REAL TIME DEMENTIA CARE AND FALL DETECTION DEVICE FOR ELDERLY

An Undergraduate CAPSTONE Project
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Fall Semester 2022-2023
January, 2023

Faculty of Engineering
American International University - Bangladesh

REAL TIME DEMENTIA CARE AND FALL DETECTION DEVICE FOR ELDERLY

A CAPSTONE Project submitted to the Faculty of Engineering, American International University - Bangladesh (AIUB) in partial fulfillment of the requirements for the degree of Bachelor of Science in their mentioned respective programs.

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DECLARATION

This is to certify that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. Any material reproduced in this project has been properly acknowledged.

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APPROVAL

The CAPSTONE Project titled **Real Time Dementia Care and Fall Detection Device for Elderly** has been submitted to the following respected members of the Board of Examiners of the Faculty of Engineering in partial fulfillment of the requirements for the degree of Bachelor of Science in the respective programs mentioned below on **January 2023** by the following students and has been accepted as satisfactory.

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ABSTRACT

Dementia has become a serious public health concern owing to its high incidence and effects on an aging population. Psychosocial interventions that increase cognitive function have been developed in recent decades. These treatments try to slow dementia's progression and promote healthy aging. This design provides an IOT-based safety hand for indoor and outdoor fall detection. The system incorporates fall detection, communication, notifications, and emergency medical aid. GPS helps caregivers find patients. Tri-axial accelerometers are used to study falls. When a fall is detected and the device detects an unconscious person, emergency contacts are called until someone responds. If no one replies within a specific time, the system calls for help. Even if the person has not fallen, he/she may press SOS to get help. A voice assistant recalls of routine, medicine, etc. This device contains a camera so that relatives or caretakers can watch over his or her activities.

Chapter 1

INTRODUCTION

1.1. Overture

Dementia is the loss of cognitive function. This affects the person's daily life Activities such as thinking, memorizing, and reasoning. Alzheimer's disease is the most generic form of dementia, the disease is progressive and slowly destructive to the brain's Limited function and reduces the quality of life and death. Both dementia and cognitive impairment are age-related illnesses that place a significant burden on those in need of medical care. The total crude prevalence rate for moderate cognitive impairment (MCI) in the over-60 population is between 6 and 42%, and 20–40% of such cases proceed into dementia [1]. The range of these two numbers represents the overall range of the crude prevalence rate. It is estimated that between 5 and 7 percent of the world's total population is living with dementia. Just in Spain, there are approximately 800,000 persons living with dementia [2]. Dementia has emerged as a significant public health problem and a top concern for healthcare in many nations because of the high frequency of the condition and the effects it has on an aging population. Many different psychosocial approaches aiming to improve and maintain cognitive ability have been developed over the past few decades. These approaches were developed to slow down the progression of dementia as much as possible and enable people affected by it to age in a healthy manner.

This project proposes a safety hand for them to detect a fall detection system that incorporates IoT (Internet of Things) based both indoors and outdoors. The entire system comprises fall detection accurately, communication services, alert notifications, and emergency medical services. When there is a need, family caregivers can find the patient via GPS. Additionally, this study uses tri-axial accelerometers to examine falls. When a fall incident is detected and the device identifies that the person is in an unconscious position, a notification message/call will be delivered to all emergency contact persons in sequence until anyone responds to the system. If no one responds within a pre-determined time, then the system immediately calls emergency medical services to procure timely help for that elderly individual. Even if the person has not fallen, but realizes something unusual can push the small, handy emergency call (SOS) button to give the actual location to the closest people to receive immediate help. A voice assistant is installed to assist the patient always to remind routine tasks, medicine time, etc. A camera module is also installed on that device so that the relatives or caregivers could watch activities anytime they want.

1.2. Engineering Problem Statement

The gap between the existing challenge state and the intended (target) condition for a process or product is what an engineering problem statement reveals to be the case. In addition to that, we can correctly identify, explain, and define the recommended solution to the problem. Most of the answers to this engineering problem statement may be gleaned from the survey of literature and research that we conducted in the past. In the past, we discovered that the currently available tools are built based on certain management, such as only fall detectors or just helplines. In certain situations, the solutions consist of both diverse types of categorizations, which both take a lot of time and require standard abilities for anybody to be able to operate. If, on the other hand, we create the solutions in a technical, we will be able to save both time and money. In the construction of the system architecture, we are using a variety of sensors that are capable of functioning exactly to the requirements of the design. As a result, we are working on developing the tool that will be able to provide us with the technical solutions for our proposed concept.

1.3. Related Research Works

Biomedical engineering health-care technologies for dementia patients are gradually making their way into our daily lives. Currently, BME (Biomedical Engineering) technologies offer solutions for Alzheimer's disease medical care support devices, allowing dementia patients to conduct their various daily routine tasks safely. One of which is the voice assistant devices, at which voice recordings help dementia patients in their daily life by playing sound notifications of time of medication, appointments, and date and time; these are simple sound "reminder" devices. Other devices employed the Internet Wi-Fi technology with GPS application; these are telemetry medical assistance devices. It monitors the location of someone who wanders such as dementia patients. In addition to tracking the current location of caregivers, the device allows for monitoring heart rate and receiving text and voice messages with fall detection [3].

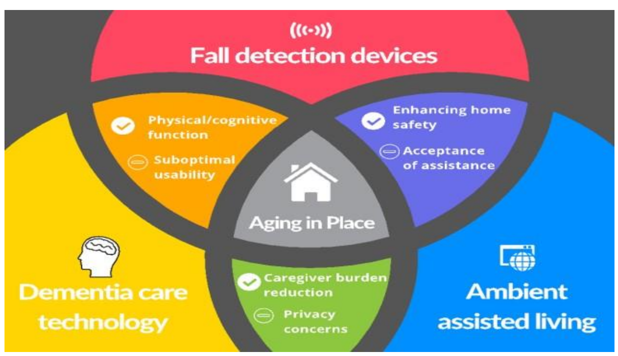


Figure 1.1 Prospects and challenges presented by ambient-assisted living technology, fall detection gadgets, and dementia care [4].

It was proposed that a GPS tracker that is tucked away within the shoe's insole and called a "Smart sole" may be used. It keeps track of the whereabouts of people with Alzheimer's disease who tend to wander. Additionally, the GPS was incorporated into a life-saving smartwatch that was created. In addition to being able to monitor one's heart rate and get text, audio, and vibration notifications, the smartwatch can also track the whereabouts of carers at any given moment. They come along with a button to press for assistance (an emergency SOS button). However, modern GPS gadgets struggle with a few different issues. The antenna, which is put on the bodies of Alzheimer's disease sufferers, may cause some difficulty as well as pain. Because they need sophisticated sensors and software that is unique to a certain manufacturer, you should anticipate paying a premium price for them. The fact that these GPS devices do not contain fall warning sensors is the most significant disadvantage, and those with hand dexterity may find that using one is impossible [5,6].

On the other hand, employing deep learning and facial recognition has also been recommended as a method to enhance the living quality of AD (Alzheimer s Disease) patients. It was conceived as a "smart headgear" those individuals with Alzheimer's disease may use to aid them in recognizing members of their family or even strangers who could pose a threat to their safety. Because of its exorbitant cost, the technology is only accessible to those who are knowledgeable in machine learning. Although it helps identify individuals by utilizing a model that has been trained in the past, it does not monitor critical data nor is it capable of providing warnings for situations such as falling, which are common occurrences for Alzheimer's disease patients [7,8]. As a result, it is assumed that BME for health care will continue to advance, replacing less intelligent devices with more intelligent ones and offering answers to unresolved issues.

1.3.1. Earlier Research

Today, there are an increasing number of technological devices on the market to help in the search and rescue of people with Alzheimer’s disease or related dementia who have become lost, whether from a home, long-term care residence, or other location. There are pros and cons to each of these active‖ systems, and no service can guarantee that an individual can be found or found unharmed every time, underscoring the need to deploy all methods of prevention to stop occurring in the first place. However, since most people with Alzheimer’s disease will wander away at some point during the disease, despite the best precautions taken, systems should be in place to aid families and law enforcement if a situation mandates a search and rescue. Approximately 75 percent of people with Alzheimer’s disease receive care at home. Noting the potential market, more companies have been developing technologically advanced systems aimed at ensuring the safety of the person with dementia and the peace of mind of the family caregiver. As we are dealing with fall detection of dementia patients, there is already a lot of work done to find human movement detection and fall detection. While previously different approaches suggested monitoring movement and detecting falls, the cameras were used to monitor dementia patients. Another approach is to make use of accelerometers and gyro sensors. Sensors are attached to the body so if there is a sudden change each time patient moves or changes in activity against gravity it detects that movement and based on an algorithmic approach it detects an accurate fall.

However, a few of the researchers tested prototypes that could only detect falling circumstances. An overview of the current research was provided in the paper that Ramachandran and Karuppiah produced together [9]. They used a variety of methods, such as environmental sensing-based systems, wearable sensor-based systems, and vision-based systems, and their accuracy ranged from 79 percent to 100 percent.

Sindhu et. al. discussed the major problems that roaming elders face today and proposes technical solutions to address them using simple tools and concepts.

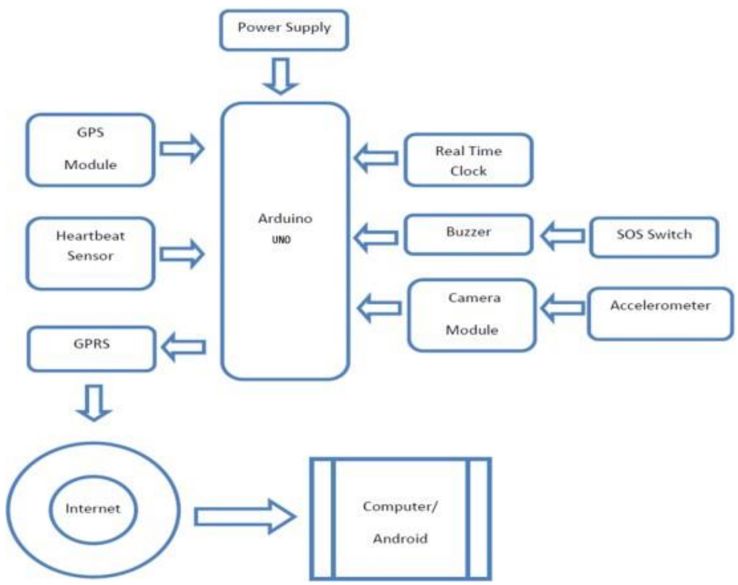


Figure 1.2 Block Diagram of Wearable Sensor [10].

The system includes components that notify users to take their medications on time using a buzzer, monitor their heart rate, take pictures with a camera module, and alert users and send messages with their position using GPS/GPRS [10].

In a different piece of study, the author proposes a wireless-sensing smart wearable medical device (SWMD) as a multi-functional solution for Alzheimer's sufferers. The SWMD makes use of a Wi- Fi controller that is built in with electrical circuits to monitor three vital signals (temperature, heart rate, and oxygen saturation), fall-down circumstances in three directions (X, Y, and Z axis), and GPS position. The SWMD was able to communicate with the Firebase Service (database hosted on the Internet Cloud). The functionalities of this prototype in real-world situations, such as rising hands, sitting or standing, and walking, were also evaluated [11].

1.3.2. Recent Research

Instead of requiring a specialized or extra connection, an android application was suggested that customers use their existing mobile devices or internet access to save expenses. The suggested gadget has a convoluted operation, which makes it difficult for consumers to utilize [12].

The Internet of Things (IoT) has seen widespread adoption as a tool for interconnecting the many medical resources that are now accessible to provide senior citizens with health care that is efficient, dependable, and innovative. One of the paradigms that may leverage the benefits of the internet of things to enhance the lifestyle of older people is health monitoring for active and supported living. An Internet of Things (IoT) architecture that has been adapted specifically for use in medical applications. The data is collected by the suggested architecture and then sent to the cloud, where it is processed and evaluated. It is possible to provide the user with feedback actions that are derived from the data that has been examined. To show the performance benefits of the proposed design, a prototype of the architecture has been developed [13].

An IoT-based wearable device was suggested as inferior quality and found that employing electronic equipment such as movement sensors may allow for an approach to care that lets individuals with dementia roam around freely. The other approach is to see "wandering" as troublesome and to lock doors in care facilities [14].

A Safety based elderly wandering project has created a brand-new safety assistance system that is based on mobile phones and can deliver information on the location of a wandering old person as well as the ambient noises that are present around that individual. A regular desktop personal computer with Internet connectivity serving as the system's server computer and a wearable sensor makes up the components of the system. The low transmitting power mobile phone (W-SIM), a tiny microphone, and a one-chip microcontroller make up the components of the wearable sensor that is fastened behind the neck of the old person's clothing. Using the W-SIM, the position of the old person who is wandering is pinpointed to within 100 meters (about 328.08 ft) of the antenna ID of the mobile phone carrier. Using specialist software, the caregiver determines the old person's permitted mobility area. When the elderly person leaves the area, the sensor will immediately begin recording the sounds of the surroundings around the wandering senior person using the little microphone to assume the person's position. The server computer receives the position of the old person who is roaming about as well as the sounds of the surrounding area thanks to the W-SIM. E- mail is automatically sent to the caregiver from the server computer, which provides the notification. Using the internet, the caregiver can keep track of both the sound and the map of the wandering person's whereabouts. The sound makes it possible to make an educated guess as to the location of the lost person and the circumstances around them [15].

From the literature review, we find that upper projects are costly and not so user-friendly. Besides, these projects can handle two or three functions at a time. Moreover, some knowledge of technology is required to operate those devices. We have undertaken this project keeping in mind the ignorance of Bangladeshi older people about technology. We have thought of this project based on the additional cost of the above items and ideas from the people’s survey on the subject.

1.4. Critical Engineering Specialist Knowledge

Since every step of this process required programming and electrical integration, we must need engineering skills to complete our project. To create the device, it was important to gather numerous sensor-related ideas and comprehend the functional limitations of each sensor. There are several types of microcontrollers on the market, but we must do significant research to discover which one is optimal for our purposes. Completion of this project will also require extensive knowledge of dementia and the difficulty of the patients to make sure that this device will help them. Since dementia has been studied in the past and there are few goods on the market, we had to put in a great deal of work to make our gadget superior to the competition. The quality of the sensors, battery life, their limitations, and categorization must all be evaluated. The placement of the cardiac sensor to gather its data is an additional area of consideration. The mechanical setup of the project will require intermediate-level assembling and electrical connection skills and coding skills. A lot of time also was spent on tasks such as discussing proposals, preparing budgets, and determining project schedules so project management skills were also important. This project completion also involves documentation and written communication skills.

1.5. Stakeholders

The project has been researched and the prospects were explored from many different angles in various papers. Many of the projects have very close human interference and are working perfectly in different areas of the world. Through the process, the dementia patient can travel anywhere anytime without any hassle. In the case of this project, the involved stakeholders would be firstly the people who are directly or indirectly connected with Alzheimer's disease. People can be informed about this device through media, news, and advertisement. Our device is designed to help elderly dementia patients. Since the patients are unable to purchase these devices for themselves due to their mental health, their family members or anyone looking after them can buy these devices for them to use. The biggest involved party would be the clinics or medical centers that treat dementia patients who may recommend this device to their patients as the complete project revolves to improve the biomedical sector. Although this device is made with dementia patients in mind, other elderly patients can also benefit from it. The project will be helpful for society and for the people who are directly or indirectly connected with this type of disease.

1.6. Objectives

Our project aims to make a device that will enable a dementia patient to be monitored around the clock. The objectives of the works are given below-

1.6.1. Primary Objectives

- To make a device that will help the Dementia patient in their need.
- Capable to detect fall conditions (in X, Y, and Z directions).
- Adding multiple features like body vitals (heart rate, oxygen saturation, body temperature) measurements.
- Provide voice assistance (Reminder of medication, appointments, and information on daily life activity).
- GPS location tracking facility.
- Enable health care giver and family members of being in real-time contact with the AD-patient.

1.6.2. Secondary Objectives

- To make the device more compact so that it can sustain in the commercial market.
- Ensure that the prototype device is cost-effective.
- Making the device light so that it is comfortable for elderly people.
- Make it more reliable.

1.7. Organization of Book Chapters

Chapter 1: Introduction:

The introduction provides an overview. This chapter analyses project completion criteria and discuss why it is useful. This chapter contrasts engineering methodologies. Past and present technologies were briefly covered. The proposed model's technology is compared to past research.

Chapter-2: Project Management

The project's management is described here. Before implementing the suggested model, various aspects were addressed to assess the project's result. Evaluations are there.

Chapter-3: Methodology and Modeling

This chapter describes the system. We have now discussed how to implement the project's model. Diagrams, flowcharts, simulation models, and decent work designs show the project's technique.

Chapter-4: Implementation of Project

This chapter shows electrical and mechanical part implementation. Components and descriptions are listed. The chapter ends with the project's first concept design.

Chapter-5: Results Analysis & Critical Design Review

This chapter summarizes the project results. The full outcome has been evaluated as a result. This chapter summarizes the overall result.

Chapter-6: Conclusion

This chapter describes the overall project result. The project's environmental implications have been briefly evaluated via survey results. Other topics include the project's originality, flaws, and future. This chapter justifies the project's environmental concerns.

Chapter 2

PROJECT MANAGEMENT

2.1. Introduction

Project management is the process of conceiving, planning, and implementing ideas, as well as supervising the strategy for implementing the project as a whole. This project incorporates an idea aimed at assisting dementia patients. The first step in carrying out the project was to emphasize the severity of the condition, examine the specifics of the affected person's issues, and take appropriate action. The procedures were then meticulously planned, and the necessary resources, materials, project cost analysis, and most significantly, time management for the project were ensured. Planning and executing project objectives and goals is also a valid aspect of project management. These arrangements result in risk, as well as efficient administrative resources, finances, and group member communication.

2.2. S.W.O.T. Analysis

SWOT Analysis is an evaluation of a project's strengths, weaknesses, opportunities, and threats. Such an analysis is required to comprehend how the implemented project can be utilized and what its future scopes are. This analysis examines the project's strengths and limitations, as well as the amount of risk and opportunity it presents for the foreseeable future. Through the analysis, it may also be determined if the project offers any risks and how they can be minimized. There are multiple techniques to identify areas for improvement, the best working method for a project, and the likelihood of the project's success, which enables a group to determine whether to work on the project or not. This project's S.W.O.T. analysis provides an in-depth overview of the project and its ultimate objective.

Figure 2. 1 S.W.O. T Analysis [16].

2.2.1. Strength

- Multitasking Device- As our device can able to detect fall, measure body vitals like measure blood pressure, body temperature, can communicate with patients relative through ip camera and voice assistance and it also detect patients' location, so it's a great strength for our device.
- Compatibility – Compared to the existing devices in market this prototype is more compact and it can able to do many tasks than others.
- Portability – As we done the PCB design, our device is portable as well as compact. So, anybody can able to move with the device easily.
- Compactness-As we designed PCB for our device, so there is no chance for loose connection.

2.2.2. Weakness

- Bulky Device: Due to lack of proper fund we cannot make the device compact.
- Malfunctional: Sometimes the devices output is irregular due to malfunction of the sensors.
- Availability: Due to BP sensor unavailability, it cannot be measure patients' blood pressure from the neck.

2.2.3. Opportunities

- Could be developed into a comprehensive compact industrial setup.
- It can be done to generate thread of industrial quality by modifying.
- The entire procedure can be completed in a compact size.
- Has the potential to become an industry project as well as the project's ultimate objective.

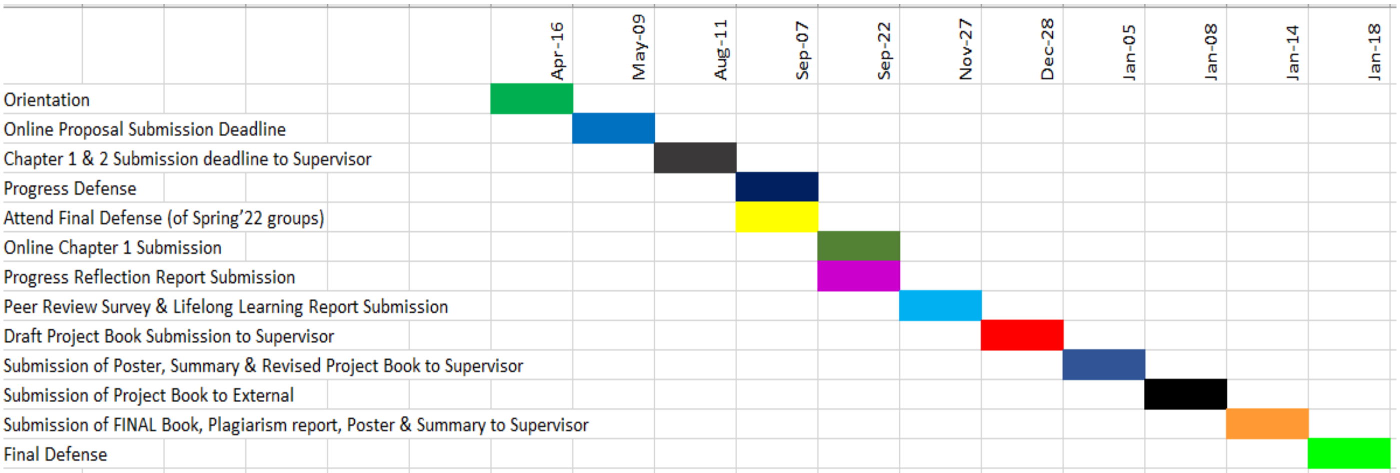
2.2.4. Threats

- If leakage occurs into the device for any reason, it may not work as well or it may even damage.
- There might be physical damages due to wireless signal communication.
- Sometimes GSM module may not be work properly due to bad weather conditions.

2.3. Schedule Management

Management of the project's schedule provides structured and planned methods and strategies. A project's progress is contingent upon numerous circumstances. Management of the schedule specifies and arranges the goals and objectives. It lays the groundwork for completing the project within the stipulated timeframe and budget. Important for the operation, monitoring, and control of the project, as well as its completion, is timetable management.

Table 2.1 Schedule Management



2.4. Cost Analysis

Table 2.2 Cost Analysis and List of Components

Serial No	Component Name and Description	Unit	Projected Price	Actual Price
01	1 Set Breadboard Male to male Jumper Wire	01	250 BDT	150 BDT
02	1 Set Male to Female Jumper Wire	01	300 BDT	170 BDT
03	SIM868 GSM/GPRS/GPS Module	01	1200 BDT	800 BDT
04	Electret Microphone	01	50 BDT	25 BDT
05	OLED Display	01	500 BDT	500 BDT
06	Heartbeat Sensor	01	1000 BDT	900 BDT
07	Infrared Temperature Sensor	01	1500 BDT	1200 BDT
08	ESP32 (Node MCU)	01	500 BDT	420 BDT

09	ESP32 Camera Module	01	1000 BDT	850 BDT
10	ESP32 USB Module	01	250 BDT	220 BDT
11	Battery	01	100 BDT	55 BDT
12	Battery Holder	02	500 BDT	390 BDT
13	Buck Converter	01	300 BDT	260 BDT
14	PCB Design	1	500 BDT	500 BDT
15	3D Casing	1	2500 BDT	2500 BDT
	Total	**-**	**10450 BDT**	**8940 BDT**

$$\boldsymbol{\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}}$$

For Projected Cost –

$$\boldsymbol{\mu = \frac{\sum x_i}{N} = \frac{8940}{15} = 596}$$

$$\boldsymbol{\sigma = 607.38}$$

So, the Standard Deviation of the projected cost is 607.38

The Coefficient of Variance of the projected cost is 101.91

For Actual Cost –

$$\boldsymbol{\mu = \frac{\sum x_i}{N} = \frac{10450}{15} = 696.67}$$

$$\boldsymbol{\sigma = 631.26}$$

So, the Standard Deviation of the projected cost is 631.26

The Coefficient of Variance of the projected cost is 90.61

Because of Coefficient of Variation in both cases is so close, it is negligible. As a result, the project's cost can be considered satisfactory. The projected costs in this case are entirely derived from the catalogues, and the actual costs are estimated to be slightly higher in order to allow for future implementations to catch up.

2.5. P.E.S.T. Analysis

The acronym PEST stands for Political, Economic, Social, and Technical Analysis. The macro-environmental components of the projects are evaluated in light of the project's major impact, and these aspects can be tracked using the PEST analysis. As the name suggests, the most essential components in this form of study are political, economic, social, and technical considerations.

2.5.1. Political Analysis

The project is a result of the team's idea, and it won't require any political or governmental engagement to be carried out. However, if production of the finished product in large quantities is desired in the future, concerned authorities should be aware of this.

2.5.2. Economic Analysis

The hardware setup for the project has a fair budget since it incorporates a whole system to produce a usable result. It is regrettable to say that any researchers or students with very limited funding may face obstacles when trying to complete the project. However, the concept itself has the potential to develop into a piece of equipment for fresh industrial enterprises with a relatively small amount of funding.

2.5.3. Social Analysis

The goal of this project is to assist dementia patients with a variety of conditions and trends that have the potential to influence medical science and the biomedical industry. Thus, established domestic enterprises or startups can select it as part of their next solo or standalone project. In such instance, Bangladesh might exploit the initiative as a possible export product. In that event, it will have a significant impact on the country's economy and will be able to promote a fair image of the nation abroad. Overall, if this project is implemented properly, it will be of immense benefit to the nation.

2.5.4. Technological Analysis

One of the objectives of this initiative is to make a significant contribution to the lives of Dementia Patients and the elderly. To do this, it is essential that the technology of this project is readily available and accessible to enterprises and corporations that can mass produce the intended product and bring about the necessary transformation. The technologies utilized in the project are entirely domestic and accessible to anyone who desires to use them.

2.6. Professional Responsibilities

It is the obligation of a project's implementers to ensure that the product or end is accessible and intelligible to all parties. Engineers are responsible for ensuring that methods, procedures, settings, and products are safe, usable, and effective. To accomplish this, engineers must utilize effective management, communication, and teamwork. The engineers' most significant roles are as follows:

- Using detailed drawings to develop plans.
- Preparing project estimates and budgets.
- Determining the project's scope.
- Designing experiments in the engineering discipline.
- Producing technical reports for clients.
- Completing regulatory paperwork pertaining to safety.
- On-time and within-budget project completion.
- Informing clients and colleagues of analysis findings and conclusions.

2.6.1. Norms of Engineering Practice

The term "norms" refers to moral guidelines. If you must compromise on design, use ethical design to achieve a balance between your moral and technological options. designing in such a fashion Engineers are required by law to conduct impact assessments to ensure that their designs have a positive effect on the society in which they are implemented. When employees feel valued, that is one of the most important social characteristics of a company. If engineering managers wish to fulfill their duties effectively, they must place a high priority on enhancing the abilities of their employees. A clear growth plan and constant dialogues about employees' abilities, needs, and aspirations are required to instill in them the belief that their employer values them.

2.6.2. Individual Responsibilities and Function as Effective Team Member

To accomplish a task successfully, it is essential to have strong groupwork and teambuilding skills. But inside the group, each member must fulfill the individual or personal tasks that will ultimately result in a comprehensive and well-executed project. Every member of a group is sure to have various features and strengths. By playing to their own strengths and merging them, a project is compiled. Throughout the project, members of the group had distinct duties and this chapter explores their contribution in depth.

Table 2.3 Individual Responsibilities

Software and Hardware Implementation

Name	ID	Responsibility
RAHMAN, MD SAMIUR	17-35973-3	Hardware
SHAKIL, WHAKIL AHMED	17-35986-3	Hardware
PAUL, SANJOY KUMAR	17-34567-2	Simulation
RAHMAN, MIDHAT	17-35936-3	Simulation

Book Writing

Name	ID	Responsibility
PAUL, SANJOY KUMAR	17-34567-2	Book Writing Lead, Chapter 1,2
RAHMAN, MD SAMIUR	17-35973-3	Chapter 3
RAHMAN, MIDHAT	17-35936-3	Chapter 4
SHAKIL, WHAKIL AHMED	17-35986-3	Chapter 5,6

Overall Project Lead

Name	ID	Lead Responsibility
PAUL, SANJOY KUMAR	17-34567-2	Book writer, ProjectManager
RAHMAN, MD SAMIUR	17-35973-3	Hardware Implementor, Designer
RAHMAN, MIDHAT	17-35936-3	Simulation, Lead of communication
SHAKIL, WHAKIL AHMED	17-35986-3	Researcher, Lead of Purchasing

2.7. Management Principles and Economic Models

In the terminology of economics, it is recognized that a decrease in manufacturing costs boosts demand. Consequently, if the product is released to the market while maintaining its quality, its demand will increase. As a result, we have emphasized boosting the product's demand by maintaining the product's quality and decreasing its price relative to comparable products on the market. The influence of Covid-19 posed one of the greatest obstacles in this regard. This has increased the pricing of electronic devices, electronic items, and other things on the global market.

In addition, even as the impact of Covid-19 continues to increase, global politics and the Russia-Ukraine conflict continue to drive up prices. With this in mind, we conducted a large number of reviews prior to acquiring device components. As the next phase, we have chosen inexpensive, high-quality components. Moreover, keeping in mind the commercial requirements and market rivals of our gadget, we have endeavored from the outset to make our device adaptable. Consequently, our device will be less expensive and more adaptable than any other device on the market. Using this paradigm, we hope that our product will successfully contribute to the economy.

2.8. Summary

This chapter presents a comprehensive analysis of the project's viability. Cost analysis, schedule analysis, the project's strengths and weaknesses, as well as the project's future prospects and threats, are reviewed. The political, economic, social, and technological contributions of the project have been evaluated. This chapter also addresses the contributions of each team to the overall project. With a comprehensive examination, it is possible to conclude that the project deserves to be a significant contributor to the environment and our society.

Chapter 3

METHODOLOGY AND MODELING

3.1. Introduction

A project's success is highly dependent on the design of its model and the methodology it employs. The model can be considered the project's skeleton. This chapter analyzes the designed models and provides an in-depth discussion of the strategies utilized to construct the project. The methods are illustrated with all required block diagrams. The initiative still has a considerable distance to travel, it must be acknowledged. It has many untapped potentials that can be unlocked with further development. To enhance the system, however, it is vital to first comprehend the fundamental principles and designs described in this chapter.

3.2. Block Diagram and Working Principle

The objective of this project is to develop a device that could help dementia patients and keep them under monitoring and take action in any unexpected event. The project proposes a complete system that detects falls and sends the location to his family if needed.

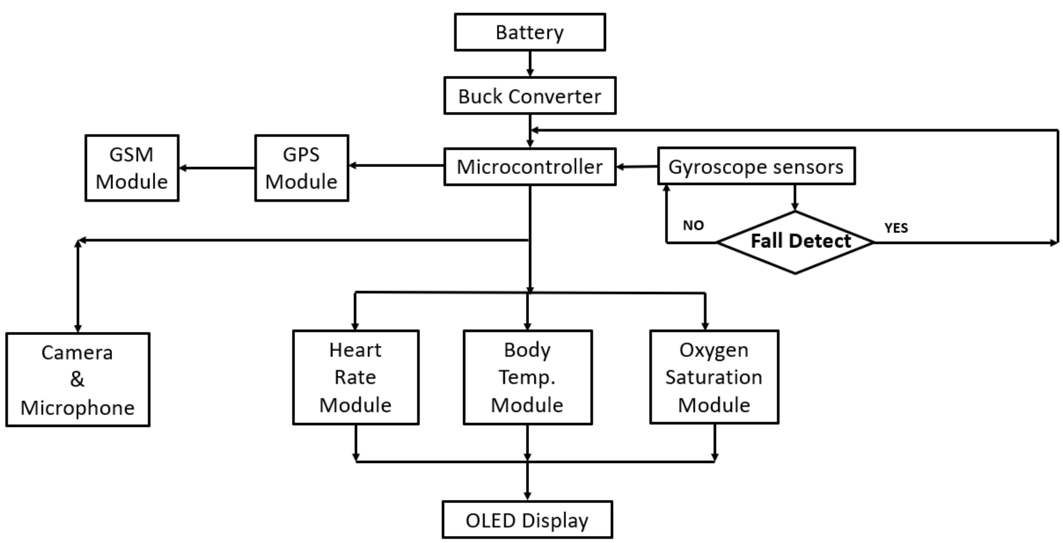


Figure 3.1 Block Diagram of the Project.

In order to achieve that system, first, it is important to understand the mechanism of the system. As the common problem of dementia patients is falling down at any time due to their disease, dementia. So, we need to fix our system as automatic, so that it could realize whether the fall is actual or not. To illustrate that we had to use a sensor called a gyroscope sensor. The gyroscope sensor transfers the data to the system microcontroller. If no more movement is detected after a sudden time by the sensor, Then the microcontroller will detect the fall and start the processing of contact with their caregiver/relatives. If the gyroscope detects any movement again after the fall detection, then the microcontroller cancels the process of contacting their relatives.

We have added some extra features to the system. And that is a camera, microphone, heart rate sensor, body temperature measurement sensor, and oxygen saturation sensor. Through these sensors, we can know more details about the patient's health issues. Through cameras and microphones, we will be able to supervise the patient at all times. We have added one more feature to this device and that is a voice alert that will help the dementia patient to take the medicine on time and reminds him about the daily routine, and appointment. This voice alert feature works manually. This feature is similar to setting an alarm ringtone which has to be pre-recorded. The specified time will ring and the recorded voice will play.

As stated before, the project is made up of two different parts, hardware, and programming. Both are vital for the project to run. The best way to understand the working of a project is through the block diagram which gives us a picture in our mind of what the project is. By understanding the block diagram, it is easy to replicate the project to mass-produce the system.

Here is the total block diagram of the system that includes fall detection device and health monitoring watch. A battery is the main power source of that system. There we used a buck converter to adjust the voltage. NodeMCU is the main controller in our system it controls all the sensors. A gyro sensor is used to detect the fall and its axis. Next it will measure the body vitals and according to patient conditions it will send a message to patients nearest person through GSM module. This device also tracks the location via GPS module and notify the location also. Further that nearest person can able to communicate with the patient via camera module and microphone.

3.3. Modeling

3.3.1. Hardware Modeling

For convenience we are dividing our project in three parts and we describe it elaborately below-

3.3.1.1. Health Monitoring

In health monitoring wrist watch arduino nano is the main microcontroller which control all the sensors and modules of health monitoring or checkup. Some conditions are also used during monitoring time.

For example, Heartbeat of normally elderly person is between 60 to 100 bpm according to medical science [17], similarly for body temperature of human body is basically 98.6-degree Fahrenheit [19], SpO2 or oxygen saturation of a human body is naturally greater than 94% [18]. So, we make a condition that if a person's body temperature get higher than that normal value it will glow a red led, similarly for oxygen saturation and heart rate we make a condition so, if any change noticed by controller, it will glow that red led. Moreover, we attached an OLED display which seems like a watch display which always show that vitals every time when a patient wear it. Here figure 3.2 depicts the block diagram of health monitoring system.

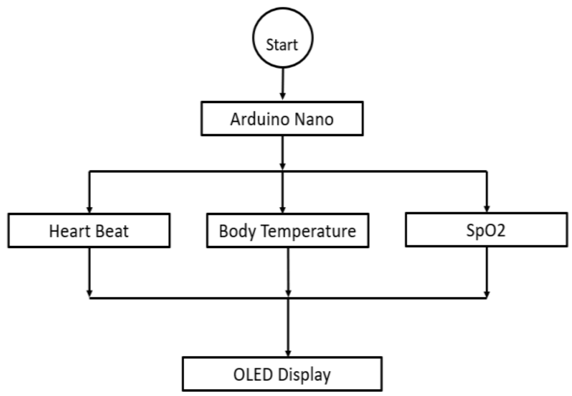


Figure 3.2 Block diagram of health monitoring system.

3.3.1.2. Fall Detection

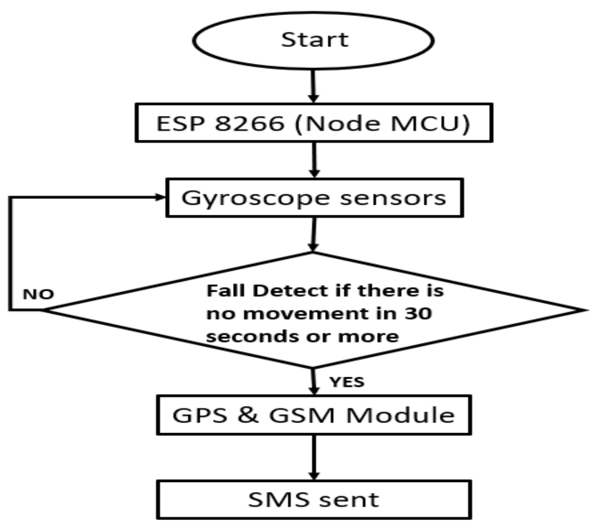


Figure 3.3 Work flow diagram of fall detection system.

Now we will talk about fall detection system part in our project. For fall detection purpose we used the ESP 8266 or Node MCU micro controller mounted with gyroscope sensor, GPS and GSM Module. These sensors and modules are controlled by esp8266. Gyroscope sensor sense the fall detection it also able to detect in which direction the patient fall depending on X, Y, Z axis. GPS or global positioning system track the patient location where that person fallen and GSM or Global System for Mobile communication sent that notification via SMS to patient nearest person according to patient choice. Which work flow diagram represented in figure 3.3.

3.3.1.3. Camera and Voice Assistant

For communication purpose we established a camera with voice assistant system which will be discussed briefly in this section. When microcontroller detect the fall and wait for 30s to get any response of movement from patient. If it can't able detect any movement of patient it will start the camera and also connect the patient with patient relative through GSM module. And it will work as a communication medium between patient with relatives or doctors from any remote corner. A block diagram of camera with voice assistant system showed in figure 3.4.

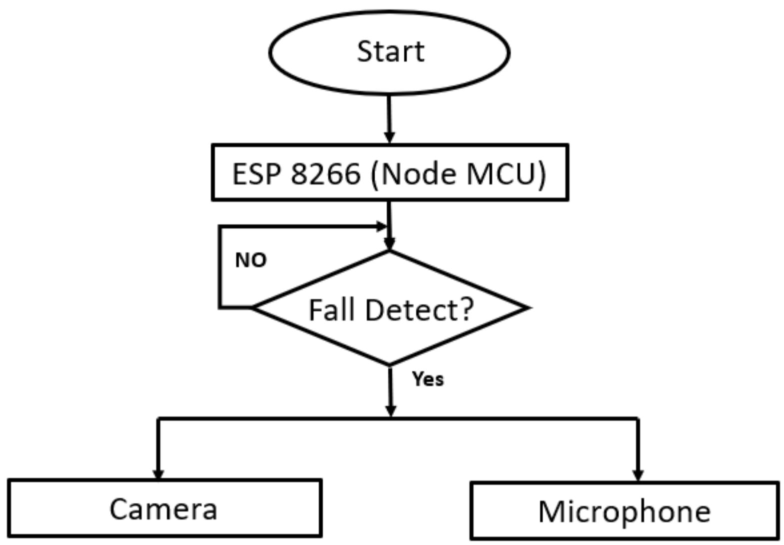


Figure 3.4 Work flow diagram of camera and voice assistant system.

Hardware connection is another main thing in every project. By connecting each and every equipment according to simulation or schematic design a system will develop and sometimes there also need soldiering. In soldering time there may be chance of short circuit and wrong connectivity. Therefore, to reduce this hustle PCB design is a great solution and we also follow this thing. By using EasyEDA software, we develop the PCB layer of fall detection device and health monitoring watch. Besides we design the schematic to saw the connection properly. Figure 3.5 and 3.6 respectively represents the PCB design of the fall detection device and health monitoring watch.

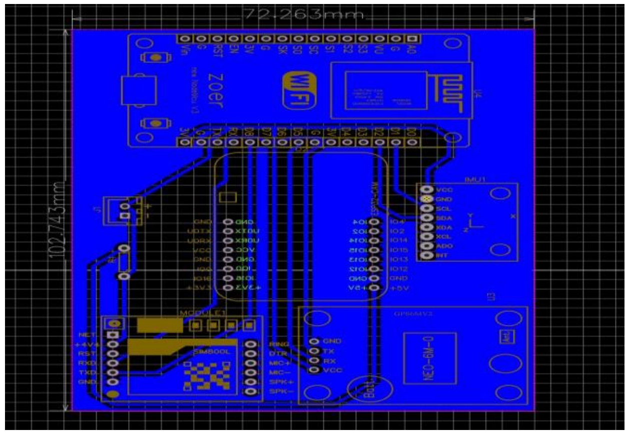


Figure 3.5 PCB design of the fall detection device.

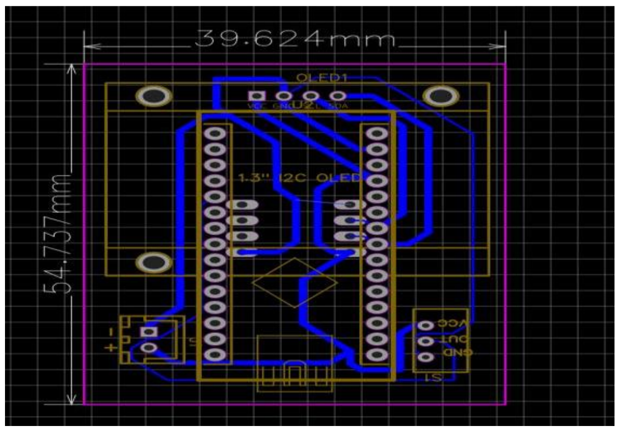


Figure 3.6 PCB design of the health monitoring watch.

Figure 3.7 and 3.8 represents the and bottom layer of the PCB which is designed in the EasyEDA software.

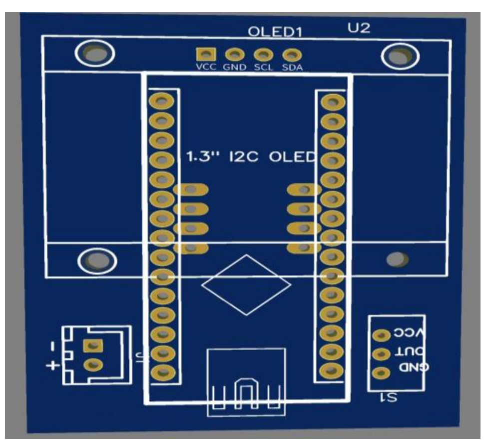


Figure 3.7 Bottom layer PCB of the fall detection device.

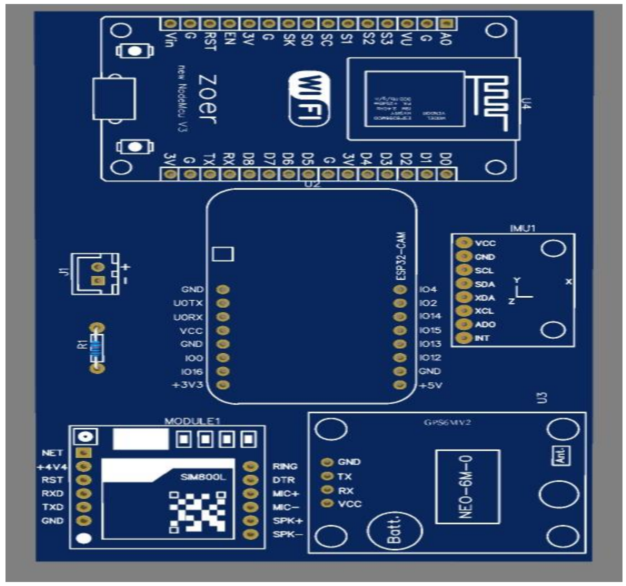


Figure 3.8 Bottom layer PCB of the health monitoring watch.

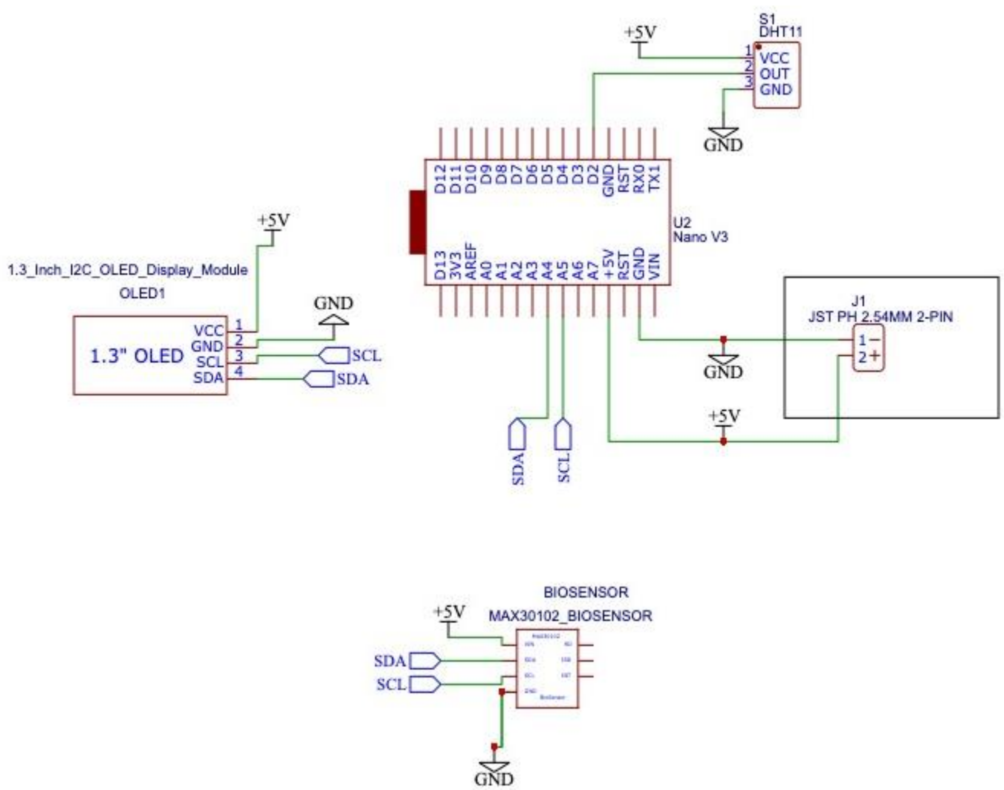


Figure 3.9 Schematic design of the health monitoring watch.

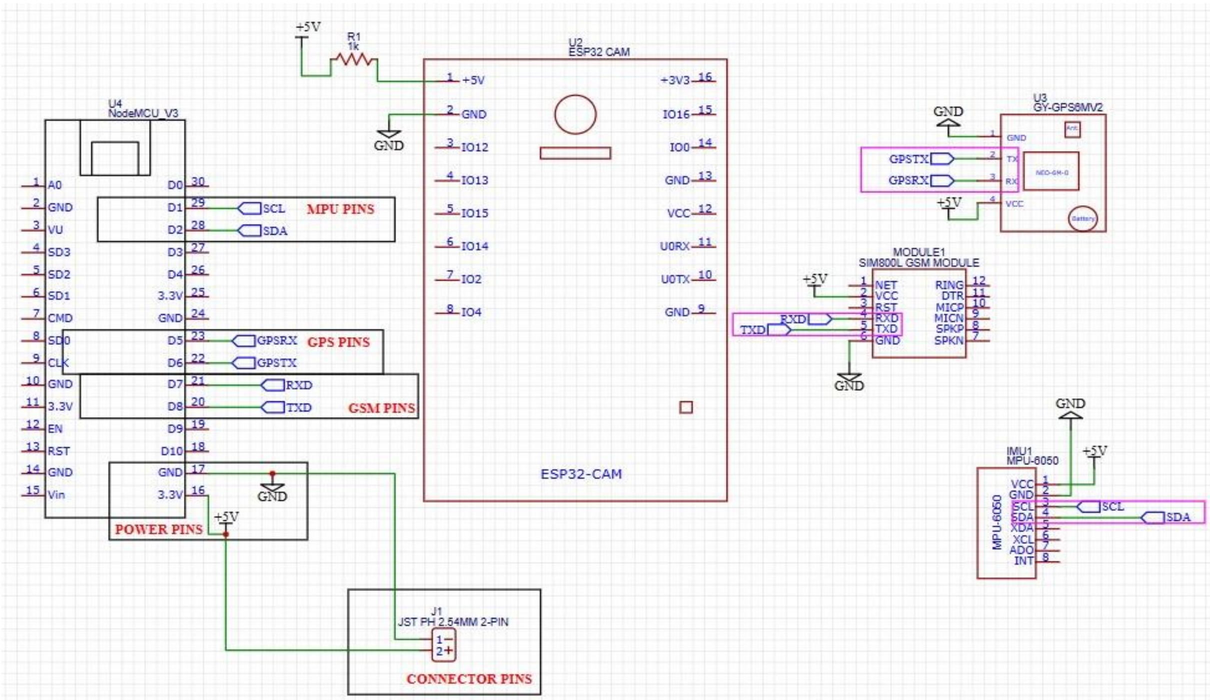


Figure 3.10 Schematic design of the fall detection device.

Schematic of a system helps during soldering time. Figure 3.9 and 3.10 represents the schematic of the health monitoring watch and fall detection device which is also done by EasyEDA Autodesk software.

3.3.2. 3D Architectural Model

To make a industry level device every system needs a unique and a compact design. Therefor we design a 3D model for our fall detection device, health monitoring device using fusion 360. Below figure represents the architectural model of our project.

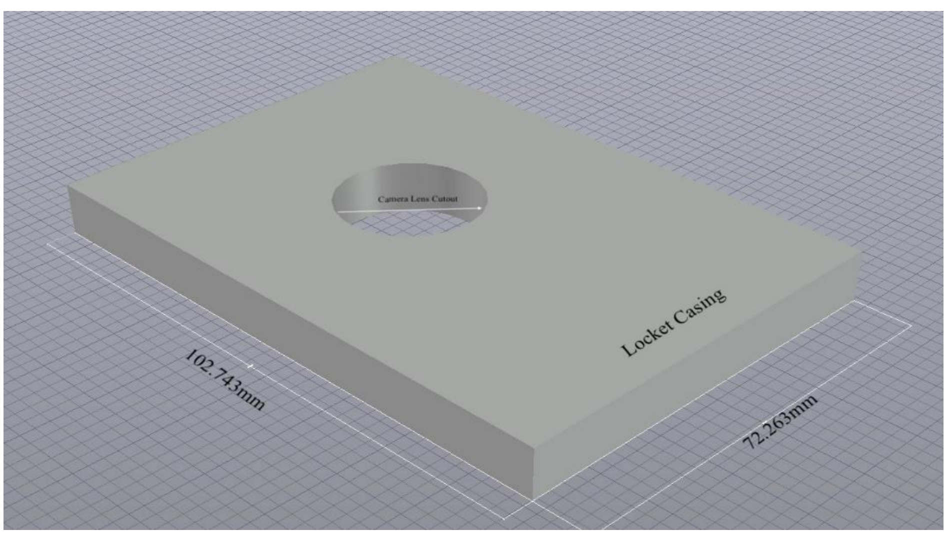


Figure 3.11 Isometric Projection of fall detection device (Locket casing).

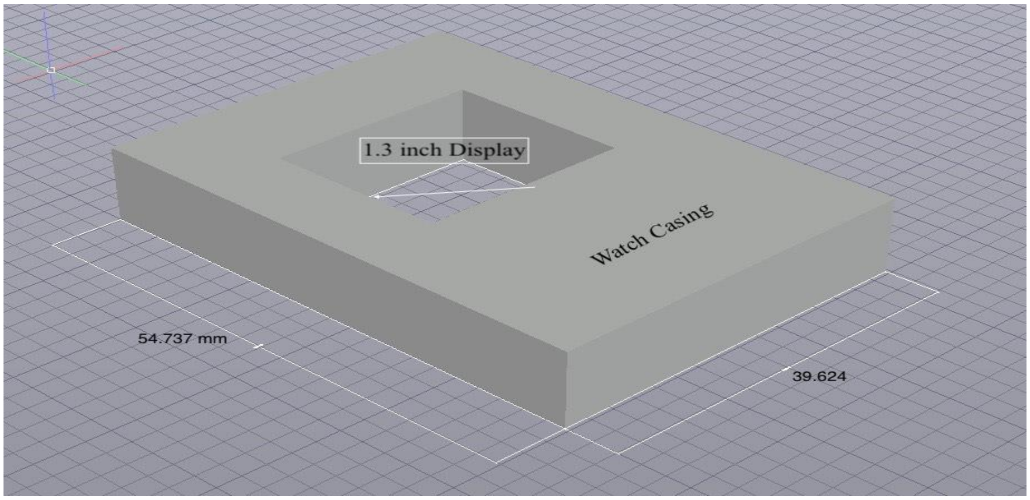
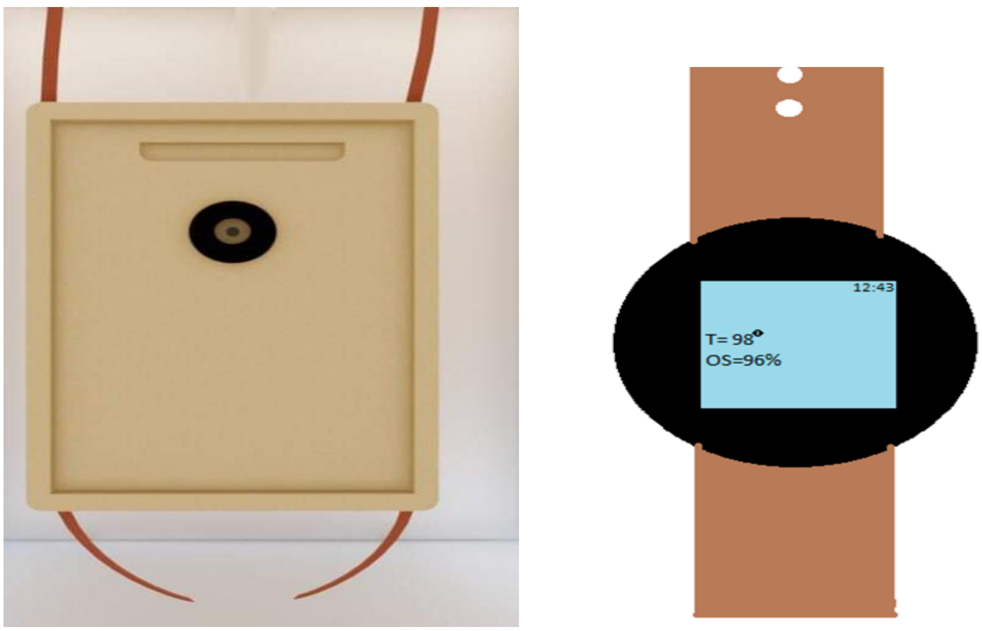


Figure 3.12 Isometric projection of health monitoring device (Wrist Watch casing).



(a) (b)

Figure 3.13 Front view of (a) fall detection device (Locket casing), (b) health monitoring device (Wrist Watch casing).

3.4. Summary

In this chapter, a summary of the flow chart, block diagram, and PCB design is provided so that the reader may understand how the project should be operated properly. Creating a Model for the Program Demonstrates the importance of the project's most important task. The particular procedure associated with the project definition has been completed successfully.

Chapter 4

PROJECT IMPLEMENTATION

4.1. Introduction

This chapter's primary goal is to demonstrate all the various ways the suggested system has been implemented. The implemented simulation model of the entire system, which was simulated using the PROTEUS software, will be the focus of this chapter. This chapter also describes a hardware prototype that has been put into use with the appropriate labeling.

4.2. Required Tools and Components

The project is constructed by comprising many different parts together. To complete the simulation of the project, Proteus software was used to get a better grasp of how the project is supposed to behave. Then, in order to construct the hardware part, we have to set it as a mechanical setup. The mechanical setup had a microcontroller, multiple sensors like mpu6050, GSM, GPS, camera module, and microphone which are connected with each other. It also requires a PCB board to complete the setup. Detailed information about all the tools and components is given below for better understanding.

4.2.1. Software Requirements

The initial step of our project is the development of the software. And in our project, we are utilizing C programming and the Arduino IDE to create the software that will run on our board. In addition, we are creating a simulation of our project with the Proteus program. The details of the software's and how these works are given below:

4.2.1.1. Proteus

Electrical engineering professionals use Proteus, a design and simulation program created by Lab Center Electronics Ltd. Proteus has a vast library of component models that can be used to design or implement almost any circuit and properly simulate and analyze it. For measuring and analysis needs, the software also offers electrical tools that are equivalent to those in real life. Additionally, Proteus offers the choice of designing PCB boards based on the created model. In order to ensure that the system will function properly when the hardware is implemented, the Proteus version 8.10 simulation tool was used for this project.

4.2.1.2. Arduino IDE

Programming Arduino-branded boards allow the use of the Integrated Development Environment, or IDE, software. Cross-platform software is another name for the Arduino IDE. A unique programming language that combines C, C++, and Java is used to create this application. Developers can write code in the Arduino IDE, upload it, and use a serial monitor to track its progress. This software has a sizable library and supports a sizable number of boards, many of which are third-party boards.

4.2.1.3. EasyEDA

To use the schematic editor in EasyEDA, start by creating a circuit diagram. In files with the. SCH suffix, a schematic is kept, whereas a device library contains a part definition. Several sheets of parts may be stacked on top of one another and linked using ports. Board files with the extension.BRD are saved in the PCB layout editor's database. It enables back-annotation to the schematic as well as auto-routing, which connects traces automatically depending on the connections specified in the design. It also has the ability to save Gerber, PostScript and Excellon layout files, as well as Sieb & Meyer drill files. Many PCB fabrication businesses and assembly factories will take board files (with the extension.BRD) with the extensions .PCB or. BRD directly, to export optimal production files and pick-and-place data.

In addition to including a multi-window graphical user interface, menu system, and project management functionality, EasyEDA has many other built-in design options to tweak the overall look and feel of the software. By using a mouse, keyboard hotkeys, or a command line, the system may be operated. Custom keyboard shortcuts may be created by the user. Commands that are run more than once may be put into script files (with file extension .SCR). In addition, it is possible to examine design files using an object-oriented programming language designed for EasyEDA (with extension.ULP).

4.2.2. List of Components

- Jumper Wire
- SIM868 GSM/GPRS/GPS Module
- Electret Microphone
- OLED Display
- Heartbeat Sensor
- Infrared Temperature Sensor

- ESP32 (Node MCU)
- ESP32 Camera Module
- ESP32 USB Module
- Battery
- Battery Holder
- Buck Converter
- PCB Board

4.2.3. Components Details

In order to accomplish our project, we are relying on a number of key components that are critical to the success of our endeavor. In addition, we provided our list of components in the preceding paragraph (4.2.2 List of Components). Describe how we will put our components into action and how we will ensure that our whole project is effectively completed in this part. All the major components used in the system are described below-

4.2.3.1. Node Microcontroller Unit:

Figure 4.1 Node MCU with built-in Wi-Fi ESP-8266.

The Microcontroller is the processing unit of the overall system. This Node MCU board uses ESP-8266 32bit System-on-a-Chip (SoC) open-source software and hardware development environment. This microcontroller is the brain of this project. This microcontroller was used because of the price-to-specification ratio and the board size of 49mmx 26mm which is easy for carrying on the neck.

4.2.3.2. ESP-32 Camera Module:

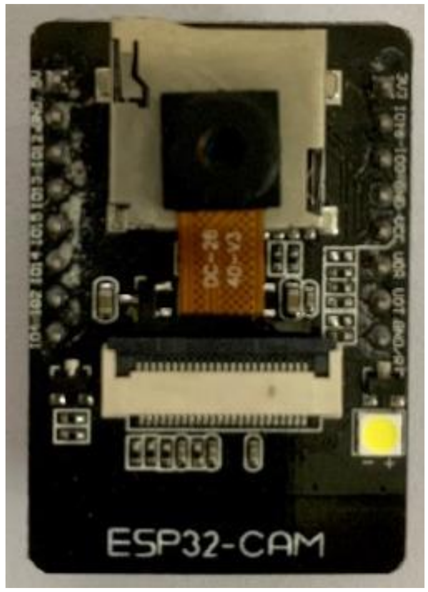


Figure 4.2 ESP32-CAM Wi-Fi.

The ESP32 module is used in this project because the module offers a system where it can be used as a monitoring device. This module also allows transferring the picture or videos through Wi-Fi which helps the caregiver to monitor the patient.

4.2.3.3. MPU-6050:

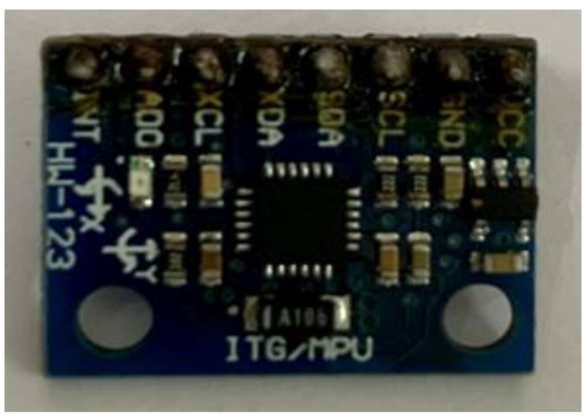


Figure 4.3 MPU 6050 (Gyro + Accelerometer) Motion Tracking Module.

The MPU-6050 module is one of the first less powerful, cheap cost, and great-performing modules. Thismodule uses Gyro and Accelerometer for tracking motion. In this project, Gyro has been used measures the resists change of its positions. When this gyro gets attached to the patient's body, with help of Node Microcontroller it starts to sense the changes in parameter.

4.2.3.4. SIM800L GSM Module:

Figure 4.4 SIM800L GSM.

GSM has been used for sending a message to the caregiver in case of any emergency situation of the Dementia patient. Also, by using this module we can get the geometric location of the patient.

4.2.3.5. Temperature Sensor Module:

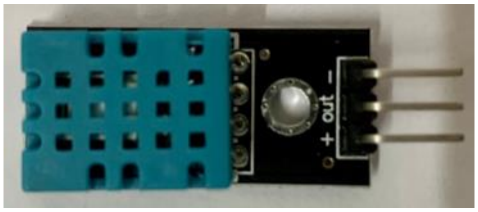


Figure 4.5 Temperature Sensor Module MLX90614ESF-BCC GY-906.

This module is non-contactable with the body and it can measure temperature accurately under the 5 cm range of the body. For better understanding and monetizing the body temperature of the Dementia patient, this temperature sensor is highly preferred.

4.2.3.6. Heart Rate and Pulse Oximeter Sensor:

Figure 4.6 MAX30102 Sensor.

As this project is built for elderly people, the monitoring of heart rate and oxygen saturation must be needed for caregivers. The accuracy rate of MAX30102 is 97.11% and 98.84%.

4.2.3.7. LED Display:

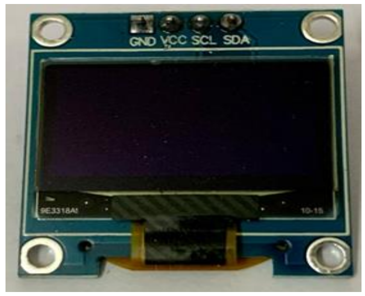


Figure 4.7 I2C 128x64 0.96-inch Display.

This Figure shows an OLED Blue Display which is capable of self-illuminating and whit a large viewing angle.This display module has been used for displaying the output of all the body parameter sensors. This displayis easily functional with Arduino.

4.2.3.8. Microphone:

Figure 4.8 Electret Microphone (AUD-00003)

This microphone matches the requirement of this project. As in Figure, there is a GSM module was used, anda voice communication system for Dementia patients was created which was the main motive for using theElectret Microphone.

4.2.3.9. Arduino Nano:

Figure 4.9 Arduino Nano

Arduino Nano was used for implementing the OLED display (Figure 4.7) and MAX30102 sensor (Figure 4.6)

4.3. Implemented Models

The model of a system is vital to understand how the project is supposed to look like. Most of time the hardware doesn't resemble the model exactly but without the model, it cannot be compared to verify the mistakes and scopes for further upgrade. In order to complete the project, both the simulation model and the hardware model are needed. The simulation model gives an idea of whether the project would work as desired and not before implementing the hardware model.

4.3.1. Simulation Model

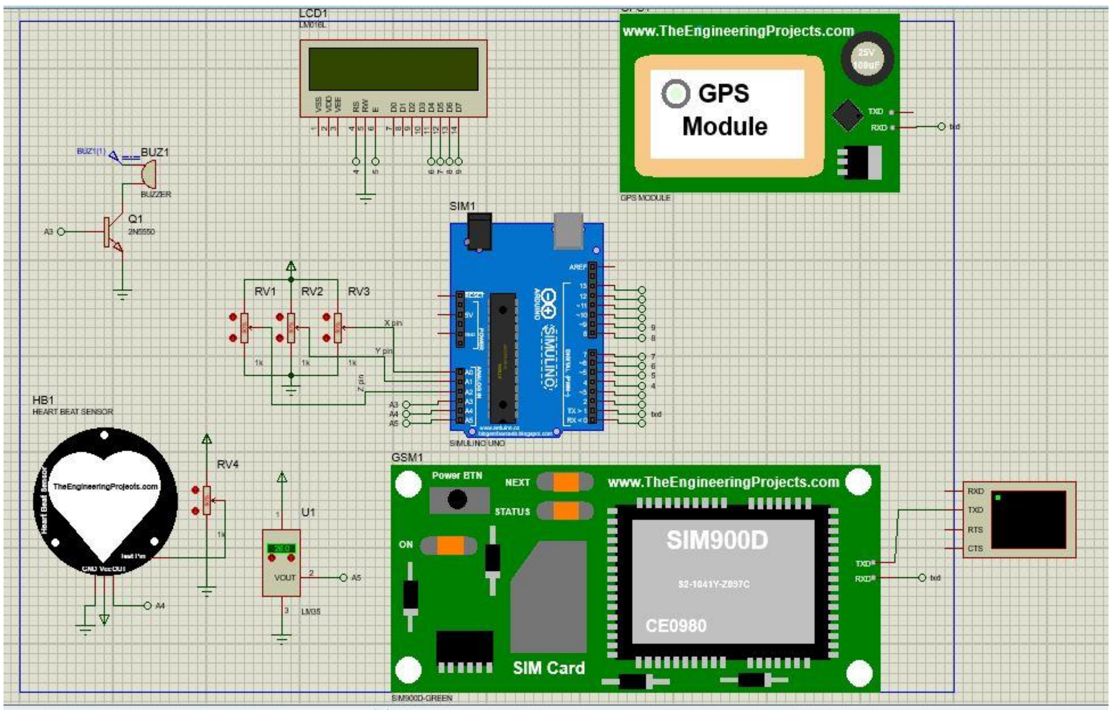


Figure 4.10 Simulation Model Designed in Proteus.

In this figure 4.13 the simulation model designed in the proteus design suite is shown. The simulation contains all the electronic parts including most of the sensors, display, GSM, GPS, and Heart rate sensor. Unfortunately, proteus doesn't have the simulation model of the Gyro Sensor.

4.3.2. Hardware Model

Hardware implementation is the main and crucial part of every project or system. Because in simulation we find effective and accurate results but during implementation time various occurrence happen due to equipment issue or connection issue. The complete project is completed by dividing the work in three sections as mentioned before, the fall detection part, health monitoring part and camera with voice assistant part. Now we will discuss about the implementation of those parts.

4.3.2.1. Health Monitoring Part Implementation

As we mentioned earlier that health monitoring device is the patient's body vitals measuring device which is controlled by Arduino nano therefore, we first implement the nano in the bread board. Next, we connect the Max30102 sensor (for heart rate and oxygen saturation measurement), GY-906 MLX90614ESF -BCC Contactless Temperature Sensor (for temperature measurement) which shown in figure 4.11. Then OLED display is mounted with that part to visualize those parameters which measured by our system.

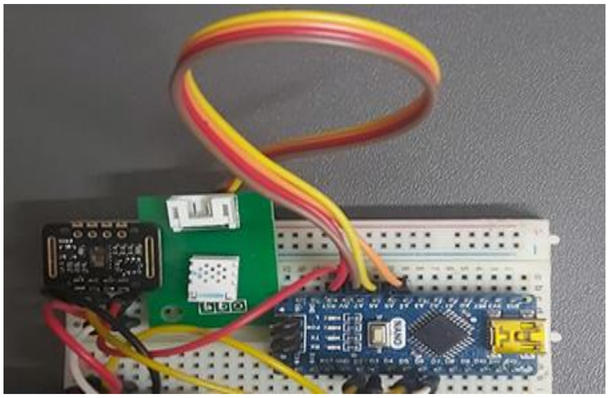


Figure 4.11 Connection of health monitoring sensor with Arduino nano.

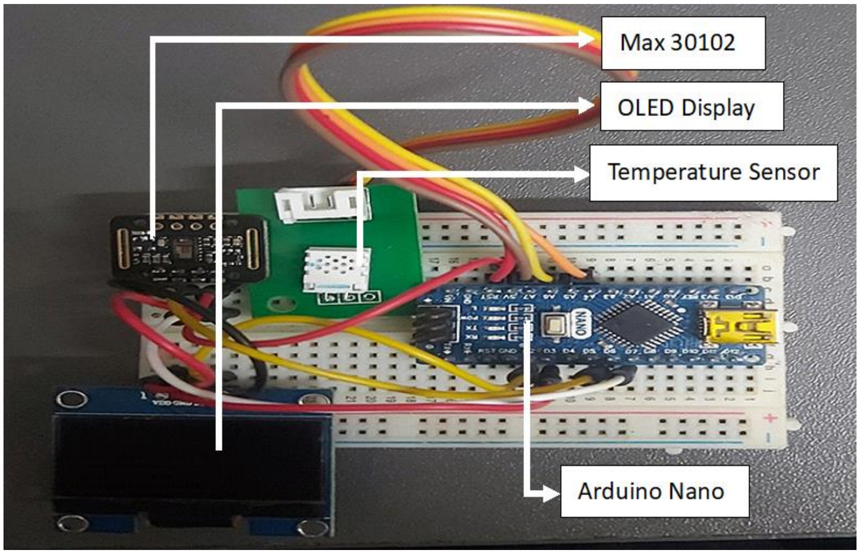


Figure 4.12 Implementation of complete health monitoring watch.

The circuit shown in figure 4.12 is the complete connection of health monitoring part. This is the secondary device of our project. This will display the body vitals (Blood pressure, Temperature, Oxygen saturation, Heart rate).

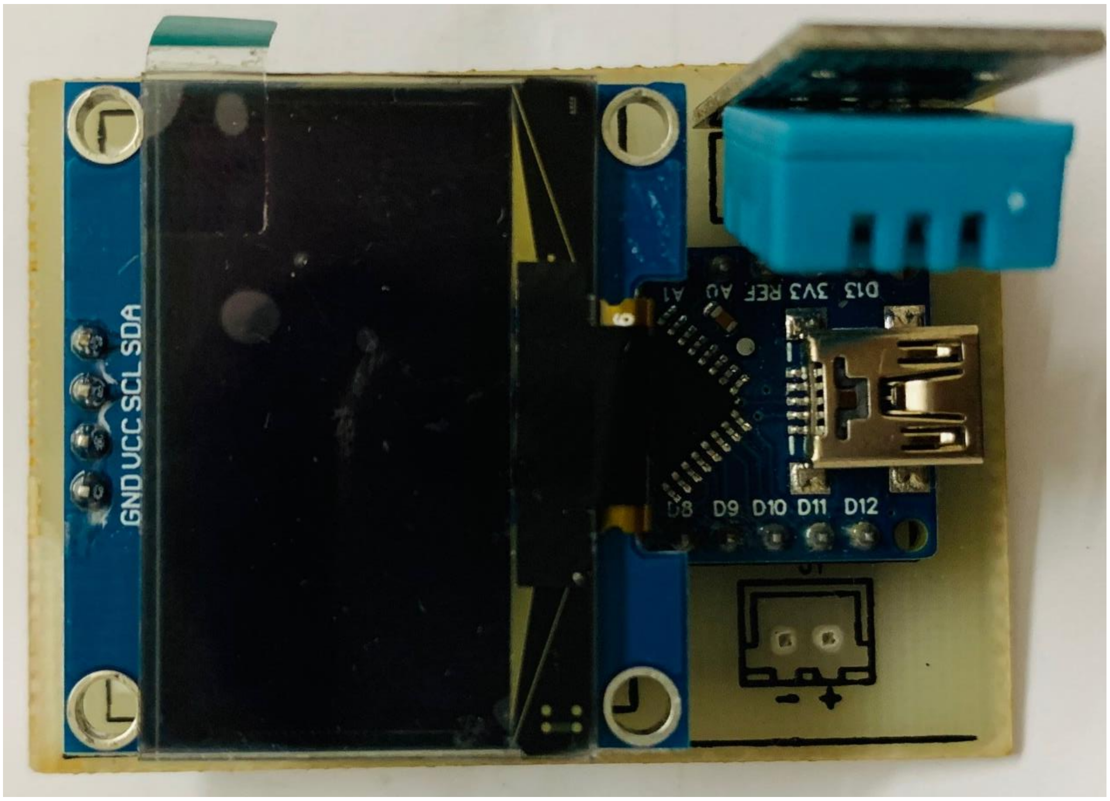


Figure 4.13 Implementation of complete health monitoring watch.

4.3.2.2. Fall Detection Part Implementation

Here figure 4.14 represents the connection between Node MCU and GPS module which is used to track the location of the patient after fall detection.

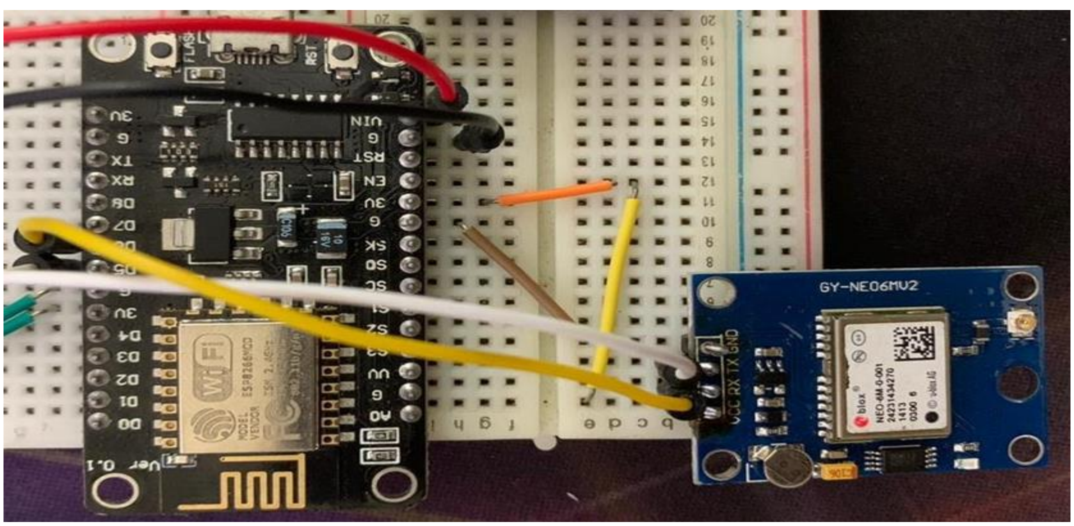


Figure 4.14 GPS module connected with Node MCU.

Gyro sensor is used to detect the angle of fallen. It describes this through X, Y, Z direction. Below figure 4.15 represents the connection between gyro scope sensor with Node MCU.

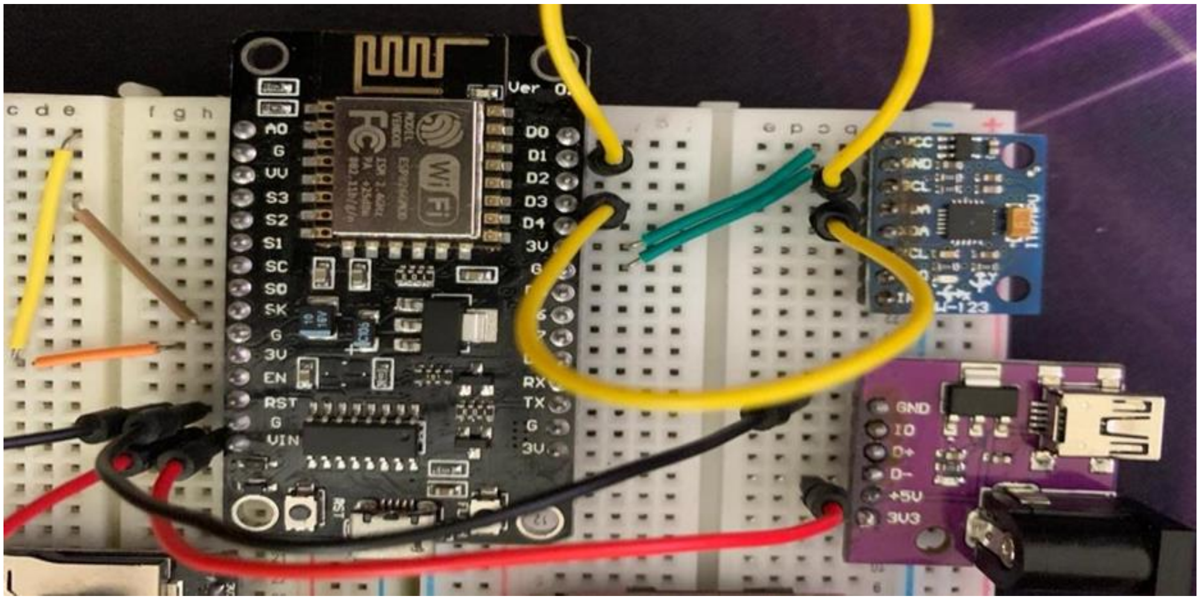


Figure 4.15 Gyro sensor connection.

GSM module is the main module of communication in this system. Which send notification of fall after fall detecting. It also used for voice communication connectivity. Figure 4.16 represent that.

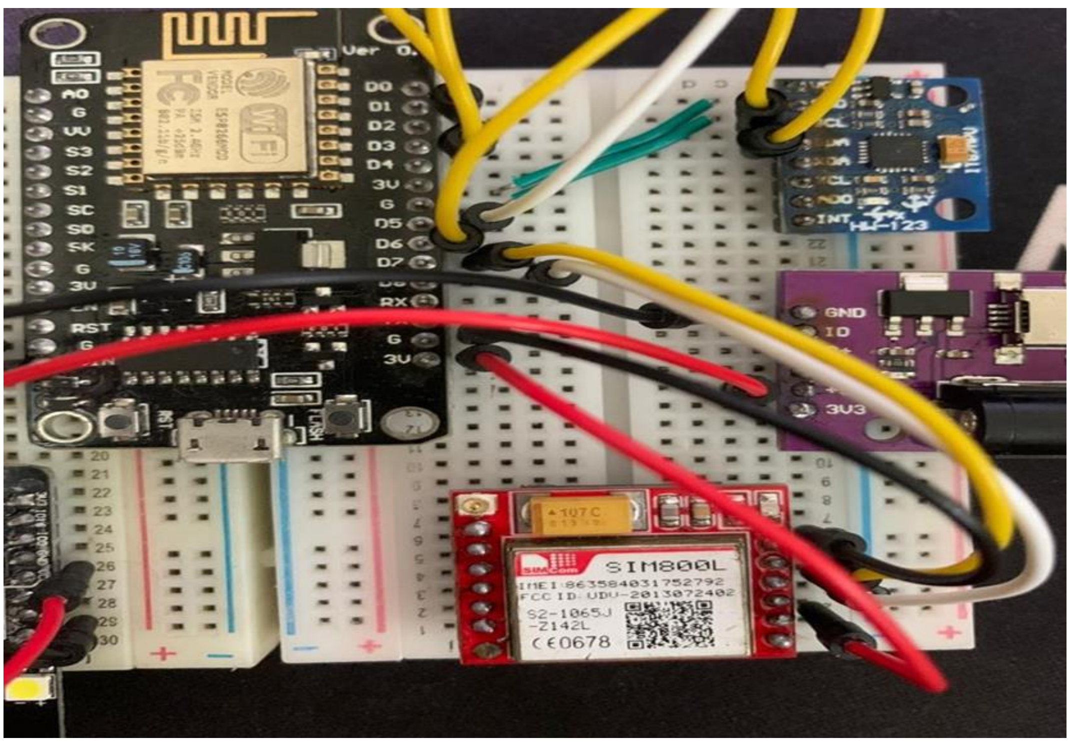


Figure 4.16 GSM module connection.

This circuit shown in figure 4.17 is the main circuit of this project. This circuit is connected with module, gyro sensor, GSM and GPRS module. It’s the primary device in this project used to detect the fall.

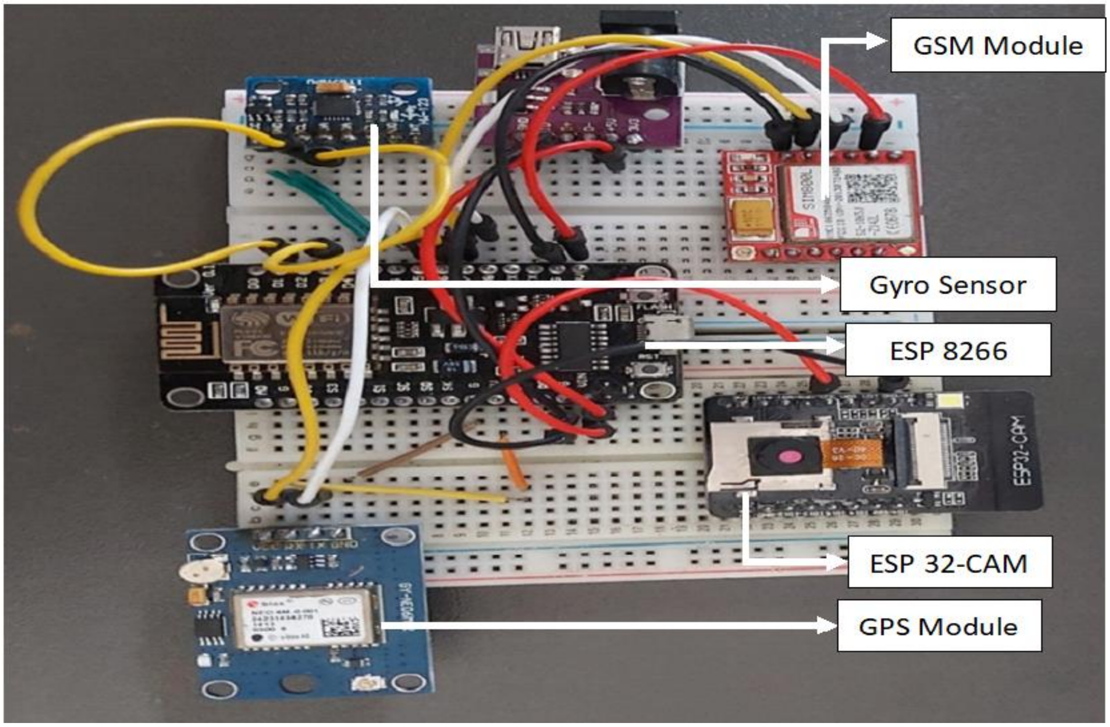


Figure 4.17 Implementation of complete fall detection device.

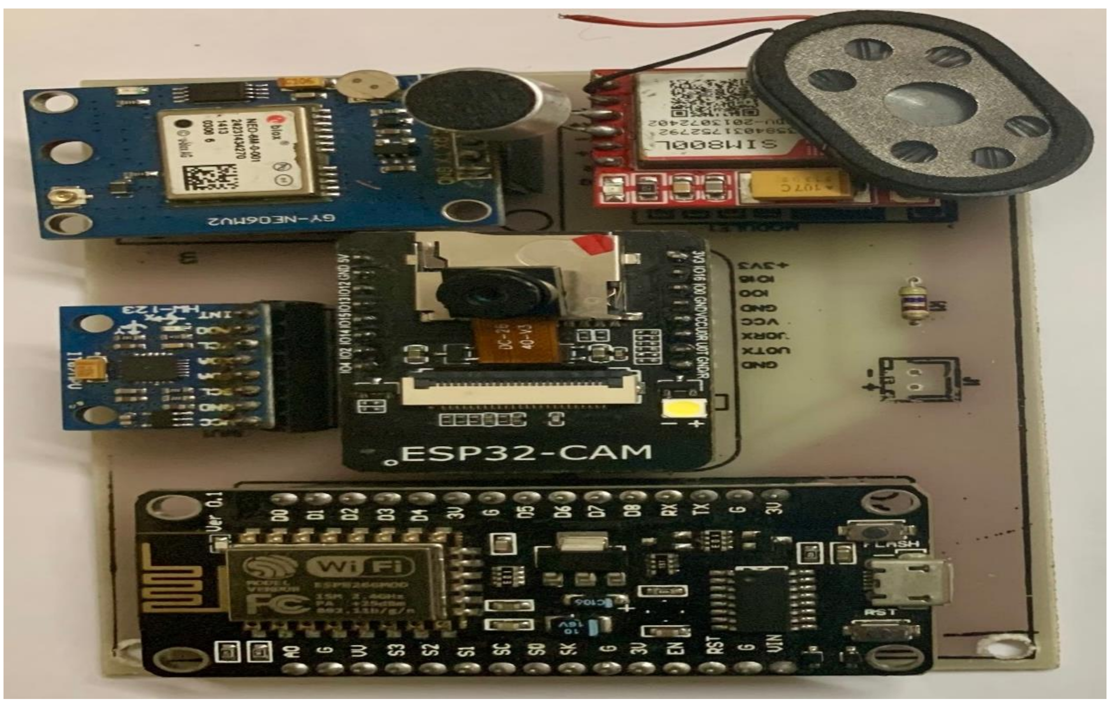


Figure 4.18 Implementation of complete fall detection device in PCB board.

4.3.2.1. Camera and Voice Assistant Part Implementation

Figure 4.19 depicts the connection between ESP-32 CAM with Node MCU. That camera used to communicate with the patient after fall detection. When a patient can't able to move after 30 seconds of fall this camera will start by clicking the IP link and it works as a communication medium between patient and patients relative.

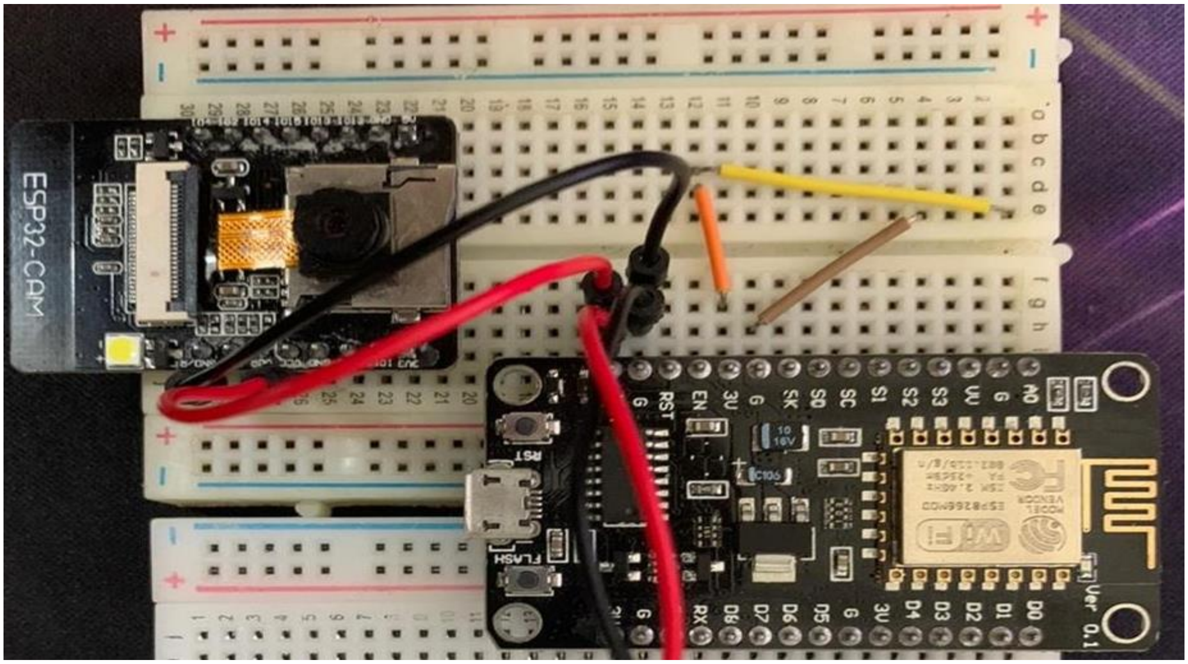


Figure 4.19 ESP 32-CAM connection.

4.4.Engineering Solution in accordance with professional practices

In order to design this project, an advanced level of understanding of circuit implementation is essential. Then, it is necessary to have knowledge about the connection of various sensors, battery power, and each sensor. It is also important to have an idea about the voltage output of the battery and its power so that the sensor inside the device is not damaged or burnt in any way.

4.5. Summary

With the help of the simulation and hardware model, it was assured that our project will work, and the design is based on that. After compiling all the components together, the project took shape, and the endeavor became a success. In order to run the project, combination and understanding of all components are a must.

Chapter 5

RESULTS ANALYSIS & CRITICAL DESIGN REVIEW

5.1. Introduction

The objective of the project was to build a device that could help dementia patients in their need and the device which was constructed is capable of achieving that goal. With the help of this device, it is detectable whether the patient has fallen or not, and provides information to the patient in case of any physical disturbance. With the help of the camera and microphone inside the device, the caregiver could communicate with him/her or monitor his/her activities and location.

5.2. Results Analysis

Like other countries, the number of dementia patients is increasing day by day in Bangladesh. According to the data of Dhaka Tribune, one in every 12 citizens above sixty is suffering from dementia. The goal of this project was to extend a helping hand to these patients so that they can move freely without being confined to a life of confinement. The project is successful in developing a device that is able to deliver its output. As the device can determine if there is a real fall or not, the device provides information to its caregiver through its own intelligence if any accident is detected. It also provides information to its caregiver based on different physical conditions and the caregiver can monitor its location and communicate or give advice whenever it wants. So, it can be said that the objective of the project is reached, and the goal of the project is achieved.

5.2.1. Simulated Results

A simulation of the project was done on Proteus 8.14 platform to understand the workings of the project and the result of the simulation gave the project its confidence to move forward.

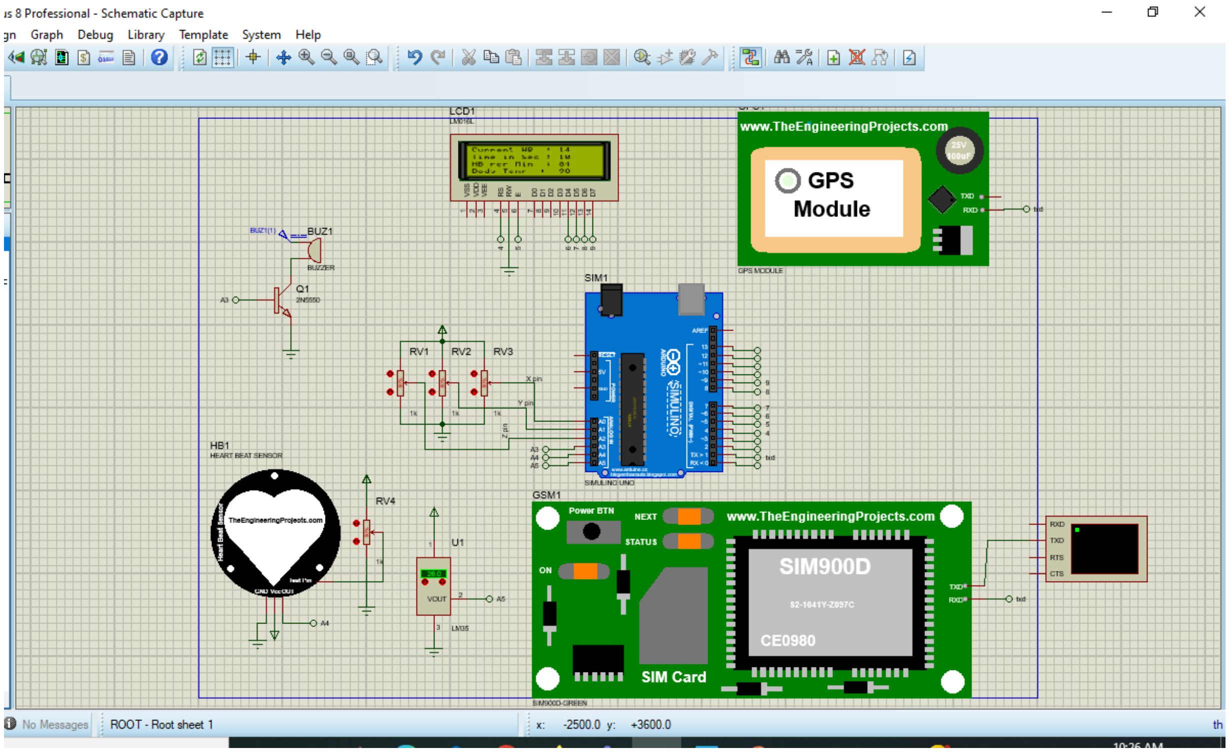


Figure 5.1 Simulation results for the proposed project.

5.2.2. Hardware Results

In this section implemented hardware results will be discussed briefly.

5.2.2.1. Fall Detection Result Analysis

A method known as the confusion matrix is used to evaluate the system's performance in terms of four performance metrics: recall, specificity, precision, and accuracy. Table 5.1 provides the shape of the confusion matrix.

Table 5.1 Shape of the confusion matrix [20-21].

<table>
<tr><td rowspan="4">Predicted Value</td><td colspan="3">Actual Value
(From our experiment)</td></tr>
<tr><td></td><td>Positives</td><td>Negatives</td></tr>
<tr><td>Positives</td><td>TP (True Positive)</td><td>FP (False Positive)</td></tr>
<tr><td>Negatives</td><td>FN (False Negative)</td><td>TN (True Negative)</td></tr>
</table>

Typically, supervised learning uses the confusion matrix. The confusion matrix approach has also been used in cluster-based image retrieval [22], showing a classifier's perception of a class configuration [23], mapping land use/land cover (LULC) [24], evaluating online services [25], and other applications. It includes both the total number of instances that were correctly and erroneously categorized. Because the anticipated group and the actual group have the same value, the examples that are correctly categorized are those that appear on the diagonal. The following formula is used to determine each performance statistic.

$$\text{Precision} = \frac{TP}{TP+FP} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

The accuracy of all document categorization findings is measured by precision. The system's accuracy is determined by dividing the number of correct recognitions it made by the total number of recognitions it made. The percentage of real negatives that are accurately detected is measured by a metric called specificity. Another name for specificity is the genuine negative level.

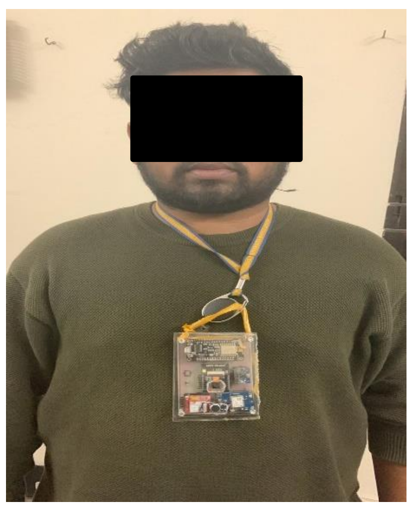


Figure 5.2 Hardware setup in human body.

Figure 5.2 depicts the fall detection system's hardware configuration. This fall detector, which has a length of about 10cm, may be installed on a belt worn around the neck by elderly people. Each component's weight is sufficiently light for older people to wear it comfortably.

To find out whether the system is capable of detecting each movement activity of the user, experimental testing are conducted. According to the criteria in the confusion matrix approach, the test results are divided into four basic conditions: TP (true positive), TN (true negative), FP (false positive), and FN (false negative). TP is shown whenever the actual condition falls and the system notices the drop. The system detects not falling, and TN is used to designate the real circumstance as not falling. While FN represents the real situation of falling and the system detects not falling, FP is a state where the actual condition is not to fall and the system detects a fall.

The system's accuracy was tested in the first experiment to see how well it could predict transitions from a standing to a falling position. The comparison between the real circumstances and the system readings, as well as the parameters in the confusion matrix derived from the experimental data, which were carried out 8 times, are shown in Table 1 along with the results of the comparison. During the experiment, the LED blinks and a short message notification appears or vanishes as shown by the binary integers 1 or 0 in Table 5.2.

Table 5.2 Findings from experiments for recognizing a change from moving to falling

Actual Condition	LED blinking			SMS	Read by system	Mark
	on	15s	30s			
Fall	1	0	1	1	Walking	FN
Fall	1	0	1	1	Slightly Moved	FN
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Slightly Moved	FN
Standing	0	0	0	0	Standing	TN
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Slightly Moved	FN
Fall	1	0	1	1	Fall	TP
Standing	0	0	0	0	Standing	TN
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Fall	TP
Fall	1	0	0	1	Fall	FP
Fall	1	0	1	1	Fall	TP
Fall	1	0	1	1	Fall	TP
Standing	1	0	0	1	Fall	FP
Standing	1	0	0	1	Fall	FP

According to the experimental findings, a total of 20 tests were performed, with the results showing that true positives occurred 9 times, true negatives occurred 2 times, false positives occurred 3 times, false negatives occurred 4 times, and testing with an undefined description occurred twice. It is possible for the test results to have undefined descriptions since neither the real situation nor the system condition depicts any movement other than falling. Such outcomes cannot be a benchmark for figuring out performance indicators. These findings indicate that a total of 18 tests were conducted in order to determine performance measures. The experiment's findings took 9, 2, 3, and 4 times respectively, for TP, TN, FP, and FN. Using equations (1) – (2), the performance metric of our suggested systems provides, respectively, precision values of around 75%, and accuracy values of 61%.

$$\text{Precision} = \frac{9}{9+3} = 0.75 = 75\%$$

$$\text{Accuracy} = \frac{9+2}{9+2+3+4} = 0.61 = 61\%$$

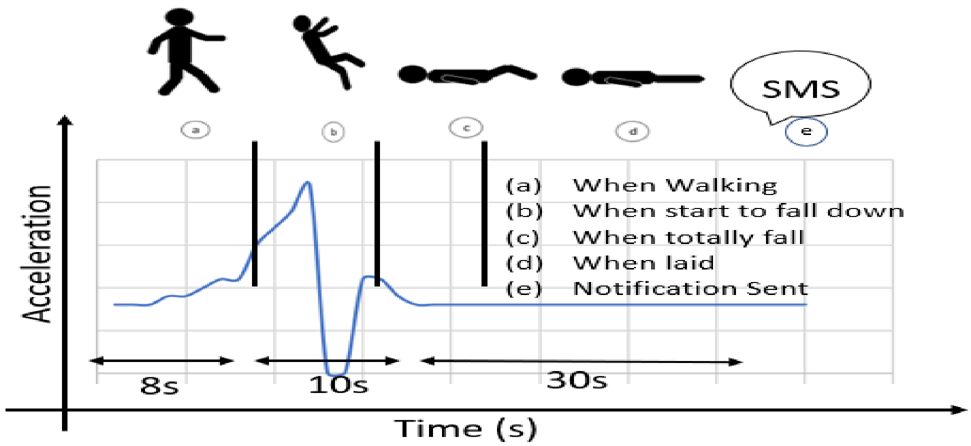


Figure 5.3 Fall detection time vs acceleration graph.

Figure 5.3 represents the acceleration vs time graph for gyro sensor. Which value are extracted from simulation.

In normal condition our fall detection device didn’t response but very few times it gives false notification. When it detects fall it sending the notification through (SMS) which shown in figure 5.4 which included an IP link for communication.

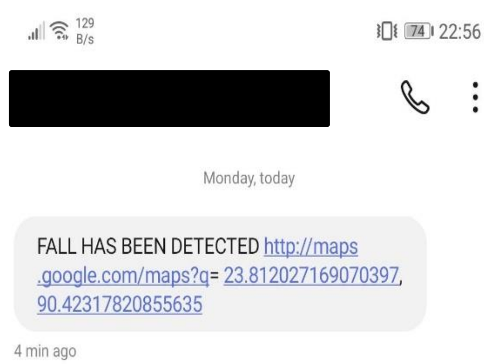


Figure 5.4 Showing the notification (SMS) alert after fall detection.

5.2.2.2. Health Monitoring Part Result Analysis

Health monitoring part is mainly the body vitals checking portion which measure body temperature, oxygen saturation, and pulse rate of the patient. Figure 5.5 represents the body vitals measuring part in normal conditions.

Figure 5.5 Health monitoring device implemented in human body.

After fall the body vitals parameters are taken which depicts in figure 5.6.

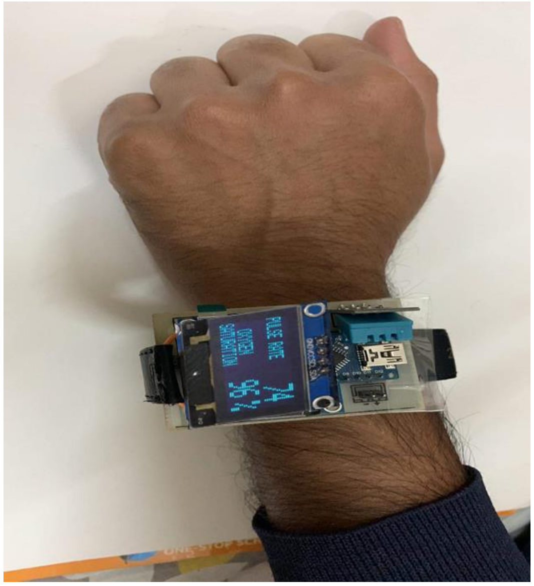


Figure 5.6 Body vitals measured by health monitoring device after fall detection.

5.2.2.3. Camera and Voice Assistant Part Result Analysis

This segment will discuss about the communication between patient with relatives via camera module and talking with other each other through microphone. An IP link will send from the fall detection device when it detects the fall. Then person who received the SMS can able to talk with the patient by clicking on that link. A microphone along with camera is attached with the system. By clicking the link, it will start to run. Then they can easily available to communicate. Moreover, we are also made the system that if patient relative want to communicate with the patient they can call to that sim and it will automatically receive by the system. And they can able to start communicate. After the completion of the hardware, the project runs successfully.

Figure 5.7 Front view of patient camera.

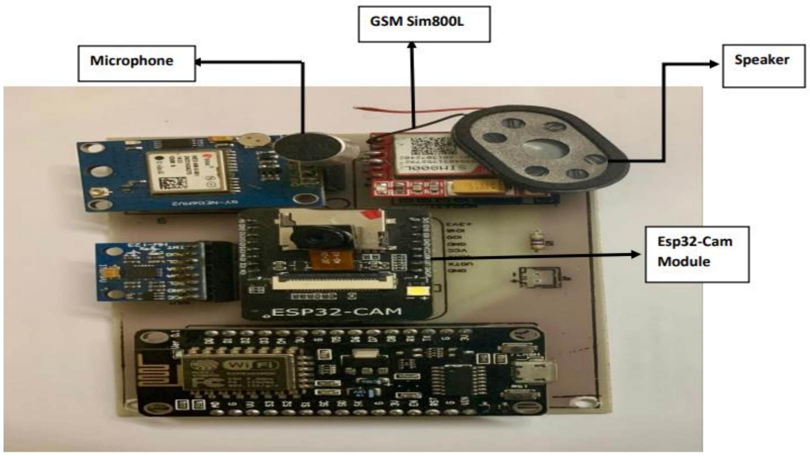


Figure 5.8 Communication through camera.

5.3. Comparison of Results

The hardware and the simulation of the project both showed very promising results. Although, no accurate simulation of fall detection has been possible since it is an extrinsic task, it is difficult to show in simulation. After proper examination of hardware, it can be said that the project is functioning properly. The output result that was found after various experiments were usable and within expectation. The complete device as a whole run smoothly beyond expectation. One of the noticeable features of the project is, it can be adjusted by the individual according to his/her daily activities.

5.4. Summary

The study of this project result takes a very thorough look at the systems components and their functioning. After completion, it was found that the project was successful and produces an 80 percent workable output. The objective of the project was to develop a constriction of thread which is achieved via plastic strings. The goal of the project is to help dementia patients with a device that will detect their physical condition and take necessary action in case of unexpected events. Although the device is built with a complex design, it is usable and its quality is better than any other device. It will not be difficult for elderly people to carry as it is very lightweight, and it won't be an overreach to say that the goals of this project are very much achievable.

Chapter 6

CONCLUSION

6.1. Summary of Findings

Old age is an integral part of human life, no one can cut this part even if they want to. And with increasing age, people are linked with various diseases. Dementia is a disease that makes an elderly person prone to forget his daily activities, fall at any time and develop mood swings that are very embarrassing to his family and relatives, and due to these reasons, he is not allowed to go out. This project has been taken up keeping these problems in mind. The device of this project can help these patients, regardless of their physical condition, location, and instant communication with caregivers. This way the person with dementia can stay safe and his family can rest assured about him.

6.2. Novelty of the work

The objective of this project is to develop a device that could help dementia patients and keep them under monitoring and take action in any unexpected event. Although the idea of the project is not new, the method, design, and combinations are certainly novel. Although there are devices for dementia patients in the global market, they are very costly and require skill to operate. But our device is made for the Bangladeshi context because most of the people in Bangladesh are unskilled and illiterate with technology, also dementia patients tend to be forgetful so they won't benefit much from using those devices. So, we built a device that works automatically keeping these things in mind. Also, keeping in mind that it will be used by elderly people, we have created this device very lightly so that it is not considered a burden for them to use. Above all, it can be said that the project is novel and the very first of its kind.

6.3. Cultural and Societal Factors and Impacts

The project has been done keeping in mind the technology inadequacy of Bangladeshi people. In making this project, many sensors have to be used in terms of quality standards and their limitation. Also, since complex circuits are used and power connections are in place; we have completed the project ensuring that there is no harm to human being through prolonged monitoring. There is no social or cultural issue that will conflict with our device.

6.4. Limitations of the Work

Although the project is successful, it is not without limitations. Since telecommunication system is used in our technology, there are some limitations i.e., SIM and Wi-Fi. There are many problems with the telecommunication network in Bangladesh and the sensor is not suitable for using any sim other than 2G SIM. Because of that, there is always a problem with network availability. Because of this, the images saved in the camera module are received by the caregiver with a little delay. But while at home i.e., when connected to home Wi-Fi, this problem does not occur. In addition, since the affordable camera sensor in Bangladesh is not more than two megapixels, the images are not very clear. As we used couple of microcontrollers it seems bulky and bigger. On the contrary the device is not able to communicate with sim due to country lock issue that’s why in this time being we are using Wi-Fi for communication purpose. And body parameters that measure by our device can’t be sent to patient’s emergency contact through SMS due to this sim issue. Moreover, the 3D design we have designed can’t able to implement because that material is not available right now. Without this situation our project is working smoothly.

6.5. Future Scopes

Technology means improving day by day, giving new form to old things. Since the project has a problem with the network, it can be worked on in the future, and maybe then there will be sensors or some kind of conditions so that the telecommunication network will not cause any kind of problem. Also, because there is a little problem with the camera model, so maybe in the future better-quality sensors will exist in Bangladesh which can take very clear pictures. Also, small portable IP cameras may be available which can easily monitor the live location of a person, which is not possible in present to manufacture in Bangladesh due to the non-availability of such cameras. In future we will try to establish that sim card system by unlocking country lock of GSM module. Besides by creating the 3D design we will make our device more compact and lucrative.

6.6. Social, Economic, Cultural and Environmental Aspects

6.6.1. Sustainability

The Sustainable Development Goals, abbreviated as SDG, are made up of 17 rules. The project we developed is included in number three of the seventeen rules of SDG and it is about good health and well-being. As we work on making a device for dementia patients, it falls under the biomedical sector, and this is how the project meets the requirement of SDG. This device is capable of long use only through charging. If the battery used in our device is damaged, the battery can be manually replaced, which means it can be used for a long time. All the components of the project are also available in the local market which makes it very sustainable and easy to repair and duplicate.

6.6.2. Economic and Cultural Factors

In order to create a device that is sustainable in the current economic environment of Bangladesh, it was made sure that the cost of the project doesn't get too high. All the components of the project are also available in the local market which makes it very sustainable and easy to repair and duplicate.

6.7. Conclusion

A compilation of mechanical and electrical knowledge in a single project gets somewhat complex and that is exactly what has been done in this project. The light device parts were constructed via PCB designing and the electrical connections were done successfully because of the knowledge provided throughout many courses in Electrical and Electronic Engineering. The project not only provides a solution for dementia patients but also creates a way to help our biomedical sector. In order to complete the project, extensive research was done to gain knowledge about the project and the mechanism of its workings. A comprehensive study based on the hardware and simulation was done to understand the process. and finally, the device is successful in producing a workable output while achieving the goals and objective of the project.

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Appendix A

Datasheet of the ICs used

1. MPU6050

Pin Number	Pin Name	Description
1	Vcc	Provides power for the module, can be +3V to +5V. Typically +5V is used
2	Ground	Connected to Ground of system
3	Serial Clock (SCL)	Used for providing clock pulse for I2C Communication
4	Serial Data (SDA)	Used for transferring Data through I2C communication
5	Auxiliary Serial Data (XDA)	Can be used to interface other I2C modules with MPU6050. It is optional
6	Auxiliary Serial Clock (XCL)	Can be used to interface other I2C modules with MPU6050. It is optional
7	AD0	If more than one MPU6050 is used a single MCU, then this pin can be used to vary the address
8	Interrupt (INT)	Interrupt pin to indicate that data is available for MCU to read.

2. ESP8266

Pin Number	Pin Name	Alternate Name	Normally used for	Alternate purpose
1	Ground	-	Connected to the ground of the circuit	-
2	TX	GPIO – 1	Connected to Rx pin of programmer/uC to upload program	Can act as a General-purpose Input/output pin when not used as TX
3	GPIO-2	-	General purpose Input/output pin	-
4	CH_EN	-	Chip Enable – Active high	-

5	GPIO - 0	Flash	General purpose Input/output pin	Takes module into serial programming when held low during start up
6	Reset	-	Resets the module	-
7	RX	GPIO - 3	General purpose Input/output pin	Can act as a General-purpose Input/output pin when not used as RX
8	Vcc	-	Connect to +3.3V only	

3. Sim868

Notes	Pin					Pin	Notes
SIM card detection	DET	1	AN	PWM	16	RING	Ring indicator
SIM reset	RST	2	RST	INT	15	CTS	Clear to send
Request to send	RTS	3	CS	TX	14	TXD	Transmit data
	NC	4	SCK	RX	13	RXD	Receive data
	NC	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
Power supply	+3.3V	7	3.3V	5V	10	+5V	Power supply
Ground	GND	8	GND	GND	9	GND	Ground

5. Cam-ESP32

Pin No.	Name	Type	Function
1	5V	POWER	5V Supply
2	GND	POWER	Ground pin
3	IO12	I/O	GPIO 12/MicroSD DATA2
4	IO13	I/O	GPIO 13/MicroSD DATA3
5	IO15	I/O	GPIO 15/MicroSD CMD

6	IO14	I/O	GPIO 14/MicroSD CLK
7	IO2	I/O	GPIO 2/MicroSD DATA0
8	IO4	I/O	GPIO 12/MicroSD DATA1/ Flash
9	GND	POWER	Ground pin
10	UOT/IO1	I/O	UART TX /GPIO 1
11	UOR/IO3	I/O	UART RX /GPIO 3
12	VCC	POWER	5V/3.3V
13	GND	POWER	Ground pin
14	IO0	I/O	GPIO 0 / Boot select
15	IO16	I/O	GPIO 16
16	3V3	POWER	3.3V Supply

6. Arduino Nano

Pin Category	Pin Name	Details
Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source (6-12V). 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: Ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A7	Used to measure analog voltage in the range of 0-5V
Input/Output Pins	Digital Pins D0 - D13	Can be used as input or output pins. 0V (low) and 5V (high)
Serial	Rx, Tx	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
IIC	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

Appendix B

iThenticate Plagiarism Report

Appendix C

Code

```
#include "esp_camera.h"
#include <WiFi.h>

//
// WARNING!!! PSRAM IC required for UXGA resolution and high JPEG quality
//            Ensure ESP32 Wrover Module or other board with PSRAM is selected
//            Partial images will be transmitted if image exceeds buffer size
//

// Select camera model
// #define CAMERA_MODEL_WROVER_KIT  // Has PSRAM
//#define CAMERA_MODEL_ESP_EYE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_PSRAM // Has PSRAM
//#define CAMERA_MODEL_M5STACK_V2_PSRAM // M5Camera version B Has PSRAM
//#define CAMERA_MODEL_M5STACK_WIDE // Has PSRAM
//#define CAMERA_MODEL_M5STACK_ESP32CAM // No PSRAM
#define CAMERA_MODEL_AI_THINKER // Has PSRAM
//#define CAMERA_MODEL_TTGO_T_JOURNAL // No PSRAM

#include "camera_pins.h"

const char* ssid = "Area 51 ^_^";
const char* password = "Internet51";

void startCameraServer();

void setup() {
  Serial.begin(115200);
  Serial.setDebugOutput(true);
```

```
Serial.println();

camera_config_t config;
config.ledc_channel = LEDC_CHANNEL_0;
config.ledc_timer = LEDC_TIMER_0;
config.pin_d0 = Y2_GPIO_NUM;
config.pin_d1 = Y3_GPIO_NUM;
config.pin_d2 = Y4_GPIO_NUM;
config.pin_d3 = Y5_GPIO_NUM;
config.pin_d4 = Y6_GPIO_NUM;
config.pin_d5 = Y7_GPIO_NUM;
config.pin_d6 = Y8_GPIO_NUM;
config.pin_d7 = Y9_GPIO_NUM;
config.pin_xclk = XCLK_GPIO_NUM;
config.pin_pclk = PCLK_GPIO_NUM;
config.pin_vsync = VSYNC_GPIO_NUM;
config.pin_href = HREF_GPIO_NUM;
config.pin_sscb_sda = SIOD_GPIO_NUM;
config.pin_sscb_scl = SIOC_GPIO_NUM;
config.pin_pwdn = PWDN_GPIO_NUM;
config.pin_reset = RESET_GPIO_NUM;
config.xclk_freq_hz = 20000000;
config.pixel_format = PIXFORMAT_JPEG;

// if PSRAM IC present, init with UXGA resolution and higher JPEG quality
//                      for larger pre-allocated frame buffer.
if(psramFound()){
  config.frame_size = FRAMESIZE_UXGA;
  config.jpeg_quality = 10;
  config.fb_count = 2;
} else {
  config.frame_size = FRAMESIZE_SVGA;
```

```
    config.jpeg_quality = 12;
    config.fb_count = 1;
  }

#if defined(CAMERA_MODEL_ESP_EYE)
  pinMode(13, INPUT_PULLUP);
  pinMode(14, INPUT_PULLUP);
#endif

  // camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }

  sensor_t * s = esp_camera_sensor_get();
  // initial sensors are flipped vertically and colors are a bit saturated
  if (s->id.PID == OV3660_PID) {
    s->set_vflip(s, 1); // flip it back
    s->set_brightness(s, 1); // up the brightness just a bit
    s->set_saturation(s, -2); // lower the saturation
  }
  // drop down frame size for higher initial frame rate
  s->set_framesize(s, FRAMESIZE_QVGA);

#if defined(CAMERA_MODEL_M5STACK_WIDE) || defined(CAMERA_MODEL_M5STACK_ESP32CAM)
  s->set_vflip(s, 1);
  s->set_hmirror(s, 1);
#endif
```

```
  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  startCameraServer();

  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  Serial.println("' to connect");
}

void loop() {
  // put your main code here, to run repeatedly:
  delay(10000);
}

#include <Wire.h>
#include <ESP8266WiFi.h>
#include <SoftwareSerial.h> // Library for using serial communication
#include <MicroNMEA.h> // Library for converting NEMA message
float lat = 28.5458, lon = 77.1703; // create variable for latitude and longitude object
SoftwareSerial gsm(7, 8);
SoftwareSerial GPSData(5, 6);

String fromGSM="";
char buffer[85];
String ring_number;
```

```
const unsigned long eventInterval = 20000;
unsigned long previousTime = 0;
MicroNMEA nmea(buffer, sizeof(buffer));

unsigned long lastLog = 0;
//int state = 0;
float latitude_mdeg ;
float longitude_mdeg ;

const int MPU_addr = 0x68; // I2C address of the MPU-6050
int16_t AcX, AcY, AcZ, Tmp, GyX, GyY, GyZ;
float ax = 0, ay = 0, az = 0, gx = 0, gy = 0, gz = 0;
boolean fall = false; //stores if a fall has occurred
boolean trigger1 = false; //stores if first trigger (lower threshold) has occurred
boolean trigger2 = false; //stores if second trigger (upper threshold) has occurred
boolean trigger3 = false; //stores if third trigger (orientation change) has occurred
byte trigger1count = 0; //stores the counts past since trigger 1 was set true
byte trigger2count = 0; //stores the counts past since trigger 2 was set true
byte trigger3count = 0; //stores the counts past since trigger 3 was set true
int angleChange = 0;
// WiFi network info.
const char* ssid = "Area 51 ^_^";
const char* password = "Internet51";
void send_event(const char *event);
const char *host = "gps.dsttamal.me";
void setup() {
  Serial.begin(19200);
  gsm.begin(115200); // baudrate for GSM shield
  GPSData.begin(9600); // baudrate for GPS data
  Serial.println("Starting...");
  Wire.begin();
  Wire.beginTransmission(MPU_addr);
```

```
Wire.write(0x6B);  // PWR_MGMT_1 register
Wire.write(0);     // set to zero (wakes up the MPU-6050)
Serial.println("Wrote");
int wifi_con = 0;
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED)
{
  delay(500);
  wifi_con++;
  Serial.print(".");              // print ... till not connected
  if (wifi_con == 10)
  {
    break;
  }
}
Serial.println("");
if (WiFi.status() == WL_CONNECTED)
{
  Serial.println("WiFi connected");
}
gsm.println("\r");
gsm.println("AT+GPS=1\r");
delay(100);
gsm.println("AT+CREG=2\r");
delay(6000);
//gsm.print("AT+CREG?\r");
gsm.println("AT+CGATT=1\r");
delay(6000);
gsm.println("AT+CGDCONT=1,\"IP\",\"WWW\"\r");
delay(6000);
// gsm.println("AT+LOCATION=1\r");
```

```
  gsm.println("AT+CGACT=1,1\r");
  delay(6000);
  //Initialize ends
  //Initialize GPS
  gsm.println("\r");
  gsm.println("AT+GPS=1\r");
  delay(1000);
  //gsm.println("AT+GPSMD=1\r");   // Change to only GPS mode from GPS+BDS, set to 2 to revert to default.
  // set SMS mode to text mode
  gsm.println("AT+CMGF=1\r");
  delay(1000);
  //gsm.println("AT+LOCATION=2\r");
  // set gsm module to tp show the output on serial out
  gsm.println("AT+CNMI=2,2,0,0,0\r");
  delay(1000);
  gsm.print("AT+CMGS=\"+8801301914097\"\r"); //Replace this with your mobile number
  delay(1000);
  //The text of the message to be sent.
  gsm.print("Tracker active...");
  gsm.write(0x1A);
  delay(1000);
  gsm.print("ATS0=1");
  gsm.print("\r");
  delay(300);
}
void loop() {
  char inChar = gsm.read();
  if (inChar == '\n') {
    if(fromGSM == "RING\r"){
      //read number
      ring_number = gsm.readString();
```

```
    //send ip
    send_address(ring_number);
    //clear the buffer
    fromGSM = "";
   }else {
      fromGSM+=inChar;
  }
}
mpu_read();
ax = (AcX - 2050) / 16384.00;
ay = (AcY - 77) / 16384.00;
az = (AcZ - 1947) / 16384.00;
gx = (GyX + 270) / 131.07;
gy = (GyY - 351) / 131.07;
gz = (GyZ + 136) / 131.07;
// calculating Amplitute vactor for 3 axis
float Raw_Amp = pow(pow(ax, 2) + pow(ay, 2) + pow(az, 2), 0.5);
int Amp = Raw_Amp * 10;  // Mulitiplied by 10 bcz values are between 0 to 1
Serial.println(Amp);
if (Amp <= 2 && trigger2 == false) { //if AM breaks lower threshold (0.4g)
  trigger1 = true;
  Serial.println("TRIGGER 1 ACTIVATED");
}
if (trigger1 == true) {
  trigger1count++;
  if (Amp >= 12) { //if AM breaks upper threshold (3g)
    trigger2 = true;
    Serial.println("TRIGGER 2 ACTIVATED");
    trigger1 = false; trigger1count = 0;
}
if (trigger2 == true) {
  trigger2count++;
```

```
    angleChange = pow(pow(gx, 2) + pow(gy, 2) + pow(gz, 2), 0.5); Serial.println(angleChange);
    if (angleChange >= 30 && angleChange <= 400) { //if orientation changes by between 80-100 degrees
      trigger2count = 0;
      Serial.println(angleChange);
      Serial.println("TRIGGER 3 ACTIVATED");
    }
  }
  if (trigger3 == true) {
    trigger3count++;
    if (trigger3count >= 40) {
      angleChange = pow(pow(gx, 2) + pow(gy, 2) + pow(gz, 2), 0.5);
      //delay(10);
      Serial.println(angleChange);
      if ((angleChange >= 0) && (angleChange <= 10)) { //if orientation changes remains between 0-10
degrees
        fall = true;
        trigger3 = false;
        trigger3count = 0;
        Serial.println(angleChange);
      }
      else {
        //user regained normal orientation
        trigger3 = false
        Serial.println("TRIGGER 3 DEACTIVATED");
      }
    }
  }
  if (fall == true) {
    //in event of a fall detection
    Serial.println("FALL DETECTED");
    send_sms("FALL DETECTED");
    send_event("FALL DETECTED");
```

```
    fall = false;
    //      break;
  }
  if (trigger2count >= 6) { //allow 0.5s for orientation change
    trigger2 = false; trigger2count = 0;
    Serial.println("TRIGGER 2 DECACTIVATED");
  }
  if (trigger1count >= 6) { //allow 0.5s for AM to break upper threshold
    trigger1 = false; trigger1count = 0;
    Serial.println("TRIGGER 1 DECACTIVATED");
  }
  delay(100);
}
void mpu_read() {
  Wire.beginTransmission(MPU_addr);
  Wire.write(0x3B);  // starting with register 0x3B (ACCEL_XOUT_H)
  Wire.endTransmission(false);
  Wire.requestFrom(MPU_addr, 14, true); // request a total of 14 registers
  AcX = Wire.read() << 8 | Wire.read(); // 0x3B (ACCEL_XOUT_H) & 0x3C (ACCEL_XOUT_L)
  AcY = Wire.read() << 8 | Wire.read(); // 0x3D (ACCEL_YOUT_H) & 0x3E (ACCEL_YOUT_L)
  AcZ = Wire.read() << 8 | Wire.read(); // 0x3F (ACCEL_ZOUT_H) & 0x40 (ACCEL_ZOUT_L)
  GyX = Wire.read() << 8 | Wire.read(); // 0x43 (GYRO_XOUT_H) & 0x44 (GYRO_XOUT_L)
  GyY = Wire.read() << 8 | Wire.read(); // 0x45 (GYRO_YOUT_H) & 0x46 (GYRO_YOUT_L)
  GyZ = Wire.read() << 8 | Wire.read(); // 0x47 (GYRO_ZOUT_H) & 0x48 (GYRO_ZOUT_L)
}
void send_event(const char *event)
{
  Serial.print("Connecting to ");
  Serial.println(host);
  // Use WiFiClient class to create TCP connections
  WiFiClient client;
  const int httpPort = 80;
```

```
  if (!client.connect(host, httpPort)) {
    Serial.println("Connection failed");
    return;
  }
  // We now create a URI for the request
  String url = "/i";
  url += longitude_mdeg;
  url += "&mobile=01301914097";
  url += "&text=FALL%20HAS%20BEEN%20DETECTED%20";
  Serial.print("Requesting URL: ");
  Serial.println(url);
  // This will send the request to the server
  client.print(String("GET ") + url + " HTTP/1.1\r\n" +
               "Host: " + host + "\r\n" +
               "Connection: close\r\n\r\n");
  while (client.connected())
  {
    if (client.available())
    {
      String line = client.readStringUntil('\r');
      Serial.print(line);
    } else {
      delay(50);
    };
  }
  Serial.println();
 client.stop();
}
void send_sms(const char *event)
{
  gsm.print("\r");
  delay(1000);
```

```
  gsm.print("AT+CMGS=\"+8801301914097\"\r");  // Replace this with your mobile number.
  delay(1000);
  //The text of the message to be sent.
  gsm.println("FALL DETECTED");
  gsm.print("www.google.com/maps/?q=");
  gsm.println(latitude_mdeg, 6);
  gsm.print(",");
  gsm.println(latitude_mdeg, 6);
  delay(1000);
  gsm.write(0x1A);
  delay(100);
}
void send_address(String ring_number)
{
  gsm.print("\r");
  delay(1000);
  gsm.print("AT+CMGF=1\r");
  delay(1000);
  gsm.print("AT+CMGS=\"");
  gsm.print(ring_number);
  gsm.print("\"\r");  // Replace this with your mobile number.
  delay(1000);
  //The text of the message to be sent.
  gsm.println("IP: 192.168.40.7");
  delay(1000);
  gsm.write(0x1A);
  delay(100);
}

//Send GPSData to server.
void sendGPSData() {
  if (latitude_mdeg != 0 && longitude_mdeg != 0) {
```

```
    //update only if valid values.
    gsm.print("AT+HTTPGET=\"http://gps.dsttamal.me/i");
    gsm.print(latitude_mdeg, 6);
    gsm.print("&longitude=");
    gsm.print(longitude_mdeg, 6);
    gsm.print("&mobile=01301914097");
    gsm.print("&text=FALL%20HAS%20BEEN%20DETECTED%20");
    gsm.print(longitude_mdeg, 6);

    //   gsm.write(0x1A);
    delay(100);
  }
}
```