DESIGN AND IMPLIMENTATION OF IOT BASED MONITORING SYSTEM FOR COMATOSE PATIENTS

PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THEAWARD OF DIPLOMA IN ELECTRONICS AND TELECOMMUNICATION ENGG.

SUBMITTED BY:

AMRUTHA GOJE
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VIRAJ BANDEBUCHE
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GUIDED BY:

PROF. J. A. RAUT

DEPARTMENT OF
ELECTRONICS AND TELECOMMUNICATON
GOVERNMENT POLYTECHNIC NAGPUR
(An Autonomous Institute of Government of Maharashtra)

(2023-24)

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CERTIFICATE

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(Gayatri Padolkar)	**(2104057)**

This is to certify that above students of ODD 2023, Electronics and Telecommunication Engg.students have submitted their project report on "**Iot Based Monitoring System on Comatose Patients"** during academic session 2023- 2024 as a part of project work prescribedby Government Polytechnic, Nagpur for partial fulfilment for the Diploma in **Electronics and Telecommunication Engg.**

The project work is the record of students own work and is completed satisfactorily.

Prof. Jayashree Raut — **Dr. R. V. Yenkar**

Project Guide — **HOD**

Department of Electronics and Telecommunication

Dr. M. B. Daigavane

Principal

Government Polytechnic, Nagpur

GOVERNMENT POLYTECHNIC NAGPUR

CANDIDATE'S DECLARATION

We hereby certify that the work which is being presented in the project report entitled "**Iot Based Monitoring System on Comatose Patients**" by us in partial fulfillment of requirements for the award of diploma in Electronics and Telecommunication Engg. submitted in the **Department of Electronics and Telecommunication Engg.** is record of our own work carried out during ODD 2023 guided by **Prof. Jayashree Raut**.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Signature of Guide

Name of Guide: Prof. Jayashree Raut

ACKNOWLEDGEMENT

We would like to place on record my deep sense of gratitude to our Guide, **Prof. J. A. Raut**,Dept. of in **Electronics and Telecommunication Engg**. for her generous guidance, help and usefulsuggestions.

We express our sincere gratitude to **Dr. R. V. Yenkar**, Head of Dept. of **Electronics and Telecommunication Engg.**, for his stimulating guidance, continuous encouragement and supervision throughout the course of present work.

We are extremely thankful to **Dr. M. B. Daigavane,** Principal of **Government Polytechnic Nagpur** for providing us infrastructural facilities to work in, without which this work would not have been possible.

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CONTENTS

Abstract

The IoT-Based Monitoring System for Comatose Patients is a cutting-edge healthcare solution leveraging the Internet of Things (IoT) technology to enhance the care and monitoring of patients in a comatose state. Comatose patients require continuous and specialized care, making real-time monitoring crucial for their well-being. This system integrates a network of sensors, microcontrollers, and a centralized monitoring platform to collect, process, and transmit vital physiological data.

Comatose patients require continuous monitoring to ensure their well-being and timely medical interventions. In response to this critical need, we present an Internet of Things (IoT)-based monitoring system tailored for comatose patients. This system leverages a network of interconnected sensors, data processing, and communication technologies to enable real-time, remote monitoring and improved healthcare management.

The IoT-based monitoring system comprises a comprehensive set of sensors, including pulse sensor, temperature sensor, ultrasonic sensor and pir sensor, which are strategically placed around the patient. These sensors collect vital physiological data and environmental parameters, delivering them to a centralized control unit. This unit processes and analyzes the data, detecting irregularities and alarming healthcare providers in real time when critical thresholds are breached.

The system communicates via a secure and robust IoT network, allowing healthcare professionals to remotely access and monitor patient status through a user-friendly interface. This remote monitoring capability reduces the need for physical presence, minimizing the risk of infection transmission in healthcare settings, especially during contagious disease outbreaks.

Furthermore, the system is designed with scalability and interoperability in mind, ensuring compatibility with existing healthcare infrastructure and the ability to adapt to evolving medical requirements. We believe that this IoT-based monitoring system has the potential to significantly enhance patient outcomes, offering a valuable tool for healthcare professionals in the challenging task of caring for comatose patients.

CHAPTER 1: INTRODUCTION

CHAPTER 1

1.1 Literature Survey

The system employs a multi-sensor approach, incorporating sensors for as heart rate, temperature, urine level of urine collected in bag and movement of patient. These sensors are non-invasive, ensuring patient comfort while providing accurate and reliable data. The collected physiological parameters are transmitted wirelessly in real-time to a centralized monitoring platform.

The centralized platform employs advanced data analytics algorithms to process the incoming data streams. Machine learning models are utilized to detect anomalies and trends in the patient's vital signs. These insights enable healthcare professionals to respond promptly to any deviations from the patient's baseline, thereby minimizing risks and optimizing treatment plans.

Moreover, the system features a user-friendly interface accessible through web and mobile applications. This interface provides healthcare providers with a comprehensive dashboard displaying real-time patient data, historical trends, and alerts. Additionally, caregivers can set personalized threshold alerts, ensuring immediate notification in critical situations.

The IoT-Based Monitoring System for Comatose Patients offers several key advantages. It facilitates continuous monitoring, allowing for timely interventions and reducing the potential for complications. Furthermore, the centralized platform allows for seamless integration with electronic health record systems, ensuring comprehensive patient care and streamlined documentation.

This innovative system represents a significant advancement in comatose patient care, providing a reliable and intelligent solution for continuous monitoring and early intervention. Its integration of IoT technology and data analytics showcases its potential to revolutionize critical care practices, ultimately improving patient outcomes and quality of life.

1.2 Introduction

The IoT-Based Monitoring System for Comatose Patients is a cutting-edge healthcare solution leveraging the Internet of Things (IoT) technology to enhance the care and monitoring of patients in a comatose state. Comatose patients require continuous and specialized care, making real-time monitoring crucial for their well-being. This system integrates a network of sensors, microcontrollers, and a centralized monitoring platform to collect, process, and transmit vital physiological data.

1.3 Purpose of study

The purpose of studying IoT based monitoring system for comatose patients is to develop a low-cost, open-source monitoring system that can be produced quickly and easily, particularly during healthcare crisis. IoT based monitoring system for comatose patients can be made witheasily available and affordable components, which means they can be produced in large quantities to meet the needs of a rapidly growing comatose patient population due to head injury, stroke, cardiac arrest, hypoglycaemia, hyperglycaemia, drug overdose, and kidney or liver failure.

By studying IoT based monitoring system for comatose patients, researchers can explore how to design and program these devices to perform the necessary functions required for treating comatose patients. They can also investigate how to ensure the safety and efficacy of the device, and how to provide appropriate levels of control and monitoring to medical professionals.

IoT based monitoring system for comatose patients have the potential to monitor the patients' vitals in healthcare systems worldwide in affordable price. By making use of open-source technology, researchers can rapidly develop and iterate on designs, collaborate with others, and share theirfindings with the wider scientific community.

CHAPTER 2: PROPOSED SYSTEM: IOT BASED MONITORING SYSTEM FOR COMATOSE PATIENTS (IBMSCP)

CHAPTER 2

2.1 Block diagram of IBMSCP

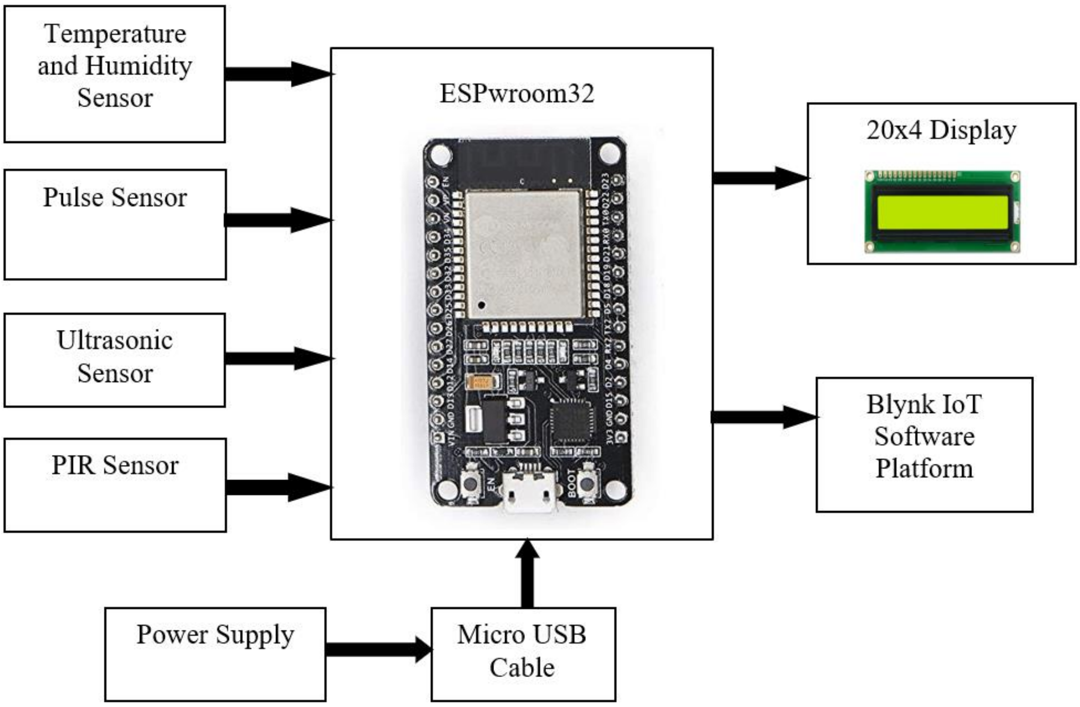

Figure.1 Block diagram of IBMSCP

2.1.1 Working of IBMSCP

An IoT based monitoring system for comatose patients block diagram typically consist of the following components:

1. ESPwroom32: The heart of the monitoring system would be the ESPwroom32, which would act as the microcontroller to run the IoT based monitoring system for comatose patients.
2. Power Supply: A power supply unit is required to provide the necessary power to the ESP32 via micro-USB cable.
3. Temperature and humidity sensor: Temperature sensor uses Negative Temperature coefficient (NTC) to measure temperature. It is used for measuring the body temperature of the comatose patients.
4. Pulse sensor: It senses the BPM (Beats Per Minute) by technique called photoplenthysmogram. It is used for monitoring the heart rate of the comatose patients.

5. Ultrasonic Sensor: It has two leading pins i.e., trigger pin and echo pin. Trigger pin triggers (transmits) the ultrasonic sound by setting pin to high. Echo pin receives the ultrasonic burst transmitted by trigger pin. This sensor is used for measuring distances. It is used for measuring the urine level of the urine bag of the comatose patients.
6. PIR sensor: A Passive Infrared (PIR) sensor is a type of motion sensor that detects changes in infrared radiation within its field of view. It is used for recognizing the body movement done by comatose patient as they are in unconscious state.
7. LCD Display: An LCD display is used to display the parameters such as Temperature, Motion detection, urine level and pulse rate.
8. Blynk IoT: Blynk is a popular platform for building Internet of Things (IoT) applications, allowing developers to easily create projects that involve controlling and monitoring hardware through a mobile app. This platform is used for monitoring the vitals of the comatose patient.

2.2 Circuit Diagram of IBMSCP

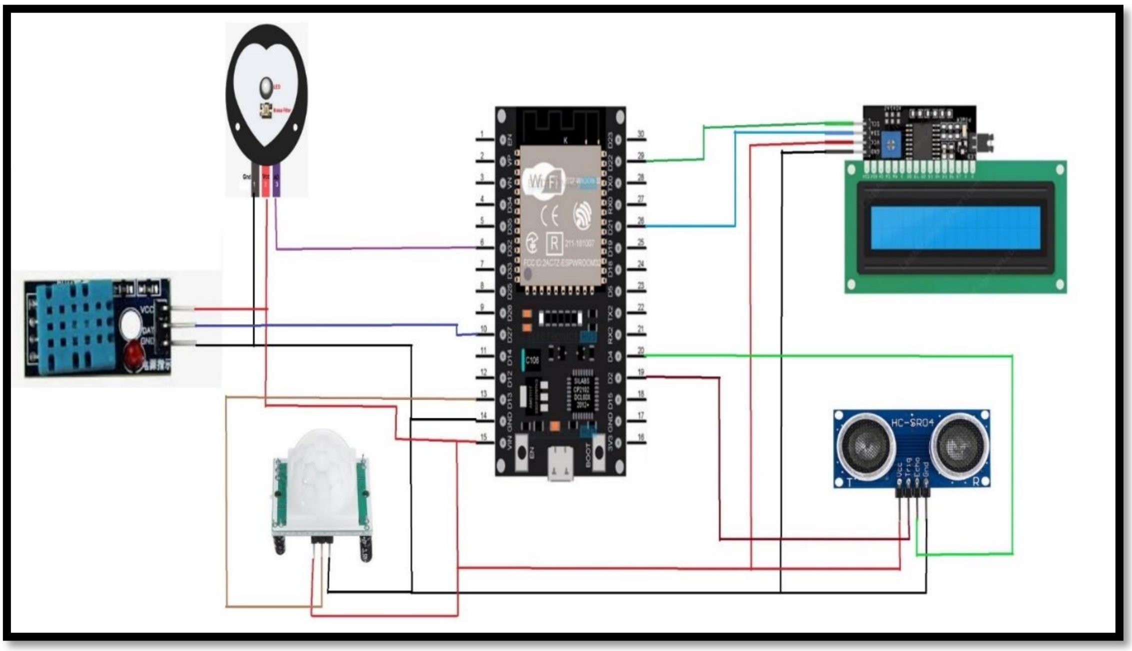

Figure. 2 Circuit Diagram of IBMSCP

2.2.2 Working of IBMSCP

An IoT based monitoring system for comatose patients typically consists of an ESPwroom32 microcontroller, a 20x4 LCD display and various sensors like Temperature and humidity sensor, Pulse sensor, PIR sensor and ultrasonic sensor. The ESPwroom32 acts as the brain of the monitoring system, controlling the various components and responding to input from sensors. The basic operation of an IoT based monitoring system for comatose patients involves measuring the patient's body temperature, heart rate, urine level in urine bag and detects the body movement made by patient.

The temperature and humidity sensor (DHT11) employs a combination of sensing elements to measure temperature in its surrounding environment (Human body). The sensor includes a negative temperature coefficient (NTC) thermistor for temperature measurement. The NTC thermistor monitors alterations in temperature. These sensing elements generate analog signals proportional to the humidity and temperature conditions. The internal analog-to-digital converters of the DHT11 then convert these analog signals into digital form.

The communication protocol of the DHT11 involves a bidirectional single-wire interface, which uses specific timing sequences for data transmission. The digital data transmitted consists of 40 bits, comprising both integral and decimal parts for temperature and humidity, as well as a checksum for error checking. This digital data is then processed by a ESPwroom32 microcontroller which is connected to the DHT11, providing an accessible and calibrated output of the ambient temperature and humidity in the sensor's environment.

The pulse sensor (HW827) measures heart rate by using the optical sensors that employ photoplethysmography (PPG). PPG works by emitting light into the skin and measuring the amount of light that is absorbed or reflected by blood vessels. As the heart beats, there are subtle changes in blood volume, and these changes can be detected by the sensor. The device then processes this information to calculate the heart rate. The device likely uses a specific communication protocol to transmit heart rate data to the ESPwroom32 microcontroller. The microcontroller receives the heart rate data and performs the necessary processing. This involves calculations, filtering and formatting the data for further use. As of my last knowledge update in January 2022, I don't have specific information about an HW416B PIR sensor or its capabilities. However, I can provide a general overview of how PIR (Passive Infrared) sensors work and how they can be interfaced with a microcontroller.

A PIR sensor (HW416B) detects motion by sensing changes in infrared radiation in its field of view. The sensor consists of pyroelectric material that generates an electric charge in response to changes in temperature. When a patient moves within the sensor's detection range, the infrared radiation patterns change, causing variations in the electric charge. The PIR sensor detects these changes and generates a signal indicating motion. The output pin of sensor is connected to a digital input pin on the ESPwroom32 microcontroller. The microcontroller continuously monitors the state of the digital input pin connected to the PIR sensor. When motion is detected, the PIR sensor generates a signal, and the digital input pin goes HIGH. The ESPwroom32 microcontroller can then respond to this signal by executing a specific set of instructions.

An ultrasonic sensor (HC-SR04) is used to measure urine level in urine bag of comatose patient using the principles of ultrasonic sound waves. When interfaced with a ESPwroom32 microcontroller, these sensors can provide accurate distance measurements, allowing for the estimation of urine level. The ultrasonic sensor typically consists of a transmitter and a receiver. The transmitter emits ultrasonic pulses, which travel through the air until they encounter the fluid's surface. Upon reaching the fluid, some of the ultrasonic energy is reflected back toward the sensor's receiver. The sensor calculates the time taken for the emitted pulse to return, and using the speed of sound in air, it determines the distance to the urine surface. With knowledge of the container's geometry, the ESPwroom32 microcontroller can then calculate the urine level.

The physical quantities which are measured by the sensors are processed by ESPwroom32 microcontroller and the digital output is gained. These parameters are displayed on 20x4 LCD display and also displayed on the dashboard of blynk IoT application.

Overall, an IoT based monitoring system for comatose patient provides a cost-effective and easily programmable solution for providing IoT based monitoring system to patients in need.

CHAPTER 3: HARDWARE AND SOFTWARE REQUIREMENTS

CHAPTER 3

3.1 ESPwroom32

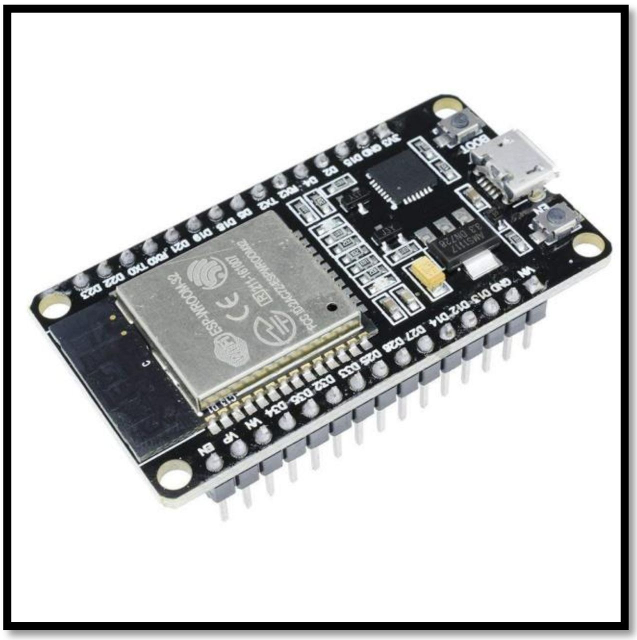

Figure 3: ESPwroom32

3.1.1 Architecture

Here's an overview of the architecture:

1. Processor: The ESP32 features a dual-core Xtensa LX6 microprocessor, providing flexibility and parallel processing capabilities. The processor architecture is 32-bit RISC (Reduced Instruction Set Computing).
2. Memory: The ESP32 has built-in memory that includes both program memory (flash) and data memory (RAM). The amount of flash memory varies depending on the specific ESP32 module or development board, but it typically ranges from 4 MB to 16 MB. RAM is usually in the range of 520 KB to 4 MB.
3. Wireless Connectivity: The ESP32 is known for its integrated Wi-Fi and Bluetooth connectivity. It supports Wi-Fi 802.11 b/g/n standards and Bluetooth Classic (BR/EDR) and Bluetooth Low Energy (BLE) protocols.
4. Peripheral Interfaces: ESP32 provides a rich set of peripheral interfaces, including GPIO (General Purpose Input/Output), SPI (Serial Peripheral

Interface), I2C (Inter-Integrated Circuit), UART (Universal Asynchronous Receiver/Transmitter), I2S (Inter-IC Sound), and more. These interfaces make it versatile for various applications.

5. Security Features: The ESP32 includes hardware-based security features such as Secure Boot and Flash Encryption to protect against unauthorized access and code execution.
6. Analog-to-Digital Converter (ADC): ESP32 has a 12-bit ADC that allows it to measure analog signals with reasonable precision.
7. Operating System: While the ESP32 can run bare-metal applications, it also supports the FreeRTOS real-time operating system (RTOS), providing task scheduling and management for more complex applications.
8. Development Environment: The ESP32 is commonly programmed using the Arduino IDE, PlatformIO, or the Espressif IDF (IoT Development Framework), which is Espressif's official development framework for the ESP32.
9. Power Management: The ESP32 includes various power-saving modes to optimize energy consumption, making it suitable for battery-powered applications.
10. Community Support: The ESP32 has a vibrant community, and a wide range of resources, libraries, and examples are available for developers. This community support contributes to the popularity of the ESP32 in the maker and IoT communities.

3.1.2 Pin Configuration

Here is a general pin configuration for the ESP-WROOM-32 module:

1. GPIO Pins: GPIO 0 to GPIO 39: General Purpose Input/Output pins used for various digital and analog functions.
2. Analog Pins: ADC1_CH0 to ADC1_CH9: Analog-to-Digital Converter (ADC) pins for reading analog signals.
3. Serial Communication Pins: TX0, RX0 are Serial communication pins for UART0 and TX1, RX1 are Serial communication pins for UART1.
4. SPI Pins: MOSI, MISO, SCK, SS: SPI (Serial Peripheral Interface) pins for communication with SPI devices.
5. I2C Pins: SDA, SCL: I2C (Inter-Integrated Circuit) pins for communication with I2C devices.
6. I2S Pins: I2S signals for audio applications.
7. PWM Pins: GPIO 0, 2, 4, 5, 12, 13, 14, 15, 16, 17, 18, 19: Pulse Width

Modulation (PWM) pins for analog output.

8. Power Supply Pins: 3.3V is Power supply pin (output) and GND is Ground pin.
9. Control Pins: EN (Enable): Enable pin for controlling the module's power. BOOT: Boot mode selection pin for firmware programming.
10. Flash Pins: GPIO 6, 7, 8, 9, 10, 11, 21, 22, 23, 24, 25, 26, 27, 28, 29: Flash-related pins for reading and writing to the flash memory.
11. Reset Pin: RST (Reset): Reset pin for restarting the module.
12. Antenna Connections: ANT, ANT1: Antenna connections for Wi-Fi and Bluetooth.

3.1.3 Description

The ESP-WROOM-32 is a highly versatile and widely used module based on the ESP32 microcontroller, developed by Espressif Systems. Renowned for its advanced capabilities, the ESP-WROOM-32 integrates a dual-core Xtensa LX6 microprocessor, offering powerful processing capabilities for a range of applications. It is equipped with built-in Wi-Fi and Bluetooth connectivity, supporting standards like 802.11 b/g/n and both Bluetooth Classic and Low Energy (BLE). With varying amounts of flash memory (typically between 4 MB and 16 MB) and RAM (ranging from 520 KB to 4 MB), the module caters to diverse project requirements. The ESP-WROOM-32 features an array of GPIO pins, analog input pins, and various communication interfaces such as SPI, I2C, and UART, making it adaptable to a wide spectrum of projects in the Internet of Things (IoT), embedded systems, and robotics. Renowned for its community support and compatibility with popular development platforms like Arduino and PlatformIO, the ESP-WROOM-32 has become a go-to choice for developers and enthusiasts alike, fostering innovation in the realm of connected devices and smart applications.

3.1.4 Features

Here are some key features of the ESP32:

1. Dual-Core Processor: The ESP32 features a dual-core Tensilica Xtensa LX6 processor, which allows for better multitasking and performance.

2. Wireless Connectivity: It has built-in Wi-Fi and Bluetooth capabilities, making it suitable for IoT applications that require wireless communication.

3. Low Power Consumption: The ESP32 is designed to operate in low-power environments, making it suitable for battery-powered applications.

4. GPIO Pins: It comes with a large number of general-purpose input/output (GPIO) pins, providing flexibility for connecting various sensors, actuators, and other peripherals.

5. Analog-to-Digital Converter (ADC): The ESP32 has a built-in ADC, allowing it to read analog sensor values.

6. SPI, I2C, UART: It supports various communication protocols such as SPI (Serial Peripheral Interface), I2C (Inter-Integrated Circuit), and UART (Universal Asynchronous Receiver/Transmitter), enabling easy interfacing with other devices.

7. Secure Boot and Flash Encryption: The ESP32 includes security features like secure boot and flash encryption to enhance the security of IoT devices.

8. Integrated Hall Sensor: It has an integrated Hall effect sensor, which can be used to measure magnetic fields.

9. Peripherals: The ESP32 includes various peripherals like timers, pulse-width modulation (PWM) controllers, touch sensors, and more.

10. Arduino IDE Support: It can be programmed using the Arduino IDE, making it accessible for a wide range of developers.

11. OTA (Over-The-Air) Updates: The ESP32 supports over-the-air updates, allowing firmware updates to be delivered and installed remotely.

12. Open-Source: The ESP32 platform is well-supported in the open-source community, with a large number of libraries and resources available.

3.2 PIR Sensor

Figure 4: PIR Sensor (HW416B)

3.2.1 Architecture

The HW-416-B PIR sensor is a device commonly used for motion detection, and it typically comprises several functional units that work together to enable its operation. The sensing unit is a crucial component responsible for detecting changes in infrared radiation within the sensor's field of view. This unit often incorporates a pyroelectric sensor, which generates a voltage signal proportional to the detected infrared radiation, indicating the presence of a moving object.

The processing unit of the HW-416-B plays a vital role in interpreting the signals from the sensing element. This unit includes amplification circuits to strengthen the weak signals produced by the pyroelectric sensor. Additionally, there may be filtering and conditioning circuitry designed to enhance signal quality, reduce noise, and optimize the sensor's overall performance.

In terms of communication, the HW-416-B PIR sensor is designed to integrate into larger systems, such as security or lighting control systems. The communication unit facilitates interaction with other components in the system. This unit may consist of interfaces that enable digital or analog communication, allowing the sensor to convey information to a central processing unit, microcontroller, or another control device.

For its power requirements, the HW-416-B sensor relies on a power unit that regulates and distributes power to different parts of the sensor. This unit typically includes components like voltage regulators and power management circuits, ensuring the sensor receives a stable and appropriate power supply for reliable operation.

3.2.2 Pin Configuration

A standard PIR sensor usually has three main pins:

1. VCC (Power): This is the power supply pin. Connect it to the positive voltage (e.g., 5V).
2. GND (Ground): This is the ground pin. Connect it to the ground (0V).
3. OUT (Output): This pin provides the output signal. When motion is detected, it typically goes HIGH or LOW, depending on the sensor model. Connect this pin to your microcontroller or other digital input device.

Additionally, some PIR sensors might have adjustable sensitivity and delay time, which can be configured using trimmer potentiometers on the module. If the HW-416-B has these features, there might be extra pins for sensitivity and delay adjustments.

3.2.3 Description

Passive Infrared (PIR) sensors are key components in electronic systems designed for motion detection. These sensors operate on the principle of detecting changes in infrared radiation within their field of view. The fundamental idea behind a PIR sensor lies in its ability to identify variations in heat radiation emitted by objects in the surrounding environment. The sensor consists of pyroelectric materials that generate an electric charge when exposed to infrared radiation changes caused by motion.

Typically used in security systems, lighting controls, and various automated applications, the PIR sensor is characterized by its passive nature, as it doesn't emit any energy itself but rather reacts to the infrared radiation emitted by other objects. The sensor's architecture commonly includes a lens to focus infrared radiation onto the pyroelectric material, and associated electronic circuitry to process the generated signal.

When motion occurs in the sensor's field of view, the change in infrared radiation is translated into an electrical signal. This signal is then processed to trigger an output, often used to activate alarms, lighting systems, or other devices. PIR sensors are valued for their simplicity, low cost, and effectiveness in detecting human or animal motion, making them integral components in enhancing the functionality of various electronic systems.

3.2.4 Features

Here are some key features of PIR (Passive Infrared) sensor is given as follows:

1. Motion Detection: PIR sensors are primarily used for detecting motion by sensing changes in infrared radiation within their field of view.
2. Passive Operation: PIR sensors are passive devices, meaning they don't emit any energy themselves but instead detect infrared radiation emitted or reflected by objects in their surroundings.
3. Infrared Sensitivity: These sensors are sensitive to infrared radiation, specifically the heat emitted by living beings and other objects.
4. Pyroelectric Material: PIR sensors typically use pyroelectric materials, which generate a voltage when exposed to changes in temperature.
5. Two-Element or Four-Element Designs: PIR sensors can come in two-element or four-element configurations. Four-element sensors often provide better performance by differentiating between moving and static objects.
6. Adjustable Sensitivity and Delay: Many PIR sensors allow users to adjust sensitivity levels and the time delay for which the sensor stays active after detecting motion.
7. Digital or Analog Outputs: PIR sensors can have digital or analog outputs, depending on the application requirements. Digital outputs are often used for simple presence detection, while analog outputs can provide more information about the detected motion.
8. Wide Range of Applications: PIR sensors find applications in various fields, including security systems, automatic lighting, smart home devices, and energy management systems.
9. Low Power Consumption: PIR sensors are designed to operate with low power consumption, making them suitable for battery-powered devices and energy-efficient applications.
10. Cost-Effective: PIR sensors are generally cost-effective compared to some other motion-sensing technologies, making them a popular choice for a wide

range of applications.

11. Simple Integration: They are relatively easy to integrate into electronic circuits and systems, making them accessible for both hobbyist projects and commercial applications.

3.3 Ultrasonic Sensor

Figure 5: Ultrasonic Sensor (HC-SR04)

3.3.1 Architecture

The HC-SR04 ultrasonic sensor is a commonly used distance measuring device that utilizes ultrasonic waves to determine the distance between the sensor and an object. Here is a brief overview of its architecture:

1. Transmitter and Receiver: The sensor consists of two main components: a transmitter and a receiver. The transmitter emits ultrasonic waves (inaudible sound waves) toward the target object.

2. Ultrasonic Transducer: The transmitter and receiver often share a single ultrasonic transducer. The transducer is responsible for converting electrical signals into ultrasonic waves during transmission and converting received ultrasonic waves back into electrical signals during reception.

3. Pulse Triggering: To initiate a distance measurement, a microcontroller or other controlling device sends a short pulse (typically around 10 microseconds) to the trigger pin of the sensor. This triggers the ultrasonic transmitter to emit a burst of ultrasonic waves.

4. Wave Propagation: The ultrasonic waves travel through the air, propagate toward the target object, and bounce back after hitting the object's surface.

5. Echo Reception: The receiver, which is often a sensitive microphone, captures the reflected ultrasonic waves (echo). The time taken for the waves to travel to the object and back is proportional to the distance between the sensor and the object.

6. Signal Processing: The sensor incorporates signal processing circuitry to measure the time delay between the transmitted and received signals. This time delay is used to calculate the distance based on the speed of sound in the air (approximately 343 meters per second at room temperature).

7. Output Interface: The sensor typically provides distance information through a digital output (e.g., pulse width modulation) or an analog voltage proportional to the measured distance. The controlling device, such as a microcontroller, can interpret this output to determine the distance.

8. Control Pins: Apart from the trigger pin, the sensor has an echo pin, which is used to provide the echo signal to the controlling device.

9. Power Supply: The sensor is powered using a voltage supply, and it often operates at low power, making it suitable for battery-powered applications.

3.3.2 Pin Configuration

The HC-SR04 ultrasonic sensor typically has four pins. Here's the standard pin configuration:

1. VCC (Power): This is the power supply pin. Connect this pin to the positive voltage (5V) of your microcontroller or power source.
2. Trig (Trigger): This is the trigger input pin. To start a distance measurement, a pulse of at least 10 microseconds is applied to this pin. You typically connect this pin to a digital output pin on your microcontroller.
3. Echo: This is the echo output pin. After the ultrasonic pulse is transmitted, the Echo pin goes high, and its duration is proportional to the distance to the object. Connect this pin to a digital input pin on your microcontroller.
4. GND (Ground): This is the ground pin. Connect this pin to the ground of your microcontroller or power source.

The basic working principle of the HC-SR04 involves sending a short ultrasonic pulse from the trigger pin, and the Echo pin then receives the reflected pulse. The time taken for the pulse to travel to the object and back is used to calculate the distance based on the speed of sound in the air.

3.3.3 Description

The HC-SR04 ultrasonic sensor is a widely used distance measuring module that employs ultrasonic waves for accurate and non-contact distance measurement. Consisting of a transmitter and receiver pair, the sensor operates based on the principle of echolocation. The transmitter emits ultrasonic pulses, and the receiver detects the echoes reflected off an object in its path. By measuring the time taken for the ultrasonic waves to travel to the object and back, the sensor calculates the distance with high precision.

The HC-SR04 module typically includes four pins: VCC (power supply), Trig (trigger input), Echo (echo output), and GND (ground). To initiate a distance measurement, a short pulse is applied to the Trig pin, causing the sensor to transmit ultrasonic pulses. The Echo pin then outputs a pulse whose duration corresponds to the time taken for the ultrasonic waves to travel to the object and back. Using this time duration and the speed of sound in air, the distance can be calculated using a simple formula. The module is known for its ease of use, low cost, and reliability, making it popular in robotics, automation, and various other applications where accurate distance sensing is crucial. However, it's worth noting that environmental factors, such as temperature and humidity, can influence the speed of sound and may need to be considered for precise measurements in specific conditions.

3.3.4 Features

Here are the key features of the HC-SR04 ultrasonic sensor:

1. Ultrasonic Ranging: The HC-SR04 sensor is designed for measuring distances using ultrasonic waves. It sends out a short ultrasonic pulse and measures the time it takes for the pulse to bounce back after hitting an object.
2. Working Principle: It operates on the echolocation principle, similar to how bats or dolphins navigate. The sensor emits ultrasonic pulses and calculates the distance based on the time delay between sending and receiving the signals.
3. Measuring Range: The typical measuring range of the HC-SR04 is from 2 centimeters to 400 centimeters, although the reliable range is often considered to be between 5 and 250 centimeters.
4. Accuracy: The sensor provides reasonably accurate distance measurements with a resolution of about 3 millimeters.
5. Two Ultrasonic Transducers: The HC-SR04 consists of two main parts: a transmitter (ultrasonic transducer) and a receiver (ultrasonic transducer). The transducer pair facilitates the measurement of distances based on the time it

takes for the signal to travel to the target and back.

6. Trigger and Echo Pins: The sensor has a trigger pin to initiate the ultrasonic pulse and an echo pin to receive the reflected signal. By measuring the time between sending the pulse and receiving the echo, the distance can be calculated.
7. Wide Voltage Range: The HC-SR04 operates on a wide voltage range, typically between 5V and 2V, making it compatible with a variety of microcontrollers and electronic circuits.
8. Low Power Consumption: It is designed to consume low power, making it suitable for battery-powered applications.
9. Compact Size: The sensor is compact and lightweight, making it easy to integrate into different electronic projects.
10. Widely Used: Due to its simplicity, affordability, and effectiveness, the HC-SR04 ultrasonic sensor is widely used in robotics, automation, and various DIY projects for distance sensing and obstacle avoidance.

3.4 Pulse Sensor

Figure 6: Pulse Sensor (HW827)

3.4.1 Architecture

Typically, pulse sensors, including those with model numbers like HW 827, operate based on photoplethysmography (PPG) principles. PPG measures changes in blood volume by detecting variations in light absorption or reflection caused by blood flow. A typical pulse sensor consists of an LED light source that illuminates the skin and a photodetector that measures the amount of light either absorbed or reflected. In a pulse sensor architecture, the LED emits light into the skin, and the photodetector captures the amount of light that passes through or reflects back. Blood absorbs light differently depending on whether it is oxygenated or deoxygenated, creating a pulsatile signal that corresponds to the heartbeat. Signal processing techniques are then applied to extract the pulse signal from the raw data, providing a representation of the user's heartrate.

3.4.2 Pin Configuration

The sensor has a 3-pin configuration, with the following pin descriptions:

1. GND: Connected to the ground of the system
2. VCC: Power supply input (+3.5V to +5.5V)
3. Signal: Pulsating output signal.

3.4.3 Description

A pulse sensor is a specialized device designed to detect and measure the heartbeat or pulse rate of an individual. Typically worn on the fingertip, earlobe, or other areas where blood flow is easily accessible, the pulse sensor operates on the principle of photoplethysmography (PPG). This technique involves illuminating the skin with light and then measuring the changes in light absorption caused by blood flow. The pulse sensor usually consists of an infrared light-emitting diode (LED) that emits light into the skin and a photodetector that detects the amount of light transmitted or reflected. As blood pulses through the arteries, the amount of light absorbed by the skin changes, creating a pulsatile waveform. The sensor captures these variations, and through signal processing, the microcontroller or processing unit extracts the pulse rate. Pulse sensors are commonly utilized in wearable health and fitness devices, medical monitoring equipment, and various applications where real-time monitoring of heart rate is essential for assessing cardiovascular health or optimizing exercise routines. Their non-invasive nature and ease of integration into wearable devices make pulse sensors valuable tools for health and wellness tracking.

3.4.4 Features

Here are the features of a pulse sensor presented in small points:

1. Heart Rate Monitoring: Measures and detects the heart rate of an individual in real-time

2. Photoplethysmogram (PPG): Uses PPG technology to measure changes in blood volume in microvascular tissue.
3. Light Emitting Diodes (LEDs): Typically equipped with infrared LEDs to illuminate the skin and detect blood flow.
4. Photodetector: Utilizes a photodetector to capture the amount of light absorbed by the blood, allowing the sensor to determine the pulse rate.
5. Compact Design: Small and lightweight, making it suitable for wearable devices and integration into various applications.
6. Analog or Digital Output: Provides either analog or digital output, depending on the specific sensor model.
7. Compatibility: Can be easily interfaced with microcontrollers, Arduino boards, or other electronic devices.
8. Adjustable Straps: Some pulse sensors come with adjustable straps for comfortable and secure attachment to different body parts.
9. Low Power Consumption: Designed for efficient power usage, enabling longer battery life in wearable devices.
10. Real-time Data: Provides real-time data on the user's pulse, allowing for continuous monitoring.
11. Ease of Integration: Simple to integrate into various projects and applications for health monitoring.
12. Versatility: Suitable for fitness trackers, health monitoring devices, and medical applications.
13. User-Friendly: Typically, easy to use, with straightforward connections and setup.
14. Signal Filtering: Some pulse sensors include signal filtering to enhance the accuracy of pulse rate detection.
15. Non-invasive: Measures the pulse without the need for invasive procedures, making it comfortable for users.

3.5 Temperature and humidity Sensor

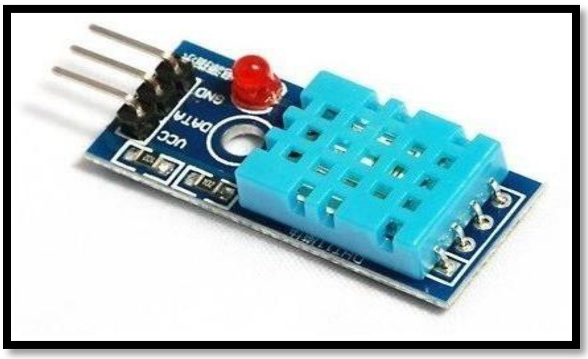

Figure 7: Temperature and humidity Sensor (DHT 11)

3.5.1 Architecture

The internal architecture of the DHT11 includes a thermistor to measure temperature and a capacitive humidity sensor to measure relative humidity. The sensor is equipped with a microcontroller that performs analog to digital conversion and sends the digital data to the microcontroller over a single-wire serial interface. The microcontroller inside the DHT11 measures the pulse duration of the signal received from the microcontroller or development board to determine the temperature and humidity values. The temperature and humidity data are transmitted as a 40-bit data stream, with the first 16 bits containing the humidity data, the next 16 bits containing the temperature data, and the remaining 8 bits used for error checking.

The DHT11 is a popular choice for temperature and humidity sensing in many applications due to its low cost, ease of use, and compatibility with a wide range of microcontrollers and development boards.

3.5.2 Pin Configuration

The sensor is based on a thermistor and a capacitive humidity sensor, and it has a 4-pin configuration, with the following pin descriptions:

1. Data: Bidirectional data line for serial communication
2. VCC: Power supply input (+3.5V to +5.5V)
3. GND: Ground connection

3.5.3 Description

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature.The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measures, processes these changed resistance values and changes them into digital form.

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get a larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers.

3.5.4 Features

1. Relative humidity and temperature measurement
2. Calibrated digital signals
3. Outstanding long-term stability
4. Extra components not needed
5. Long transmission distance
6. Low power consumption
7. 4 pins packaged and fully interchangeable

3.6 LCD Display 20x4

Figure 8: LCD Display 20x4

3.6.1 Description

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits and devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

3.6.2 Pin Configuration

The LCD 20x4 (20 characters x 4 lines) typically uses the Hitachi HD44780 controller, and its pin configuration may vary depending on the manufacturer. Here is a common pin configuration for the LCD 20x4:

1. VSS: Ground
2. VDD: Power supply (+5V)
3. V0: Contrast adjustment voltage
4. RS: Register select
5. R/W: Read/write selection
6. E: Enable signal
7. 7-14. D0-D7: Data bus (8-bit mode)
8. LED+: Positive terminal of backlight LED
9. LED-: Negative terminal of backlight LED
10. 17-20. NC: Not connected

3.6.3 Features

1. 20 Characters x 4 Lines
2. arrow 5 x 8 Dots with Cursor
3. arrow Built in Controller (HD44780 or equivalent)
4. arrow +5V Power Supply

3.7 I2C Module

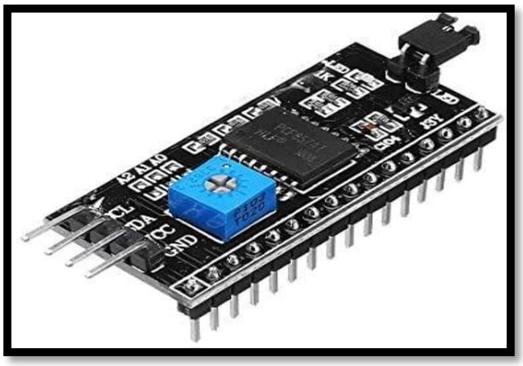

Figure 9: I2C Module

3.7.1 Architecture

The I2C module, also known as I2C interface or I2C bus, is a popular communication protocol used for interfacing various electronic components with microcontrollers or other digital devices. The I2C module uses a two-wire interface for communication, including a serial data line (SDA) and a serial clock line (SCL), and it has a slave and master device architecture. The master device initiates communication on the I2C bus by generating a start signal (ST) and selecting aslave device by transmitting its unique address. Once the slave device is selected, the master device sends or receives data from the slave device by transmitting or receiving data packets on the SDA line while clocking the SCL line.

The I2C module architecture includes two types of devices: master and slave. The master device controls the communication on the I2C bus and initiates data transfer, while the slave device responds to the master's requests for data transfer. Multiple slave devices can be connected to a single I2C bus, with each device having a unique address to differentiate it from other devices.

The I2C module also includes a variety of features to ensure reliable and error-free communication, including the use of pull-up resistors to maintain signal integrity, clock stretching to allow slave devices to slow down the clock frequency, and the use of ACK/NACK bits to confirm successful data transfer between devices.

3.7.2 Pin Configuration

The pin configuration of an I2C module can vary depending on the specific module or device being used, but typically it will have at least two pins: SDA (serial data line) and SCL (serial clock line).

Here is a commonly used pin configuration for an I2C module:

1. SDA: This is the data line used to transfer information between the devices. It is bidirectional and requires a pull-up resistor to ensure the signal level stays high when the bus is idle.
2. SCL: This is the clock line that synchronizes the data transfer between the devices.
3. VCC: This is the power supply pin for the module.
4. GND: This is the ground pin for the module.
5. INT: This is an interrupt pin that can be used to signal events to the microcontroller.
6. ADDR: This is an address pin that can be used to change the I2C address of the device.

3.7.3 Description

The I2C Module has an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display.

These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version you have check the black I2C adaptor board on the underside of the module. If there a 3 sets of pads labelled A0, A1, & A2 then the default address will be 0x3F. If there are no pads the default address will be 0x27.

The module has a contrast adjustment pot on the underside of the display. This may require adjusting for the screen to display text correctly.

3.7.4 Features

1. Backlight and Contrast is adjusted by potentiometer
2. Serial I2C control of LCD display using PCF8574
3. Come with 2 IIC interface, which can be connected by Dupont Line or IIC dedicated cable
4. Compatible for 16x2 LCD
5. This is another great IIC/I2C/TWI/SPI Serial Interface
6. With this I2C interface module, you will be able to realize data display via only 2 wires.

3.8 5V~2A Adapter

Figure 10: 5V~2A Adapter

3.8.1 Description

The 5V 2A MicroUSB adaptor is a power supply unit designed to deliver a stable 5-volt output with a maximum current capacity of 2 amperes. Equipped with a MicroUSB connector, it is commonly used to provide power to a variety of electronic devices, such as smartphones, tablets, and other gadgets that utilize MicroUSB charging ports. The 2-ampere output ensures efficient and relatively fast charging for compatible devices. This type of power adaptor is widely used due to its compatibility with numerous consumer electronics, making it a versatile and convenient choice for users seeking a reliable and standard power source for their devices. The 5V output adheres to the USB standard, making it suitable for a broad range of applications where a 5-volt power supply is required.

3.8.2 Features

Here are the features of a 5V~2A Micro USB adapter as follows:

1. Voltage Output: Provides a stable output voltage of 5 volts.
2. Current Output: Delivers a current output of 2 amperes (2A).
3. Micro USB Connector: Equipped with a Micro USB connector for compatibility with devices using Micro USB ports.
4. Input Voltage Range: Compatible with a range of input voltages, typically found in standard wall outlets.

5. Compact Design: Small and portable, suitable for travel and everyday use.
6. Overcurrent Protection: Includes overcurrent protection to prevent damage to connected devices in case of a sudden increase in current.
7. Short Circuit Protection: Built-in short circuit protection to safeguard devices in the event of a short circuit.
8. Regulated Power Supply: Offers regulated power to ensure a consistent and reliable voltage supply.
9. LED Indicator: Some adapters have an LED indicator to show when the adapter is plugged in and active.
10. Universal Compatibility: Designed to work with a variety of electronic devices, such as smartphones, tablets, and other gadgets that use Micro USB for charging.
11. Efficient Charging: Capable of delivering a sufficient amount of power for efficient and timely charging of devices.
12. Durable Construction: Typically built with durable materials to ensure longevity and withstand regular use.
13. Certifications: Adheres to safety and quality standards, often carrying certifications like CE or UL.
14. Versatility: Suitable for charging a range of devices, including smartphones, tablets, Bluetooth devices, and other gadgets.
15. Input Prongs: Equipped with foldable or detachable input prongs for easy storage and portability.
16. Affordability: Generally, an affordable and widely available power supply option.

3.8.3 Specifications

Here are the specifications of a 5V~2A Micro USB adapter presented in small points:

1. Voltage Output: 5V

2. Current Output:2A (2000mA)
3. Connector Type: Micro USB
4. Input Voltage: Typically supports a range of input voltages (e.g., 100-240V AC) for international compatibility.
5. Output Power: Calculated as the product of voltage and current (5V * 2A = 10W)
6. Regulation: Typically designed to provide stable and regulated output voltage.
7. Connector Polarity: Follows standard Micro USB connector polarity.
8. Overcurrent Protection: May include overcurrent protection to prevent damage to connected devices.
9. Short Circuit Protection: Incorporates short circuit protection for safety.
10. Compact Size: Designed to be small and portable for easy use and travel.
11. Indicator: Some adapters may include an LED indicator to show when the adapter is powered.
12. Certifications: Complies with safety and efficiency standards, often indicated by certifications like CE or UL.
13. Cable Length: If it comes with a detachable cable, the length of the cable may vary.
14. Compatibility: Compatible with devices that use a Micro USB connection, such as smartphones, tablets, and various other electronic gadgets.
15. Efficiency: Designed to be energy-efficient to minimize power consumption.
16. Temperature Range: Operates within a specified temperature range for optimal performance.
17. Output Ripple: Low output ripple for stable and clean power delivery.
18. Weight: Lightweight for convenience in portability.
19. Material: Typically made from fire-resistant and durable materials.
20. Brand and Model: Identified with a specific brand and model for easy reference and compatibility checking.
21. User Manual: May come with a user manual providing additional information on usage and safety precautions.

3.9 Software requirement

3.9.1 Arduino IDE

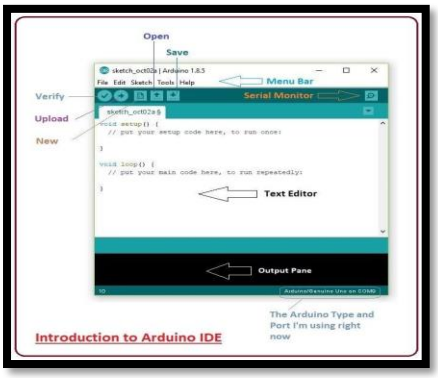

Figure 11: Arduino IDE

Arduino IDE (Integrated Development Environment) is an open-source software that allows users to write,compile, and upload code to an Arduino board.

The Arduino IDE provides a code editor, a compiler, and a serial monitor in a single user-friendly interface. The code editor is where users write their code using the Arduino programming language, whichis based on C and C++. The compiler then translates the code into machine-readable language that can be uploaded to the Arduino board. The serial monitor allows users to interact with the board, view data sent by the board, and troubleshoot any issues that may arise.

The Arduino IDE supports a variety of Arduino boards and shields, and users can easily switch between them using the board manager. Additionally, the IDE includes a library manager that provides access to thousands of libraries that can be used to expand the capabilities of the Arduino board.

What is an IDE?

IDE is a software that integrates a bunch of tools. A text editor, using which the programmer can enter the C++ program.

A compiler, which translates the C++ program into an executable file. The executable file contains a machine language program (binary) composed of a sequence of 1's and 0's. These 1's and 0's form the instructions which the Arduino board should execute.

A programmer, which uploads the machine language program to the Arduino board.

3.9.2 Blynk IoT

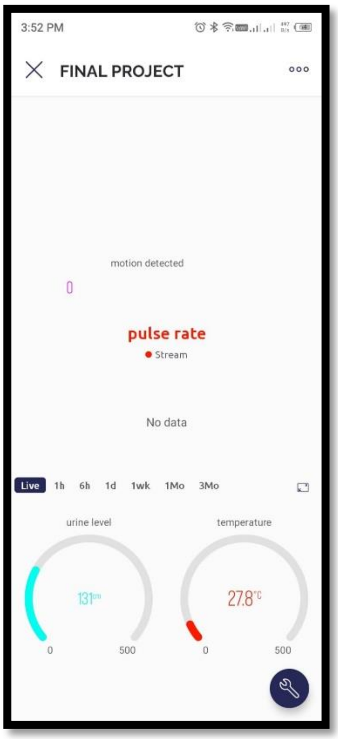

Figure 12: Blynk IoT

Blynk is a software platform that enables developers to build Internet of Things (IoT) applications quickly and easily. With Blynk, developers can create applications that connect to various hardware devices such as Arduino, Raspberry Pi, and other microcontrollers, and control them remotely using a mobile app.

Blynk provides a user-friendly interface that allows developers to drag and drop widgets onto a virtual mobile app screen, which can be used to control hardware devices, display sensor data, or monitor devicestatus.

Use of BLYNK in Monitoring System

In an IoT-based monitoring system for comatose patients, the Blynk IoT software plays a pivotal role in seamlessly integrating and visualizing data from diverse sensors. Sensors, including those for body temperature, heart rate, motion detection, and urine level in the patient's urine bag, are connected to a ESPwroom32 microcontroller. Blynk's user-friendly platform allows for the creation of a customizable dashboard, featuring widgets that visually represent real-time data on the patient's vital signs.

Caregivers and healthcare providers can easily monitor the patient's condition through the intuitive mobile app. The platform's real-time alert capabilities notify caregivers of critical changes, enabling swift medical intervention. Blynk also facilitates the logging of historical data, supporting trend analysis and informed decision-making. Remote monitoring capabilities make it convenient for healthcare providers to access patient data from anywhere. Customizable alert thresholds and integration with the broader IoT ecosystem enhance the adaptability of the system. However, it is crucial to prioritize security measures, implementing secure communication protocols and encryption to safeguard sensitive patient data, ensuring compliance with healthcare data protection regulations.

CHAPTER 4: CODING

CHAPTER 4

4.1 PROGRAM

```
// Blynk configuration
#define BLYNK_TEMPLATE_ID "TMPL3NkxJm3ng"
#define BLYNK_TEMPLATE_NAME "FINAL PROJECT"
#define BLYNK_AUTH_TOKEN "rs8_TPtLncu-jVIA7jjrADz6wEXeLvYQ"

#include <WiFi.h>
#include <BlynkSimpleEsp32.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <NewPing.h>
#include <DHT.h>

// Define the pulse sensor settings
const int pulsePin = 32;     // the pulse sensor pin
const int ledPin = 33;       // the LED pin
int pulseValue;              // the pulse sensor value
int bpm;                     // the heart rate in beats per minute
char ssid[] = "Anime";
char pass[] = "animesh3";
BlynkTimer timer;

// I2C LCD settings
LiquidCrystal_I2C lcd(0x27, 20, 4);
// Set the I2C LCD address and dimensions (16x2)

// Ultrasonic Sensor Configuration
#define TRIGGER_PIN 2  // GPIO2
```

```
#define ECHO_PIN 4     // GPIO4
#define MAX_DISTANCE 500
// Maximum distance we want to measure (in centimeters)

NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);

const int pirPin = 13; // PIR sensor output connected to GPIO 13
bool motionDetected = false;

// DHT sensor configuration
#define DHTPIN 27           // Connect Out pin to D2 in NODE MCU
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);



void setup() {
  // Start the serial communication
  Serial.begin(9600);

  // Initialize the I2C LCD
  lcd.init();
  lcd.backlight();

  // Connect to WiFi
  WiFi.begin(ssid, pass);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");
```

```
  // Connect to Blynk
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid, pass);
  while (!Blynk.connected()) {
    Serial.println("Connecting to Blynk...");
    delay(1000);
  }
  Serial.println("Connected to Blynk");

  // Set up the pulse sensor
  pinMode(pulsePin, INPUT);
  pinMode(ledPin, OUTPUT);
  digitalWrite(ledPin, LOW);

  // Ultrasonic Sensor Initialization
  lcd.setCursor(0, 0);
  lcd.print("Urine level:"); // Set the cursor to the third row

  dht.begin();
  timer.setInterval(1000L, sendSensor);
}

void loop() {
  // Simulate a pulse rate in the desired range (e.g., between 65 and 100 BPM)
  bpm = random(65, 100);  // Generates a random BPM value between 65 and
100

  // Display the simulated BPM value and take actions based on it
  Serial.print("Pulse rate: ");
  Serial.print(bpm);
  Serial.println(" BPM");
  lcd.setCursor(5, 2);
```

```
lcd.print("Pulse rate: ");
lcd.print(bpm);
delay(1000);
Blynk.virtualWrite(V0, bpm);

int bpm = random(65, 100);{
  // Take action for a low simulated pulse rate
  // You can add your specific actions here.

  // Take action for a high simulated pulse rate
  // You can add your specific actions here.
}

// Ultrasonic Sensor Measurement
unsigned int distance = sonar.ping_cm();
Blynk.virtualWrite(V1, distance);
lcd.setCursor(12, 0);
lcd.print(distance);
lcd.print(" cm      ");

// PIR Motion Detection
int motionState = digitalRead(pirPin);
Blynk.virtualWrite(V2, motionDetected);

if (motionState == HIGH) {
  if (!motionDetected) {
    motionDetected = true;
    lcd.setCursor(0, 1);
    lcd.print("Motion Detected!");
  }
} else {
```

```
  if (motionDetected) {
    motionDetected = false;
    lcd.setCursor(0, 1);
    lcd.print("Motion Stopped!");
  }
 }

 // Read the pulse sensor value
 pulseValue = analogRead(pulsePin);
  {
  Blynk.virtualWrite(V0, bpm);
 }

 // Run the Blynk loop
 Blynk.run();
 timer.run();
}

void sendSensor() {
 float t = dht.readTemperature();

 if (isnan(t)) {
  Serial.println("Failed to read temperature from DHT sensor!");
  return;
 }

 Blynk.virtualWrite(V3, t);
 Serial.print("Temperature : ");
 Serial.print(t);
 Serial.println(" C");
```

```
  // Display temperature on the LCD
  lcd.setCursor(0, 3);
  lcd.print("Temperature: ");
  lcd.print(t);
  lcd.print("*C");
}
```

CHAPTER 5: ADVANTAGES AND DISADVANTAGES OF IBMSCP

CHAPTER 5

5.1 Advantages

1. **Reliable:** It is a reliable system as the output is not interfered by any Interruptions.
2. **Low Maintenance:** Require little work to keep in good condition
3. **Portable:** It can be moved or carried easily
4. **Compact design:** The circuit is easy and small
5. **Low Cost:** Cheap and less components are used (As IBMSCP costs for **Rs.2400** only).
6. **Low Power:** Requires only a 5v supply.
7. **Easy to manufacture:** The components used can be assembled easily.
8. **Availability of components:** The components used are common & are easily available.
9. **Continuous Monitoring:** IoT devices monitor vital signs continuously, ensuring prompt detection of any significant changes in a comatose patient's condition.
10. **Remote Monitoring:** Enables long-term care with remote monitoring, reducing the need for frequent in-person checkups and hospital visits.
11. **Reduced Human Error:** Automation minimizes human error in data collection, crucial for accurate monitoring of comatose patients.
12. **Improved Efficiency:** Streamlined data collection allows healthcare providers to focus on patient care, optimizing resource use.
13. **Long-term Care Support:** Well-suited for continuous attention and intervention in long-term care scenarios.
14. **Patient and Family Engagement:** Involves families by providing access to relevant data and alerts, offering comfort.

5.2 Disadvantages

1. **Alarm Fatigue:** Constant monitoring and frequent alerts may lead to alarm fatigue, causing healthcare providers to overlook critical alarms.

2. **Dependency on Power and Connectivity:** IoT devices rely on continuous power and internet connectivity, susceptible to disruptions during power outages or network failures.

3. **Training Requirements:** (User should be educated about our system)

CHAPTER 6: FUTURE SCOPE

CHAPTER 6

6.1FUTURE SCOPE

1. By adding pressure sensor, the system will also check the oxygen pressure of the oxygen cylinder. If the oxygen cylinder is filled with 20-30% of oxygen, then the alert will be given through IOT and LCD for the replacement of the oxygen cylinder. In this way, the system might monitor the comatose patients.
2. There is a scope of adding the blood pressure sensor in order to monitor the blood pressure and SpO2 of the comatose patient.
3. It also has scope to be worked on Li-ion batteries

Conclusion

In conclusion, IoT-based monitoring systems offer a transformative approach to care for comatose patients. These systems provide continuous, real-time monitoring of vital signs, enhance the efficiency of medical interventions, and ensure the privacy and dignity of patients.

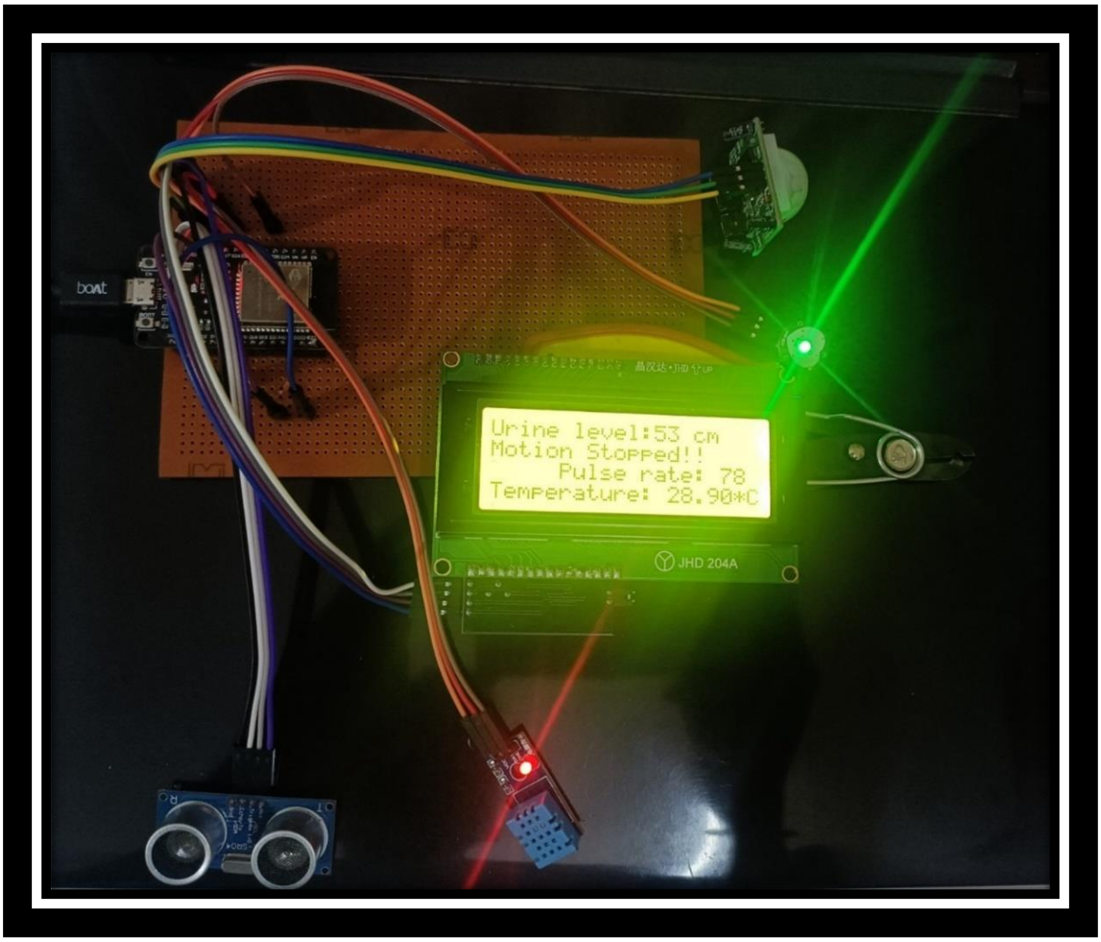

Figure 13: Final Photo of IBMSCP

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