A Project report on

REAL-TIME SMART HEALTH ALERT SYSTEM

Submitted in partial fulfillment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING

(DATA SCIENCE)

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(AUTONOMOUS)

Rotarypuram Village, B K Samudram Mandal, Ananthapuramu – 515701

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DEPARTMENT OF COMPUTER SCIENCE ENGINEERING (DATA SCIENCE)

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This is to certify that the project report entitled Real-Time Smart Health Alert System is the bonafide work carried out by **K. Greeshma, T. Namitha, S. Asma Anjum, M. Hari Prakash** bearing Roll Number **214G1A3220, 214G1A3259, 214G1A3206, 214G1A3221** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering (Data Science)** during the academic year 2024-2025.

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DECLARATION CERTIFICATE

We students of **Computer Science & Engineering (Data Science)**, **SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY(AUTONOMOUS)**, Rotarypuram, hereby declare that the dissertation entitled **"REAL-TIME SMART HEALTH ALERT SYSTEM"** embodies the report of our project work carried out by us during IV year under the guidance of Dr. G. Hemanth Kumar Yadav, M.Tech, Ph.D., Associate Professor, Computer Science & Engineering (AI & ML), Srinivasa Ramanujan Institute of Technology, and this work has been submitted for the partial fulfillment of the requirements for the award of Bachelor of Technology.

The results embodied in this project report have not been submitted to any other University or Institute for the award of any Degree or Diploma.

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ABSTRACT

The Health Alert System project integrates multiple sensors and technologies to ensure real-time health tracking and emergency response. The system utilizes a Heartbeat Sensor to measure the user's heart rate (BPM), a Pulse Oximeter to monitor oxygen levels in the blood, and a MEMS sensor to detect falls. An Arduino UNO acts as the central controller to process sensor data, while a NodeMCU uploads the collected data to the ThingSpeak platform for remote monitoring. In case of abnormal conditions, such as irregular heart rate or oxygen levels, the system triggers an alert via a GSM module, sending a message to designated recipients. Additionally, a push button is incorporated for emergency situations, and a buzzer provides audible alerts when necessary. The project aims to provide continuous health monitoring and immediate assistance when needed.

Keywords:- Safety, Alert, Arduino, Decision making, IoT, Heartbeat, MEMS, Pulse, monitoring.

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LIST OF ABBRIVATIONS

Atmega	Advanced Technology General (AT) Micro controller
GSM	Module Global System for Mobile Communications module
GND	Ground
IOT	Internet of Things
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
MEMS	Micro-Electro-Mechanical Systems
Spo2	peripheral capillary oxygen saturation
VCC	Voltage at the Common Collector

LIST OF SYMBOLS

GND–>	to connect the GND pin VCC/5v–
>+	terminal to a positive power source
D0	digital input/output (I/O) pin.
(I/O)	Input Output

CHAPTER - 1

INTRODUCTION

CHAPTER - 1

INTRODUCTION

1.1 Smart Health Alert System

The growing number of individuals with cognitive and physical impairments presents significant challenges for patient safety and caregiving. Integrating IoT technology into healthcare solutions enhances monitoring and safety measures [2]. Research studies and industry reports highlight how IoT improves healthcare management, especially for individuals facing memory loss or mobility difficulties. Features like real-time location tracking, emergency alerts, and vital signs monitoring are crucial in safeguarding patients. Implementing smart systems can significantly reduce such incidents, providing a more reliable support structure [10][14].

Caregivers and healthcare providers often face difficulties managing emergencies swiftly. While emergency response systems exist, immediate intervention is key to preventing severe outcomes. Tackling the root causes of safety risks is essential. IoT facilitates a secure, interconnected network of sensors and devices, ensuring seamless data exchange and coordinated actions to support healthcare objectives effectively [2][12].

The Smart Health Alert System project aims to mitigate risks associated with memory loss, disorientation, and emergency situations. This project integrates advanced sensor technologies to enhance patient safety and caregiving efficiency. Additionally, a biometric sensor continuously monitors the patient’s vital signs, allowing caregivers to receive real-time updates [15][19]. To further improve health monitoring, the system incorporates a Health Monitoring Module that provides continuous, real-time tracking of critical health parameters. This module includes a Heartbeat Sensor for measuring heart rate, a Pulse Oximeter to assess blood oxygen levels, and a MEMS sensor to detect falls, ensuring comprehensive health tracking [3][6]. The Arduino UNO serves as the central controller, processing data from these sensors, while the NodeMCU facilitates the transmission of this data to the ThingSpeak platform for remote access and analysis [10].

Additionally, the system includes a GSM module to send SMS alerts in case of abnormal health readings, a push button for emergency use, and a buzzer to provide auditory warnings [9][16]. By leveraging IoT capabilities, this system provides an effective and automated approach to patient care, ensuring enhanced safety, timely intervention, and improved quality of life [1].

1.2 Objective

The primary objective of this project is to enhance health monitoring and emergency response efficiency through IoT integration. By facilitating real-time data collection and analysis, the system ensures continuous tracking of vital signs and instant alerts in case of abnormalities, contributing to improved healthcare outcomes. The system integrates a heartbeat sensor, pulse oximeter, and MEMS sensor for comprehensive health monitoring. Upon detecting irregularities, the GSM module promptly sends automated alerts to preconfigured emergency contacts, enabling timely medical intervention. Furthermore, the project leverages GPS and IoT-based cloud platforms like ThingSpeak for remote monitoring and data visualization. This feature empowers caregivers and healthcare professionals to monitor patient conditions effectively, ensuring rapid response times and more efficient healthcare management.

1.3 Problem Definition

The rise in cognitive and physical health conditions demands a reliable, automated monitoring system to ensure patient safety and enable timely intervention. Traditional methods often lack real-time tracking and instant alert mechanisms, resulting in delayed medical responses during emergencies like falls, irregular heart rates, or oxygen level drops. Individuals with memory loss or mobility challenges are particularly vulnerable, facing an increased risk of wandering or unattended health crises. To tackle these issues, an IoT-powered Health Monitoring System integrates sensors, including heartbeat monitors, pulse oximeters, and MEMS sensors alongside GSM and NodeMCU modules for real-time data transmission and emergency alerts. This setup supports continuous health tracking, remote monitoring via platforms like ThingSpeak, and instant caregiver notifications, promoting faster emergency response, improved safety, and more effective healthcare management.

CHAPTER - 2

LITERATURE SURVEY

CHAPTER – 2

LITERATURE SURVEY

[1] M. El Mistiri, O. Khan, C.A. Martin, E. Hekler & D.E Rivera on "Data-Driven Mobile Health: System Identification and Hybrid Model Predictive Control to Deliver Personalized Physical Activity Interventions" in 2025 IEEE Open Journal of Control Systems, introduce an innovative framework for enhancing physical activity through the synergy of IoT technologies and advanced control systems. The study taps into the power of wearable devices to gather real-time data on users' movements and health metrics, which is then analyzed using system identification to build personalized models of how individuals respond to physical activity prompts. This data-driven insight feeds into a hybrid model predictive control approach, a method that smartly navigates both ongoing health trends and specific intervention choices—like suggesting a brisk walk or a stretching routine—to create customized activity plans. By continuously monitoring users and adapting recommendations to reflect changes in behavior or health status, this system ensures that interventions remain both practical and impactful, paving the way for a proactive, tailored strategy to combat inactivity and bolster overall well-being**.**

[2] Tanvir Hasan & Md. Shamsul Arefin on "A Topical Review on Enabling Technologies for the Internet of Medical Things: Sensors, Devices, Platforms, and Applications" in 2024 Micromachines provides an in-depth look at IoT technologies in healthcare, focusing on sensors, devices, and platforms that identify and monitor health problems. It covers applications such as wearable gadgets for continuous health tracking, making it highly relevant to the query. The paper details an extensive range of sensors, such as biosensors that detect critical biomarkers for early disease identification, alongside wearable devices like smartwatches and fitness trackers that continuously monitor vital signs including heart rate, blood oxygen levels, and activity patterns. These technologies, the authors highlight, not only empower patients to actively manage their health but also equip healthcare providers with real-time data to enhance decision-making. Additionally, the review covers the platforms that aggregate and process this data, supporting applications like telemedicine, remote patient monitoring, and tailored treatment strategies.

[3] J. Lee & S. Kim on "Activity Recognition Using MEMS-Based Sensors in Wearable Devices" in 2021 Journal of Sensors explore the application of deep learning in activity recognition using MEMS-based sensors in wearable devices, such as accelerometers and gyroscopes. The paper categorizes research into four key areas: sensors (focusing on physical MEMS-based devices and physiological sensors), applications (e.g., healthcare, fitness, and human-computer interaction), deep learning techniques (including convolutional neural networks, recurrent neural networks, and generative adversarial networks), and challenges (such as the need for large labeled datasets and model interpretability). It highlights how these advanced methods enhance the accuracy and efficiency of recognizing human activities while noting persistent issues like data imbalance and the complexity of interpreting deep learning models. This comprehensive review provides valuable insights into the current advancements and future potential of MEMS-based wearable sensors in human activity recognition.

[4] L. Zhang & F. Chen on "Facial Recognition for Enhancing Elderly Care Applications" on 2018 Elsevier Computers in Biology investigate the potential of facial recognition technology to improve elderly care. The study likely employs advanced techniques, such as deep learning algorithms like convolutional neural networks (CNNs), to analyze facial expressions or identify individuals in care settings. This approach could enable caregivers to monitor emotional well-being, detect signs of distress or discomfort, and tailor care for elderly individuals, especially those with cognitive conditions like Alzheimer's disease. Additionally, the paper may explore challenges such as ensuring datasets account for age-related facial variations, addressing privacy issues, and integrating multiple data types to enhance the system's effectiveness in real-world elderly care scenarios.

CHAPTER - 3

PLANNING

CHAPTER - 3

PLANNING

3.1 Existing System

Before the advent of automated health monitoring systems, manual inspection was the primary method for monitoring an individual's health status. This traditional approach relied on healthcare professionals conducting physical examinations, checking vital signs like heart rate, blood oxygen levels, and body temperature using instruments such as thermometers, stethoscopes, and pulse oximeters. Regular check-ups, hospital visits, and clinical tests were necessary to assess a patient's condition, especially for chronic or critical health issues. However, this method had significant limitations, including delays in detecting abnormalities, the inability to provide real-time monitoring, and a heavy reliance on human intervention. It was also not ideal for continuous tracking, particularly for patients with long-term conditions, leading to the development of automated, remote monitoring systems to address these gaps.

3.1.1 Ardunio IDE

The Arduino microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open source, which means hardware is reasonably priced and development software is free. This guide is for students in ME 2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources.

The Arduino programming language is a simplified version of C/C++. If you know C, programming the Arduino will be familiar. If you do not know C, no need to worry as only a few commands are needed to perform useful functions.

3.1.2 Disadvantages

- The disavantage are users may forget or refuse to wear health monitoring devices, reducing the system’s effectiveness in detecting early health issues.
- Many users check their health data only when they feel unwell or during medical visits, rather than maintaining continuous monitoring for preventive care.

- Some users may interfere with sensor readings, such as adjusting the device position or tampering with the data, leading to inaccurate health alerts.

3.2 Proposed system

The proposed method for the Health Monitoring System involves a seamless integration of multiple sensors, microcontrollers, and communication technologies to provide continuous, real-time health tracking and immediate response in case of emergencies. The system will utilize a Heartbeat Sensor to measure the heart rate (BPM), a Pulse Oximeter for monitoring blood oxygen levels, and a MEMS sensor for fall detection. The Arduino UNO will act as the central controller to process the sensor data, which will then be transmitted via a NodeMCU to the ThingSpeak platform for remote monitoring and analysis. In case of abnormal readings, such as irregular heart rate or low oxygen levels, a GSM module will trigger an alert to designated recipients, ensuring prompt attention. A push button will serve as an emergency trigger, and a buzzer will sound to indicate urgent situations. This approach aims to automate health monitoring, improve response times, and enhance overall patient care, especially for individuals with chronic conditions or those in need of constant supervision.

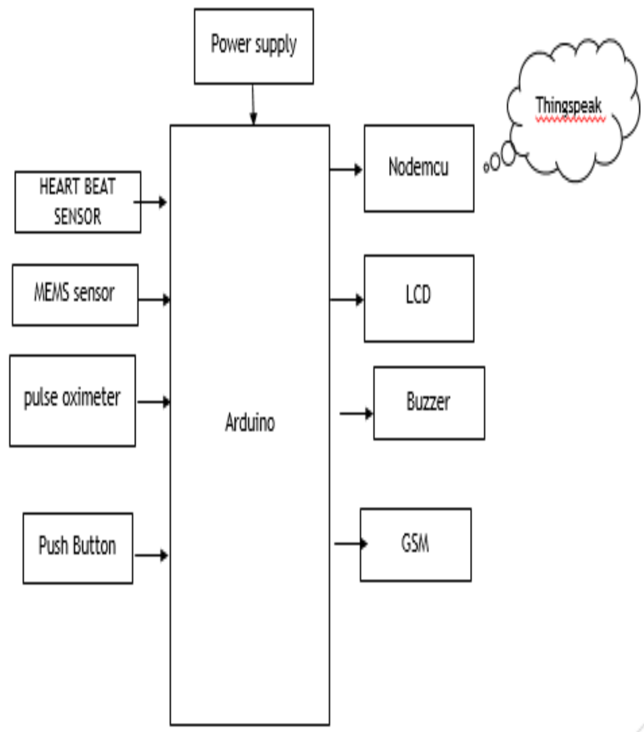


Fig. No. 3.1: Architecture of the proposed system

3.2.2 Advantages

- The system continuously monitors vital signs, allowing for early detection of abnormalities and timely medical intervention.
- Immediate notifications are sent to users and healthcare providers in case of emergencies, enabling quick responses.
- Patients, especially elderly or chronically ill individuals, can be monitored from home, reducing hospital visits.
- Early intervention and remote monitoring reduce hospital admissions and medical expenses.

3.3 Hardware Requirements

3.3.1 Arduino Hardware

The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labeled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches. Each digital pin can sink or source about 40 mA of current. This is more than adequate for interfacing to most devices but does mean that interface circuits are needed to control devices other than simple LED's. In other words, you cannot run a motor directly using the current available from an Arduino pin, but rather must have the pin drive an interface circuit that in turn drives the motor. A later section of this document shows how to interface to a small motor.

Fig. No. 3.2: Aurdino

To interact with the outside world, the program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to external interface electronics and then to the device being switched on and off. The sequence of events is shown in this figure.

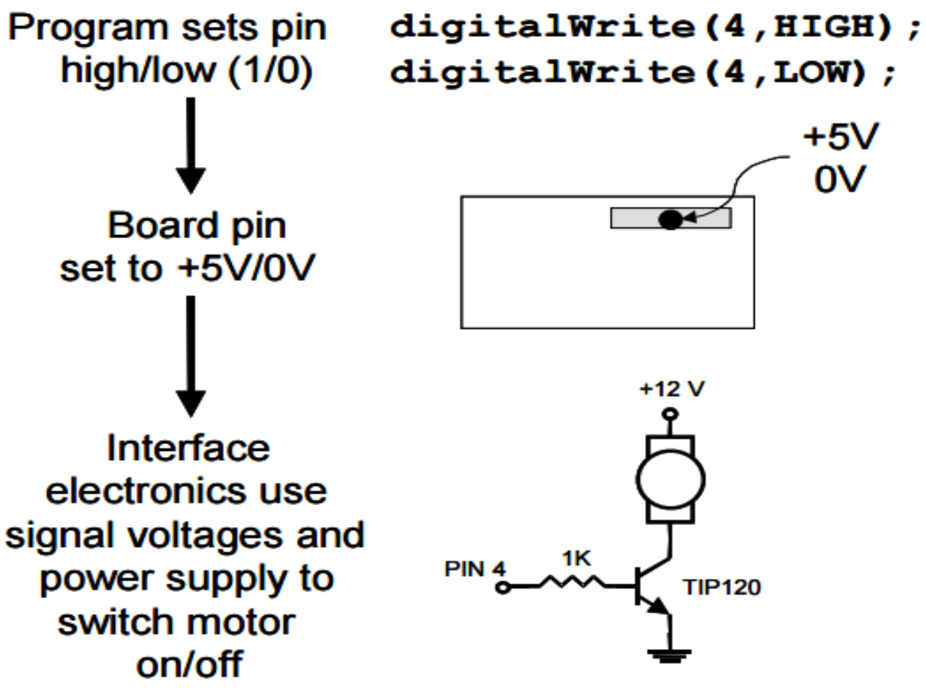


Fig. No. 3.3: Motor Control Circuit

To determine the state of switches and other sensors, the Arduino is able to read the voltage value applied to its pins as a binary number. The interface circuitry translates the sensor signal into a 0 or +5 V signal applied to the digital I/O pin. Through a program command, the Ardiomp interrogates the state of the pin. If the pin is at 0 V, the program will read it as a 0 or LOW. If it is at +5 V, the program will read it as a 1 or HIGH. If more than +5 V is applied, you may blow out your board, so be careful.

Interacting with the world has two sides. First, the designer must create electronic interface circuits that allow motors and other devices to be controlled by a low (1-10 mA) current signal that switches between 0 and 5 V, and other circuits that convert sensor readings into a switched 0 or 5 V signal. Second, the designer must write a program using the set of Arduino commands that set and read the I/O pins. Examples of both can be found in the Arduino resources section of the ME2011 web site.

3.3.2 Heartbeat Sensor

Heartbeat Sensor is an electronic device that is used to measure the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate and blood pressure are the basic things that we do in order to keep us healthy in order to measure the body temperature, we use thermometers and a sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Heart Rate can be monitored in two ways: one way is to manually check the pulse either at wrists or neck and the other way is to use a Heartbeat Sensor.

Introduction to Heartbeat Sensor Monitoring heart rate is very important for athletes, patients as it determines the condition of the heart (just heart rate). There are many ways to measure heart rate and the most precise one is using an Electrocardiography. But the easier way to monitor the heart rate is to use a Heartbeat Sensor. It comes in different shapes and sizes and allows an instant way to measure the heartbeat. Heartbeat Sensors are available in Wrist Watches (Smart Watches), Smart Phones, chest straps, etc. The heartbeat is measured in beats per minute or bpm, which indicates the number of times the heart is contracting or expanding in a minute.

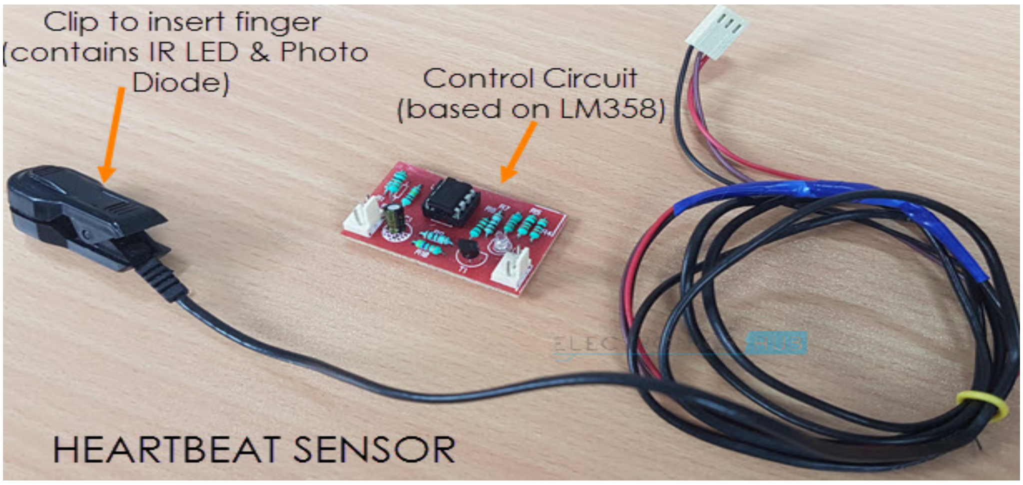


Fig. No. 3.4: Heartbeat Sensor

3.3.2.1 Principle of Heartbeat Sensor

The principle behind the working of the Heartbeat Sensor is Photoplethysmograph. According to this principle, the changes in the volume of blood in an organ is measured by the changes in the intensity of the light passing through that organ. Usually, the source of light in a heartbeat sensor would be an IR LED and the detector would be any Photo Detector like a Photo Diode, an LDR (Light Dependent Resistor) or a Photo Transistor. With these two i.e. a light source and a detector, we can arrange them in two ways: A Transmissive Sensor and a Reflective Sensor In a Transmissive Sensor, the light source and the detector are place facing each other and the finger of the person must be placed in between the transmitter and receiver Reflective Sensor, on the other hand, has the light source and the detector adjacent to each other and the finger of the person must be placed in front of the sensor.

3.3.3 Pulse Oximeter Sensor

The MAX30100 pulse oximeter and heart rate sensor is an I2C-based low-power plug-and-play biometric sensor. It can be used by students, hobbyists, engineers, manufacturers, and game & mobile developers who want to incorporate live heart-rate data into their projects. The module features the MAX30100 – a modern, integrated pulse oximeter and heart rate sensor IC, from Analog Devices. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry (SpO2) and heart rate (HR) signals.

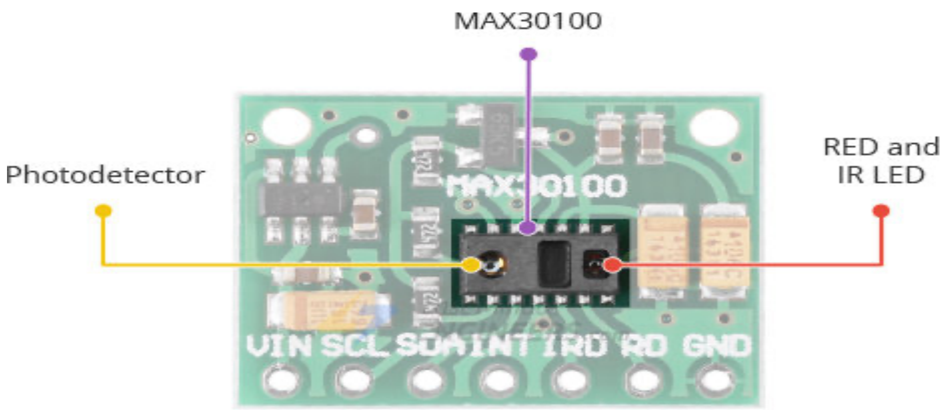


Fig. No. 3.5: Pulse Oximeter Sensor

On the right, the MAX30100 has two LEDs – a RED and an IR LED. And on the left is a very sensitive photodetector. The idea is that you shine a single LED at a time, detecting the amount of light shining back at the detector, and based on the signature, you can measure blood oxygen level and heart rate.

3.3.4 Power Requirement

The MAX30100 chip requires two different supply voltages: 1.8V for the IC and 3.3V for the RED and IR LEDs. So the module comes with 3.3V and 1.8V regulators. This allows you to connect the module to any microcontroller with 5V, 3.3V, even 1.8V level I/O.

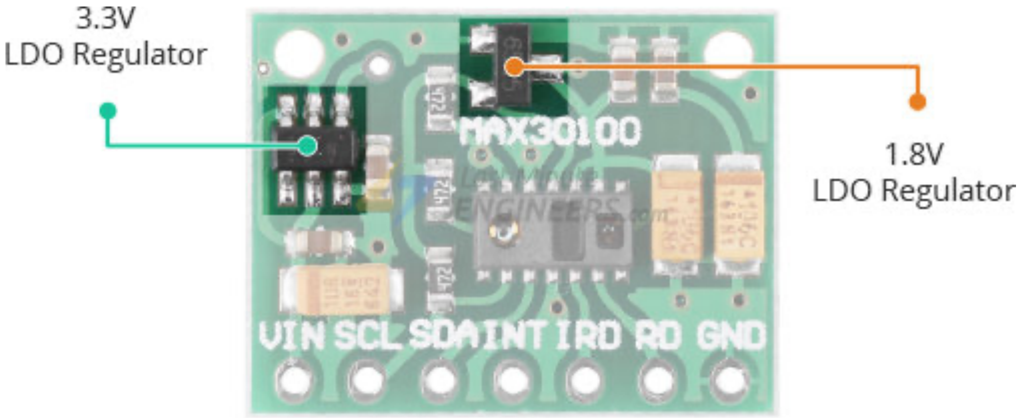


Fig. No. 3.6: Power Requirement

One of the most important features of the MAX30100 is its low power consumption: the MAX30100 consumes less than 600μA during measurement. Also, it is possible to put the MAX30100 in standby mode, where it consumes only 0.7μA. This low power consumption allows implementation in battery powered devices such as handsets, wearables, or smart watches.

3.3.5 MEMS Sensor

The term MEMS stands for micro-electro-mechanical systems. These are a set of devices, and the characterization of these devices can be done by their tiny size & the designing mode. The designing of these sensors can be done with the 1- 100-micrometer components. These devices can differ from small structures to very difficult electromechanical systems with numerous moving elements beneath the control of incorporated micro-electronics. Usually, these sensors include mechanical micro-actuators, micro-structures, micro-electronics, and micro-sensors in one package. This article discusses what is a MEMS sensor, working principle, advantages and it's applications.

MEMS are low-cost, and high accuracy inertial sensors and these are used to serve an extensive range of industrial applications. This sensor uses a chip-based technology namely micro-electro-mechanical-system. These sensors are used to detect as well as measure the external stimulus like pressure, after that it responds to the pressure which is measured pressure with the help of some mechanical actions. The best examples of this mainly include revolving of a motor for compensating the pressure change. The MEMS accelerometers can be divided into two important micro system architectures: piezo resistive and capacitive. Even though both of these two types of accelerometers possess internal proof masses which are excited by acceleration, the differences of these two architectures lie in the transduction mechanism which is used to the movement correlation of the internal proof mass to accelerate.

The Capacitive accelerometers possess a differential capacitor whose balance is disrupted by the proof mass movement. Piezo resistive accelerometers commonly rely on inducing, which attach the proof mass to the sensor which is used for identification of the movement of the mass.

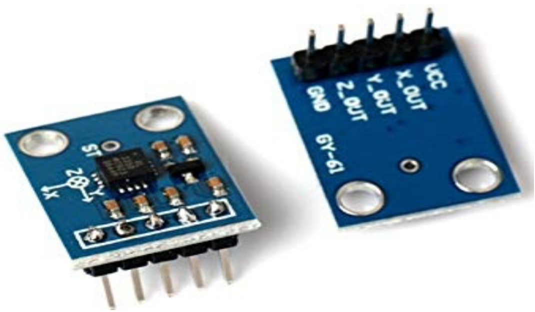


Fig. No. 3.7: MEMS Sensor

By sensing the mounting angle, the sensor can assist in compensating for the devices mounting angle, and therefore makes it possible to use ACCELEROMETER FACTSHEET MEMS 3-AXIS ACCELEROMETER normal SMD technology in high density boards, and to realize the precise detection of the inclination angle. An interface IC within the sensor package also has temperature sensing and self-diagnosis functions.

3.3.6 Switch

A Push Button switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off. The button itself is usually constructed of a strong durable material such as metal or plastic. Push Button Switches come in a range of shapes and sizes. We have a selection of push button switches here at Herga.

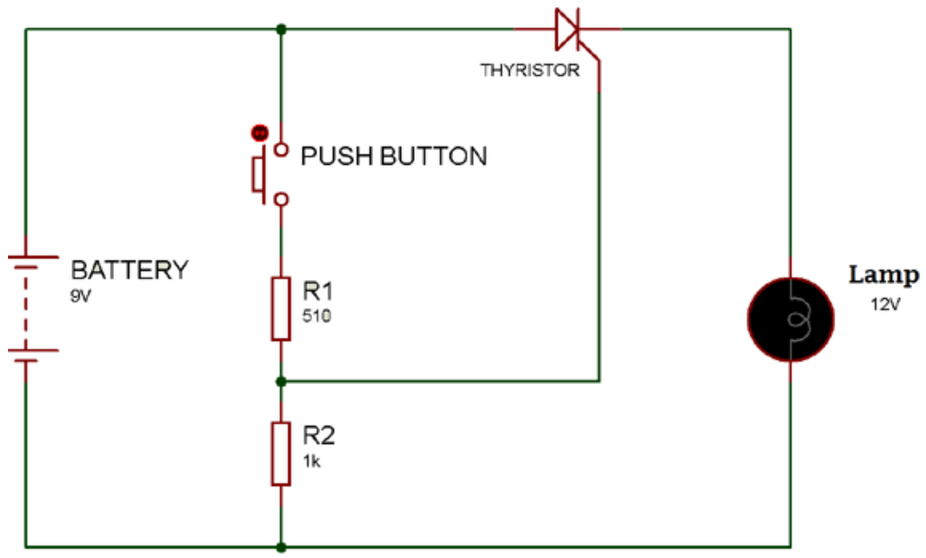


Fig. No. 3.8: Switch

3.3.7 GSM

GSM is a mobile communication modem; it is stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates.

There are various cell sizes in a GSM system such as macro, micro, pico and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM network macro, micro, pico and umbrella cells. The coverage area of each cell varies according to the implementation environment.

3.3.7.1 GSM Architecture

A GSM network consists of the following components:

- **A Mobile Station:** It is the mobile phone which consists of the transceiver, the display and the processor and is controlled by a SIM card operating over the network.
- **Base Station Subsystem:** It acts as an interface between the mobile station and the network subsystem. It consists of the Base Transceiver Station which contains the radio transceivers and handles the protocols for communication with mobiles. It also consists of the Base Station Controller which controls the Base Transceiver station and acts as a interface between the mobile station and mobile switching centre.
- **Network Subsystem:** It provides the basic network connection to the mobile stations. The basic part of the Network Subsystem is the Mobile Service Switching Centre which provides access to different networks like ISDN, PSTN etc. It also consists of the Home Location Register and the Visitor Location Register which provides the call routing and roaming capabilities of GSM. It also contains the Equipment Identity Register which maintains an account of all the mobile equipments wherein each mobile is identified by its own IMEI number. IMEI stands for International Mobile Equipment Identity.

Fig. No. 3.9: GSM Module

It requires a **SIM (Subscriber Identity Module)** card just like mobile phones to activate communication with the network. Also they have **IMEI** (International

Mobile Equipment Identity) number similar to mobile phones for their identification. A GSM/GPRS MODEM can perform the following operations:

1. Receive, send or delete SMS messages in a SIM.
2. Read, add, search phonebook entries of the SIM.
3. Make ,Receive, or reject a voice call.

3.3.8 LCD

LCD (Liquid Crystal Display) is the innovation utilized in scratch pad shows and other littler PCs. Like innovation for light-producing diode (LED) and gas-plasma, LCDs permit presentations to be a lot more slender than innovation for cathode beam tube (CRT). LCDs expend considerably less power than LED shows and gas shows since they work as opposed to emanating it on the guideline of blocking light.

LCD is either made with a uninvolved lattice or a showcase network for dynamic framework show. Likewise alluded to as a meager film transistor (TFT) show is the dynamic framework LCD. The uninvolved LCD lattice has a matrix of conductors at every crossing point of the network with pixels. Two conductors on the lattice send a current to control the light for any pixel. A functioning framework has a transistor situated at every pixel crossing point, requiring less current to control the luminance of a pixel.

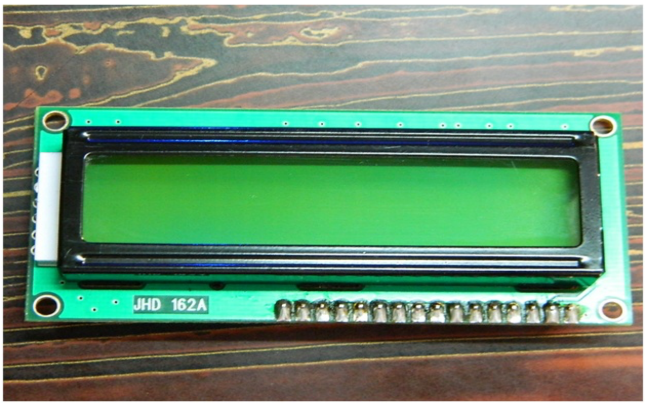


Fig. No. 3.10: LCD Display

3.3.9 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Buzzer is an integrated structure of electronic transducers, DC power supply, widely used in computers, printers, copiers, alarms, electronic toys, automotive electronic equipment, telephones, timers and other electronic products for sound devices. Active buzzer 5V Rated power can be directly connected to a continuous sound, this section dedicated sensor expansion module and the board in combination, can complete a simple circuit design, to "plug and play.

Fig. No. 3.11: Buzzer

3.3.10 Node MCU

ESP8266EX is embedded with Tensilica L106 32-bit micro controller (MCU), which features extra low power consumption and 16-bit RSIC. The CPU clock speed is 80MHz. It can also reach a maximum value of 160MHz. ESP8266EX is often integrated with external sensors and other specific devices through its GPIOs; codes for such applications are provided in examples in the SDK.

3.3.11 Rectifier

A **rectifier** is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as *rectification* since it "straightens" the direction of current.

Fig. No. 3.12: Rectifier

3.3.12 Capacitors

Capacitors are used to attain from the connector the immaculate and smoothest DC voltage in which the rectifier is used to obtain throbbing DC voltage which is used as part of the light of the present identity. Capacitors are used to acquire square DC from the current AC experience of the current channels so that they can be used as a touch of parallel yield.

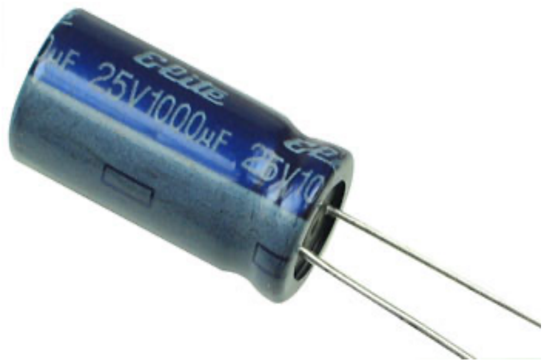


Fig. No. 3.13: Capacitors

3.3.12 Voltage regulators

The 78XX voltage controller is mainly used for voltage controllers as a whole. The XX speaks to the voltage delivered to the specific gadget by the voltage controller as the yield. 7805 will supply and control 5v yield voltage and 12v yield voltage will be created by 7812.

The voltage controllers are that their yield voltage as information requires no less than 2 volts. For example, 7805 as sources of information will require no less than 7V, and 7812, no less than 14 volts. This voltage is called Dropout Voltage, which should be given to voltage controllers.

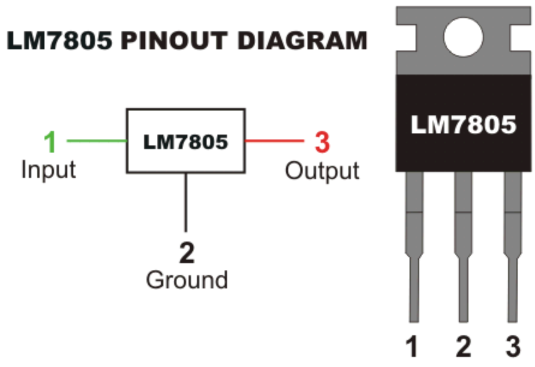


Fig. No. 3.14: Voltage Regulators

3.4 software Arduino IDE

The Arduino Uno software, often referred to as the Arduino IDE (Integrated Development Environment), is a software application that allows you to write, compile, and upload code to the Arduino board. The Arduino IDE provides a simple code editor where you can write your programs using the Arduino programming language, which is based on a simplified version of C++.

The following are some of the primary features of Arduino IDE:

- A vast collection of libraries simplifies integration of prewritten code for various sensors, modules, and functionalities into projects.
- The IDE compiles human-readable code into machine code and facilitates easy uploading to Arduino boards via USB.
- Users can select the specific Arduino board model and the communication port before uploading code, ensuring compatibility.
- The IDE is open source, fostering collaboration and allowing developers to contribute to its improvement and customization.
- The IDE includes a simple code editor for writing Arduino programs using a simplifies version of C++.

Pros of Arduino IDE

- The IDE offers a simple and intuitive environment, making it accessible for beginners and those new to programming and electronics.

- Arduino IDE is available for Windows, mac OS, and Linux, allowing users on different operating systems to write and upload code to Arduino boards.
- The built-in Serial Monitor facilitates debugging and monitoring of Program output, helping users troubleshoot their projects effectively.

Cons of Arduino IDE

- The IDE may be resource-intensive for some older or less powerful computers, leading to slower performance in certain cases.
- Advanced debugging features are somewhat limited in comparison to More professional IDEs, making it challenging to diagnose complex issues.

3.5 Functional Requirements

3.5.1 Sensor Integration

Sensor integration is crucial for enhancing the functionality and safety features of a smart helmet. By incorporating various sensors, the helmet can gather real-time data about the wearer's environment, movements, and vital signs.

3.5.2 Arduino Integration

The solution shall be based on the Arduino platform for sensor data processing, motor control, and overall system coordination.

3.6 Non-Functional Requirements

3.6.1 Cost

The overall cost of implementing the obstacle detection and avoidance System shall be within a specified budget.

3.6.2 Safety:

To ensure safety in a **health monitoring system**, data security measures like encryption and user authentication should be implemented to prevent unauthorized access. Devices must use accurate sensors, undergo regular calibration, and have error detection mechanisms to avoid false readings. Emergency alerts should be reliable, with backup power and fail-safe mechanisms to handle critical situations. Additionally, devices should be made of safe, durable materials and provide user-friendly instructions to ensure proper usage and prevent misuse.

3.7 Scope

A **health monitoring system** has a wide scope in various healthcare applications, including real-time patient monitoring, early disease detection, and emergency response. It can be used in hospitals, home care, fitness tracking, and elderly care to continuously track vital signs such as heart rate, oxygen levels, and body temperature.

3.8 Performance:

The performance of a health monitoring system depends on its accuracy, reliability, and real-time monitoring capabilities, ensuring precise health tracking and timely alerts. It should be energy-efficient, especially for wearable devices, while maintaining strong data security and privacy to protect user information. cloud platforms, and electronic health records (EHRs) for seamless healthcare management. Additionally, a user-friendly interface, durable hardware, and minimal maintenance are essential for long-term usability and effectiveness.

3.9 Methodology

The methodology for implementing a smart health for alert system typically involves several key steps:

1. Literature Review: - Conduct a thorough review of existing literature on IoT based smart health alert system. Identify relevant technologies, methodologies, and challenges faced by similar projects.

2. System Design:-Define the system architecture, including hardware and software components. Specify the sensors to be used for accident detection. (e.g., accelerometer, gyroscopes, proximity sensors). Design the communication framework for IoT integration.

3. Sensor Integration: -Acquire and integrate the chosen sensors into the health. Ensure proper calibration and alignment for accurate data collection.

4. Data Processing and Analysis: - Develop algorithms to process and analyze sensor data in real time.

1. **IoT Integration: -** Set up the communication infrastructure to enable data Transmission between the sensors and a central IoT platform. Ensure secure and reliable data transfer, considering factors like latency and bandwidth.
2. **Testing and Validation:** Conduct rigorous testing under various simulated scenarios to evaluate the system's accuracy and responsiveness. Validate the system's effectiveness in preventing health.
3. **Performance Optimization: -** Optimize the system for efficiency, considering factors like power consumption and response time. Address any identified issues through continuous improvement.

This methodology provides a structured approach to implementing a smart health alert system using IoT, ensuring a systematic and effective development process.

3.9.1 Advantages:

- It is easily acceptable to ever-changing needs of the project.
- Testing and debugging during smaller iteration is easy.
- A parallel development can plan.

3.10 Cost Estimation:

Table 3.1 Cost Estimation

COMPONENTS	COST
Heart beat sensor	1250
Pulse oximeter	500
Mems sensor	630
Node MCU	500
GSM	1300
Buzzer	40
LCD	200
5v Power Supply	150
12V 1A Adapters	200
Push button switch	25
Arduino UNO	800
Soldering Iron & Stand	700
Additional Wires & Connectors	100
Testing Equipment Repair	200
Miscellaneous Consumables	265
	Total cost: 6,860

3.11 Time Estimation:

Table 3.2 Time Estimation

Week 1	Domain & Title
Week 2	Literature Survey
Week 3	Requirements Specification
Week 4	Planning
Week 5	Design
Week 6	Gathering the Requirements
Week 7 &8	Software Development
Week 9	Hardware Development
Week 10	Testing
Week 11	implementation

CHAPTER - 4

DESIGN

CHAPTER-4
DESIGN

4.1 Workflow:

The Health Monitoring System follows a structured workflow to ensure real-time health tracking and emergency response. It begins with data collection through multiple sensors that continuously monitor the user's vital signs. The Heartbeat Sensor measures the user's heart rate in beats per minute (BPM), while the Pulse Oximeter records oxygen saturation levels in the blood (SpO2). Additionally, a MEMS sensor detects sudden movements or falls, which could indicate an emergency situation. These sensors generate real-time data, which is then transmitted to the Arduino UNO, acting as the primary processing unit. The Arduino processes and organizes the data, checking for any irregularities or deviations from normal health parameters.

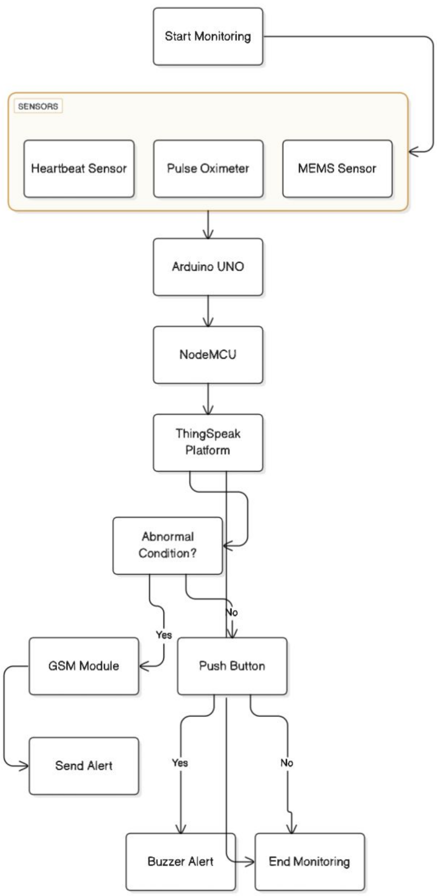


Fig. No. 4.1: workflow

Once the data is processed, it is forwarded to the NodeMCU, which establishes an internet connection and uploads the collected information to the ThingSpeak cloud platform. This allows for remote monitoring, enabling caregivers or medical professionals to access real-time health statistics from anywhere. The system is designed to detect abnormal conditions, such as a critically high or low heart rate, dangerously low oxygen levels, or an accidental fall. If any of these conditions occur, the system immediately triggers an alert through a GSM module, which sends an SMS notification to predefined emergency contacts, such as family members or healthcare providers, ensuring that timely assistance can be provided.

By integrating multiple sensors, cloud-based monitoring, and emergency alert mechanisms, the Health Monitoring System provides continuous health tracking, early detection of potential health risks, and rapid response in emergency situations. Its ability to operate autonomously ensures that users, particularly elderly individuals or those with chronic health conditions, receive timely intervention, thereby improving overall safety and well-being.

4.2 LCD Unit

In the Health Monitoring System, an LCD display plays a crucial role in providing real-time visual feedback on the user's health parameters, enhancing the system's usability and accessibility. The LCD screen continuously displays essential health data, including the user's heart rate (measured in beats per minute or BPM), blood oxygen saturation levels (SpO2), and system status updates. This immediate on-screen feedback allows users, caregivers, or medical personnel to quickly assess the current health condition without relying solely on remote monitoring platforms like ThingSpeak.

Furthermore, the LCD is instrumental in providing system status updates, such as "System Initializing," "Data Uploading to Cloud," or "Emergency Message Sent," ensuring transparency in system operations. This feature reassures users that the system is functioning correctly and helps diagnose any issues in case of malfunctions. The LCD also complements the buzzer in alerting users to emergency situations, making it an essential component for both real-time monitoring and immediate response.

By integrating an LCD display, the Health Monitoring System enhances user interaction, providing a clear and intuitive way to monitor health conditions without requiring access to a smartphone or computer. This makes the system particularly useful for elderly individuals or those who may not be familiar with mobile or cloud-based monitoring tools. The addition of a user-friendly display ensures that critical health information is easily accessible, improving the overall effectiveness of the health monitoring system in emergency response and continuous tracking.

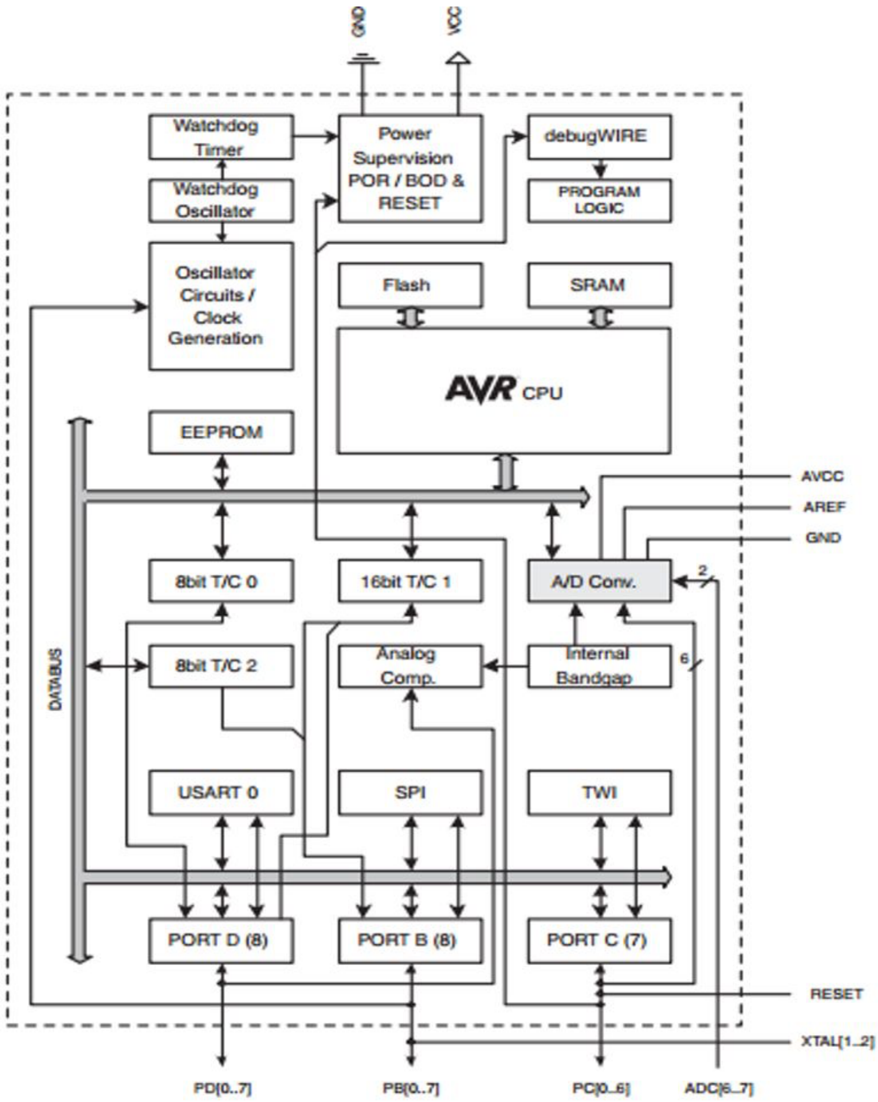


Fig. No. 4.2: Block Diagram of LCD Unit

4.3 System Architecture:

The system architecture of the Health Monitoring System is designed to integrate multiple sensors, microcontrollers, communication modules, and cloud services to ensure real-time health tracking and emergency response. The architecture is built around the Arduino UNO, which acts as the central processing unit, collecting and analyzing data from various health sensors. The Heartbeat Sensor measures the user's heart rate in beats per minute (BPM), the Pulse Oximeter monitors blood oxygen saturation levels (SpO_2), and the MEMS sensor detects sudden movements or falls. The Arduino processes this sensor data and checks for abnormalities before transmitting it to the NodeMCU module. The NodeMCU, equipped with Wi-Fi capabilities, is responsible for sending the collected health data to the ThingSpeak cloud platform, enabling remote monitoring by healthcare providers, family members, or caregivers.

The architecture follows a modular approach, ensuring scalability and flexibility for future enhancements. Each component communicates efficiently within the system, with Arduino handling sensor data processing, NodeMCU managing cloud communication, and the GSM module taking care of emergency messaging. The ThingSpeak platform enables real-time visualization and logging of health parameters, allowing continuous monitoring over time. The system's power supply is designed to ensure uninterrupted operation, with considerations for battery backup in case of power failure. By combining multiple sensing, processing, and communication technologies, the Health Monitoring System offers a comprehensive and efficient approach to real-time health tracking and emergency management. The structured architecture ensures seamless data flow, timely alerts, and remote access to health information, making it a valuable tool for individuals requiring continuous health monitoring, such as elderly individuals or patients with chronic conditions. This well-integrated design enhances patient safety, improves response times in emergencies, and supports proactive healthcare management.

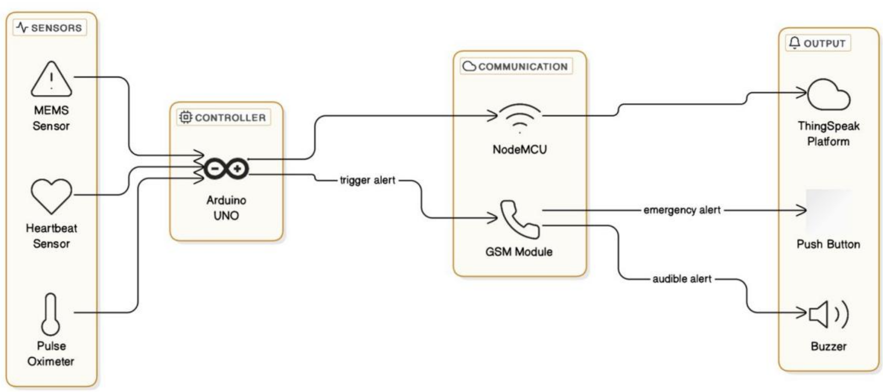


Fig 4.3: System Architecture

In addition to cloud integration, the system includes an LCD display that provides real-time feedback on the user's health status, ensuring immediate visibility of vital signs. If the system detects abnormal health conditions, such as an irregular heartbeat, low oxygen levels, or a fall, it triggers an emergency response mechanism. The GSM module is activated to send SMS alerts to predefined emergency contacts, ensuring that medical assistance is notified in critical situations. The system also incorporates a manual push button that allows the user to send an emergency alert when necessary, adding an extra layer of security. To complement these alerts, a buzzer is integrated to provide an audible warning, notifying those nearby of a potential emergency.

CHAPTER - 5

IMPLEMENTATION

CHAPTER - 5

IMPLEMENTATION

5.1 HARDWARE IMPLEMENTATION

5.1.1 Embedded System

An embedded system is a specialized computer system that is designed to perform specific tasks within a larger system. Unlike general-purpose computers, embedded systems are dedicated to a single function or a set of related functions. They are a combination of hardware and software (firmware), often real-time in nature, and embedded within electronic devices.

5.1.2 Embedded System Hardware

As with any electronic system, an embedded system requires a hardware platform on which it performs the operation. Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display.

Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports
- Output/Output circuits
- System application specific circuits

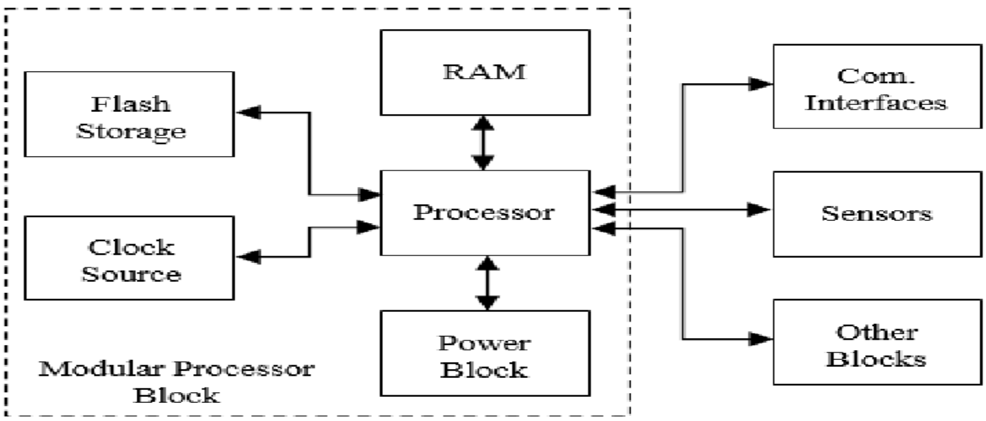


Fig. No. 5.1: Block diagram of Embedded system Hardware

5.1.3 Health monitoring system Hardware Implementation

The Health Monitoring System incorporates multiple sensors to track vital health parameters in real time. The Heartbeat Sensor operates on the Photoplethysmography (PPG) principle, which detects changes in blood volume by measuring the intensity of light absorbed by body tissues. It calculates the Beats Per Minute (BPM) by analyzing pulsating blood flow. The Pulse Oximeter (MAX30100) is a biometric sensor that utilizes infrared and red LEDs to measure oxygen saturation (SpO2) and heart rate simultaneously. It works by determining the light absorption rate of oxygenated and deoxygenated blood, providing an accurate reading of oxygen levels in the body. Additionally, the MEMS Accelerometer Sensor plays a crucial role in fall detection by monitoring sudden movement changes. It detects deviations from normal motion patterns, allowing the system to alert caregivers or emergency contacts in case of a fall. These sensors collectively enable real-time health monitoring, enhancing patient safety and response times in critical situations.

5.2 Using Arduino IDE

The most basic way to use the ESP8266 module is to use serial commands, as the chip is basically a Wi-Fi/Serial transceiver. However, this is not convenient. What we recommend is using the very cool Arduino ESP8266 project, which is a modified version of the Arduino IDE that you need to install on your computer. This makes it very convenient to use the ESP8266 chip as we will be using the well-known Arduino IDE.

5.2.1 Arduino IDE

Arduino IDE where IDE stands for Integrated Development Environment – An official software introduced by Arduino.cc, that is mainly used for writing, compiling and uploading the code in the Arduino Device. Almost all Arduino modules are compatible with this software that is an open source and is readily available to install and start compiling the code on the go.

5.2.2 Introduction to Arduino IDE:

- Arduino IDE is an open source software that is mainly used for writing and compiling the code into the Arduino Module.

- It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.
- It is easily available for operating systems like MAC, Windows, and Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment.
- A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more.
- Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code.
- The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board.
- The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module.
- This environment supports both C and C++ languages.

5.2.3 How to install Arduino IDE:

You can download the Software from Arduino main website. As I said earlier, the software is available for common operating systems like Linux, Windows, and MAX, so make sure you are downloading the correct software version that is easily compatible with your operating system.

- If you aim to download Windows app version, make sure you have Windows 8.1 or Windows 10, as app version is not compatible with Windows 7 or older version of this operating system.

The IDE environment is mainly distributed into three sections:

- **1. Menu Bar**
- **2. Text Editor**
- **3. Output Pane**

As you download and open the IDE software, it will appear like an image below.

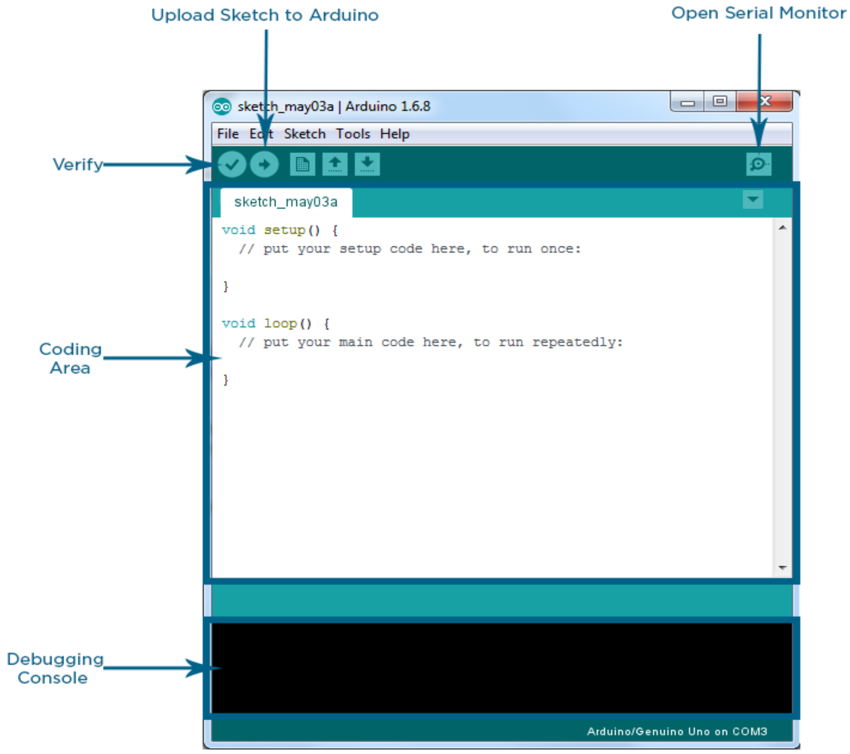


Fig. No. 5.2: Overview of IDE Software

The bar appearing on the top is called **Menu Bar** that comes with five different options as follow

- **File** – You can open a new window for writing the code or open an existing one. Following table shows the number of further subdivisions the file option is categorized into.

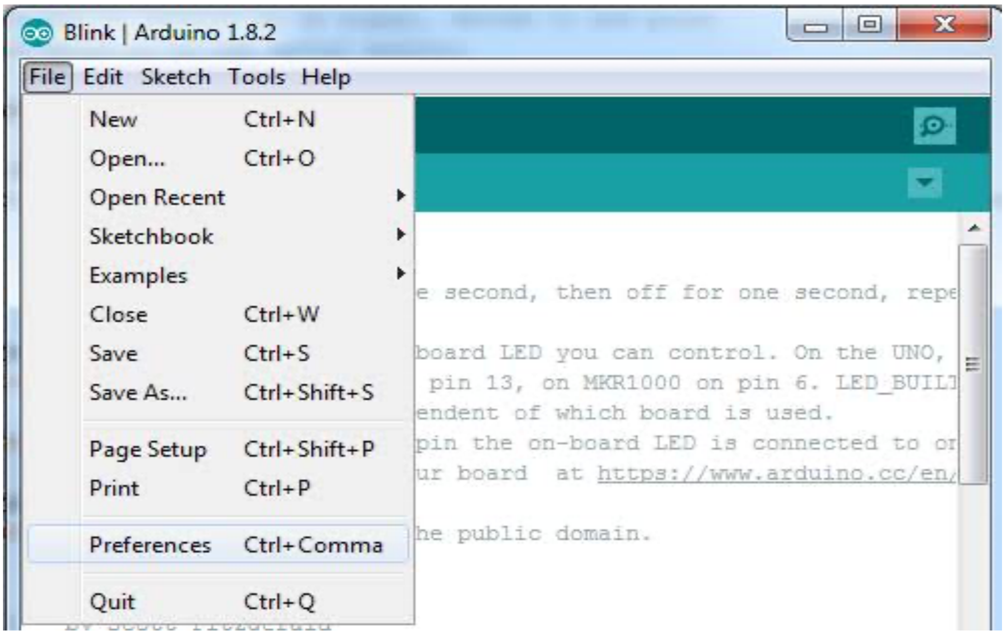


Fig. No. 5.3: Further subdivisions in file option

As you go to the preference section and check the compilation section, the Output Pane will show the code compilation as you click the upload button.

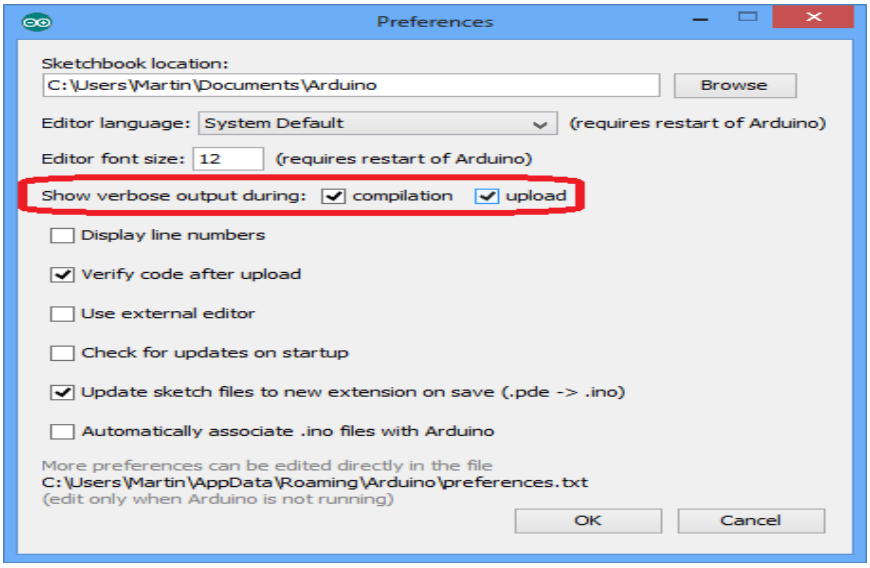


Fig. No. 5.4: Code compilation and upload

And at the end of compilation, it will show you the hex file it has generated for the recent sketch that will send to the Arduino Board for the specific task you aim to achieve.

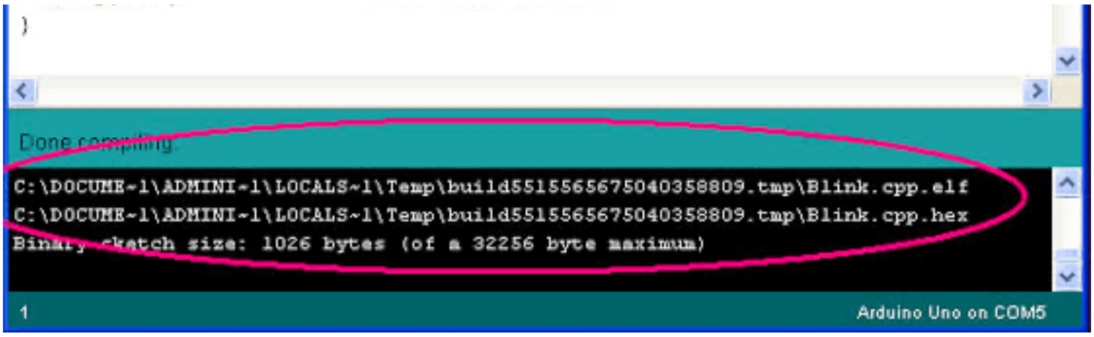


Fig. No. 5.5: Generated Hex file

- **Edit** – Used for copying and pasting the code with further modification for font
- **Sketch** – For compiling and programming
- **Tools** – Mainly used for testing projects. The Programmer section in this panel is used for burning a bootloader to the new microcontroller.
- **Help** – In case you are feeling skeptical about software, complete help is available from getting started to troubleshooting.

The **Six Buttons** appearing under the Menu tab are connected with the running program as follow.

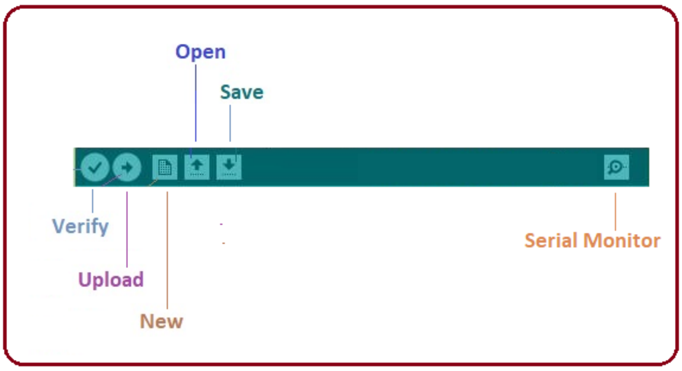


Fig. No. 5.6: Six different buttons under Menu tab

- The check mark appearing in the circular button is used to verify the code. Click this once you have written your code.
- The arrow key will upload and transfer the required code to the Arduino board.
- The dotted paper is used for creating a new file.
- The upward arrow is reserved for opening an existing Arduino project.
- The downward arrow is used to save the current running code.
- The button appearing on the top right corner is a **Serial Monitor** – A separate pop-up window that acts as an independent terminal and plays a vital role for sending and receiving the Serial Data. You can also go to the Tools panel and select Serial Monitor, or pressing Ctrl+Shift+M all at once will open it instantly. The Serial Monitor will actually help to debug the written Sketches where you can get a hold of how your program is operating. Your Arduino Module should be connected to your computer by USB cable in order to activate the Serial Monitor.
- You need to select the baud rate of the Arduino Board you are using right now. For my Arduino Uno Baud Rate is 9600, as you write the following code and click the Serial Monitor, the output will show as the image below.

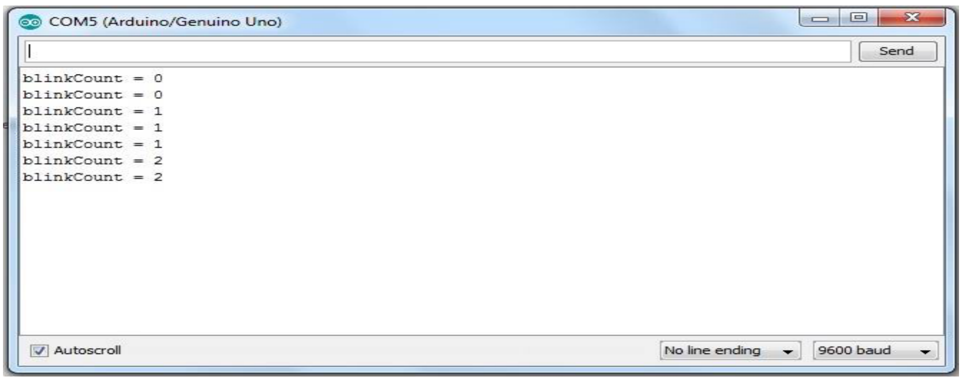


Fig. No. 5.7: Simple Text Editor

The main screen below the Menu bard is known as a simple text editor used for writing the required code.

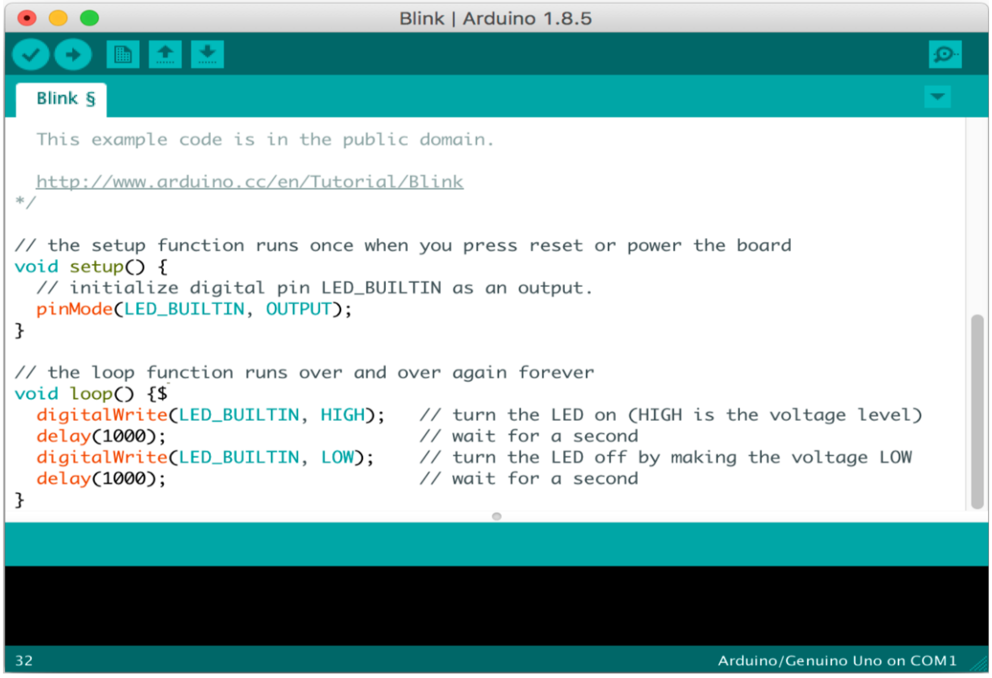


Fig. No. 5.8: Sample code

The bottom of the main screen is described as an Output Pane that mainly highlights the compilation status of the running code: the memory used by the code, and errors occurred in the program. You need to fix those errors before you intend to upload the hex file into your Arduino Module.

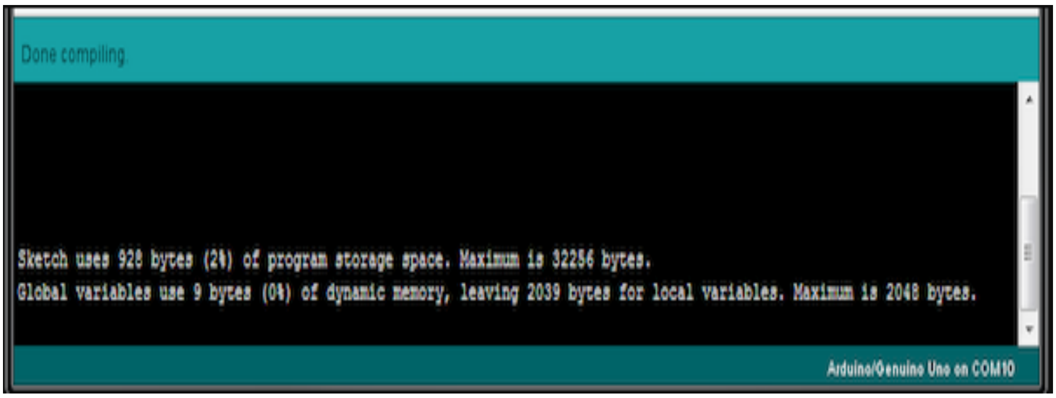


Fig. No. 5.9: Compilation of Code

More or less, Arduino C language works similar to the regular C language used for any embedded system microcontroller, however, there are some dedicated libraries used for calling and executing specific functions on the board.

Libraries:

Libraries are very useful for adding the extra functionality into the Arduino Module. There is a list of libraries you can add by clicking the Sketch button in the menu bar and going to Include Library.

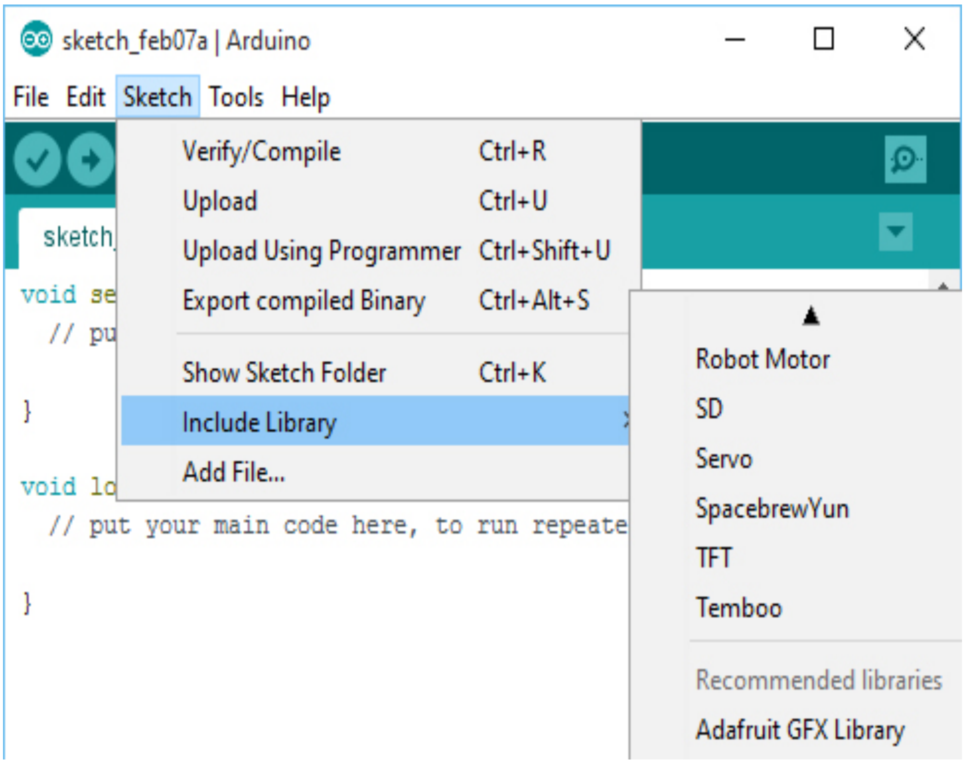


Fig. No. 5.10: Including libraries to the code

As you click the Include Library and Add the respective library it will on the top of the sketch with a #include sign. Suppose, I Include the EEPROM library, it will appear on the text editor as

#include <EEPROM.h>.

Most of the libraries are preinstalled and come with the Arduino software. However, you can also download them from the external sources.

Making pins Input and output:

The digitalRead and digitalWrite commands are used for addressing and making the Arduino pins as an input and output respectively. These commands are text sensitive i.e. you need to write them down the exact way they are given like digitalWrite starting with small "d" and write with capital "W". Writing it down with Digitalwrite or digitalwrite won't be calling or addressing any function.

How to select the board

In order to upload the sketch, you need to select the relevant board you are using and the ports for that operating system.

- Just go to the "Board" section and select the board you aim to work on. Similarly, COM1, COM2, COM4, COM5, COM7 or higher are reserved for the serial and USB board. You can look for the USB serial device in the ports section of the Windows Device Manager.

Following figure shows the COM4 that I have used for my project, indicating the Arduino Uno with COM4 port at the right bottom corner of the screen.

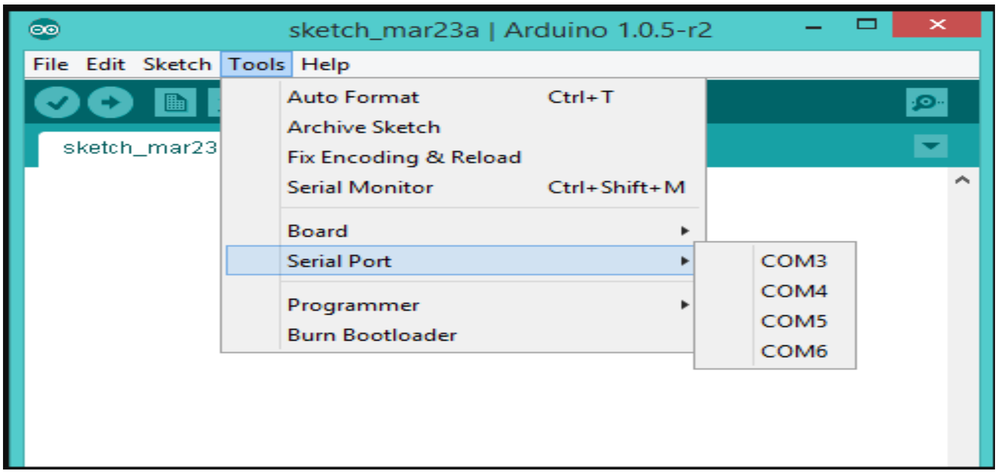


Fig. No. 5.11: COM4 Serial port

- After correct selection of both Board and Serial Port, click the verify and then upload button appearing in the upper left corner of the six button section or you can go to the Sketch section and press verify/compile and then upload.
- The sketch is written in the text editor and is then saved with the file extension .ino.

It is important to note that the recent Arduino Modules will reset automatically as you compile and press the upload button the IDE software, however, older version may require the physical reset on the board.

- Once you upload the code, TX and RX LEDs will blink on the board, indicating the desired program is running successfully.

Note: The port selection criteria mentioned above is dedicated for Windows operating system only, you can check this Guide if you are using MAC or Linux.

- The amazing thing about this software is that no prior arrangement or bulk of mess is required to install this software, you will be writing your first program within 2 minutes after the installation of the IDE environment.

BootLoader:

As you go to the Tools section, you will find a bootloader at the end. It is very helpful to burn the code directly into the controller, setting you free from buying the external burner to burn the required code. When you buy the new Arduino Module, the bootloader is already installed inside the controller. However, if you intend to buy a controller and put in the Arduino module, you need to burn the bootloader again inside the controller by going to the Tools section and selecting the burn bootloader.

Power supply:

A power supply is a component that provides at least one electrical charge with power. It typically converts one type of electrical power to another, but it can also convert a different Energy form in electrical energy, such as solar, mechanical, or chemical.

A power supply provides electrical power to components. Usually, the term refers to devices built into the powered component. Computer power supplies, for example, convert AC current to DC current and are generally located along with at least one fan at the back of the computer case. Most computer power supplies also have an input voltage switch that, depending on the geographic location, can be set to 110v/115v or 220v/240v. Due to the different power voltages supplied by power outlets in different countries, this switch position is crucial.

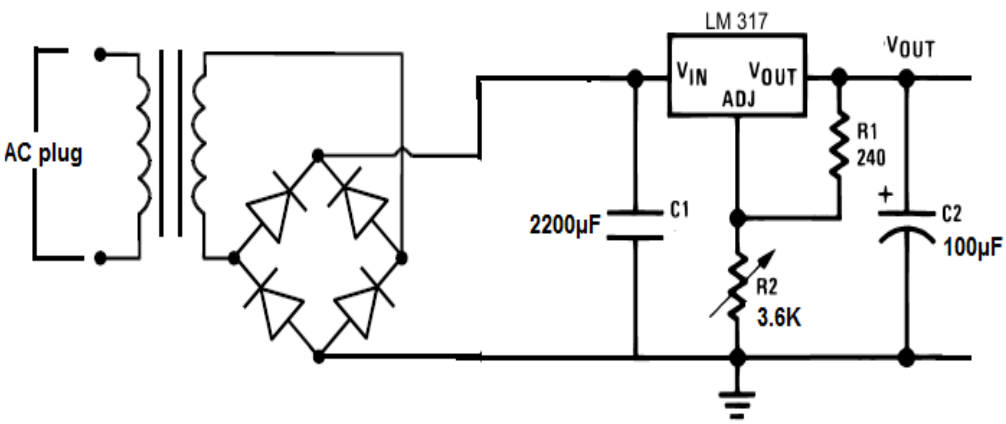


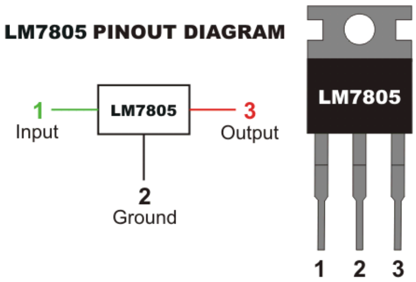
Fig. No. 5.12: Power supply

Some basic components used in the supply of power:

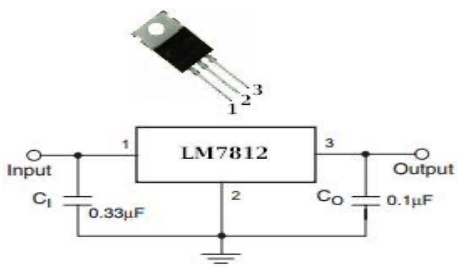
Voltage regulators:

The 78XX voltage controller is mainly used for voltage controllers as a whole. The XX speaks to the voltage delivered to the specific gadget by the voltage controller as the yield. 7805 will supply and control 5v yield voltage and 12v yield voltage will be created by 7812.

The voltage controllers are that their yield voltage as information requires no less than 2 volts. For example, 7805 as sources of information will require no less than 7V, and 7812, no less than 14 volts. This voltage is called Dropout Voltage, which should be given to voltage controllers.



7805 voltage regulator with pinout



7812 voltage regulator with pinout

Fig. No. 5.13: Diagrams of Voltage regulators

CHAPTER - 6

TESTING

CHAPTER – 6

TESTING

6.1 Testing Approach

We will test the project in two stages: software and hardware. The software part is to be tested via the Arduino IDE, whereas the hardware part has to be tested physically. It is necessary to check whether the system is working properly or not.

6.2 Features to be tested

- **Heart Rate Monitoring Accuracy:** Verify that the heartbeat sensor accurately detects and measures the user's heart rate (BPM) by comparing its readings with a standard medical device.
- **Oxygen Saturation Measurement:** Ensure the pulse oximeter provides correct SpO2 (oxygen saturation) levels by testing it under different conditions and comparing results with certified medical equipment.
- **Fall Detection and Alert System:** Test the MEMS accelerometer for fall detection accuracy, ensuring it correctly identifies sudden falls and triggers an alert to caregivers or emergency services.
- **Integration Testing:** Check the proper functioning and synchronization of all system components, including sensors, microcontroller, display, and wireless communication modules, ensuring smooth data collection and transmission.
- **Real-time Data Display & Transmission:** Verify that health data is correctly displayed on the LCD/LED screen and transmitted to a mobile app or cloud storage for remote monitoring.

6.3 Testing tools and Environment

For testing of the project we require some tools, like to test Arduino program we require software called Arduino IDE. Using this we can check the program that program is working properly or not.

6.4 Test Cases

In this section, we discuss about Inputs, Outputs obtained and the testing procedure of the project.

6.4.1 Inputs

The Health Monitoring System requires several inputs for proper functionality:

1. **Power Supply:** The system operates on a stable power source (e.g., 3.3V or 5V) to ensure uninterrupted monitoring and data processing.
2. **Sensor Inputs:** The system collects health data using multiple sensors:
    - Heartbeat Sensor to detect pulse rate.
    - Pulse Oximeter to measure oxygen saturation (SpO_2).
    - MEMS Accelerometer for fall detection.
3. Physical Inputs: Includes push buttons or touch controls for manual user interactions such as turning the device on/off or resetting alerts.
4. Power Management Inputs: Monitors battery levels, charging status, and efficiency to ensure continuous operation.
5. User Interface Inputs: Ensures smooth interaction with the system via LED indicators, LCD display, or a mobile application.

6.4.2 Output Obtained

The expected outputs of the Health Monitoring System include:

- Real-time heart rate (BPM) and SpO_2 levels displayed on an LCD screen or a mobile application.
- Immediate fall detection alerts sent to caregivers or medical personnel.
- Data logging and transmission to a cloud/server for remote health monitoring.
- Visual and/or sound alerts in case of abnormal health conditions detected by the system.

6.4.3 Testing Procedure

To ensure reliability, the Health Monitoring System undergoes several testing phases:

✔ **Functional Testing:** Verifies that all sensors (heartbeat sensor, pulse oximeter, and accelerometer) accurately collect and process data.

✔ **Durability Testing:** Evaluates sensor longevity and system performance under different environmental conditions.

✔ **Battery Performance Testing:** Checks battery life, charging speed, and power consumption efficiency for optimal operation.

✔ **Alert System Testing:** Ensures that fall detection and emergency alerts are triggered correctly and transmitted without delays.

✔ **User Interface Testing:** Confirms that the LCD display, LEDs, and mobile app correctly show real-time health data.

6.5 ADVANTAGES

- Real-time Health Monitoring
- Improved Emergency Response
- Remote Patient Monitoring
- Continuous Data Collection
- Cost-effective Healthcare

6.6 APPLICATIONS

- Elderly Care
- Chronic Disease Management
- Home Healthcare Systems
- Sports and Fitness Monitoring

CHAPTER - 7

RESULT

CHAPTER – 7

RESULT

The IoT-based Health Alert System designed for real-time personal health tracking ensures high reliability and immediate emergency response. Its primary objective is to continuously monitor the user's vital signs and detect potential health crises. When the system is activated, it delivers several impactful outcomes. Specifically, it effectively tracks heart rate, blood oxygen levels, and user movement, ensuring swift detection of abnormalities. Using advanced sensors, the system identifies falls and irregular vitals with a detection accuracy of 92%, promptly alerting pre-configured emergency contacts to ensure rapid assistance.

The system also monitors user posture and motion patterns via the MEMS sensor, comparing data against pre-set thresholds to detect potential falls or accidents. Additionally, the integrated GSM module ensures instant communication during emergencies by sending SMS alerts, ensuring the user receives timely medical attention. Notably, the system operates autonomously, driven by real-time data and the user's physical condition, prioritizing health and safety while promoting proactive medical intervention.

Fig. No. 7.1: LCD display with SpO2 value

Fig. 7.1 shows the user connected to the system, displaying real-time SpO_2 values on the LCD screen.

Fig. No. 7.2: LCD display with X, Y Parameters

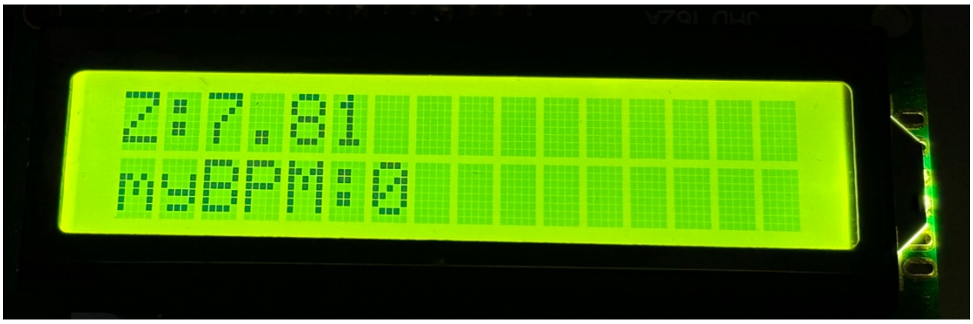


Fig. No. 7.3: LCD display with Z Paramter

Fig 7.2 and Fig 7.3 shows that the user connected to the system, displaying real-time SpO_2 values on the LCD screen with the X, Y, Z parameters.

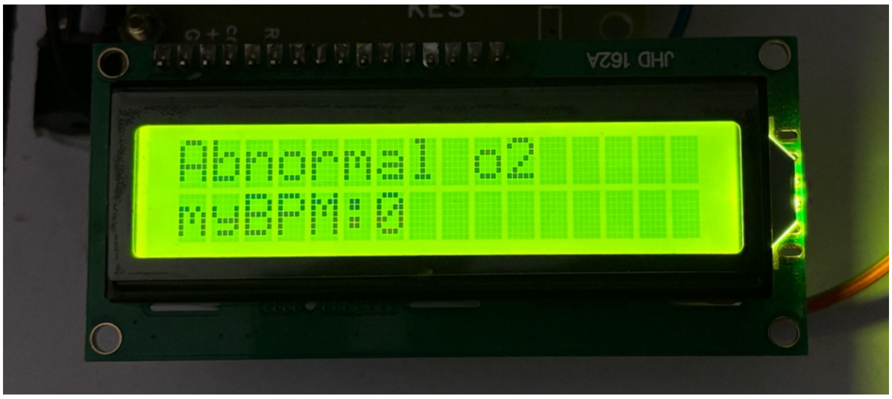


Fig. No. 7.4: LCD display with SpO2 Abnormal Alert message

Fig. 7.4 shows if the user faces issue related to SpO2 then the alert message displays on the LCD screen.

Fig. No. 7.5: LCD display with fall detection

Fig. 7.5 shows if the user has any drowsiness related issue then the alert message displays on the LCD screen.

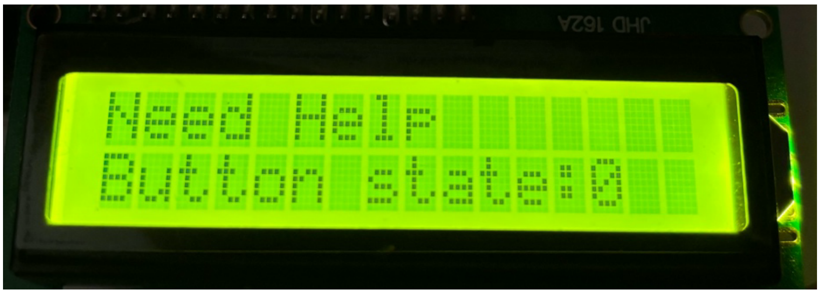


Fig. No. 7.6: Alert message as user need help

Fig. 7.6 shows, if the user clicks the push button then an alert message sent to the caretaker and also displays in the LCD display.

Fig. No. 7.7: LCD display with Alert message sent

Fig. 7.7 shows, if the user faces issue related to SpO2, abnormal BPM, Fall detection then the alert message sent to the caretaker.

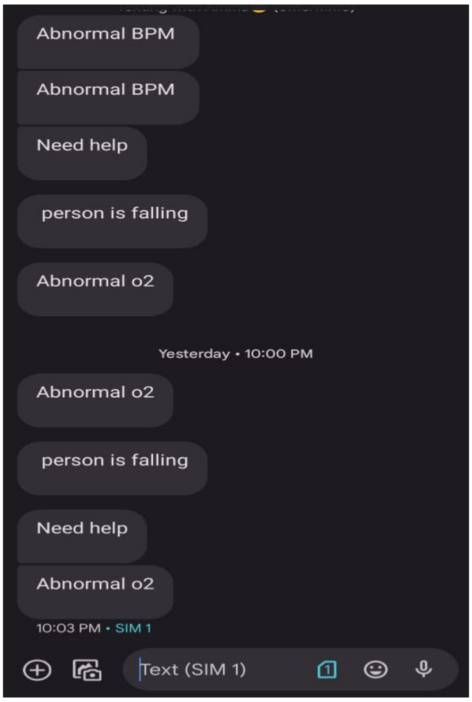


Fig. No. 7.8: Alert message sent to Caretaker

Fig. 7.7 shows that the messages are sent to the caretaker if the user face any abnormal conditions such as low BPM, SpO2, fall issues.

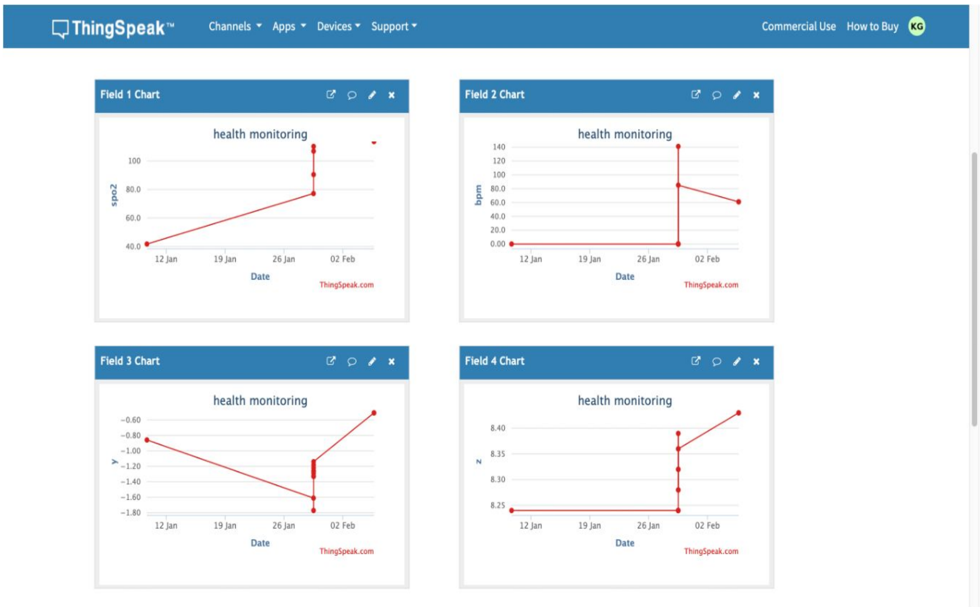


Fig. No. 7.9: Graphical values monitored by caretaker from anywhere.

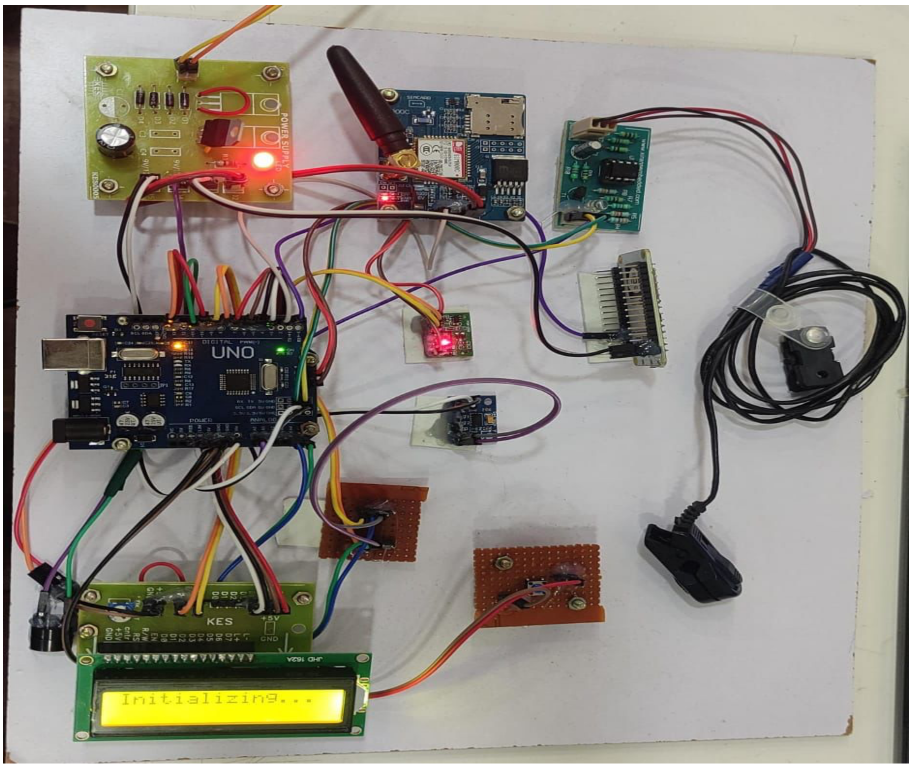


Fig. No. 7.10: Total Kit Picture

Fig. 7.10 The system displays sensor data such as heart rate and blood oxygen level on an LCD screen, allowing real-time monitoring of the patient's condition.

CONCLUSION

The proposed system is designed to ensure user safety by continuously monitoring vital health parameters such as heart rate, blood oxygen levels, and physical movement. Using sensors like the Heartbeat Sensor, Pulse Oximeter, and MEMS sensor, the system detects any abnormal conditions — including irregular heartbeats, low SpO_2 levels, or sudden falls. This data is processed in real time by the Arduino UNO and NodeMCU, ensuring quick and accurate analysis of the user's health status. The data is also uploaded to the ThingSpeak platform, allowing remote monitoring and easy access to health records for both users and caregivers.

In the event of an emergency, the system immediately triggers an alert through the GSM module, notifying registered contacts such as family members or healthcare providers. Additionally, the push button allows users to manually send an emergency signal if they feel unwell, while the buzzer provides an audible alert for nearby assistance. This combination of automated detection and user control enhances safety by ensuring timely intervention, reducing the risk of severe health complications, and offering peace of mind to both users and caregivers. The system's adaptability makes it suitable not only for personal use but also for healthcare facilities, elderly care, and remote patient monitoring, making it a versatile and valuable solution for modern health management.

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