Automated Health Monitoring System

by

Sheikh Farhan Tanvir Fahim
19101205
S.M. Mahmudul Hasan Rudra
19101457
Nirvik Guha Roy
19101110
Abdullah-Al-Maruf
19101259
Zahrun-A-Zannat
19101364

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School of Data and Sciences
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Declaration

It is hereby declared that

1. This paper is contain our original work as part of our degree program at Brac university
2. All significant sources of assistance have been acknowledged.
3. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
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Student's Full Name & Signature:

Sheikh Farhan Tanvir Fahim

19101205

S.M. Mahmudul Hasan Rudra

19101457

Nirvik Guha Roy

19101110

Abdullah-Al-Maruf

19101259

Zahrun-A-Zannat

19101364

Approval

The thesis/project titled "Automated Health Monitoring System" submitted by

1. Sheikh Farhan Tanvir Fahim (19101205)
2. S.M. Mahmudul Hasan Rudra (19101457)
3. Nirvik Guha Roy (19101110)
4. Abdullah-Al-Maruf (19101259)
5. Zahrum-A-Zannat (19101364)

Of Fall, 2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of B.Sc. in Computer Science on January, 2023.

Examining Committee:

Supervisor:
(Member)

Md. Tanzim Reza
Lecturer
Department of Computer Science and Engineering
Brac University

Co-Supervisor:
(Member)

Sifat Tanvir
Contractual Lecturer
Department of Computer Science and Engineering
Brac University

Thesis Coordinator:
(Member)

Md. Golam Rabiul Alam, PhD
Professor
Department of Computer Science and Engineering
Brac University

Head of Department:
(Chair)

Sadia Hamid Kazi, PhD
Chairperson and Associate Professor
Department of Computer Science and Engineering
Brac University

Abstract

One of the most popular proverbs we have heard since we were little is that "Health is wealth". Ever since the beginning of time, people have been curious to learn and discover new techniques to maintain good health. They are continuously looking for new and improved ways to keep track of their health. In the early stages of the outbreak, people investigate their symptoms and try to piece together what caused them. According to what they discovered, they got the appropriate medical treatment. The next step is for people to investigate methods for monitoring real-time circumstances by measuring things like blood pressure, heart rate, oxygen saturation, and so on. The method that scientists use to measure this is being improved so that they can get more accurate results. But now the technology has developed, people do not even need to use their hands to measure anything. Automation makes the work very easy for the human being. In our research, we tried to develop an automated health monitoring system which will measure the health parameter from which a person can know about his health condition in real time. So, the sensors we are using will be inside a vest. When a patient wears that vest, the sensor will start to read the parameters and store them in the cloud storage. If the patient wants he can extract data from the storage. Also if there are any abnormalities in readings, then the patient and the close people of that patient along with a nearby hospital will be notified.

Keywords: Arduino Mega2560 with esp8266, Neo-7M, Max30102, MPU6050, AD8232.

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Chapter 1

Introduction

1.1 Background

People have always been interested in discovering ways to make their regular activities more productive. If we go all the way back to the dawn of civilization, we can see that every single task was carried out by hand. There were no machines, no robots, and no current in this place. When we fast forward to the first century B.C. we can see that the water wheel was rapidly gaining popularity. We are able to drive a mechanical process that is known as semi-automation or the early stage of the automation process with the help of the water wheel. A sensor is a

device that collects environmental physical input and converts it into data that can be measured by a human or machine. The majority of sensors are electronic, which converts analog data into digital data. However, other sensors, such as a glass thermometer, convey data visually. Sensors have played a crucial part in the expansion of data-centric organisational thought and action.

A sensor is a device that gets a signal or stimulus and response with an electrical signal. The output signals represent many sorts of electrical signals, including current and voltage. The sensor is a device that converts chemical, physical and biological signals into an electric signal. On the basis of the operations, input signal, conversion technique, material applied, and sensor attributes such as price, precision, or range, there are numerous varieties of sensors.There are a countless number of different types of sensors since the first one was created in 1883. Consider a typical pressure sensor, which mostly consists of mechanical components and measures pressure through the deformation of elastic components. However, due to its size, mass, and inability to produce electrical output, this structure is most frequently used in the industrial sector. Pressure sensors have become more common with the advancement of science and technology. These sensors are distinguished by their tiny size, light weight, high accuracy, and favourable temperature properties. Additionally, before the revolutionary age, other types of sensors were created and used in industrial, technological, and agricultural domains with less facility. When

it comes to sensors, the maxim "the smaller, the better" is currently prevalent. Researchers are responsible for the creation of some sensors that are roughly the size of the tip of a needle. The most recent sensors, in particular those that are used in Internet of Things devices and wearable devices, are about to bring about a revolution in the electronic goods business. Whether it's a sensor that can detect silent heart attacks, Sensors can be found in a variety of devices, including mobile phones, autos, home security systems, and even commonplace things. Through their applications in virtually every industry, sensor technologies have made people's lives easier in many aspects of their daily routines. Because of how far humanity has progressed, many essential systems in the modern world would be impossible to revive if sensor data were removed. The use of sensors designed specifically for smart hotels results in both a decrease in operating costs and a significant enhancement of the experience provided to hotel guests. Thermostats and occupancy sensors offer intelligent energy management and make rational use of energy by automating temperature controls and light settings respectively. In today's workplace, technologies that are based on sensors are changing the ways in which people engage with one another and work. This modification calls for the use of intelligent sensors, which result in increased levels of productivity and performance.

1.2 Problem Statement

The issue of dying is our primary concern, and it is the one that we have brought up in this discussion. In our daily life, we have heard and experienced that there were no outward signs of illness but people died and the person who is the closest and most deeply connected to the patient cannot understand whether or not there is activity occurring within their body they passed away. In addition to this, there is a serious lack of treatment, which causes a

huge number of deaths every year. From research, we came to the conclusion that in 2016, middle class countries saw an additional 15.6 million fatalities due to a total of 61 different diseases. It is estimated that 8.6 million extra fatalities may have been avoided if proper medical treatment had been provided. It was projected that 5.0 million of these deaths were the result of individuals receiving care that was of a lower quality, while 3.6 million of these were the consequence of individuals not making use of the available health care resources. Inadequate medical treatment was a primary factor in the occurrence of excess mortality caused by a wide variety of conditions, including cardiovascular illness, accidents, neonatal difficulties, and infectious infections. This was the case because inadequate medical treatment was a primary factor in the occurrence of excess mortality. This was the case despite the fact that appropriate medical care was not made available. The incidence of chronic diseases has been identified as the

second issue that has been brought up in this conversation. The term "chronic disease" refers to conditions that have been present for more than three months and are typically untreatable. They affect around 133 million individuals in the United States, which is comparable to more than forty percent of the total population in this country. In other words, they are the leading cause of death in the country. In 1986, the leading causes of death in the United States were

cardiovascular and cerebrovascular disorders, chronic obstructive lung disease, chronic liver disease and cirrhosis, malignant neoplasms, and diabetes. Other im- portant causes of death included suicide and accidents. These six significant chronic diseases were responsible for a combined total of 1.58 million fatalities in the United States in 2014. These deaths accounted for 75 % of the total deaths that were registered in the United States during that time period. In 2019, the top 10 causes of death accounted for 55 % of the total 55.4 million fatalities that

occurred in the world. This statistic was derived from the World Health Organization. Data from 2019 were used in the calculation of this statistic. There are three broad categories that can be used to classify the leading causes of death around the world: respiratory (chronic obstructive pulmonary disease, cardiovascular (ischaemic heart disease, stroke),lower respiratory infections, and neonatal conditions. Neonatal conditions include preterm birth complications, neonatal sepsis and infections, as well as birth asphyxia and birth trauma. This list has been arranged in a descending order based on the total number of lives that have been lost as a result of each of these factors; hence, it begins with the most common cause. A varied amount of fatalities can be attributed to each of these causes individually. The phrase "communicable

causes of mortality" can be used to refer to a wide range of disorders, including infectious and parasitic diseases, as well as difficulties relating to maternal health, perinatal health, and nutrition. Injuries and other non-contagious or chronic causes of mortality are some examples of what might be referred to as "non communicable" causes of death. "Non" causes of death are distinct from" communicable" causes of death. Another aspect that needs to be taken into

consideration is the consider- able amount of money that will need to be spent in order to get a diagnosis. In order to complete the diagnostic, a substantial amount of financial re- sources will be required. On the other hand, those who come from different socioeconomic strata are unable in this activity since it is not available to them. People who are deemed to be of a lower middle class or a lower class do not have the financial means that are sufficient to pay for a fee like that. Those people are considered to be of a lower class. This is an uncomplicated truth. Because of this, people are frequently unable to receive the essential treatment because they do not have the funds, which in many instances ends in the patient either passing away or suffering for a longer period of time.

1.3 Research Objective

Our primary objective is to design an automated health monitoring system that is capable of determining fundamental aspects of a person's health, such as their heart rate, oxygen saturation, temperature, electrocardiogram, and blood pressure. These characteristics are the most fundamental ones, and they are the ones that reveal the abnormalities that people have. Not only that, but the information gleaned from the parameters can also be saved which allows a person to consult it during a consultation with a medical professional if they so choose.

The purpose of our research is to, first and foremost, make an effort to acquire in-depth understanding regarding the functioning mechanism of sensors through these studies and how exactly they do their functions. Furthermore, we see that people are passing away, yet there are no

outward signs of illness. Therefore, if there are any irregularities in the health parameters, it will give an indicator so that people may go get treated for it. It is also capable of lowering the mortality rate. Also from the previous statistics, we see that many people die just because

of wrong treatment or wrong identification of the disease. It happens because when a patient visits a doctor without any test report or previous documents sometimes it's very difficult for a doctor to judge appropriate disease and give treatment according to that as there is no necessary data or information. So, in our system a patient can measure the necessary health parameters regularly and the data will be stored so when they visit a doctor the doctor could see the result and can easily identify the exact problem. So, it's become easier for them to give actual and proper treatment to the patient. So, it not only decreases the mortality rate, it also decreases the possibility of having a chronic disease. As we have discussed in the past, there

are a great number of people who have passed away just because they were careless. Therefore, if they are able to independently verify the health indicators, perhaps there will be a reduction in the number of deaths caused by carelessness.

Chapter 2

Literature Review

Latif et al. in their [2] paper stated about the Implementation and Use of Disease Diagnosis Systems for Electronic Medical Records Based on Machine Learning. He stated that patients' checkups, vaccines, and health outcomes can be tracked using electronic health records. Patient data can still be reidentified even if the Health Insurance Portability and Accountability Act (HIPAA) in the United States safeguard patient privacy. It takes a long time and can be laborious to perform this task manually. There are numerous ways to automate the extraction of data and the accurate identification of sickness. For the most part, these solutions rely largely on the machine- and deep learning-based diagnostic methods. The most recent articles include rule based, machine learning, and deep learning methods. More in-depth research can be done on the subcategories of machine learning such as SVM, Bayes, and Decision Tree Methods (DT). In terms of deep learning algorithms, the three most common ones are autoencoders, deep belief networks (DBN), and convolutional neural networks (CNN, RNN). Here, we examine a wide range of diagnostic methods, highlighting both their pros and downsides. Each category has its own pros and disadvantages, illness focus, the dataset used, and publication year.

Tulika Lodh, Anirban Dey, and Sunil Kumar[3] their team "Health Monitoring System using IoT and Machine Learning," the report conducted human being's body temperature as well as pulse rate. We must say there is an urgent need to check on the health of the people daily because of the ongoing growth in the number of persons having health concerns due to the covid 19 pandemic. In their project, by using the ESP 8266 Node MCU to gather data from people of varying ages and then using ThingSpeak to compile that information into a data set, this project aims to determine a person's temperature as well as their pulse rate. Firstly, the temperature and the pulse rate will be accomplished using the ESP 8266 Node MCU. Then, using an algorithm called Linear Regression Machine, we check for normal and abnormal traits among people of varying ages, and ultimately, we exhibit a comparison of two age groups using various types of graphs. So, in this project's context, they are using the ESP 8266 node MCU to collect data from people of varying ages and then construct a dataset based on this information using ThingSpeak. Following this, the dataset that was just created is used in machine learning, specifically in the process of linear regression analysis, which is utilised to determine whether or not various people's conditions are normal or abnormal. Their methodology includes an input unit, a processing unit, and an end unit. Pulse rate and temperature sensors are included in the input device. When measuring physiological parameters, the pulse rate sensor and the temperature sensor are on opposing ends of the spectrum. Using analog pins, pulse rate and temperature sensors are connected to the ESP 8266 NODE MCU. All three-node MCU's pins are connected to the pulse rate sensor's Vcc and ground pins. The node MCU's A0 pin also relates to a pulse rate sensor's A0 pin, completing the circuit. The sensor's positive terminal (Vcc) is linked to the 3V3, and the sensor's ground pin is connected to the D1 pin on the ESP 8266 node MCU again. The breadboard and jumper wires are used to connect all of the pins. In their

research, Fahad Ahmed and Fahnaz Farid argued [4] that PH increases the quality of patient treatment. There are numerous ways to gather patient information, including electronic health records (EHR), sensors in wearable devices, smartphones, and social networking sites. AI in the clinical setting facilitates clinical prediction, self-management, and intervention. Modelling with ML. These models are utilised in CDSS and healthcare applications. Patient sensor data can be utilised to assess patient behaviour and clinical issues. These models take into account every aspect of a patient's everyday activities, including sleeping, moving about, eating, digesting, and digesting. The modifications are represented in care plans, CDSS, and applications. There may be suggestions for maintaining a healthy lifestyle provided. Concerning AI, there is considerable confusion. Information concerning biology, medicine, and behaviour. There is insufficient data collection and evaluation. This may result in a broad issue without the user's knowledge. Through this approach, the precision of machine learning models is improved.

In their research paper, Muneer and Fati [5] suggest a health monitoring system for people who are in coma and that is based on GSM and the internet (IoT). The Internet of Things is a relatively recent development in information technology that speeds up the transfer processes, data collection processing. The heart rate, body temperature and acceleration of the subject using an accelerometer and eye blinks are all measured by this suggested system. The requirement for clinical staff and accompanying individuals will be minimized as a result of the integration of these four characteristics with a live monitoring module or a GSM module. This is because the system will enable family members and staff to monitor the coma patient online via mobile phones or receive status-based alerts. The system's outputs include measurements of the user's core temperature and heart rate as they occur in real time. In the end, the results acquired by the eye blink sensor and the MPU-6050 gyroscope were quite satisfying to examine and interpret.

Tamura et al. in their paper [6]explained how they aimed to improve the quality of life for the elderly and disabled by facilitating everyday health care through the integration of fully automated signal assessment with personal identification. They came up with a health monitoring system for the home that doesn't get in the way of eating, bathing, or elimination. Devices for monitoring and data collection are included in the system. Data from the bed, bathroom, and toilet were transmitted to a data console in the bedroom where it could be analyzed further. Each room was tested by having a young, healthy person spend the night there. The data were gathered without difficulty.

Nandyal et al.[7] in their work, they outline an Old Age People Health Monitoring System that uses ML and IoT. According to the initiative's new health paradigm, patients can be monitored 24 hours a day, seven days a week. As a result, there are fewer patients admitted to hospitals. The Internet of Things and wearable sensors make it possible to track a patient's health. Wearable sensors were chosen because of their capacity to measure temperature, ECG, location, and heart rate to name a few characteristics. These sensors can be monitored with a Raspberry Pi. A Raspberry Pi with an internet connection offers data on demand based on user requests. Portable devices such as laptops and cell phones can be used to monitor network-connected assets. The ability of machine learning (ML) to analyse and report on a person's normal or abnormal health condition based on sensed data can aid with elder care.

Mena et al. in their paper [8] described that they developed a wearable ECG monitor with a custom wireless ECG sensor. For the automated classification of captured ECG beats from the aged people, it is used in combination with a native, purpose-built smartphone application that makes use of machine learning techniques. In a study involving 100 elderly people, the monitoring system had a high rate of accuracy (97%), sensitivity (100%), and specificity (96.6 %) when determining normal versus abnormal ECG signals. With further testing, the system may be able to detect cardiac abnormalities in the comfort of a home, helping in the prevention, early diagnosis, and effective treatment of cardiovascular diseases, all while lowering healthcare costs and expanding access for the elderly.

Zhou et al. in their research paper [9] stated that it might be challenging for older people to communicate with loved ones or medical professionals via live video chat due to limitations such as hearing loss and mobility concerns. The authors of this study provide an innovative mobile robot-based remote health care system for the elderly that is based on their research. The proposed technology makes it possible for older people to immediately communicate with their loved ones and medical specialists via the internet no matter where they are located in the world. Their method exceeds the capabilities of existing remote care systems because it incorporates algorithms for accurate indoor item detection as well as automatic health data collection. As a consequence of this, the method that has been offered offers solutions to a variety of difficult issues that are prevalent in the field of elder care. The findings of the testing demonstrated that the care system that was proposed offers an exceptional level of performance and a satisfactory experience for its users.

In this paper [10], Islam MM, Rahaman A and Islam MR introduce an Internet of Things (IoT)-based smart healthcare system capable of real-time monitoring of a patient's vital signs and environmental factors. Five sensors (for carbon dioxide (CO2), heart rate (HR), carbon monoxide (CO), body temperature (BT), and room temperature (RT) are used in this system to gather information about the hospital setting. Each example's error rate is within the created system's allowable range (¡5%). A portal conveys patient status updates to the attending medical staff so they can assess the situation. The success of this prototype proves the technology is well suited for healthcare monitoring.

Dhrubo et al. in their study [11] stated that the previous tracking devices for sleeping issues did not begin collecting data until after a specific period of time had passed, making it difficult to identify a solution in real time. The diagnosis of sleep apnea needs the continuous, real-time monitoring of sleep. Due to this, an internet of things (IoT) based system for real-time sleep apnea monitoring has been developed. It will monitor several indicators of the user's sleep quality and deliver push notifications to the user's smartphone if anything out of the ordinary is detected. Sensors in the system can monitor a person's skin response, electrocardiogram (ECG), pulse rate, blood oxygen saturation (SpO2) and heart rate while they are sleeping. Using a Bluetooth module and then displaying the data in a mobile application, this system has the potential to measure sleep indices without waking the individual. The system is intended for usage by everyone, regardless of their level of skill. In order to collect data on a range of sleep-related parameters, an Arduino UNO board is paired with analog sensors in a variety of configurations.

Bhardwaj, Joshi and Gaur [12] described that due to the global spread of the COVID-19 pandemic, some governments have enacted quarantine and social isolation measures. With the help of IoT health monitoring gadgets, users no longer need to make as frequent doctor visits or specialist consultations. In spite of this, a sizeable portion of the population requires ongoing attention from medical specialists. Using technology, we have devised a strategy to save lives and improve the efficacy of patient therapy. This health monitoring system that uses IoT technology to track vitals such as a person's pulse, respiration rate, and temperature. As a result of this approach, rural clinics and urban hospitals can share information about patients' medical situations more efficiently. However, the IoT system will notify the doctor or physician if the patient's health demonstrates anomalies. These results are comparable to those observed in commercially available health monitoring devices. This health monitoring system enables physicians to collect real-time data. Due to the broad availability of high-speed Internet, the system is able to perform periodic parameter checks. In addition, the cloud architecture enables data storage, which afterwards enables retrieval of past measurements.

In [13] Sangeethalakshmi et al. stated that numerous diseases cause difficulty and untimely mortality, but there are insufficient medical resources. Internet of Things-based real-time health monitoring is recommended as a viable solution by industry experts. Using a smartphone application and GSM (Global System for Mobile) connections, doctors may monitor their patients without them leaving their beds. The primary objective of this research is to create a secure Internet of Things (IoT)-based patient monitoring system that will enable physicians and nurses to monitor patients from anywhere, including their own homes. Using a WiFi adapter, sensors monitor vital signs and transfer the data to the cloud. The recently created wireless healthcare monitoring device may one day be used to transmit online, real-time patient condition data. The system is comprised of sensors, a data aggregation device, a microcontroller (such as an ESP32), and software. Among the metrics that can be gathered and transmitted to the doctor's app-enabled mobile device are heart rate, electrocardiogram (ECG), blood pressure, temperature and blood oxygen saturation (SPO2). When a monitored value surpasses a specified threshold, an alert is sent to the doctor's phone. As a result, Internet of Things-based real-time health monitoring devices are increasingly used to regularly track patients' symptoms, potentially saving lives.

Yadav et al. [14] provide a system for monitoring Alzheimer's patients' daily routines and adjusting care accordingly. It relies on information collected by Internet-connected, implanted sensors in the patient's body. The patient's vitals, including core body temperature, blood pressure, heart rate, and walk, are all recorded by these sensors. The Atmega microcontroller keeps track of everything that is being sent to it by the sensors. Any data collected is immediately sent to a remote server for further processing and analysis. Access to the patient's required parameters facilitates real-time medical care. The inability of our current technologies to accurately estimate a patient's status prior to a key stage of an emergency further compounds the problem.

Jennifer et al. [15] used an Internet of Things (IoT)-based health monitoring system that included a smartphone and a Wi-Fi-connected wearable electronic device. This system's sensors are capable of recording vital signs such as the heart rate, blood pressure, and blood oxygen saturation. Wi-Fi permits the remote gathering of data, its storage in the cloud, and the continuous monitoring of patients. When an out-of-the-ordinary occurrence occurs with a patient, the medical team is instantly alerted of their status. This particular piece of writing contains neither experimental results nor an analysis.

Chapter 3

Internal Circuit Design

3.1 Arduino Mega 2560 with esp8266:

We used Arduino Mega 2560 as our microcontroller. It has 54 input and output pins. Among these pins, 16 pins are used as analog input pins, 4 pins are used for UARTs hardware serial port, a power jack, an ICSP header and a reset button. This Arduino can be powered with an external power supply or via usb connection. 6 to 20 volts power supply is enough to operate the board. The board may be unstable if the supplied power is less than 7v because then the 5v pin may supply less power. Using more than 12 volts can overheat the regulator which results in damage to the board. It has a built-in WIFI module. For this reason, there was no necessity of using a WIFI module in our project which reduced wire complexity as well as its often used for IoT application. It has more pins than Arduino UNO which helped us a lot to connect the components of our project and reduce the circuit complexity. [16]

3.2 Neo-7m(GPS Module:)

We used this component as our GPS Module. It can track 22 satellites(50 channels) and can identify locations anywhere in the world. This module consumes low power, it is affordable and has an easy interface. We used a GPS Module to track the patient/user to see his/her exact location. As our main target audience of this project is basically patient so in case if the patient faces any difficulties or any unexpected things happen with him/her like heart attack or becomes senseless then we can find him/her by getting the location provided by this GPS Module. So, to track those serious patients we use this sensor model. Here Neo-7m is

using the UART protocol. We know the UART protocol is used in GPS modules , Bluetooth modules and RFID card readers.Here its transmit and receive serial data. One of the useful and important things of this protocol is it uses only two wires to transmit data between devices and transmit data bit by bit. Here we also have a priority bit to check the errors. Also neo-7m

is better Unlike other GPS modules, it can update its location five times in a second with a 2.5m horizontal position accuracy.The Time-to-First-Fix (TTFF) of the U-blox 6 positioning engine is also less than 1 second. Power Save Mode is one of the best things about the chip (PSM)[17].

Arduino Mega 2560	Neo-7m
3.3 Volt	VCC
Ground	Ground
TX1(18)	RX
RX1(19)	TX

Table 3.1: Neo-7M Pin out with Arduino

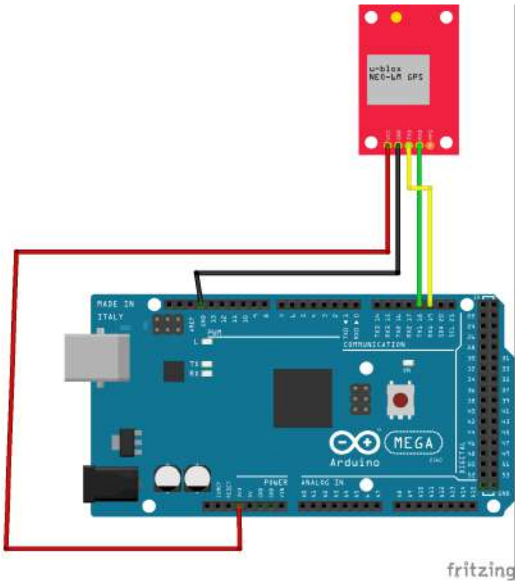

Figure 3.1: Neo-7m Pin out with Arduino Mega

3.3 AD8232 (E.C.G Sensor)

We used a heart rate sensor to continuously observe the patient's heart rate to avoid any unwanted circumstances. This heart rate sensor will sense the heartbeat of a patient and when there will be any problem in the heart rate like low heart rate or high heart rate then the sensor will send the reading to the microprocessor and microprocessor will process the information and notify the users accordingly.By doing these they can observe their regular heartbeat and took necessary action as a result different kind of heart related chronic diseases can be cured.

AD8232 basically follows SPI protocol to communicate with Microcontrollers. The data transfer between microcontrollers and Sensors in a synchronous manner in SPI protocol. Microcontrollers and sensors have the master-slave relationship between them. Here, AD8232 will work as a slave and Arduino will work as the master. In SPI protocol, a clock signal is used to synchronise the data transmission. It should be mentioned that the master will initialise the clock rate and also it will select the slave device to communicate with. AD8232 has three input lines- SCLK, MOSI, MISO. SCLK is for the clock signal. MOSI is for taking input from the master. MISO is for giving output to the master. Another line is used for selecting the chip which is CS/SS. The data transmitted in serial form on the MOSI and received through MISO.

The most important advantage for using SPI protocol is that this protocol is high speed, synchronous which means the data transfer rate between arduino and sensor. As we know AD8232 has three input lines, SPI protocol provides all these three lines. Besides, these SPI protocols use full-duplex communication. We know in full-duplex communication data can be transferred and received simultaneously. Lastly, for high speed data acquisition, it can help us. On the other hand, I2C uses only two lines for communication whereas the AD8232 requires three lines for communication. Also AD8232 requires high-speed data transmission and I2C cannot provide that[18].

Arduino Mega 2560	AD8232
3.3 Volt	VCC
Ground	Ground
A0	Output
11	LO-
10	LO+
Not Used	SDN(Shutdown)

Table 3.2: AD8232 Pin out with Arduino

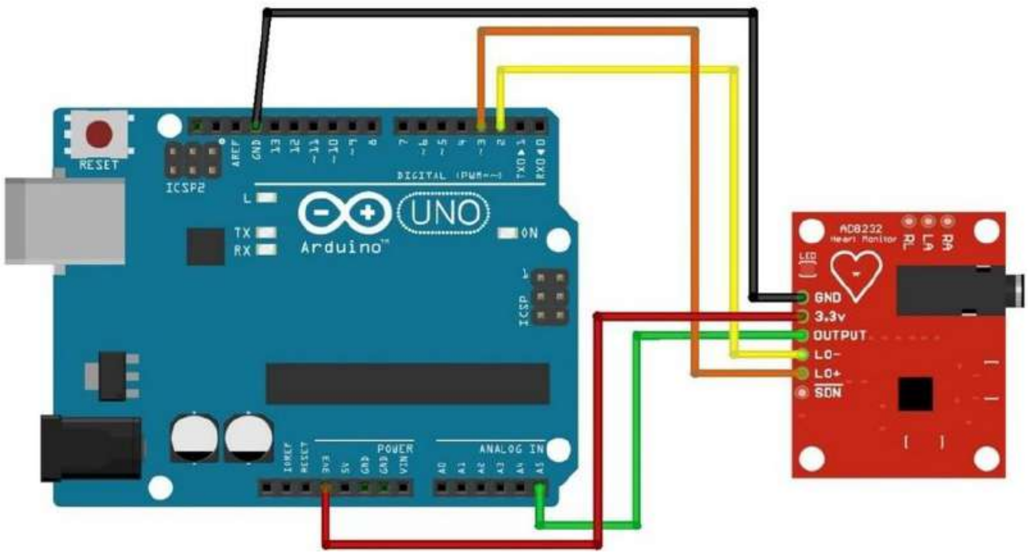

Figure 3.2: AD8232 Pin out with Arduino Mega

3.4 MAX30102

The most common indications to know about the health condition of the person is his heart rate and pulse rate. If there is any inconsistency in these two parameters, then it indicates that the health condition of a person is not that good. Besides these two parameters, temperature should also be taken under consideration. So to measure these parameters we have used MAX30102. It will take the data from the person and send it to the microcontroller which is the Arduino. From the Arduino the result will be shown to an output device so that the person or patient and the closest people to him can know if there is any inconsistency in these parameters.

The I2C protocol is followed by MAX30102. The Data transfers bidirectionally in the I2C protocol. In I2C protocol there is a master-slave relationship between the microcontroller and the sensor. Here the microcontroller is the master device and the sensor is the slave device.

Here, like SPI the master controls the clock signal to synchronise the data transfer. But it also assigns a unique address to the slave device. In MAX30102 there are two data transfer lines-SDA and SCL. SCL is used for the clock signal. For the data transmission SDA line is used. Here the data is transmitted in serial form.

The reason behind I2C is best for MAX30102 is it is simple. It has a two wire interface that uses only two lines for the communication between the sensor and arduino. Besides, it also requires fewer pins on the arduino than SPI. Most importantly, I2C supports multiple slave devices on a single bus which means if we need we can connect multiple MAX30102 sensors using only two lines. On the other hand, SPI protocol is a high speed and full-duplex communication protocol which requires four lines[19].

Arduino Mega 2560	MAX30102
5 Volt	VIN
Ground	Ground
A4	SDA(Select Data)
A5	SCL(Select Clock)

Table 3.3: MAX30102 Pin out with Arduino

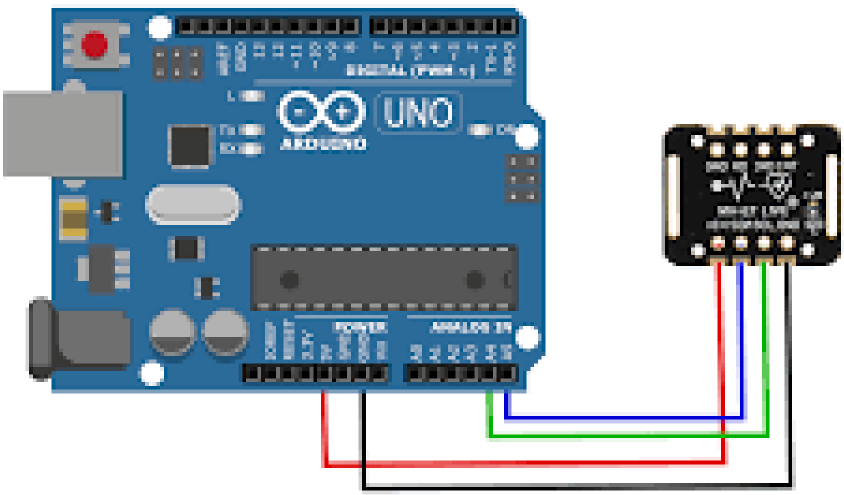

Figure 3.3: MAX30102 Pin out with Arduino Mega

3.5 MPU6050

Our project's goal is to help those who are very old and suffering from chronic diseases. Therefore, by using these sensors, we are primarily detecting the patient's movement because almost everyone has experienced the problem of losing a relative or other close family member without even realising it. Using the sensor, it is possible to determine whether or not the patient is moving normally. The sensor will automatically send a reminder or SOS message to the emergency number if a patient does not respond or move normally after a predetermined period of time.

The MPU6050 is one of the best sensors for motion detection because it measures the linear acceleration angular velocity with a high degree of accuracy and sensitivity. These sensors can track or detect even a small movement and changes in position. Not only that, the MPU6050 is small and also consumes low-power.

Arduino Mega 2560	MPU6050
VCC	5 Volt
Ground	Ground
A5	SCL(Select Clock)
A4	SDA(Select Data)

Table 3.4: MPU6050 Pin out with Arduino

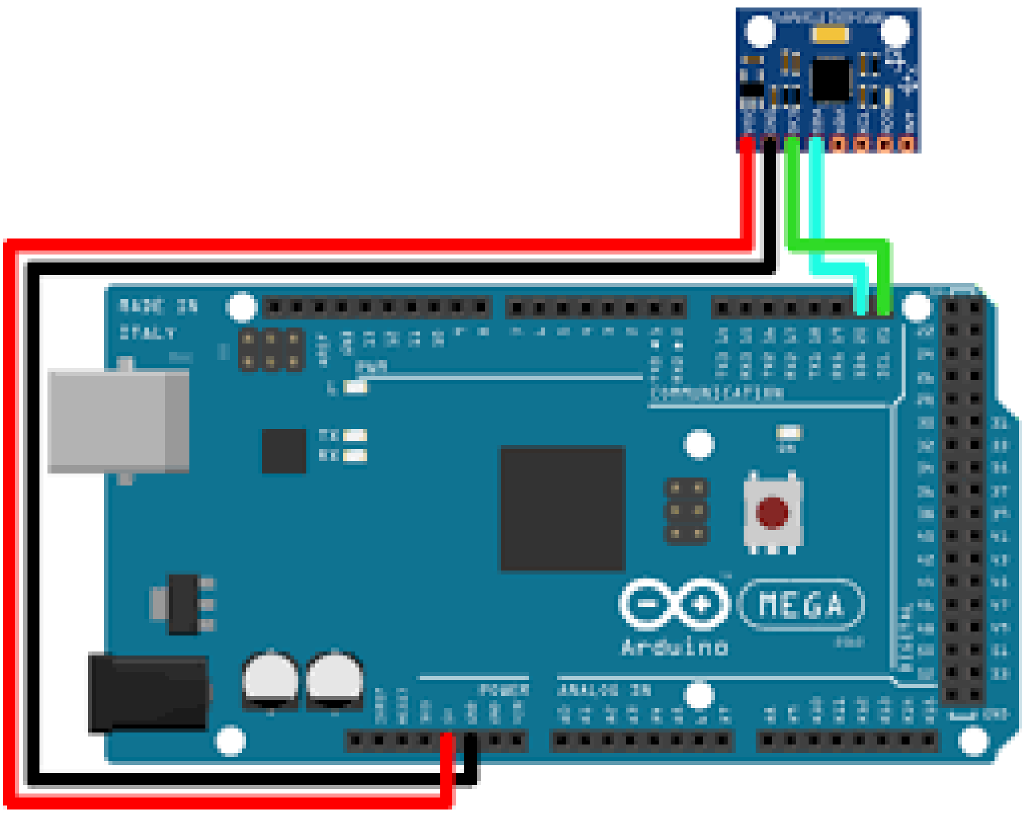

Figure 3.4: MPU6050 Pin out with Arduino Mega

Chapter 4

Model Description

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4.1 Neo-7M

Neo-7M (GPS Module) is mainly based on the u-blox NEO-7M chip. It is a high performance GPS receiver based on the location information in terms of latitude, longitude and altitude. This module basically picks up the radio signal from a network of GPS satellites that are on the orbit around the earth. The antenna on the module picks up the signals, and a GPS receiver uses the signals to figure out where the module is or more specifically where the patient's current location. Here the module uses a technique named "trilateration " to determine the

exact location. Trilateration is a way to figure out where an object is by measuring how far away it is from three or more reference points.Here mainly the reference points are the GPS satellite.As several satellite give signal to the module and by calculating the time difference between those signals it figure out how far away each satellite is.By using these information with the known position of the satellite . It determines the location of the patient as well as the device. Along with the technique of trilateration it also uses a process called TTFF(Time

to First Fix). Which mainly refers to the time that is taken by the module to get the signals from at least 4 satellites and after getting that it calculates the time, position and the velocity.

Overall, the NEO-7M GPS module is a dependable and effective method of determining the time and location of such a device by utilising satellite signals; as a result, it is used in a variety of applications, including Geo-location, tracking and navigation.

4.2 AD8232

The AD8232 is capable of detecting the cardiac electric signals of the human body and it is a single-lead heart rate monitor sensor. This sensor measures the electrocardiogram(E.C.G), which measures the electrical activity of the heart. Its used to determine several cardiac function parameters including the rhythm and and heart rate.

This AD8232 has three electrodes where one is working as a reference electrode and the other two is used for detecting the heart's electrical activity. The reference electrode is placed on the arm and the other two electrodes are placed on the skin these two are basically the sensing electrode.These three electrodes detect the heart's electrical signals and transmit them to the AD8232.

The AD8232 is developed to filter out undesired noise and interference, so it incorporates a low noise instrumentation amplifier that enhances tiny ECG signals while rejecting noise. The sensor then converts the amplified signals from analog to digital and then this digital data is converted to the microcontroller so that this microcontroller can process it. The signal which

is generated by the E.C.G sensor is basically a complicated waveform that changes over the period of time. It shows how the heart is working. By looking at the ECG signal, it is possible to find out several other things about how the heart works, such as its rhythm, heart rate, and whether or not there are any arrhythmias. By looking all those things we can determine the condition of the heart.

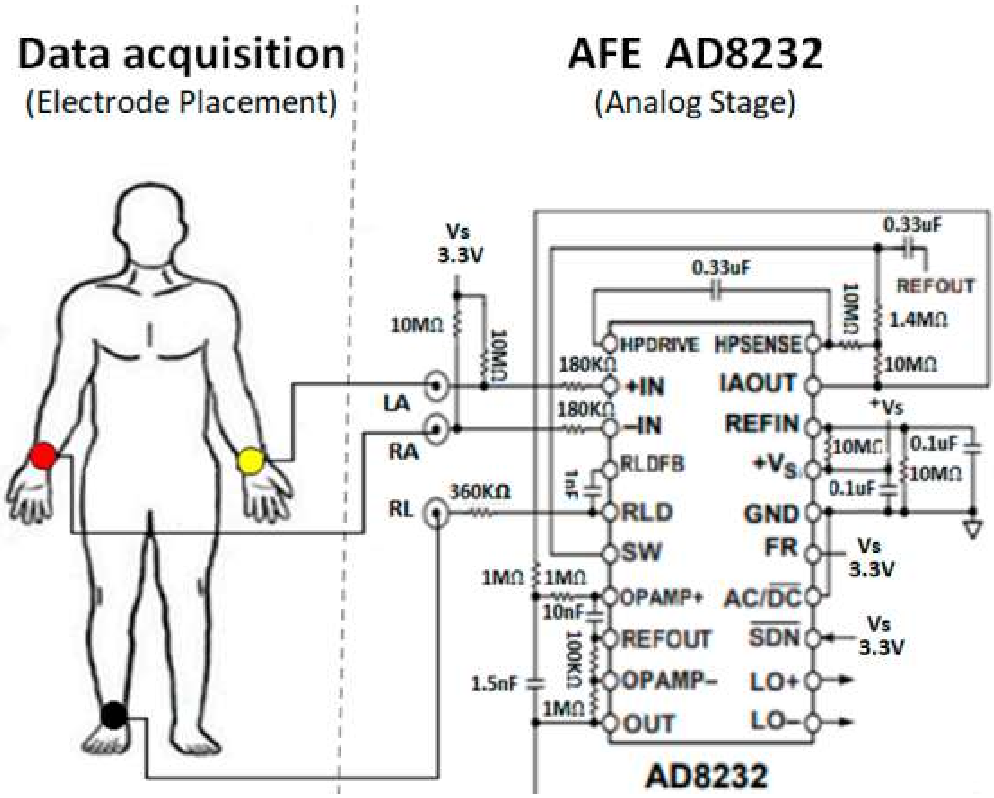

Figure 4.1: E.C.G Measurement Image

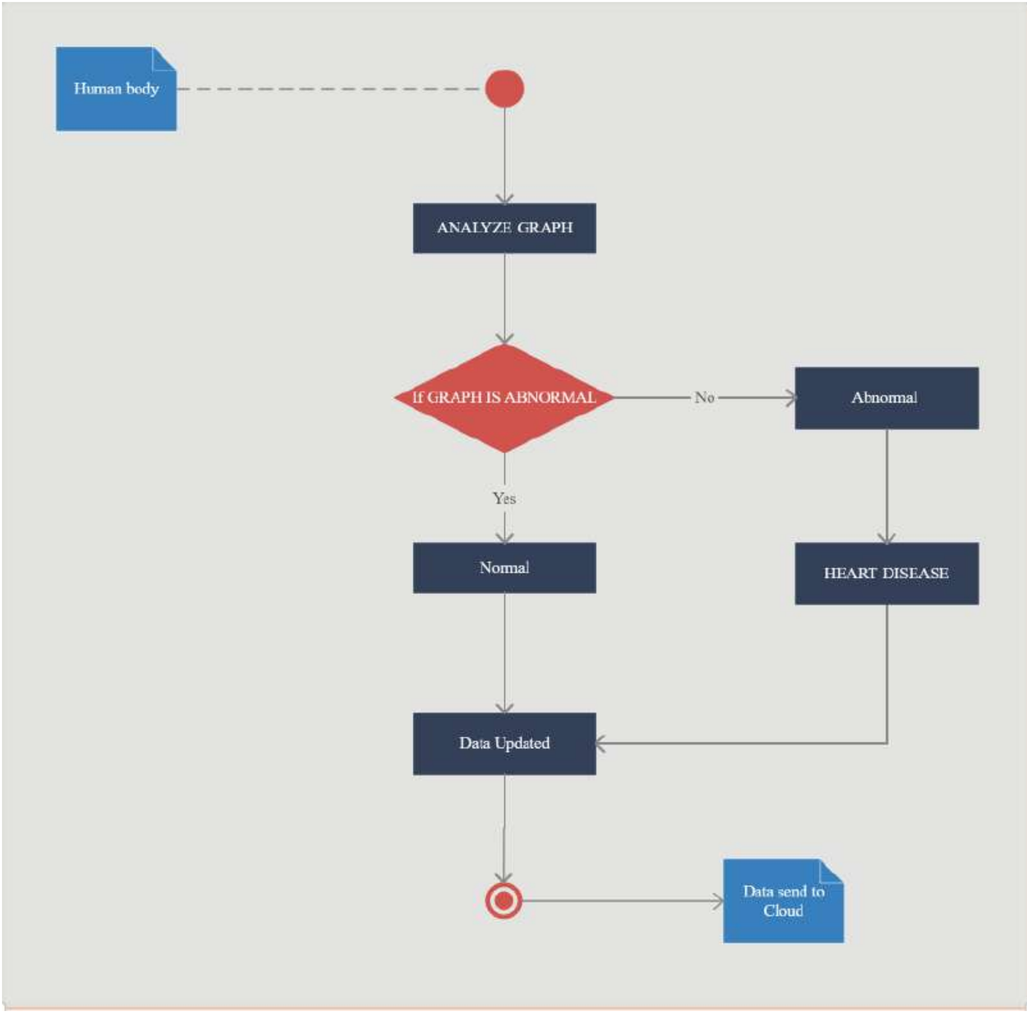

Figure 4.2: E.C.G Working Method

Here in [Figure: 4.2] we can see that, through electrode we will measure the e.c.g. When the graph is abnormal than it will recognize it as heart disease and update the data sheet and if the graph is okay then it will recognize it as normal and then update the data and it will store in cloud.

4.3 MAX30102

It's a heart rate and pulse oximetry sensor. It's basically use LEDs , infrared rays(IR) and photodiode to see changes in the amount of oxygen in the blood cell and the heart rate.The device operates by shining light and these light goes through the skin and it measures the result by seeing how the intensity of the light changes because of the blood vessels absorption of the brightness of light. Here the IR emits light whose wavelength is 940nm and the LEDs light wavelength is 660 nm and the light which passes through the skin is detected by the photodiode [figure:7]. Then this data is used to calculate the oxygen saturation as well as the heart by the sensor. The sensor also has a built-in feature. The feature is called "Ambient light rejection" . This feature helps to get rid of the interference which is caused by the normal light around us. For this feature we get accurate measurement even though in the bright places.

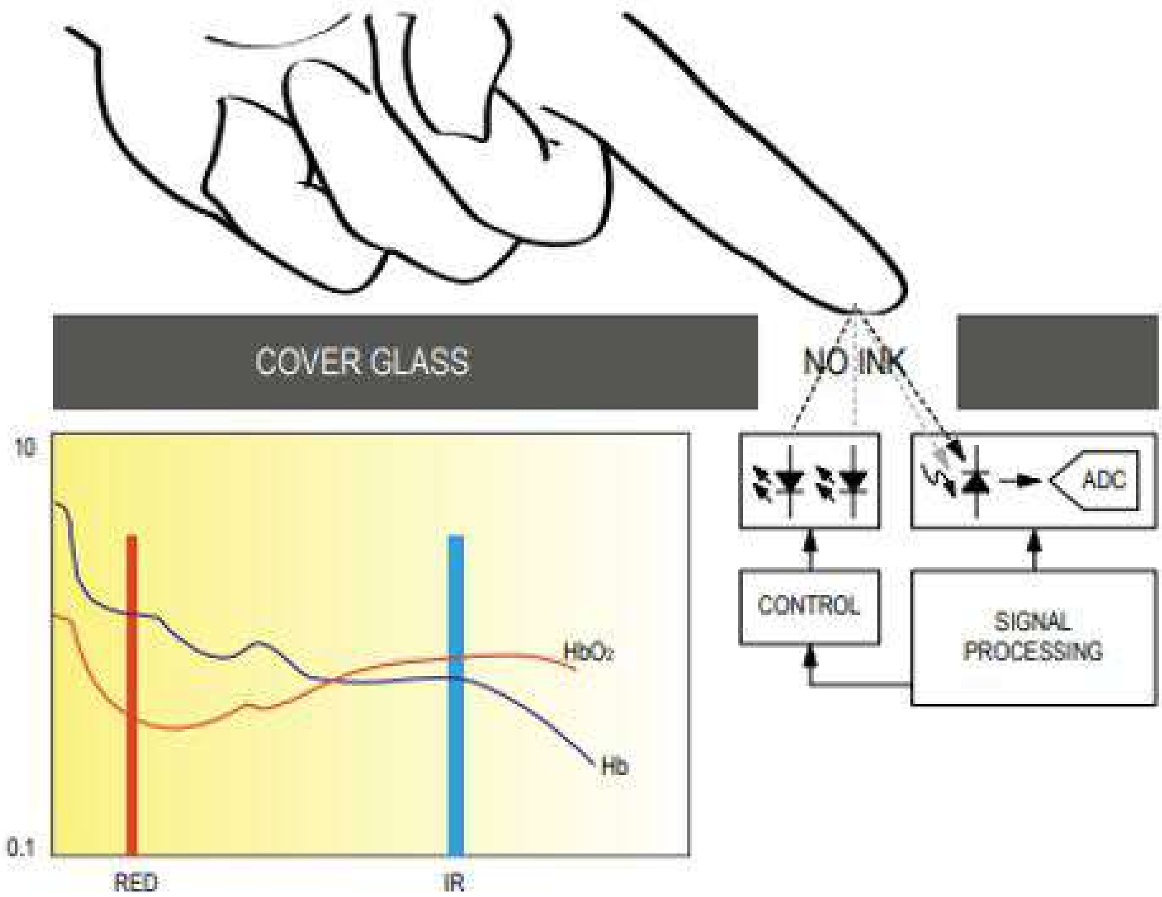

Figure 4.3: MAX30102 Working Method

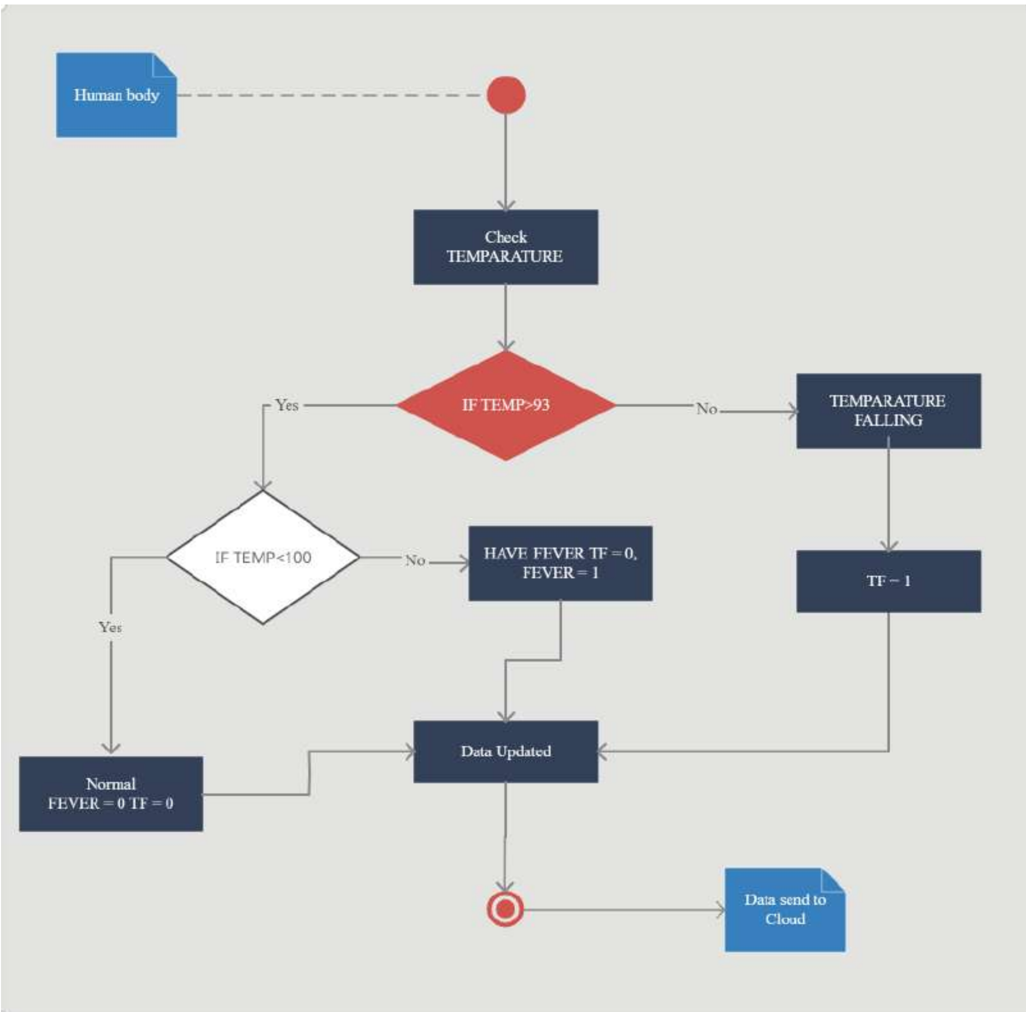

Figure 4.4: Temperature Measurement Flow Chart using MAX30102

Here MAX30102 will operate like the above flowchart[Figure:4.4]. Here first the sensor will take the temperature from the human body.If the temperature is less than 93 degree fahrenheit then it will show that the temperature is falling and TF=1 and the data will be updated and store in the cloud. When the temperature is greater than 93 and also less then 100 degree fahrenheit then it will consider it as no fever and also set the TF=0. If the temperature is greater than 93 and also it's greater than 100 then the sensor will mark it the patient that he/she has fever and the data will saved and store in cloud.

4.4 MPU6050

The MPU-6050 is an integrated circuit . It has a 3-axis gyroscope and a 3-axis accelerometer built into it. It works by assessing how fast an object is moving and how fast it is turning. More specifically it measures the angular velocity and the acceleration . Here the gyroscope mainly used to determine the angular velocity in the 3-axis(x,y,z) and the accelerometer used to determine the linear acceleration in the 3-axis(x,y,z).

As we know its an integrated circuit so that means these two types of measurement sensor are combinedly situated in a single chip. It gives us the information about both the angular velocity and the linear acceleration and this information or the data is used for figuring out how the device is oriented in space.As here we have both the accelerometer and the gyroscope. So these two sensors combined data uses the fusion algorithm to deliver us the stable and precise readings of the devices orientation in space.Here we also have a built-in function called "DMP" (Digital Motion Processor) . It calculates the orientation of the device in real time[20] .

Chapter 5

Approach Model

Automated Health Monitoring System – Vest Approach
In the vest approach, basically the whole hardware system will be inside of the vest. So, inside the vest, all the sensors will be present. The sensor will read the data as analog signal from the human body and the signal will be sent to the microcontroller. Then the ADC(Analog to Digital Converter) inside the microcontroller will process the signal from analog to digital signal. Then the microcontroller will store the data to the cloud storage. From the cloud storage, the data will be transmitted by the wifi or bluetooth to the receiver end.

As we want to track the heart rate , oxygen saturation , e.c.g , temperature , current location, stability at the same time of a particular patient, it's really necessary for us to have all the sensors in one place to collect all those real time data for observing a patient. By having these vest approaches we can have or use all the sensors at the same time, So, it will help us a lot to achieve our desired goal.And like the below model [figure:09] we will arrange the sensor and took those data from human body.

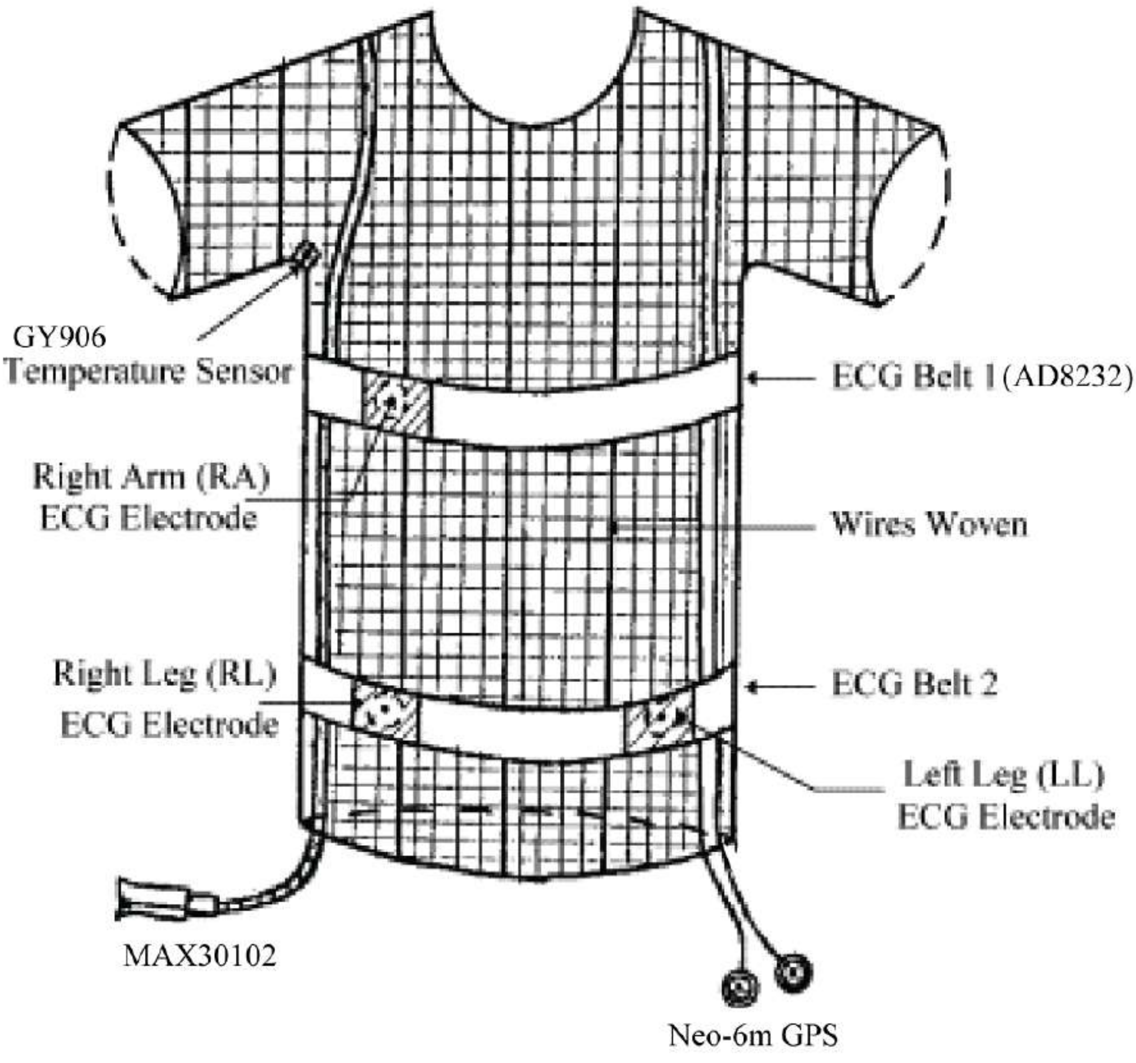

Figure 5.1: Vest Approach

Chapter 6

Result

6.1 Result From Hardware Devices

We have applied the circuit and made up to this in Figure 6.1. we can see when we used the finger to read the data and the bpm spo2, and the temperature is normal, so it shows green light. But when we kept the finger slightly and made it to fall the beats, then the light turned red, which is visible in Figure 6.2. If it continues for more then 1 minute and the object is also not moving then it will fetch the location and will send to the nearest hospital for help and will also find if any living being is near. If yes, then it will give a siren to notify it for help.

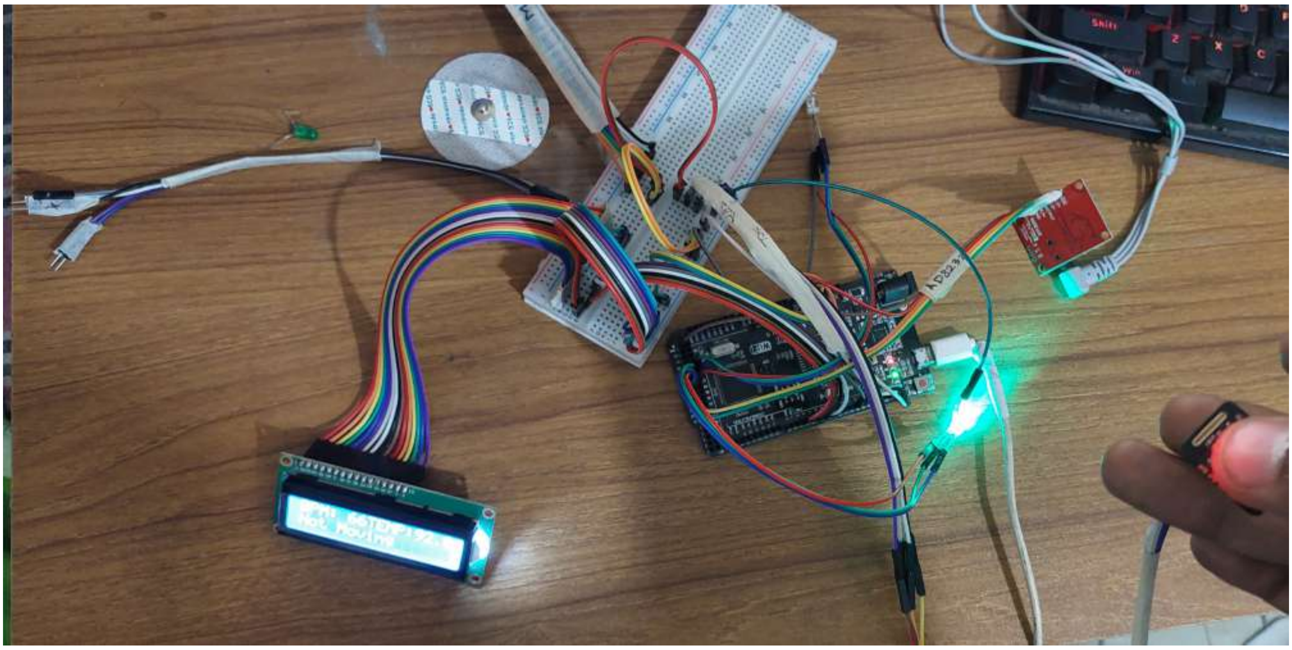

Figure 6.1: Live Example

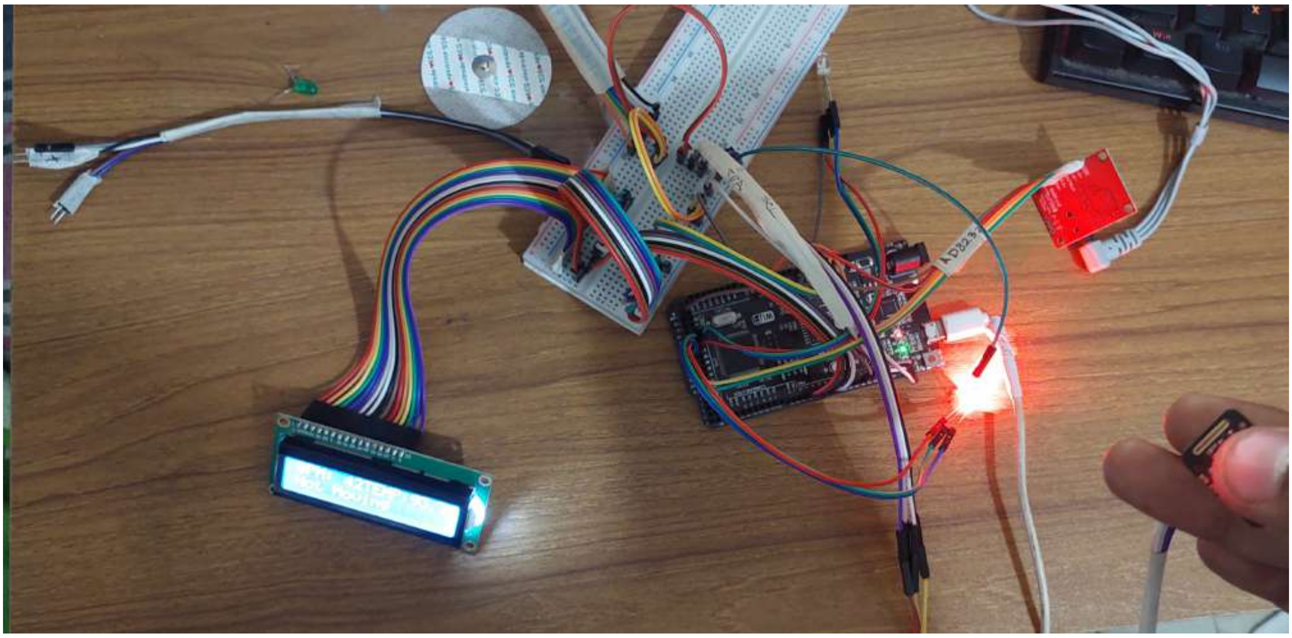

Figure 6.2: Live Example

6.2 Data Set

Fahim S.F.T., Rudra S.M.M.H., Maruf A.A., Pian Z.A.Z., Roy N.G.(2023). *Automated Health Monitoring System* [Data set]

https://docs.google.com/spreadsheets/d/1r44a4J7cQjdpqGb--LO9yKpj0n_ljPeqxzsAX68Zvio/edit?usp=sharing

Person	Name	Gender	Age	Height	Weight	BMI	Heart Rate	Temparati	SPO2	Motion	ECG Graph	ECG Min	Conditi
1		Male	32	174	96	31.70828	67	100	0.99	1	0		Normal
2		Male	38	189	87	24.35542	100	102	0.91	1	1		Covid
3		Female	45	185	110	32.14025	94	97	0.93	1	0		tachyca
4		Female	60	195	104	27.35043	69	99	1	1	0		Fever
5		Male	41	149	61	27.47624	115	105	0.97	1	0		Fever
6		Male	51	189	104	29.11453	82	100	0.93	0	0		Normal
7		Male	50	147	92	42.57485	67	100	1	1	0		Normal
8		Male	61	154	111	46.80385	99	96	0.92	1	1		Normal
9		Male	45	174	90	29.72652	100	87	0.95	0	0		Normal

Figure 6.3: Data Set

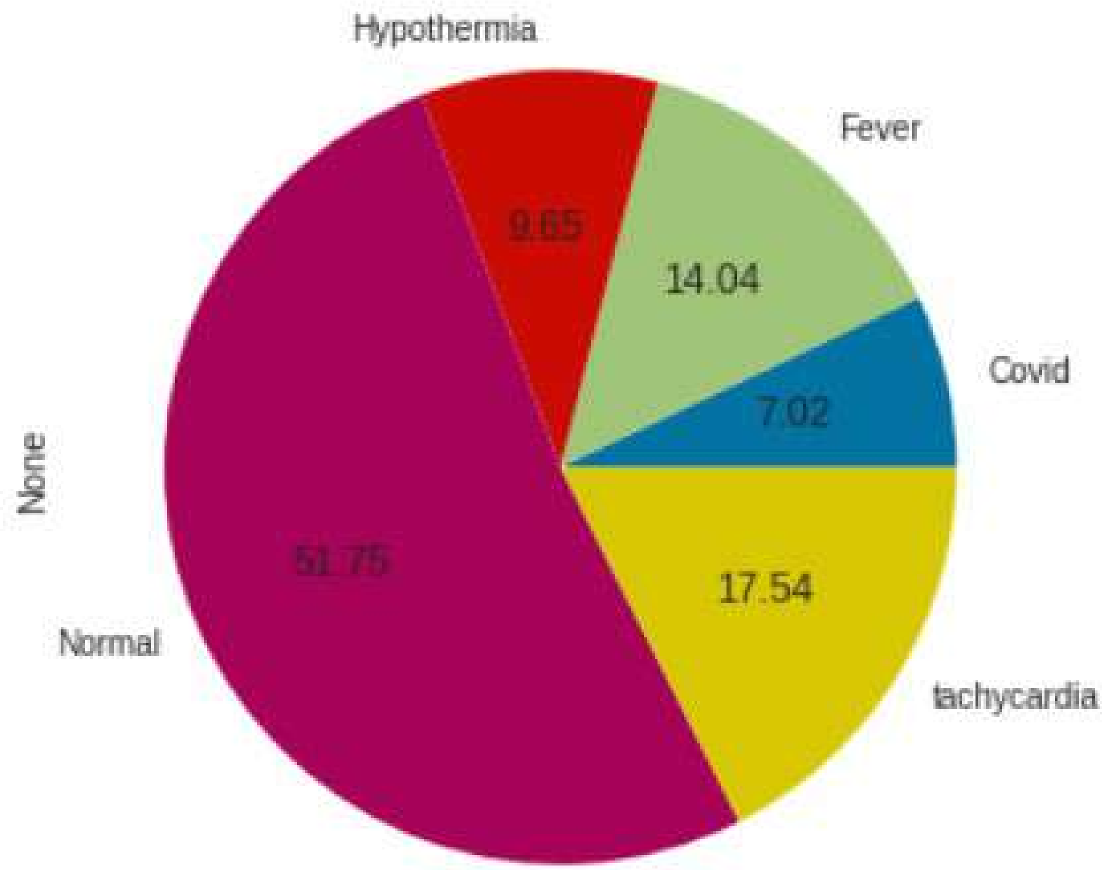

Figure 6.4: Class Distribution

Classification Model	Performance Matrices	Score
Random Forest	Accuracy	97.142%
	Precession	0.950
	Recall	0.972
	F1 Score	0.966
KNN	Accuracy	57.142%
	Precession	0.35
	Recall	0.3954
	F1 Score	0.3691
Decision Tree	Accuracy	71.052%
	Precession	0.5216
	Recall	0.5136
	F1 Score	0.4847

Figure 6.5: Accuracy Rate Using ML

Conclusion

We read on a daily basis in the news that individuals are passing away as a result of not receiving the appropriate level of care. There are occasions when we find out that someone has passed away due to the lack of treatment that they received. Not only that, but we are also observing that individuals are avoiding going to the doctor for treatment since therapies in today's world are so expensive. The most unfortunate aspect is that we lose people before we are able to take any necessary action to help them since sometimes there are no indications to be found. There have been a great number of instances in which a person has passed away in his room or at his house, but nobody knows about it. A lifeless body has been in either sleeping position or on the floor for the past couple of hours. It is the most terrible aspect of the situation. As a result, in order to tackle the problem and stay true to our philosophy of providing "Treatment for Everyone," we developed this project. Because a person who uses our system will obtain all of the information that is important for daily life and will also be able to know the current state of his or her health, among other benefits. It is also very good for elderly people, who are in a health risk zone, and as a result, they can benefit much from it. Therefore, by using it, one is able to keep track of the health status of his or her nearest one and, depending on the situation, either take the appropriate actions or provide the appropriate therapy. Because our system stores the data of the results that are measured by utilising sensors, it will also be very helpful in terms of providing the appropriate treatment. This will be the case because our system will help ensure accurate data. Therefore, doctors are able to easily identify diseases and prescribe medications that are appropriate for them after seeing or analysing that information.

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