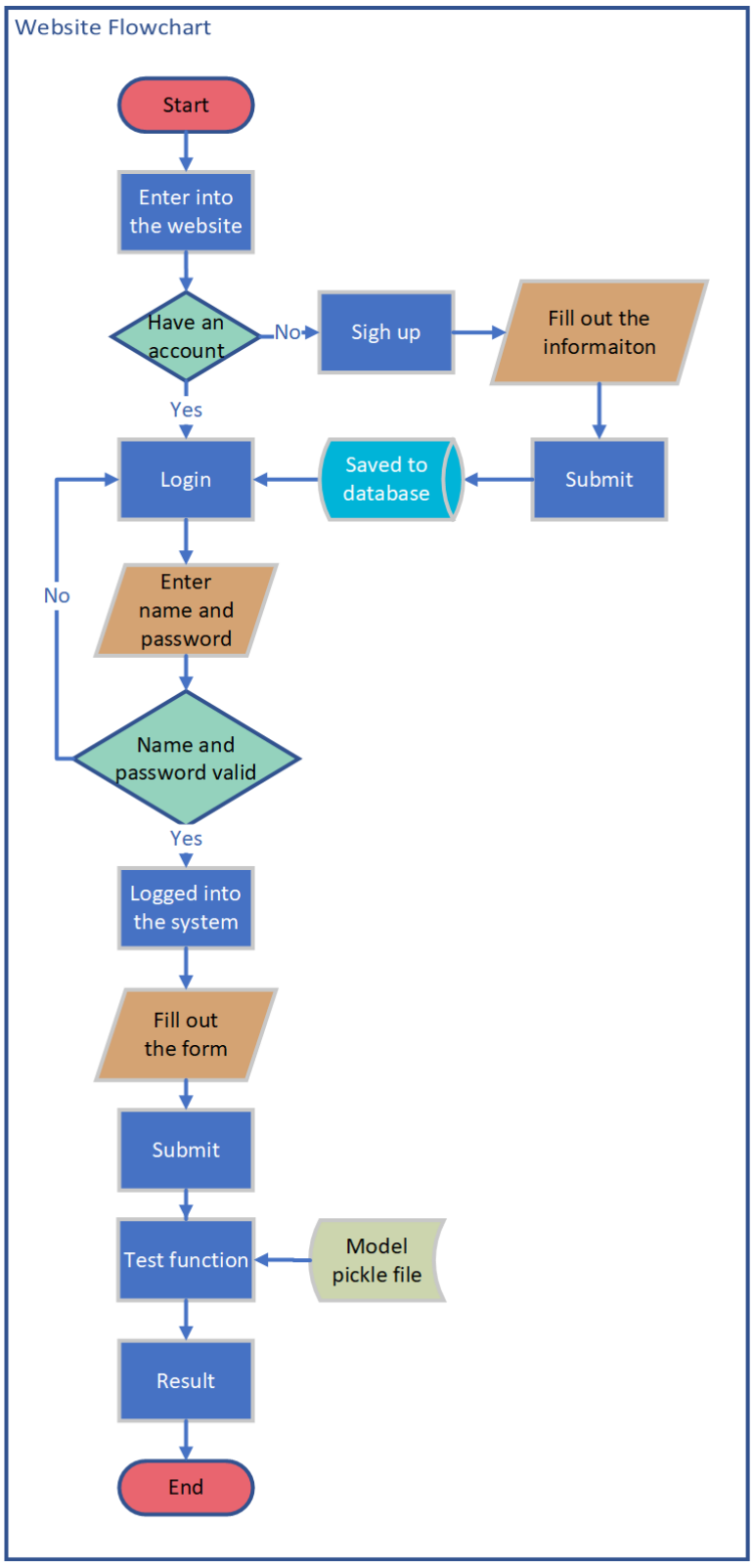


Fig: Dataset correlation between all the features (heatmap)

Website deployment:



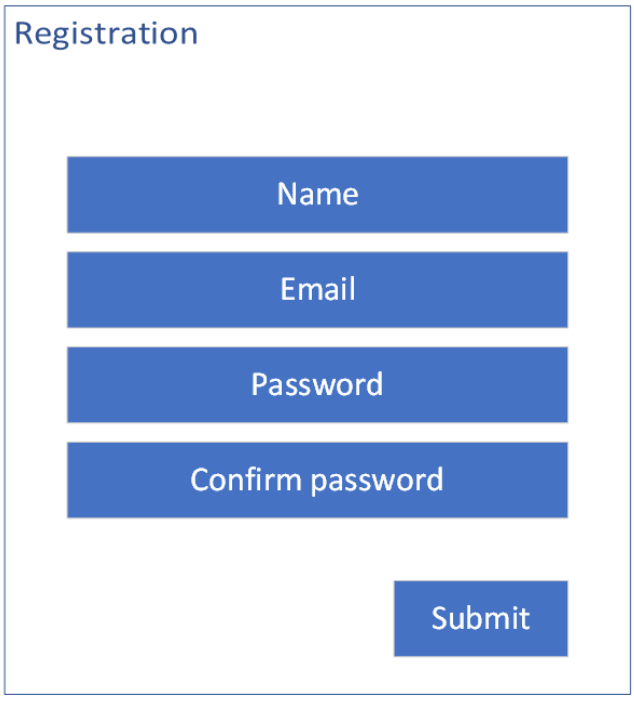
The proposed system has integration with a website which allows us to do machine learning prediction of diseases. The website gathers the data into its database and then doing the test it generates an appropriate result. So to input the data we need an operator or the user to fill out

a form. The form has its own options and some have empty boxes to fill it up with integer values. When the data is submitted the result is generated instantly on the result page.

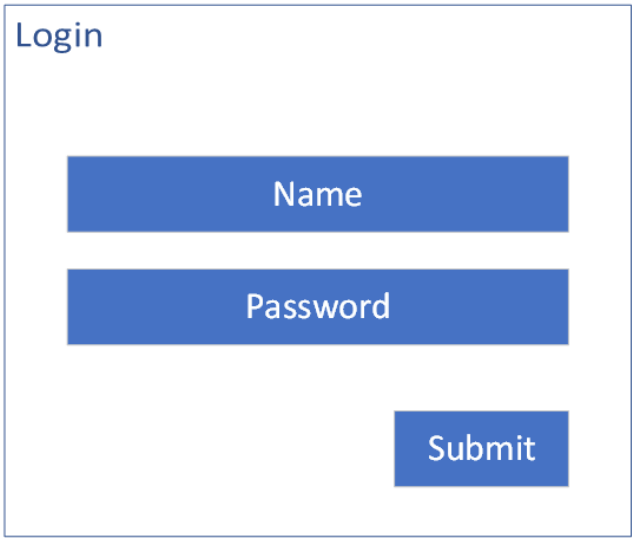
The user may enter into the website by typing the url of the website on the user's device. The website then prompts the user to login into the server. The login will be successful if the user data is already available in the database of the server. If the data is not available in the database already the webpage will prompt an error message. Users enter into the sign up page of the website. After the user fills all the information of the signup page the user presses the submit button. This action will take the user to the login page.

Login page will prompt users to fill the information and also prompt them to submit the information. Afterwards the user will be redirected to the page where the form is located. The form has several questions related to the diseases we are aiming to predict. The questions in the form have boxes to fill up by the user. There are two types of question boxes. One with no option but empty boxes and the other with option but no empty box. The user may put only integer values to the empty boxes, the result will not be generated otherwise. The boxes with options are expected to be filled out by the user choosing one required option.

The user enters all the expected values into the empty boxes and chooses all the options from the other boxes. The user submits the data by pressing the submit button. The website receives those data from the user and puts those data into the test function of the backend. Test function puts those data into the model of the system, which is the K-Nearest Neighbor. The model produces a result based on the data. The result is a particular disease name string that is most suited based on the data. The string data is passed into the server and the user is directed to the result page. The result page displays the disease name of the user and also the test result accuracy percentage of the model.



The registration prompt is given to the user when there is no account of that particular user in the system of the website. The registration includes the credentials like name, email, password and confirm password. The user submits the information by pressing the submit button on that page. The user directed to the login page.



The login page allows the user to enter into the main server. The login page consists of two boxes and each box prompts two credentials from the user, that is name and password. The user enters the credentials and submits the data to the server by pressing the submit button. The user will be directed to the next page.

4.4 Conclusion:

To sum it up, here we have four subsystems of our project. The 1st one is implementation of hardware, 2nd one is data collection, 3rd one is machine learning and finally deploying machine learning on the website. The four subsystems were implemented separately into multiple sections so that the workload can be divided. In each section, there were many issues present to obtain the desired result so, after a few trials and research; it was finally working as expected. The device is able to collect all the desirable datas quite precisely. The collected data through our device also with the help of a hospital was reliable enough for machine learning and disease prediction. Also the machine learning result by using k nearest neighbor and Random forest was giving us 95% accuracy. Also the integration of the machine learning on the website helps the user to get the disease prediction result quite easily and efficiently. As all the individual components are working at four subsystems, it can be claimed that the entire system is working properly separately.

Chapter 5: Completion of Final Design and Validation.

5.1 Introduction

We chose our best design and implemented the system in the previous chapter. As we were putting the project together, we decided to make some design tweaks to make it more efficient

and sophisticated. The alterations made to finish the design are discussed in this chapter. And a prototype has been shown.

5.2 Completion of final design:

Initially, we attempted to use the MAX30100 as our pulse oximeter, however there was a voltage drop issue. As a result, we were supposed to add resistors in the sensor, which is a time-consuming task. Also the device will become more complex. To get a better result, we updated this sensor and added MAX30102 sensor, which is a second generation oximeter sensor. Which works just fine with arduino uno and gives more reliable reading . Second, we used an LM35 temperature sensor but because it does not offer a stable value, we had no choice but to add an advanced sensor, the MAX30102. We are now able to obtain a stable value. Finally, due to the voltage issue, we utilized an Arduino Nano for the heart rate sensor. When we used the sensors into a single arduino we faced overheating problems. That's why we have used a second arduino device.

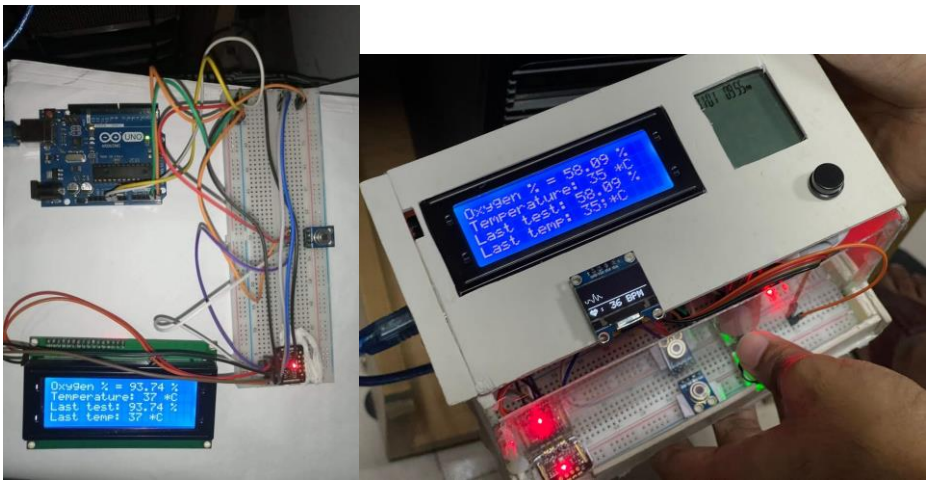


Fig: Before and after completion of device

Fig: Upper view of device

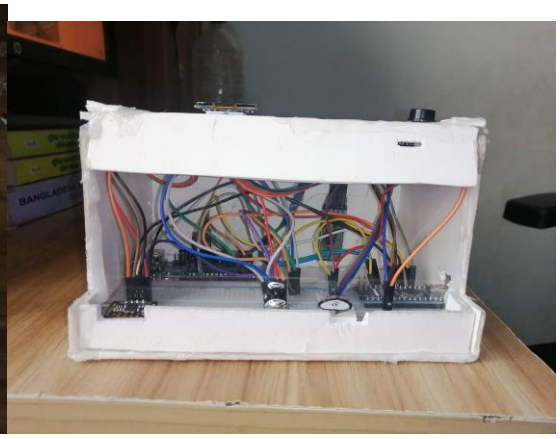


Fig: Front view of device

Fig: Side view of device

Finally we have made a box using PVC sheet. And designed it in a way to make it more compact for better usability and portability and safety of the device. We have also designed a PCB for our device. We are planning to build our device using PCB for better portability and efficiency.

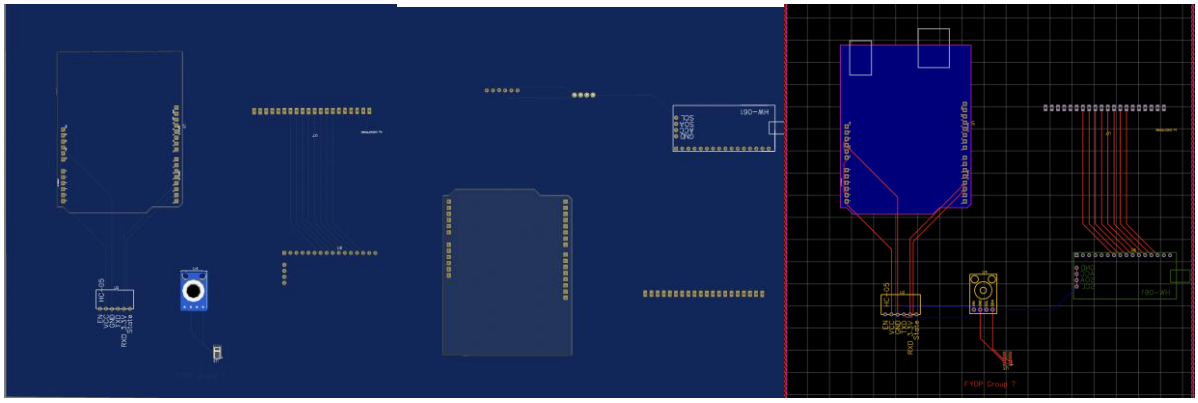


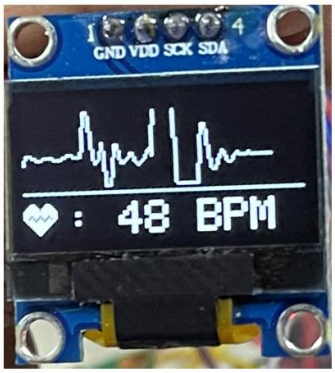
Fig: 3D model and the schematic of the PCB

5.3 Evaluate the solution to meet desired need:

The device: The process starts with powering up the whole device with batteries.Arduino Uno which we are calling Arduino-1 is connected to the oximeter Max30102, infrared temperature sensor GY-906, a 16x4 LCD display which displays the oxygen level and temperature data from the oximeter and the temperature sensor. Arduino-2, which is an Arduino Nano, is connected to a heart rate sensor which displays heart rate to a 64x32 OLED display. After powering up all the sensors. The glucometer is integrated into the device separated from the arduino-1 and arduino-2 and it is used for displaying the glucose level of a user. A user powers up all the modules with a battery and cable provided. The LCD display will display " Running…" to confirm that the device is running and ok to use. After 3 seconds the LCD display and all the sensors will be ready to use. Then a user will put two of their fingers on the oximeter and temperature sensor and wait for about 10 seconds. After waiting for 10 to 12 seconds the LCD display will show their two text lines "oxygen %:" and "temperature:" and beside these two lines the oxygen saturation and temperature will be displayed. Then the user removes the two fingers and again puts a finger on the heart beat sensor. The heart beat sensor

is connected to the arduino-2. Arduino 2 will read the value from the sensor and send the value to the OLED display connected to it for the user to know about his heart beat. After measuring the heartbeat, the user measures the glucose level by using a glucometer. The user makes a hole and a drop of blood bleed out of his finger with a pen provided with the device. The user takes a stripe, puts that stripe into the device and measures glucose level by providing the drop of blood into the stripe. The glucose level will be shown on the display, so, therefore, we now have four parameters, oxygen level, temperature, heart beat rate and glucose level.

Displaying Oxygen saturation and body temperature



Displaying BPM

Displaying Glucose level

Fig: Displaying all the sensor based parameters

Website: The user uses his phone browser with an internet connection and goes into the url or the QR code that has been provided.

Fig: QR code of our website

The URL or QR code takes the user to the login page. Since the user is using the device for the first time, he goes to the sign up page and puts in the required credentials and submit them. After that the user will go to the login page to enter into the server. The user puts the credentials and submit which will allow the 'Form' page to pop up. In this page, the user puts all the parameters that have been asked according to the question. The user completes the parameters and submits those. The result will follow afterwards. The disease will be displayed on the next page immediately including the test accuracy of the model.

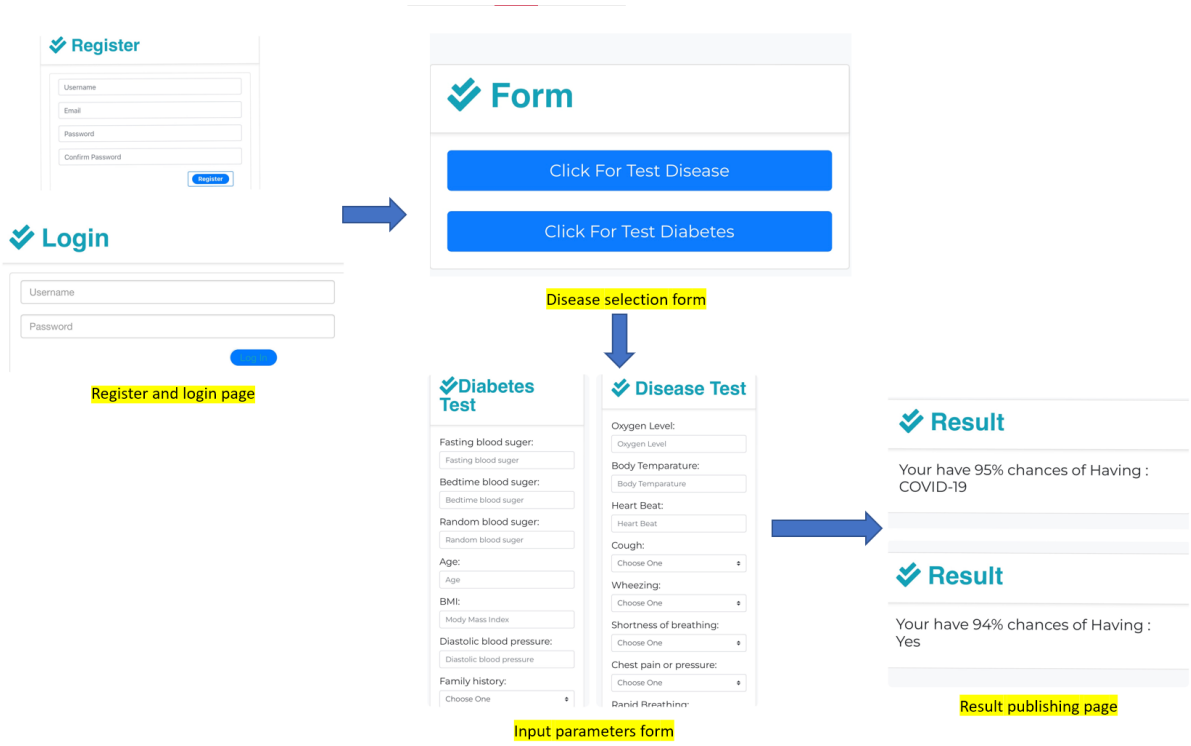


Fig: Website working flow diagram

5.4 Conclusion

To summarize, the final design effectively satisfies all of the requirements. Though our inferred and pulse sensor may sometimes give wrong values it is not properly used by the user. as it is a non contacting sensor the user should not make any contact with the sensor while measuring the body temperature. otherwise the value will be higher than the expected value. Also for the pulse sensor the user needs to be seated in a steady position for getting the correct measurement. Also a PCB has been designed for future modification and more compact devices.

Chapter 6: Impact Analysis and Project Sustainability.

6.1 Introduction:

When launching a new initiative, there is always some concern about how the public will react to it. So, in order to satisfy them, compromising is a necessary aspect of resolving such conflicts. This is a difficult stage because it will involve societal, cultural, and environmental changes, which will cause users to be concerned. Their input is the foundation of our project.

6.2 **Assess the impact of solution:**

The impact of our project can be classified into two sections; health impact and societal impact. As we know there is a lack of diagnostic equipment in rural areas & lack of trained doctors is an alarming problem for a developing country like Bangladesh. Our project will be a lung diseases monitoring system. By which Patients will be able to know their possible lung diseases without going to hospital. As our device will give the early prediction of lung related disease so the 7/9 patients can start taking treatment before it is too late. Since patients will know about their lung problem in an early stage this will reduce the chance of falling in an emergency situation which will eventually reduce the cost of their treatment. Mortality rate due to lung related diseases will be decreased.Moreover, diabetes is very frequent in our country.For diabetes people have to suffer other diseases caused by diabetes.We normally do not check the glucose meter. But by using our device machine learning people can know their possibilities of having diabetes. Which eventually saves them from other consequences.

6.3 **Evaluate the sustainability:**

When evaluating our system we have to consider three key areas: Environmental, Social and Governance (ESG). In terms of the environmental impact of the system we may have to consider the lifetime of the system. Although the biomedical device is being manufactured in mass, they have a very short life. The amount of waste these biomedical devices produce is alarming. When designing a device as such one has to consider that it should have a full life cycle. That is how it determines that it will be beneficial to earth and all its habitats. Our system has got a sensor that is high in quality available in the market. It aims to be more reliable and more sustainable than the cheap and fragile products. Thus this system ensures a full life cycle. Also a modern engineering tool can have societal impact. Biomedical is used in many cases for the betterment of people. The proposed biomedical device has an impact on societal life. Lung related diseases and diabetes being a major issue in people's life the proposed device would reduce the time to detect one's disease because of its compatibility. Due to less time to detect the disease it would make a chain of increase in people's life span.

6.4 **Conclusion:**

To sum it up, developing something is a risky venture because user feedback can vary, causing a huge problem in project management. If everything goes as planned, this project will have a bright future. This will enable future system upgrades and plans to be made.

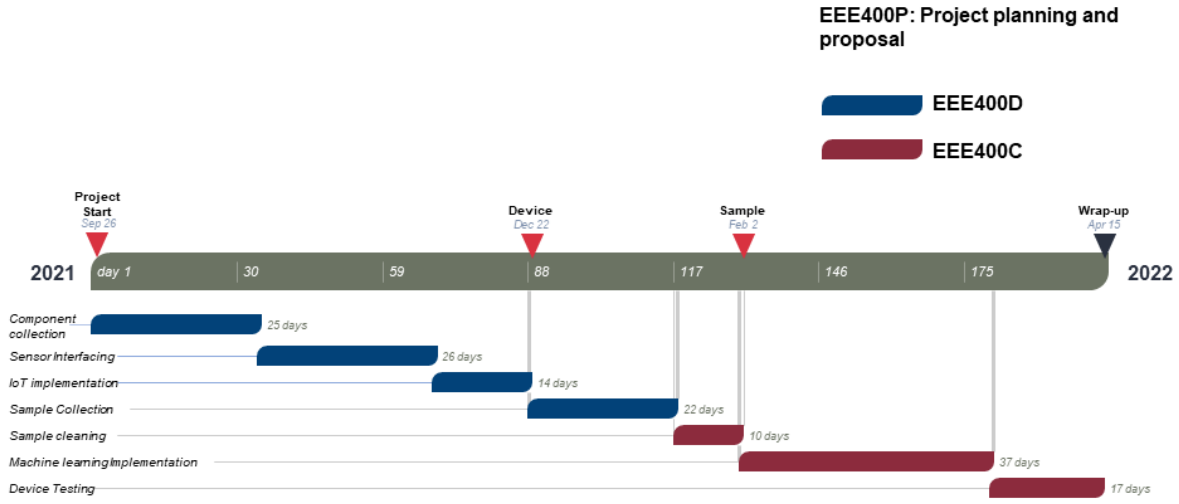
Chapter 7: Engineering Project Management.

7.1 Introduction:

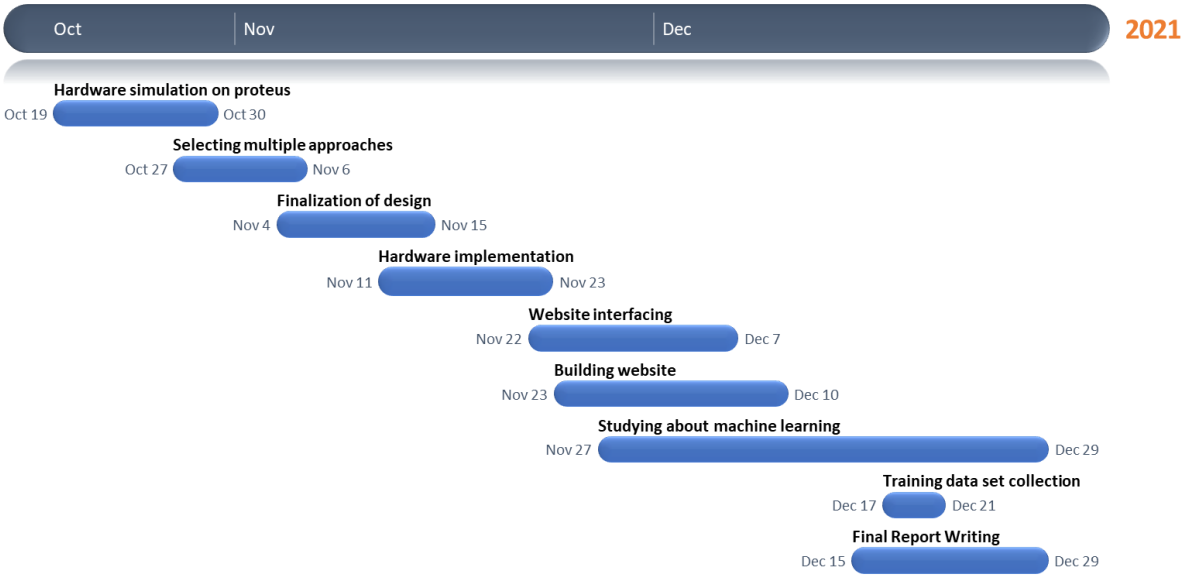
Project management is essential for displaying the overall progress of the defined approach. When a project is chosen, organizing it becomes a challenge because it is the foundation of any project. As a result, there are several points in the planning process where the designed plan may not produce accurate results due to difficulties or risk factors. Prior to beginning any project, a backup plan is projected to account for any potential dangers. Everything is controlled through the assignment of particular responsibilities. Teamwork is essential for resolving any risk concerns and maintaining a consistent output.

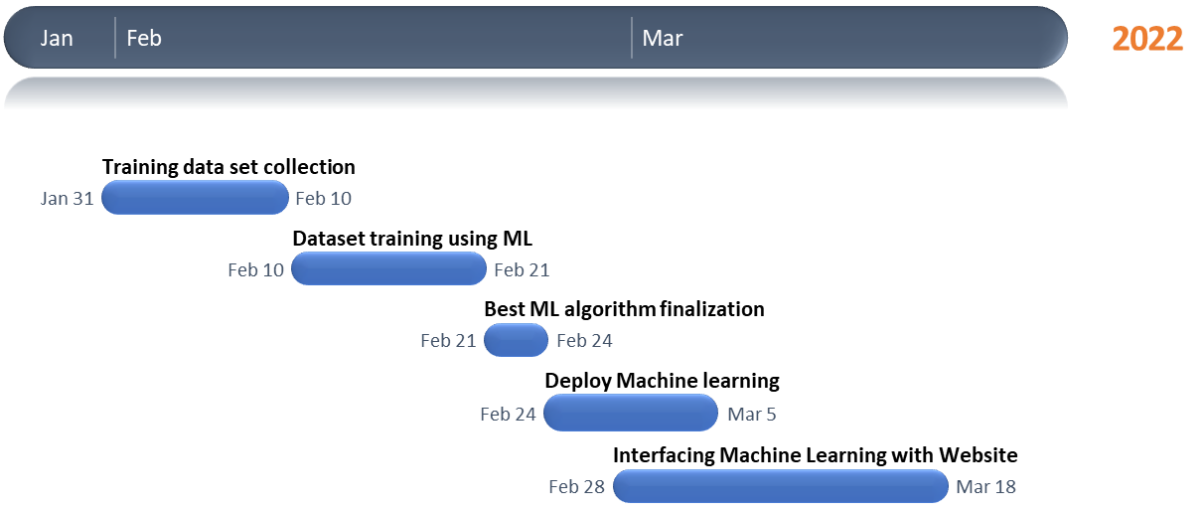
Define, plan and manage engineering project

i) Initial Plan:



ii) Updated plan:





7.2 Risk Management and Contingency Plan:

Risk is an uncertain moment in which it can have several unknown consequences. When an accident happens, various risks can arise, such as Design malfunction, accidental short circuits, damage to expensive components, server jams, etc. In order to manage such risks, we therefore divide our responsibilities into specific subject areas.

Risk Event	Response	Contingency Plan	Trigger	Who is responsible	Worst Case
Interfacing Problems	Mitigate: Test the prototype to find the problem.	Immediately , stopping the problem from spreading and solving it as much as possible.	Not solved within 2 days.	Ashraful Hossain	Same issues at the final product.
System freezing	Mitigate: Test the prototype to find the problem.	Recheck the connections and restart the system if required.	Frozen still after 2 days.	Shahidul Islam Pranto	User discomfort.
User backlash	Mitigate: Observing the entire problem and trying to find	Reallocating the resources and selecting the best-improvised	Unable to manage resources and budget.	Mohammed Moontasir Fahim	Huge delay to fix the problem.

	the optimal solution.	decision.			
Equipment malfunction	Mitigate: Select a reliable seller providing a warranty.	Order replacement.	Equipment fails.	Nur-E-Sultan Alif	Entire system will collapse if delayed .

7.3 Evaluate project progress:

When a project is successfully implemented, project management is required. Progress is observed by completing any task in order to maintain a consistent outcome. All tasks are assigned in a systematic manner. Initially, an estimate was used to create a plan, but unfortunately, it did not go as planned due to component testing issues. As a result, a new updated plan with a new timeline has been created. This should result in more accurate project progress. Furthermore, responsibility for dividing the workload has been assigned to each member. Furthermore, because risk is an uncertain case, a backup plan is required to manage resources. While implementing our project, we encountered some component damage and troubleshooting. As a result, precautions were taken from our designed procedures in order to continue operating effectively.

7.4 Conclusion:

To summarize, project management is critical to the success of every project. It aids in the organization of the strategy and the achievement of goals. Another key aspect of project management is risk management, which demonstrates a backup plan for effective management. Improvising is sometimes important to arrive at a swift answer in a short amount of time.

Chapter 8: Economical Analysis.

8.1 Introduction

The study of economic systems is called economic analysis. It could also be an investigation of a manufacturing process or an industry. The aim of the analysis is to determine how well the economy, or a component of it, is performing. For example, an economic overview of a company focuses primarily on the amount of profit it generates. In addition, it also enables estimation of business outcomes through data-driven techniques,convenient decision-making, and shows how resources are best utilized.

8.2 Economic analysis

Economic analysis is a tool to assist in the optimal allocation of resources, which can result in higher returns on the investment. One purpose of business economic analysis is to paint a clear picture of the current economic situation. What impact, if any, the current economic climate is having or will have on the company's ability to do business. Since a smart disease prediction tool setting up such a system requires a lot of resource management. This enables an effective method to achieve the desired goal. Everything is built to be mass produced because prototyping costs more than mass produced parts. After implementation, one of the most important aspects is maintenance. In order to provide maximum maintenance and customer support, a new source of employment will be created. The recruitment of new employees makes it possible to maintain resources and customer service at all times. Remuneration and retention of the regular customer are possible.

8.3 Cost benefit analysis

Through cost-benefit analysis, the feasibility review of a project is valued, giving a vision for the organization in terms of present, future and risk factors. For this project, the selected design has dedicated strengths and weaknesses in performance and management. Each component has its pros and cons (strengths and weaknesses) to work effectively. Also, more importance should be given to management as customer satisfaction, competition and strategies can have an immense impact on an organization. A table is used for further analysis:

	Components	**Price**	**Strength**	**Weakness**
1	Arduino UNO	650	1.Powerful processing unit. 2.Future proof. performance. 3.Supports display ports (HDMI)	1.Expensive repair. 2.More delay to fix the problem.
2	16*4 LCD monitor	350	1.Wide dimension. 2.Better visible. 3.Lightweight. Future proof.	1.Might break for careless activity. 2.Can’t visualize more than 4 rows. 3.More delay to fix the problem
3	HC-05 Bluetooth Monitor	300	1.High Bandwidth. 2.Future proof. 3.Cost efficient	1.Sensitive to overvoltage. 2.Range limitation (100 meters)

4	MAX30102 Oximeter	540	More precise measurement capability than max30100 (1st gen)	1.Expensive repair. 2.Sensitive to overvoltage.
5	MLX90614 Infrared Thermometer	1450	More precise measurement and health safety than other temperature modules.	1.Expensive repair. 2.Sensitive to overvoltage. 3.Costly
6	Glucometer	1140	Health safety	1.High cost 2.One time use stripe
7	Heart beat sensor	300	Cost efficient	Sensitive to over voltage

All selected modules were analyzed here in terms of price and their advantages and disadvantages. This will definitely be helpful in both performance evaluation and management strategies and will provide scope for a new vision of an organization's resources in the present and future.

8.4 Evaluate economic and financial aspects

The prototype version of our project is fully ready. It is working according to our expectations. We have already tested this tool with our friends and relatives. And the result was satisfactory. For more convenient implementation if we get some time, we can execute this project plan on medical hospitals. For that, we need a suitable fund. If our government, local clinics or diagnosis centers or any related authority come to us for this project, we will help them to build this device4. However, we will charge accordingly. To develop this smart medical device all over the country we need to produce it in massive numbers.Also a huge quantity of patient data is needed. If all such actions are taken then a successful system is ensured, thus managing it will be the main priority. To provide maximum customer satisfaction, the system can offer attractive services with discounts or similar activities.

	Components	**Price**
1	Arduino UNO	650

2	16*4 LCD monitor	350
3	HC-05 Bluetooth Monitor	300
4	MAX30102 Oximeter	540
5	MLX90614 Infrared Thermometer	1450
6	Glucometer	1140
7	Heart beat sensor	300
8	Miscellaneous	1500
	Total	6230

8.5 Conclusion

In summary, to develop a project, not only the performance of the system is enough, but also an economic vision is necessary, since it allows to develop a vision of the present and future of the project. This allows for an estimation of the resource consumption at the initialization of a project and after its implementation. Without such management, it becomes difficult to carry out the project.

Chapter 9: Ethics and Professional Responsibilities

9.1 Introduction:When working on a product that will be utilized by consumers in the future, there are several factors to consider in order to keep the user satisfied. If they aren't, a negative image of the manufacturer is established. To maintain a consistent image, a product must be developed in such a way that users are consistently given top priority.

9.2 Identify ethical issues and professional responsibility:

The main goal of our project is to serve the people through our device and system. That will make people's lives easier. To do so, engineers should always maintain the ethical rules and obligations so that people can always trust the process. some ethical issues of this project is given below :

1. Using quality sensors
2. User’s personal data preservation

3. Diseases prediction accuracy
4. Reliable dataset build

9.3 Apply ethical issues and professional responsibility:

We must use quality sensors. It may increase the cost but the possibility of wrong output will be less. As we are working on health related data collection like body temperature, glucose meter, bpm etc. Accurate results of the sensor are needed to proceed. Otherwise the system will predict the wrong diseases. So, we must use the best quality product to ensure the best output. The sensors we are using take data from the user end and through the questions we ask to the users, some personal data of users will be sent to the website host server. We have to preserve those data very confidentially. Four members of our group are the admin of that host server.And apart from us,nobody can access the server without an admin username and password. We will not share the password or username to any one. We should not use those personal data for any other purposes. It is our big responsibility to make the proper use of that data.

Disease prediction mainly depends on a few things. These are : appropriate data input,using the sensors in an appropriate way,machine learning accuracy etc. Users have to input the data very carefully otherwise the result may go wrong.Users have to use the sensor appropriately ,if they press too hard or to light in the temperature sensor ,the output value will show the wrong result. In the glucometer, the blood should be put in the required section of the stripes otherwise the output will give the wrong value. We will give a user manual for the customer so that they can get a clear idea about using the sensors properly.

We made the dataset on our own. We contacted a doctor and SMC Hospital for the data collection by using our own device. Based on this dataset, we made our machine learning model and the accuracy is 95%. So we can say that the dataset is reliable and the model is accurate enough to predict the diseases.

9.4 Conclusion: To summarize, the basic goal of employing technical expertise to build a product or service is to make customers satisfied all of the time. As a result, there must be zero tolerance for any fraud actions that leave a negative image on customers. Customers are always comforted, which ensures maximum support.

Chapter 10: Conclusion and Future Work.

10.1 Project summary/Conclusion:

To summarize, we completed our detailed multiple designs and identified the best one that meets all of the requirements, objectives, constraints, and specific conditions. All designs have been tested for various scenarios in order to determine their functionality and the best solution. Furthermore, relevant tool selection was carried out in order to demonstrate the project in the future. Following that, we introduced an updated project plan, contingency plan, and budget in which we will divide the workload and responsibilities among ourselves. The best solution has been thoroughly discussed in terms of ethical concerns and potential consequences. Individual subsystems were subjected to multiple test cases. There were some issues that rose during the

implementation of each component. After some analysis and research, we were able to receive our results. For the background surveys, all references have been included in the report. Finally, we kept a logbook in which we recorded all of our activities.

10.2 **Future work:**
There are numerous factors to consider, as there is no limit to a better system. However, a prototype cannot accommodate all of them. As a result, here are some examples of future works:
i. Adding new diseases - It will help the patient to predict their several diseases.
ii. Doctor and hospital suggestion - For each disease, there are some specialists who can cure the disease. So, our device will give them suggestions where and who will get the better solution.
iii. Voice assistant - Our plan to provide a service where a voice assistant can help to fill the form easily especially for handicap people.
iv. PCB design - Our entire system will be integrated using a PCB to manage cable.

Chapter 11: Identification of Complex Engineering Problems and Activities.

11.1: Identify the attribute of complex engineering problem (EP)

Attributes of Complex Engineering Problems (EP)

	Attributes	**Put tick (√) as appropriate**
P1	Depth of knowledge required	√
P2	Range of conflicting requirements	√
P3	Depth of analysis required	√
P4	Familiarity of issues	√
P5	Extent of applicable codes	√
P6	Extent of stakeholder involvement and needs	√
P7	Interdependence	√

Note: Project must have P1, and some or all from P2-P7

11.2: Provide reasoning how the project address selected attribute (EP)

Depth of knowledge: In order to carry out our study, we researched extensively from academics and published publications. We can pursue a developed method with a created plan using both of these background studies.

Range of conflicting requirements: We went through a process of satisfying many parameters in order to find the best design. One of the competing objectives was that certain designs be

easy to install versus easy to use and maintain. Some designs showed huge potential with rather high prices. Furthermore, several designs had problems when it came to choosing more precise reading versus budget of the device.

Depth of analysis required: We conducted extensive research on budget, user convenience, maintenance, efficiency, sustainability, and associated dangers in order to select the best design from a number of options. Finally, we discovered the finest design for our needs.

Familiarity of issues:
As Bangladesh is a developing country, the absence of such an optimized system is common. Though nowadays online medical services are getting popular. In developed countries such a system is very common. However, without costly diagnosis, preliminary disease prediction just sitting at home and with very little cost is still a new thing. We are often not aware of our health checkup. By implementing this system now anyone can get an idea of their health at any time.

Extent of applicable codes:
We have gathered all appropriate codes of specific components and services in order to complete the design in an orderly manner. We've gathered them all, attempting to adhere to all of their regulations and guidelines. There are also certain applications that have been modified to our requirements.

Extent of stakeholder involvement and needs:
As the project is to ensure the health safety of the people in the country, we have many stakeholders who will want to install this device on their hospital or many biomedical company may want to sell this device to the mass consumer level. Normally, there are two types of stakeholders. 1. Internal, 2. External. Internal stakeholders are people or groups within the core team. For example, Project Supervisor, Team members, project-related people, etc. External stakeholders are people or groups who are outside of the business. For example, users, suppliers, buyers, and investors. In our case, general people are the primary users here.
For any successful project, the roles of stakeholders are very important. For that, the project manager needs to be very careful about the day-to-day work. Some steps should be taken to make a successful project:

· Prioritizing the stakeholders
· Understanding the stakeholders
· Clear view about the roles of the stakeholders
· Proper communication with the stakeholders

Overall, we can say that it is teamwork. If communication & understanding is well defined and all the stakeholders can work properly being a team, a project can be successful.

Interdependence:
We have divided our project into 2 individual subsystems:
i) Sensor based parameter collection device
ii) Gather dataset
iii) Machine learning

iv) Website deployment

Furthermore, each section has been divided into multiple sections so that the load can be distributed with convenience.

11.3 Identify the attribute of complex engineering activities (EA)

Attributes of Complex Engineering Activities (EA)

	Attributes	**Put tick (√) as appropriate**
A1	Range of resource	√
A2	Level of interaction	√
A3	Innovation	
A4	Consequences for society and the environment	√
A5	Familiarity	√

Note: Project must have some or all of the characteristics from attributes A1 to A5

11.4 Provide reasoning how the project address selected attribute (EA)

Range of resource:

We are creating a prototype to fulfill our goals, and appropriate components must be considered. We bought the majority of the components and borrowed some from the EEE department's thesis lab. After conducting extensive component study, we arrived at a budget conclusion. In addition, to discover the best design, we ran several analyses on various datasheets.

Level of interaction:

To get the most support for our idea, we needed to interact and collaborate with a large number of experts. All of their proposals were benevolent in nature, urging people to take action at a steady pace**.**

Consequences for society and the environment:

Because people want a better life, a system like this will give better services than before. Our system is made out of common approaches that will not make you feel uncomfortable while utilizing it. If something goes wrong, compensation is available on a regular basis. Furthermore, there is a reduction in environmental crowding.

Familiarity:

As Bangladesh is a developing country, the absence of such an optimized system is common. Though nowadays online medical services are getting popular. In developed countries such a system is very common. However, without costly diagnosis, preliminary disease prediction just sitting at home and with very little cost is still a new thing. We are often not aware of our health checkup. By implementing this system now anyone can get an idea of their health at any time.

References:

1. WHO. WHO Coronavirus Disease (COVID-19) Dashboard. Accessed: 2020.[Online].Available: https://www.who.int/redirectpages/page/novel-coronavirus-(covid-19)-situation-dashboard
2. Y. Bai, L. Yao, T. Wei, F. Tian, D.-Y. Jin, L. Chen, and M. Wang, "Presumed asymptomatic carrier transmission of COVID-19," Jama, vol. 323, no. 14, pp. 1406–1407, 2020.
3. H. Chen et al., "Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: A retrospective review of medical records," Lancet, vol. 395, no. 10226, pp. 809–815, Mar. 2020.
4. WHO, CDC, World Bank and UN, "World Health rankings, Health profile:Bangladesh[online]."Available: https://www.worldlifeexpectancy.com/country-health-profile/Bangladesh
5. Sohail Akhtar ,1 Jamal Abdul Nasir,1 Aqsa Sarwar,1 Nida Nasr,1 Amara Javed,1,2 Rizwana Majeed,1 Muhammad Abdus Salam,1 Baki Billah3,"Prevalence of diabetes and pre-diabetes in Bangladesh: a systematic review and meta-analysis"[online]. Available : " https://bmjopen.bmj.com/content/10/9/e036086"
6. Aayush Chaudhary, Kanav Bhatnagar, Harshit Sharma" SMART SYMPTOM DETECTOR AND DATA ANALYSIS FOR COVID-19," Volume no :03, issue:09, September-2021
7. Asthma &Allergy Foundation of America , "Coronavirus (COVID-19): What People With Asthma Need to Know", Accessed 2021. [Online].Available: https://community.aafa.org/blog/coronavirus-2019-ncov-flu-what-people-with-asthma-need-to-know
8. Revar, D., Sevaniya, J., & Joshi, V. 2020, Pulse Oximeter Design to Predict COVID-19 Possibilities on Patient's Health using Machine Learning. Gujarat Technological University, Volume .
9. "Global Report on Diabetes, 2016". Available at: https://apps.who.int/iris/bitstream/handle/10665/204871/9789241565257_eng.pdf;jsessionid=2BC28035503CFAFF295E70CFB4A0E1DF?Sequence=1.
10. "Diabetes: Asia's 'silent killer'", November 14, 2013". Available at: www.bbc.com/news/world-asia-24740288
11. Radwa Sameh, M. Genedy, A Abdeldayem and Mohamed H. Abdel azeem, "Design and Implementation of an SPO2 Based Sensor for Heart Monitoring Using an Android Application",journal of physics:conference series,Vol :1447, september ,Cairo , Egypt.
12. Abishek jaglan,Daksh trehan,priyash shingal, " COVID-19 Trend Analysis using Machine Learning Techniques",International Journal of Scientific & Engineering Research Volume 11, Issue 12, December-2020
13. Maros Smondrk, Stefan Borik,Tadeas Bednar, Branko Babusiak, "Design and Implementation of Low-Cost and Low-Energy Home Health-Care Monitoring System" IEEE, 2020ELEKTRO,25-28May,2020,Taormina,Italy Doi:10.1109/ELEKTRO49696.2020.9130264
14. Arnab Dey, Pramit Brata Chanda, Subir Kumar Sarkar, "Patient Health Observation and Analysis With Machine Learning And IoT Based in Realtime Environment", *Research in Computational Intelligence and Communication Networks (ICRCICN) 2020 Fifth International Conference on*, pp. 196-201, 2020.

15. Santosh Sanjeev, Gowtham Sai Ponnekanti, G. Pradeep Reddy, "Advanced Healthcare System using Artificial Intelligence", *Cloud Computing Data Science & Engineering (Confluence) 2021 11th International Conference on*, pp. 76-81, 2021.

Appendix

Logbook:

Date/Time /Place	**Attendee**	**Summary of Meeting Minutes**	**Responsible**	**Comment by ATC**
02.06.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Group formation	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
20.06.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Brainstorming ideas. 2. Found out four ideas	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 2: Completed.
01.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We had a meeting with ATC members. 2. We discussed our ideas and got reviews. 3. The project on disease detection was highly recommended by the ATC members.		
02.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Discussed about the project again and evaluated 2. Decided to go with the project on Healthcare detection. 3. Mailed ATC	Task 1&2: Ashraful, Pranto, Alif, Fahim Task 3: Alif	Task 1:Completed Task 2: Completed Task 3: Completed

		members about our decision.		
07.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Prepared presentation slides.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
08.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. First FYDP presentation	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
12.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Meeting with ATC members 2. Got reviews. 3. Found out our strength and flows.	Task 1,2&3: Ashraful, Pranto, Alif, Fahim	Task 1,2&3:Completed.
16.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Collected journal paper on our selected idea. 2. We divided the papers for each person to analyze. 3. We wrote the summary of those papers.	Task1: Ashraul Task 2: Ashraful Task 3: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed. Task 3:Completed.
22.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We had selected four diseases for the implementation. (Diabetes, cardiovascular disease, mental stress & covid-19) 2. We have also added Iot feature	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.

		for data transferring**.**		
25.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Find out more precise articles on those selected diseases & their machine learning applications. 2. Find out the implementation difficulties & their relevance in our society.	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.
28.07.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Had a meeting with the ATC members and discussed our findings with them.. 2. Got feedback from them. like on which disease we should work on. Also discussed about the implementation of Iot.	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.
10.08.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Prepare our presentation slides 2. emailed it to the ATC	Task 1: Ashraful, Pranto, Alif, Fahim Task 2: Fahim	Task 1:Completed. Task 2:Completed.
12.08.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Just before the presentation we had a short practice session. 2. 2nd FYDP presentation.	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.

18.08.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Got feedback from the ATC members of that presentation. 2. Got some ideas from the ATC members on the concept note**.**	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.
19.08.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Started to work with concept notes.	Task 1: Pranto, Fahim	Task 1:Completed.
27.08.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Started to learn machine learning based python language. 2. Saw some machine learning videos & their implementation on specific diseases.	Task 1&2: Ashraful, Pranto	Task 1:Completed. Task 2:Completed.
08.09.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Prepared presentation slides for the 3rd presentation. 2. Also got feedback from the ATC members to improve the slides.	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.
09.09.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Gave our 3rd FYDP presentation 2. Submitted our project proposal draft report..	Task 1: Ashraful, Pranto, Alif, Fahim Task 2: Pranto	Task 1:Completed. Task 2:Completed.

14.09.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We had a meeting with ATC. 2. Got feedback from them about the slides. 3. Update some points in the slide.	Task 1&2: Ashraful, Pranto, Alif, Fahim Task 3: Ashraful	Task 1:Completed. Task 2:Completed. Task 3: Completed
15.09.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Completed the slide for the final presentation. 2.We gave a demo presentation in in front of ATC Members. And got feedback. 3. Design our final model & circuit diagram. 4.We practiced a few times among ourselves and reviewed each other.	Task 1&2: Ashraful, Pranto, Alif, Fahim Task 3: Pranto Task 4:Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed. Task 3: Completed. Task 4: Completed.
17.09.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We reviewed our project proposal . And update some points according to the feedback. 2.Had a discussion about the hardware implementation	Task 1: Fahim Task 2: Alif, Fahim	Task 1:Completed. Task 2:Completed.
24.09.2021	1. Ashraful	1. Completed our	Task 1:Fahim	Task

	2. Pranto 3. Alif 4. Fahim	concept note 2. Completed project proposal report 3. Updated the log book.	Task 2: Pranto Task 3: Ashraful	1:Completed. Task 2:Completed. Task 3: Completed.
06.10.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Brainstorming session: Should hardware and software should be done parallelly? 2. Decision: Hardware should be completed first.	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1:Completed. Task 2:Completed.
9.11.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.finalizing circuit diagram 2. Finalizing presentation slide	Task1: Ashraful Task2: Alif, Pranto	Task 1:Completed. Task 2:Completed.
11.11.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Discussion with ATC members	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
26.11.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. Discussion about the progression about our project with ATC members	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
27.11.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.multiple approach brainstorming 2.Taking ideas from our peers from the field of CSE	Task 1&2: Ashraful, Pranto, Alif, Fahim	Task 1: Completed. Task 2: Complete
29.11.2021	1. Ashraful 2. Pranto 3. Alif	1. draft report completion task	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.

	4. Fahim			
30.11.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Meeting with Md. Mehedi Hasan Shawon sir 2.Review of draft report l 3.Review of the structure of our report	Task 1,2&3: Ashraful, Pranto, Alif, Fahim	Task 1: Completed. Task 2: Completed Task 3: Completed
02.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.circuit completion	Task 1:Alif, Fahim	Task 1: Completed.
05.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.consultaion with a medical specialist i.e. a doctor.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
06.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Survey question preparation 2.Report writing	Task1: Ashraful Task2: Fahim, Pranto, Alif	Task 1: Completed. Task 2: Completed
10.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Data collection for ML	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
12.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Data collection for ML	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
13.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Data collection for ML	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
15.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Preparing dataset on google form	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
20.12.2021	1. Ashraful 2. Pranto 3. Alif	1.Design report writing	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.

	4. Fahim			
24.12.2021	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.Submitted the report to our respected ATC members.	Task 1: Ashraful	Task 1: Completed.
05.01.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We had a meeting with our ATC members and they gave us some suggestions where we can improve.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
13.01.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We again submitted the report to our respected ATC members.	Task 1:Pranto	Task 1: Completed.
12.02.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We had a meeting with our ATC members and they gave us instructions what to do next about the machine learning part.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
12.02.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1. We trained our machine learning algorithms.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
17.03.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We prepared our presentation slide and mailed it to our ATC members.	Task 1: Ashraful, Pranto, Alif, Fahim	Task 1: Completed.
25.04.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We finally did our machine learning part 2.We also finalize our device with QR codes and all.	Task1: Ashraful,Pranto Task2: Fahim,Alif	Task 1: Completed. Task 2: Completed

27.04.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We gave a mock presentation for defense. 2.We also send it to the slides to the ATC members for the suggestions.	Task1: Ashraful,Pranto, Fahim,Alif Task2: Ashraful	Task 1: Completed. Task 2: Completed
28.04.2022	1. Ashraful 2. Pranto 3. Alif 4. Fahim	1.We finally faced the final defense.	Task1: Ashraful,Pranto, Fahim,Alif	Task 1: Completed