MEDISAFE - STAY AWAY AND DEFEAT DISEASE

Project Id: 2022 - 143

Final Project Thesis

B.Sc. (Hons) Degree in Information Technology Specializing in Information Technology

Department of Information Technology

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Dissertation submitted in partial fulfilment of the requirements for the Bachelor of Science in Information Technology specializing in Information Technology

Department of Information Technology

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Declaration

I declare that this is my own work and this thesis report does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Name	Student Id	Signature
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The supervisor/s should certify the thesis report with the following declaration.

The above candidates are carrying out research for the undergraduate Dissertation under my supervision.

……

Signature of the Supervisor
(Mr.Ravi Supunya)

……

Date

……

Signature of the Co-Supervisor
(Mr.Samantha Rajapaksha)

……

Date

Abstract

The spread of the Covid 19 pandemic has created a huge impact on society in many forms and ways. Along with the outbreak, it became difficult for people to meet the doctor in person. With that, it became unable to diagnose the disease at the right time and take the right decision whether the person can either receive medication by staying at home or should be hospitalized for medication. In such situation that is most important to check body health status. Several lives were lost, being unable to do so. Therefore, the ideal solution will be to go for a machine which will directly reduce personal contact with the doctor and will have the ability to get the measurements and analyse them accurately. Thus, if analysing the data and the part of making the decision can be done by staying at home it would be the ideal solution for the current situation. Here, temperature, pulse rate, ECG and blood pressure will be measured as parameters. Temperature will be measured by MAX 30205, pulse rate by Pulse Sensor SEN-11574, Exhale detector ugm and blood pressure by pressure sensor, respectively. These data will then be uploaded to the system to be analysed. Finally, they will be sent to the cloud database. Patients can use chatbots to acquire the medicine and medical advice they need as well. With this, it becomes able to create one simple and low-cost device to measure several parameters-temperature, pulse rate, Exhale detector and blood pressure, analyse them and give prescription report to patient what are the areas that patent need to prevent what are the vitamins and specially foods patient need to get, also with after detected Covid 19 and before positive covid 19 with using neural networks, using an expert system to analyse the condition of the patient and make the right decision.

Keywords: Covid 19, symptoms, CNN, Temperature, Exhale detector

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The completion of my research would not have been possible without the help of many people, and I am excited to use this opportunity to thank them all.

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Abbreviation	Description
WHO	World Health Organization
ML	Machine Learning
RQA	Recurrence quantification analysis
NLU	Natural-language understanding
IoT	The Internet of things
ECG	Electrocardiography

Chapter 1: Introduction

1.1 Background literature

The COVID-19 pandemic has resulted in a staggering worldwide death toll and represents a new level of peril for the world's food supply, public health, and economy. The economic and social stability of countries hit hard by the epidemic is fragile since most people there lack social security and access to good medical care.

The Covid 19 pandemic has not resulted in any deterioration of this planet's condition. Many people, until recently, would avoid going to medical institutions unless it was absolutely required.

The government has developed various cutting-edge technological solutions as a direct response to the extensive spread of the coronavirus outbreak, guaranteeing the continuation of business as normal while also increasing the efficiency with which tasks are completed. Some examples of such endeavours are the promotion of online shopping and robotic delivery, the usage of digital and contactless payment systems, remote employment, long-distance education, "Telehealth," and online entertainment.

Forbes has identified fourteen (14) "pandemic-driven tech innovations that will continue to impact the world." Some of these innovations include cloud computing, computer-assisted telephone interviewing, financial process automation, intelligent security technology, mental fitness apps, streaming services, and personal service apps. These are just a few examples of the innovations.

In spite of the fact that science, technology, and innovation have the potential to positively influence healthcare systems all over the world, the COVID-19 outbreak demonstrated that healthcare stakeholders have encountered significant challenges in responding to the crisis through well-integrated science, technology, and innovation-oriented health initiatives and policies. The speed with which SARS-CoV-2 test diagnostics and new mRNA vaccines have been developed is a clear illustration of this point. As a direct consequence of the epidemic, professionals, businesses, and governments have been motivated to investigate alternative courses of action in an effort to foster more efficient communication between science, technology, and innovation and public health.

When the background studies are taken into consideration, it can be seen that a significant amount of research has been conducted about computerised pulse diagnostic. Because it is non-invasive and simple to use, it is gaining popularity as a method for detecting people's health state. This is one of the reasons why it is becoming more common. It has been suggested to use a few different acquisition devices in order to acquire pulse waves and contact pressure signals with a higher degree of precision.

Research on computerised pulse diagnosis, which makes use of sensor techniques to gather the pulse signal and machine learning techniques to assess the patient's health based on the acquired pulse signals, has seen an uptick in interest as of late. This can be attributed to the fact that computerised pulse diagnosis can detect irregularities in a patient's pulse more accurately than traditional methods. There have been many different types of sensors that have been utilised for the purpose of obtaining pulse signals. These sensors may be broken down into three categories: pressure sensors, photoelectric sensors, and ultrasonic sensors. [15]

A study was carried out in which the nonlinear methodology of recurrence plot and recurrence quantification analysis (RQA) was used to the evaluation of wrist pulse data in order to differentiate between those who had diabetes and those who did not have the condition. RQA methods were utilised in order to evaluate the wrist pulse signals of the thirty-two individuals who had their readings taken in the wee hours of the morning. Variables such as entropy, divergence, and the average diagonal line length were examined, and it was shown that persons with diabetes and non-diabetic people vary significantly from one another in terms of these characteristics. As a result, one can deduce that the properties of RQA may be employed to apply to wrist pulse signals for the purpose of early sickness diagnosis and that they can be used to differentiate between persons who do not have diabetes and those who do have diabetes. [16]

A gadget has been developed that is able to differentiate between the pulses of diabetes patients and the pulses of normal persons. In this case, the goal is to normalise the signals under normal settings before attempting to find variations in pulse characteristics in fundamentally abnormal situations, such as diabetic cases [4]. Normalizing the signals under normal settings will allow the researchers to find variations in pulse characteristics in basic abnormal situations.

In addition to this, a remote patient diagnosis system that operates on the Internet of Things (IoT) devices and predictive machine learning models that are periodically executed on patient data has been created [7].

Ayurvedic practitioners are currently conducting tests to see whether or not the technology can be included into a computer-aided diagnostic tool.

In addition to this, a computerised method has also been utilised for the diagnosis of Siddha pulses. The Siddha pulse diagnostics system is able to be digitised, which enables for a more exact detection of irregularities in the body. According to Siddha medicine, three pressure transducers are utilised at three different reading points, namely vadha, pita, and Kapha, to examine the distortion of the radial artery, which eventually feels pressure in them. This examination is carried out in order to determine the optimal treatment for the patient. The demands are then read and conveyed to a smartphone application using a Bluetooth transmitter that is coupled to an audrino board. After that, the programme modifies the requirements by utilising the previously created database, and it finishes by delivering the diagnosed reports in digital format. [17]

Because so many people are deciding against going to hospitals during the epidemic, medical professionals are missing out on the chance to get as much insight as possible into their patients' current health conditions as soon as feasible. Alternative strategies are being utilised by medical professionals in order to maintain a close watch on their patients and reduce the length of their patients' hospital stays. There are limitations to the technologies that are now available, such as surveys and telemedicine. The first method can only gather recognised risk variables, which means that additional pre-existing and life-threatening risk factors cannot be collected using this method. Because a single nurse may only visit a certain number of patients throughout the course of a workday, the use of telemedicine by nurse practitioners is hampered by a bandwidth issue. In this context, chatbots play a significant role.

Previous to the use of chatbots for COVID-19, Penn Medicine, Google, and Verily cooperated on a chatbot that answered questions regarding COVID-19 and did basic symptom evaluations. This was done when the use of chatbots was being considered for COVID-19. The app is designed for sensitive groups rather than validated COVID-19 patients, and it focuses on basic yes/no and categorical questions rather than NLU-based analysis of a patient's input, such as symptom descriptions. Additionally, the software is not available for download on iOS devices. After providing responses to the questions, an instant survey of the user experience was carried out in order to collect feedback.

Another chatbot that was produced by researchers at the University of California was designed just for the aim of screening staff members working in health systems; it is not meant for usage by the general public. [9]

For the purpose of tackling the COVID-19 question answering challenge, a preliminary COVID-19 chatbot paradigm has been developed. The challenge made use of the pre-trained Google BERT language model. The COVID-19 sample questions and answers dataset served as the basis for the evaluation of the suggested chatbot. According to the early findings, the strategy that was provided was successful in generating responses that were suitable to the question that was addressed. In the future, it is planned to incorporate new datasets in an effort to increase the model's accuracy as well as its resilience [10].

The proposed system, which is based on the Internet of Things (IoT), has the capability to both save lives and deliver significant services to the healthcare industry. In the fight against infectious diseases, it has the potential to be a very helpful resource for both medical professionals and law enforcement officials. Additionally, this system is able to deliver essential medical treatment to those who are afflicted or suspected of having the disease, in addition to providing appropriate surveillance. Because the method allows for the maintenance of a physical distance between the provider and the patient while therapy is being administered, the probability that a healthcare provider may become infected as a result of providing treatment to any patient can be reduced. The multiple sensors that were installed into the device detected biological and environmental data with a high level of accuracy [11].

On the basis of the symptoms, a project to use an Internet of Things-based chamber to detect possible COVID-19 suspects has been initiated. When a person enters the chamber, the device utilises Neural Networks and Artificial Intelligence (AI) to identify COVID-19 signs such as fever, anosmia, coughing, and shortness of breath. Using the recommended methodology, the accuracy of fever detection is 95%, anosmia detection is 96%, and cough analysis is 94% [12].

An IoT-based UAV-based approach to collecting raw data using on-board thermal sensors has been presented. In this approach, a thermal image of a huge crowd in a city that was acquired by a thermal camera is used to identify potential people who may have covid 19 based on the temperature that was recorded. An effective hybrid strategy for a face recognition system has been presented in order to identify people in infrared photographs taken in real time who have a high body temperature. The photographs would be taken in a setting where the people would have a high body temperature. In addition to this, a face

mask identification tool has been included so that it can be determined whether or not a person is wearing a mask on their face [13].

Since the outbreak of the viral disease, infrared thermometers have been placed in public areas to take readings of people's body temperatures. This allows for the identification of sick individuals who may be hiding in the crowd. It takes a long time to check each person's body temperature, and the most important factor is that close contact with the infected could spread it to the person who performs the screening process, or from the person in charge of screening to the people who are being screened. This prevention is still lacking because it takes a long time to check each person's body temperature. It proposes the design of a system that can identify the coronavirus automatically from a thermal picture with minimum input from a person by making use of a smart helmet that is equipped with a thermal imaging device installed on it. In order to provide real-time data monitoring during the screening process, the thermal camera technology has been included into the smart helmet and connected with IoT technology. In addition, the device being suggested is outfitted with technology capable of recognising faces, and it is able to display personal information about the pedestrian as well as automatically collect their temperatures [14].

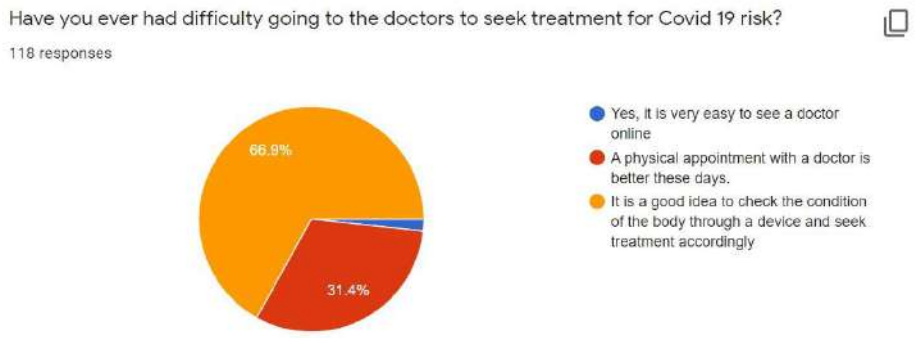

Figure 1.Willingness to see the doctor

According to the findings of the poll, the vast majority of respondents think that it is a good idea to check the state of one's body through a gadget and seek treatment rather than having a physical visit with a doctor in today's world (Figure 1.1)

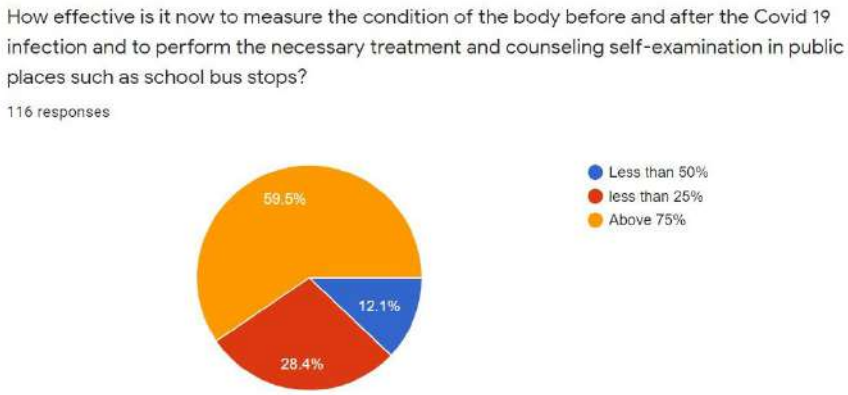

Figure 2: Effective of measure the condition

According to Figure 1.2, an equal number of people believe that it is effective to now measure the condition of the body before and after the Covid 19 infection and to perform the necessary treatment, counselling, and self-examination in public places like school bus stops. The number of people who believe this is above 75% and less than 50%, respectively. The primary explanation for this may be because establishments of this sort, which are considered to be public spaces, are among the locations that have the greatest potential for the propagation of this kind of sickness.

1.2 Research gap

There are many different reasons to have doubts about the accuracy of e-precisions. On the other hand, it rose to prominence during the pandemic circumstances. Because there is no opportunity for face-to-face interaction, the physician is forced to make assumptions, and such assumptions might be incorrect in some instances. Some customers have not yet caught up to the times and are not conversant with the most recent technology. The vast majority of them still prefer having a conversation with another person and receiving drugs. As a result, a web application and a mobile application that are both straightforward and easy to use has to be developed. On the other hand, as a result of the Covid 19 epidemic, physicians were extremely busy. In addition to this, the user is required to possess the necessary hardware equipment in order to verify.

At the present day, there are distinct equipment available on the market for measuring the parameters of blood pressure, pulse rate, temperature, and ECG pattern. These instruments are costly, and as a result, the vast majority of people are unable to buy them. In addition, even if these examinations are carried out in independent laboratories located in other locations, a certain quantity of financial resources will still need to be invested. As a result, the development of a single device that can measure a variety of factors while at the same time being inexpensive, non-intrusive, and straightforward need to be the primary focus of effort.

The difficulty in breathing that comes along with the discomfort that is being produced by Covid 19 is now the most pressing problem. It is of the utmost significance to maintain a constant state of vigilance regarding these diseases. However, what sort of a predicament does the patient find themselves in after receiving a significant quantity of input from the same device, and what kind of treatment is required in this case? The patient is provided with information on the medications that the doctor has prescribed for them to take. A prudent choice would unquestionably be to make this information available for use in crowded locations such as school bus stops, for example.

The below table will describe the comparison of previous research and our suggested system.

Research products	Features				
	Identify gender & age	Development of advanced equipment	Identify chronic diseases	Disease risk level-wise identify	Provide recommendations and suggestions in western & Ayurveda methods
Research A	✓	×	✓	×	×
Research B	×	✓	×	×	×

Research C	✓	×	✓	×	×
Proposed system (MediSafe)	✓	✓	✓	✓	✓

Table 1.1Comparision of previous research and proposed system

Chapter 2: Research problem

As a result of the continued development of the Covid 19 pandemic, the number of people who contracted Covid continued to rise on a daily basis, and the workload of the medical professionals rose significantly. Meeting with the doctor in person became problematic as a result of how extremely contagious it was. Face-to-face interactions are become impossible as the pandemic sweeps throughout the globe, preventing doctors from gathering the necessary data from patients and preventing them from being able to provide correct diagnoses. Patients were had to monitor their own blood pressure, pulse rate, temperature, and ECG pattern using a hardware equipment, and if they did not already own one, they were forced to go out and buy one if they did not already have one. Because the hardware that was available to test such conditions was so expensive, many people at the time of the collapse of the economy caused by the Covid 19 epidemic were unable to afford to buy this hardware. As a result, they were unable to leave their homes at all and did not even have the opportunity to get out of the house.

On the other hand, there are users who are not up to date with the most recent technological developments. The majority of those included in this category are members of the older generation. Because of their lack of expertise, it's possible that they won't be able to utilise these programmes or gadgets. Nevertheless, it is necessary for them to remain current with technological developments. By the year 2020, it was clear that the original and alpha variants of the Corona virus had caused at least 20 additional symptoms and anomalies, including skin rashes, sore throats, and red eyes, in addition to the three usual symptoms of cough, fever, and smell loss. The disease can be passed on by physical contact, but the symptoms, which include a rash on the skin, a sore throat, and red eyes, cannot be diagnosed without direct contact with a patient who has the condition.

Humans are cautious to utilise chatbots because at the moment, they can only use one word, and there is no greater connection between people and chatbots than there is today.

The vast majority of people in this day and age do not watch television or read newspapers; rather, they rely on mobile phones and applications found on the internet. As a result, many individuals do not obtain accurate information on the issue with Covid 19. In addition to that, it is imperative that individuals be reminded on a consistent basis to clean themselves, wear masks correctly, and adhere to safety and health rules.

Chapter 3: Research Objectives

3.1 Main Objective

Give the user the opportunity to monitor the results of monitoring their blood pressure, pulse rate, temperature, ECG pattern, and external symptoms, and provide the user with the ability to obtain the necessary guidance from home using the health care system in order to maintain a healthy lifestyle and make an accurate diagnosis of the disease. Create a computer-aided system that is non-invasive, uncomplicated, inexpensive, and painless, and one that has the capability to detect blood pressure, pulse rate, temperature, and pulse pattern. In order to build solutions, this method requires first employing an expert system to analyse the data that has been seen, and then uploading the data that has been produced to the cloud. It would be quite helpful to be able to swiftly and easily establish which exercises a person who suffers from Covid should practise on a regular basis. Permit the patient to send lengthy communications and to provide information in a manner that can be understood by persons of varying socioeconomic classes. It also serves to offer a communication route between humans and chatbots, which is another purpose it fulfils.

The user may make use of the mobile and online applications in order to get a deeper comprehension of the sickness and the rate at which it is spreading. By using the applications, he or she may also get some suggestions on how to protect yourself from the illness. Make it possible for a single device to monitor several aspects of a patient's condition, such as their temperature, heart rate, electrocardiogram, and blood pressure.

3.2 Specific Objectives

The Medi Safe system only accepts inputs from the user and then directs those inputs to the appropriate configuration in order to provide the user, in this case the patient, with all of the essential instructions and information regarding the condition. An algorithm is able to render inputs such as blood pressure, pulse monitoring, and the amount of air that can be kept in the chest once it has been computed with a high degree of accuracy once all of the relevant data has been collected.

Examining the circumstances of people with and without a corona infection is one technique to provide the patient with an appropriate level of education. They will also be informed of whether or not any treatments or conditions are suitable for them at this time.

Chapter 4: Methodology

This inquiry is broken up into four main parts or sections. The fact that the gadget is assembled from a variety of sensors and that all of the information that is gathered is processed and analysed before being transmitted to the patient as required is the most important feature. The ability to connect with patients through the use of talking robots that are able to respond quickly and accurately to the inquiries and concerns raised by patients is one of the distinguishing features of Medisafe. We give extensive descriptions of upcoming activities that will be carried out to prevent and prevent disease, as well as continuing monitoring of disease situations and associated data.

First, relevant sensor and microprocessor should be gathered. Then, device should be *integrated* and implemented. Next, datasets should be found, and model should be trained. Then, device data should be updated in database and covid probability should be given. Recommendations should be generated for day-to-day life and specific areas patient needs to attend. Finally, device and system, web application and mobile application should be integrated.

4.1 Overall System Architecture

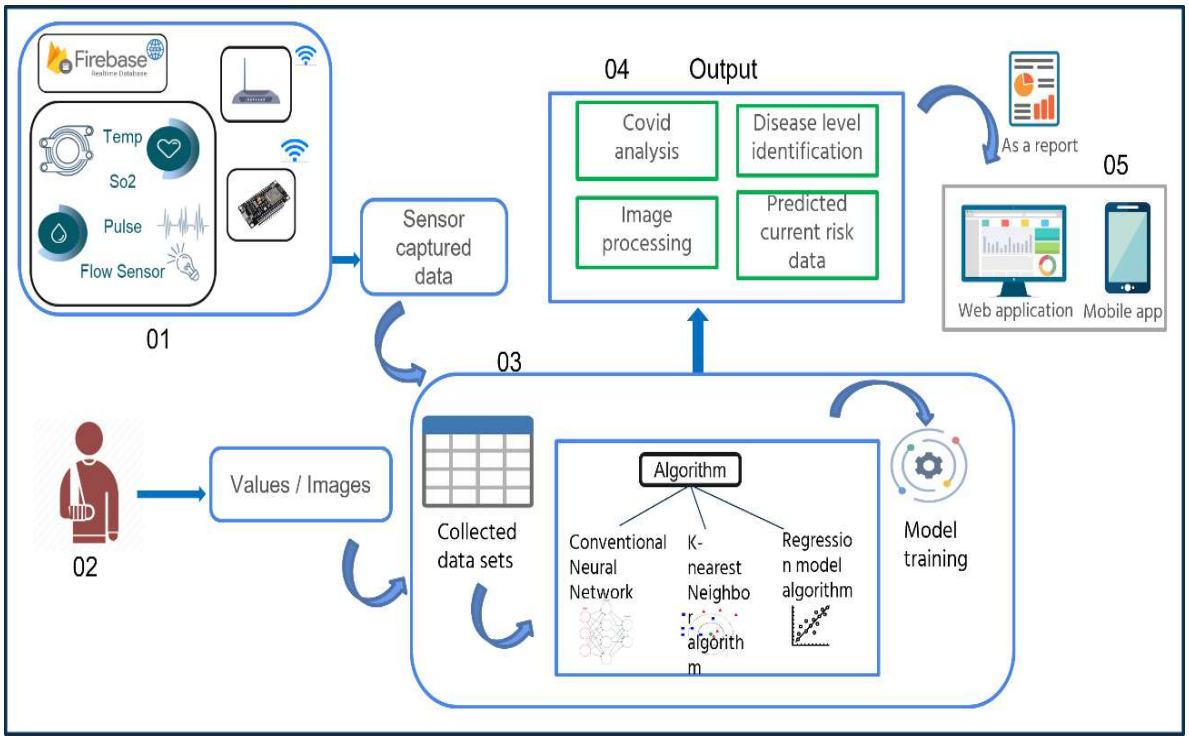

Figure3.Overall System Architecture

The proposed "MediSafe" system is a device implementation with a web application that can perform the following tasks: In the brief introduction of each component.

1) Measuring the current situation parameters of the patient via the proposed device and analyzing data and covid 19 identification.
   - The proposed device should be able to detect data. The proposed system includes temperature detectors, breath detectors, and blood pressure detectors. The sensors should provide correct values for the parameters. The captured data should be transferred to the cloud database via Wi-Fi. Finally, it will retrieve the sent data from the cloud database and present the relevant analyzed data to the user via the web application.

2) Frequency distribution of pulse rate variability data use to identify the heart and lung-based diseases analyzed by risk level and providing recommendations.
   - Patients may check their pulse rate via the implemented device that is connected to the web application. Additionally, it is getting some user inputs from the patient

and processes it according to the trained model and it provides the disease risk level and suggestions to prevent those ailments.

3) Image processing techniques to identify lung diseases

- Patients have to upload their X-ray images to the web application. Then according to the trained model of image processing-based techniques, it will provide the affected disease and its probability as a percentage to the user via the web application.

4) Identify the Sri Lankan current diseases spread rate diseases information.

- Users have to insert their current location and date via the web application. Then the use of machine learning prediction and trained data sets system will provide the future prediction that number of patients can be affected in the selected location.

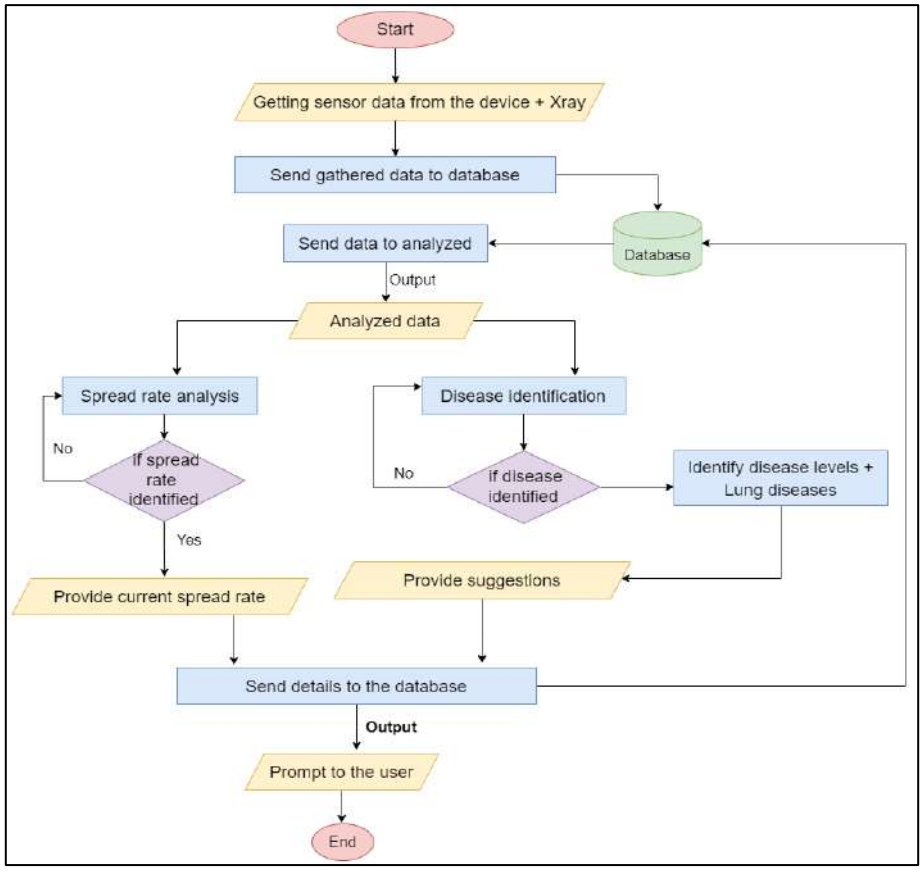

Figure 4.Entire system architecture working process

4.2 Individual component Architecture

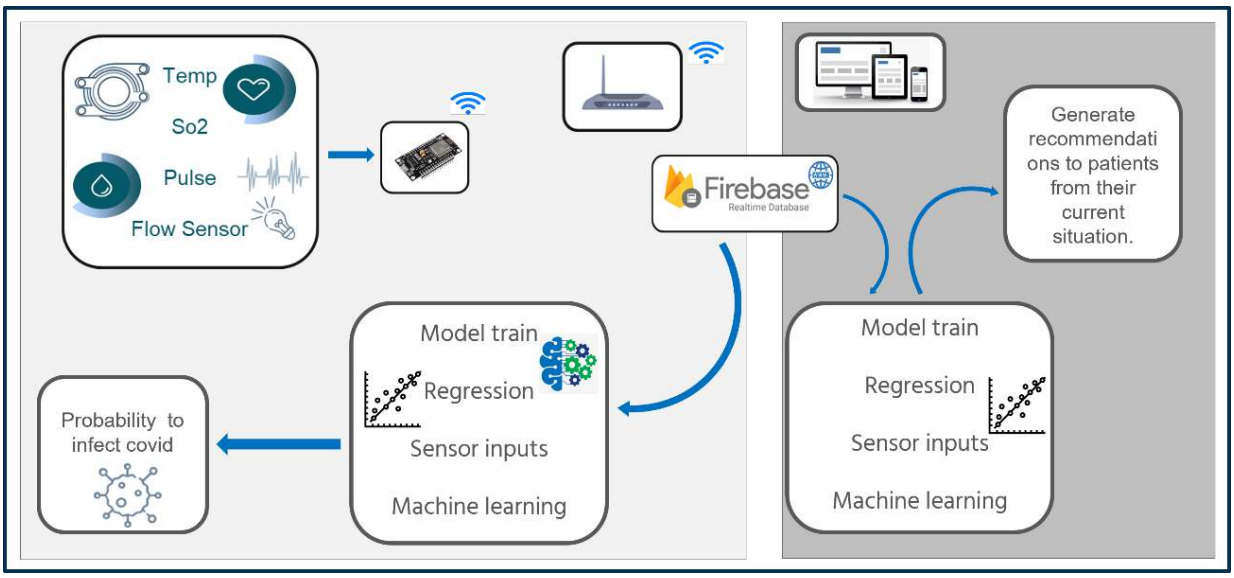

Figure 5.Individual component Architecture

- Collect sensor (Temperature sensor, Pulse detect sensor, Exhale sensor, Blood pressure sensor) data from various data sources as needed. Medi safe system should collect data from the sensors and transmit it to an external cloud storage using microcontroller so that the following operations may be conducted. All of the information gathered is transferred to a database and then routed to a microcontroller for processing. All of the information is input and then processed

- The data collected from the database is analysed by the neural network, and if the patient is a corona infected person, the Algorithm will determine at what level of the body he or she should seek medical attention, as well as whether or not there is a potential of getting any illness.

4.2.1 Data collection and model selection

The neural network performs analysis on information gleaned from the database. The algorithm determines the patient's risk of developing any disease and the level of the body at which medical attention is necessary if the patient is a corona infected person.

Finding an appropriate dataset for the model training is the first step in the implementation process. A number of my module's features are based on machine learning coded in Python, which I used in this investigation. To determine the likelihood of a Covid infection, I sought out data relating to SO2, temperature, and pulse. Kaggle.com was mined for the datasets. In light of this discovery,

1. Clean the dataset – Using leaner regression to clean up a dataset by eliminating redundant or unnecessary information and correcting or removing instances of error.
2. Data arrange – The features that are important for the necessary implementations should be combined.
3. Divide dataset – Here, the entire dataset was split in half between two groups. In other words, just 20% should be spent on actual testing and validations while the remaining 80% is allocated to actual teaching.
4. Fourth, a leaner regression was used to train the gathered dataset. Nearly 95% of the time, it was right.

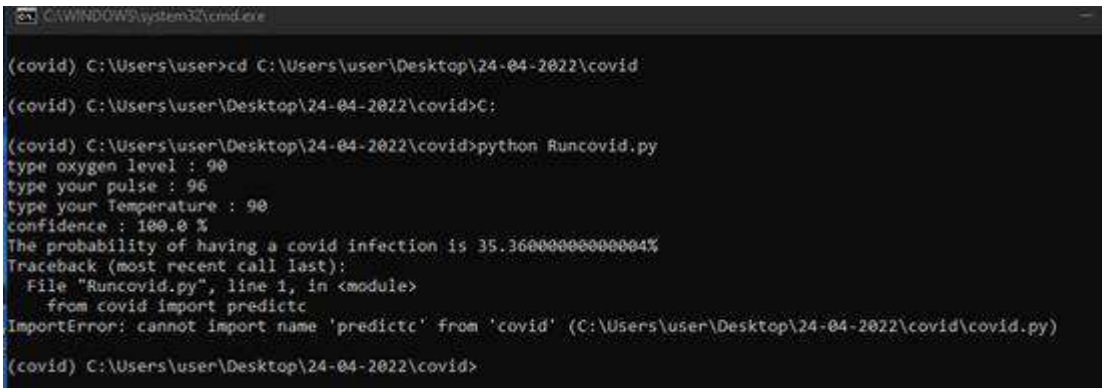

Figure 6. Accuracy of the selected model

4.2.2 Model training and data analysis using machine learning techniques

This implementation was completed by using the leaner regression model. Here Pandas, numpy, and Sklearn, ColumnTransformer, OneHotEncoder libraries were used for this model training. First, need to import the .csv files and had to call for the features (Attributes of the dataset) of the separate dataset files. Then need to do normalization, where the training model is saved, and then need to call the normalization function to make a scaler for the to find out probability to infect covid. Using the transform method will apply the scaler file. After applying the train values and test values those were normalized.

Then had to import the Pandas. Then train the classifier according to the previously introduced X and Y axes. After that, need to define the scaler file that should be saved and provide a proper naming. Finally using the pickle save the scaler file and model files. After model training, 20% of testing data was tested and it provides the expected output as shown in the dataset results.

```
import pandas as pd
import numpy as np
from sklearn import linear_model
from sklearn import preprocessing, svm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
import warnings
warnings.filterwarnings("ignore")
import matplotlib.pyplot as plt
import pickle
```

Figure7. Importated library

4.2.3 Output generation of the trained model

The trained model will display probability of infection the covid as percentage (%). In order to determine the likelihood of a Covid infection, the initial user must enter their SO2, temperature, and pulse characteristics, and then the entered data will be analysed using the trained model. After the system has determined the possibility of a Covid infection, it will display the probability of infect covid as a level and supply the user with a prescription through the website.

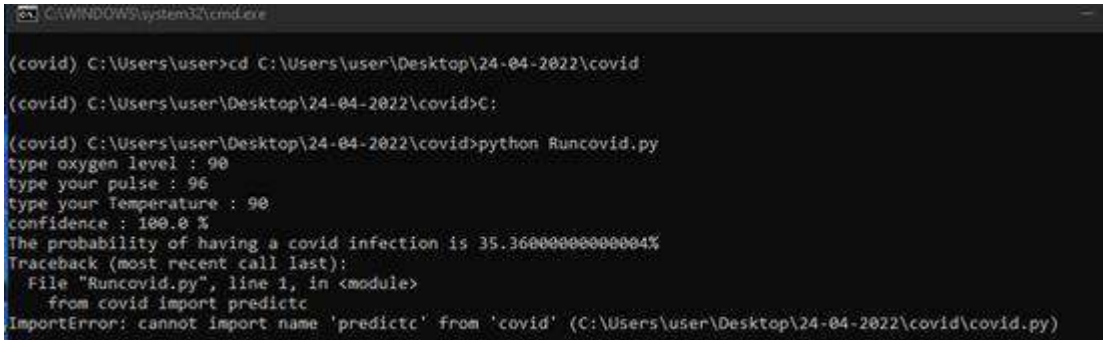

Figure 8. out put

4.3 Software solution

Agile methodology will be used to create the software. A supervisor will check in on the system every 10 days (twice a month) to see if any changes or tweaks are needed as the system is being built. The Agile process will accommodate evolving requirements and preferences, resulting in a system that is both more versatile and easier to operate.

Figure 9.Agile methodoly

- **Requirements analysis**

  We polled widely to gather data for analysis and to ensure that this project would be completed successfully. The usage of a survey programme allowed us to do this. For this reason, we used a Google form to solicit responses from those who were curious about participating. Additionally, we looked at past research conducted by other scholars and drew inspiration from their published works. This was done so that our own study could benefit from the additional data. Not only that, but we were also able to ask questions of medical professionals working in various fields of medicine and those who specialise in the treatment of specific diseases. As long as we have access to qualified medical personnel, we will keep pushing forward with this effort.

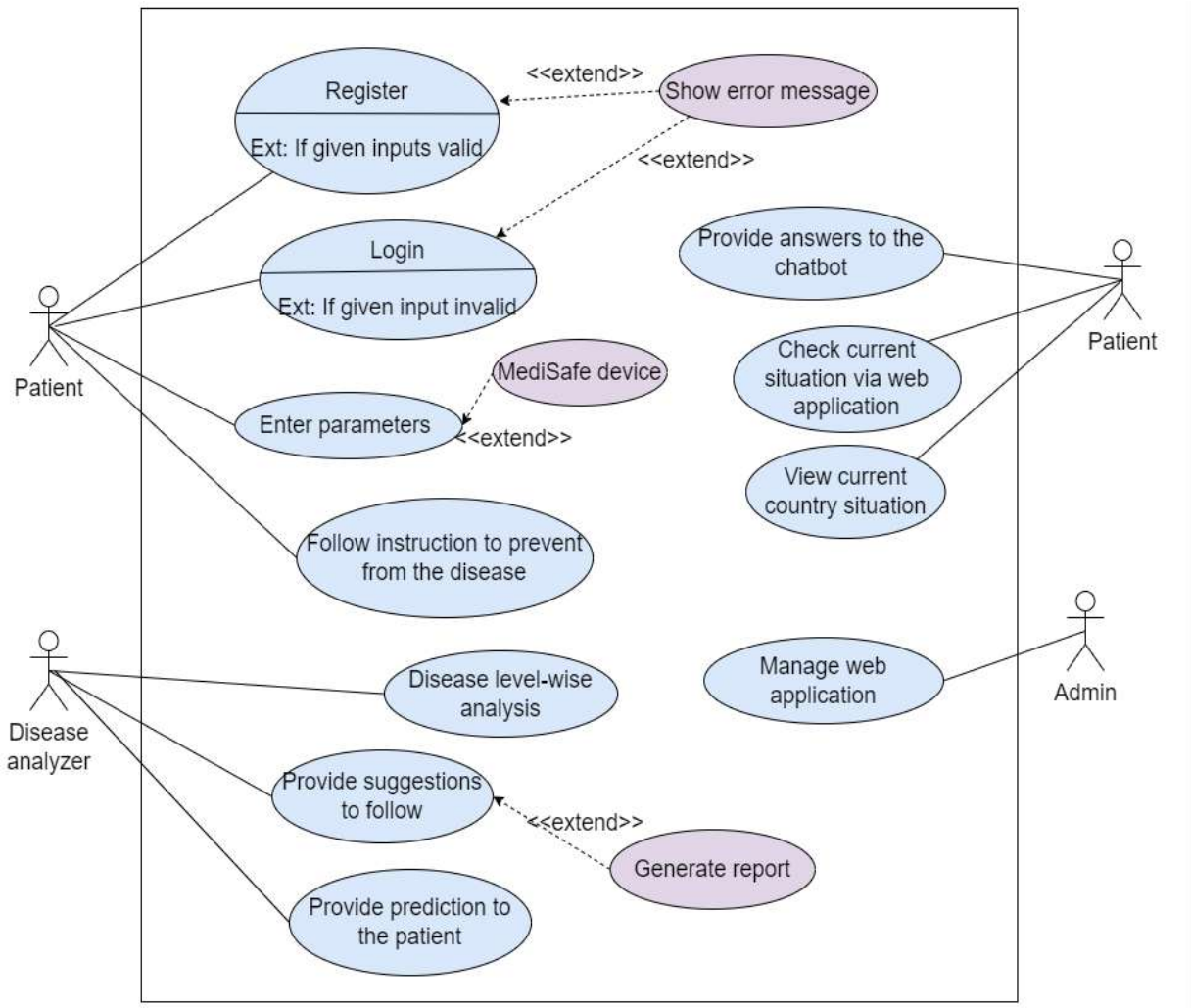

Figure 10.Use case diagram

- **Design and development**

At this stage in the design process, the focus turned to the application's visual style and how to maximise usability in terms of both technical and aesthetic considerations. After addressing interface difficulties with the rest of the team, first wireframe designs were accomplished without a hitch. MockFlow is a tool that aids in the design process. Following this text, in the appendices, are the resulting wireframe designs. Members at this tier have also discussed the technologies that will be needed for the proposed deployments. We've now opted on utilising React for the web app's frontend and Flask for the server-side components.

- **Feasibility study**

As a result of our work on this project, the web application will be able to make use of our built system to provide the appropriate responses to issues, resulting in accurate results that are free of any omissions or mistakes.

In addition, the cost of the designs remains low. In addition, the active outputs of the components used should be stable, and the cost of those components should be low. Therefore, measures need to be taken to supply alternatives with reasonable total costs of use.

The development of some kind of apparatus is going to be an essential part of this endeavour. As a consequence of this, it is of the utmost importance to have a complete understanding of both the equations necessary to attain the desired output as well as the electronics that are utilised in the design in order to acquire the correct output by connecting the various components. For the purpose of gathering this information, we are required to rely on particular sources.

- **Implementation**

This investigation can be split down into four main categories. The fundamental idea behind the gadget is that it should make use of a wide variety of sensors in order to collect data, which is then processed and sent to the user in accordance with their specific needs.

In order to conduct meaningful interactions with patients and give fast and suitable responses to their questions and concerns, Medisafe utilises technology developed by Arduino. The activities that will need to be completed in the future for disease prevention and control are detailed, along with the methods and data that will be utilised to maintain track of the current condition of disease prevention and control.

The hardware itself is an Arduino project, while the accompanying web app is a React one. The utilisation of a remote server in the cloud is not limited to just the testing and development phases. Flask is the name of the host machine.

This project took the following steps.

- ✓ Data will be gathered by the device's sensors and processed.
- ✓ Disease level identification and recommendations
- ✓ Disease detection using image processing
- ✓ Patients will be allowed to contribute additional information in addition to the information provided.

This is accomplished by using a web application to provide the user with diagnoses for the final diagnosed ailment.

- **Testing**

It is necessary to conduct tests on every single procedure that plays a role in the operation of the system as a whole. Unit testing is carried out to ascertain that all of the subsystems are operating appropriately and to identify any problems with the system in the earliest feasible stage. In order to avoid a catastrophic failure, it is necessary, before the entire system can be merged, to examine the validity of each individual component first. As a consequence of this, any errors that may be present in the code will become readily obvious to the reader. Integration testing is the next step, which is performed once the system has been successfully integrated, with the goal of determining the system's

functionality. After this has been completed, you will be aware that the system is functioning at its optimum level. During the phase of integration testing, any issues that may have arisen as a consequence of integrating the systems are looked for and rectified.

- **Maintenance**

During the course of the maintenance process, a more recent version of the system that includes a large number of newly added features should be installed. To put the cherry on top of it all, they need to be able to control it in such a way that it never breaks, and they need to design it in such a way that the user can use it without any assistance from anyone else.

4.4 Requirements

The implementing system should be capable of satisfying the conditions listed below.

4.4.1 Functional requirements

A product's functional requirements are the features and capabilities that must be implemented by the developers in order for the product to be useful to the end users in doing their daily tasks. Therefore, it's important to provide a detailed explanation of them to the stakeholders as well as the development team. The primary purpose of functional requirements is to define how a system acts in specific scenarios.

The functional requirements of a system are those that deal with the system's actual technical operation. Users' interactions with the programme are laid out in the functional requirements, thus it's imperative that the application can conform to these specifications and be tested.

As a result, the functional requirements listed below can be referred to as the functional requirements of my component.

- Reliability
- Portability

- Usability

4.4.2 Non- functional Requirements

Non-functional requirements are those that are not directly related to the functionality of the system itself. They define the standards by which the programme is judged. Non-functional requirements are designed to ensure that issues like scalability, maintainability, performance, portability, security, and dependability are met. Non-Functional Requirements is a section in the software system's requirements document that focuses on quality issues that cannot be solved by modifying the code.

The non-functional requirements of a system have an effect on the user experience when it comes to determining the behaviour, features, and general characteristics of the system. Both the usability and performance of the system will benefit from a thorough specification and implementation of the system's non-functional requirements..

As a result, the non- functional requirements listed below can be referred to as the non-functional requirements of my component.

- Security
- Recoverability
- Capacity

4.5 Commercialization

The aged population, who are more likely to be affected by disease, stands to gain the most from the Medisafe strategy that we outline. Because of this reason, we are currently making preparations to use this technology at an aged care facility. As a consequence of this, referring elderly people to hospitals is difficult job, and the elderly themselves do not need to make any further efforts; but, if the threat posed by their diseases is substantial, they can be transported to a hospital as soon as possible. They won't be required to devote as much of their time or money to addressing it.

Many people, as a direct consequence of their overbooked schedules, have very little time to devote to thinking about and caring for their health. The installation of such a gadget at a strategic area within a company affords workers the opportunity to take better care of their bodies during their free time in a manner that is both easy and accessible. That's accurate; not only in the previously described case, but also in the one you just described might this technology be put to use, which would result in huge benefits. The installation of this device is slated to take place in a low-key commercial environment.
When it comes to putting this strategy into practise at the healthcare institution where our external supervisor is employed, we want to take his lead. By conducting examinations on newly admitted patients, we will be able to validate the dependability of both the apparatus and the system.

In addition, I would like to take advantage of this opportunity to discuss it with a third party who is not emotionally invested in the matter. That's a sign that the business climate is strong and stable. After that, we would be able to move on with this implementation at a normal speed.

The use of social media in the promotion of our future release is another excellent suggestion. The dissemination of information on our items may be accomplished via the publication of a variety of articles. In addition to this, using this way to advertise a product is more effective than using other methods, and it does so without requiring an increase in either the money or the number of people working on the project. When it comes to the promotion of our products, promoters are no longer essential. It's possible that members of the team may spread the information via various social media platforms. (Social media/Instagram/Internet: daraz.lk, ikman.lk)

Chapter 5: Testing & Implementation

5.1 Testing process

The system's functionality is tested individually. Unit testing is used to check each functionality of the system to identify bugs in the functions and to confirm those are working smoothly. This should be tested before integrating each function together to avoid system failure. As a consequence, any coding flaws will be obvious.

After completing the system integration, the whole integrated system can be tested by using integration testing. Integration testing is performed to uncover any errors that might have happened after the system has been integrated.

After the system has already been finished, it must be tested. System testing guarantees that the system produces the expected output and meets the needs of the user. Here we can verify that the expected outcome is the same as the actual outcome by discussing the external supervisor also. Then it allows using for anyone.

5.2 Test Plan and Test Strategy

"Test planning" refers to the process of organising and preparing the various tests that need to be executed to ensure that the programme is functioning properly. Establishing a set of initial conditions for the project is necessary in order to keep track of its progression. These requirements include compiling a list of activities, as well as its scope and goals. A test strategy is a method that consists of a series of steps and processes that can be used to direct the steps of the software testing process. It outlines the functions and features that need to be investigated in light of the risks that might be posed to the final consumers. Methodology Procedures for Testing

- Define the items to be tested o
- Select the functions based on the importance and risk on user
- Design test cases as identified by the use case description
- Execute
- Record results

- Identify bugs
- Correct bugs
- Repeat the test case until expected results are met

5.3 Test Case Design

The following test cases were designed to ensure system reliability by testing all system functionalities.

Test Case ID	TestCase_01
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 2.TestCase_01

Test Case ID	TestCase_02
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 3.TestCase_02

Test Case ID	TestCase_03
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 4.TestCase_013

Test Case ID	TestCase_04
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 5.TestCase_04

Test Case ID	TestCase_05
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 6.TestCase_05

Test Case ID	TestCase_06
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 7.TestCase_06

Test Case ID	TestCase_07
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 8.TestCase_07

Test Case ID	TestCase_08
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 9.TestCase_08

Test Case ID	TestCase_09
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 10.TestCase_09

Test Case ID	TestCase_010
Test Scenario	
Test Input	
Test output	
Expected output	
Actual output	

Table 11.TestCase_10

5.4 Implementation

MediSafeis a IoT Based software solution comprised of web applications. The web application is used to assess disease identification, classification, and progression level calculation. The results were displayed in the web application for the user to monitor the process. Frontend development of web applications were implemented using React and Node js respectively. Firebase cluster is used as the database. All the backend servers and the web application are deployed in the Google Cloud. The Models and algorithms were implemented using Python (version 3.6.13) on Jupyter Notebook and IOT device was connected using Arduino IDE. The implemented models were trained using Google Colab.

The disease level-wise identification component act according to the user entered values. After inserting the values that should analyze the entered data according to the trained model. And then provide the risk level and according to the risk level that will give an output to the user as a recommendation. Accuracy and performance are non-functional requirements of the component. The technologies utilized to construct my component for illness risk level identification are listed in the table below. Python was used to implement the risk level detection and analysis. The implementation of the risk level identification and analysis function is the primary emphasis of this section.

Algorithm	Regression
Libraries	Pandas, sklearn, joblib, numpy
Distribution	Anaconda Navigator
Language	Python, React, Node js
IDE	Jupiter Notebook Arduino IDE Visual studio code
Data collection	Kaggle

Table 12.Project technology stack

A. Model training

The likelihood of a Covid infection doing according to the user entering details. So first, it should have to train the model by referencing the collected data sets.

```
import pandas as pd
import numpy as np
from sklearn import linear_model
from sklearn import preprocessing, svm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
import warnings
warnings.filterwarnings("ignore")
import matplotlib.pyplot as plt
import pickle

def readcsv():
    df = pd.read_csv('covid/data_set.csv')

    df.dropna(inplace=True)

    return df

def labelling_covid():
    df = readcsv()

    df['target'] = df['Covid']

    df = df.drop(columns=['Covid'])

    return df


df = labelling_covid()

def regression(df):

    x = df.iloc[:, :-1].values
    y = df.iloc[:, -1].values

    X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.25)
```

Figure 11.Importing libraries and datasets for model training

Above figure 5.1 describes the libraries importing and dataset importing to the model training and introduces the features of the datasets. (numpy,and Sklearn, ColumnTransformer, OneHotEncoder) Those are the three main diseases that I analysed.

```python
df = labelling_covid()

def regression(df):

    x = df.iloc[:, :-1].values
    y = df.iloc[:, -1].values

    X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.25

    regr = LinearRegression()

    regr.fit(X_train, y_train)

    r2_score = regr.score(X_test,y_test)
    # print('confidence :',r2_score*100,'%')

    pickle.dump(regr, open('model.sav','wb'))

    return regr
```

Figure 12.Model Training process

B. Generated Output

Here, by referring to the output will provide to the user like this

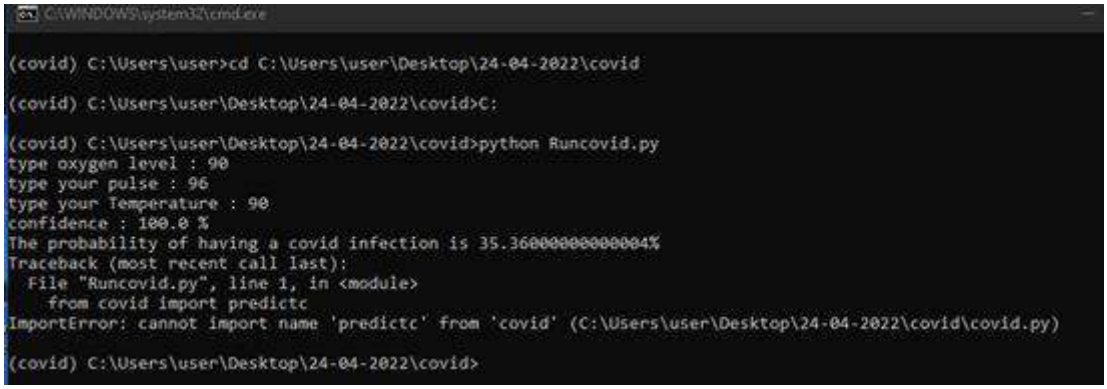

Figure 13. The way output should print

The user will see something like the output in Figure 5.6. The current implementation is only adequate for halfway through. In the future, we shall describe other developments.

C. Detection of parameters using hardware device

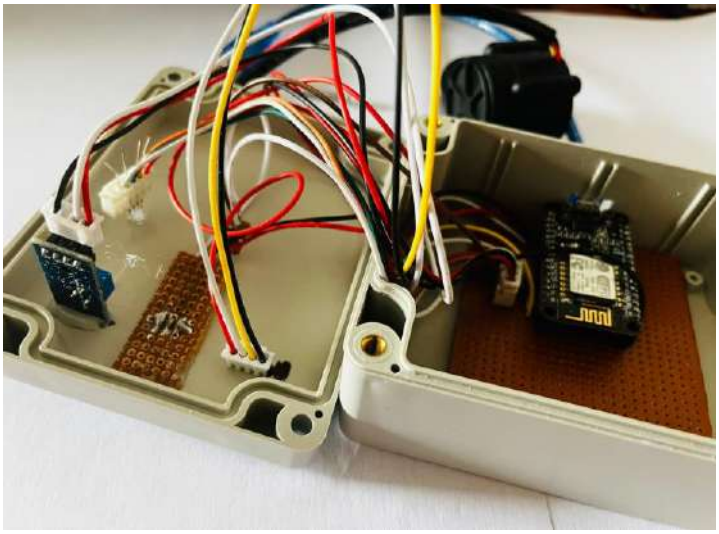

Figure 14.Implemented device

The ATMEGA328 microcontroller used on the Arduino Uno is mostly used for prototyping. Here, analogue signals from the SPO2, Temperature, and Flow sensor are converted to digital ones by the Arduino Uno's A/D converter, and the resulting digital signals are gathered and communicated to the firebase via the ESP8266 module. After retrieving the necessary information from the database, the system will show a preview to the user in the form of a web interface.

D. Disease analysing and generate prescription

When data is posted to Firebase from a user or a sensor, it is evaluated by a machine learning system that has already been trained. After that, the trained model will be used to make an assessment. According to the results of the analysis, the patient's risk level can be determined with precision. Furthermore, prescriptions are written in accordance with the identified patient. If the severity of the patient's condition warrants it, they will be transferred to the nearest hospital promptly. A prescription can be filled at your local drugstore, which is listed as an additional resource.

A. Web application implementation

From this onwards will describe the individual implementation of this web application.

- **Frontend development**

```
@app.route('/covid', methods=['GET', 'POST'])
def predictCO():
    data = {}
    post_data = request.json

    oxygen = str(post_data['oxygen'])
    pulse = str(post_data['pulse'])
    Temperature = str(post_data['Temperature'])

    covid = predictC(int(oxygen),int(pulse),int(Temperature))

    data['prediction_covid'] = covid

    return jsonify(data)

if __name__ == '__main__':
    print('Loading model...')

    app.run(host='127.0.0.1', port=8081, debug=False)
```

Figure 15.API connect backend and frontend

```
submit = async () => {
  const form = { ...this.state.form };
  const oxygen = form.oxygen;
  const pulse = form.pulse;
  const Temperature = form.Temperature;

  const data = {
    oxygen: oxygen,
    pulse: pulse,
    Temperature: Temperature,
  };
  this.setState({ loading: true });
  try {
    await fetch("/covid", {
      method: "POST",
      headers: {
        "Content-Type": "application/json",
      },
      body: JSON.stringify(data),
    })
      .then((response) => response.json())
      .then((response) => {
        var covid = response["prediction_covid"];
        //    console.log(msg)

        this.setState({
          covid: covid,
        });
      });
    this.setState({ loading: false });
  } catch (error) {
    this.setState({ loading: false });
  }
  this.resetFields();
  this.setState({ loading: false });
};
```

Figure 16. User creation form

In order to identify predictions, it is necessary to begin by importing pertinent libraries, files, and other files that have been incorporated into the already existing folder. The user will be presented with a graphic depicting the likelihood of a Covid infection at this point.

If there are any characteristics in the targets or the outputs that don't have a corresponding mapping to the input attributes, a Constant Column will be created. In this context, we are working on a front-end for disease identification. As seen in figure 5.8, we'll need to make some new fields in order to collect the necessary information from the user. Those are the kinds of data I'd like to glean from the user.

The function Object() { [native code] } for a React component is executed before the component is actually deployed. For the function Object() { [native code] } of a React component, all I have to do is call super(props) before each statement. This happens if the super(props) method is not invoked. Any mistakes that arise from the lack of prop specification in the function Object() { [native code] } are the responsibility of the

developer.

```
@app.route('/covid', methods=['GET', 'POST'])
def predictCO():
    data = {}
    post_data = request.json

    oxygen = str(post_data['oxygen'])
    pulse = str(post_data['pulse'])
    Temperature = str(post_data['Temperature'])

    covid = predictC(int(oxygen),int(pulse),int(Temperature))

    data['prediction_covid'] = covid

    return jsonify(data)

if __name__ == '__main__':
    print('Loading model...')

    app.run(host='127.0.0.1', port=8081, debug=False)
```

Figure 16.Sending data to the server

It's recommended to post the information to the server. Afterwards, change the JavaScript value to a JSON string with the "body: JSON.stringify(data)" method. Once a Response stream has been created, the json() method of the Response interface can be used to check it for completion using a json() object. Following this, the process will read the user input and prepare a response.

```
void max30105sens(){
  if (checkForBeat(irValue) == true)
  {
    //We sensed a beat!
    long delta = millis() - lastBeat;
    lastBeat = millis();
if(count>0){
    beatsPerMinute = 60 / (delta / 1000.0);

    if (beatsPerMinute < 255 && beatsPerMinute > 20)
    {
      rates[rateSpot++] = (byte)beatsPerMinute; //Store this reading in the array
      rateSpot %= RATE_SIZE; //Wrap variable

      //Take average of readings
      beatAvg = 0;
      for (byte x = 0 ; x < RATE_SIZE ; x++)
        beatAvg += rates[x];
      beatAvg /= RATE_SIZE;
    }}
  Serial.print("IR=");
  Serial.print(irValue);
  Serial.print(", BPM=");
  Serial.print(beatsPerMinute);
  Serial.print(", Avg BPM=");
  Serial.println(beatAvg);
 // Serial.println();
  count++;
```

Figure 17.IOT device code segment related to the pulse sensor

```
//--------------------Firebase-----------
WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
Serial.print("connecting");
while (WiFi.status() != WL_CONNECTED) {
  Serial.print("."); digitalWrite(BLULED, HIGH);
  delay(500);
}
digitalWrite(BLULED, LOW);
Serial.println();
Serial.print("connected: ");
Serial.println(WiFi.localIP());

Firebase.begin(FIREBASE_HOST, FIREBASE_AUTH);

pinMode(SENSOR, INPUT_PULLUP);
pulseCount = 0;
flowRate = 0.0;
flowMilliLitres = 0;
totalMilliLitres = 0;
previousMillis = 0;
attachInterrupt(digitalPinToInterrupt(SENSOR), pulseCounter, FALLING);

digitalWrite(REDLED, HIGH);
delay(1000);
digitalWrite(REDLED, LOW);
digitalWrite(GRELED, HIGH);
delay(1000);
digitalWrite(GRELED, LOW);
```

Figure 18.IOT device light indication colors and Wi-Fi connecting

This is the how final output will display to the user. The output will display as an image then the user can zoom in and zoom out to see the recommendations. Here if the user risk level is low and medium the same suggestions will provide to the user and if it is high, it will display another suggestion to the user for their reference.

In this documentation, important snapshots are only included.

- **Backend development**

From the front end entered data will be analysed according to the trained model by using the below coding implementation.

According to the GET and POST method, the data will gather from the server and return the analyzed identified risk level via frontend to the user. This is how backend development was implemented.

```
import pandas as pd
import numpy as np
from sklearn import linear_model
from sklearn import preprocessing, svm
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
import warnings
warnings.filterwarnings("ignore")
import matplotlib.pyplot as plt
import pickle

def readcsv():
    df = pd.read_csv('covid/data_set.csv')

    df.dropna(inplace=True)

    return df

def labelling_covid():
    df = readcsv()

    df['target'] = df['Covid']

    df = df.drop(columns=['Covid'])

    return df


df = labelling_covid()

def regression(df):

    x = df.iloc[:, :-1].values
    y = df.iloc[:, -1].values

    X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.25)
```

Figure 19.Backend development I

```
df = labelling_covid()

def regression(df):

    x = df.iloc[:, :-1].values
    y = df.iloc[:, -1].values

    X_train, X_test, y_train, y_test = train_test_split(x, y, test_size=0.25

    regr = LinearRegression()

    regr.fit(X_train, y_train)

    r2_score = regr.score(X_test,y_test)
    # print('confidence :',r2_score*100,'%')

    pickle.dump(regr, open('model.sav','wb'))

    return regr
```

Figure 20.Backend development 2

- **User Interfaces**

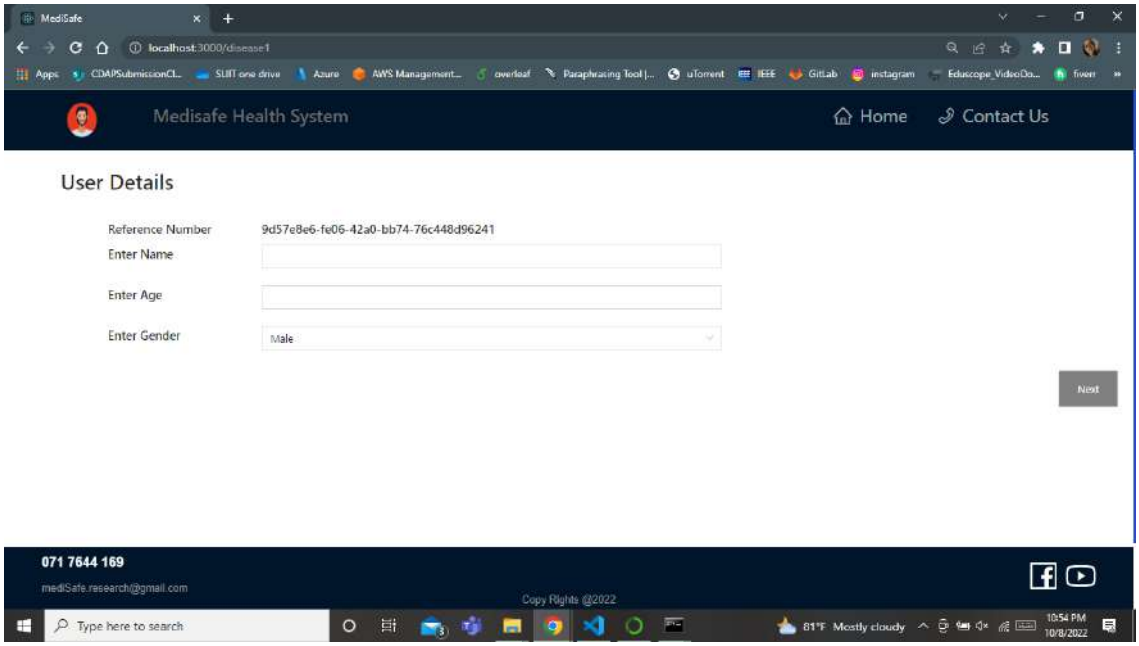

Figure 21.UserDetails

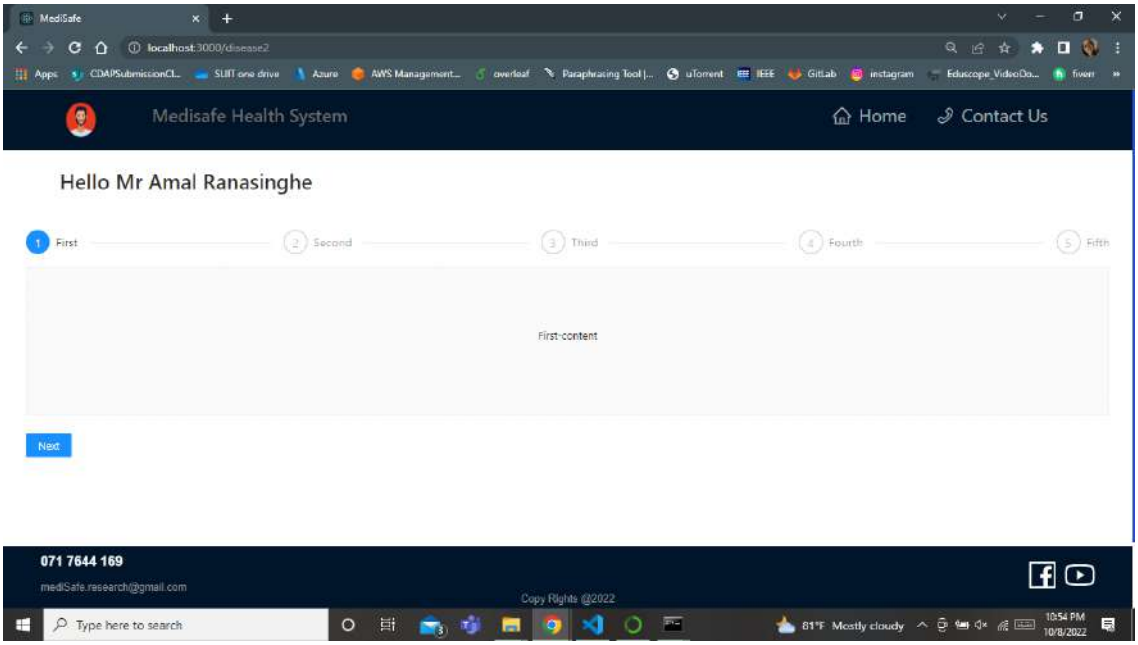

Figure 22.dashboard

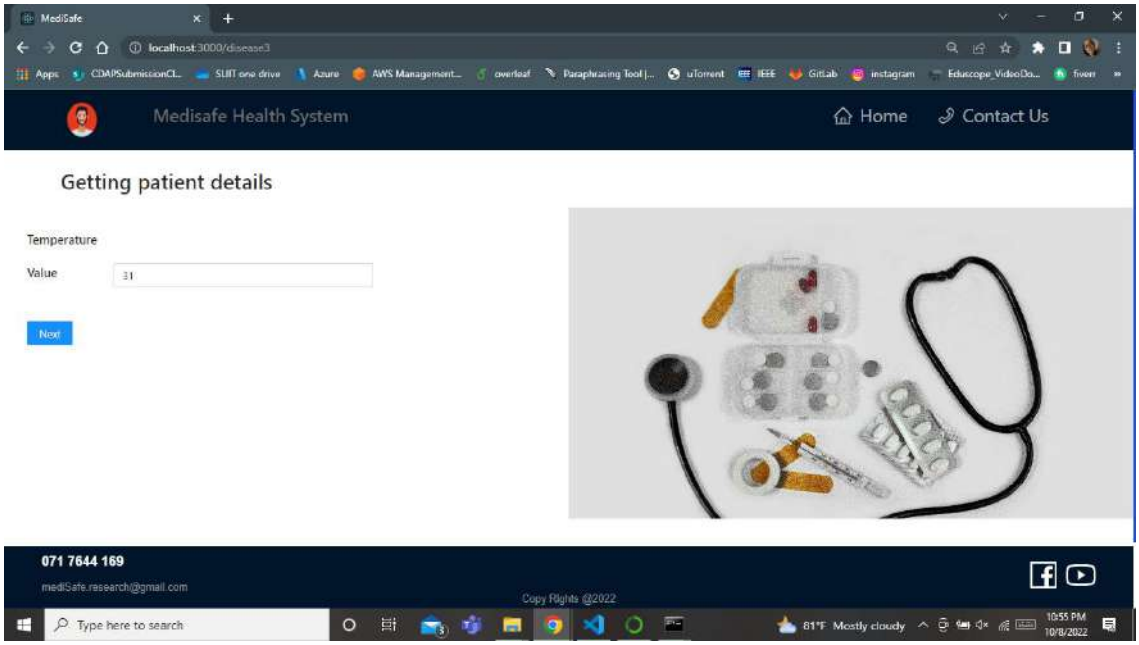

Figure 23.patient tempurature

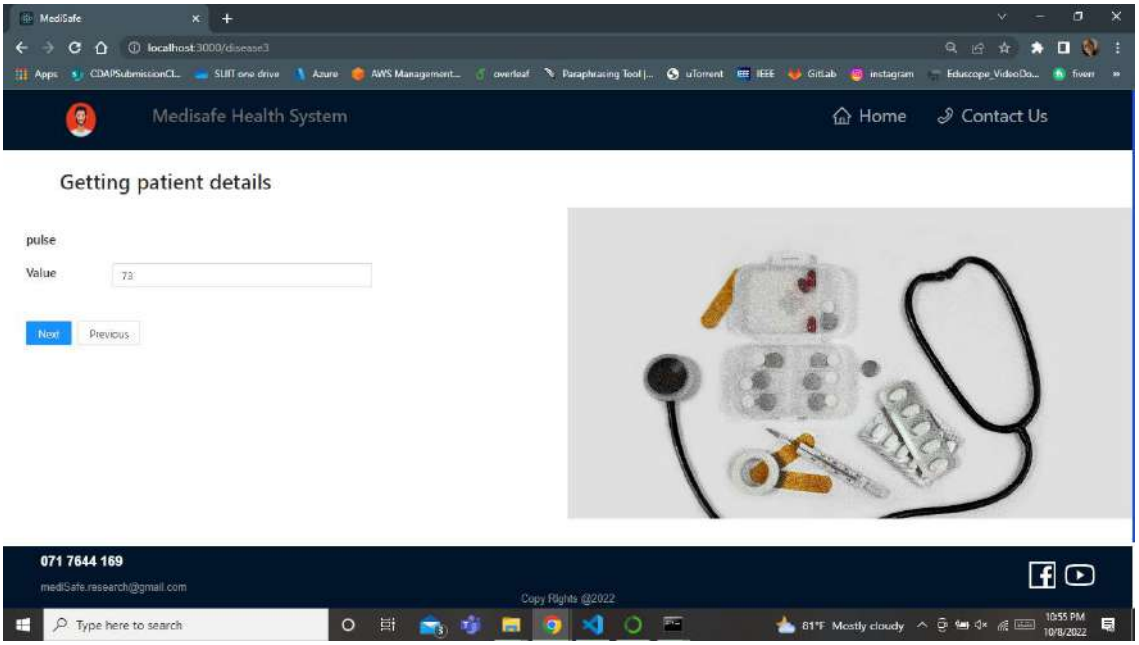

Figure 24.patient pulse

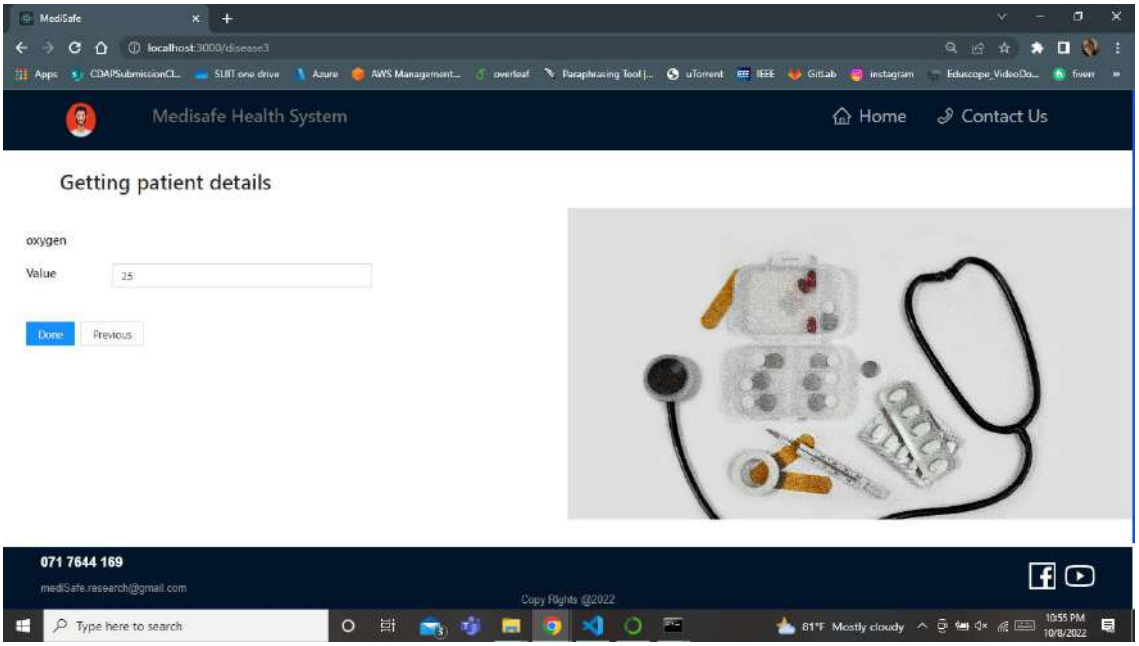

Figure 25.patient oxygen level

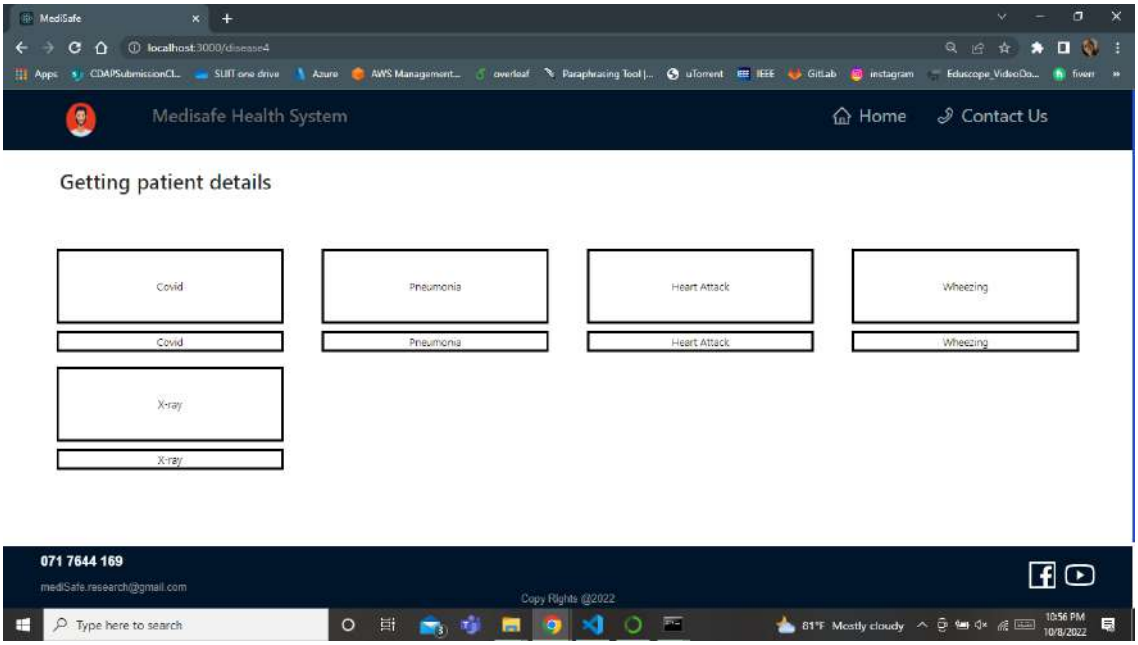

Figure 26.display the prediction according to the entered details

Chapter 6: Result & Discussion

6.1 Result

6.2 Research findings

6.3 Discussion

Chapter 7: Conclusion

The elderly population is intended to be the recipient of this work's message. Because patients are unable to make regular visits to hospitals and retirement communities, we are hoping to present our proposal to one of these two types of facilities. We are currently carrying out the essential activities and making the necessary preparations for future endeavours, and we have received the blessing of the relevant authorities in order to do so. If we put in more time and effort into developing this idea, we will be able to enter the market not only in our own country but also in other countries with a finalised product.

It is expected that both the installed device and the web application will undergo future improvement to improve the quality of service they provide to users and the overall efficiency of the system.

If the site is designed correctly, patients and doctors can have face-to-face consultations and guidance sessions.

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Appendices

- Poster for Marketing

- Designed wireframes for web Application