Implementation of IoT Based Smart Assistance Gloves for Disabled People

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Declaration of Candidates

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Acknowledgement

In the name of Allah, the Most Merciful, the Most Forgiving. Gratitude to Allah (SWT) for making it possible for us to prosper and for demonstrating His kindness to us along the journey. And may Allah's blessing and peace be upon Prophet Muhammad (PBUH), who has been a source of inspiration and guidance for us all. To my thesis supervisor Mohammad Woli Ullah. I offer profound thanks as well as obligation of gratitute for his appreciation, helpful guidance and motivation during the thesis process. Please also accept my sincere thanks for the superb facilities and timely ideas supplied by my supervisor. For his hard work, devotion and also thesis exam committee has been a massive help. I also wish to congratulate all of my educators fot their dedication and hard work throughout the year. In addition, I are grateful to mour parents for their guidance and support throughout my lives. I would also want to thank my family, friends and well wishers who have been involved in any manner in helping us finishing this thesis.

Abstract

People's health risks are increasing day by day. Patients are facing major problems due to a lack of daily checkups on things like heart rate and oxygen level. In particular, elderly patients who cannot move are the worst sufferers. In addition, aged patients have the additional issue of needing 24/7 supervision, which is both time-consuming and expensive. In order to address the issues, this work seeks to offer an intelligent, IOT-based solution. A smart hand glove has been designed for this purpose. This allows the measurement of the patient's oxygen saturation (SpO2) and Heart Rate level via sensors. Moreover, if the patient falls, the result will be detected. The patient can use hand movement to urgently communicate needs such as "Need Food" or "Need Help," which is another crucial feature of this glove. To monitor a patient's health, the messages from each sensor will be forwarded to the particular device via email and mobile SMS. The paper's outcome will make it easier to monitor the health of elderly and disabled people.

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Chapter-1

Introduction

1. General Introduction

A network of physical devices with sensors, software, and other technologies attached make up the Internet of Things (IoT). These "things" are able to communicate in real time with other networked devices and systems thanks to their connection to the Internet. These automated systems and connected devices work together to collect Internet of Things (IoT) data that may be analyzed to help with tasks or discover how to better a process.

Since it is such a sensitive topic, the quality of healthcare services has long been the target of criticism. Health monitoring, particularly for the elderly and paralyzed patient, is important because most people in modern society hold jobs and lead busy lives. Managing to keep an eye on the senior residents of the residence constantly is challenging. The cost of keeping a caretaker or maid is likewise very high today.

With the help of IOT, it is now possible to gather and analyze data remotely and without involving any humans. This proves that future risks can be accurately detected and avoided, and that it is also possible to alert the relevant authorities, such as a family member or a doctor, in the event of an alarming scenario. IOT is crucial for this project for two main reasons, the first of which is that it is automated and doesn't require human interaction. Additionally, automation reduces the possibility of errors, resulting in a more effective system and higher-quality services overall.

The Internet of Things can be utilized to implement a health monitoring system that uses sensors to record patients room temperatures, oxygen level and heart rates as well as to display the data in real-time. As a result, people can better manage their health conditions. People can obtain their health information online and begin tracking their health status rather than depending on rare trips to clinics or hospitals for different testing. Making use of open source services like Google Assistance and IFTTT makes it possible to perform tasks like sending an alert email and texts during an emergency thanks to the Internet of Things, which realizes the link between devices. Additionally, geolocation allows for user location to be tracked.

1.1 IoT in Healthcare

Sensors having Internet of Things (IoT) abilities have made real-time monitoring possible in the healthcare sector, opening up new opportunities to protect patients safe and well and to improve the quality of medical care. Contacts with clinicians are more efficient and convenient, which has increased patient satisfaction and involvement. IoT is undeniably transforming the healthcare industry by expanding the scope of gadgets and personal interaction in the delivery of healthcare solutions. IoT has uses in healthcare that are advantageous to clients, families, doctors, hospitals, and insurance firms. Additionally, two advantages of distant health status monitoring are reducing hospital stays and preventing readmissions. IoT also has a significant impact on treatment efficiency and healthcare cost reduction.

1.1.2 IoT for Patients

Thanks to wearable technology, including fitness bands and other directly connected medical devices like glucometers and heartbeat and blood pressure rate monitor cuffs, people now have accessibility to tailored care. Users of these devices can program them to remind them to log their meals, workouts, consultations, blood pressure changes, and much more. The ongoing surveillance of medical conditions made possible by IoT has transformed people's lives, particularly those of elderly patients.

People who live only and their families are significantly impacted by this. An alarm mechanism notifies relatives and concerned healthcare professionals of any disruption or changes in a person's regular activities.

1.1.3 IoT for Hospitals

In besides patient health monitoring, IoT devices are very beneficial in a number of other sectors in hospitals. IoT technology allow for the real-time tracking of medical products like wheelchairs, implantable heart monitors, steroid inhalers, oxygen pumping, and other monitoring equipment. For the deployment of medical personnel across numerous locations, actual research is also an option. An important concern for hospital patients is the transmission of infection. Patient protection from infection is aided by IoT-enabled hygiene monitoring technologies.

Additionally, IoT devices help with asset management, such as inventory management in pharmacies, and pollution management, including checking the refrigerator's temperature and adjusting humidity and temperature.

1.1.4 IoT for Physicians

Healthcare practitioners can interact with patients more actively and watchfully greetings to IoT. With the use of data acquired from IoT devices, Physician may select the most effective path of therapy for their patients and obtain desired results.

Physicians can more successfully monitor patients' health by employing wearables as well as other residential monitoring equipment that is embedded with IoT. They can keep tabs on how well patients are following their prescribed treatments or if they require emergency care.

1.1.5 IoT for Health Insurance Companies

For utilizing and distributing health data produced by IoT devices, insurers may reward their clients. Customers that utilize IoT devices to track their normal things, adherence to treatment plans, and utilization of preventative healthcare practices might receive rewards from these businesses. As a result, claims will be greatly reduced for insurers. By using the data that these sensors collect, Iot systems can also help insurance companies verify claims.With IoT-connected intelligent devices, there are several prospects for health insurance. During their assessment and claims management processes, insurance firms might make use of the data collected by health monitoring devices. With the help of this information, they will be capable of recognizing fraud allegations and locate potential underwriters.

IoT devices facilitate communication between insurance companies and their customers during the processes of screening, costing, managing claims, and risk assessment. In light of IoT-captured data-driven judgments, customers will have ample transparency into the underlying reasons behind each decision made and the effects of each operation process.

1.1.6 Benefits of IoT Healthcare

Data on heart rate, oxygen and glucose levels, weight & ECGs are all collected and transmitted by the IoT gadget. An authorized person, such as a doctor, insurance company, a partner health organization, or an independent consultant, can be given access to these data, which are stored in the cloud, allowing them to access the data collected from any place at any time on any gadget

Telehealth observation using smart gadgets can save lives in cases of medical emergencies including heart difficulties, diabetes, asthma attacks, etc. Thanks to a digital medical product connected to a mobile app, real-time health status analysis is now possible. Linked medical gadgets can gather clinical and other essential health data and use the smartphone's internet connection to send data to a physician or a cloud platform.

1.1.7 Affordability and Connectivity

IoT may streamline patient care workflow through the utilization of new IoT technologies, cutting-edge medical facilities, and health mobility services. IoT in healthcare accomplished, artificial intelligence gadget connection, sharing of information, and data transfer, which improves the efficiency of healthcare service delivery.Therefore, a technology-driven system lowers healthcare costs by reducing pointless visits, leveraging better resources, and enhancing planning and allocation.

1.1.8 Alerts and Tracking

Real-time alerts, tracking, and monitoring made possible by the Internet of Things (IoT) enables hands-on therapies, greater precision, suitable medical intervention, and generally improved patient care delivery results. A chronic illness requires ongoing vigilance, which is crucial. Medical Internet of Things (IoT) gadgets gather critical signs of any illness and communicate that data to physicians for tracking in live time. They also warn the public about critical elements via mobile apps and sensor technologies.. No matter where they are or when they are received, reports and alerts provide a clear assessment of a patient's status. Informed decisions and prompt treatment are also made possible by it for medical professionals.

1.1.9 Remote Medical Assistance

Medical professionals may rapidly check patients and diagnose illnesses while on the go thanks to mobility solutions. With the help of clever mobile apps, patients can reach a physician who is located miles away in case of an emergency. A lot of Internet - of - things healthcare delivery chains are also planning to construct devices that can distribute medications depending on the prescriptions of patients and the medical information that is made available by connected devices. Hospital patient care will be improved via IoT. As a result, healthcare costs for individuals will decrease.

1.1.10 Research

Applications for IoT in healthcare can be used for research. The reason for this is that IoT makes it possible for us to gather a large amount of data regarding the people's illness that would have taken several years to do otherwise. In order to support medical research, this data might be used for data analysis. IoT has a significant impact on medical research. It makes it possible to develop more advanced medical procedures. IoT saves us money that would have been spent on research as well as time.

IoT therefore has a significant impact on the discipline of medical research. It makes it possible to develop more advanced medical procedures. IoT is employed in many different gadgets that improve the caliber of the healthcare patients receive. By merely using the embedded chips of smart medical devices, indeed the existing gadgets are now updated by IoT. This chip improves the support and care that a person needs.

1.2 Challenges of IoT Healthcare

1.2.1 Privacy and Security of Data

One of the main issues that IoT presents to the healthcare sector is data security and privacy. IoT security devices send and record data continuously. The bulk of IoT devices lack data security and protocol requirements. Regarding data ownership regulations for electronic devices, there is a lot of confusion. Due to all of these factors, the information is extremely vulnerable to attackers who might compromise the Private Patient Data of both patients and physicians by infiltrating the system. Cybercriminals can utilize patient electronic health records to construct fraudulent identifications that they can use to purchase pharmaceuticals and medical supplies that they can later resell.

1.2.2 Data Accuracy and Overload

A lot of data is recorded by IoT devices. IoT devices' data collection is used to uncover important information. Despite the abundance of data, physicians are finding it more and more difficult to interpret it, which affects their degree of decision-making. There will eventually be problems with patient safety as a result of this. Additionally, this concern is expanding as more devices are linked and record substantially more data.

1.2.3 Integration of Multiple Protocols and Devices

It is challenging to integrate the IoT healthcare business due to the integration of various devices. This problem is brought on by the inability of device manufacturers to settle on communication protocols and guidelines. Due to the variations in their communication protocols, the method of data collection is difficult and hindered even when a variety of devices are connected. The non-uniformity of connected gadget standards, which drags down the entire procedure, makes IoT in healthcare less scalable.

1.2.4 Importance of IoT Healthcare

An IoT healthcare architecture can be thought of as a collection of external operations-focused cloud computing systems. Medical IoT-based healthcare systems collect a variety of patient data and solicit input from doctors. The best illustration of this is the continual glucose monitoring in insulin pens. These devices can all communicate with each other and carry out crucial tasks that might act rapidly to protect a person's life.

This essential data would be collected by an IoT healthcare device and transmitted to the cloud so that physicians could respond on it. This leads us to the reasonable conclusion that IoT healthcare applications have the potential to significantly improve patient health, healthcare professional productivity, and hospital operations.

1.3 Future Of IoT Healthcare

An IoT device can be thought of as a gadget with a sensor in which it can communicate with the real world and transmit data to the Internet. These IoT-based medical gadgets can all connect with one another and take critical actions that could save a life or provide timely assistance.

After acquiring passive data, IoT healthcare devices would broadcast this crucial information to the cloud so that clinicians could act on it. IoT-based health services improve patient comfort, offer support in an emergency, and increase workflow effectiveness for healthcare organizations.

1.4 Application of IoT Healthcare

1.4.1 Systematic Monitoring of Glucose

Patients with diabetes may have sensors-equipped devices inserted just beneath their skin. When a patient's blood glucose levels become dangerously low, the device's sensors will notify them through text message and also preserve previous data. Patients will be able to determine when they are the most danger of low glucose levels both now and in the future by doing this.

1.4.2 Heart Rate Monitoring

Patients can wear gadgets to track their heart rates and check their blood pressure to see whether they have excessive blood pressure. When needed during checks and tests, healthcare personnel will have accessibility to monitoring of patient heart monitor data. Even patients who are having arrhythmias, strokes, attacks, or full heart attacks can receive alerts from the wearable devices to the medical staff. The distinction for both life and death can then be determined by how quickly ambulances are deployed.

1.4.3 Cancer Treatment

The best course of action for a cancer victim typically involves considerations beyond weight and age. Their habits and levels of fitness also have a significant impact on what the best healing process for them will include. Patients' movements, degrees of weariness, hunger, and other factors are tracked using activity trackers. Additionally, the information gathered by the tracker both before and after therapy will let medical personnel know what modifications should be made to the suggested treatment plan.

1.4.4 Systems for Medical Alerts

People can wear jewelry-like items that are intended to inform loved ones or colleagues in the event of a crisis. As an illustration, if a person wearing a wearable medical wristband slipped out of bed in the late hours of the night, the individuals they have designated to assist them in an emergency will be alerted right away on their cellphones that assistance was required.

1.4.5 Consumable Sensors

Gadgets with sensors that resemble tablets can now be swallowed by patients. The sensors are swallowed, and after that, they deliver information to a patient's smartphone app to help them stick to the suggested dosages for their medications. The majority of medications are not used as prescribed because of human error or forgetfulness.This ingestible sensor helps to make sure that people are taking the appropriate drugs at the appropriate times and amounts. Additionally, certain sensors are employed to provide more precise diagnoses for individuals with conditions including irritable bowel syndrome or cancer.

1.4.6 Remote Supervision

IoT devices make it possible for medical professionals to monitor patients who have recently undergone surgery or are undergoing outpatient care at home. A patient will be told if they develop a critical ailment or need urgent care.

1.4.7 Monitorable Inhalers

By sending data to patients' cellphones or tablets, Internet of Things inhalers are alerting patients to the things they are doing or experiencing that are triggering asthma attacks. Their doctors may also receive the information. Patients who have linked inhalers are also reminded when to take their medicines.

1.5 Problem Statement

People are expected to visit clinics or medical facilities on a regular basis for checkups under the outdated and time-consuming traditional healthcare system. People will be deterred from scheduling routine medical exams 2 due to the high expense of healthcare and lengthy wait times. The people will benefit from a health monitoring system that collects and tracks the user's health status in real-time by saving them time and money on unnecessary trips to clinics and medical facilities. A physician or other paramedical staff member typically monitors the condition of elderly patients in homes and hospitals by continuously checking vital signs including blood pressure, oxygen saturation level, and room temperature. Consequently, after a while, this task grows tiresome. Thus, it can result in issues. However, numerous researchers have made prior attempts to solve it in a variety of methods. Before it is not monitored for halfly paralyzed and elderly patient, they need extra care and they can't ask for help easily.I will solve this problem.

1.6 Aim and Objective

The project's objective is to develop wearable gloves for health monitoring that , continuously measures their heart rate, oxygen level and displays the information in real time. To monitor the patient's health information, authorized users will have access to the collected data kept in the database. When the person wearing the health system experiences abnormalrom or rapid changes in heart rate and oxygen level, the system has the ability to send alert notifications to phones and emails. Also if the patient falls anywhere alert will be sent to the host. As a result, the project's goals are to suggest an Internet of Things (IoT) based health monitoring system that continuously gathers and records the user's body temperature and heart rate. To suggest 3 a system that displays and keeps the health information .

1.7 Scope and Limitations

The aim of the project is to make a hardware and software-based IoT-based health monitoring system.

The accuracy of the sensors used in this system will not be taken into consideration because they have not been medically verified and are in no way appropriate to be used for any serious medical analysis because the project's focus is on the implementation and involvement of IoT in the health monitoring system and because of budgetary constraints.

1.8 Thesis Outline

Chapter-1: In this chapter I gave the introduction to my ideas for this project, the motivation I got from and my objectives with this project.

Chapter-2: This chapter describes the literature review for this project. It discusses the concept of this project, related and similar works done (if any) and how I differ from them.

Chapter-3: In this chapter, I described the steps of method I followed to complete the project, which includes data collection, data storing, analysis with the data etc.

Chapter-4: This chapter gives a through view on the result that is obtained after the analysis from the data.

Chapter-5: The conclusion is given in this chapter.

Chapter-2

Literature Review

This chapter addresses the idea behind the project I am attempting to implement, the types of projects that have been worked on in the past, and how my project is unique and better than prior initiatives.

2.1 Concept

The health of elderly and paralyzed persons serves as a fundamental paradigm for monitoring utilizing various sensors.I opted to monitor elderly adults since they are typically more susceptible to illness and other aging issues. As a result, it is typically challenging for those who work to continuously supervise the elder members of the household. Even while it is possible to take care of the elderly when they are at home, it can be challenging to monitor their activities and health while they are working. Therefore, it was imperative to develop a solution, which included creating a health monitoring system that can track older people's everyday routines.Already given to the system will be a threshold value.

The system will daily data collection through sensors that will be positioned in accordance with the system's requirements. Once the data has been retrieved, it will be compared to the given threshold values. If everything is normal, additional investigation won't be made. But if there are any irregularities or anomalies, captured, after which the data are subjected to additional analysis using the relevant predictive algorithm. Then The system will assess the severity of the problem using those forecasts. the case if the situation is that serious, a message will be sent to the concerned family members with the recent both the patient's state and the system's prediction are discussed.

The fundamental parameters that will be observed in this study include the patient's heart rate and oxygen level. The research's sensors will function in the ways described below:

1. The sensors will send the data collected from the host in a regular basis after definite span of time.

2. The data thus collected will undergo a comparison with the given threshold value to the system.

3. If the data set concurs with the threshold value then the situation will be considered to be normal thus the system will not take any further action.

4. The data set thus retrieved if contains any abnormities, will then go for further analysis to predict how serious the condition of the person is. And also send a alarming message to concerning authorities.

2.2 Related Works:

In this era, IOT-based health monitoring systems have achieved incredible development in the health sector. In order to further advance the healthcare industry, many researchers are continually researching IOT monitoring systems. The work of some researchers is given below;

A thorough investigation into the system's topic reveals that only a very small number of the linked works were actually able to construct their own system prototype and basic framework. Some of the publications, such as the research on Ambient Assisted Living (AAL) [1], really performed more of a literature review of the state of the monitoring system's current condition. Additionally, they made an effort to recognize and emphasize the crucial problems, service quality, and user-driven experiences in their work. Some people focused on demonstrating or emphasizing the value of IoT in the healthcare industry and some recommendations for the architectures of health monitoring.

A health monitor for a clinical setting, the Masimo Radical-7 [2], aids in data collection and wireless transmission for continuous display. This allows for a better level of graphical capability and high quality information display. A touch-based user interface is also included. However, given how economical it is, it cannot send an alert signal to alert for any emergencies. The Free Scale Home Health Hub reference platform stores patient data to the cloud via a variety of sensors, allowing access to those who are connected to the patient. This platform is also unable to alert those caring for the patient to any worrying circumstances.

For senior persons, falling poses a serious health danger. If action is not taken quickly, it could result in older people losing their lives or suffering from impairments, both of which would lower their quality of life. The author of this study proposes a wearable device called Fall Detection System based on Internet of Things (FallDS-IoT) [3] to identify older people's falls in order to address this issue. To obtain precise results for fall detection, they used accelerometer and gyroscope sensors. Elderly people's everyday activities are divided into four categories: sleeping, sitting, walking, and falling. To handle the aforementioned work, they employ two well-known machine learning algorithms, the K-Nearest Neighbors (K-NN) algorithm and decision tree. Their created dataset's resulting accuracy was 90.59% and 98.75%, respectively. They were able to draw the conclusion that the K-NN method, which is employed for classification, provides more detection rate falls. Every time a fall occurs, a message notifying the fall is delivered to a contact number via a Python script.

It might be challenging to communicate with those who have vocal and hearing issues and regular people. Communication is hampered by the fact that most people cannot understand the sign language these individuals use. Paralyzed people also frequently need assistance. The author has suggested using IOT-based smart support gloves for disabled persons [4] as a solution for these people. Comparing my design to the current system, the gloves they created are incredibly straightforward yet effective. The thumb gesture is recognized by flex sensors, and the accompanying instructions are then displayed via the Android app with voice output. The wireless serial port module is used in the proposed system's communication between Arduino Uno and Raspberry Pi since it offers safe data transmission. During an emergency, a warning message will be transmitted via the GSM module.

A patient monitoring system was put in place by a researcher [5] with the intention of gathering information for scientific and clinical study. PHS will make it possible to provide preventive care more quickly and safely, at a lower total cost, with more patient-centered practice, and with greater sustainability.

Researchers created a system that tracks bodily parameters including heart rate and ECG in this paper [6]. The main interface, an ARM7LPC 2138 processor, is employed, and a graphical user interface is used to show data. A notification is sent by SMS to the mobile device if any of the parameters exceeds the typical range.

This article [7] describes an electronic device that uses wireless sensor technologies to monitor older people's health at home.

A patient monitoring device that measures the patient's Oxygen Saturation (SpO2) and Heart Rate Level has been developed by a researcher [8]. In this work, a MAX3100 sensor is used to measure Oxygen Saturation (SpO2) and Heart Rate Level, through which the data will be sent to the microcontroller ESP8266 and stored in the cloud, where the user can see it.

In this paper, a researcher [9] developed an IOT-based fall detection monitoring and alarm system for elderly people. In this work, a wearable accelerometer and gyroscope sensor called MPU6050 is used to detect falls, and the Raspberry Pi is used as a microprocessor. The data will be sent to the cloud if the sensor picks up the fall. When a fall is detected, a message is sent to the medical expert via an Android application that has been designed to see the data.

A researcher [10] developed a smart IoT assistance glove for disabled people whose purpose was to use sign language to help paralyzed patients. In this work, a flex sensor is used for finger gesture detection. Also, Arduino Uno and Raspberry Pi are used, and they are connected via wireless serial port modules. The output and audio output are displayed via an Android app. An emergency message alert system has been maintained through GSM.

2.3 Thesis Contribution:

I differ from all of these concepts, theories, paradigms, and platforms examined for this study in very fundamental and fundamentally different ways. The studies mentioned above may have used numerous monitoring variables, but my variables are more focused. However, the primary functional distinction is that I developed this project with the intention of generating a useful response and providing feedback to the host's family so that they may act swiftly to ensure the host's wellness. Email and the social networking site Twitter will be the sources of this response. But the research's fundamental thesis follows an entirely different paradigm.

Nevertheless, it is true that maintaining a user's health, predicting anomalies, and providing valuable feedback are not particularly simple processes or to enter into the framework. But this study will raise the bar for health monitoring, which is currently one of the most fascinating IoT-related issues. The practical knowledge gleaned from the research was very helpful in carrying out and providing a workable model, which will be detailed in the following section of the article. I struggled to gather useful data, but once I had it, it was correctly handled to allow the research to proceed.

The majority of the related research that has been done that is relevant to my topic was therefore emphasized in this section, and it was thoroughly stated how my research differs from existing studies. I were inspired to go above and above in this discipline by a few of those study studies that really helped us comprehend the significance of this industry. For the doctor treating the host, the platform that tracks their everyday actions would be helpful. The system's daily activity tracking will assist the doctor in quickly diagnosing the patient and coming to a decision and forecast.

Chapter-3
Methodology and Implementation

The hardware necessary for the project's implementation is covered in this chapter, along with the circuit connections and implementation-related pseudocodes.

The main function of the smart hand glove is shown in figure indicating the basic functionality.

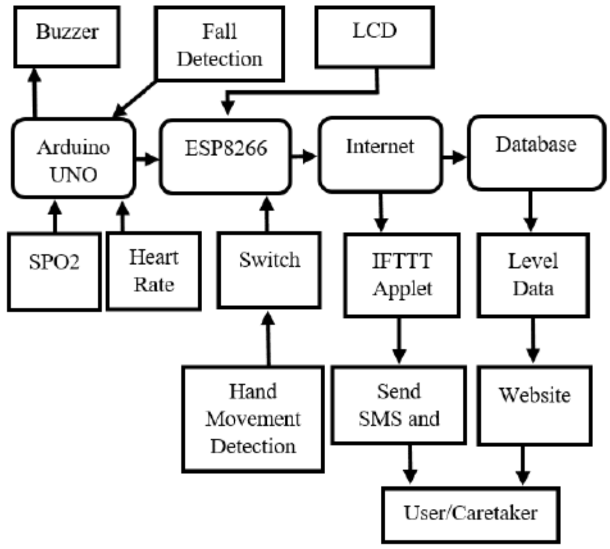


Figure : Basic block diagram of the proposed system

The function of each section is described below:

A. Fall detection

MPU6050 sensor is used for achieving this task. Both an accelerometer and a gyroscope sensor are integrated within the MPU6050 sensor module. It has a 3-axis Accelerometer and a 3-axis Gyroscope. The accelerometer gives information on the angular parameters, such as the X, Y, and Z-axis data, while the gyroscope determines orientation. A fall is detected by comparing the acceleration magnitude with the threshold value. The fall detection message from the mpu6050 sensor will go to the Arduino UNO microcontroller, which is connected to the mpu6050 sensor. This will send a request to NodeMCU ESP8266 and the message will go through NodeMCU ESP8266 to IFTTT.

IFTTT is used to send messages which is connected to the WiFi module. IFTTT means "If This Then That". It is a web-based service. This allows for the creation of a conditional statement known as an applet. Email and SMS messages will be sent to the caretaker via applet if elderly person falls for any reason. The message of fall detection will be displayed on the LCD screen, and there will be a buzzer that beeps when the old person falls.

B. Emergency message with hand gesture

The MPU6050 sensor is used to convey emergency messages by hand movement. MPU6050 is work as accelerometer sensor. The MPU6050 has an accelerometer and a gyroscope. It can measure rotation in three axes, static gravity acceleration, and motion. With the help of

mpu6050 accelerometer sensor, the old man can send four important messages by moving his hand forward, backward, right, and left. For example, moving the hand in the right direction will send the message "Need Food" and waving the hand in the left direction will send the message "Need Water". Moving the hand forward will send the message "Emergency Help Coming" and moving back will send the message "Call Attendee". If the hand is moved in any direction, it goes from mpu6050 to esp82866. The NodeMCU ESP8266 connects the microcontroller to a WiFi network, through which the message goes to the IFTTT web service. Through IFTTT, the elderly person's message will easily go to the caretaker's phone via sms and email.

C. SpO2 and heart rate monitoring

Firstly, a full spo2 and heart rate circuit is constructed. The MAX30100 sensor is utilized since it can deliver both SpO2 and heart rate data [4]. An open source programmable microcontroller board called Arduino Uno is connected to the Max3100 Sensor. The microcontroller NodeMCU ESP8266 is being used in order to connect the arduino UNO as well as collect data from the elderly patient [5]. Using the WiFi module, it can send data to the internet.

The data from the sensor can be viewed in two ways: one is through the website, and the other is in Google Sheets. The data will also be displayed on the LCD screen. This allows the caretaker to access and view the patient's previously recorded oxygen saturation (SpO2) and heart rate readings. Only the doctor, caretaker, and family member of an old person can visit the website and Google Sheet and can see on the LCD screen. With the help of this system, elderly patients' health conditions can be remotely monitored in real-time by medical caretakers.

3.1 Hardware

I need sensors to carry out this project so that I can keep an eye on the elderly and crippled population's health. To do this, i selected three different metrics to track the elderly and crippled patients. The three criteria i settled on were pulse rate, patient oxygen level, and room temperature. Therefore, i selected the following sensors based on those three criteria.

Another thing i have done is the use of hand movement communication. This will be conducted through a hand glove. The patient can send different types of messages by moving the hand right, left, forward, backward. For example: hand movement right means I need to go to the bathroom, left hand movement. It means feeling hungry etc.

3.2 Heart Rate and Oxygen Level Sensor

A low-power, plug-and-play biometric sensor with a oximeter as well as heart rate sensor, the MAX30100 is based on the I2C protocol. Students, amateurs, engineers, producers, and game and smartphone developers can all utilize it to incorporate real-time heart-rate data into their works.

Figure 1: MAX30100

On the right side of the MAX30100, there are two LEDs: one red and one infrared. On the left, there is a photodetector that is extremely sensitive. The idea is to light up only a single LED at a moment, gauge the amount of light that comes back to the detector, and then, using the signature, calculate the heart rate and blood oxygen saturation.

Requirement of Power

The MAX30100 chip requires two different supply voltages: 1.8V for the IC and 3.3V for the RED and IR LEDs. The module therefore has two voltage and 1.8V regulators. Due to this, the module can be coupled with any microcontroller that supports I/O at the 5V, 3.3V, or even 1.8V level.

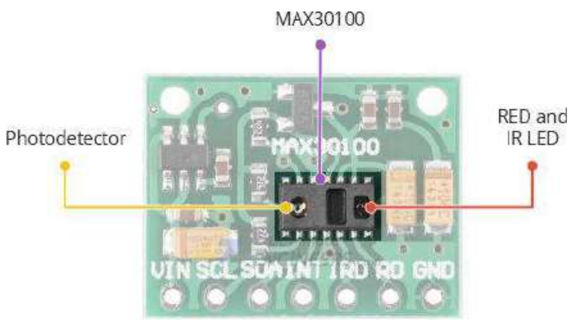


Figure 2: MAX30100 with photodetector

Low power consumption—the MAX30100 uses less than 600A while measuring—is one of the device's most significant characteristics. Additionally, the MAX30100 can be used in standby mode, which uses just 0.7 A. This low power consumption enables integration in battery-operated gadgets like mobile phones.

I2C Interface

The module and microcontroller communicate with each other using a simple two-wire I2C interface. For writing and reading activities, it has a fixed I2C address of 0xAEHEX and 0xAFHEX, respectively (for read operation).

FIFO Buffer

The FIFO buffer for storing data samples is part of the MAX30100. The 16-sample memory bank of the FIFO is capable of holding up to 16 SpO2 and heart rate readings. The FIFO buffer can spare the microcontroller from having to read each new data item from the sensor, hence lowering system power consumption.

Specifications

Table 1: Specifications of MAX30100

Power supply	**3.3Volt - 5.5Volt**
Current	**~600µA**
Wavelength of IR LED	**880nm**
Wavelength of Red LED	**660 nm**
Range of Temperature	**-40˚C to - 85˚C**
Accuracy of Temperature	**1˚C**

MAX30100 Pulse Oximeter and Heart Rate Sensor Working Principal

The MAX30100, like oximeters as well as heart rate sensors for such a matter, is made up of a pair of extremely bright LEDs (RED and IR, each with a different wavelength), as well as a photodetector. The wavelengths of these LEDs are 660 nm and 880 nm, respectively.

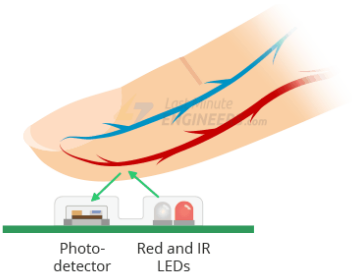


Figure 3: Photo-detector,Red and IR LEDs

The MAX30100 works by placing each lights on the fingertip or earlobe, or where the skin isn't too tight so both lights can easily penetrate the tissue, and then measuring the amount of light rebounded using a photodetector. The name of this method of pulse detection by light is photoplethysmogram. The MAX30100's function could be divided into two parts: oximetry and heart rate measurement.

Heart Rate Measurement

The arterial blood's oxygenated hemoglobin has the property of absorbing IR radiation. The more hemoglobin there is in the blood, the more IR light is absorbed. Each time your heart beats, blood is pumped through your finger, changing how much light is reflected and, consequently, the waveform at the photodetector's output.

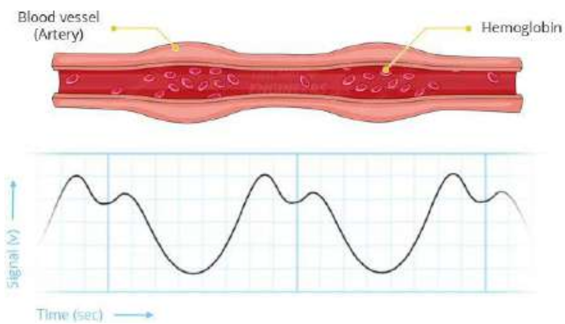


Figure 4: Heart Rate Measurement

Pulse Oximetry

The foundation of pulse oximetry is the idea that depending on the level of oxygen in blood, different amounts of RED and IR light are absorbed. The absorption spectra of hemoglobin with oxygen (HbO2) and hemoglobin with deoxygenation is shown in the accompanying chart.

MAX30100 Module Pinout

The following connections are made by the MAX30100 module.

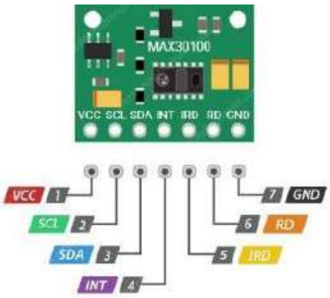


Figure 6: MAX30100 Module Pinout

GND ground.

RD pin is utilized to drive the Red LED, but it is equivalent to the IRD pin. Leave the red LED unconnected if you don't wish to operate the device yourself.

IRD An LED driver is integrated within the MAX30100 to drive LED pulses for SpO2 and HR readings. If you want to run the IR LED yourself, connect this; otherwise, leave it disconnected.

INT For each pulse, the MAX30100 can be programmed to trigger an interrupt. Due to the open-drain nature of this line, the internal resistor pulls it HIGH. The INT pin becomes low and remains low until the interrupt is cleared when an interrupt happens.

SDA is the I2C data pin; join it to the I2C data line on your Arduino.

SCL link to the I2C clock line on your Arduino using the I2C clock pin.

VIN is the pin for power. It can be connected to your Arduino's 3.3V or 5V output.

3.3 Arduino UNO

Arduino Uno is an Extended version microcontroller board . It has a reset button, a USB port, six analog inputs, an ICSP header, a power jack, and a 16 MHz ceramic resonator. There are digital pins input/output pins total, with 6 of them being PWM outputs. Everything needed to maintain the microcontroller is included; all you need to do to utilize it is plug in an AC-to-DC adapter, a battery, or connect it to a computer through USB. You can always buy a new chip and start again with your Uno if you make a mistake while messing with it, but that is quite improbable.

Figure 7: Arduino UNO

The Italian term "Uno," which means "one," represents the release of Arduino Software (IDE) 1.0. Later versions of Arduino were built on top of the Uno board and the Arduino Software version 1.0. The Uno board is the first in a series of USB Arduino boards as well as acts as the platform's benchmark. For a comprehensive list of all the other boards, both current and old or out-of-date, visit the Arduino list of boards.

3.3.1 Board Layout of Arduino UNO

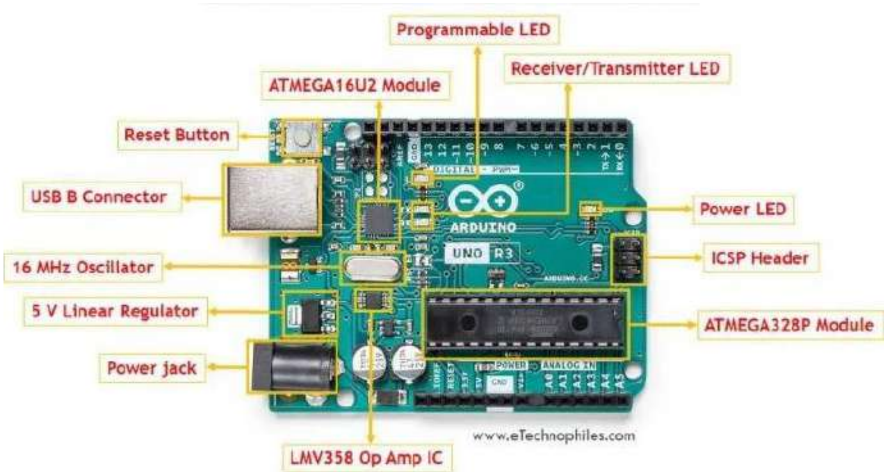


Figure 8 Layout Board of Arduino UNO

Atmega328P

A single-chip, high-performance, and effective microcontroller belonging to the megaAVR family, the ATmega328p was developed by Atmel. An 8-bit AVR RISC processor powers the microcontroller. It has 32 KB of read-write ISP flash memory, 23 general-purpose I/O pins, 2 KB of static RAM, 1 KB of EEPROM, as well as read-write capabilities.

Crystal Oscillator

The clock signal for the microcontroller is delivered by the crystal oscillator, which operates at a frequency of 16 MHz. The board receives the fundamental timing and control from it.

Voltage Regulator

The voltage regulator reduces the voltage level to 5V. The primary job of a voltage regulator is to control the reference voltage, especially in Arduino boards. Even when the incoming voltage level fluctuates, the regulator's output voltage remains constant and near to 5 volts.

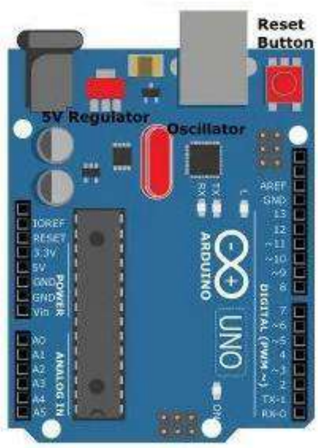


Figure 9: Regulator,Oscillator and Reset Button

Atmega 16U2

In the Arduino UNO, the Atmega 16U2 serves as either a USB to serial converter.

RESET Button

For resetting the board, use it. Every time the code is flashed to the board, it is advised to hit this button.

Barrel Jack

By using DC Power Jack and otherwise Barrel jack, an additional power source powers the Arduino board. In most cases, an adapter is attached to the barrel jack. Although the manufacturer advises maintaining it between 7 and 12 volts, the board could be powered by a converter with a 5 to 20 volt range.

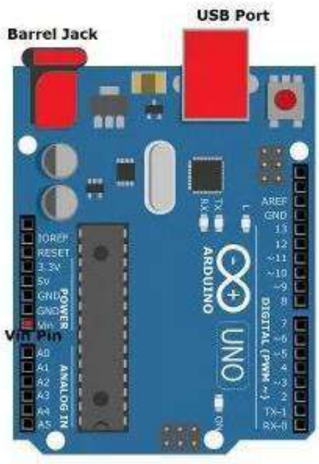


Figure 10: Barrel jack, USB port, and Vin Pin

USB Port

To connect the USB cable, use the USB interface. The 5V supply can be utilized to power the gadget through this connector. I can use it to link the board to the PC. Through a USB cable, the computer uploads the program serially to the board.

3.3.2 Arduino Uno Pin Description:

The board contains a number of Arduino Uno pins, notably I/O digital and analog pins that run on 5V. The working ratings for these pins, however, range from 20 to 40 milliamps. Internal pull-up resistors are used on the circuit board to limit current that exceeds the required operating parameters. However, a significant increase in current causes these resistors to lose their effectiveness and destroy the device.

Analog Pin:

The Arduino Uno has six analog pins that employ ADC (Analog to Digital converter). These pins have the ability to be used as digital inputs or outputs in addition to analog inputs. These pins take analog signals as inputs and produce values between 0 and 1023 as outputs .

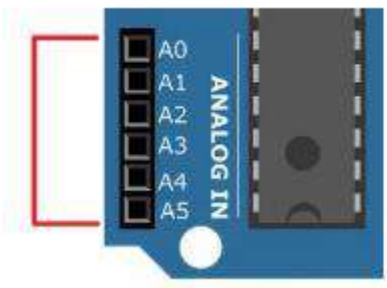


Figure 11: Analog Pin

Sampling, quantization, and digitalization are the three steps in the process of an analog to digital converter. The step size of the Arduino is 5/1023=0.00488volts or 4.88mV because it has a 0–5 volt operating range.

As a result, i can read a 4.88 mV input voltage on any of the analog pins as 1, a 9.77 mV as 2, and so on until 5 V is read as 1023. Anything with a potential difference between 4.88 mV and 4.99 mV is regarded as 0, while anything higher is regarded as 1023.

Digital Pin

Digital input/output pins on the Arduino UNO board are numbered 0 through 13.Only two states—when a voltage signal is there while there is none—can be read by an Arduino digital pin. The terms HIGH and LOW, or 1 and 0, are used to describe these states of the input, which is typically referred to as digital (or binary).

Figure 12: Digital Pin

LED – The built-in LED on the Arduino Uno is wired to pin 13 and is included with the board. You may turn it ON by giving the pin a HIGH value. It can be made OFF by specifying LOW.

Vin – That which powers the Arduino Board is known as the input voltage. Voltage is provided through this pin. Similar to a USB port, it does not supply 5 V. Through this pin, a voltage can be accessed if it is supplied by the power jack.

5V – Voltage control is a function that this board can perform. For output controlled voltage, the 5V pin is used. Three methods—USB, the board's Vin pin, or a DC power jack—are available for powering the board. While Vin and Power Jack can handle voltages ranging from 7V to 20V, USB only supports voltages around 5V.

GND - These are pins with a ground. The circuit board is equipped with many ground pins. As needed, they can be put to use.

Reset – On the board, there is a pin that restarts the software that is now running. A feature of the IDE allows for programming-based reset of the board in place in board.

IOREF – Input Output Voltage Reference has been shortened to IOV. As a voltage reference for the board, this pin is quite helpful. This pin is measured by a shield, which chooses the best power supply after that.

PWM – The following pins provide pulse width modulation: 3, 5, 6, 9, 10, and 11. These pins are set up to produce PWM with an 8-bit resolution.

SPI - Serial Peripheral Interface is the name given to it. SPI communication is provided by the SPI library using the four pins 10 (SS), 11 (MOSI), 12 (MISO), and 13 (SCK).

AREF - It goes under the name Analog Reference. This pin serves as a reference voltage source for the analog inputs.

TWI - Two-Wire Interface is the name of it. Wire Library provides access to TWI communication. For this, A4 and A5 pins are utilized.

Serial Communication – Two pins, Pin 0 (Rx) and Pin 1, are used for serial communication (Tx).

3.3.3 Arduino UNO Specification

Table 2: Arduino UNO Specification

Voltage	**5 Volt**
Voltage Limit	**6 Volt To 20 Volt**
Microcontroller	**ATmega38P – 8 bit**
Digital Iinput/Output Pins	**14**
Current on I/O Pins	**40 mA**
Memory	**32 KB**
EEPROM	**1kB**
Frequency	**16MHz**

3.3.4 Communication of Arduino Uno

The Uno R3 contains a variety of features for interacting with a computer, additional Arduino, or even other microcontrollers. On digital pins 0 (RX) & 1, the ATmega328 offers UART TTL (5V) serial connection (TX). This serial communication is routed through USB by an ATmega16U2 on the board, which to computer software acts as a virtual com port. No additional driver is required because the '16U2 firmware makes use of the built-in USB COM drivers. On Windows, a.inf file is necessary. Simple textual data can be delivered to and received as from Arduino board using the serial monitor that is part of the Arduino software.

When data is transmitted through the USB-to-serial chip and USB, the RX and TX LEDs on the circuit will flash.

3.3.5 Arduino Uno Programming

Arduino software allows for programming of the Uno R3 (download). The Tools > Board menu should be used to choose "Arduino Uno" (according to the microcontroller on board). Check out the tutorials and reference for more information.The ATmega328 in the Uno R3 is pre-burned with a loader that enables you to upload unique script to it without using a various hardware programmer. Originally designed STK500 protocol is used for communication (reference, C header files).

The firmware source code for the ATmega16U2 (or 8U2 inside the rev1 and rev2 boards) is accessible. The DFU bootloader for the ATmega16U2/8U2 can be triggered by:

- On Rev 1 boards, connect the solder jumper located behind the Italy map before resetting the 8U2.
- The 8U2/16U2 HWB line is pulled to ground by a resistor on Rev. 2 or later boards, making it simpler to enter DFU mode.

3.3.6 Features of the body

The USB connector & power jack stretch beyond the Uno PCB's maximum diameter and length of 2.7 and 2.1 inches, respectively. A top or case can be mounted to the board using the four screw holes. Please be aware that the gap across input pin 7 and 8 is 160 mil (0.16″), not an even number of the other pins' 100 mil spacing.

3.3.7 Software reset system

The Arduino Uno is made in such a way that software running on a linked computer can reset it without having a manual touch of either the reset button before the first upload. A 100 nano-farad capacitor is used to connect one of the ATmega8U2/16U2's device flow measurement lines (DTR) to the ATmega328's reset line. The reset line lowers long enough as to reset the chip whenever this line is claimed (taken low). By utilizing this feature, the Arduino software enables you to publish code by pressing down the install button in the Arduino interface. Because the lowering of DTR and the beginning of the upload can be perfectly timed, the boot-loader can now have a reduced timeout.

This configuration has additional effects. The Uno resets every whenever a link is established to it via software when it is connected to a computer running either Mac OS X or Linux (via USB). The boot-loader is active on the Uno for the next half-second or so. The application will receive the first bytes of data sent to the device after a connection is made, even though it is designed to discard invalid data (i.e., anything other than an upload of new code). Make sure the program with which it connects waits a second after initiating the contact and before delivering this data if a design running on the board takes one-time setting or other data when it initially starts.

3.3.8 Power

Arduino Uno board is being powered by an external power source or by a USB connection. Automatic selection of the source of power is made.

An AC-to-DC adapter or a battery can provide external (non-USB) power. By inserting a 2.1mm center-positive jack into the board's power jack, the adapter can be attached. The GND and Vin pin connectors of the POWER connection can accept battery leads.

The board may run on an external source ranging in voltage from 6 to 20 volts. However, if provided with less than 7V, the 5V pin may only supply less than 5 volts, which may cause the board to become unstable. Utilizing more than 12V could cause the voltage regulator to overheat and harm the circuit board. The advised range is 7 to 12V

The power pins look like this:

- Vin is the Arduino board's input voltage when it is powered externally You can access voltage through such pin if it is being supplied via the power jack or you can provide voltage through this pin.
- 5V.The regulator on the circuit outputs a controlled 5V through this pin. Power for the board can be provided by the USB connector (5V), the DC power jack (7–12V), or the board's VIN pin (7-12V). The regulator is bypassed when power is supplied via the 5V or 3.3V pins, which could harm your board. I do not recommend it.
- 3V3. a regulator on-board that produces a 3.3 volt supply. There is a 50 mA maximum current drain.
- GND. grounded pins.
- IOREF. The voltage reference that the microcontroller uses is provided via this pin on the Arduino board. When properly set up, a shield may read the voltage at the IOREF pin and either choose the proper power source or feature based converters on the outputs to operate with either 5V or 3.3V.

3.3.9 Application

Smart Homes

I may control home activities with Arduino boards by using control systems like motion sensors, outlet control, temperature sensors, compressor control, door lock control, and air control of flow, sprinklers, and material bills

Body Control

With The handSight gloves, breathalyzer microphone, heart rate monitoring system, and other body control devices using Arduino are employed in the healthcare industry using ArduinoCompared to a simple measurement, a heart rate monitor is more sophisticated.the user's heartbeat. My heart rate monitors communicate. Every buttonprovides a verbal explanation of its operation and makes the On-screen measurements are displayed. The display here will store the showing the past four values, averaging them, and providinga few motivating sayings . This sensor measures fever,detections of activity levels and patterns , as well as hypothermia.This gadget is capable of reading facial expressions.With the help of this Arduino device, i can determine my respiration rate and my depth, activity level, and level of arousal.

Traffic Signal Control

Arduino is used to operate traffic lights, as well as real-time control systems with configurable timings, pedestrian illumination, and other applications . In a traffic control system, the timing of the junctions is automatically adjusted to provide for smooth vehicle movement and minimize waiting time at junctions.

Industries

Arduino is utilized in many industries because of its user-friendly programming environment, variety of signal kinds, and simplicity of setup. When upgrading smaller legacy industrial systems with remote control and monitoring capabilities, Arduino boards provide a flexible, affordable alternative to the typical industrial gadgets. Wireless systems have become boring in my daily lives as a result of the expansion of wireless technologies like Wi-Fi and cloud services in recent years.

Defence

RADAR , an object-detection system based on radio waves, you may determine the distance, altitude, direction, and speed of objects. Radars come in a variety of sizes and with various performance requirements. It can be used for long-range surveillance, air traffic management at airports, and shipboard early-warning systems. A missile guidance system's brain is represented by this system. In times of conflict, both systems that take up many large rooms and a small number of portable radars are maintained and managed.

Medical

Heartbeats per minute are counted using an Arduino-based heartbeat monitor. An attached heartbeat sensor module detects the heartbeat when a finger is placed on the sensor in this. Numerous medical devices, including a customisable Breathalyzer, a tiny automatic foot massager, an open source EEG/ECG/EMG, a thermometer, a WI-FI body scale with an Arduino board, and others, are designed using Arduino.

Laboratories

Arduino offers a practical platform in the lab for learning and building circuits. It could be expensive for the students utilise new electronic components and there's a danger that the beginners will do something incorrectly or damage anything. No damage is done to your hardware, no money is spent on hardware, quicker circuit prototyping, and absolutely no bother with cabling are all issues that the Arduino Simulator addresses. A fairly affordable laboratory tool is a controlled slide movement microscope built on Arduino.

3.4. ESP 8266 Wi-Fi Module

Any microcontroller can connect to your WiFi network with the ESP8266 WiFi Module, a self-contained SOC with an integrated TCP/IP protocol stack. Either an application can be hosted on the ESP8266 or all WiFi networking tasks can be delegated to another application processor. Each ESP8266 module is already pre-programmed including an AT command set firmware, so all you have to do is connect it to your Arduino project to receive nearly the same amount of WiFi functionality as a WiFi Shield (and that's right out of the box). With a large and continuously expanding community, the Wifi module is a very affordable board.

Figure 13: ESP 8266 Wi-Fi Module

Through its GPIOs, this module may be coupled with sensors and other application-specific devices with a minimum of upfront development and runtime loading thanks to its robust on-board data processing capabilities. Because of its high level of on-chip integration, it only requires a small amount of external circuitry, and even the front-end module is made to take up little space on the PCB. The ESP8266 includes a self-calibrated RF enabling it to function under all operational situations and requires no external RF parts. It also offers APSD for Services and applications and Bluetooth co-existence interfaces.

3.4.1 Characteristics of ESP 8266

- It is 802.11 b/g/n protocol compatible.
- It can establish a connection to your router & function as a client, a standalone access point, or both.
- It can also be a Web Server and has an IP address.

- Two digital pins in the "standard" version can be utilized for input or output. Using LEDs or relays as an example. PWM can also be utilized with these pins. Other iterations disclose additional pins. Take the ESP-12, for instance, which is a fantastic choice if you require additional pins. The programming is the same in either case.
- Also on ESP8266 chip (ADC/TOUT), analog input is also accessible, however the ESP-01 does not have it set up.
- This can be configured to operate with an Arduino or coupled with one.

3.4.2 Operation of ESP8266

The ESP8266 WiFi Module supports three different WiFi operation modes. As follows:

- Soft AP and Station
- Station Mode
- Soft Access Point

Soft AP and Station

It is possible for the ESP8266 WiFi Module to operate in Station Mode and Soft AP Mode.Such modes of operation can all be configured using AT commands.

Station Mode

Its ESP8266 WiFi Module will also be linked to a WiFi Network in Station Mode that has previously been established by an Access Point, such as a WiFi Router.

Soft Access Point

The ESP8266 Module serves as a base station and offers a WiFi network to the other stations in this mode (mobile or laptop).Normally, a base station can connect its stations to the internet via a wired network, but since this mode lacks a wired interface, it is known as a soft access point.Before configuring the ESP Module in Station Mode, it is first set up in Soft AP mode. When the WiFi network's username (SSID) and login are unknown, this is useful.

3.4.3 Capability of ESP8266

- Wi-Fi (802.11 b/g/n, including WPA/WPA2) operating at 2.4 GHz, 16 GPIOs for general-purpose input/output, and the Inter-Integrated Circuit (I2C) serial communication protocol
- Digitalization of analog data (10-bit ADC)
- Serial Peripheral Interface (SPI) synchronous serial protocol

- DMA (Direct Memory Access) and I2S (Inter-IC Sound) interface (sharing pins with GPIO),
- UART (on specialized pins, in addition to a transmit-only UART that can be configured on GPIO2), and
- PM (pulse-width modulation) (PWM).

It uses a Tensilica Xtensa L106-based 32-bit RISC CPU operating at 80 MHz (to 160 MHz). A 64 KB booting ROM, 64 KB guidance RAM, and 96 KB data RAM are all included. SPI enables access to external flash memory.For end-point Internet of Things advancements, the ESP8266 module is a low-cost standalone wireless transceiver.

Microcontroller needs to employ a certain set of AT instructions in order to connect with the ESP8266 module. Utilizing a UART with a predetermined Baud rate, the microcontroller talks with the ESP8266-01 module.

3.4.4 Operating System of ESP8266

It can be operated in various ways.Be careful while designing circuits because the ESP8266 module can only operate at 3.3V; at 3.7V or more, the module would be destroyed. Using an FTDI board that enables 3.3V programming is the ideal method for programming an ESP-01. It is advised to purchase one if you don't already have one, though you might temporarily utilize an Arduino board. The ESP-01's powering up issue is a typical issue that everyone has. Because the module requires some power while being programmed, you can use an Arduino 3.3V pin to supply power to it, or you can simply choose a potential divider.

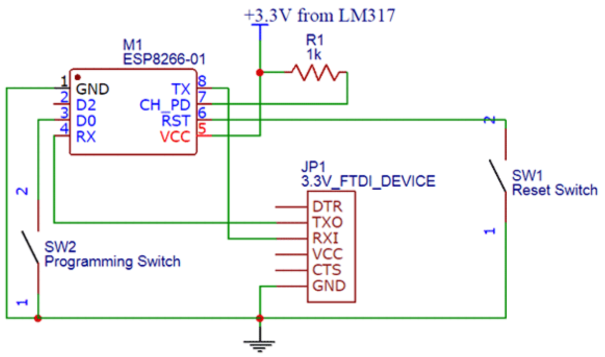


Figure 14: Circuit Diagram of ESP8266

3.4.5 Application of ESP8266

The ESP8266 is a very user friendly and low cost device to provide internet connectivity to your projects. The module can work both as a Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making Internet of Things as easy as possible. It can also fetch data from internet using API's hence your project could access any information that is available in the internet, thus making it smarter. The fact that this module can be controlled using the Arduino IDE, which greatly improves its use, is another intriguing aspect. However, this version of the module only has 2 GPIO pins (you may hack it to utilize up to 4), thus you must use it in conjunction with some other microcontroller like Arduino; alternatively, you can check into the more independent ESP-12 or ESP-32 variants. So, whether you're seeking for a component to be get began with IOT or to give your project internet connectivity, this module is the best option.

3.5. MPU-6050

The MPU-6050 components are the first MotionTracking devices in the world developed for both the low power, low cost, and high performance needs of mobile devices like smartphones and tablets as well as wearable sensors.The MPU-6050 includes InvenSense's MotionFusionTM and run-time calibration firmware, allowing manufacturers to do away with the time-consuming and expensive choice, credential, and control system integration of various measures in motion-enabled products while still ensuring that sensor fusion methods and calibration processes provide the best performance for customers.

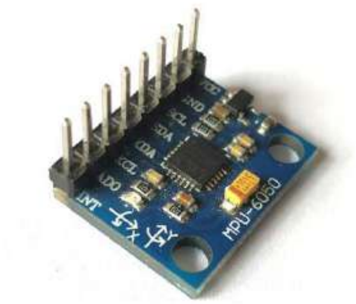


Figure 15: MPU-6050

The MPU-6050 devices feature a 3-axis gyroscope, 3-axis accelerometer, and an inbuilt Digital Motion ProcessorTM (DMPTM), which handles intricate 6-axis MotionFusion algorithms. Through the use of an auxiliary master I2C bus, the device is able to connect to additional magnetometers or other sensors, enabling the devices to collect the entire range of sensor data without the need for the system processor's assistance. A QFN packaging of 4 mm x 4 mm x 0.9 mm is available for the devices.

Figure 16: Diagram of MPU-6050

The MPU-6050's included InvenSense MotionAppsTM Platform simplifies sensor control from the operating system and delivers a systematic set of APIs for developing applications while abstracting motion-based complexity.

A user-programmable gyro with a full-scale range of 250, 500, 1000, and 2000 °/sec (dps) and an accelerometer with a full-scale range of 2 g, 4 g, 8 g, and 16 g are also included in the parts for precise tracking both of fast and slow motions. An on-chip oscillator with a 1% fluctuation over the working temperature range and an incorporated temperature sensor are further features.

3.5.1 Hardware Specification of MPU-6050

A low-cost, 6-axis MotionTracking chip with a 3-axis gyroscope, 3-axis accelerometer, and then a Digital Motion Processor (DMP) lies at the core of the module. It measures just 4mm by 4mm.

The static acceleration brought on by gravity, and the dynamic acceleration brought on by motion, shock, or vibration, can all be measured. It can also detect angular momentum or rotation across all three axes.

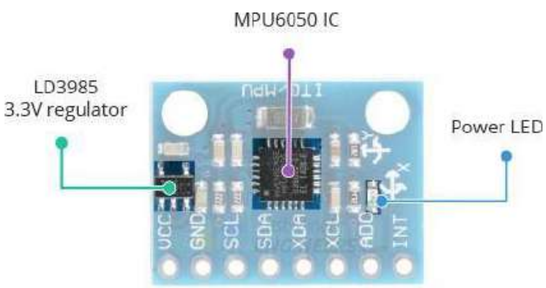


Figure 17: MPU6050 IC, Power Led, LD3985

Since the module has a built-in LD3985 3.3V regulator, you can use it without issue with such a 5V logic microcontroller such as the Arduino.The MPU6050 uses only 5 mA when it is idle and less than 3.6 mA when performing measurements.

The implementation in battery-operated devices is made possible by this low power consumption.The module also features a power LED, which illuminates whenever the module is activated.

3.5.2 Acceleration Measurement

With four configurable huge scale ranges of 2 g, 4 g, 8 g, and 16 g, the MPU6050's on-chip accelerometer can monitor acceleration. The MPU6050 includes three 16-bit analog-to-digital processors that sample all three movement axes simultaneously (along X, Y and Z axis).

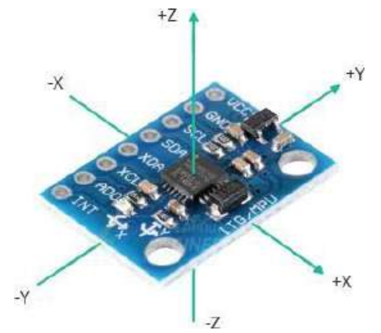


Figure 18: Acceleration Measurement

3.5.3 Rotation Measurement

With four configurable full scale ranges of 250°/s, 500°/s, 1000°/s, and 2000°/s, the MPU6050's on-chip gyroscope can measure angular rotation.

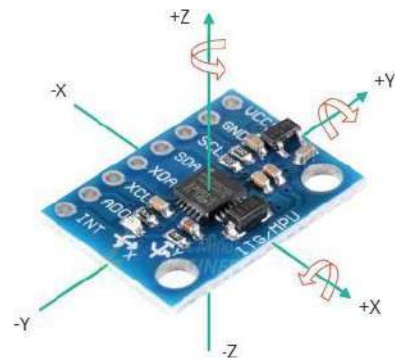


Figure 19: Rotation Measurement

Three more 16-bit analog-to-digital processors that sample three rotational axes simultaneously are part of the MPU6050 (around X, Y and Z axis). From 3.9 to 8000 fragments per second can be selected as the sampling rate.

3.5.4 Temperature Measurement

A temperature sensor built inside the MPU6050 can monitor temperatures with an accuracy of 1°C from -40 to 85°C.

Please take note that the temperature being measured corresponds to the silicon die itself, not the surrounding air. Instead of measuring absolute temperatures, such measures are frequently used to correct for accelerometer and gyroscope calibration or to detect temperature variations.

3.5.5 I2C Interface

For connection with the Arduino, the module use the I2C interface. The I2C addresses 0x68HEX and 0x69HEX are supported separately. In to prevent addressing collisions with some other equipment on the bus or to use two MPU6050s on the same bus, this is necessary.

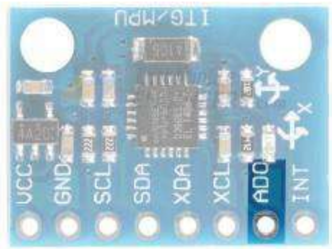


Figure 20: Address Selection Section of I2C

I2C address of something like the module is determined by the ADO pin. A 4.7K pull-down resistor is already present on this pin. As a result, the ADO pin's usual I2C address is 0x68HEX while it is unconnected, and it changes to 0x69HEX when it is connected to 3.3 V since the line is pulled HIGH.

3.5.6 Specification

Table 3: Specification of MPU-6050

Voltage	(2.3–3.4)V
Accelerometer Measuring ranges	±2 g ±4 g ±8 g ±16 g
Gyroscope Measuring ranges	±250/500/1000/2000 °/sar
Calibration tolerance	±3%
Temperature	-40 °C to +85 °C
Dimensions	25.5 × 15.2 × 2.48 mm

3.5.7 Additional Sensors

The MPU6050 module offers a function for connecting external sensors, which raises the level of precision even further. The additional I2C bus (XDA and XCL), which itself is fully independent of the primary I2C bus, is used to link these external sensors to the MPU6050.

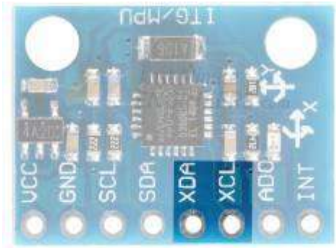


Figure 21: Additional Sensors Pin

A magnetometer that can detect magnetic fields over three axes is typically attached using this external connection. The MPU6050 has six Degrees of Freedom (DOF), 3 for such accelerometer and three for the gyroscope combined. A magnetometer increases the sensor's DOF by three, bringing its total DOF to nine.

3.5.8 Arduino Interfacing MPU6050

The values that can be retrieved while using module are shown below. The corresponding data parameters can be determined using the example given in the graphic.w, x, y, and z are the quaternion components. Euler angles, Yaw, Pitch, Real world Acceleration, Roll, World framework Acceleration, and Teapot invent sense Values are also included.

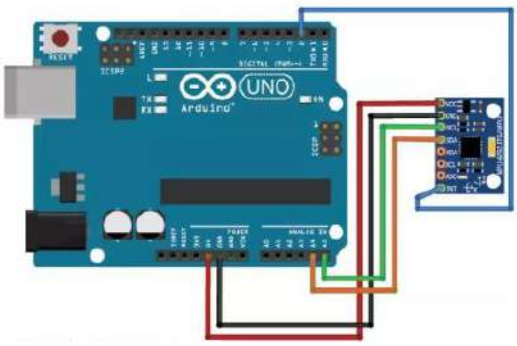


Figure 22: Arduino Interfacing of MPU6050

3.5.9 MPU6050 Pinout With Description

Table 4: MPU6050 Pinout With Description

Pin No	Pin Name	Description
1	Vcc	For supply voltage, utilize this pin. From +3 to +5V is the input voltage.
2	GND	Use of this pin for ground is
3	SCL	This pin is utilized for the I2C protocol's clock pulse.
4	SDA	The I2C protocol is used to transport data using this pin.
5	XDA	It is possible to connect a different I2C module to the MPU6050.
6	XCL	Additionally, it can be used to interface MPU6050 with other I2C modules.
7	AD0	This pin is able to change the address when using multiple MPU6050s on a single MCU.
8	Int	This pin serves as a signal that the MCU can read available data.

3.5.10 Features

- The world's initial complete six motion tracking system is called PU6050.
- It is made up of such a digital motion processor, with a lot of processing capability.
- The temperature sensor already has it.
- Its dimensions are 21.2mm (0.84") in length, 16.4mm (0.65") in width, and 3.3mm (0.13") in height (without pins).
- It is 2.1g in weight.
- It boasts the shortest and thinnest QFN packaging (4x4x0.9 mm) for portable devices.
- When both the DMP and its six motion sensor axes are moving, its working current is 3.9 mA.
- It also includes a gyroscope, with an operational current of 3.6 mA.
- Gyroscopic stand-by current for it is 5 A. It also performs better in low-frequency noise environments.
- It functions within the gyroscope range of 250 500 1000 2000 °/ s.
- It can be utilized as an interface for IIC equipment like magnetometers.
- Its pins are 0.1 inches apart.
- Its accelerating range is between -2, 4, 8, and 16 g.
- It uses the I2C protocol as its primary means of communication.
- It has a built-in 16 BIT ADC that offers exceptional accuracy.

3.5.11 Application

- It can function as a rotation or orientation detector.
- In handheld and portable gaming, it is possible.
- InMotion-based game controllers were utilized.
- It is utilized for 3D remote controls with Internet-connected set-top boxes and DTVs as well as 3D mice.
- For IMU measurement, it is employed.
- It's being used as a controller for direction in drones and quadcopters.
- In self-balancing robots, it is used.
- You could use it to control a robotic arm.
- It can be applied to human-like robots.
- In tilt sensors, it is employed.

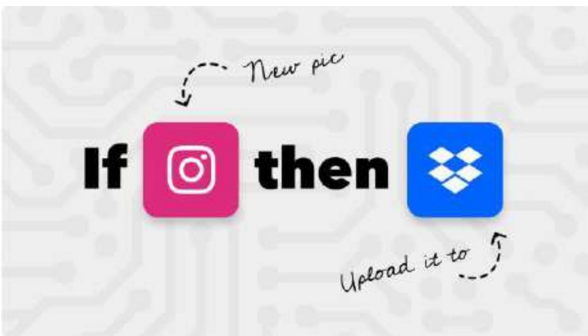
3.6. IFTTT

The greatest method to link applications, gadgets, and services is through IFTTT, which stands for If This Then That. I support the integration of new and potent services, apps, and gadgets.

Everything works better together, according to the philosophy of IFTTT. For anybody attempting to design a smart home or establish regular routines in their life, tech compatibility has become a challenge. With IFTTT, it's simple.

3.6.1 Working of IFTTT

Simply told, IFTTT is capable of anything. Using the weather to gauge the temperature inside house, turning on security system when you depart, and using your speech to turn on a gadget are some of my most well-liked smart home Applets. The most popular social media Applets may cross-post information for you and streamline online approach.



3.6.2 Applets

Applets connect two or even more applications or gadgets that would otherwise stay separate using a script that is customisable. An Applet accomplishes a task that none of the connected applications or devices can do alone by allowing this virtual link.The digital world is connected with IFTTT. Thousands of products, platforms, and apps are connected in ways that wouldn't be possible without IFTTT. Applet technology is the cornerstone of this connection. The network of links that makes up the IFTTT cosmos is held together by applets.

For instance, a music player on an Android smartphone does not always instantly connect to a Google Home device that is close by. However, a voice command may be used to control the Google Home device to play music from the smartphone using an Applet. Finding a missing phone usually isn't of much use with a Google Home device. However, a user may request their Google Home via an Applet to locate their smartphone, and the gadget will ring the missing phone at 100% volume and do so.

3.6.3 Working of Applets

IFTTT, which stands for "if this, then that," is an acronym. "Conditional statements" are a term used in computer science to describe programming constructs in which the outcome of one action depends on the outcome of a different action. The collection of programming code that makes up an Applet is a statement with a condition: if (and only if) x occurs, then y follows.Triggers and actions are the building blocks of applets. A run of an Applet produces actions as the result of the triggers that instruct it to begin. Triggers and the activities they start existing within several, independent programs or devices, which demonstrates the connective potential of applets.

3.7. Methodology of Hardware

3.7.1 Fall Detection

The MPU6050 sensor was used to construct a fall detector for the elderly in this study, along with a notification system that sends a brief message to let people know when someone falls or gets up after falling. The user's relative location can be determined using the MPU 6050 sensor, which is also utilized to determine the user's kind of movement. Three categories—light movements, strong movements, and falling movements—are used to categorize these motions. Small motions, standing up, or sitting down are considered light movements, but walking and jogging are considered heavy movements. Based on the angle information produced by the gyroscope integrated within the MPU6050 sensor, each user's movement may be categorised. For 0.1 seconds, angle data was gathered to determine the user's movement type. The fall detector prototype is mounted on a belt at a height of approximately 88.5 cm from the ground, and the length of the chair being utilized for seating movement is approximately 44.5 cm. A buzzer sound and a brief message alert will be delivered as messages on mobile devices or through email in response to movement that the sensor has identified.

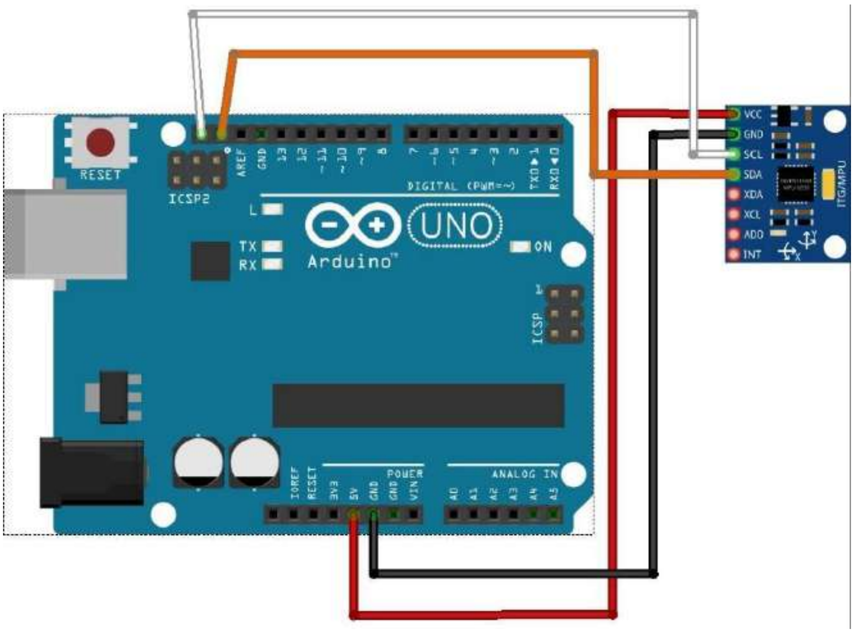


Figure: Arduino UNO with MPU6050

3.7.2 Hand Movement

Gloves can process sensor inputs and transform it into sign language in the form of message to improve communication. They are created using sensors and electronics to execute the duty of interpreting gesture sign language. The information can then be used to create an algorithm that converts sign language indications from gesture to text.

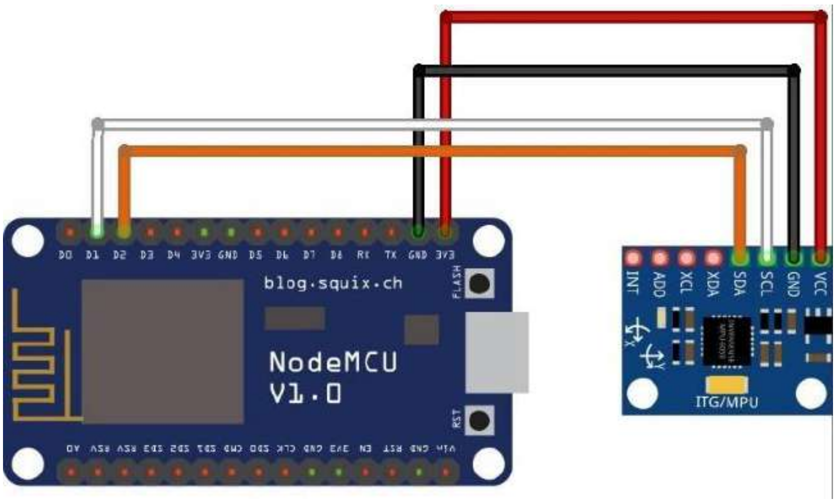


Figure: ESP8266 with MPU6050

The development of a hardware glove system that combines sensors and sensors MPU6050 with an Arduino microcontroller for processing and monitoring sensor output values through email, message, or website. The MPU6050 is a 3-axis accelerometer and 3-axis gyroscope, or more precisely, the module based on it is. The traditional gyroscope functions similarly to a toy whip. Everyone is familiar with it and its effects from childhood. The theory behind how an accelerometer operates is the same. The gyroscope detects motion about the axes, whereas the accelerometer senses acceleration in the x, y, and z directions. The gyroscope outputs 0 for x, y, and z when the module is in the idle mode. While at rest, the acceleration sensor, on the other hand, may detect the acceleration brought on by gravity (in the z-direction when the module is flat). By moving the hand in three different axes, three messages will be sent to the host, such as "need food," " need to use the washroom," and so on.

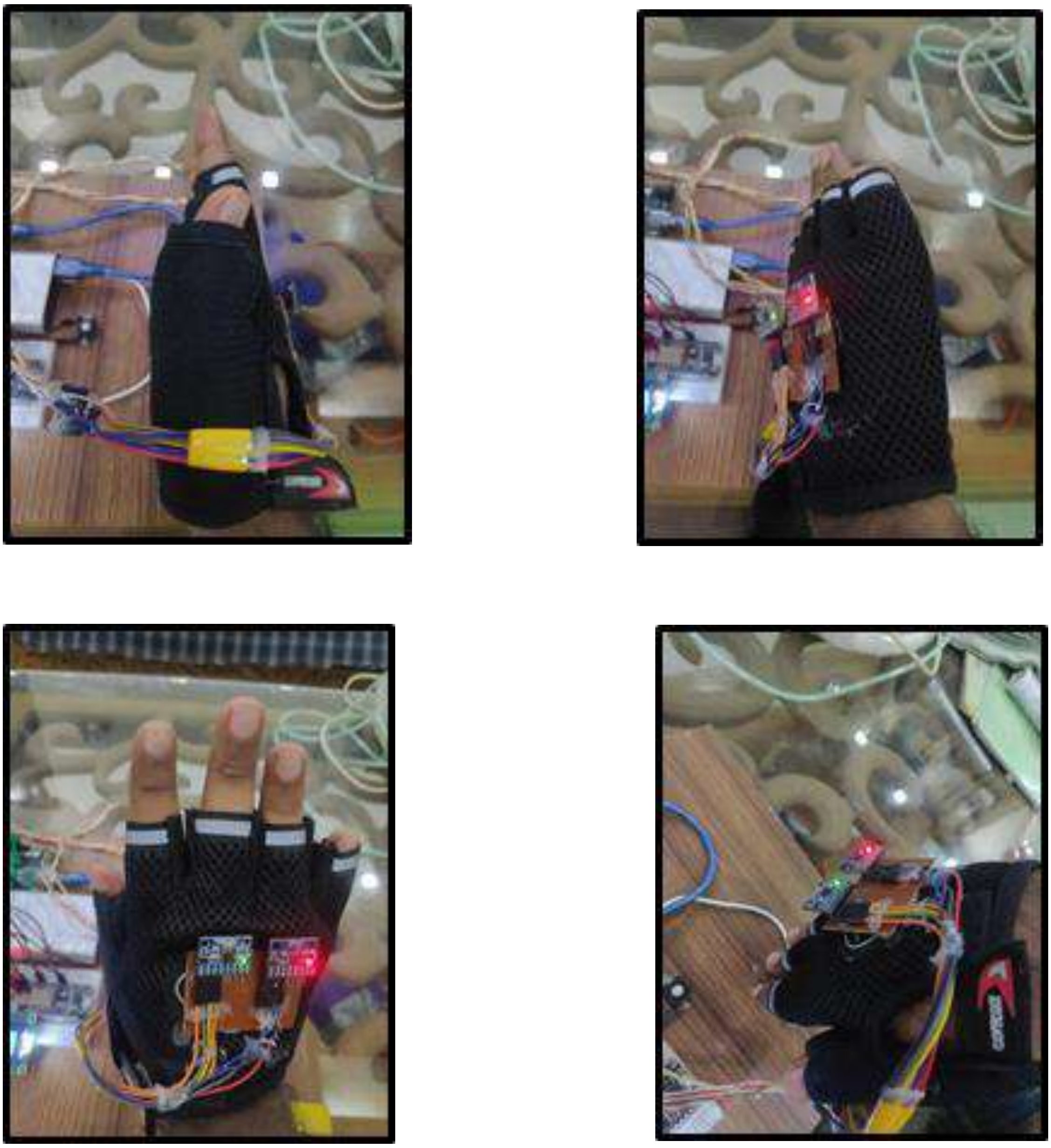


Figure : Moving the hand in four different directions with smart glove

3.7.3 Monitoring Heart Rate and Oxygen Level

The sensor, designated as MAX 3100, is in charge of measuring and sensing the blood's oxygen content as well as the rate of heartbeat.

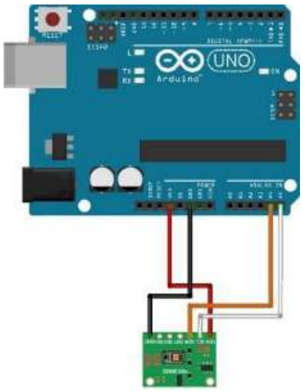


Figure: Arduino With Max3100

In this project, i'll use an Arduino UNO board and the MAX30100 Pulse Oximeter to build a device that can test blood oxygen levels and heart rate. Heartbeat/Pulse Rate is measured in BPM, while Blood Oxygen Concentration, or SpO2, is recorded in percentage. The MAX30100 is a sensor system for pulse oximetry and heart rate monitoring. Use MAX30102 instead, which is an improved version of MAX30100.The SpO2 and BPM values will be shown on an LED display. The display value on the LED screen is altered with each beat. Using this, i am able to wirelessly communicate data to the Mobile sms or email or website, monitor that data there, and preserve a text-based record of the data as well. So, i can transmit the information retrieved from the device to another device or the Internet. The patient can use this wearable glove to continuously track their heart rate and blood oxygen levels throughout the day.

3.7.4 ESP8266

In this Project, ESP8266 connect the microcontroller Arduino UNO with the WiFi.

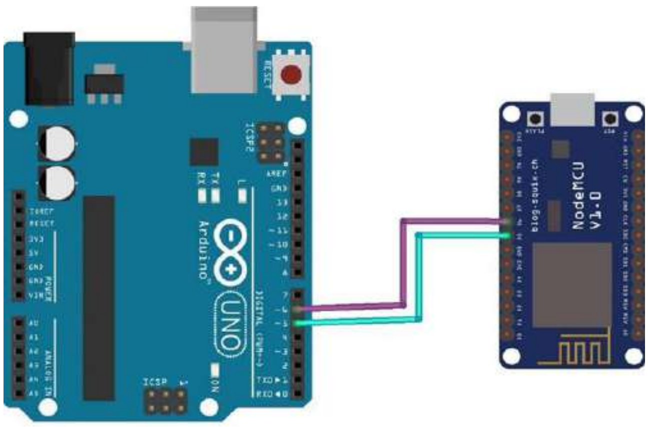


Figure: Arduino UNO with ESP8266 Serial Communication

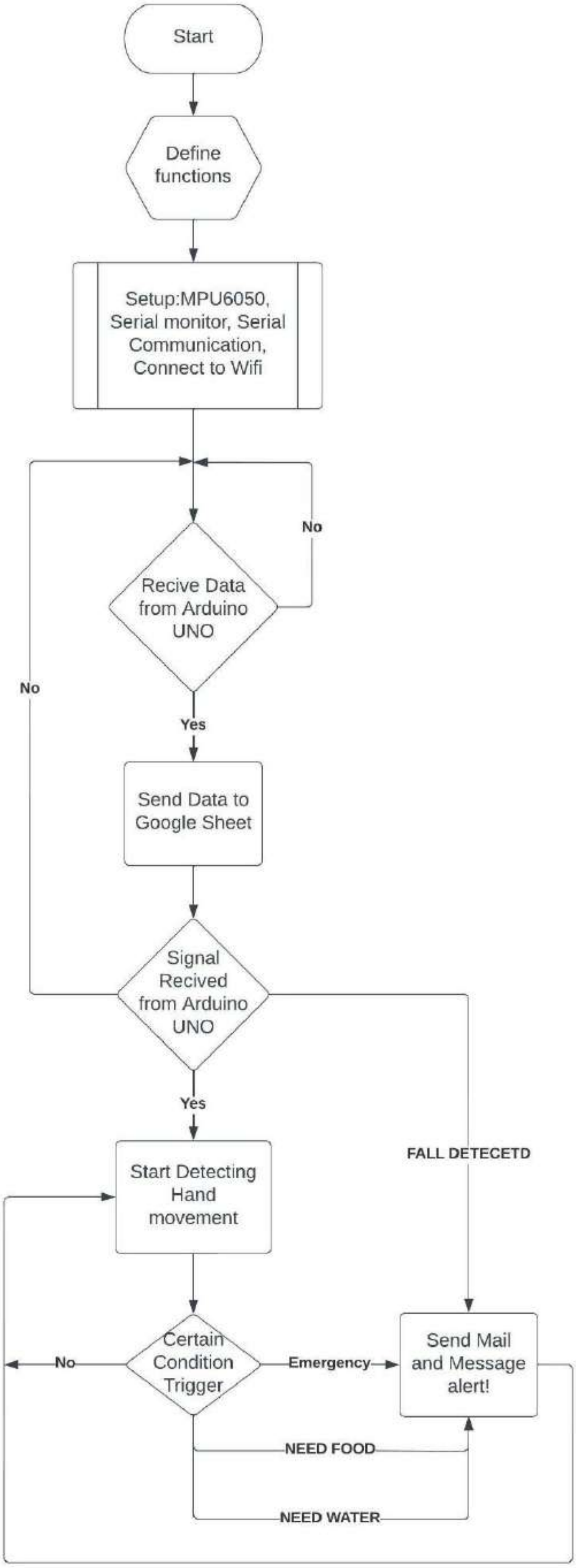


Figure: Algorithm of ESP8226

3.8. Methodology of Software

3.8.1 Fritzing

I have used Fritzing for my circuit designing. An open-source hardware project called Fritzing makes electronics available to anyone as a creative medium. They promote a creative ecosystem by providing a software package, a public website, and services in the style of Processing and Arduino. These tools allow users to describe their experiments, publish them with everyone, instruct electronics in a lesson, and layout and create expert PCBs.A designer, artist, researcher, or enthusiast can use the software to record their Arduino-based prototype and generate a PCB layout for manufacturing. It was developed with motivation from the Processing Computer programming language as well as the Arduino microcontroller.

3.8.2 IFTTT Applet

IFTTT Applet is an automation, integration, or link between two services that allow to carry out tasks that neither service could carry out independently. I have used IFTTT Applet to send messages by email and mobile phone.

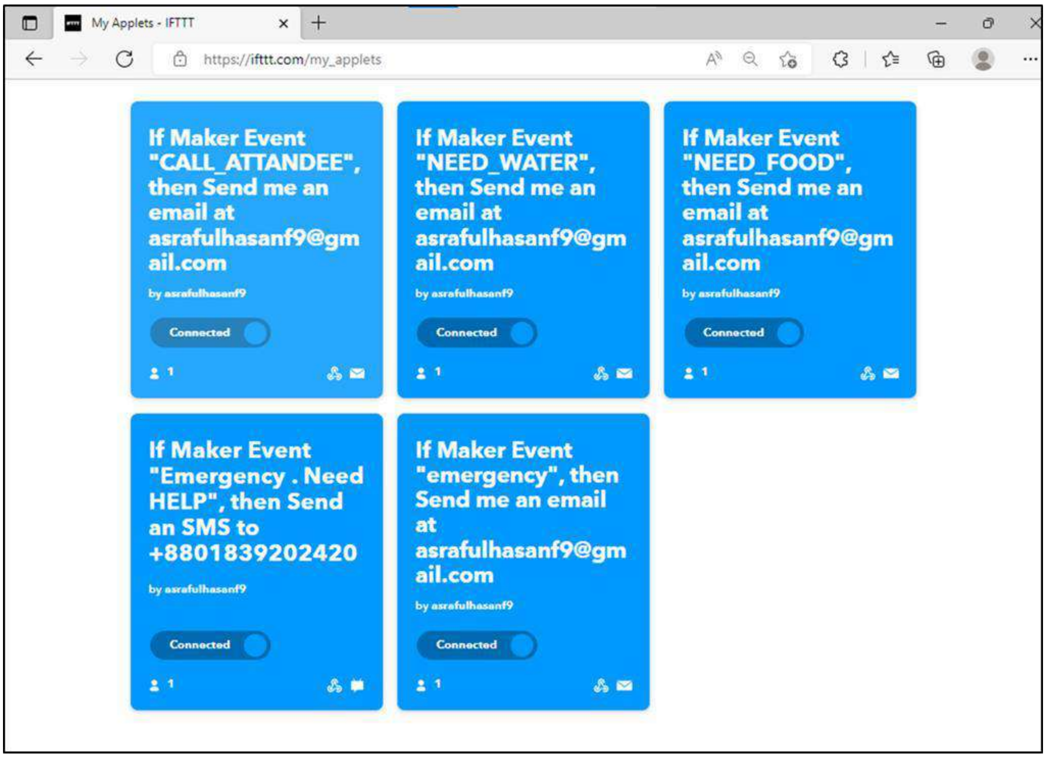


Figure: Sending Email alert by using IFTTT Applet

3.8.4 Google Sheet

Google Sheet can store data for various need. I have utilized Google Sheet for storing data.

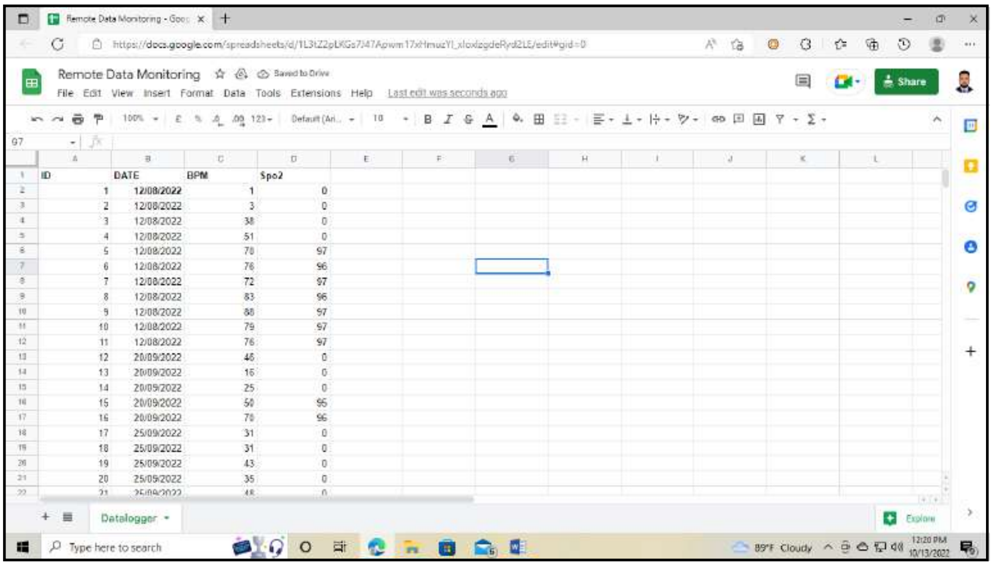


Figure: Storing data for Heart Rate and Oxygen Level by using Google Sheet

3.8.4 Arduino IDE

The open-source software known as the Arduino IDE is used to create and upload code to Arduino boards. For different operating systems, including Windows, Mac OS X, and Linux, the IDE program is appropriate. The programming languages C and C++ are supported.

Figure: Arduino IDE Interface

3.9. Arduino UNO Algorithm

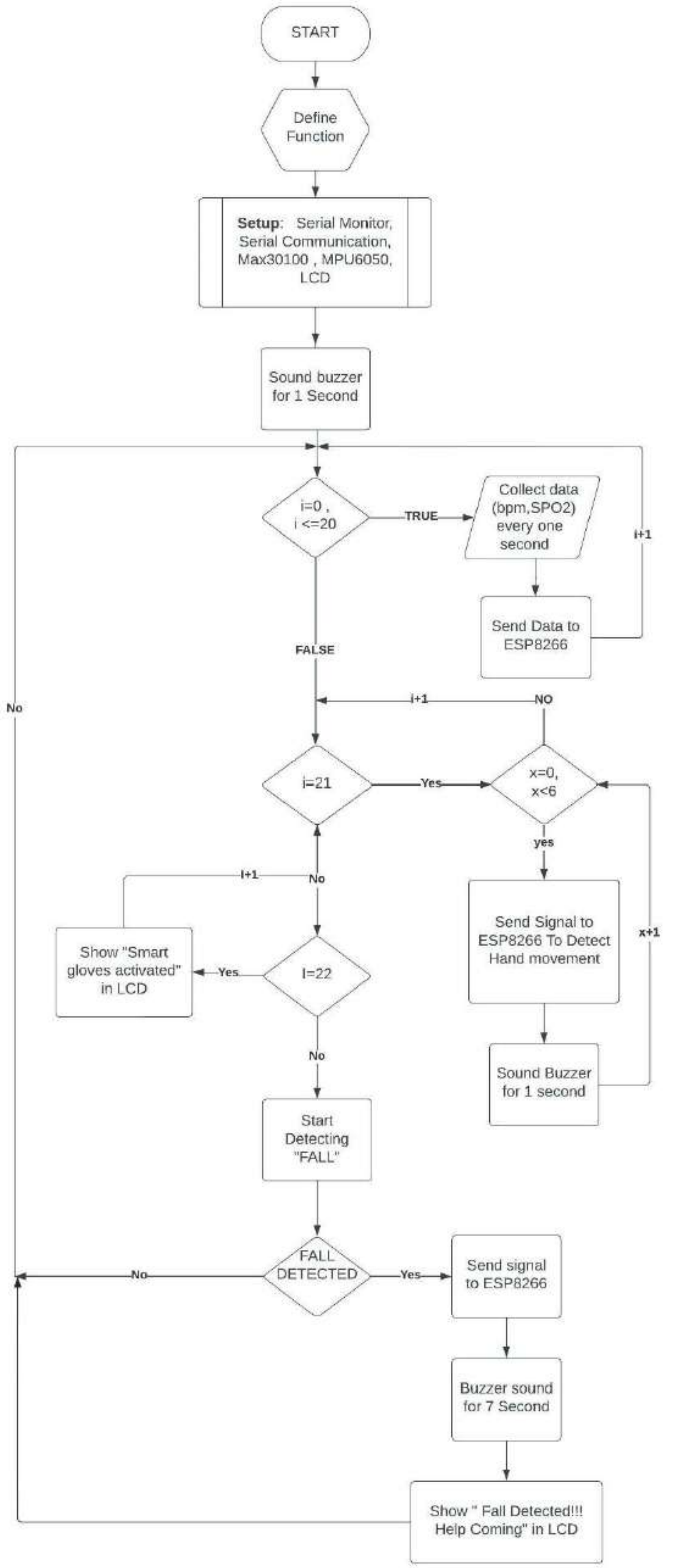


Figure: Arduino UNO Algorithm

3.10. Complete Algorithm of the Project

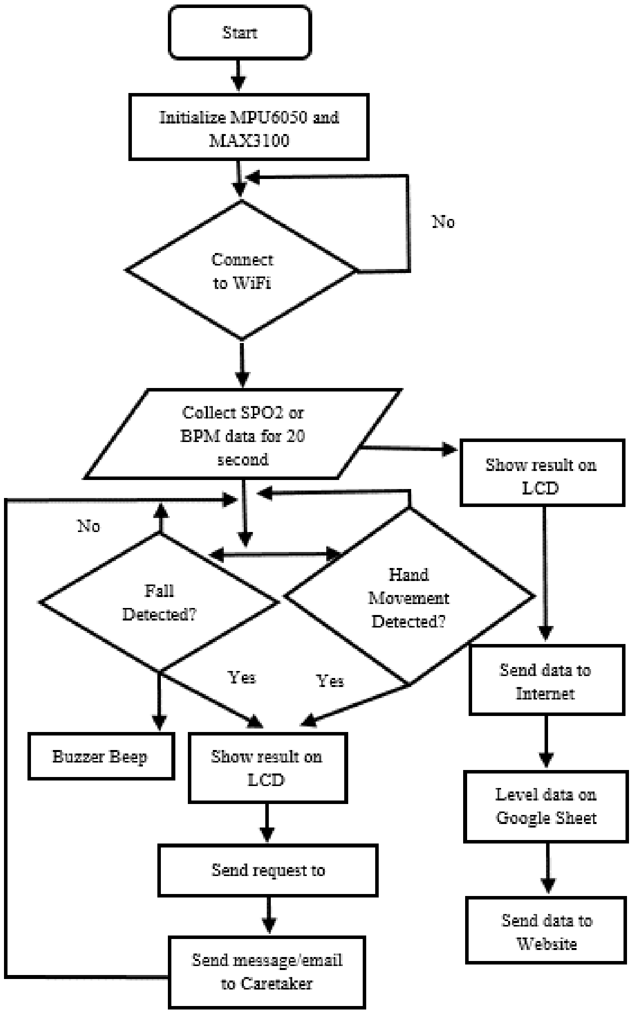


Figure: Complete Algorithm of the Project

There are three sections to this research. The first ones are oxygen saturation (SpO2) and Heart Rate level monitoring.The second one is fall detection, and the third one is sending messages with hand gestures. The Arduino Uno microcontroller connects to the WiFi network using the hand glove's input data, and from there, it sends the information straight to the caretaker via email and SMS. It also shows the results on LCD.

3.11. Full Circuit Diagram of the Project

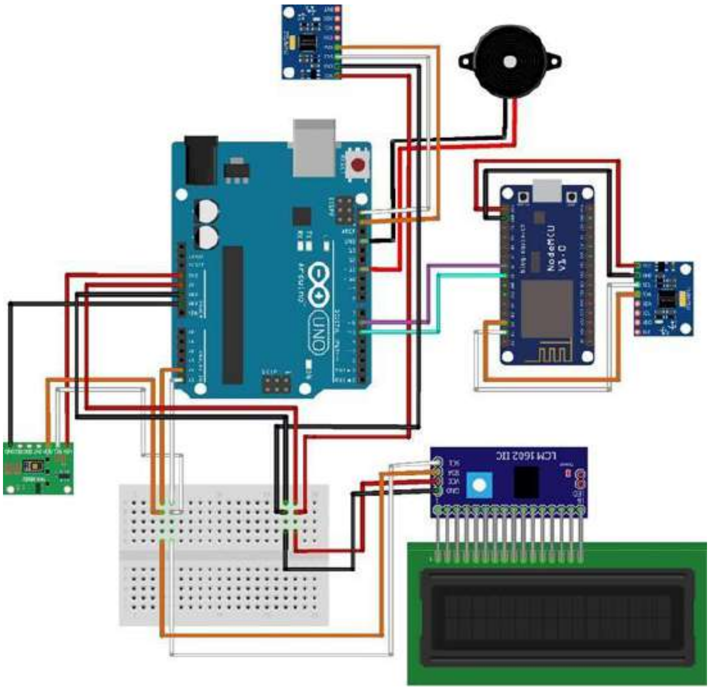


Figure: Full Circuit Diagram of the Project

Hardware Setup:

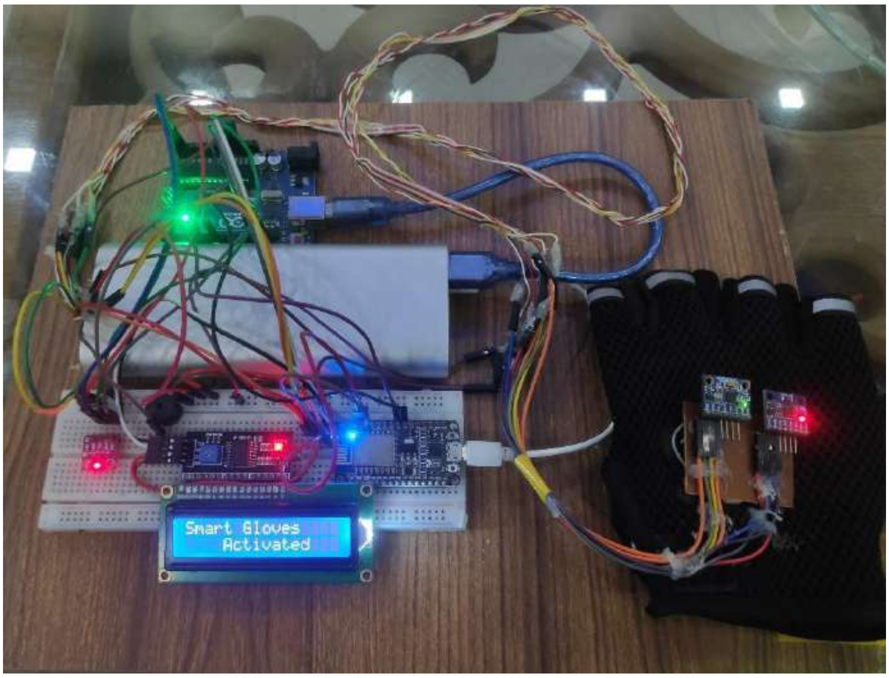


Figure: Total system model

Chapter 4
Result and Discussion

In this chapter, how the result is displayed after code implementation is described. By using the IFTTT Applet data was received from sensors and then it was shown on the LCD Display, email and text.

4. Result Display

In this part, i will show bit per minute (bpm), oxygen saturation level (SpO2), fall detection and also show on the LCD display and in email and text.

4.1 Output of Heart rate and oxygen saturation (SpO2)

4.1.1 On LCD

On the LCD, Figure displays real-time monitoring information for heart rate and oxygen saturation (SpO2).

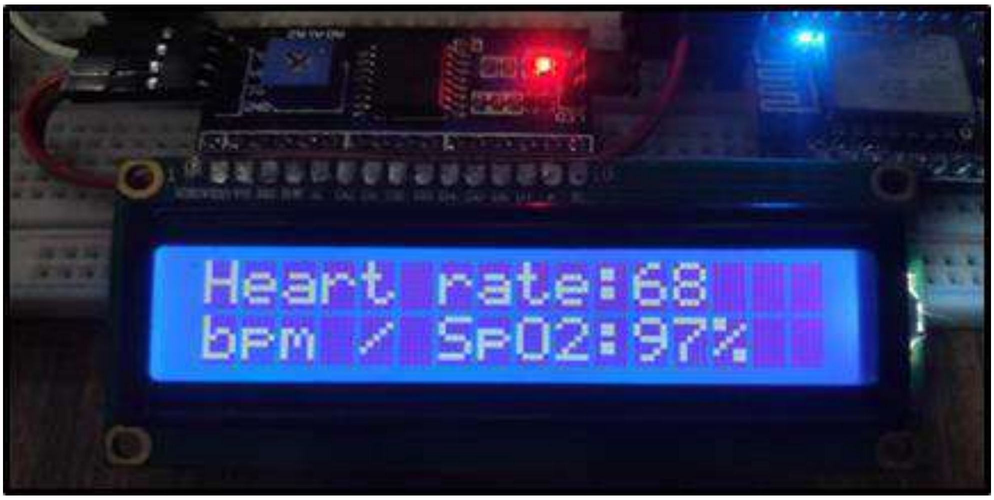


Figure : Heart rate and oxygen saturation (SpO2)

4.1.2 On Website

The data for heart rate and oxygen saturation (SpO2) from the website is displayed in Figure .

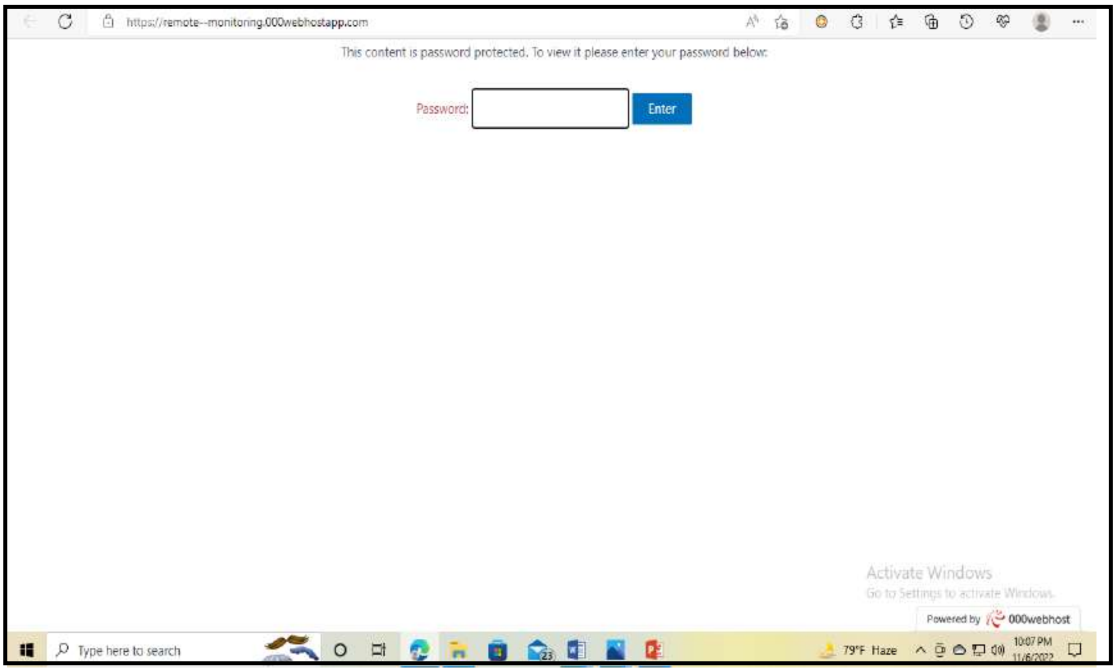


Figure :Password protected Login page of the website

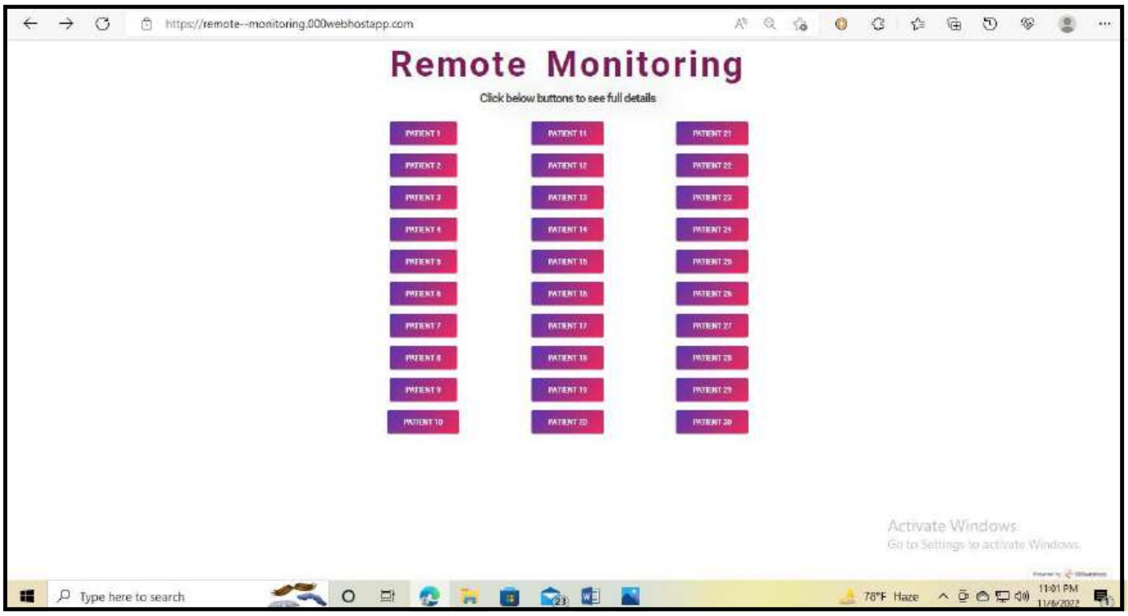


Figure : Patients dashboard on website

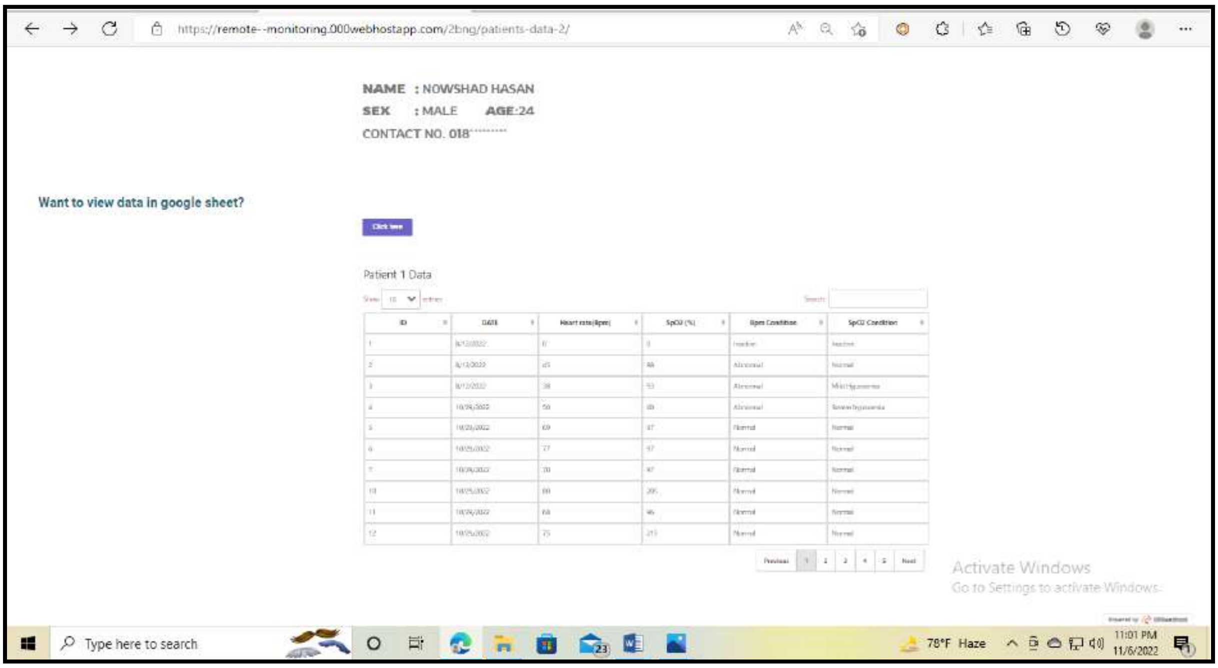


Figure : A patient's heart rate and oxygen saturation (SpO2) information for the entire month

4.1.3 On Google Sheet

The data for heart rate and oxygen saturation (SpO2) from the Google Sheet is displayed in Figure .

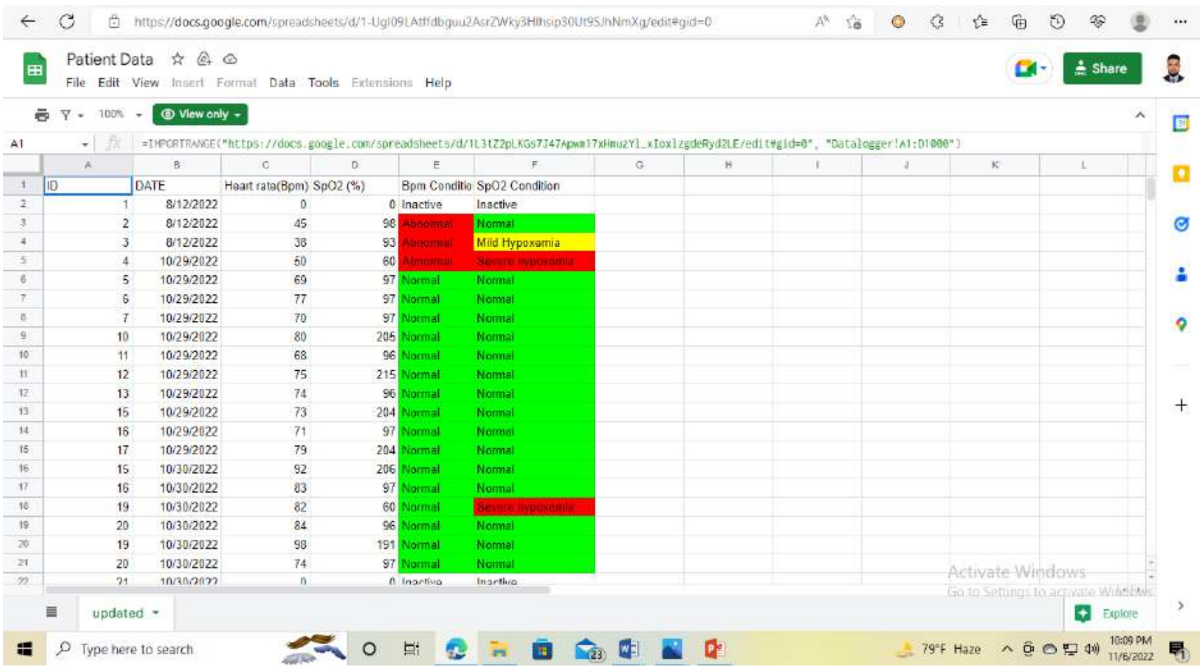


Figure: Heart rate and oxygen saturation (SpO2) information on a Google Sheet with Data Validation

4.1.4 BPM Graph

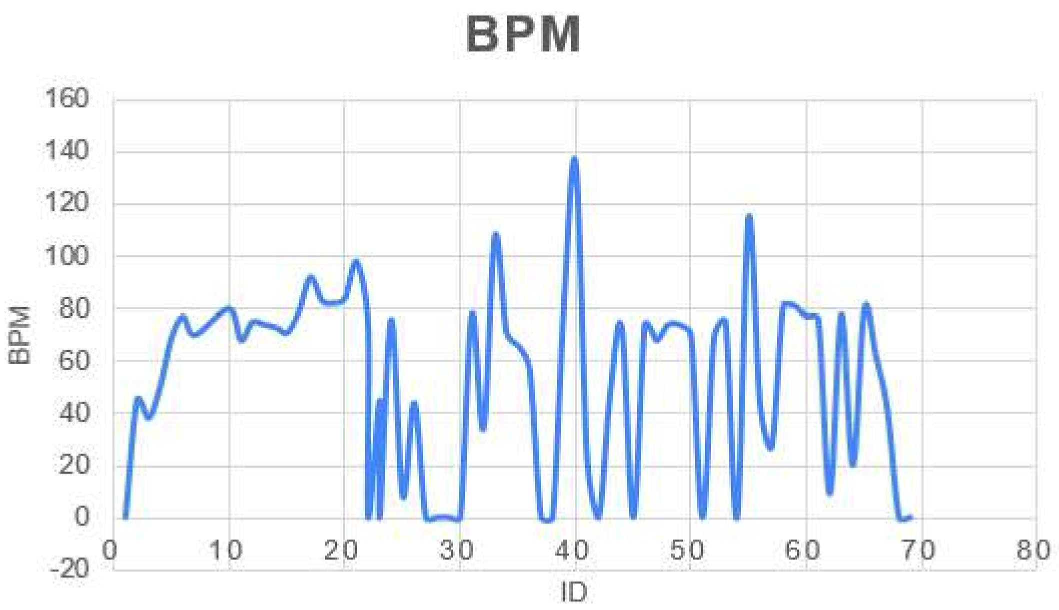


Figure: BPM Graph

4.1.5 Oxygen Level Graph

Figure: Oxygen Level Graph

4.1.6 Data collection and validation

The MAX30100 sensor offers a set of SpO2 data that is made up of IR and RED LED data. The Photoplethysmography (PPG) signal refers to these data. The datasheet that came with this sensor includes references for healthy and unhealthy ranges [20]. The information gathered will be used as a basis for datasheet references and health regulations [21]. The range of SpO2 and heart rate conditions based on health regulations are shown in Tables I and II.

TABLE I. LEVEL OF SPO2 CONDITION

SpO2 reading (%)	Level
>=94	Normal
91 – 94	Mild hypoxemia*
86 – 90	Moderate hypoxemia*
< 86	Severe hypoxemia*

* Hypoxemia is defined as decreased partial pressure in blood and oxygen available to the body or an individual tissue or organ.

TABLE II. LEVEL OF HEART RATE CONDITION

Heart rate (bpm)	Condition
> 99	Abnormal
60 – 99	Normal
< 60	Abnormal

4.2 Output of Emergency message with hand gesture

Figure 8 shows the LCD output of gesturing the hand in four different directions to deliver an emergency message.

Figure 8(a): The "Need Water" message is displayed as the hand moves to the left side.

Figure 8(b): The "Need Food" message is displayed as the hand moves to the right side.

Figure 8(c): The "Call Attendee" message is displayed as the hand moves backward.

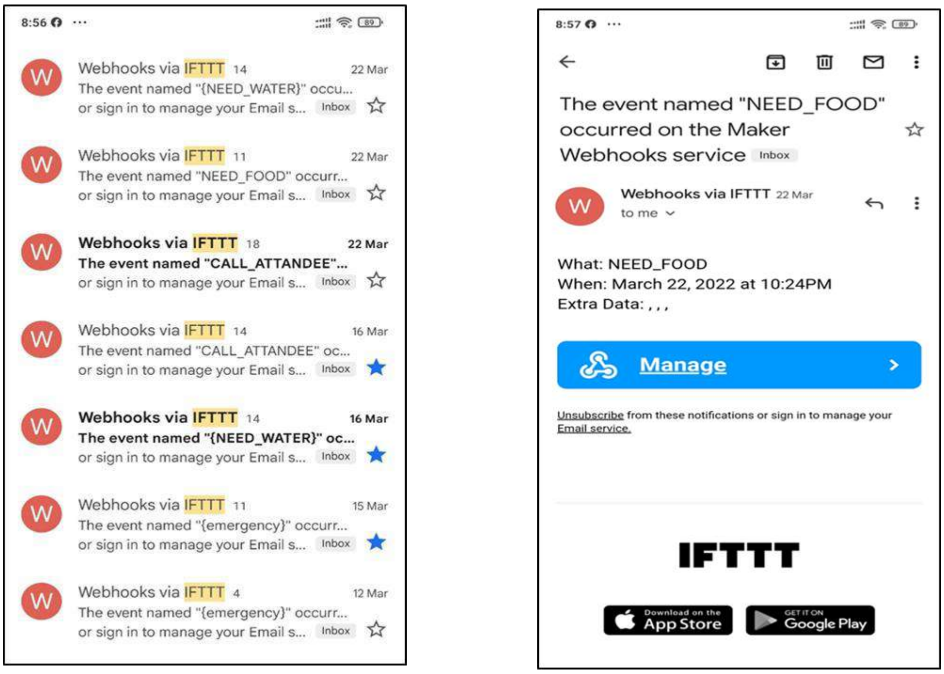


Figure: Received Email For Urgent Need

4.3 Output of Fall Detection

Figure: The "Emergency Help Coming" message is displayed as the fall is detected.

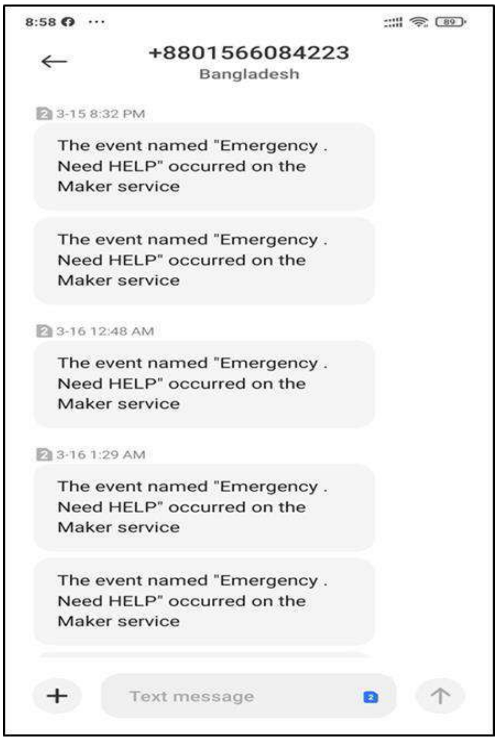


Figure: Sending Text in Mobile Number For Urgent Need as the fall is detected

4.3 Cost Analysis

For my project, the only expense was the purchase of the hardware; however, any other project would have required more expensive gear with fewer capabilities. Therefore, it is safe to state that my project is much more feature-rich and cost-effective.

Chapter 5

Conclusion

This project presented three important tasks performed by a smart glove in the health care of elderly patients. In this work, a convenient solution has been developed for vital activities such as elderly patients sending important messages to caretakers by gesturing hands, detecting falls and notifying specific people via email and SMS, and monitoring heart rate and oxygen saturation (SpO2) through website.The heart rate and oxygen saturation (SpO2) monitoring website's login page allows caregivers to access it with ease by entering a password. When an older person falls, a buzzer will sound, alerting the caregiver by email and SMS. Additionally, via email and SMS, the caretaker's mobile phone will get the messages transmitted by the patient's hand gesture.

Although the three tasks of fall detection, heart rate measurement, and sending messages by hand gestures have been done separately in the past, But a simple solution combining the three tasks has been presented before. Utilizing a single device for a single activity makes it exceedingly complicated and expensive to utilize. My technology is incredibly user-friendly and cost-effective. My system will play an important role in the health care of elderly and disabled people.

5.1 Challenges

ESP-8266 WiFi Module

The wifi module operates in a distinct language. As a result, i encountered numerous issues with its language. The wifi module itself may occasionally be unable to connect to the local network, which frequently causes data transmission to be halted. Therefore, a better wifi module hardware support is anticipated to enable smooth data transmission.

BPM and Oxygen Level Sensor

The information obtained from the BPM and Oxygen Level Sensor sensor occasionally contains some readings that are incorrect due to my country's lack of better pulse sensors.

Data Analysis and React

I encountered several difficulties with the data processing using the Arduino IDE and the IFTTT services. It was challenging to link the email and mobile number with the message, especially the alert message.

5.2 Future Work

- Integration with more sensor with low price
- Can be used for rural area people with affordable price
- Can be used for large scale with the help of government

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