GOVERNMENT POLYTECHNIC COLLEG BETUL (M.P.)

(SESSION 2023-2024)

A MAJOR PROJECT ON

“IOT BASED SMART HELMET FOR COAL MINING INDUSTRY”

A Dissertation submitted to

Rajiv Gandhi Proudyogiki Vishwavidyalaya, Bhopal [M.P]

For the partial Fulfillment of diploma in

(Electronics & Telecommunication Engineering)

RAJIV GANDHI PROUDYOGIKI VISHWAVIDYALAYA BHOPAL [M.P]

Guided by: -

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Abhay Geed	- 21048E03005
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CERTIFICATE

This is to certify that the work embodies in this project entitled **"IOT BASED SMART HELMET FOR COAL MINING INDUSTRY"** being submitted by **Abhay Geed, Ajay Pawar, Ayush sarle, Ankit Dhurve, Yash kumar Waghmare** in partial fulfillment of the requirements for the award of Diploma in Electronics & Telecommunication Engineering to Rajiv Gandhi Proudyogiki Vishwavidyalaya Bhopal (M.P.) during the academic year 2023-2024 is a record of bonafied piece of work carried out by the under my supervision and guidance.

We are satisfied by their sincere effort and wish them every success in their career.

Mr. Vasant Singh Dhurvey
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Govt. Polytechnic College Betul (M.P.)

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GOVERNMENT POLYTECHNIC COLLEGE

BETUL (M.P.)

Department of Electronics & Telecommunication Engineering

RECOMMENDATION

This is Certify That **Abhay Geed, Ajay Pawar, Ankit Dhurve, Ayush Sarle, Yash kumar Waghmare** students of Final year Diploma in Electronics & Telecommunication Engineering in the academic year 2023- 2024 of the institute has completed the project work entitled **"IOT BASED SMART HELMET FOR COAL MINING INDUSTRY"** and have submitted a satisfactory report as a part of recommendation to wart the partial fulfillment for the award of Diploma in Electronics & Telecommunication Engineering from Rajiv Gandhi Proudyogiki Vishwavidyalaya Bhopal (M.P.)

Internal Examiner **External Examiner**

Mr. VASANT SINGH DHURVEY

ACKNOWLEDGEMENT

Thanks God for giving me knowledge and ability to complete this work in this major Project. The satisfaction that accompanies the success in completion of any task would be without mentioning the people who made it possible, whose constant Guidance and encouragement crowned our effort with success.

We feel pleasure in conveying my profound thanks to our guide and project in charge **Mr. Vasant Singh Dhurvey** for his constant support, valuable guidance and encouragement. During the entire course of this project he reviewed with greatest care and his innovation ideas led to the successful completion of this work. His continuous strong encouragement had some very profound effect on us that went beyond scientific supervision.

We have been able to successfully complete this project because of excellent guidance and infinite help given to us by our **Ms. Deepika Sakre**. It is difficult to acknowledge adequately the help and encouragement we received from him but we take this opportunity to thanks him profusely.

We would like to use this opportunity to thank with gratitude to our respected **Dr. Arun Singh Bhadoriya**, Principal Govt. Polytechnic College Betul for his constant support and encouragement. We are thankful to all other faculty members and laboratory staff in department of for their cooperation extended during the project work.

Abhay Geed
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INTRODUCTION

INTRODUCTION

In the coal mining industry, safety and efficiency are paramount. Miners face numerous hazards including toxic gases, cave-ins, and high levels of dust, which can lead to serious health issues and even fatalities. Traditional safety equipment often falls short in providing real-time data and alerts to prevent accidents. To address these challenges, the integration of Internet of Things (IOT) technology with protective gear has emerged as a revolutionary solution.

An IOT - based smart helmet for coal mining introduces advanced safety features that go beyond conventional helmets. Equipped with sensors and wireless communication capabilities, this smart helmet can monitor environmental conditions such as **gas levels, temperature, and humidity**. It can also track the location and physical health of miners, sending real-time alerts to both the miners and the control room in case of emergencies. This proactive approach not only enhances the safety of miners but also improves operational efficiency by allowing for quicker responses to potential hazards.

The adoption of IOT technology in mining safety gear exemplifies the industry's move towards modern, tech-driven solutions. This innovation represents a significant step forward in creating a safer working environment, reducing the risk of accidents, and ensuring the well-being of miners.

THEORY

1. Introduction to IoT in Mining

The Internet of Things (IoT) technology in coal mining enables advanced monitoring and real-time data exchange. This technology primarily aims to enhance safety and improve operational efficiency.

2. Components of Smart Helmet

Sensors:

- **Gas Sensors**: Detect methane, carbon monoxide, and other toxic gases.
- **Temperature Sensors**: Monitor environmental temperature.
- **Humidity Sensors**: Measure moisture levels.
- **Communication Module**: Uses Wi-Fi, Bluetooth, or Zigbee to wirelessly transmit data to a central monitoring system.
- **Microcontroller:** - Processes data from the sensors and controls the communication module.
- **Power Supply**: Battery or other power sources to ensure continuous operation

3. Working Mechanism

- **Data Collection**: Sensors embedded in the helmet continuously monitor environmental conditions and the miner's vital signs.
- **Data Transmission**: Collected data is transmitted wirelessly to a central monitoring system in real-time.
- **Data Analysis**: The central system analyzes the data to detect any hazardous conditions or anomalies.
- **Alerts and Notifications**: If dangerous conditions are detected, the system sends immediate alerts to the miner and the control room, enabling prompt action.
- **Preventive Measures**: Real-time data allows for proactive measures, such as evacuation in case of high gas levels or extreme temperatures.

4. Challenges and Considerations

- **Power Management**: Ensuring a reliable power supply for continuous operation is crucial.

- **Data Security**: Protecting transmitted data from cyber threats is essential.

- **Environmental Durability**: The helmet must withstand the harsh conditions of a coal mine.

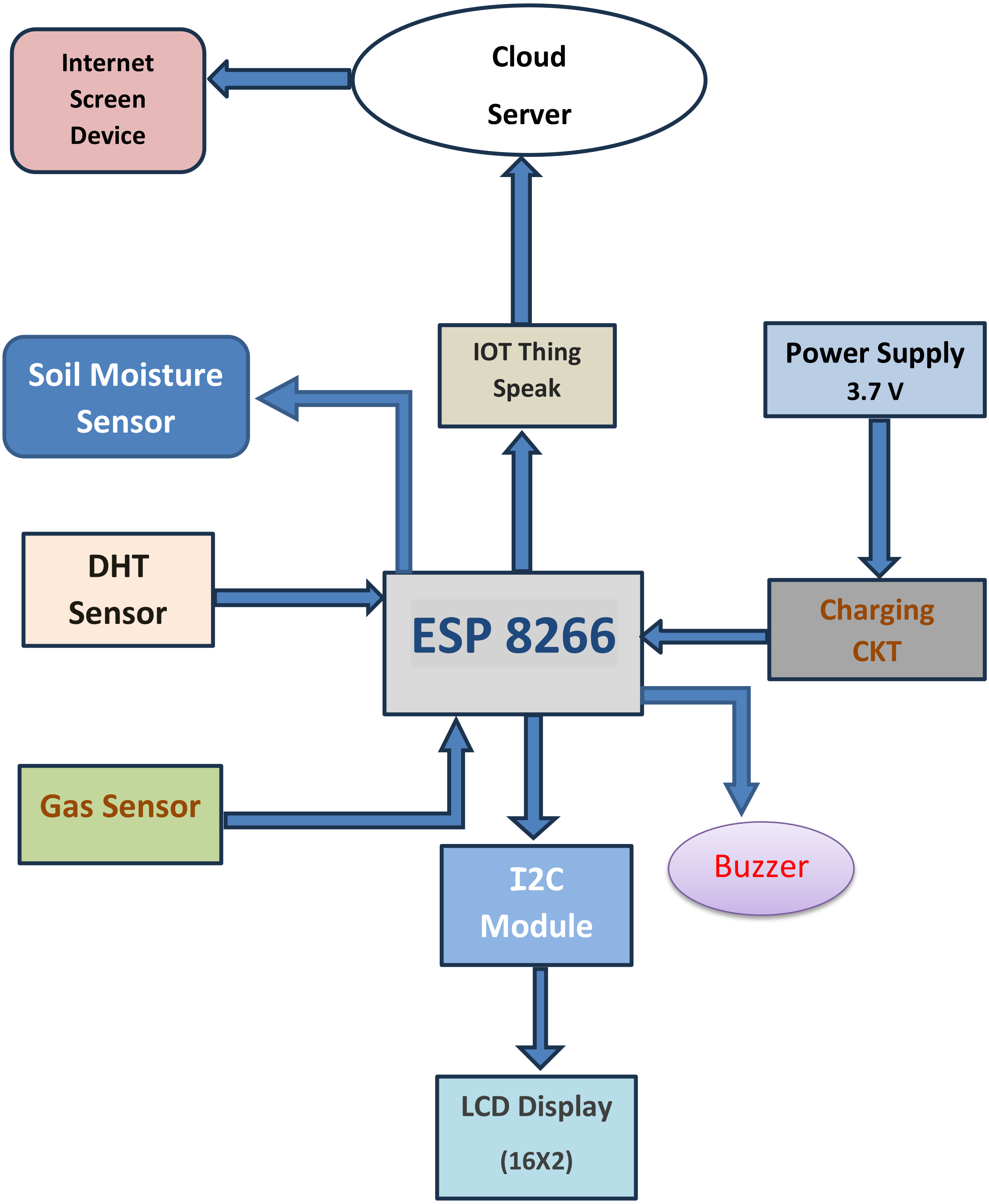
- **Cost and Implementation**: Managing the initial cost and the complexity of integrating IoT technology into existing mining operations is necessary.

5. Future Prospects

Future advancements may include more sophisticated sensors, enhanced data analytics, and AI integration, which will further improve predictive maintenance and safety measures. The continuous development of IoT technology promises to revolutionize the mining industry, making it safer and more efficient.

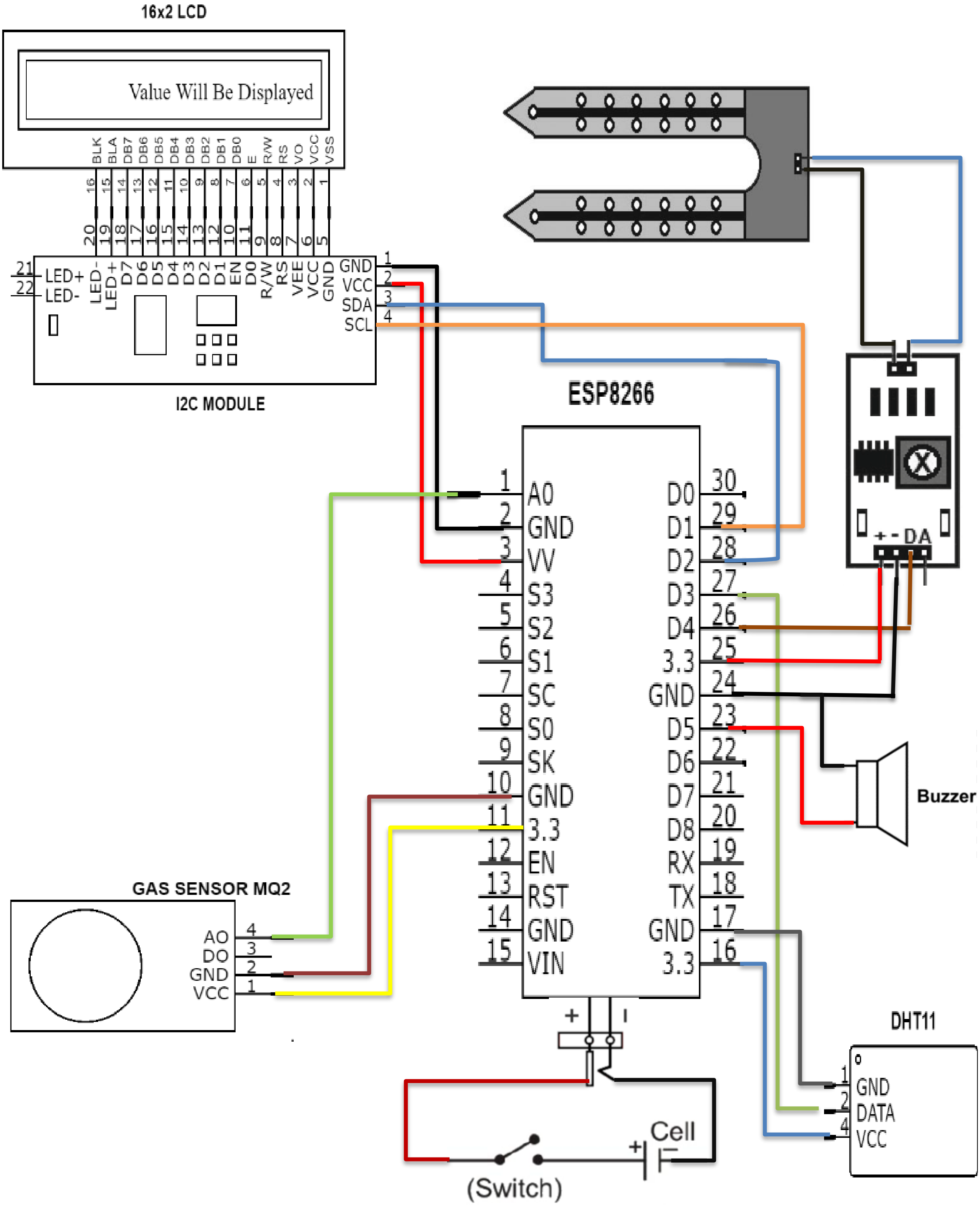
BLOCK DIAGRAM

BLOCK DIAGRAM



CIRCUIT DIAGRAM

CIRCUIT DIAGRAM



WORKING

WORKING

The IoT-based smart helmet integrates various sensors and modules to monitor environmental conditions and enhance miner safety. Here's a detailed explanation of the connections and working:

Components and Their Connections

Node MCU v3:

Function: Acts as the main controller. It collects data from sensors, processes the information, and sends it to the cloud or a remote server via Wi-Fi.

Connectivity: Provides Wi-Fi capabilities to transmit data to a remote server or cloud.

Gas Sensor (MQ-2, MQ-7, etc.):

Function: Detects harmful gases like carbon monoxide (CO), methane (CH_4), and other combustible gases.

Working: The sensor measures the concentration of gases in the environment and outputs an analog signal proportional to the concentration.

VCC: Connect to the 5V pin of the Node MCU.

GND: Connect to the GND pin of the Node MCU.

AO (Analog Output): Connect to an analog input pin (e.g., A0) on the Node MCU.

DHT11 Sensor:

Function: Measures temperature and humidity.

Working: The sensor provides digital output for both temperature (in Celsius) and humidity (percentage), which the Node MCU reads.

VCC: Connect to the 3.3V pin of the Node MCU.

GND: Connect to the GND pin of the Node MCU.

DATA: Connect to a digital pin (e.g., D4) on the Node MCU, with a 10k pull-up resistor between DATA and VCC.

Soil Moisture Sensor: Measures moisture levels in the soil, sending an analog signal to the Node MCU.

VCC: Connect to the 5V pin of the Node MCU.

GND: Connect to the GND pin of the Node MCU.

AO (Analog Output): Connect to another analog input pin (e.g., A1) on the Node MCU.

LCD Display with I2C Module:

Function: Displays real-time data from the sensors, like gas concentration, temperature, humidity, and soil moisture levels.

Working: The I2C module simplifies connections by using only two pins (SDA and SCL) to communicate with the Node MCU.

VCC: Connect to the 5V pin of the Node MCU.

GND: Connect to the GND pin of the Node MCU.

SDA: Connect to the D2 pin on the Node MCU.'

SCL: Connect to the D1 pin on the Node MCU.

Power Supply:

Battery Pack/Regulated Power Supply: Provide 5V to the VIN pin and GND to the GND pin of the Node MCU.

Wiring Diagram

Here is a simplified wiring diagram for the connections:

Node MCU v3:

Pin	Connected to
3.3V	VCC of DHT11 Sensor
5V	VCC of Gas Sensor, Soil Moisture Sensor, LCD I2C
GND	GND of all components
D4	DATA pin of DHT11 Sensor
A0	AO pin of Gas Sensor
A1	AO pin of Soil Moisture Sensor
D2 (SDA)	SDA of LCD I2C Module
D1 (SCL)	SCL of LCD I2C Module

Working Process

1. **Initialization:**

Power up the system using the battery pack or power supply.

The Node MCU initializes all sensors and the LCD display.

Connects to a Wi-Fi network for data transmission.

2. **Data Collection**

Gas Sensor: Continuously monitors the concentration of gases and sends an analog signal to the Node MCU.

DHT11 Sensor: Measures temperature and humidity periodically, sending digital data to the Node MCU.

Soil Moisture Sensor: Measures moisture levels in the soil, sending an analog signal to the Node MCU.

3. **Data Processing:**

Node MCU reads the analog and digital signals from the sensors.

Processes the data to determine gas concentrations, temperature, humidity, and soil moisture levels.

Checks the data against pre-set thresholds to identify any hazardous conditions.

4. **Data Display**

The Node MCU sends the processed data to the LCD display via the I2C module.

The LCD shows real-time readings of gas levels, temperature, humidity, and soil moisture.

5. **Data Transmission**:

The Node MCU transmits the sensor data to a remote server or cloud platform over Wi-Fi for logging and further analysis.

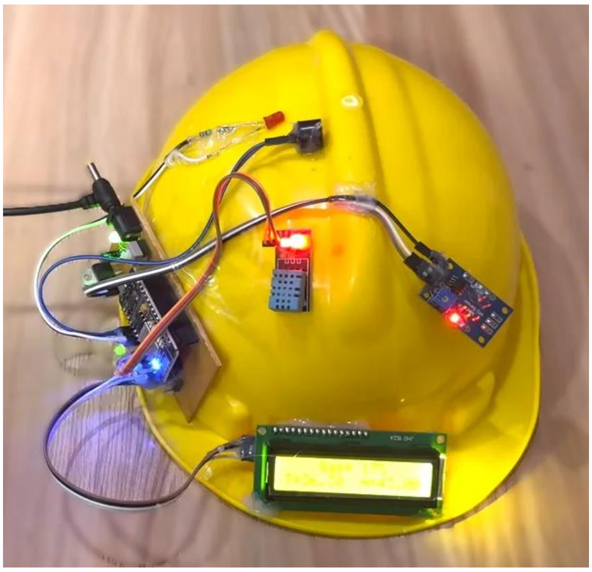
6. **Alerts and Safety Measures:**

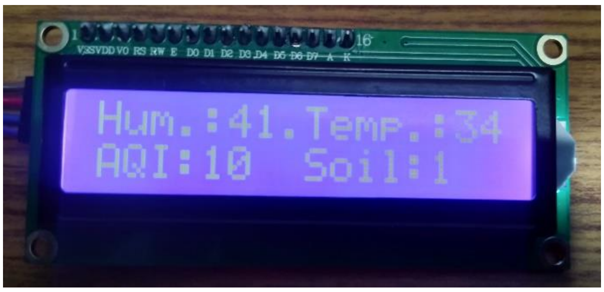
If any sensor readings exceed safe limits, the Node MCU triggers an alert (e.g., buzzer or LED).

Sends an alert notification to remote monitoring systems for immediate action.

PROJECT PHOTOS

Operation Off





Operation On

IOT (INTERNET OF THINGS)

What is IoT (Internet of Things)?

IoT (Internet of Things) is a network of physical devices (referred to as "things") connected to the internet that collect and exchange data. These devices are equipped with sensors, actuators, and communication hardware to gather and share data in real-time.

Features of IoT

1.Connectivity:

Devices are connected to the internet.

2.Data Collection:

Sensors gather data from the environment.

3.Communication:

Devices share their collected data with the cloud or other devices.

4.Analysis and Processing:

The collected data is analyzed and processed to provide actionable insights.

5.Automation and Control:

Devices can be remotely controlled and automated based on the data they collect.

THING SPEAK

Role of Thing Speak in an IoT-Based Smart Helmet Project

Thing Speak is an IoT analytics platform used for real-time data collection, analysis, and visualization. In the context of an IoT-based smart helmet for the mining industry, Thing Speak plays a crucial role in ensuring the safety and monitoring of miners by collecting and analyzing data from various sensors embedded in the helmet.

Thing Speak' s Role in the Project

1.Data Collection and Transmission:

Sensors: The smart helmet is equipped with various sensors such as a gas sensor, DHT11 (temperature and humidity sensor), and a soil moisture sensor. These sensors collect environmental data continuously

.

Node MCU: This microcontroller gathers data from the sensors and uses its built-in Wi-Fi module to send the collected data to Thing Speak.

2.Data Storage:

Thing Speak Channels: On Thing Speak, a channel is created for the smart helmet. This channel consists of multiple fields, each designated to store different types of sensor data (e.g., gas levels, temperature, humidity, soil moisture).

API Key: The Node MCU uses the API key provided by Thing Speak to securely transmit data to the appropriate channel.

3.Data Visualization:

Graphs and Charts: Thing Speak provides tools to create graphs and charts that visualize the sensor data in real-time. This helps in monitoring the environmental conditions in the mining area.

Dashboards: Custom dashboards can be created on Thing Speak to display all relevant data in a user-friendly format.

4.Data Analysis:

MATLAB Integration: Thing Speak supports MATLAB, allowing for sophisticated data analysis. Custom scripts can be written to analyze the collected data, identify trends, and generate insights.

Steps to Implement Thing Speak in the Project

1.Create a Thing Speak Account:

Sign up and log in to Thing Speak.

2.Create a New Channel:

Navigate to the Channels tab and create a new channel. Define fields for each type of data you will be collecting (e.g., Field 1 for gas levels, Field 2 for temperature, etc.).

3.Obtain the API Key:

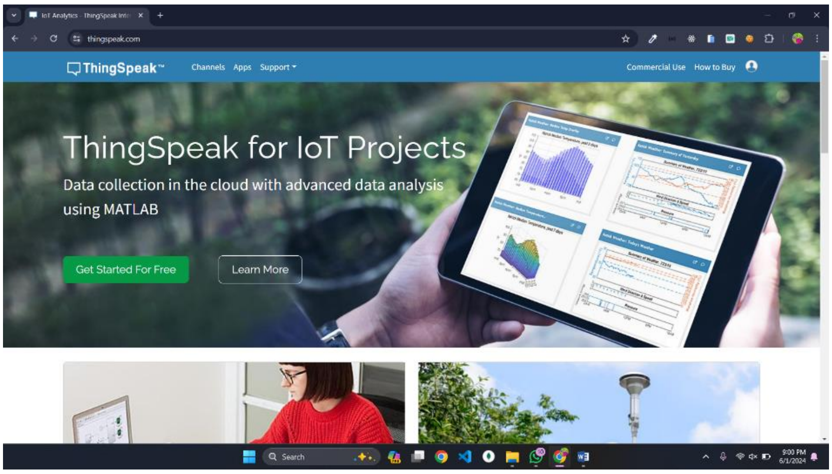
Go to the API Keys tab in your channel settings and note down the “Write API Key”. This key will be used to send data to Thing Speak.

4.Program the Node MCU with Arduino IDE:

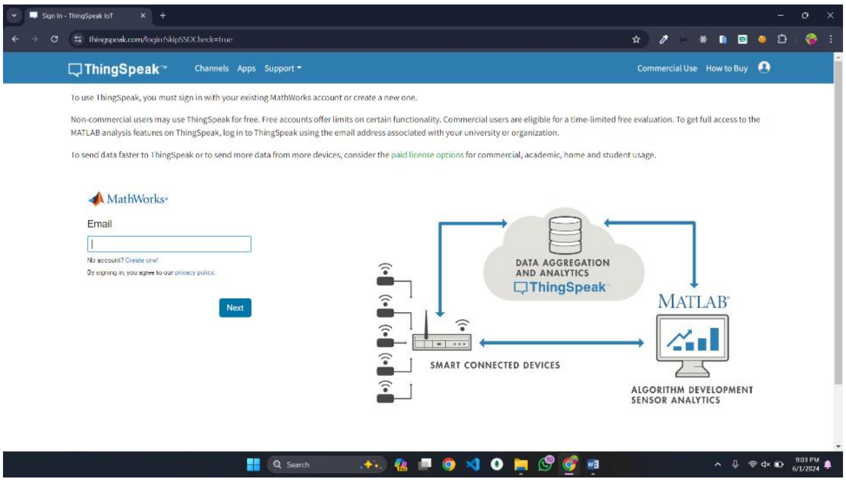
Write and upload the code to the Node MCU that reads sensor data and sends it to Thing Speak using the API key.

PROCEDURE

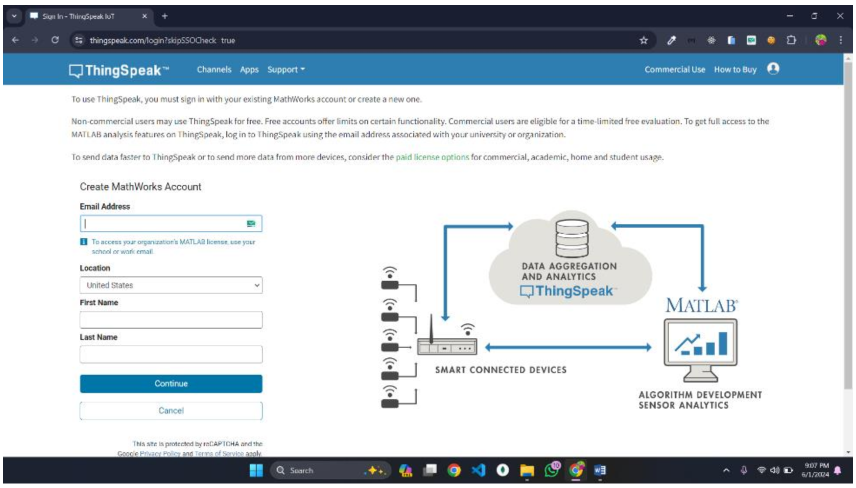
1.Open Thing speak official site then sign up the requirement.



2. Click the button get started for free.

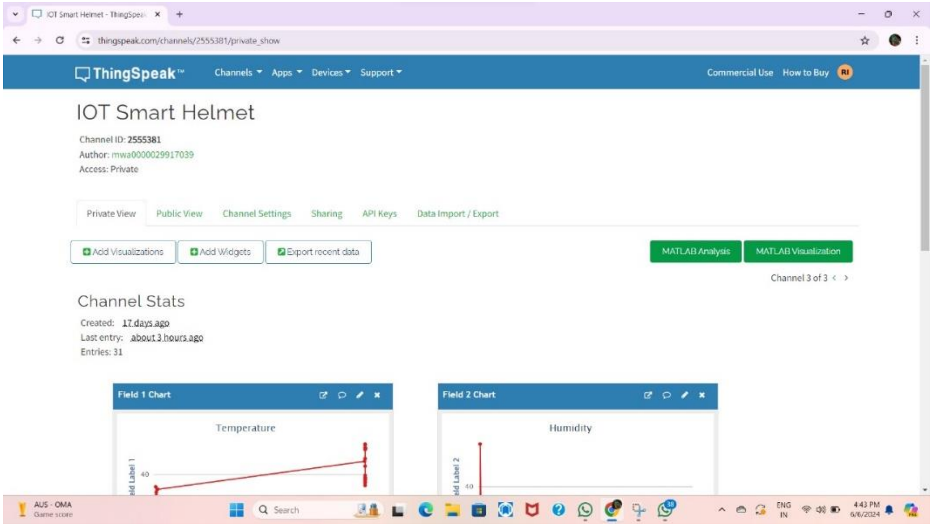


3. Get create on and fill the required detail suppose Email ID, NAME, COUNTRY

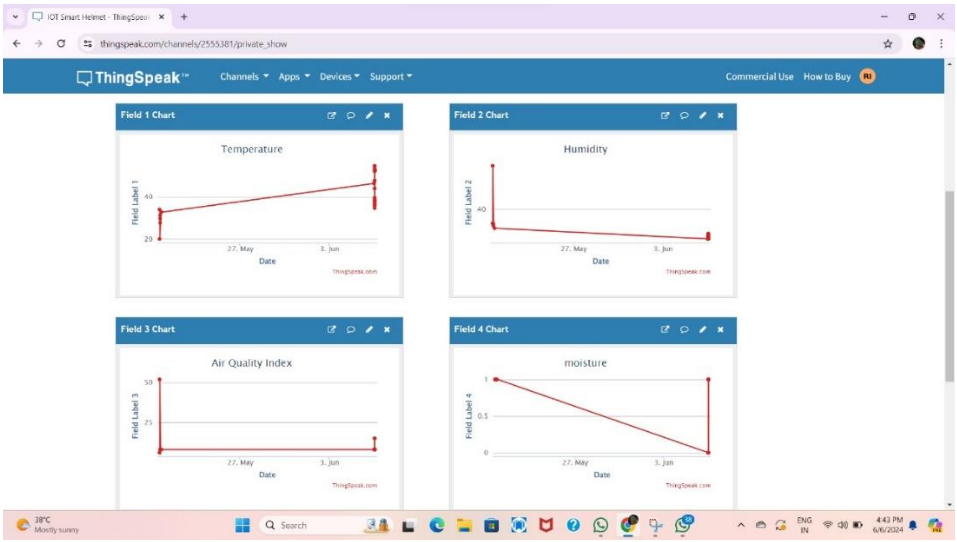


Then click on continue button.

4. Then create channels for readings.



5.Then complete your process and reading performs of IOT Graph.



COMPONENT DESCRIPTION

COMPONENT LIST

- ESP 8266 / Node MCU v3 Wi-Fi Module
- Soil moisture sensor module
- MQ2 Gas Sensor Module
- DHT11 Humidity Temperature Sensor
- I2C Module for 16x2 (1602) Character LCD
- Buzzer
- Helmet
- Male to Female Jumper Wires
- Power bank 5v/2A charging circuit
- 3.7v 2000mah 18650 Li-Ion Battery
- Data cable
- Switch

ESP 8266 / Node MCU v3 Wi-Fi Module

The ESP8266 is a low-cost Wi-Fi microchip developed by Espressif Systems. It is a microcontroller with an integrated TCP/IP stack, allowing devices to connect to a Wi-Fi network. In smart helmets, using the ESP8266 provides IoT (Internet of Things) capabilities, enabling the helmet to connect to the internet and transmit and receive data.

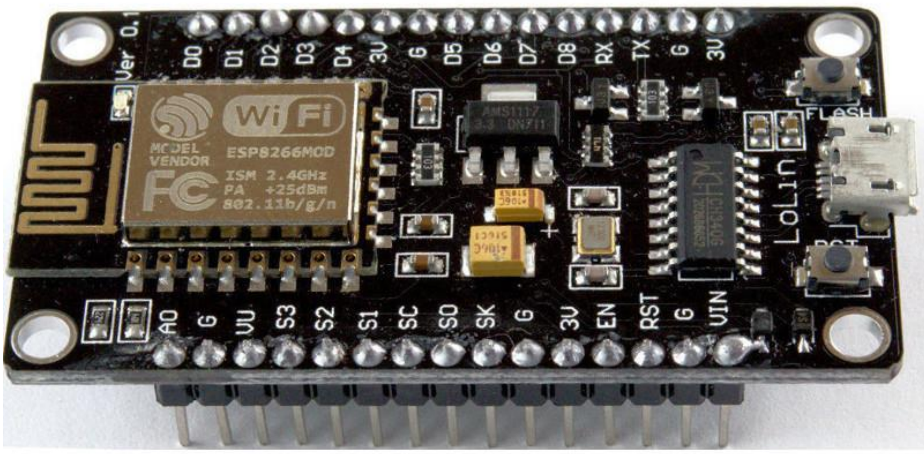
Here are some ways the ESP8266 can be used in a smart helmet:

1. Real-time Monitoring: The helmet can monitor sensor data (such as from a gyroscope, accelerometer, etc.) in real-time and send it to a remote server or smartphone app via Wi-Fi.

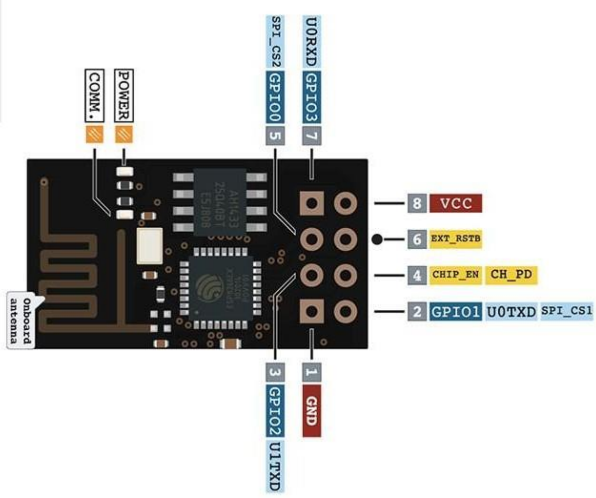
2. Emergency Alert System: In case of an accident or mishap, the helmet can automatically send alerts to emergency contacts, including the location.

3. Navigation Assistance: The helmet can integrate with a GPS module to provide navigation instructions, which can be relayed via a smartphone connected through the ESP8266.

4. Voice Control and Communication: The helmet can accept voice commands and communication features through the internet.



The **ESP8266 Wi-Fi module pin configuration/pin diagram** is shown in the figure below. The ESP8266-01 Wi-Fi module runs in two modes. They are;



Pin Configuration of ESP8266

Flash Mode: When GPIO-0 and GPIO-1 pins are active high, then the module runs the program, which is uploaded into it.

UART Mode: When the GPIO-0 is active low and GPIO-1 is active high, then the module works in programming mode with the help of either serial communication or Arduino board.

The ESP8266 Wi-Fi module, particularly the ESP-01 version, has 8 pins. Here's the pin configuration for the ESP8266 ESP-01 module:

1. **VCC:(3.3V power supply)** This is the power supply pin. It should be connected to a 3.3V power source.

2.GND:(Ground) Ground pin. It should be connected to the ground of the power source.

3. TXD: (Transmit data) This pin is used to transmit serial data. It should be connected to the RX (Receive) pin of a microcontroller or USB-to-Serial adapter.

4. RXD: (Receive data) This pin is used to receive serial data. It should be connected to the TX (Transmit) pin of a microcontroller or USB-to-Serial adapter.

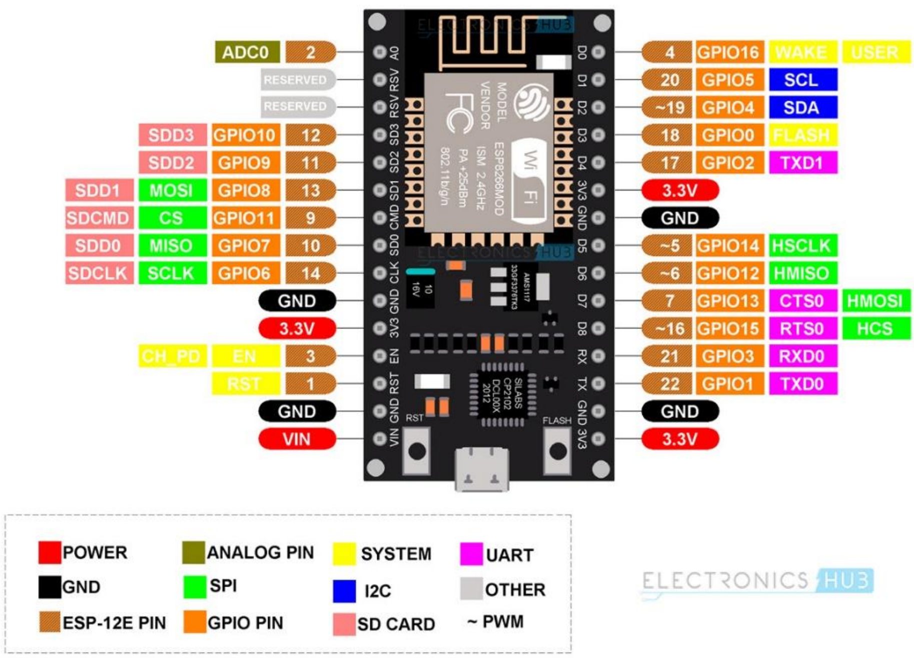
5. **CH_PD (Chip Power-Down) :(Chip enable, connect to 3.3V)** This pin is used to enable or disable the chip. It should be connected to 3.3V to enable the chip.

6. **RST (Reset):(Reset, active low.)** This pin is used to reset the module. It should be pulled low to reset the module.

7. **GPIO0: (General-purpose input/output pin.)** It can be used for various purposes, including entering the bootloader mode for flashing firmware.

8. **GPIO2:** Another general-purpose input/output pin.

Make sure to use a 3.3V power supply, as the ESP8266 is not 5V tolerant and can be damaged by higher voltages.



Soil moisture sensor module

A soil moisture sensor is an electronic device that measures the water content in soil. It is commonly used in agriculture, horticulture, environmental science, and irrigation systems. Below is detailed information about the components of soil moisture sensors:

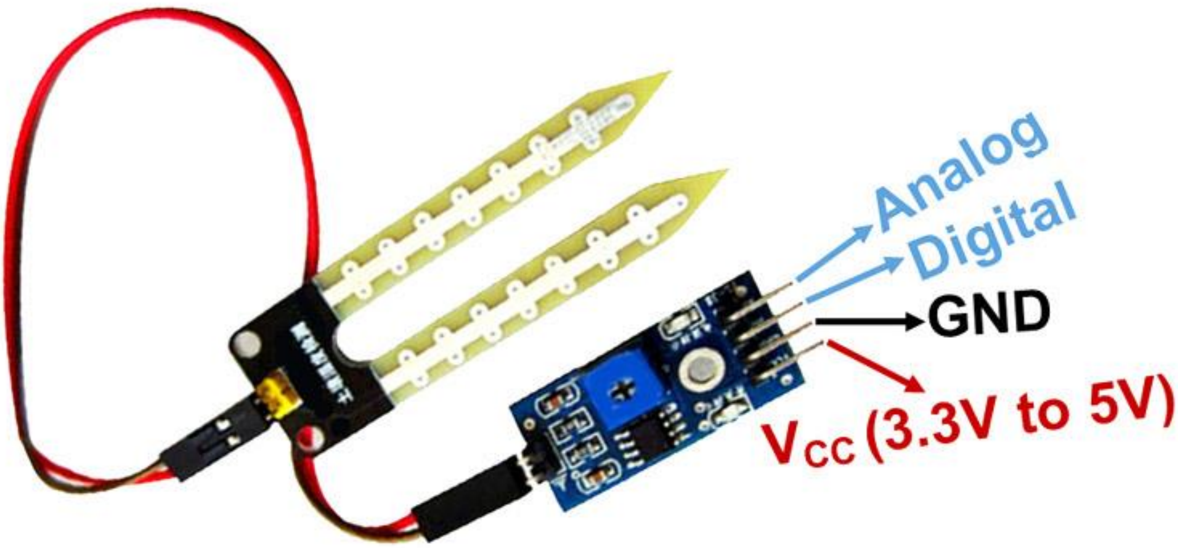
Components of a Soil Moisture Sensor

Probes:

Typically, two metallic probes are inserted into the soil. These probes measure the soil's conductivity or capacitance.

Electronics Module:

This module contains a microcontroller and signal conditioning circuitry that processes the sensor data and provides an output.



MQ2 Gas Sensor Module

Integrating an MQ2 gas sensor into an IoT-based smart helmet enhances the wearer's safety by providing real-time monitoring and alerts for hazardous gases and smoke. This can be particularly beneficial in industrial, construction, and fire safety applications, helping to prevent accidents and improve emergency response times.

Specifications

Operating Voltage: Typically, 5V.

Detection Range: 300 ppm to 10,000 ppm for gases like methane, propane, and LPG.

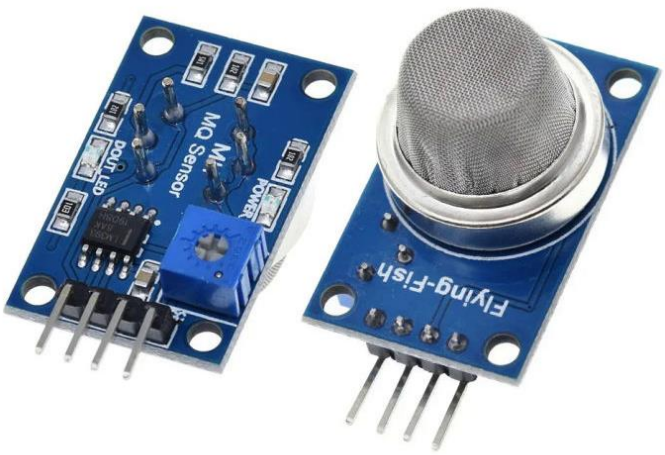
Sensitivity: Adjustable via a potentiometer on the module.

Response Time: Typically, within a few seconds.

Preheat Time: Approximately 24 hours to stabilize after initial power-up.

Applications

1. Gas leak Detection.
2. Smoke Detection.
3. Alcohol Detection.
4. Air Quality monitoring.



DHT11 Humidity Temperature Sensor

The DHT11 sensor in an IoT-based smart helmet plays a crucial role in monitoring and managing temperature and humidity levels. This helps in preventing heat stress, managing sweat and moisture, and improving overall comfort and health. By integrating with IoT technologies, the helmet can provide real-time data, alerts, and remote monitoring capabilities, enhancing safety and user experience in various environments.

Function: Measures temperature and humidity.

Working: The sensor provides digital output for both temperature (in Celsius) and humidity (percentage), which the Node MCU reads

Specifications:

Power Supply: 3.5V to 5.5V

Humidity Range: 20% to 90% RH (Relative Humidity)

Temperature Range: 0°C to 50°C

Humidity Accuracy: ±5% RH

Temperature Accuracy: ±2°C

Sampling Rate: 1 Hz (1 reading per second)

Interface: Single-wire digital interface

Applications

1. Weather Stations.
2. HVAC System.
3. Greenhouses.
4. Home Automation.
5. Industrial Applications.

I2C Module for 16x2 (1602) Character LCD

16x2 character LCDs are commonly used in various projects for displaying alphanumeric characters. To interface a 16x2 character LCD with a microcontroller or Arduino, an I2C (Inter-Integrated Circuit) module is often used to simplify the wiring and reduce the number of required pins. Here's an overview of the I2C module for a 16x2 character LCD:

Purpose:

The I2C module serves as an interface between the 16x2 character LCD and the

Functionality:

The I2C module allows communication with the LCD using the I2C protocol, which is a serial communication protocol for devices to exchange data with minimal wiring.

It converts the commands and data from the microcontroller into the appropriate signals required by the LCD.

Pin Configuration:

The I2C module typically has four pins:

VCC: Power supply pin (usually connected to +5V).

GND: Ground pin.

SDA: Serial Data Line for I2C communication.

Benefits:

1. Real-time Monitoring.
2. Immediate Alerts.
3. Enhanced communication.

LCD DISPLAY

Uses of LED Display in an IoT-Based Smart Helmet

Displaying Environmental Conditions:

Temperature and Humidity: The LED display can show real-time temperature and humidity levels inside the helmet. This helps the wearer monitor the conditions and take necessary actions to stay comfortable and safe.

Air Quality: If the helmet includes gas sensors, the LED display can show air quality levels, alerting the wearer to dangerous gases like carbon monoxide or other pollutants.

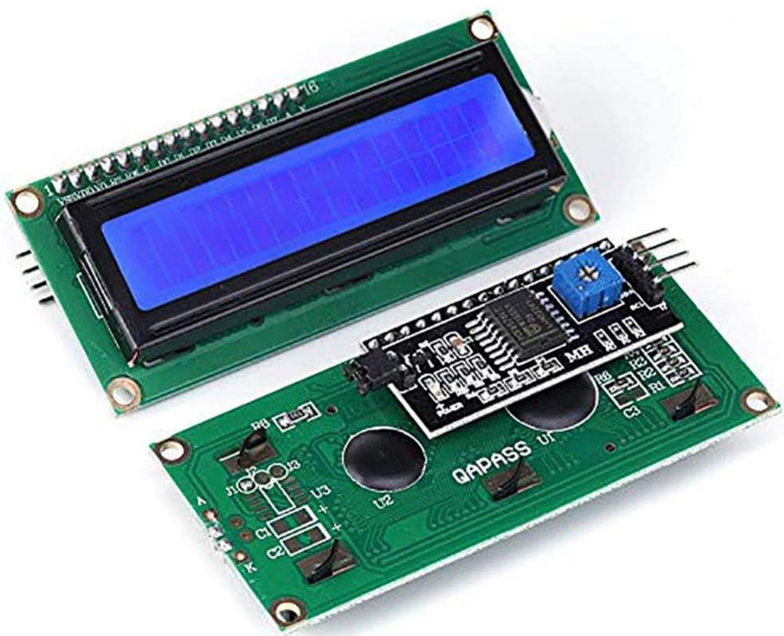
Applications:

1. Construction Sites:

Monitor and display real-time data on temperature, humidity, and air quality.

Provide safety warnings about hazardous areas or equipment.

2. Mining Operation.
3. Firefighting.
4. Cycling and Motorcycling.
5. Industrial Maintenance.



Buzzer

A buzzer is an electronic device that produces sound. It is commonly used for alerting or notifying people about various conditions or events. Buzzers come in different types and sizes, depending on their specific applications.

In an IoT-based smart helmet, the buzzer plays an important role because it:

Provides Safety Alerts: Warns the wearer about immediate dangers such as high temperatures or toxic gas presence.

Health Monitoring Alerts: Alerts the wearer about abnormal health readings, like high heart rate or low oxygen levels.

Navigation Assistance: Provides directional and proximity alerts to help the wearer navigate safely.

Emergency Response: Emits SOS signals and alerts in case of accidents.

Task and Status Notifications: Indicates task completion and system status, such as low battery warnings or sensor malfunctions.

Uses of Buzzer:

1. Alerts and Notifications.
2. Emergency Situations.
3. General Applications.

Male to Female Jumper Wires

What are Male to Female Jumper Wires?

Male to female jumper wires have one end with a male connector (a pin) and the other end with a female connector (a socket). These wires are used to connect components or modules with different types of connectors.

Key Features:

1. Connector Types:

Male End: Has a pin that fits into female sockets.

Female End: Has a socket that fits onto male pins.

2. Length and Colors:

Available in various lengths to suit different needs.

Come in different colors to help identify connections and organize circuits.

3.Wire Gauge:

Typically, these wires are thin and flexible, making them easy to use in tight spaces and on breadboards.

Uses and Applications:

1. Prototyping on Breadboards.
2. Microcontroller Projects.
3. Extending Connections.
4. Testing and Debugging.

Power bank 5v/2A charging circuit

The charging circuit in an IoT-based smart helmet is essential for safely and efficiently charging the battery. It regulates voltage and current, provides protection mechanisms, and ensures proper power management. This continuous power supply is critical for the helmet's sensors, communication modules, and other electronics to function effectively. Additionally, the charging circuit enhances user convenience and extends the battery's lifespan.

Uses of Charging Circuit

1. **Battery Charging : -**The charging circuit safely and efficiently charges the helmet's internal battery.

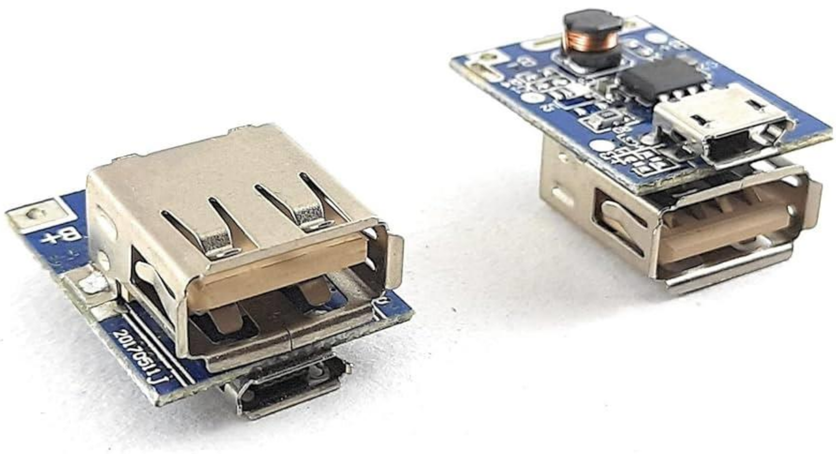
2. **Voltage Regulation : -** The charging circuit regulates the input voltage to match the required charging voltage of the battery.

3. **Current Regulation : -** The charging circuit regulates the charging current to protect the battery from overcurrent.

4. **Protection Mechanisms :-** The charging circuit includes safety features such as overcharging protection, short circuit protection, and reverse polarity protection.

5. **Power Management :-** The charging circuit helps manage power distribution, ensuring the helmet's various components receive the required power supply.

6. **User Convenience : -**The charging circuit allows users to easily charge their helmet from an external power source.



3.7v 2000mah 18650 Li-Ion Battery

In an IoT-based smart helmet, a Li-ion (Lithium-Ion) battery is used to provide a reliable and efficient power source for the helmet's electronic components. This includes sensors, microcontrollers, communication modules, and displays. Here are the key uses and benefits of using a Li-ion battery in a smart helmet:

Uses of Li-Ion Battery

1. **Power Supply:**

Primary Source: The Li-ion battery serves as the primary power source for the helmet's sensors, microcontrollers, and communication modules.

2. **Compact and Lightweight:**

Size and Weight: Li-ion batteries have a high energy density, making them compact and lightweight, which is ideal for wearable technology like smart helmets.

3. **Rechargeable:**

Ease of Use: Li-ion batteries are rechargeable, making them ideal for daily use in smart helmets. Users can easily recharge the battery using a standard charger or a power bank.

4. **Fast Charging:**

Reduced Downtime: Li-ion batteries support fast charging, minimizing the time needed to recharge the helmet’s battery and making it ready for use quickly.

5. **Stable Voltage Output:**

Consistent Performance: They provide a stable voltage output, ensuring that all electronic components in the helmet receive consistent power, which is crucial for reliable performance.

Data cable

In an IoT-based smart helmet project, the data cable plays a crucial role in programming the microcontroller, powering the helmet's components, transferring data, enabling communication, updating firmware, and integrating with external systems. It ensures that all the electronic components within the helmet can communicate effectively and operate as intended, thereby enhancing the functionality and usability of the smart helmet.

Uses of Data Cable

1. **Programming the Microcontroller:**

Firmware Uploading: The data cable is used to connect the microcontroller (such as Arduino, ESP8266, or similar) to a computer for uploading the necessary firmware or software code.

2. **Power Supply:**

Charging the Battery: Some data cables can also be used for charging the helmet's internal battery by connecting it to a power source like a USB charger or power bank.

3. **Data Transfer:**

Sensor Data: The data cable transfers sensor data from the helmet's sensors to the microcontroller or other processing units.

4. **Communication:**

Serial Communication: The data cable facilitates serial communication between the microcontroller and external devices like a computer, another microcontroller, or a communication module (e.g., GSM, GPS).

Switch

Switches in an IoT-based smart helmet are used for power control, mode selection, enabling safety features, facilitating user interaction, and maintenance. These switches enhance the helmet's functionality and usability, ensuring that the user can maximize the benefits of the smart features and that the device operates effectively and efficiently.

Helmet

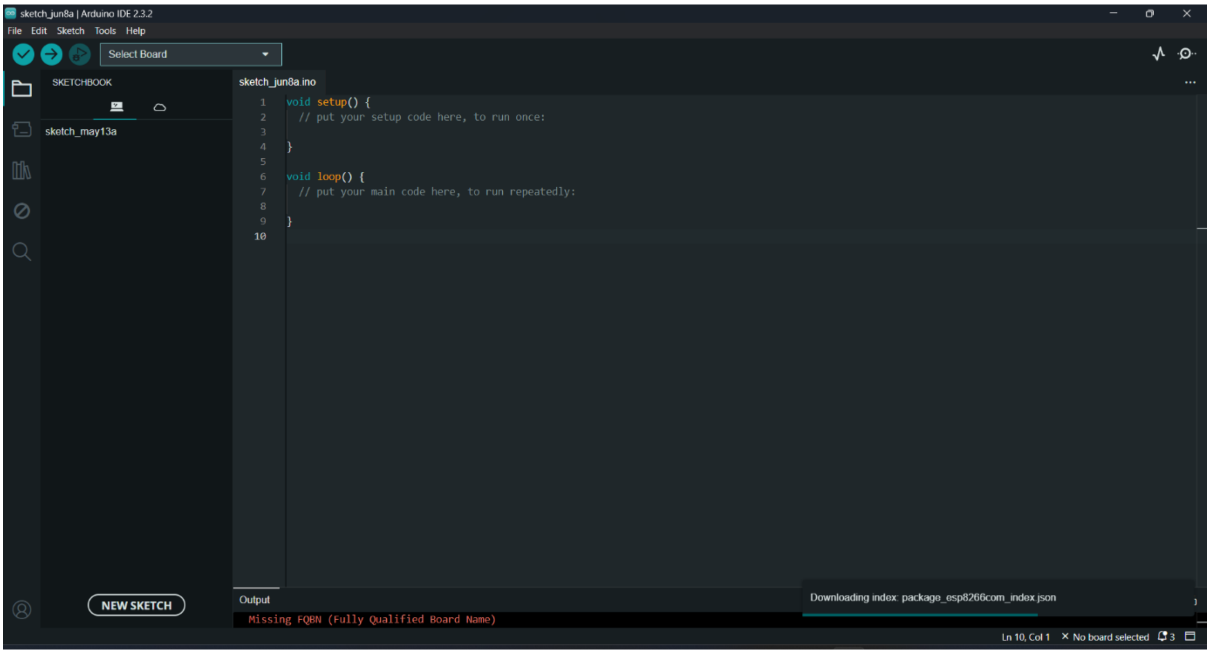
In an IoT-based smart helmet, the helmet serves not only for physical protection but also enables advanced safety, communication, monitoring, navigation, and convenience features. The smart helmet combines traditional helmet protection with advanced sensors, communication modules, and data analytics to provide users with a safer, connected, and informed experience.

ARDUINO IDE

Arduino IDE is a user-friendly software application used to write, compile, and upload code to Arduino boards. It's an essential tool for anyone working with Arduino microcontrollers, whether they are beginners or experienced developers.

Features

1. Code Editor.
2. Sketchbook.
3. Libraries.
4. Serial Monitor.
5. Board Manager.
6. Library Manager.



Working with Arduino IDE

1. **Installing Arduino IDE:**

Download the latest version from the official Arduino website.

Follow the installation instructions for your operating system (Windows, macOS, Linux).

2. **Writing a Sketch:**

Open Arduino IDE and start a new sketch.

Write your code in the editor. A basic sketch typically has two main functions:

Setup (): Runs once when the program starts and is used to initialize settings.

Loop (): Runs continuously after setup () and is used to execute the main logic of the program.

3. **Compiling and Uploading:**

Select your board and the correct port under the Tools menu.

Click the checkmark button to compile your code and the right arrow button to upload it to the board.

4. **Using the Serial Monitor:**

Open the Serial Monitor from the Tools menu.

It allows you to send and receive data from the Arduino, useful for debugging.

SOFTWARE CODE

SOFTWARE CODE

```
#include <DHT.h>
#include <ESP8266WiFi.h>
#include <LCD_I2C.h>

LCD_I2C lcd(0x27, 16, 2);
String apiKey = "8ML2JWJ8SOL1TW2A";     //  Enter your
Write API key here
const char *ssid =  "Vivo";     // Enter your WiFi Name
const char *pass =  "12345678"; // Enter your WiFi
Password
const char* server = "api.thingspeak.com";
#define DHTPIN D3
int  Buzzer = D5;

#define Light D4
 DHT dht(DHTPIN, DHT11);
WiFiClient client;


#define ANALOG_IN_PIN A0


void setup()
{
       Serial.begin(9600);
       lcd.begin(); // If you are using more I2C devices
using the Wire library use lcd.begin(false)
                 // this stop the library(LCD_I2C) from
calling Wire.begin()
    lcd.backlight();
     lcd.clear();
lcd.setCursor(0,0);
lcd.print("Safety Helmet");


       delay(10);
       pinMode(Buzzer, OUTPUT);
       dht.begin();
       Serial.println("Connecting to ");
```

```
        Serial.println(ssid);
        WiFi.begin(ssid, pass);
        while (WiFi.status() != WL_CONNECTED)
      {
             delay(550);
             Serial.print(".");
      }
       Serial.println("");
       Serial.println("WiFi connected");
       delay(3000);
}


void loop()
{

  int adc_value = analogRead(ANALOG_IN_PIN);



      float h = dht.readHumidity();
      float t = dht.readTemperature();

      int B = digitalRead(Light);

              if (isnan(h) || isnan(t))
                 {
                     Serial.println("Failed to read from
DHT sensor!");
                      return;
                 }
                      if (client.connect(server,80))
                     {
                            String postStr = apiKey;
                            postStr +="&field1=";
                            postStr += String(h);
                            postStr +="&field2=";
                            postStr += String(t);
                            postStr +="&field3=";
                            postStr += String(adc_value);
                            postStr +="&field4=";
```

```
                              postStr += String(B);
                              postStr += "\r\n\r\n\n\r\n";

                              client.print("POST /update
HTTP/1.1\n");
                              client.print("Host:
api.thingspeak.com\n");
                              client.print("Connection:
close\n");
                              client.print("X-
THINGSPEAKAPIKEY: "+apiKey+"\n");
                              client.print("Content-Type:
application/x-www-form-urlencoded\n");
                              client.print("Content-Length:
");
                              client.print(postStr.length()
);
                              client.print("\n\n");
                              client.print(postStr);
                              Serial.print("Temperature:
");
                              Serial.print(t,0);
                              Serial.println("degrees
Celcius:");
                              Serial.print("Humidity:");
                              Serial.println(h,0);

                              Serial.print("AQI: ");
                           //    Serial.println(in_voltage);
                              Serial.println("%. Send to
Thingspeak.");


  lcd.clear();
lcd.setCursor(0,0);
lcd.print("Hum.:");
lcd.print(h);

lcd.setCursor(8,0);
lcd.print("Temp.:");
lcd.print(t);
```

```
lcd.setCursor(0,1);
lcd.print("AQI:");
lcd.print(adc_value);

lcd.setCursor(8,1);
lcd.print("Soil:");
lcd.print(B);

  if (adc_value > 110) {
    // turn LED on:
    digitalWrite(Buzzer, HIGH);
  }
   else if (t > 50) {
    // turn LED on:
    digitalWrite(Buzzer, HIGH);
  }

  else {
    // turn LED off:
    digitalWrite(Buzzer, LOW);
  }

                          }
          client.stop();
          Serial.println("Waiting...");
          delay(1000);
}
```

ADVANTAGES

ADVANTAGES

1. **Enhanced Safety:**

Accident Detection: Automatic alerts to emergency contacts or services.

Real-time Health Monitoring: Monitors vital signs (heart rate, temperature) and alerts in case of anomalies.

2. **Improved Communication:**

Hands-free Calls: Enables hands-free phone calls.

Navigation Assistance: Provides real-time GPS navigation.

3. **Environmental Monitoring:**

Pollution and Weather Alerts: Monitors air quality and weather, providing alerts.

4. **Data Collection and Analysis:**

Performance Tracking: Collects and analyzes data on activities and performance.

Predictive Maintenance: Alerts for maintenance or replacement needs.

5. **Convenience and Efficiency:**

Smart Controls: Controls devices via voice commands or gestures.

Battery Management: Monitors battery levels of helmet and connected devices.

APPICATIONS

1. **Industrial Safety:**
    - For ensuring worker safety in construction sites, mining, and manufacturing plants.
    - To avoid hazards through real-time monitoring and accident detection.
    - Monitoring workers' vital signs, such as heart rate and body temperature.

2. **Healthcare:**
    - Real-time health monitoring for patients, especially those with chronic conditions.
    - Emergency response systems integrated with hospitals and healthcare providers.
    - Remote monitoring and data collection for medical research.

3. **Workplace Safety**:
    - Ensuring worker safety in hazardous environments like chemical plants and power stations.
    - Monitoring compliance and enforcing safety protocols.
    - Predictive maintenance and risk management.

4. **Transportation and Commuting:**
    - Enhanced safety features for motorcyclists and bicyclists, such as accident detection and emergency alerts.
    - Hands-free communication and GPS navigation.
    - Real-time traffic updates and route optimization.

5. **Sports and Adventure Activities:**
    - Performance tracking and data analysis for cyclists and motorcyclists.
    - Safety alerts and real-time monitoring in adventure sports like skiing and mountaineering.
    - Monitoring vital signs and environmental conditions.

FUTURE SCOPE

The future of IoT-based smart helmets is bright, with continuous advancements likely to enhance their functionality, efficiency, and adoption across various sectors. These developments will make smart helmets an integral part of modern safety and health monitoring systems.

1. **Enhanced Integration and Connectivity:**

Advanced Sensors: Future smart helmets will likely incorporate more advanced sensors for even more accurate health and environmental monitoring.

5G Connectivity: With the advent of 5G technology, smart helmets will benefit from faster and more reliable data transmission, enhancing real-time monitoring and alerts.

2. **Improved Safety Features:**

Augmented Reality (AR): Integration of AR for heads-up displays, providing users with real-time information such as navigation, traffic conditions, and hazard alerts without distracting them.

3. **Sustainability and Energy Efficiency:**

Solar-Powered Helmets: Development of energy-efficient helmets powered by solar panels to reduce the need for frequent charging.

4.Cost Reduction and Accessibility:

Affordable Technology: As technology advances and economies of scale are achieved, the cost of smart helmets will decrease, making them accessible to a broader audience.

5.Regulatory and Standardization Advancements:

Safety Standards: Establishment of global safety and performance standards for smart helmets to ensure reliability and effectiveness.

Data Privacy and Security: Development of robust frameworks to protect user data and ensure privacy.

CONCLUSION

IoT-based smart helmets represent a significant advancement in personal safety and technology integration. They offer enhanced safety features, such as real-time accident detection, health monitoring, and emergency alerts, making them invaluable in various fields including industrial safety, transportation, sports, healthcare, military, and smart cities. The future scope of these helmets includes further integration with advanced sensors, AI, machine learning, and 5G connectivity, leading to more personalized and efficient safety solutions.

As technology continues to evolve, IoT-based smart helmets will become more affordable and accessible, promoting widespread adoption. They will not only enhance individual safety and performance but also contribute to broader safety and efficiency improvements across multiple sectors. With ongoing advancements and collaborations, these smart helmets will become an essential part of modern safety infrastructure, ensuring better protection and convenience for users worldwide.