MEDILAB – MEDICAL DATA ACQUISITION AND ANALYSIS

A PROJECT REPORT

Submitted by

Abhishek P	**(113316106001)**
Sri Balaji M	**(113316106080)**
Vamsi Krishna Reddy	**(113316106015)**

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ANNA UNIVERSITY::CHENNAI 600 025

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ANNA UNIVERSITY::CHENNAI 600 025

BONAFIDE CERTIFICATE

Certified that this project report titled **"MEDILAB – MEDICAL DATA ACQUISITION AND ANALYSIS"** is the bonafide work of **Mr. Abhishek P (113316106001), Mr. Sri Balaji M (113316106080) and Mr. Vamsi Krishna Reddy (113316106015)** who carried out the project work under my supervision.

SIGNATURE
Dr. B. Sridevi, M.E., Ph.D
HEAD OF THE DEPARTMENT
Professor
Electronics and Communication
Velammal Institute of Technology
Panchetti, Chennai – 601 204.

SIGNATURE
Dr. B. Sridevi, M.E., (Ph.D)
SUPERVISOR
Professor
Electronics and Communication
Velammal Institute of Technology
Panchetti, Chennai – 601 204.

Submitted for the project Viva – Voce examination held on _____ at Velammal Institute of Technology.

INTERNAL EXAMINER **EXTERNAL EXAMINER**

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Abhishek P

Sri Balaji M

Vamsi Krishna Reddy

ABSTRACT

The proposed model can diagnose diseases and work solely based on the audio inputs from the user without having the need for them to know to read or write any language. It recites the symptoms one by one in the native language used in the locality and the user just have to press Yes or No to react. Based on the complexity of the disease, the device can provide prescriptions, dispense drugs, or alert the nearest health facility if a serious disease is diagnosed. Once several of these devices are installed in a city or town, they form a network and start communicating with each other, becoming more efficient with every diagnosis. This collective network would later analyze all the medical data collected from the individual devices and facilitate data visualization by representing them in various graphs. This would help to easily identify disease outbreaks and in isolating them.

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6.11	Website	55

LIST OF ABBREVIATIONS

AI	**Artificial Intelligence**
ML	**Machine Learning**
NVBDCP	**National Vector Borne Disease Control Programme**
HIS	**Hospital Information System**
TCM	**Traditional Chinese Medicine**
SDAT	**Syndrome differentiation and Treatment**
PyPi	**The Python Package Index**
API	**Application Programming Interface**
HDMI	**High-Definition Multimedia Interface**
DVI	**Digital Visual Interface**
SCART	**Syndicat francais des Constructeurs d'Appareils Radio et Television**
LCD	**Liquid Crystal Display**
USB	**Universal Serial Bus**

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

Even after having an enormous development in medical research and diagnosis, there is no effective method to identify, isolate, diagnose and cure a sudden spread of diseases. Diseases like diarrhoea and influenza could prove fatal if left untreated. This becomes even worse when it comes to the rural population who completely neglect treatment. Countries like India have a long history of having disease outbreaks.

We have a very huge ratio of people residing in rural areas who do not have enough awareness of getting themselves diagnosed. They either completely avoid getting diagnosed due to lack of confidence or they live in an area which is very far away from medical help. Diseases like Malaria, Cholera, Dengue, Ebola etc., will not only affect an individual but also the population living around them. It finally ends up causing countless fatalities. There is no way to know the number of people who are exposed to a particular disease other than conducting a manual survey or analyzing the individual 10 serves one by one.

The proposed model would help in solving all these problems and also would provide general check-ups to the local public. The goal is to establish a system which consists of several diagnostic sub-systems around our cities and villages. These subsystems can diagnose and provide prescriptions and medicines to its users. Whereas the system as a whole would help in identifying any sudden fluctuations in the number of patients who have a common disease or symptom. This would indicate that a new disease is spreading in a locality. If confirmed, the medical personnel could immediately assess the situation and act on it without any delay. Any further spread or loss in life could be prevented.

1.2 MOTIVATION FOR THE PROJECT

The National Vector Borne Disease Control Programme (NVBDCP) maintains reports and counts of the number of deaths caused by a particular disease. It is surprising to know that even simple and curable diseases might lead to death if left untreated. But this is exactly what has happened at several points in history. NVBDC says that in 2019, Karnataka will have a huge outbreak of Dengue. Over 15,232 cases were recorded. Whereas in 2007, TamilNadu had an even worse experience with Malaria. TamilNadu reported over 5449 cases of deaths which were caused by the disease.

Similar to this Bangladesh recorded a staggering 206,000 cases of Diarrhoea which claimed over 15 lives. India is not the only country which faces these threats. Even well-developed countries like Italy, the USA and German had various encounters with epidemics. Hepatitis A was initially declared as eradicated in Colorado, USA. But again in 2017, over 571 new cases were recorded.

The huge numbers indicate how difficult it is to control the disease before it affects a huge population. It is also surprising to know that most of the diseases which have a huge death rate are curable. But people neglect medical attention thinking the same. It is extremely difficult to know how serious the disease really is. We have no strategies to know the number of patients suffering from a particular disease in real-time. We have to manually survey an area to know the statistics. This takes a lot of time and it is inefficient.

1.3 NEED FOR THE PROJECT

India is a country which has its majority of the population residing in rural areas. They have no medical awareness and do not generally seek help when the symptoms of the disease last for days. Another major problem is, most of these people live very far away from medical help.

The government has no means to know about a disease outbreak. The only way in which they can know is through manual surveying which might take weeks. Even when they do, it is usually too late and a lot of people become seriously ill due to the contagious nature of the diseases. This collective network of diagnostic devices will not only diagnose the diseases effectively but also would help to analyze the type of diseases which people get exposed to in a city.

1.4 INTENDED USERS AND INTENDED USES

1.4.1 Users

- Uneducated Population who neglect medical help.
- Villagers who have to travel long distances to get medical assistance.
- People who are afraid to have an in-person meeting with a doctor.
- People who deny medical help due to language barriers.

1.4.2 Uses

- Visualizes the medical data collected from the devices' network in the form of graphs to know any sudden rise in the number of cases.
- Allows the medical personnel to identify the spread of a new disease.
- Provides easily accessible medical help.
- Removes the language barrier and reduces the distance between a patient and a doctor.
- Provides prescription for simple diseases.
- Alerts the medical centre if any complicated diseases are diagnosed.
- Provides an authorised medical prescription.

1.5 OPERATING ENVIRONMENT

The operation of the device would be very similar to that of an ATM machine. But with one major difference, the device is language independent. The device will be installed in a particular area like a street corner. Each device could efficiently serve more than 100 patients per day. Based on the need or the number of patients in a locality, the number of devices can be increased.

Similarly, various devices will be installed all around the city, town or the villagers. The data which these devices collect individually will be organised in a database collectively. This means that these devices connect together to form a network. This network would help in analysing the types of diseases which the people in a particular locality is exposed to.

1.6 EXISTING SOLUTIONS

1.6.1 Manual Surveying

Although diseases are diagnosed with advanced tools and techniques, in order to know the overall number of patients exposed to a particular disease or the number of patients who have the same set of symptoms, individual hospitals should be contacted and the information from their servers should be collected and aggregated.

1.6.2 Health Care Help Lines

A lot of customer helplines which can be accessed through individual mobile phones exist, but they have been proved to be inefficient in rural areas, as the patient/user is not comfortable enough with technology.

1.6.3 Temporary Medical Camps

Medical personnel occasionally set up health camps which provide free medical check-up and medicines to the people in need. But, factors like ignorance, shyness, and lack of awareness among the rural people, a lot of sick individuals avoid these Health camps.

1.7 LITERATURE SURVEY

	Journal 1	Journal 2	Journal 3
Advantage	• Less Reaction / Processing time • Improved accuracy on selected diseases	• Provides meaningful insights from unprocessed data. • Reduces the time taken for successive diagnosis.	• An innovative approach to diagnose diseases. • Impressive accuracy when used in localized areas.
Limitation	• Accuracy of diagnosis is questionable • Complex Programming and algorithms	• Redundancy occupies much space in the system and it is hard to identify. • Accuracy is questionable.	• The process is extremely descriptive and Time-consuming. • Might not work at every locality.
Method adopted	Including previous diagnostic results into the existing programming.	Assimilating the unorganized data into a simple interface	Approaching the patients based on the locality which they live in

Table 1.1 Literature Survey

Cheng Xie, Po Yang, Yun Yang, "Open Knowledge Accessing Method in IoT-Based Hospital Information System for Medical Record Enrichment" Special Section On Multimedia Analysis For Internet-of-things, Volume 6, 2018.

Physicians and doctors have to go through the raw medical reports of the patients before jumping into conclusions or diagnosis. These raw medical reports are collected from various devices such as pacemakers, digital assistants, smartwatches and auto analysers. The information from all these devices is not structured. They also come in a massive number at once. The doctor cannot proceed to his medical advice if he/she cannot understand this information which might take a whole lot of time. This can be made easy with the help of a HIS. HIS is nothing but a specialized interface which is abbreviated as Hospital Information System. With HIS, the doctors do not have to analyse the individual Raw patient information and data anymore. Instead, all the data from the patient will be first passed through the information system. It will turn the unstructured data into structured data. This will make the job so much easier for a doctor or any other medical personnel. Having all the information stored in a commonplace will also make it easy to maintain and have a track record.

Ju Chen, Dianxing Yang, Yue Cao, Yiyi Ma, Chuan Jiao Wen, Xiwei Huang, And Jin Hong Guo "Syndrome Differentiation and Treatment Algorithm Model in Traditional Chinese Medicine Based on Disease Cause, Location, Characteristics and Conditions" Special Section On Advanced Information Sensing And Learning Technologies For Data-centric Smart Health Applications, Vol. 6, 2018.

The TCM or Traditional Chinese Medicine has proved efficient for over 2000 years. Syndrome Differentiation and Treatment is one of the major principles which doctors use to diagnose diseases. The symptoms associated with a particular disease has to be confirmed without making any conclusions. Only after getting cleared with the symptoms and confirming the disease, the doctor can move on to the treatment. This paper deals with the implementation of the SDAT algorithm into traditional Chinese medicine. It also includes another important feature. The method of disease diagnosis varies with respect to the cause, location, characteristics and conditions. It is possible for a disease to spread in a particular locality due to its climatic and environmental condition. The knowledge of these factors would help the medical personnel to improve the process of disease diagnosis.

Wenxing Hong, Ziang Xiong, Nannan Zheng, And Yang Weng "A Medical-History Based Potential Disease Prediction Algorithm" Special Section On Data-enabled Intelligence For Digital Health, Vol. 7, 2019.

Every patient who is revisiting a hospital would already have an existing patient history. Even then, the doctor would have to start the process of diagnosis right from the start. This is going to consume a lot of time and resources. Instead, this existing patient history can be put to good use. With the use of Artificial Intelligence (AI) and Machine Learning (ML), the patient's previous medical history can be used to detect his current medical condition. The algorithms would analyse your current medical condition by extracting inputs from you and by calculating your bio inputs. It would later compare them with your previous test results, blood levels, and patient history. If the levels are found to be the same, then instead of wasting resources the disease will

automatically get diagnosed. After analysing the patient history, the algorithm can also approximately detect the diseases which the patient might encounter in the future.

CHAPTER 2

WORKING METHODOLOGY

2.1 INTRODUCTION

The rural population of India is one of the largest in the world. The people in these areas are completely deprived of medical surveillance and supplies. Since the population is so large, it is almost impossible to track the onset of a disease. The proposed device is a mini-computer setup with a custom-made interface which is designed favourably to treat rural people. Each device can handle several hundred patients each day and can potentially serve as a medical consultant.

2.2 INSTALLATION AND SETUP

The proposed hardware can diagnose a disease solely based on the audio inputs provided by the patient. There is no need for him/her to know to read or write a language. Just like a doctor, the device interacts with the patient by questioning him in the local language. The given hardware has an LED display, a Microprocessor, Bio-sensors, a Speaker, Microphone and a Printer. The device has a power reserve which can charge itself whenever the power supply is available.

The device has a stable internet connection but can also continue to function efficiently without the Internet using the programming which it is fed with. The device is programmed in such a way that it recites the symptoms of the diseases programmed to it in audio format. After diagnosis, it can provide you with prescriptions or give an alert to the nearest health centre if a much serious disease is diagnosed. The Bio-sensors which are attached can calculate the patient's vital readings which include pulse rate, body temperature, ECG, Blood Glucose and also the surrounding temperature and humidity. The following figure 2.1 shows the working block diagram of the prototype.

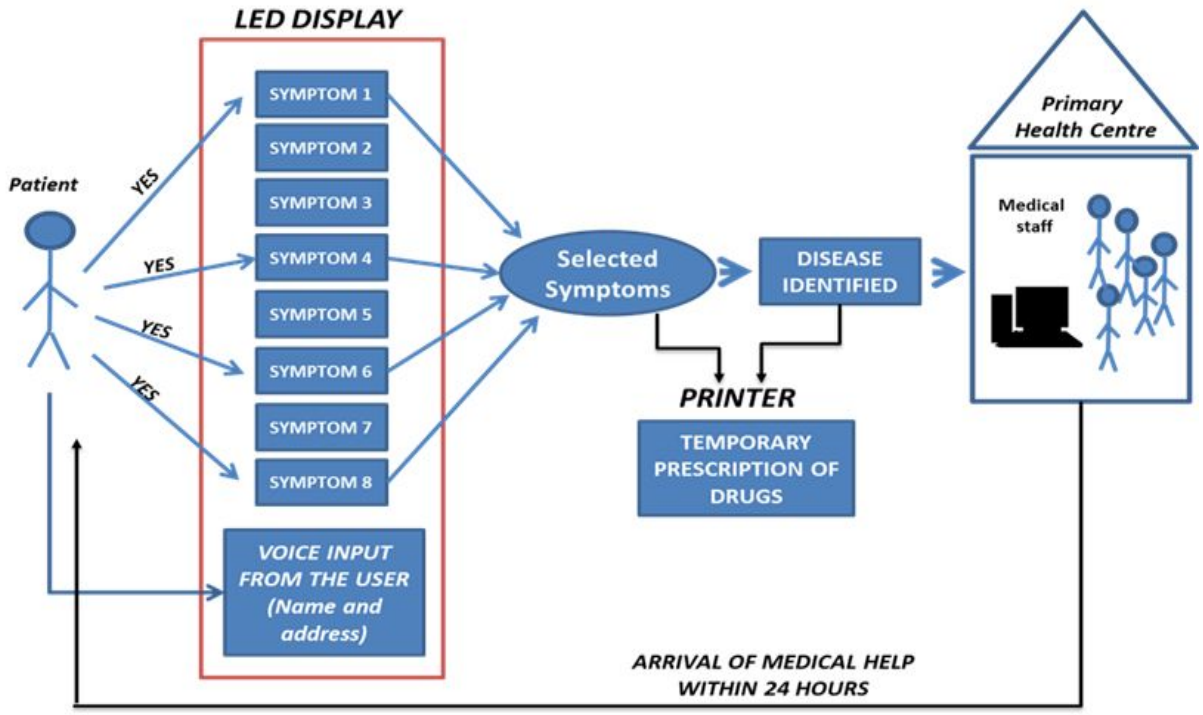


Figure 2.1 Block Diagram Of The Working Prototype

2.3 CONSTRUCTION

The construction of the device can be divided into three layers. The input layer, an output layer and the processing layer. The input layer includes a camera, a microphone and bio-sensors (Pulse, Body Temperature, Surrounding Temperature and Humidity sensor). These are the components through which the patient interacts and provides inputs to the system. The web camera is used to capture the patient's face and also helps the patient to have a video call with the medical personnel when the network connectivity is commendable. The microphone is used to receive the patient's input in the audio format. The microphone is essential and without it, the device cannot have a language-independent operation. The bio-sensors is used to receive the patient's vital signatures. The processing layer includes a microprocessor. Raspberry pi has been used in the prototype. The output layer has the following components: A Display, a Printer, a Speaker and a Website. The speaker is used to recite the symptoms to the user in their local language. The display is not essential. But it can benefit the users who can read and

write. The printer prints an authorised prescription which can be used to purchase the prescribed drugs. The website receives the patient history which is stored in the database and makes it easy for the medical personnel or the doctors to monitor the patients from the back end.

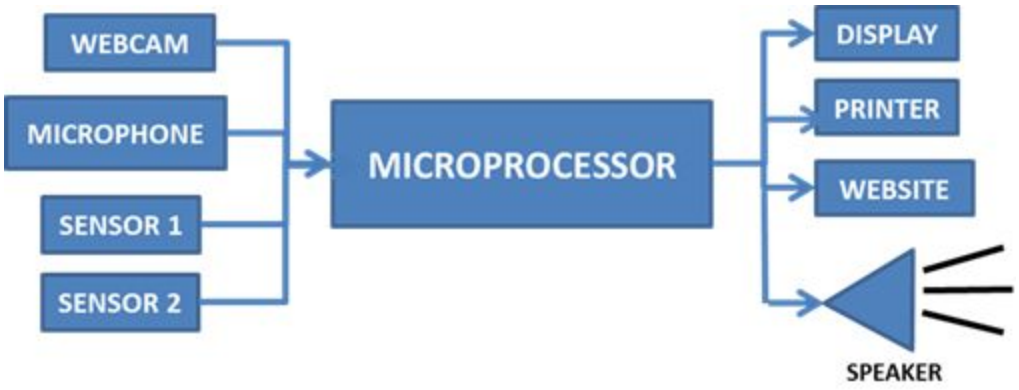


Figure 2.2 Block Diagram Of The Components

2.4 WORKING

As soon as the user presses the home button, he/she is provided with a unique user ID and their thumb impression is recorded. Audio recitation of the symptoms associated with all the diseases which are familiar in that locality is played one by one and waits for the input from the user (audio format in his regional language is used assuming that the user is unable to read a text). The Name, contact information, Age, Weight, Gender etc., are received as voice inputs and converted as text during processing. The prescriptions vary for each person based on these factors. Based on the inputs from the user, the symptoms are scrutinized and the disease is confirmed (approximately). The device can provide self-remedies for simple abnormalities like head-ache and the common cold.

A temporary prescription for a period of 48 hours is printed by the printer which is connected to the device. If the patient is found to have a more serious form of a disease such as tuberculosis, malaria, dengue, sexually-transmitted diseases etc., the device saves the patient history and sends the case file to the nearest available PHCs (Primary Health Centers), and hence medical personnel

could reach the area to help the needy and prevent further spread of the disease with suitable means. The web camera which has been interfaced with the device is not just to capture the face of the user/patient but also helps the patient to get advice from a doctor through live video chat. Every patient history will get saved in a specific cloud database and they can be viewed by the doctors all around India.

If the patient was diagnosed with a simple disease which does not get cured by the prescribed drugs, he/she can approach the device again without having to start the process right from the beginning. The user can just type in their Unique user ID or place their finger impression to resume the process where they left. They are now considered to be the priority and hence would be provided personal medical assistance either through video conferencing or direct contact. A custom-made mobile application is available for commercial use of the patients. With their unique user ID, they can view their own diagnostics and patient reports. It can also be used as a reference by the doctors who later treat the patient.

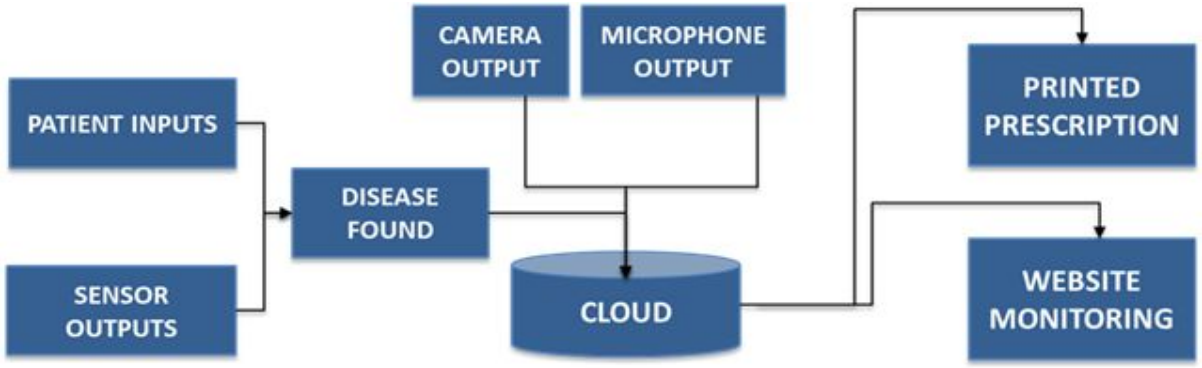


Figure 2.3 Dependency Diagram

2.5 THE MEDILAB NETWORK

Once these devices get installed in several localities in a village, these devices start to communicate with each other. These devices become more and more efficient with use owing to the use of machine learning algorithms. After a fixed period of time, they collectively generate a graphical representation using

Data Analytics which contains various features such as the most common disease, onset of a new disease, the number of people exposed to a disease etc. which can be analyzed to take steps to prevent further spread of that disease in that particular region.

This entire process is constantly monitored by a doctor from the backend. If the user/patient wishes, he/she can have a video chat with a doctor. Once several devices are installed, they start to communicate with each other and become smarter over time. They collectively provide a graphical representation of the diseases to which the people are exposed to using Data Analytics. Based on this report, the health department can know which area to focus their most attention. These devices have a dedicated server which keeps track of all the patient's histories to generate the monthly report of disease outbreaks and also for future references.

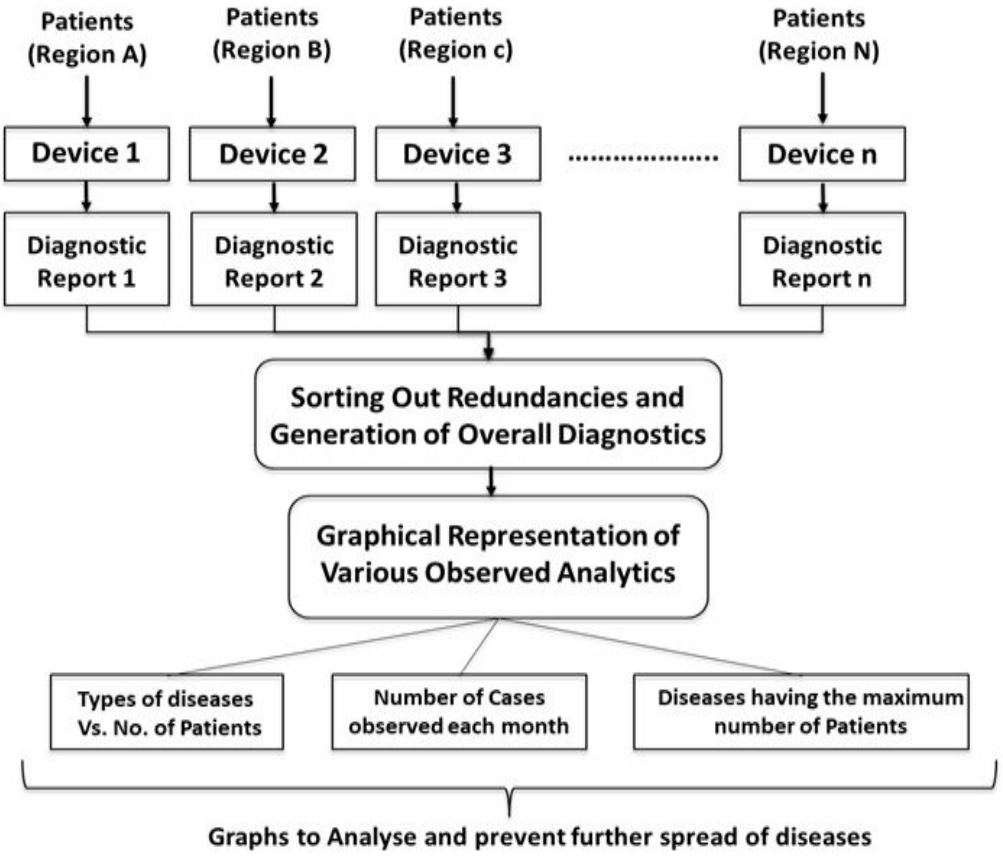


Figure 2.4 Collective Working As A Network

CHAPTER 3

HARDWARE DESIGN

3.1 RASPBERRY PI 3

The proposed hardware model uses Raspberry Pi as its microprocessor. The Raspberry Pi is a miniature size computer whose size is nothing more than a circuit board. The size of the Raspberry Pi is very similar to that of a credit card. But this does not mean it is not powerful. The processing of it is nothing less than a regular computer. Raspberry Pi has various commercial applications. The major advantage of using it is its size. Instead of relying on huge processors which are not scalable and expensive, the raspberry pi is a viable replacement. When the proposed prototype is manufactured in huge numbers, a custom made processor can be made to fit the needs of the device and its operating environment.

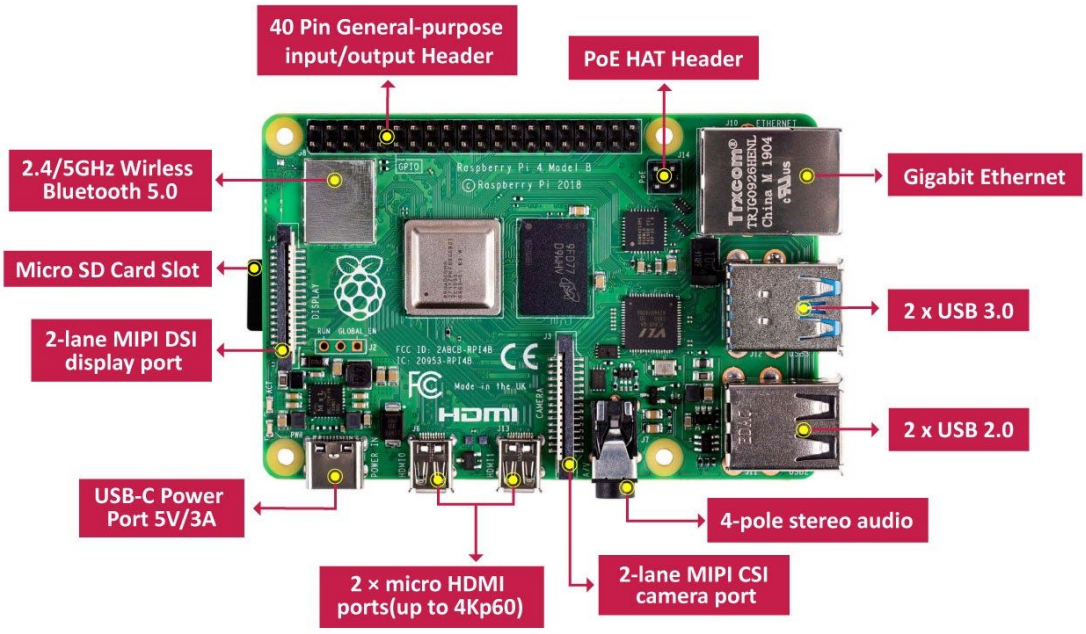


Figure 3.1 Architecture Of Raspberry Pi 3

3.1.1 Typical Hardware Connections

Although Raspberry Pi is an efficient processor, it is more or less useless when it is not used along with other input and output devices. There are several additional hardware devices which are essential to make the processor work.

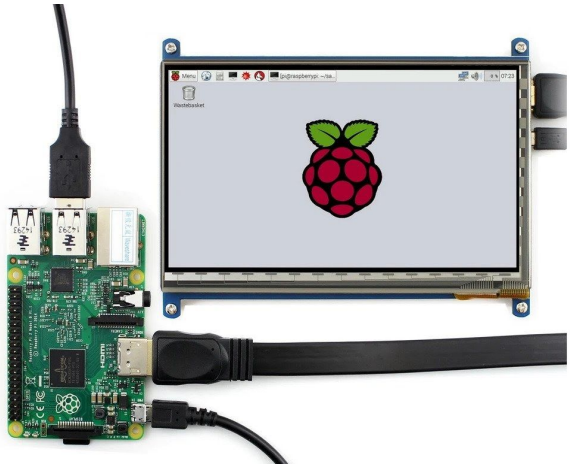
The following are more or less essential:

1. Raspberry Pi board
2. Prepared Operating System SD Card
3. USB keyboard
4. Display (with HDMI, DVI, Composite or SCART input)
5. Power Supply
6. Cables

Highly suggested extras include:

1. USB mouse
2. Internet connectivity
3. A USB Wi-Fi adaptor (Model A/B) or a LAN cable (Model B)
4. Powered USB Hub
5. Case

3.1.2 Connecting Together



The following diagram would be helpful in establishing the connection or you can make use of the following instructions.

1. Plug the SD Card into the Processor.
2. Using a USB Hub plug the USB keyboard and mouse into the Processor.
3. Connect it to the power supply.
4. Connect the video cable to the Display and into the Processor.
5. Plug the other essential components such as Wi-Fi or an Ethernet, Storage etc.
6. Make sure that the USB Hub and display are working.
7. Connect the power supply into the main socket.
8. With the display on, plug the other side of the power supply into the Processor.
9. The Processor should start up and you should be able to see messages on the display.

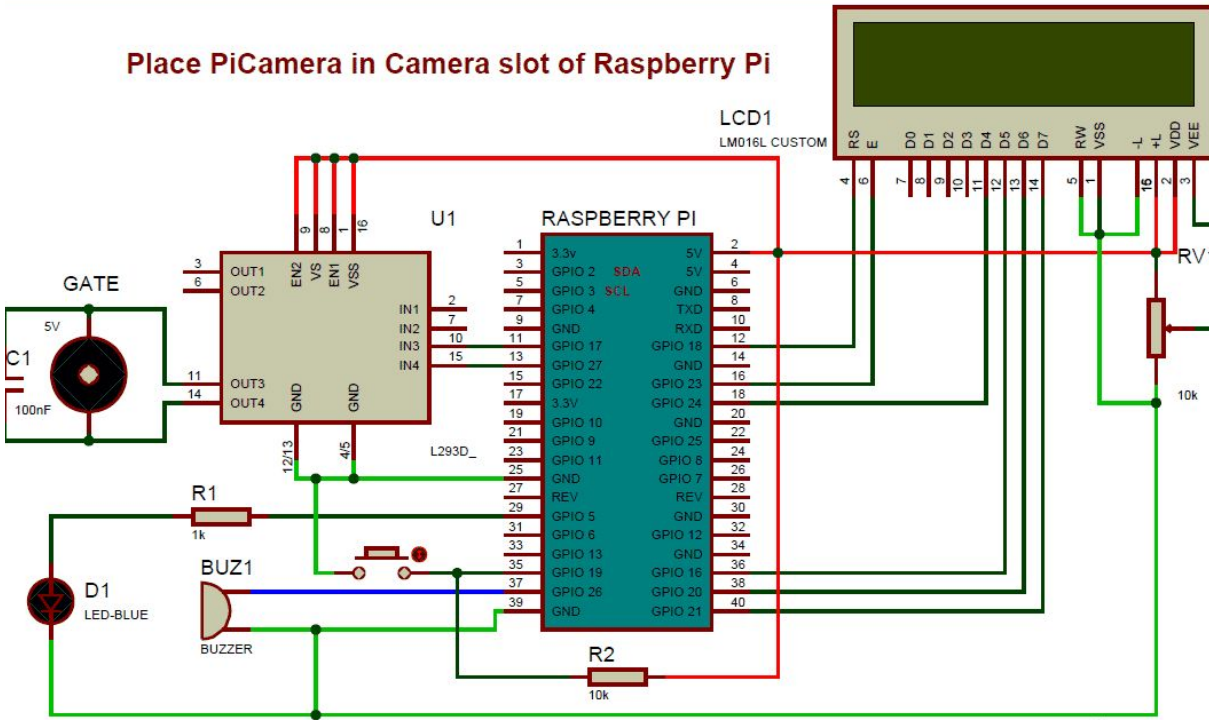


Figure 3.2 Schematic Diagram

3.2 DISPLAY

High Definition Displays and almost all LCD displays can be connected to the processor with the help of a 'male' HDMI cable, and with a cheap adaptor in the case of DVI. The Raspberry Pi supports HDMI versions of 1.3 and 1.4. But the version 1.4 cable is preferable.

Figure 3.3 Display Ports

3.3 KEYBOARD & MOUSE

The Raspberry Pi has a limited number of USB ports. Hence it is preferable if the keyboard and the mouse can be connected to the processor using a single USB Bluetooth dongle. Although the keyboard is not essential for the proposed hardware to function, it is essential in order to boot the Raspberry Pi. The mouse would also help in the boot-up process but it will not be needed in the completed prototype. The USB dongle should have the Model B type pin.

3.4 POWER SUPPLY

The Micro USB Type B pin is the only means to power the Raspberry Pi. It can either be powered by a power bank or with a direct power supply. A regular mobile charger with a micro USB connector will be sufficient, but it should yield at least 700mA at 5 volts. The power supply's rating should be checked frequently. An improper voltage level might damage the entire processor. Other power sources can be used as long as they yield the required 700 mA

The Other Sources are:

1. Computer USB Port or powered USB hub.
2. Special wall warts with USB ports.
3. Mobile Phone Backup Battery but we will be needing a USB A 'male' to USB micro 'male' cable

3.5 CABLES

In order to connect various devices to the Raspberry Pi processor, several cables are essential.

They are:

1. Micro-B USB Power Cable.

2. HDMI-A to connect Raspberry Pi to the Display/Monitor/TV of choice.
3. Audio cable, this is not needed if we use an HDMI TV/monitor.
4. Ethernet/LAN Cable.

3.6 INTERNET CONNECTIVITY

An Ethernet/LAN cable or a USB Wi-Fi adaptor is essential to provide network functionality. The Raspberry Pi Ethernet port is auto-sensing which means that it may be connected to a router or directly to another computer.

3.7 CONFIGURING THE MICROPROCESSOR

The Raspberry Pi is a fascinating Linux-based computer system. It has been remarkably victorious in its sales and uses. The Raspberry Pi is an important tool in traditional IT environments and can be a cheap way to perform remote network monitoring. The following steps would be useful in configuring the Raspberry Pi to suit the prototype's requirements and for network monitoring purposes.

Procedure to Set up Remote Desktop Access for Raspberry Pi on Windows 7 Desktop Linux Platform:

Step 1: Insert the SD Card with NOOBS-RaspbianOS.

Step 2: Open a Terminal in Linux.

Step 3: Log in to Superuser in Linux terminal.

Step 4: Move to the folder media CD /media Login to the SD Card reader file name.

Step 5: Before editing please make a copy of the interfaces file and rename in another file name for further reference. Edit the interfaces file in path location "Etc/network/interfaces".

Step 6: On Windows Go to the below path Control Panel\Network and Internet\Network Connections

Step 7: Click on Local Area Network Connection Properties

Step 8: Click IPv4 set the system IP Static configuration

Step 9: Download the Putty http://www.putty.org/. Install the Putty software in the system

Step 10: Click on the putty icon as an administrator (Right Click).Insert SD Card in Raspberry Pi Board and connect the RJ network cable to Board and Laptop.

Step 11: Type on run –cmd

Step 12: Type ipconfig in cmd and Check with Ethernet IP address in cmd

Step 13: Ping 192.168.122.2 In cmd

Step 14: Open putty and type the IP address 192.168.122.2

Step 15: Type the Login: pi / Password:raspberry. Now the SSH shell will be opened

Step 16: For remote desktop please download the XmingXserver software and install in the system, Now, moving on to access the Raspberry Pi's desktop, we first need to install Xming X Server for Windows from this link: Make sure you install the SSH components also when prompted to do so. Once that gets successfully installed, simply click the Xming icon and make sure it's running in the background.

Figure 3.4 Configuring Raspberry Pi

3.8 BIO-SENSORS

3.8.1 Pulse Sensor

The Pulse sensor works in accordance with the Arduino Board. The Pulse Sensor is used to acquire the patient or the user's heart rate at that instant in time. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side, we have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in our human body.

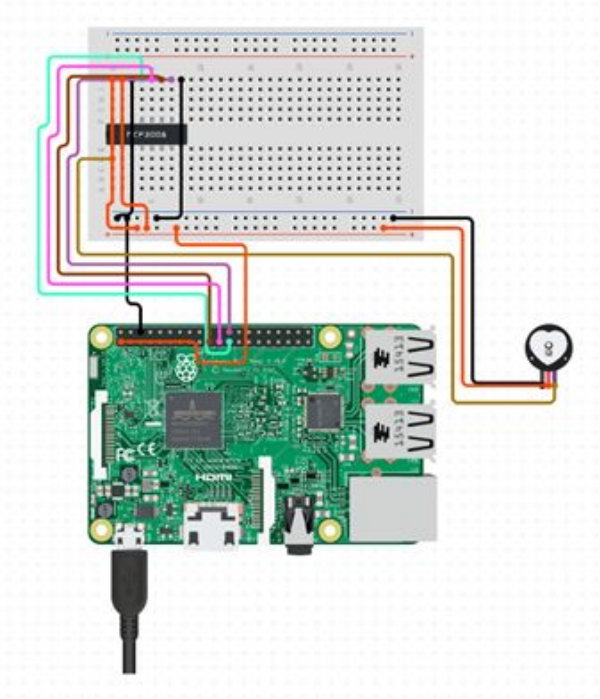


Figure 3.5 Configuration Of Pulse Sensor

Pin Configuration

Pin Number	Pin Name	Wire Colour	Description
1	Ground	Black	Connected to the ground of the system
2	Vcc	Red	Connect to +5V or +3.3V supply voltage
3	Signal	Purple	Pulsating output signal.

Table 3.1 Pin Configuration Of Pulse Sensor

3.8.2 Temperature Sensor

The LM35 IC is used to identify the patient's body temperature. The sensor has a negative temperature coefficient. Therefore as the temperature increases, the

resistance of the IC decreases. This change in resistivity is calculated by the Arduino to calculate the body temperature of the user.

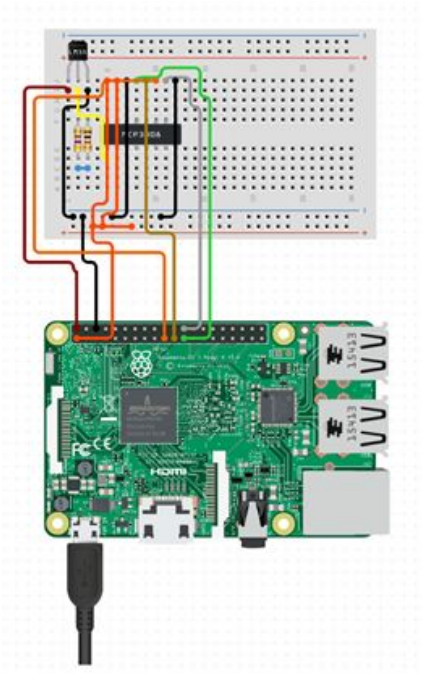


Figure 3.6 Configuration of LM-35 IC

Pin Configuration:

Pin Number	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Analog Out	There will be an increase in 10mV for raise of every 1°C. Can range from -1V(-55°C) to 6V(150°C)
3	Ground	Connected to the ground of the circuit

Table 3.2 Pin Configuration Of Temperature Sensor

3.8.3 Humidity Sensor

The humidity sensor would help the doctor to understand the surroundings in which the patient/user is residing in. This is because the causes and spread of a disease might be different in warmer and colder areas. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you.

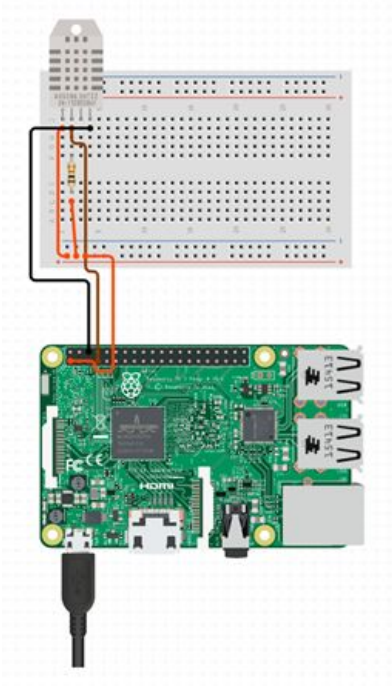


Figure 3.7 Configuration of Humidity Sensor

Pin Configuration

Number	Pin Name	Description
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data

3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit

Table 3.3 Pin Configuration Of Humidity Sensor

3.9 MICROPHONE

The microphone in the proposed model is used to receive audio inputs from the user and provide it to the microprocessor for further processing. The microphone is an essential component when it comes to making the device language independent.

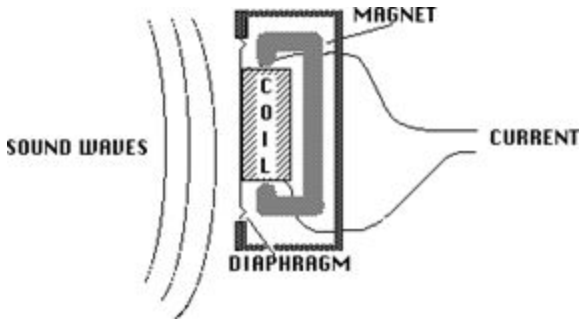


Figure 3.8 Structure Of The Microphone

3.10 SPEAKER

The speaker is an important output device used in this prototype. The speakers are used to recite the symptoms of the diseases in the local language of the people. Based on this, the patients just have to press Yes or No and the process of disease diagnosis would begin.

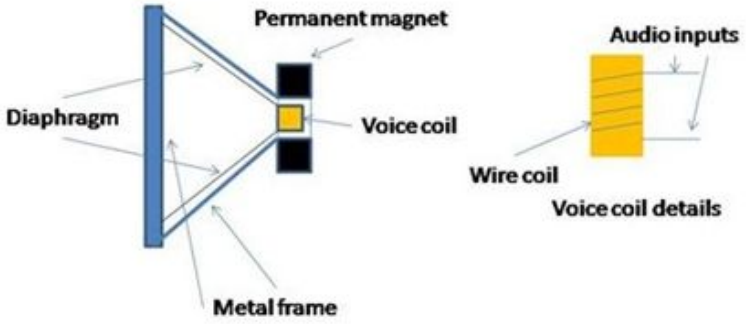


Figure 3.9 Construction Of The Microphone

CHAPTER 4

SOFTWARE SPECIFICATIONS

4.1 PYTHON PACKAGES

4.1.1 NumPy

We have used the NumPy package from python for computing our information and for economical manipulation. It's an associate open supply library accessible in Python. Since we want to perform the mathematical and scientific operation so as to attain our results, NumPy has been an excellent support. Generally, NumPy is employed additionally if the information is two-dimensional and in matrix structure that gladly necessitates it. It helped the United States in generating random variety that created our analysis and testing of our algorithmic rule faster.

NumPy addresses the slowness downside part by providing two-dimensional arrays and functions and operators that operate with efficiency on arrays, requiring redaction of some code, largely inner loops mistreatment NumPy. Using NumPy in Python provides practicality to cherish MATLAB since they're each understood, and that they each enable the user to write down quick programs as long as most operations work on arrays or matrices rather than scalars. compared, MATLAB boasts an outsized variety of further toolboxes, notably Simulink, whereas NumPy is in and of itself integrated with Python, an additional fashionable and complete artificial language.

Moreover, complementary Python packages square measure available; SciPy may be a library that adds additional MATLAB-like practicality and Matplotlib may be a plotting package that gives MATLAB-like plotting practicality. Internally, each MATLAB and NumPy accept BLAS and LAPACK for economical algebra computations. Python bindings of the widely used pc vision library OpenCV utilize NumPy arrays to store and care for information. Since pictures with multiple channels square measure merely pictured as three-dimensional arrays, indexing, slicing or

masking with different arrays square measure terribly economical ways in which to access specific pixels of a picture.

The core practicality of NumPy is its "ndarray", for the n-dimensional array system. These arrays square measure strode views on memory. In distinction to Python's inherent list system (which, despite the name, maybe a dynamic array), these arrays square measure homogeneously kind: all components of one array should be of an equivalent type. Such arrays may also be viewed into memory buffers allotted by C/C++, Cython, and FORTRAN extensions to the CPython interpreter while not the necessity to repeat information around, giving a degree of compatibility with existing numerical libraries. NumPy has inherent support for memory-mapped ndarrays.

4.1.1.1 Installation

Raspberry Pi uses the Linux operating system in which everything works with commands. The command used is **pip install numpy**. The prerequisites are python of version higher than 2 and its respective modules.

Example

Array creation

```
>>> import numpy as np
>>> x = np.array([1, 2, 3])
>>> x
array([1, 2, 3])
>>> y = np.arange(10)  # like Python's range, but returns an array
>>> y
array([0, 1, 2, 3, 4, 5, 6, 7, 8, 9])
```

4.1.2 Pandas

Pandas is Associate in Nursing open supply, BSD-licensed Python library. Pandas improved the economical use of NumPy by providing tools for numerous

information Structures and information Analysis. In our theme we'd like regular practicality, therefore selecting NumPy with Pandas consummated our demand.

In creating mental acts, pandas square measures a software package library written for the Python artificial language for information manipulation and analysis. It offers information structures and operations for manipulating numerical tables and statistics. it's a free software package discharged beneath the three-clause BSD license. The name springs from the term "panel data", Associate in Nursing economic science term for information sets that embody observations over multiple time periods for identical people.

• DataFrame object for information manipulation with integrated categorization.
• Tools for reading and writing information between in-memory information structures and completely different file formats.
• Data alignment and integrated handling of missing information.
• Reshaping and pivoting of knowledge sets.
• Label-based slicing, fancy categorization, and subsetting of enormous information sets.
• Data structure column insertion and deletion.
• Group by engine permitting split-apply-combine operations on information sets.
• Data set merging and change of integrity.
• Hierarchical axis categorization to figure with high-dimensional information during a lower-dimensional organization.
• Time series-functionality: Date varies generation and frequency conversion, moving window statistics, moving window linear regressions, date shifting and insulant.
• Provides information filtration.

The library is very optimized for performance, with crucial code methods written in Cython or C. Pandas is especially used for machine learning in kind of data frames. Pandas enable mercantilism information of assorted file formats like CSV, Excel etc. Pandas permit numerous information manipulation operations like group by, join, merge, melt, concatenation also as information improvement options like a filling, replacement or imputing null values.

4.1.2.1 Installation

It is similar to the installation of NumPy, **pip install pandas**.

Example

Customarily we must import these

```
In [1]: import numpy as np

In [2]: import pandas as pd
```

Creating a series by passing a list of values

```
In [3]: s = pd.Series([1, 3, 5, np.nan, 6, 8])

In [4]: s
Out[4]:
0    1.0
1    3.0
2    5.0
3    NaN
4    6.0
5    8.0
dtype: float64
```

4.1.3 SciPy

It is a scientific library for python associated it's additionally an open supply. It's a BSD-licensed library for arithmetic, science and engineering. SciPy library is actually based on NumPy that assists convenient and faster N-dimensional array manipulation. It works a lot economically with the arrays of NumPy. SciPy contains modules for improvement, algebra, integration, interpolation, special functions, FFT, signal and image process, lyric solvers and different tasks common in science and engineering. SciPy was developed over the NumPy array object and is a part of the NumPy stack which has features like Matplotlib, pandas and SymPy, and other sets of scientific computing libraries. This NumPy stack has similar users to different applications like MATLAB, GNU Octave, and Scilab. The NumPy stack is additionally typically remarked because of the SciPy stack.

Enthought originated the SciPy conference within the U.S. and continues to sponsor several of the international conferences furthermore as host the SciPy web site. The SciPy library is currently under the BSD license, and its development is

supported by an open community of developers. It's additionally supported by NumFOCUS, a community foundation for supporting duplicatable and accessible science.

The SciPy package has algorithms and functions used for scientific computing capabilities accessible sub-packages include:
• constants: physical constants and conversion factors
• cluster: graded cluster, vector division, K-means
• fft: distinct Fourier remodel algorithms
• fftpack: gift interface for distinct Fourier Transforms
• integrate: numerical integration routines
• interpolate: interpolation tools
• io: knowledge input and output
• lib: Python wrappers to external libraries
• linalg: algebra routines
• misc: miscellaneous utilities (e.g. image reading/writing)
• ndimage: contains built-in functions for the multi-dimensional image processing
• optimize: improvement algorithms together with applied math
• signal: signal process tools
• distributed: sparse matrix and connected algorithms
• spatial: KD-trees, nearest neighbours, distance functions
• special: special functions
• stats: applied math functions
• weave: a tool for writing C/C++ code as Python multiline strings

As per the need, the sub-packages may be downloaded. For Example, we have a tendency to need cluster packages that we have a tendency to use for communication and compression, therefore, we've to transfer the package from the browser that was scipy.cluster.vq with vq extensions. The basic organisation employed by SciPy could be a two-dimensional array provided by the NumPy module. NumPy provides some functions for algebra, Fourier transforms, and random range generation, But Scipy provides additional features along with them. NumPy may be used as an associate economical two-dimensional instrumentality

of information with impulsive data types. This enables NumPy to seamlessly and space integrate with a large form of databases. Older versions of SciPy used Numeric as an associative array sort, which is currently deprecated in favour of the newer NumPy array code.

4.1.3.1 Installation

Standard python distribution does not come bundled with any SciPy module, so we have to install by python package installer,

sudo apt-get install python-numpy python-scipy

We use ubuntu for which we use the above command to save the packages in the given path.

Example:

```
from scipy.special import cbrt
#Find cubic root of 27 & 64 using cbrt() function
cb = cbrt([27, 64])
#print value of cb
print(cb)
```

Output: array([3., 4.])

These are the packages which enabled us to perform the tedious and time manipulative operations effectively and in real-time

4.1.4 Matplotlib

In order to Visualize the 2D graphics from the available data, python provides a plotting library Matplotlib. Most of the Web Applications and Graphical user interface toolkits use this library to Visualize data. Various toolkits are available to use along with matplotlib functionalities. Some of them can be included directly where other toolkits have external dependencies. Various types of

plots available in matplotlib where the input data has to be formatted in different ways. Some of the plottings were listed below:

- Bar Graph
- Histogram
- Scatter Plot
- Area Plot
- Pie Chart

The basic plot that can be plotted using pyplot toolkit can be visualized as below

```
from matplotlib import pyplot as plt
from matplotlib import style

style.use('ggplot')
x = [5,8,10]
y = [12,16,6]
x2 = [6,9,11]
y2 = [6,15,7]
plt.plot(x,y,'g',label='line one', linewidth=5)
plt.plot(x2,y2,'c',label='line two',linewidth=5)
plt.title('Epic Info')
plt.ylabel('Y axis')
plt.xlabel('X axis')
plt.legend()
plt.grid(True,color='k')
plt.show()
```

The output of the following code is generated as follows:

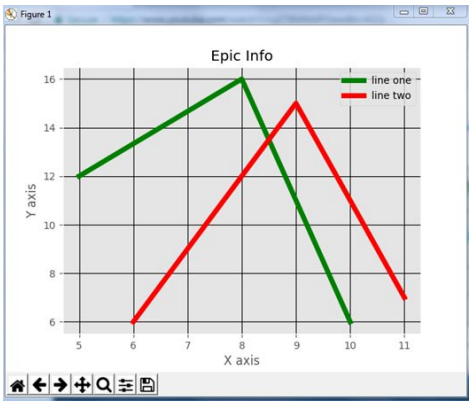


Figure 4.1: Output Of The Basic Plot Code

A bar chart uses bars to check knowledge among totally different classes. it's similar temperament once you need to live the changes over an amount of your time. It may be drawn horizontally or vertically. Also, the necessary issue to stay in mind is that the longer the bar, the bigger the price. Now, allow us to implement it victimisation python matplotlib.

```
from matplotlib import pyplot as plt

plt.bar([0.25,1.25,2.25,3.25,4.25],[50,40,70,80,20],
label="BMW",width=.5)
plt.bar([.75,1.75,2.75,3.75,4.75],[80,20,20,50,60],
label="Audi", color='r',width=.5)
plt.legend()
plt.xlabel('Days')
plt.ylabel('Distance (kms)')
plt.title('Information')
plt.show()
```

The corresponding output of the following code is:

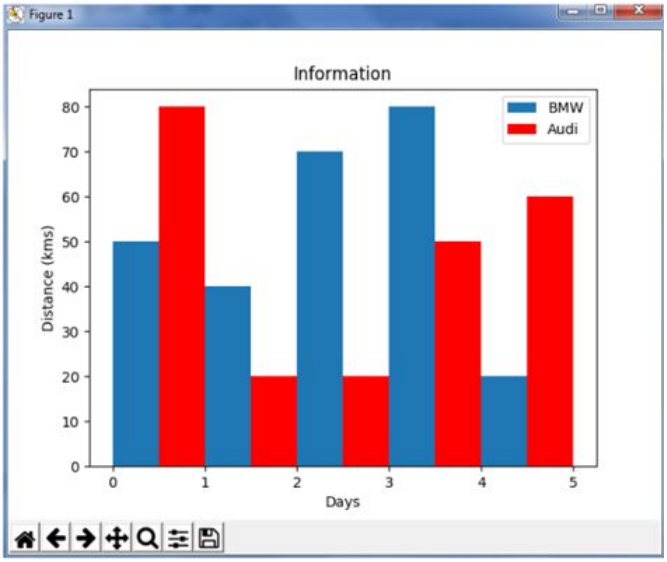


Figure 4.2 Output Of The Barchart Code

Histograms square measure want to show a distribution whereas a chart is employed to check totally different entities. Histograms square measure helpful once you have arrays or an awfully long list. Let's contemplate an associate degree

example wherever I actually have to plot the age of population with reference to the bin. Now, bin refers to the variety of values that square measure divided into a series of intervals. Bins square measure sometimes created of identical size. Within the below code, I actually have created the bins within the interval of ten which suggests the primary bin contains parts from zero to nine, then ten to nineteen so on.

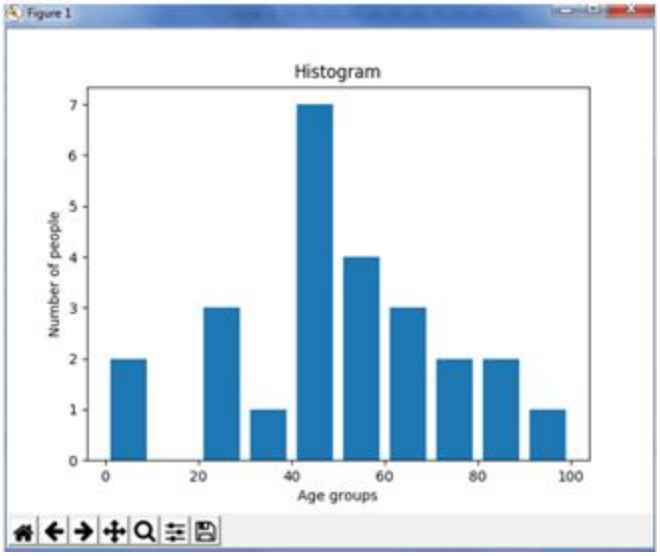


Figure 4.3 Output Of The Histogram Code

4.1.5 TensorFlow

TensorFlow is an open supply library for quick numerical computing. It was created and is maintained by Google and discharged below the Apache a pair of.0 open supply license. The API is nominally for the Python programming language, though there's access to the underlying C++ API.

Rather than the numerical libraries which are to be used in Deep Learning like Theano, TensorFlow was developed to be used each in analytics and in production systems, not least RankBrain in Google search and also the fun DeepDream project. It will run on single C.P.U. systems, GPUs in addition to mobile devices and huge scale distributed systems of many machines.

4.1.5.1 Installation

Installation of TensorFlow is simple if you have already got a Python SciPy atmosphere. TensorFlow works with Python a pair of.7 and Python three.3+. you'll follow the transfer and Setup directions on the TensorFlow web site. Installation is maybe simplest via PyPI and specific directions of the pip command to use for your UNIX operating system or waterproof OS X platform square measure on the transfer and Setup webpage. There are virtual and labourer pictures that you just will use if you favour. To make use of the GPU, a UNIX operating system is supported and it needs the Cuda Toolkit.

4.1.5.2 Computation

Computation is delineated in terms of knowledge flow and operations within the structure of a directed graph.

Nodes: Nodes perform computation and have zero or additional inputs and outputs. information that moves between nodes square measure called tensors, that square measures multi-dimensional arrays of real values.

Edges: The graph defines the flow of knowledge, branching, iteration and updates to state. Special edges are accustomed to synchronize behaviour at intervals in the graph, for instance watching for computation on a variety of inputs to complete.

Operation: An operation can be called as an abstract computation which can get input attributes and provides output attributes. for instance, you'll outline an add or multiply operation.

```
1 import tensorflow as tf
2 sess = tf.Session()
3 a = tf.constant(10)
4 b = tf.constant(32)
5 print(sess.run(a+b))
```

Running this example displays:

```
1 42
```

4.1.6 OpenCV

OpenCV-Python may be a library of Python bindings designed to unravel pc vision issues. cv2.imread() methodology masses a picture from the required file. If the image can't be scanned (because of the missing file, improper permissions, unsupported or invalid format) then this methodology returns an associate empty matrix.

4.1.6.1 Read a Picture

Use the perform cv2.imread() to scan a picture. The image ought to be within the operating directory or a full path of image ought to run.

The second argument may be a flag that specifies the means the image ought to be scanned.

- cv2.IMREAD_COLOR : masses a colour image. Any transparency of image is neglected. it's the default flag.
- cv2.IMREAD_GRAYSCALE : masses image in grayscale mode
- cv2.IMREAD_UNCHANGED : masses image per se together with alpha channel

```
import numpy as np
import cv2

# Load an color image in grayscale
img = cv2.imread('messi5.jpg',0)
```

4.1.6.2 Display a Picture

Use the perform cv2.imshow() to show a picture in a very window. The window mechanically fits the image size.

The first argument may be a window name that may be a string. The second argument is our image. you'll produce as several windows as you want, however with totally different window names.

```
cv2.imshow('image',img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

cv2.waitKey() may be a keyboard binding performance. Its argument is the time in milliseconds. The performer waits for such milliseconds for any keyboard event. If you press any key at this time, the program continues. If zero is passed, it waits indefinitely for a keystroke. It may also be set to find specific keystrokes like if key a is ironed etc that we are going to discuss below.

```
cv2.namedWindow('image', cv2.WINDOW_NORMAL)
cv2.imshow('image',img)
cv2.waitKey(0)
cv2.destroyAllWindows()
```

There is a special case wherever you'll already produce a window and cargo image thereto later. In this case, you'll specify whether or not the window is resizable or not. it's through with the perform cv2.namedWindow(). By default, the flag is cv2.WINDOW_AUTOSIZE. however, if you specify the flag to be cv2.WINDOW_NORMAL, you'll size the window. It'll be useful once the image is just too massive in dimension and adding a track bar to windows.

4.1.6.3 Write a Picture

Use the perform cv2.imwrite() to save lots of pictures. The first argument is the file name, the second argument is that the image you wish to save lots of.

```
cv2.imwrite('messigray.png',img)
```

4.1.6.4 Sum it Up

The mentioned program processes the image in grayscale and displays it, it will save the image if you press ‘s’ and then exit.

```
import numpy as np
import cv2

img = cv2.imread('messi5.jpg',0)
cv2.imshow('image',img)
k = cv2.waitKey(0)
if k == 27:         # wait for ESC key to exit
    cv2.destroyAllWindows()
elif k == ord('s'): # wait for 's' key to save and exit
    cv2.imwrite('messigray.png',img)
    cv2.destroyAllWindows()
```

4.1.7 Speech_Recognition:

Speech Recognition is a vital feature in many applications used like home automation, computing, etc. this text aims to produce associate degree introduction on the way to build use of the SpeechRecognition library of Python. may be} helpful because it can be used on microcontrollers like Raspberry Pi with the assistance of associate degree external mike.

You can install SpeechRecognition from a terminal with pip:

Shell

```
$ pip install SpeechRecognition
```

Once installed, you should verify the installation by opening an interpreter session and typing:

Python >>>

```
>>> import speech_recognition as sr
>>> sr.__version__
'3.8.1'
```

4.1.7.1 Set up mike (For external mikes): It's recommended to specify the microphone throughout the program to avoid any glitches. Type lsusb within the terminal. an inventory of connected devices can show up. The mike name would

seem like this USB Device 0x46d:0x825: Audio (hw:1, 0) Make a note of this because it is going to be employed in the program.

4.1.7.2 Set Chunk Size: This primarily concerned specifying what percentage bytes of information we would like to browse quickly. Typically, this worth is per powers of two like 1024 or 2048

4.1.7.3 Set Sampling Rate: rate defines however usually values area unit recorded for process

4.1.7.4 Set Device ID: to the chosen microphone: during this step, we tend to specify the device ID of the mike that we would like to use so as to avoid ambiguity just in case there are multiple microphones. This conjointly helps right, within the sense that, whereas running the program, we are going to recognize whether or not the required mike is being recognized. throughout the program, we tend to specify a parameter device_id. The program can say that device_id couldn't be found if the mike isn't recognized.

4.1.7.5 Enable Adjusting for close Noise: Since the encircling noise varies, we tend to enable the program a second or two to regulate the energy threshold of recording, therefore, it's adjusted consistent with the external background level.

4.1.7.6 Speech to text translation: this can be finished with the assistance of Google Speech Recognition. this needs a full of life web association to figure.

```
#Python 2.x program to transcribe an Audio file
import speech_recognition as sr

AUDIO_FILE = ("example.wav")

# use the audio file as the audio source

r = sr.Recognizer()

with sr.AudioFile(AUDIO_FILE) as source:
    #reads the audio file. Here we use record instead of
    #listen
    audio = r.record(source)

try:
    print("The audio file contains: " + r.recognize_google(audio))

except sr.UnknownValueError:
    print("Google Speech Recognition could not understand audio")

except sr.RequestError as e:
    print("Could not request results from Google Speech
              Recognition service; {0}".format(e))
```

4.2 SOFTWARE

4.2.1 **FireBase** (Cloud Database)

Firebase is the backend platform for building net, robot and IOS applications. It offers real-time info, completely different genus APIs, multiple authentication sorts and hosting platform. This is often an introductory tutorial, that covers the fundamentals of the base of operations platform and explains a way to influence its varied parts and sub-components.

Firebase Features:

• **Real-time info** base of operations supports JSON information and {every one} users connected to that receive live updates once every amendment.

• **Authentication**: we are able to use anonymous, watchword or completely different social authentications.

• **Hosting info** The application is deployed over a secured association to the base of operations servers.

Database Setup:

To store the data which is in the form of dictionaries to the database. Few basic setups have to be done on Firebase. In firebase.google.com, create a new account and then create a project. In the pop-up, Enter all the necessary details of the corresponding project. After completing the above process, a dashboard appears. In the dashboard click “Create database” to create a new Real-Time database

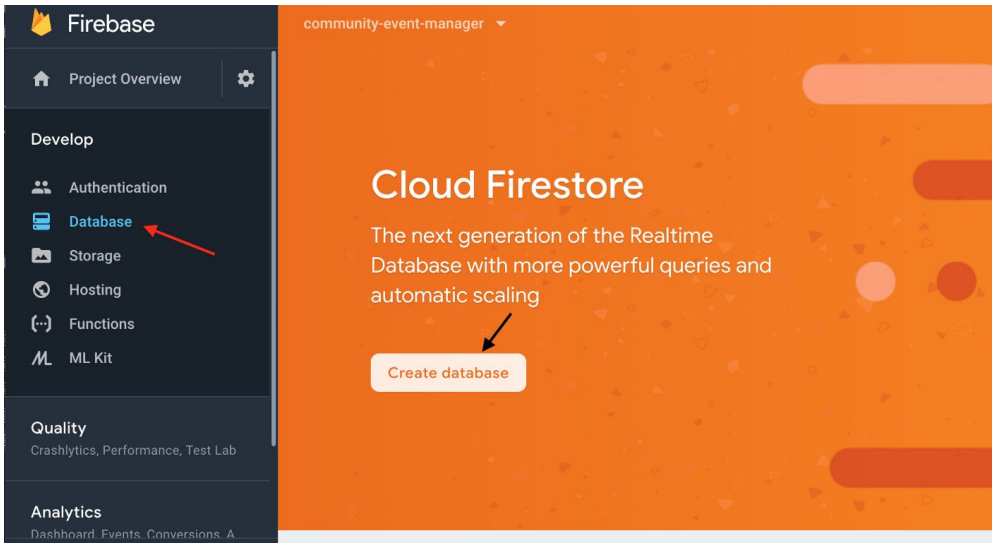


Figure 4.4 Firebase Setup

When the database was created, Set the security rules for the database. Select the test mode rule.

Installing Pyrebase:

Pyrebase can be installed using the following command **pip install pyrebase.**

To configure the database and to get authentication. The following method is used.

```
import pyrebase

config = {
  "apiKey": "apiKey",
  "authDomain": "projectId.firebaseapp.com",
  "databaseURL": "https://databaseName.firebaseio.com",
  "storageBucket": "projectId.appspot.com"
}

firebase = pyrebase.initialize_app(config)
```

Services

To check the authentication - firebase.auth()

To access the database - firebase.database()

To access the storage - firebase.storage()

Authentication

To authenticate the database using the key generated. The following code snippet was used.

```
# Get a reference to the auth service
auth = firebase.auth()

# Log the user in
user = auth.sign_in_with_email_and_password(email, password)

# Get a reference to the database service
db = firebase.database()

# data to save
data = {
    "name": "Mortimer 'Morty' Smith"
}

# Pass the user's idToken to the push method
results = db.child("users").push(data, user['idToken'])
```

Functions available

The path of the path could be build by utilizing the child() method

```
db = firebase.database()
db.child("users").child("Morty")
```

Push - In order to push the data into the corresponding node, push() method is used.

```
data = {"name": "Mortimer 'Morty' Smith"}
db.child("users").push(data)
```

Set - Own keys can be set using the set() method. In the below example “Morty” is set as key.

```
data = {"name": "Mortimer 'Morty' Smith"}
db.child("users").child("Morty").set(data)
```

Update - In order to update the value update() method is used.

```
db.child("users").child("Morty").update({"name": "Mortiest Morty"})
```

Remove - Similarly, remove() method is used to remove data from the database

```
db.child("users").child("Morty").remove()
```

Pyrebase also facilitate multi-location updates using the update() method

```
data = {
    "users/Morty/": {
        "name": "Mortimer 'Morty' Smith"
    },
    "users/Rick/": {
        "name": "Rick Sanchez"
    }
}

db.update(data)
```

4.2.2 Fswebcam App

fswebcam is a little and straightforward webcam application for Unix. It can catch pictures from various sources and perform straightforward control on the caught picture. The picture can be spared as at least one PNG or JPEG document.

Language structure:

fswebcam [<options>] <filename> [[<options>] <filename> ...]

The PNG or JPEG picture can be sent to stdio utilizing the filename "- ". The yield filename is designed by strftime.

General Options

- -? - help -Show a utilization synopsis.
- -c, - config -Burden choices from a record. You can stack more than one config record, and can blend them in with order line contentions.
- -q, - calm -Conceals all messages aside from blunders.
- -v, - verbose -Print additional data during the catch procedure.
- - - adaptation -Print the form number and exit.
- -l, - circle <frequency> -Consistently catch pictures. The time between pictures is indicated like a flash. Default conduct is to catch a solitary picture and exit.
- - - counterbalance <seconds> -Sets the counterbalance to utilize while computing when the following picture is expected in circle mode. Worth can be sure or negative.
- -b, - foundation -Run out of sight. Right now, and reassure logging are inaccessible.

Example:

Figure 4.5 Output Of fswebcam

CHAPTER 5

TECHNOLOGIES USED

5.1 DATA CLEANING

Data cleansing or information cleanup is that the method of sleuthing and correcting (or removing) corrupt or inaccurate records from a recordset, table, or info and refers to characteristic incomplete, incorrect, inaccurate or impertinent elements of the info then commutation, modifying, or deleting the dirty or coarse information. information cleansing is also performed interactively with information wrangle tools, or as instruction execution through scripting.

5.1.1 HIGH QUALITY information NEEDS:

• **Validity:** The degree to that the measures adapt to outlined business rules or constraints.

• **Accuracy:** The degree of conformity to a regular or real worth. Accuracy is incredibly exhausting to realize through information-cleansing within the general case as a result of it needs accessing associate external supply of knowledge that contains truth value: such "gold standard" data is usually untouchable.

• **Completeness:** The degree to that all needed measures area unit legendary.

• **Consistency:** The degree to that a group of measures area unit equivalent in across systems.

• **Uniformity:** The degree to which group information lives is unit-specific victimization of similar units of measure in all told systems.

5.1.2 DATA cleanup STEPS:

1. indiscriminately sample a pandas data frame: the primary step in information cleanup is to quickly get a plan of what's within your dataset.

2. Indiscriminately selecting a number of rows to look at can assist you to succeed.

print(df.take(np.random.permutation(len(df))[:2]))

len() simply measures the length of the data frame that is associated with the input to np.random.permutation().

The value two indicates that any two rows are often picked up indiscriminately by the operator. **df.take()** selects rows from the data frame. If you probably did not need to indiscriminately choose rows, then you'll be able to simply pass the number of rows as a parameter to df.take().

5.2 DATA AGGREGATION

Data Aggregation is any procedure wherein data is accumulated and communicated in a rundown structure, for purposes, for example, factual investigation. A Data Aggregation reason for existing is to get more data about specific gatherings dependent on explicit factors, for example, age, calling, or pay. The data about such gatherings would then be able to be utilized for Web website personalization to pick substance and publicizing prone to engage an individual having a place with at least one gathering for which information has been gathered. For instance, a site that sells music CDs may publicize certain CDs dependent on the age of the client and the information total for their age gathering. Online investigative handling (OLAP) is a straightforward sort of information collection where the advertiser utilizes a web-based revealing system to process the data.

Data Aggregation can be client-based: individual Data Aggregation administrations offer the client a solitary point for an assortment of their own data from other Web destinations. The client utilizes a solitary ace individual ID number (PIN) to give them access to their different records, (for example, those for money related establishments, carriers, book and music clubs, etc). Playing out this sort of information total is here and there alluded to as "screen scratching."

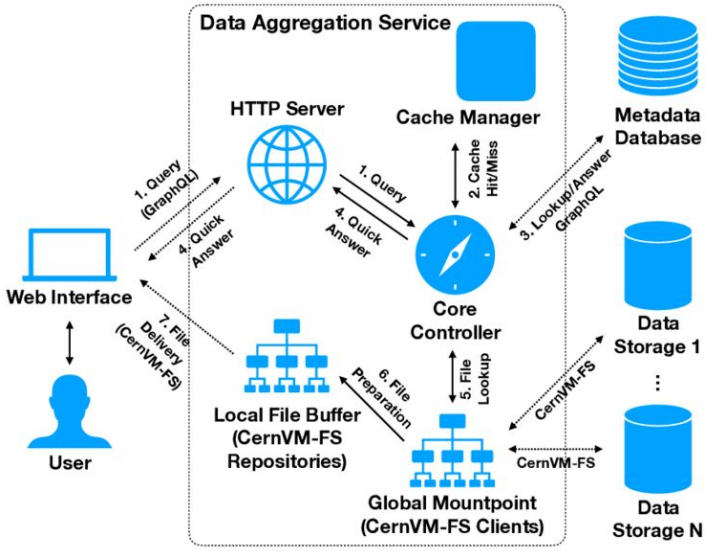


Figure 5.1 Example flow diagram of Data Aggregation

Web Data Integration (WDI) is an answer to the tedious idea of web information mining. WDI can separate information from any site your association needs to reach. Applied to the utilization cases recently talked about or to any handle, Web Data Integration can slice the time it brings to total information down to minutes and increment exactness by annihilating human mistake in the information total procedure. This permits organizations to get the information they need, when they need it, from any place they need it. All worked in quality control to guarantee exactness.

WDI not just concentrates and totals the information you need, it additionally gets ready and cleans the information and conveys it in a consumable configuration for joining, revelation and examination.

5.3 DATA VISUALIZATION

Data visualization is a graphic illustration of knowledge. It involves manufacturing pictures that communicate relationships among the pictured knowledge to viewers of the photographs. This communication is achieved through the utilization of a scientific mapping between graphic marks and knowledge values within the creation of the visual image. This mapping establishes, however,

knowledge values are going to be pictured visually, determinative however and to what extent property of a graphic mark, like size or colour, can modify to replicate changes within the worth of a data point.

To communicate data clearly and expeditiously, knowledge visual image uses applied mathematics graphics, plots, data graphics and different tools. Numerical knowledge is also encoded victimization dots, lines, or bars, to visually communicate a quantitative message. The effective visual image helps users analyze and reason concerning knowledge and proof. It makes complicated knowledge a lot accessible, graspable and usable.

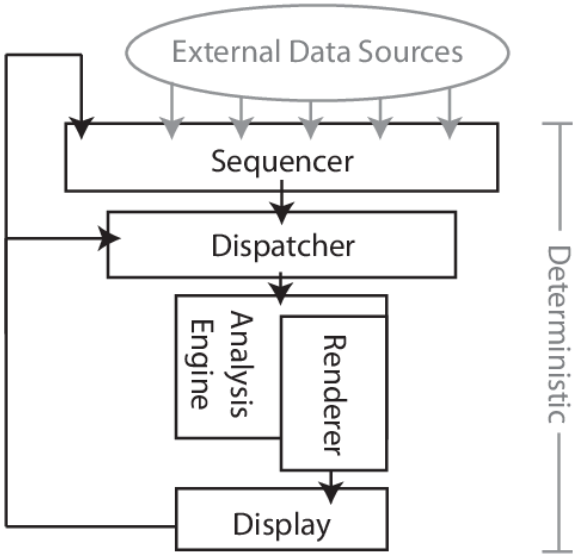


Figure 5.2 Block Diagram For Data Visualization

Data visualization is each an art and a science. it's viewed as a branch of descriptive statistics by some, however additionally as a grounded theory development tool by others. The goal is to speak data clearly and expeditiously to users. it's one among the steps in knowledge analysis or knowledge science. To convey concepts effectively, each aesthetic kind and practicality have to be compelled to go hand in hand, providing insights into a rather thin and complicated knowledge set by communication its key-aspects during a lot of intuitive methods

Data visual image is closely associated with data graphics, data visual image, scientific visual image, beta knowledge analysis and applied mathematics graphics. Within the new millennium, knowledge visual image has become a lively space of analysis, teaching and development. per Post et al. (2002), it's a united scientific and knowledge visual image.

5.4 DATA WRANGLING

Data wrangling once in a while alluded to as Data munging is the way toward changing and mapping information from one "crude" information structure into another organization with the expectation of making it progressively proper and important for an assortment of downstream purposes, for example, examination. An information wrangler is an individual who plays out these change tasks.

This may incorporate further munging, information representation, Data aggregation, preparing a measurable model, just as numerous other potential employments. The expression "Information Wrangler" was likewise recommended as the best similarity to coder for somebody working with information. The beneficiaries could be people, for example, information planners or information researchers who will examine the information further, business clients who will devour the information legitimately in reports, or frameworks that will additionally process the information and compose it into targets, for example, information distribution canter's, information lakes or downstream applications.

Example:

```
import pandas as pd

filename = 'data/breast_cancer_data.csv'
df = pd.read_csv(filename)
df.dtypes
```

```
patient_id               int64
clump_thickness        float64
cell_size_uniformity   float64
cell_shape_uniformity    int64
marginal_adhesion        int64
single_ep_cell_size      int64
bare_nuclei             object
bland_chromatin        float64
normal_nucleoli        float64
mitoses                  int64
class                   object
doctor_name             object
dtype: object
```

Data wrangling, as most information investigation forms, is an iterative one – the expert should do these means over and over so as to deliver the outcomes he wants.

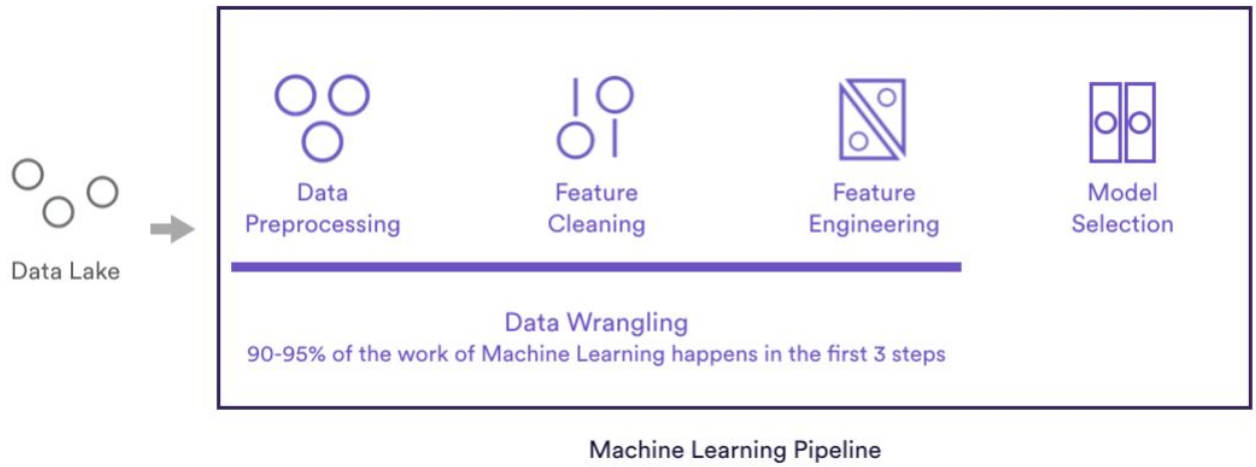


Figure 5.3 Block Diagram of Data Wrangling

There are six wide strides to information wrangling, which are:

Finding: Right now, information is to be seen all the more profoundly. Before executing strategies to clean it, you will need to have a superior thought regarding what the information is about.

Organizing: Crude information is given to you in a random way, by and large – there won't be any structure to it. This should be redressed, and the information should be rebuilt in a way that better suits the expository strategy utilized

Cleaning: All datasets make certain to have a few exceptions, which can slant the consequences of the investigation. These should be cleaned, for the best outcomes.

Improving: In the wake of cleaning, it should be enhanced – this is done in the fourth step. This implies you should consider what is in the information and strategies whether you should enlarge it utilizing some extra information so as to improve it.

Approving: Approval rules allude to some monotonous programming steps which are utilized to check the consistency, quality and the security of the information you have.

Distributing: The readied wrangled information is distributed so it tends to be utilized sometime later – that is its motivation all things considered. If necessary, you will likewise need to record the means which were taken or rationale used to wrangle the said information.

5.5 DATA ANALYTICS

Data Analytics refers to the set of quantitative and qualitative approaches to account valuable insights from information. It involves several processes that embrace extracting information and categorizing it. so, as to derive varied patterns, relations, connections, and different such valuable insights from it. Today, virtually every organization has morphed itself into a data-driven organization, Associate in Nursing. This implies that they're deploying an approach to gather a lot of information that's associated with their customers, markets, and business processes. This information is then categorised, stored, and analyzed to create sense out of it and derive valuable insights from it.

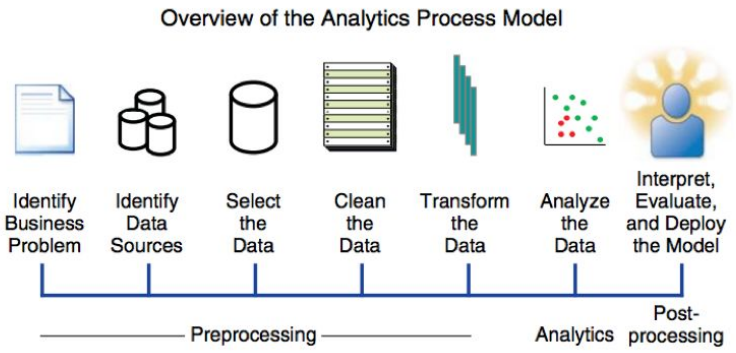


Figure 5.4 Block Diagram Of Data Analytics

CHAPTER 6

EXPERIMENTAL RESULTS

6.1 GRAPHICAL VISUALISATIONS

The major aim of the Medilab network is to collect the diagnostic information from all the individual Clinicon devices. Based on this information, several graphical representations can be plotted. Some of these graphical outputs are given below.

6.1.1 Location Vs. Number of Men & Women Affected

This graph shows the number of men and women who fall sick in various locations. The x-axis represents locations where the Clinicons are installed. Y-axis represents the total number of cases who fell sick in that particular area.

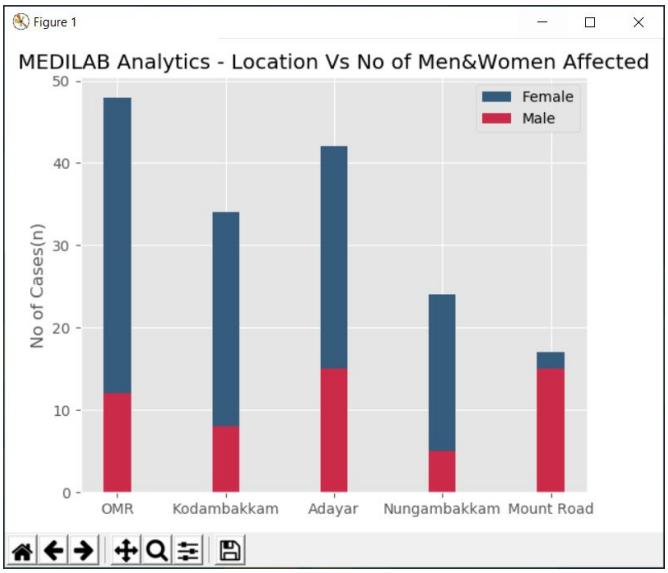


Figure 6.1 Graph - Location Vs Number of Cases

6.1.2 Types of Diseases Vs Number of Patients

This graph represents various diseases which were diagnosed and the number of people who are affected by the diseases respectively. The x-axis represents the different types of diseases and the y-axis represents the number of patients who are affected by them.

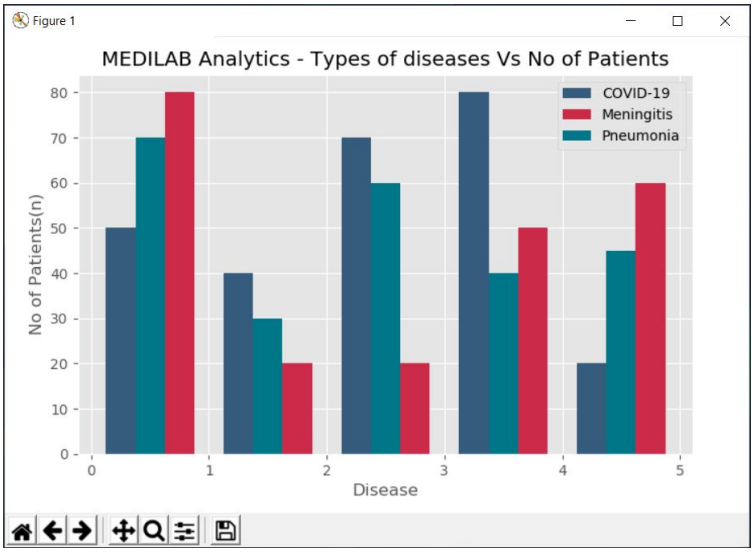


Figure 6.2 Graph - Types of Diseases Vs Number of Patients

6.1.3 Periodic Analysis

This graph is a representation of the periodic data analysis feature. It shows any sudden increase in the patient count for a particular disease or the sudden increase in patients who have the same type of symptoms. If any sudden rise is found the medical personnel can immediately address the issue and cure them before it starts to spread even more.

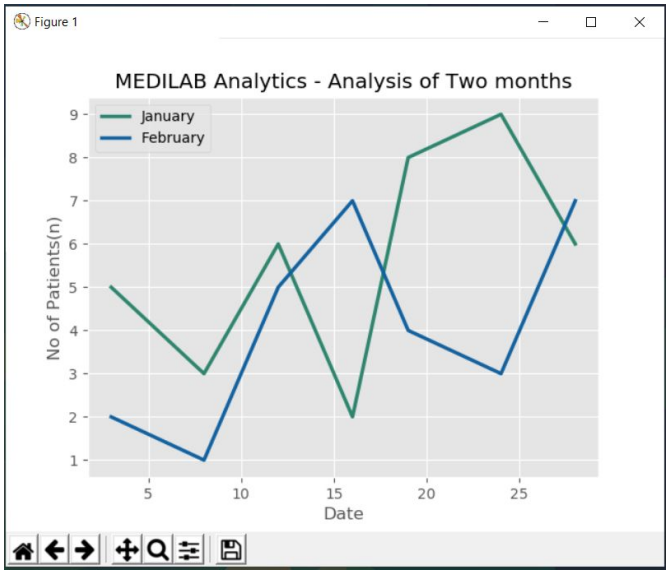


Figure 6.3 Graph - Analysis of Two months

6.1.4 Age-Based Analysis

This graph represents the histogram of the Pneumonia infection rate. This is an age-based analysis which would let us know which age group of the population is the most vulnerable to a particular infection. The x-axis represents the age group of people and the y-axis represents the number of people who are affected.

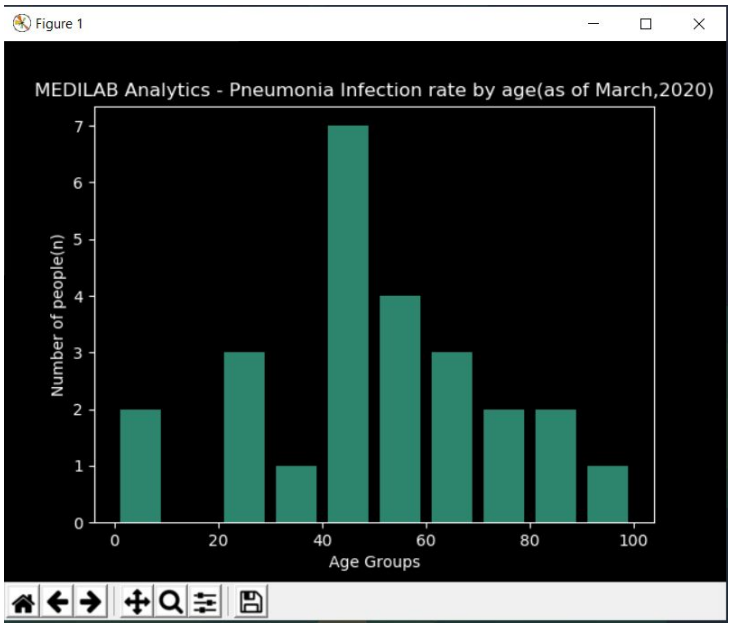


Figure 6.4 Age-based Analysis

6.2 LANGUAGE INDEPENDENT DISEASE DIAGNOSIS

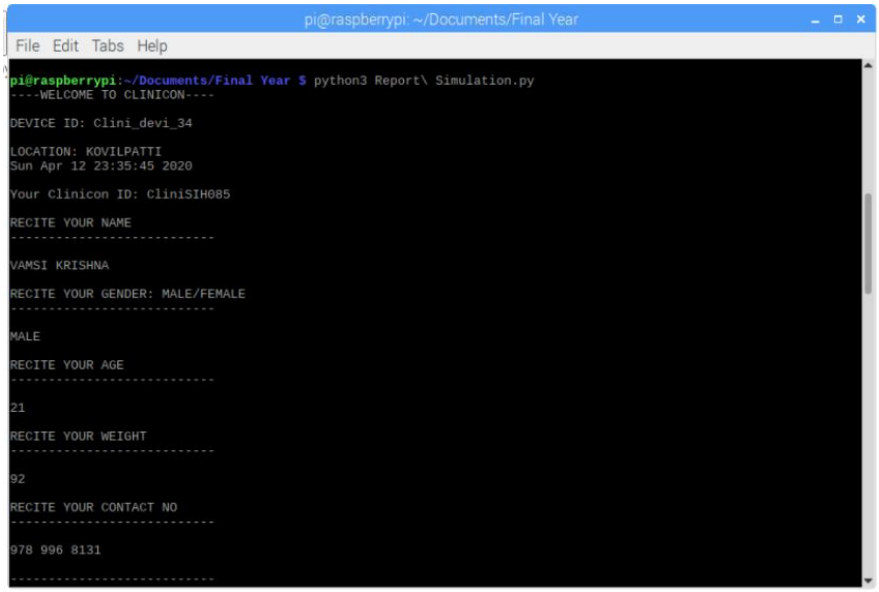


Figure 6.5 General Audio Inputs

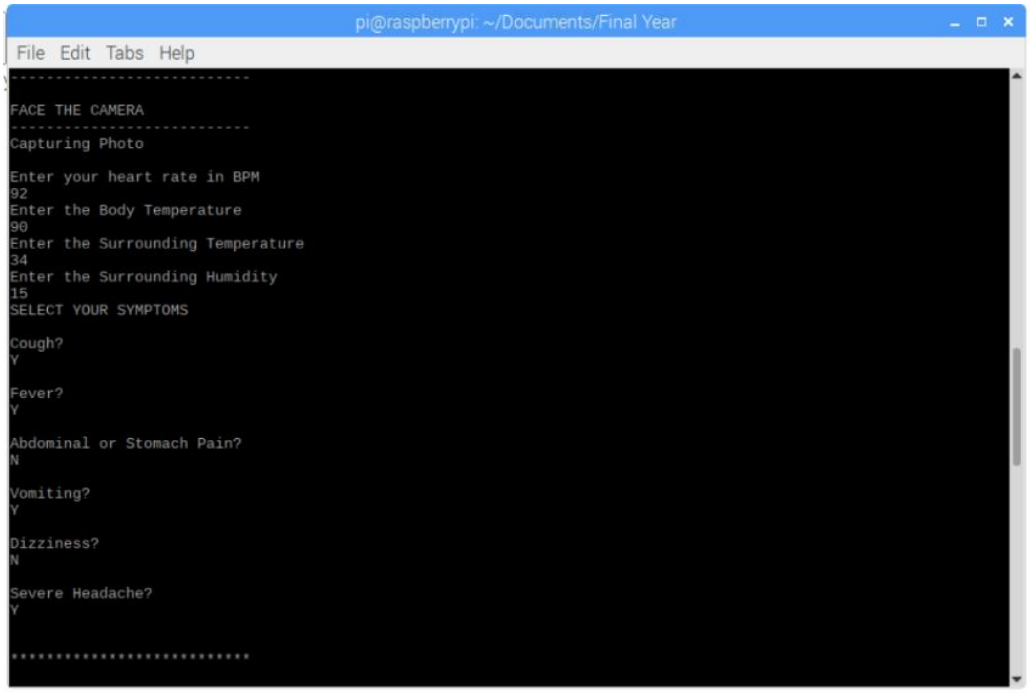


Figure 6.6 Recitation of Primary Symptoms

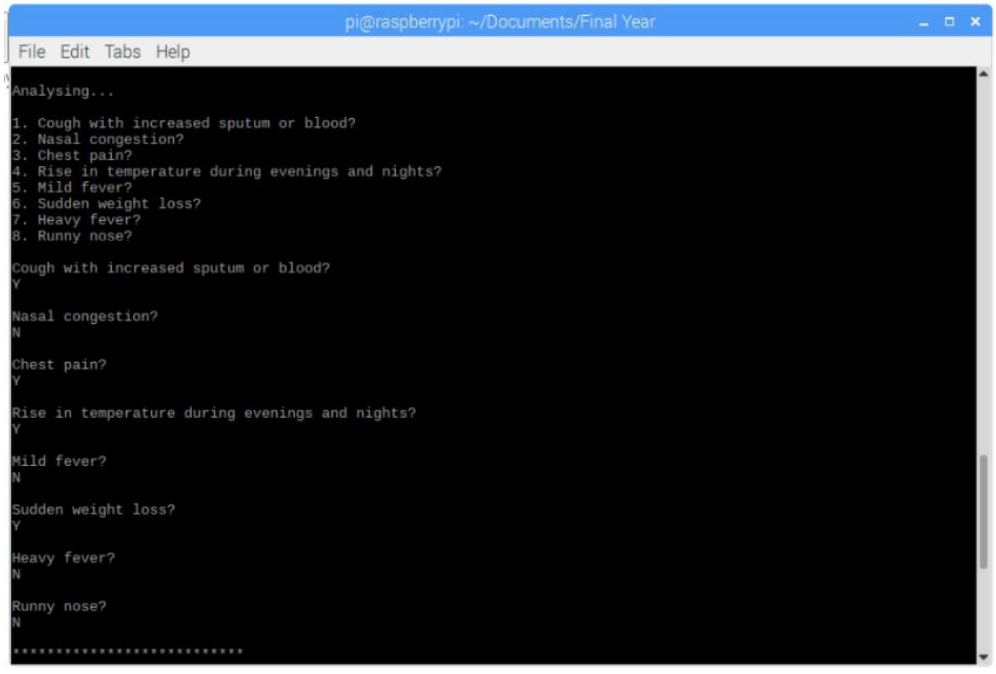


Figure 6.7 Recitation of Secondary Symptoms

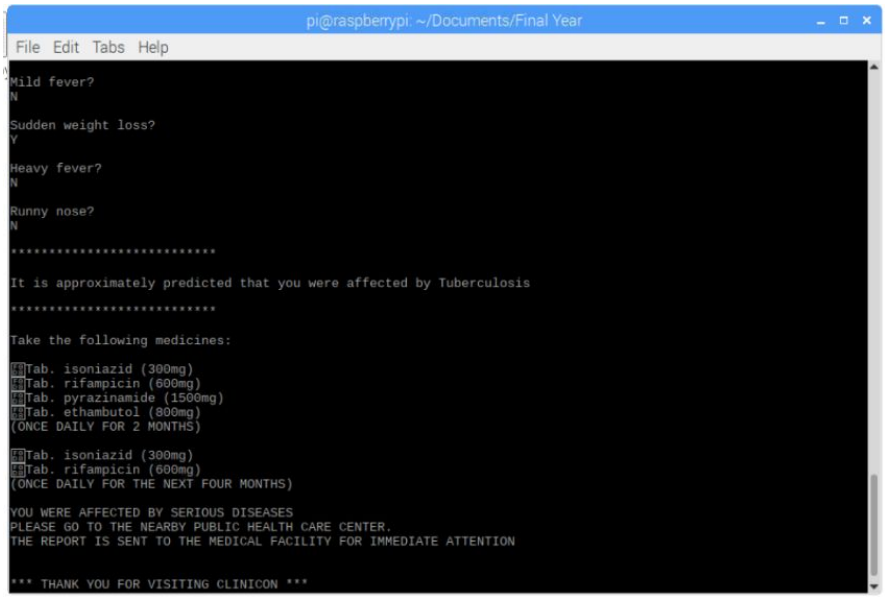


Figure 6.8 Disease Diagnosis

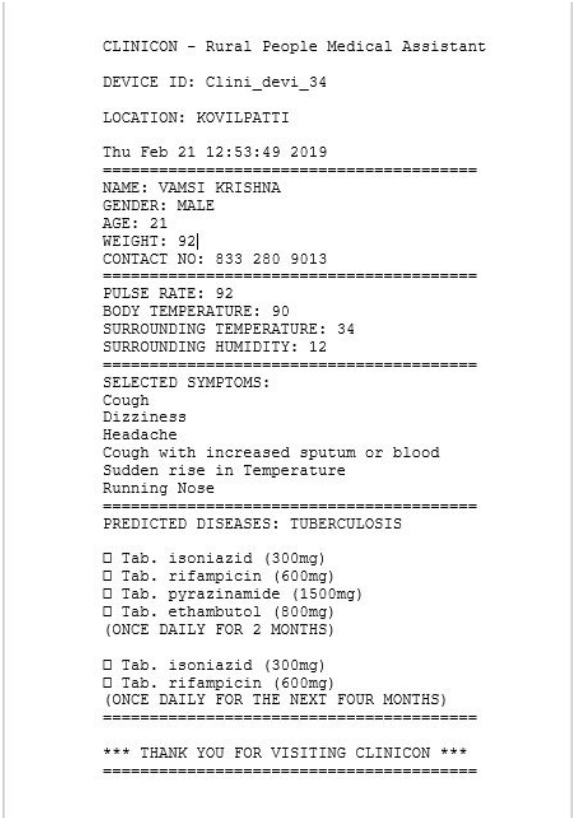


Figure 6.9 Generated Prescription

This can be taken out as a print out using the attached Thermal Printer.

6.3 CUSTOM-MADE MOBILE APPLICATION

Once the users get diagnosed and receive his/her prescriptions, they can view their patient history at any point in time using the personalised mobile application. The users just have to type in their user ID which they receive at the beginning of the diagnostic procedure. It can also be used as the replacement for the prescriptions.

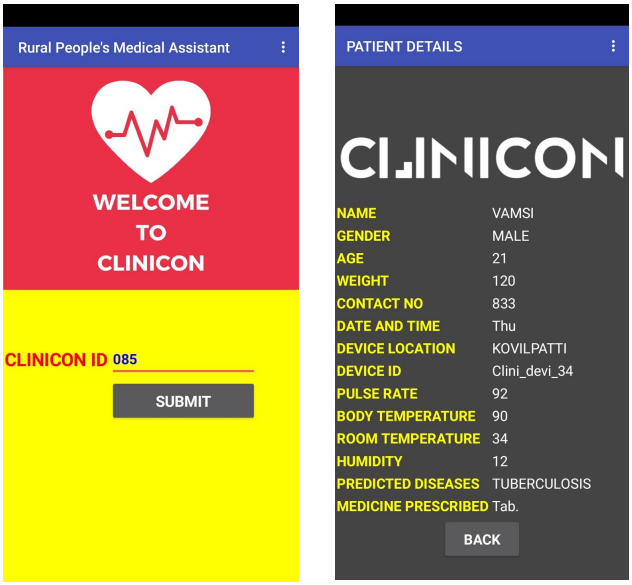


Figure 6.10 Personalised Mobile Application

6.4 SECURE WEBSITE

The medical personnel and doctors can view the information which is stored in the server using the designated website. The website would have a detailed patient history of every patient who has used the device. It would be of help during future references.

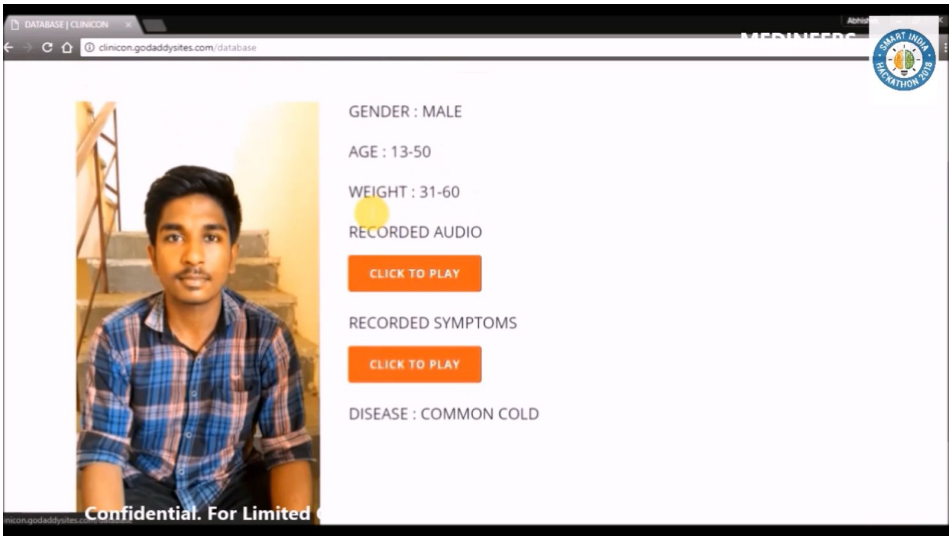


Figure 6.11 Website

CHAPTER 7

CONCLUSION

The proper implementation of this network of devices can reduce any sudden disease outbreaks through constant medical surveillance. The proposed model would help in solving all these problems and also would provide general check-ups to the local public. The goal is to establish a system which consists of several diagnostic sub-systems around our cities and villages. These subsystems can diagnose and provide prescriptions and medicines to its users. Whereas the system as a whole would help in identifying any sudden fluctuations in the number of patients who have a common disease or symptom. This would indicate that a new disease is spreading in a locality. If confirmed, the medical personnel could immediately assess the situation and act on it without any delay. Any further spread or loss in life could be prevented.

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