Smart Helmet for Miners

Submitted in partial fulfilment of the requirements for the degree of

Bachelor of Technology

in

Computer Science with specialization in

Internet of Things

by

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Under the guidance of

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VIT , Vellore

November 2022

DECLARATION

I hereby declare that the thesis entitled “Smart Agri-Gloves" submitted by me, for the award of the degree of Bachelor of Technology in Computer Science with specialization in Internet of Things to VIT is a record of Bonafede work carried out by me under the supervision of Jafar Ali Ibrahim

I further declare that the work reported in this thesis has not been submitted and will not be submitted, either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university.

Place: Vellore

Date: 10/11/2022

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CERTIFICATE

This is to certify that the thesis entitled “Smart Agri Gloves” submitted by Animesh Pandey 20BCT0114, Om Dhapodkar (20BCT0142) and Naman Varma (20BCT0124), SCOPE, VIT, for the award of the degree of Bachelor of Technology in Computer Science with specialization in Internet of Things, is a record of Bonafede work carried out by him / her under my supervision during the period, 17. 7. 2022 to 11.1.2022, as per the VIT code of academic and research ethics.

The contents of this report have not been submitted and will not be submitted either in part or in full, for the award of any other degree or diploma in this institute or any other institute or university. The thesis fulfils the requirements and regulations of the University and in my opinion meets the necessary standards for submission.

Place: Vellore

Date: 10/11/2022

Internal Examiner Signature of the Guide External Examiner

Dr. Vijayrajan V

Computer Science engineering with Internet of Things

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Executive Summary

This project aims at enhancing the existing wearable safety helmets for the mining industry with the concept of Internet of things and Miners in the mining area are prone to dangers that can't be detected by normal human senses (such as Carbon monoxide pocket leaks). A Smart Mining Helmet will be able to alert the miner whenever the area around him becomes unsafe with poisonous gases or unusually high temperature. The primary danger in the mines is mainly due to air quality around the miner, many toxic gases in the mine and some nontoxic gases present in the vicinity of the miner Which can greatly harm the miner health over the long term of his life. Our project focuses on a mine supervising system monitor using IOT with sensors attached on top of the helmet to give real-time surveillance with early-warning system on various harmful gases using a small buzzer and LED. In addition to that, once a area becomes unsafe the helmet acts as a broadcasting device which gives necessary warning to other helmets as well about the potential danger which are interconnected to each other using a real time Ad-hoc network of helmets.

The helmets would be equipped with An ESP MCU with wireless communication modules and multiple sensors that detect the nearby surroundings , the sensors will be able to detect the current situation of the nearby environment of the miner and send the data to the ESP MCU embedded on the helmet , The ESP MCU Will then decide whether the situation is dangerous or not for the miner , if the situation is not appropriate and there is a gas leak or abnormal temperature then the buzzer installed on the helmet will activate along with a red LED that will tell the miner that he should evacuate the area along with this the MCU Will transmit a SOS Broadcast message to other miner helmets and tell them to evacuate too, basically following a bottom up approach on warning the other miners , the SOS Will be flooded to the Ad hoc network analogous to a nuclear reaction where one SOS broadcast will lead to the entire mining group being warned without any 3rd party assistance such as a server or administrator.

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Introduction

The primary focus of any industry today is the safety of the workers working in that industry. But more often times, these standards don't really apply with much sincerity for miners working in the mining industries. Mining is an occupation where miners are required to go into mines to extract various resources, where their lives are constantly at risk. The risk they face can be immediate live threatening like the collapse of the mines or some misplaced landmine, or it can be a like a slow poison to them like constant exposure to CO in unsafe concentration.

The problems faced by miners due to air quality in the mine comes out to be more dangerous than any immediate danger they face during mining. It kills miners slowly over the course of his/her life, without the miner even knowing the reason for his bad health.

The area around the miners in the mine is not something a human being can accurately access relying solely on his senses, there is a strong need for proper safety measures for miners working in the mines, and one of the solutions for the above-mentioned problem is to make an equipment wore by the miners that is intelligent enough to help the miner detect the danger around him.

If Miners senses aren't enough to access the environment around him then he needs to be given extra sensors which can sense what is required and can alert the miner accordingly.

But Mining is a hard job where the miners often change or drop their equipment depending on their weight and use and comfort for them while working, so instead of providing an extra equipment to them, it is far better to integrate the safety system into their helmet using IOT technology and make it wearable.

Objective

To enhance the current safety standard of the Helmet available for miners using embedded IOT Based hardware and sensors

Motivation

Coal mines have had the highest number of fatalities as a result of mine accidents. More than half, 210, of the 377, were killed in coal mines. Jharkhand has had the highest number of coal mine worker deaths in accidents inside mines over the last three years, with 69 deaths (11 in 2015, 46 in 2016, and 12 in 2017). In December of that year, 23 workers died in one of the worst open cast mine accidents in Jharkhand, Goda. In these three years, Telangana had 32 deaths, while Madhya Pradesh had 29.

152 people died in metal mine accidents across the country during this time period. Rajasthan, one of the country's top mineral-producing states, was responsible for 48 deaths.

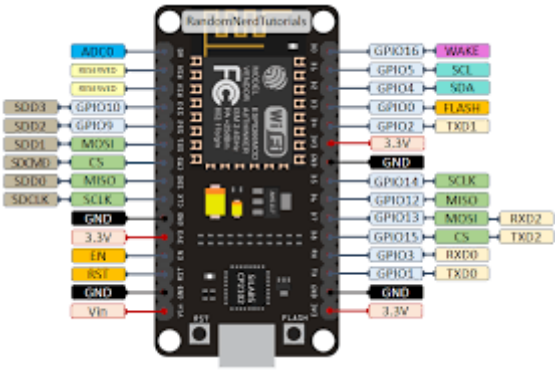
The central motivation of this project is to save lives of miners, this is something that gets overlooked by the industry every time, they also have a life and not just industrial value, the industry lacks integration of cutting edge technology that is being used by the rest of the world in the technological IOT sphere, with this project we aim to bring this integration into the industry. Even if this project leads to a prevention of one death of a miner, the efforts made to develop this project will be justified if our opinion is considered.

Technical Specification

Hardware Required:

1)ESP8266: The ESP8266 is a low-cost Wi-Fi microchip, with built-in TCP/IP networking software, and microcontroller capability, produced by Espressif Systems in Shanghai, China. The chip was popularized in the English-speaking maker community in August 2014 via the ESP-01 module, made by a third-party.

The ESP8266 module **enables microcontrollers to connect to 2.4 GHz Wi-Fi**, using IEEE 802.11 bgn. It can be used with ESP-AT firmware to provide Wi-Fi connectivity to external host MCUs, or it can be used as a self-sufficient MCU by running an RTOS-based SDK.



2)DHT11: The DHT11 is **a basic, ultra-low-cost digital temperature and humidity sensor**. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data.

This sensor is used in various applications such as **measuring humidity and temperature values in heating, ventilation and air conditioning systems**. Weather stations also use these sensors to predict weather conditions. The humidity sensor is used as a preventive measure in homes where people are affected by humidity.

3)MQ135: The MQ-135 Gas sensor can **detect gases like Ammonia (NH3), sulfur (S), Benzene (C6H6), CO2, and other harmful gases and smoke**. Similar to other MQ series gas sensor, this sensor also has a digital and analog output pin.

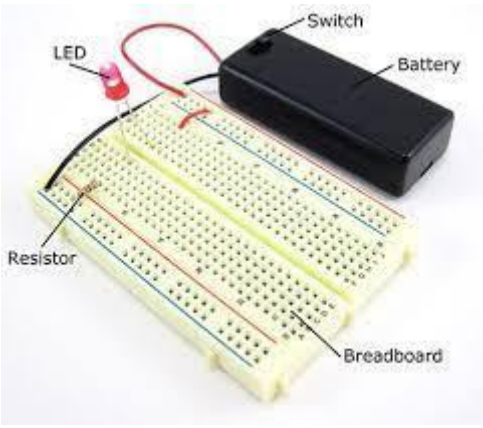
4)Buzzer: A buzzer or beeper is **an audio signaling device**, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

When power is applied, current runs through the coil of wire inside the buzzer, which produces a magnetic field. The flexible ferromagnetic disk is attracted to the coil when the magnetic field is activated, then returns to rest when the magnetic field is off.

5)LED: The major uses of LED (Light Emitting Diodes) are **to illuminate objects and even places**. Its application is everywhere due to its compact size, low consumption of energy, extended lifetime, and flexibility in terms of use in

various applications. Applications and uses of LEDs can be seen in: TV Backlighting.

6)Breadboard: A breadboard (sometimes called a plugblock) is used for **building temporary circuits**. It is useful to designers because it allows components to be removed and replaced easily. It is useful to the person who wants to build a circuit to demonstrate its action, then to reuse the components in another circuit.



Software Requirements:

1. Arduino IDE
2. Tinkercad
3. Omnett++
4. Thingsspeak Platform
5. Libraries:
6. ESP Now

Concerned work and Flow:

In this section we illustrate the solution to the above specified domain of work. That is a smart helmet based on various functionalities with broadcasting abilities. The entire workflow can be divided into 3 Sections:

1. **The Node/ Individual Helmet:**

The entire system of helmets can be broadly classified into 3 general sections:

1. The Node/ Individual Helmet

2. The Server Side

3. The Network

The Node/ Individual Helmet

1. *MQ135*

There are various sensors which can be used to get the overall air index value of the environment, but for a mining helmet, the following requirements must be met, that is:

The sensor must have a wide range of detection.

The miners don't work side by side to each other and hence a considerable distance is maintained between them, if we assume each miner to be a single node, then we need to cover almost all the working area of the miner to not leave any blind spot so that the gas leak or pouches can be detected as soon as they appear while mining not when it's too late to notice and the miner have already suffered.

The required sensor must be highly sensible to the environment and should offer fast response, since the NON-FUNCTIONAL requirement for the system would be to be as fast as possible and to detect even the slightest change in the environment.

Sensors usually have short life as compared to other components in a wearable and hence must be integrated in the safest zone of the wearable. The design for the Helmet is open to make it as slim as possible, which leaves the gas sensor in a sensitive spot. The Helmet hence must contain the gas sensor which is robust and have a long life with simple drive circuit.

The overall system must be power efficient, since the safety of miners should never be blocked with the overall profit mining makes, and hence the safety feature must also be made as power efficient as possible.

To reach all the above criteria, we go with MQ135 sensor for air index value. It has a single output instruction which is triggered every 1 minute to balance the sensitivity and the power efficiency of the device.

Expected output voltage for the sensor is between 0 and 4.2V, and hence the overall power isn't very high in an average scenario, but can change once the overall area around the miner gets dangerous.

Furthermore, the dimensions for the sensor also makes it highly easy to integrate in regards to the functionality (types of gases it can sense) it offers.

2. DHT11

Aside from the air index around the miner, the helmet must also tell the temperature and humidity around it. The proposed system of helmet uses DHT11 sensor for temperature and humidity.

DHT11 sensor is cheap, power efficient (more than MQ135), stable and highly reliable, the only drawback being it's digital signal acquisition and transversal technique.

The temperature and humidity given by the sensor is transmitted in bit streams and needs to be calculated by the helmet to get the float value from it.

To ensure stable transmission, the stream also consists of a checksum value given by the sensor to validate the received values.

Like MQ135 sensor, this also will be triggered every 1 minute to maintain sensitivity and power efficiency of the system.

By default, the sensor will not send any data and will have to be triggered by the microcontroller every 1 minute.

The helmet will make the connected pin to the sensor - an output pin and write 0 to it for 18 milliseconds followed by a sudden high signal.

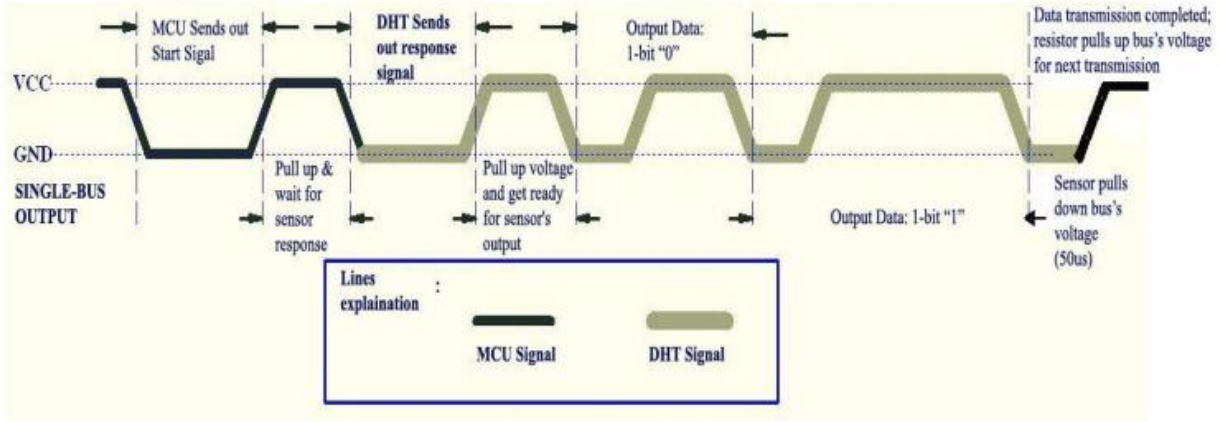
This is the initial trigger for the sensor to start and will automatically start the DHT sensor to give data.

After the sensor have been successfully triggered, the helmet needs to take the data from it, so the output pin will be converted into input one.

This entire process saves the overall system energy since the DHT11 sensor is in low-power-consumption mode until it is triggered.

In response to the trigger the sensor sends a discrete waveform to the Helmet having encoded both the temperature and humidity values in it. Once the wave reaches the helmet, the sensor again goes back to low-power-consumption mode and remains there until it is triggered again after 1 minute of time.

The discrete waveform will look like this:



After this trigger, the waveform will come within 20-40us of time, which will be read to take the data in form of bit manually by the sensor in following way:

a. The first thing to note in the waveform is the presence of an alternating pulse, and hence we will ignore the GND value of the wave since the wave is made

pulsating for transmission and this lower crest have nothing to do with the actual reading given by the sensor.

b. The bits are encoded in such a way that the time duration for which the high crest maintains its VCC value gives the single bit for the stream.

That is if the wave is at peak for less than 30us then the bit for that part is assumed to be 0.

c. Similarity if the peak is there for more than 30us then the bit for that part is assumed to be 1. The bit stream is shifted accordingly to take the entire stream as input.

But if the peak is minted for more than 90us then, it is safe to conclude that something actually went wrong with the trigger or the sensor and it isn't giving values or the waveform.

d. The bit stream is then segregated to obtain 16-bit value of humidity, temperature and the checksum, which then is again segregated to the value's integer and decimal part.

The only concern using DHT11 is the light affect, that the sensor loses its sensitivity over prolonged UV light but since the helmet is wore under the mines, the prolonged exposure isn't an issue in the system.

3. *ESP8266*

This is a microchip with in-build low cost WIFI module with TCP networking protocol. Following are some features of the chip which makes it suitable for the given system

17GPIO pins.

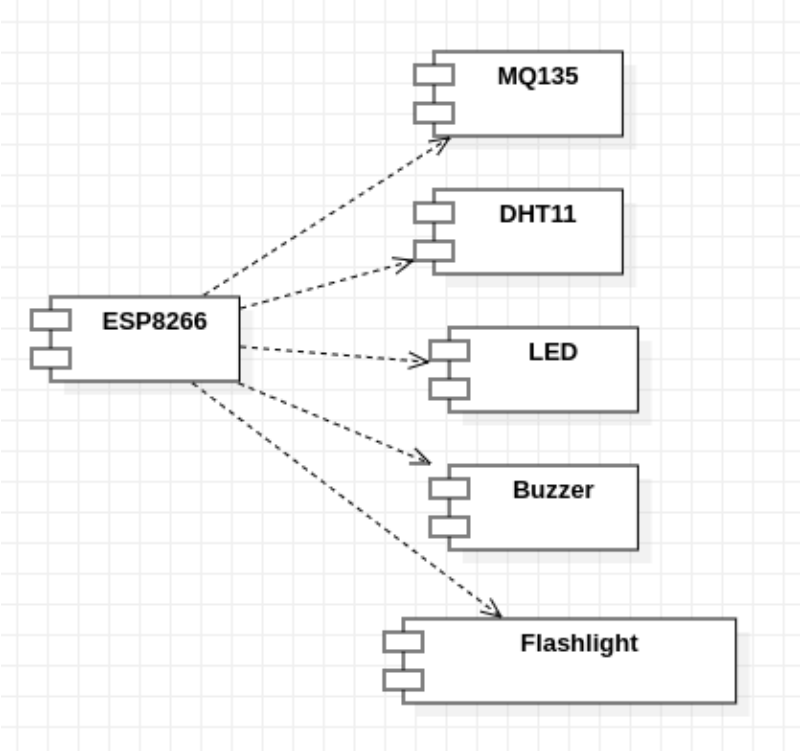
UART on dedicated pins.

RISC structure

SPI present and

the support to give 5V output which is what is needed for MQ135 as well as DHT11 sensor.

Furthermore, the waveform given by both the signals could be computed more easily by the availability of user-data Ram, system-data Ram, instruction RAM and instruction-cache RAM which adds to make the overall system more smooth, fast and reliable.



HDPE, Polypropylene Plastic will be used to make the entire helmet which follows the ISI for Indian mining standards and is already in use across globeIn addition to being highly durable and easy to wear, The Helmet will be supporting the following entities on its body:

- An ESP 8266 Microcontroller with ESP Now
- An MQ135 Gas sensor
- A DHT11 Temperature and Humidity
- A Multicolor LED Supporting at least two colors(RGB 5mm Preferable)
- A Section of EPE Foam Sheet for Protecting the MC And other sensors

- Active Buzzer Module (3.3 to 5 Volts)
- An LED Display (Optional)
- A Suitable Flashlight
- An Inbuilt Silicone Purifier/Respirator

2. The Server Side:

The server side or the administration will be constantly able to monitor the situation of any miner who wears the smart helmet. These include the current Gas concentration near the helmet/miner, The temperature of that particular area and the humidity

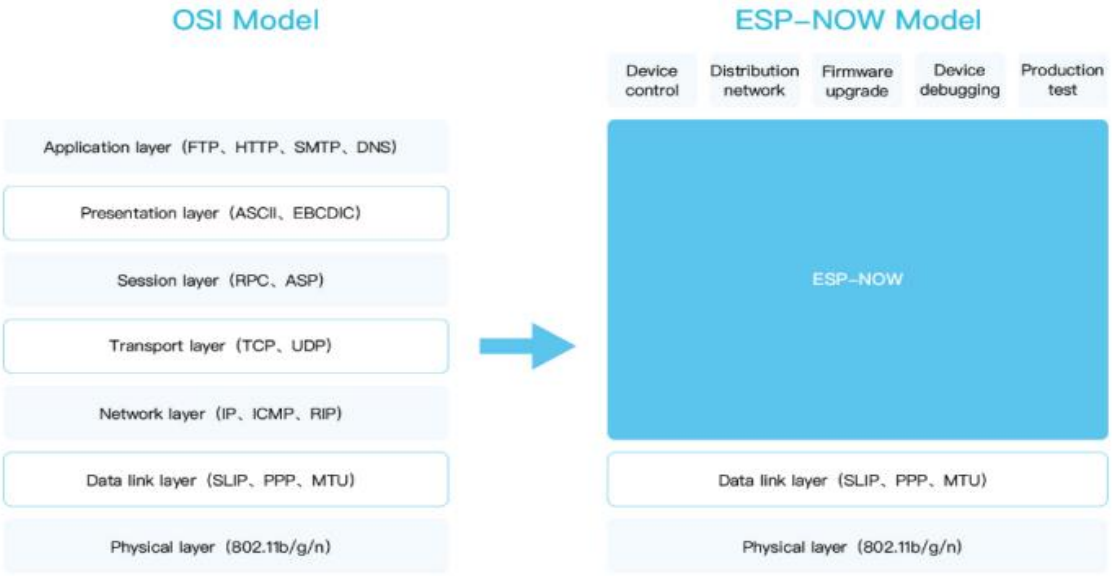
The Server side will have a GUI Interface and wireframe to provide a convenient Dashboard with maximum functionalities and Database integrations with the cloud. The databases will store the current and as well as the past behaviours of the mine based on the parameters the helmet can collect data of(Notably The temperature, Humidity, Gas concentrations) which can also be used for later analysis or simply data collection. The dashboard will preferably be built using Flex Dashboard which runs on R (A very well-known Statistically Specialized Programming Language) , The dashboard will be aimed to provide a very concise yet informative view of the mine and its behaviour based on which the administrator will take decisions. As a whole the server side will be designed for data collection, monitoring and special provisions for Emergency Services in case of any adversity in the mine or on the miner.

3. The Network:

All of these above nodes/Helmet will be equipped with a microcontroller(ESP8266 as mentioned above), these boards have inbuilt WIFI and BLE modules to support wireless communication. The aim will be to materialise a Wireless Ad-Hoc Network of Sensors (WASN) Using an inbuilt protocol on the ESP82 Board which is known as ESP Now.

ESP Now:

ESP-NOW is yet another protocol developed by Espressif, which enables multiple devices to communicate with one another without using Wi-Fi. The protocol is similar to the low-power 2.4GHz wireless connectivity that is often deployed in wireless mouses. So, the pairing between devices is needed prior to their communication. After the pairing is done, the connection is secure and peer-to-peer, with no handshake being required. Different from traditional Wi-Fi protocols, the first five upper layers in OSI are simplified to one layer in ESPNOW, so the data does not need to go through the physical layer, data link layer, network layer, transport layer in turn, which reduces the delay caused by packet loss under congested network, and leads to a quick response time.



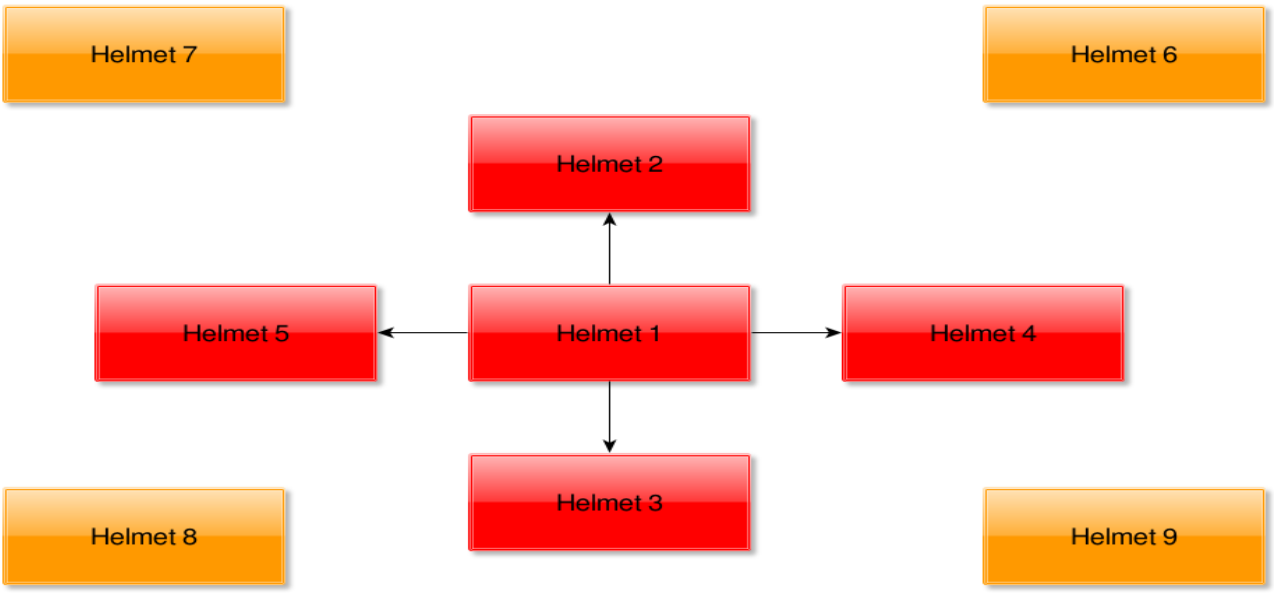
The data transmission mode of ESP-NOW is flexible including unicast and broadcast, and supports one-to-many and many-to-many device connection and control. ESPNOW can be also used as an independent auxiliary module to help network configuration, debugging and firmware upgrades.

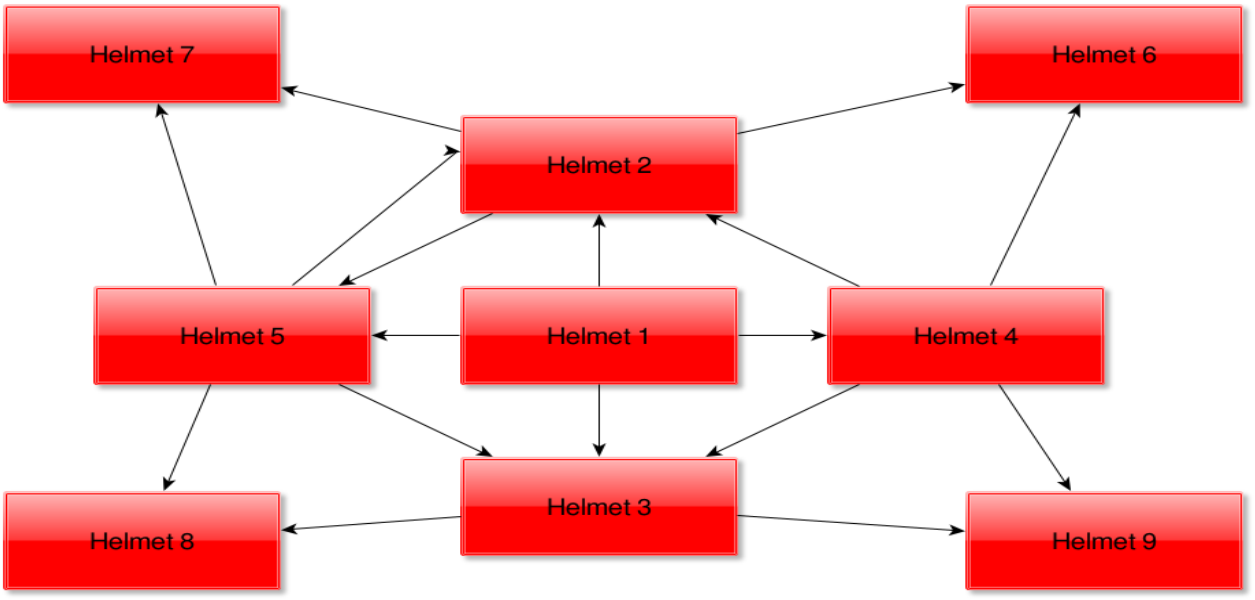
There are two roles defined in ESP-NOW according to the data flow, initiator and responder. The same device can have two roles at the same time. Generally, switches, sensors, LCD screens, etc. play the role of initiator in an IoT system, when lights, sockets and other smart applications play the role of responder.

Broadcast Mode:

Specifically with the ESP Now we will be using the ESP Now Broadcast mode to configure the helmets, The Broadcast mode allows the nodes to act as both a Sender and a receiver of the packet that is concerned.

LMK of the paired device is used to encrypt the vendor specific action frame with the CCMP method. The maximum number of different LMKs is six. If the LMK of the paired device is not set, the vendor-specific action frame will not be encrypted.

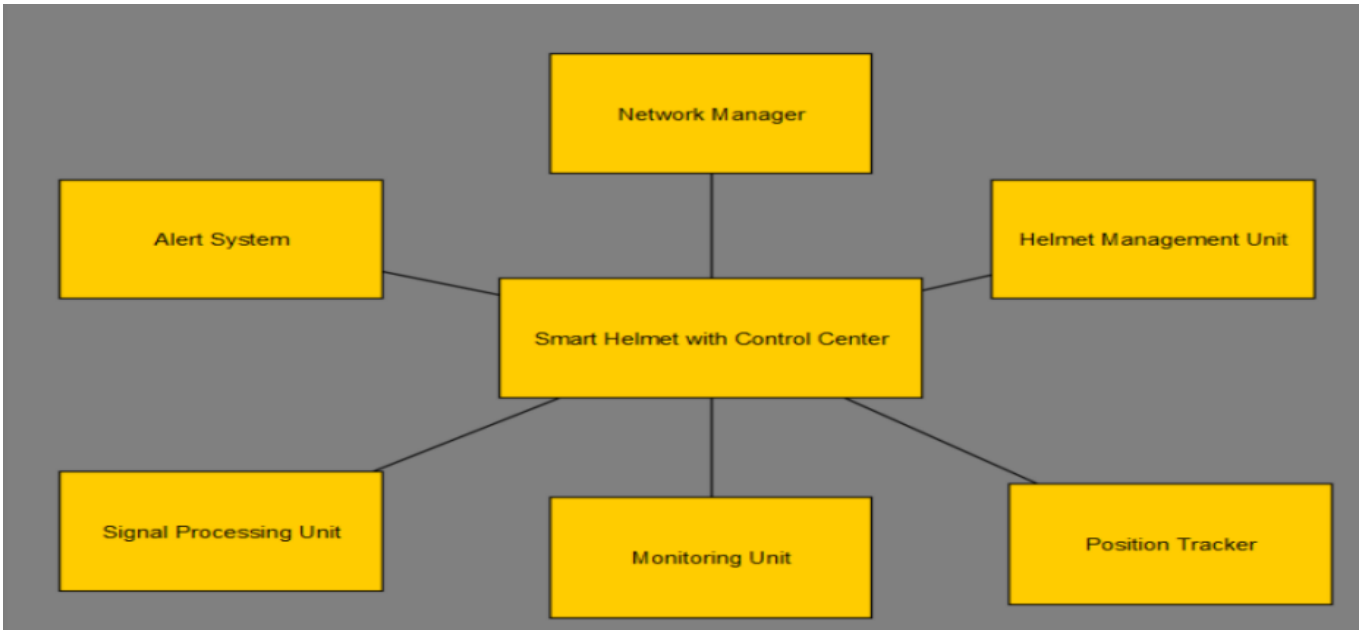

Helmet 7
Helmet 6
Helmet 2
Helmet 5
Helmet 1
Helmet 4
Helmet 3
Helmet 8
Helmet 9


Helmet 7
Helmet 6
Helmet 2
Helmet 5
Helmet 1
Helmet 4
Helmet 3
Helmet 8
Helmet 9

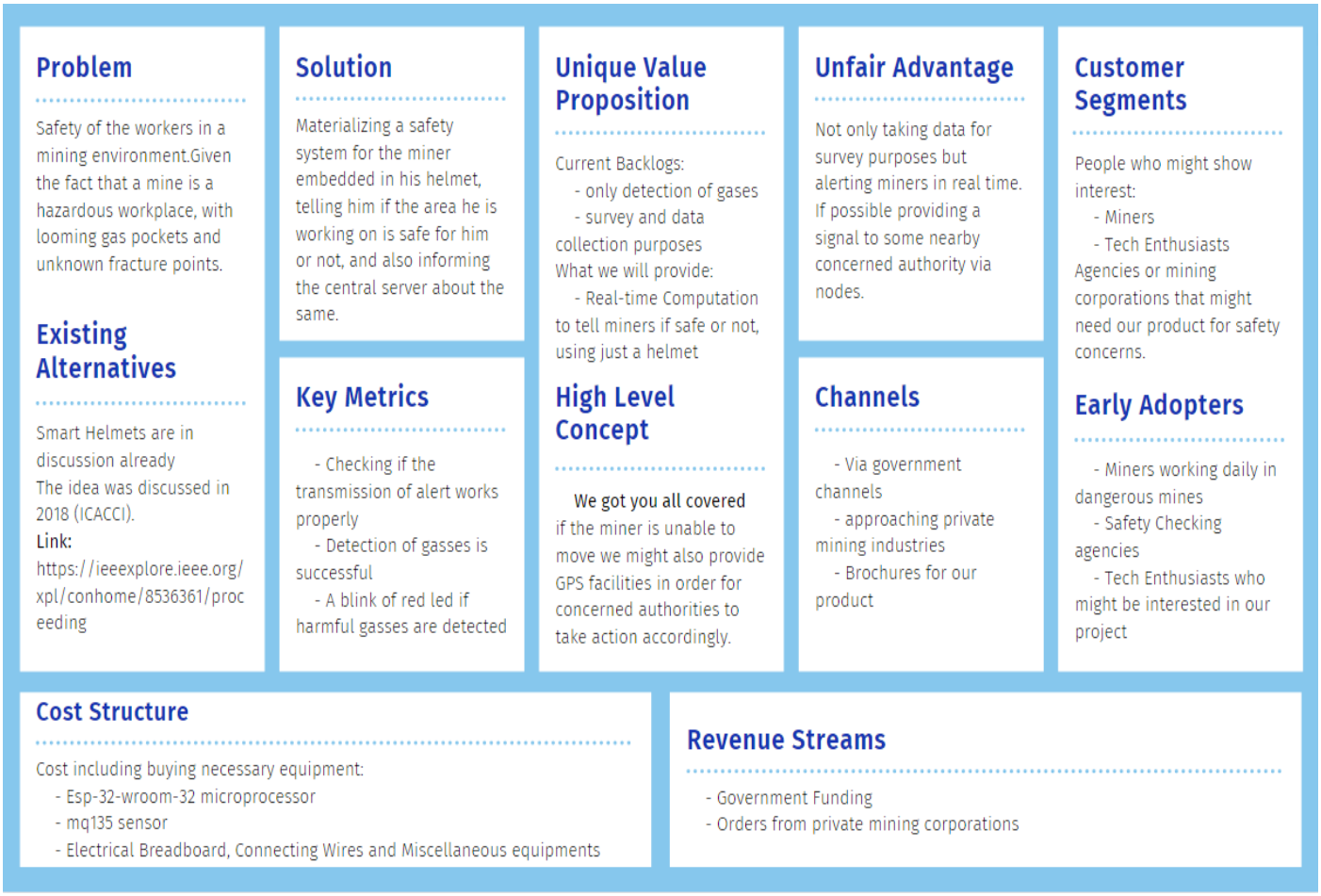
Flowcharts:

Activities:

Control Structure:



Lean Canvas:


Problem
Safety of the workers in a mining environment.Given the fact that a mine is a hazardous workplace, with looming gas pockets and unknown fracture points.
Existing Alternatives
Smart Helmets are in discussion already
The idea was discussed in 2018 (ICACCI).
Link:
https://ieeexplore.ieee.org/xpl/conhome/8536361/proceeding
Solution
Materializing a safety system for the miner embedded in his helmet, telling him if the area he is working on is safe for him or not, and also informing the central server about the same.
Key Metrics
- Checking if the transmission of alert works properly
- Detection of gasses is successful
- A blink of red led if harmful gasses are detected
Unique Value Proposition
Current Backlogs:
- only detection of gases
- survey and data collection purposes
What we will provide:
- Real-time Computation to tell miners if safe or not, using just a helmet
High Level Concept
We got you all covered if the miner is unable to move we might also provide GPS facilities in order for concerned authorities to take action accordingly.
Unfair Advantage
Not only taking data for survey purposes but alerting miners in real time. If possible providing a signal to some nearby concerned authority via nodes.
Channels
- Via government channels
- approaching private mining industries
- Brochures for our product
Customer Segments
People who might show interest:
- Miners
- Tech Enthusiasts
Agencies or mining corporations that might need our product for safety concerns.
Early Adopters
- Miners working daily in dangerous mines
- Safety Checking agencies
- Tech Enthusiasts who might be interested in our project
Cost Structure
Cost including buying necessary equipment:
- Esp-32-wroom-32 microprocessor
- mq135 sensor
- Electrical Breadboard, Connecting Wires and Miscellaneous equipments
Revenue Streams
- Government Funding
- Orders from private mining corporations

Sample Code: To be uploaded on each MCU (Helmet)

```
// //ANIMESH PANDEY
// //20BCT0114
// AD-Hoc network implementation
// File created: 14th September 2022
// Last Modified: 11th November 2022

// Include Libraries
#include <WiFi.h> //to enable comms via wifi
#include <esp_now.h> //to include esp now protocol
#include <MQ135.h>

// Define LED and pushbutton state booleans
bool danger=false; //false state means initially there's no danger
to the miner
bool ledOn = false; //led is initially off
int gas_threshold=400;
int gas_reading;
// Define LED and pushbutton pins
#define STATUS_LED 15 // linking pin 15 on esp32 to Led


void formatMacAddress(const uint8_t *macAddr, char *buffer, int
maxLength) // a prebuilt function to format the MAC Address
correctly
// Formats MAC Address
{
  snprintf(buffer, maxLength, "%02x:%02x:%02x:%02x:%02x:%02x",
macAddr[0], macAddr[1], macAddr[2], macAddr[3], macAddr[4],
macAddr[5]);
}


void receiveCallback(const uint8_t *macAddr, const uint8_t *data,
int dataLen)
// Called when data is received -- Runs on the recieving board
{
    // Basic checking of data
  // Only allow a maximum of 250 characters in the message + a null
terminating byte
  char buffer[ESP_NOW_MAX_DATA_LEN + 1]; // ESP_NOW_MAX_DATA_LEN=
250 characters
  int msgLen = min(ESP_NOW_MAX_DATA_LEN, dataLen); //storing the
message length in a variable
```

```
  strncpy(buffer, (const char *)data, msgLen); //char *strncpy(char
*dest, const char *src, size_t n)

  // Make sure we are null terminated
  buffer[msgLen] = 0;

  // Format the MAC address
  char macStr[18];
  formatMacAddress(macAddr, macStr, 18); //macStr now stores the
properly formatted MAC Address of the reciever

  // Send Debug log message to the serial port
  Serial.printf("Received message from: %s - %s\n", macStr,
buffer);

  // Check switch status
  if (strcmp("on", buffer) == 0)
  {
    ledOn = true;
  }
  else
  {
    ledOn = false;
  }
  digitalWrite(STATUS_LED, ledOn);
}


void sentCallback(const uint8_t *macAddr, esp_now_send_status_t
status)
// Called when data is sent --Runs on the sending board
{
  char macStr[18];
  formatMacAddress(macAddr, macStr, 18);
  Serial.print("Last Packet Sent to: ");
  Serial.println(macStr);
  Serial.print("Last Packet Send Status: ");
  Serial.println(status == ESP_NOW_SEND_SUCCESS ? "Delivery
Success" : "Delivery Fail");
}

void broadcast(const String &message)
// Emulates a broadcast
{
  // Broadcast a message to every device in range
```

```
  uint8_t broadcastAddress[] = {0xFF, 0xFF, 0xFF, 0xFF, 0xFF,
0xFF}; //same as unsigned int 8bits // 0xFF Is 255
  esp_now_peer_info_t peerInfo = {}; //an empty array at the start
of the communication , we discover the neighbours we have near to
the helmet
  memcpy(&peerInfo.peer_addr, broadcastAddress, 6);
//memcpy(dest,src,size)
  if (!esp_now_is_peer_exist(broadcastAddress))
  {
    esp_now_add_peer(&peerInfo);
  }
  // Send message
  esp_err_t result = esp_now_send(broadcastAddress, (const uint8_t
*)message.c_str(), message.length()); //esp_now_send sends the data

  // Print results to serial monitor
  if (result == ESP_OK)
  {
    Serial.println("Broadcast message success!");
  }
  else
  {
    Serial.println("Unknown error!");
  }
}
void setup()
{

  // Set up Serial Monitor
  Serial.begin(115200);
  delay(1000);

  // Set ESP32 in station mode to begin with
  WiFi.mode(WIFI_STA); //The Station mode (STA) is used to connect
the ESP32 module to a WiFi access point. The ESP32 behaves like a
computer that is connected to our router
  Serial.println("Helmet is now active");

  // Print MAC address
  Serial.print("The helmet ID is: ");
  Serial.println(WiFi.macAddress());

  // Disconnect from WiFi
  WiFi.disconnect(); //to operate correctly in Station mode
```

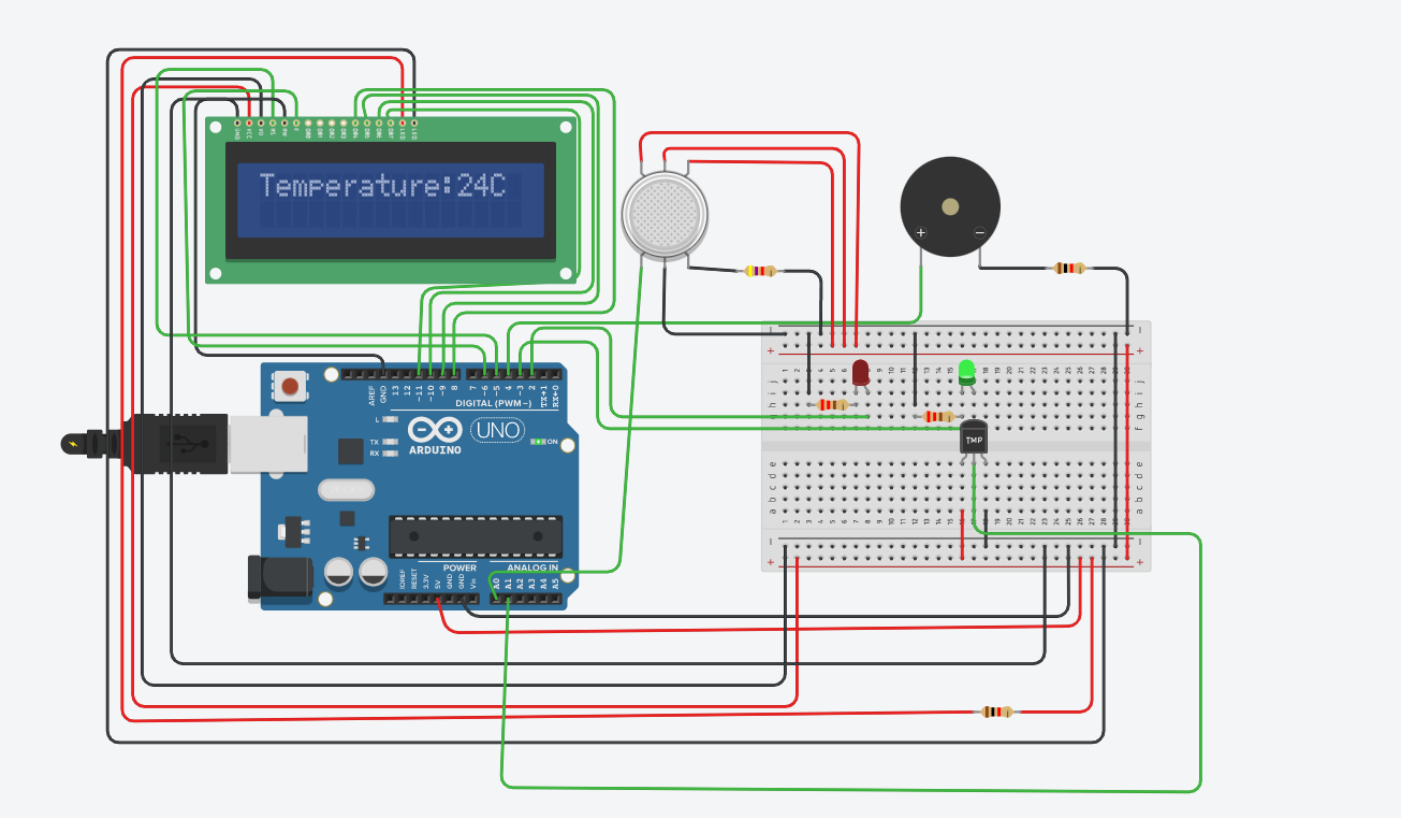
```
  // Initialize ESP-NOW
  if (esp_now_init() == ESP_OK)
  {
    Serial.println("Communication successful!"); //cue to start the
callback functions
    esp_now_register_recv_cb(receiveCallback);
    esp_now_register_send_cb(sentCallback);
  }
  else
  {
    Serial.println("Communication failed!");
    delay(3000);
    ESP.restart(); //restarting the board
  }
  // LED Output
  pinMode(STATUS_LED, OUTPUT);
}

void loop()
{
  gas_reading=analogRead(A0);
  if (gas_reading>gas_threshold)
  {
      ledOn = !ledOn;
      digitalWrite(STATUS_LED, ledOn);

      // Send a message to all devices
      if (ledOn)
      {
        broadcast("on");
      }
      else
      {
        broadcast("off");
      }
    // Delay to avoid bouncing
    delay(500);
  }
  else
  {
    // Reset the button state
    ledOn=!ledOn;
  }
}
```

Results

Tinker-cad Simulations:

Simulation link:

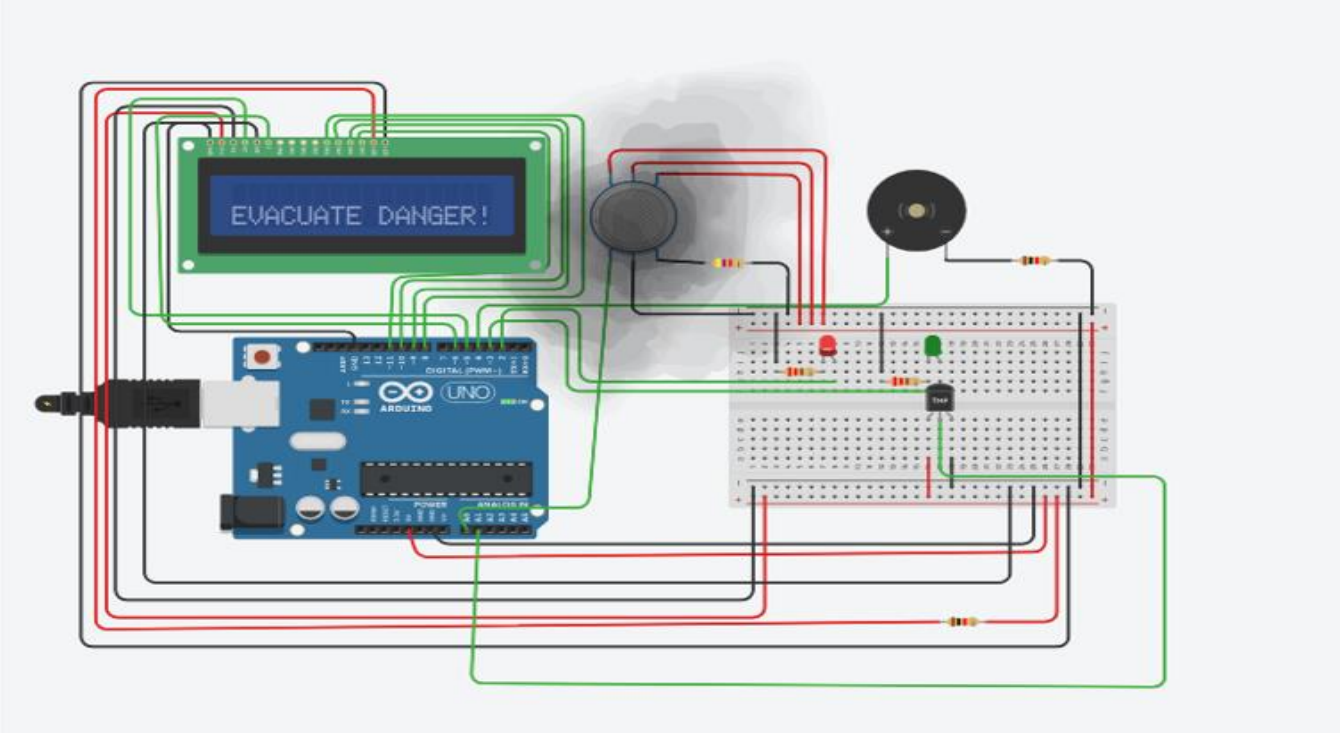
https://www.tinkercad.com/things/4fPJXSMQtZN-individual-helmet-ptype-1/editel?sharecode=AxFUfQfRIpkxe3HHy1z90bXU5ggoLoPJPs_LX57QEPs



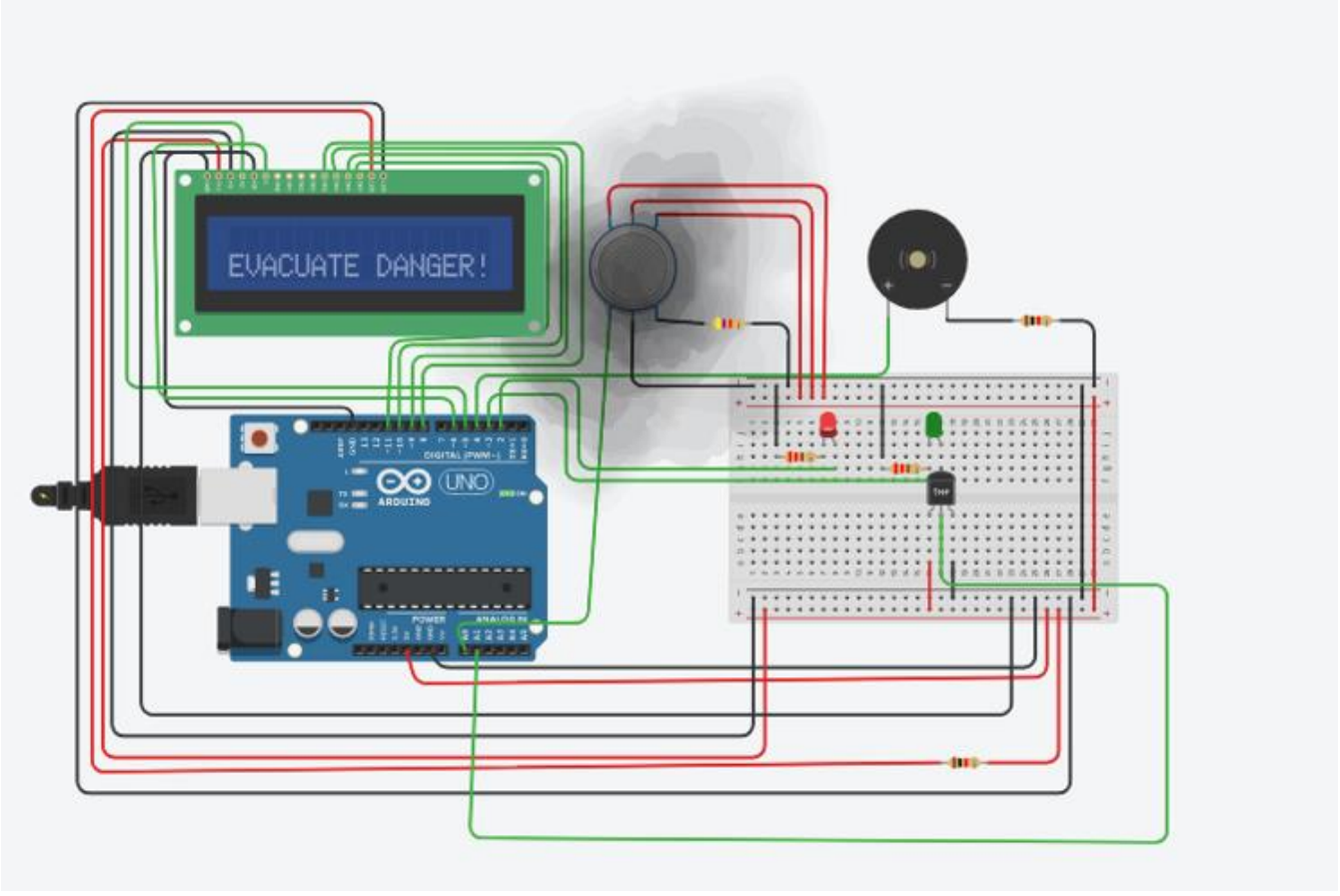
The above simulation does not involve the ad-hoc network simulations and focuses specifically on the sensors behaviour when the gases cross a particular threshold

Case based output:

IN HIGH TEMPRATURE(UNSAFE):



IN HIGH GAS CONCENTRATION(UNSAFE):



SPACE TAKEN ON BOARD:

```
Sketch uses 657350 bytes (50%) of program storage space. Maximum is 1310720 bytes.
Global variables use 38044 bytes (11%) of dynamic memory, leaving 289636 bytes for local variables. Maximum is 327680 bytes.
```

ARDUINO IDE SCREENSHOTS OF REAL TIME DATA (DATA IS RECEIVED AFTER EVERY 18 SEC):

```
connected
Humidity: 63.00%
Temperature: 23.80°C
PPM: 345.46
Gas Level: 17.20
Data Send to Thingspeak
Waiting...
connected
Humidity: 63.00%
Temperature: 23.80°C
PPM: 284.40
Gas Level: 16.23
Data Send to Thingspeak
```

Output Serial Monitor ×

Message (Enter to send message to 'Node32

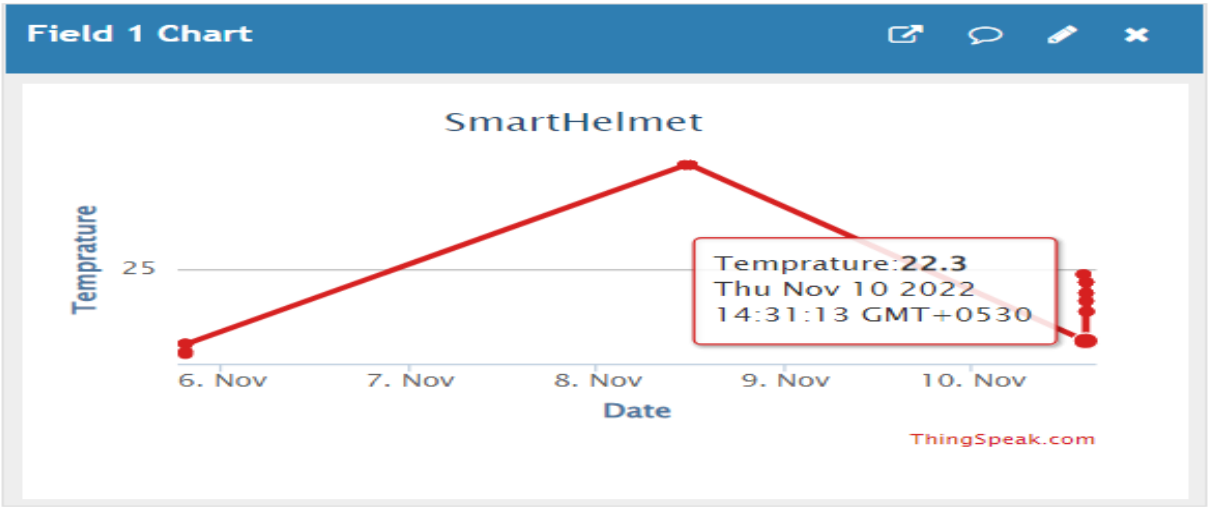
```
pm open,type:2 0
Waiting...
connected
Humidity: 62.00%
Temperature: 24.10°C
PPM: 346.41
Gas Level: 17.30
Data Send to Thingspeak
Waiting...
connected
Humidity: 63.00%
Temperature: 24.10°C
PPM: 378.36
Gas Level: 17.69
Data Send to Thingspeak
```

UPDATION OF DATA IN DATABASE:

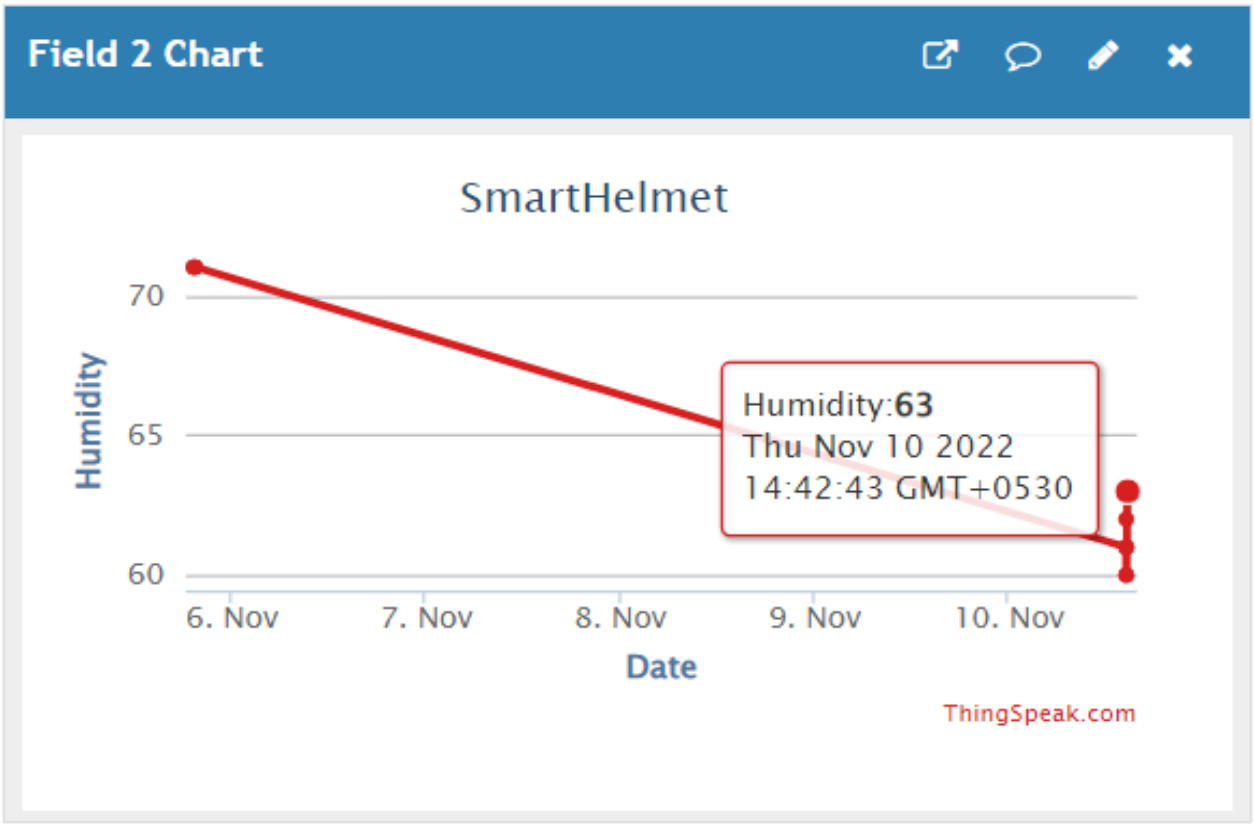
Channel Stats

Created: 5 days ago
Last entry: less than a minute ago
Entries: 426

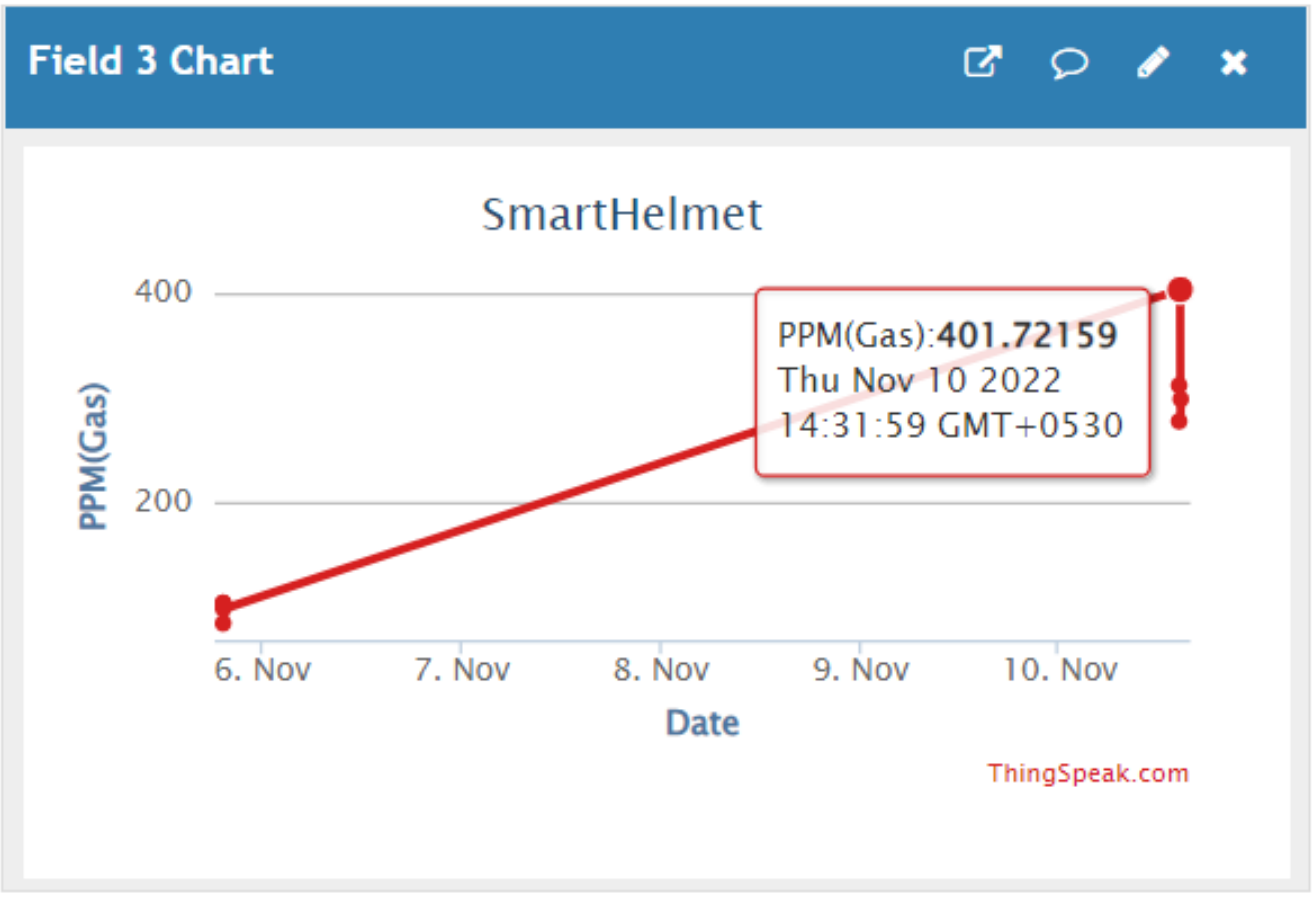
CHANGE IN TEMPRATURE:



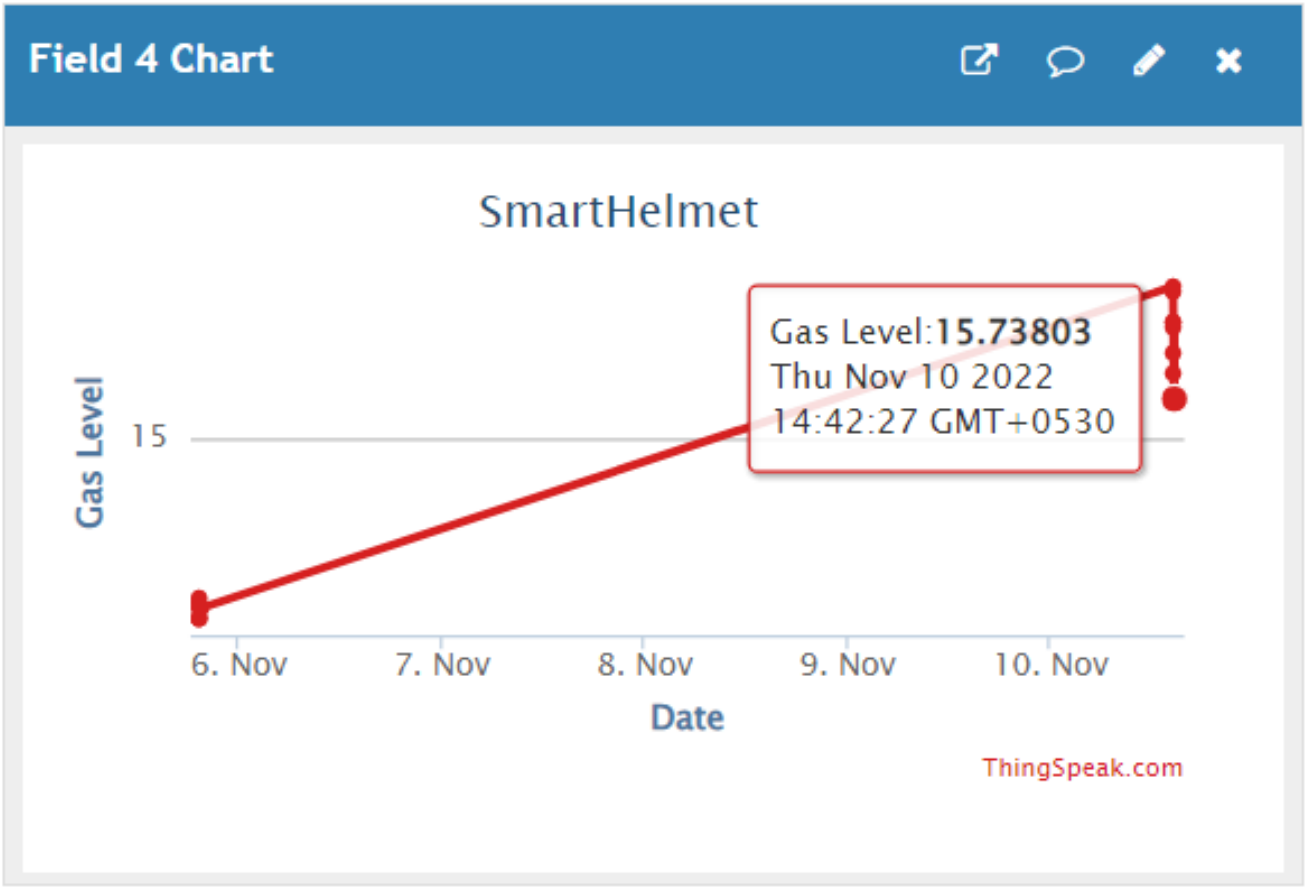
CHANGE IN HUMIDITY:



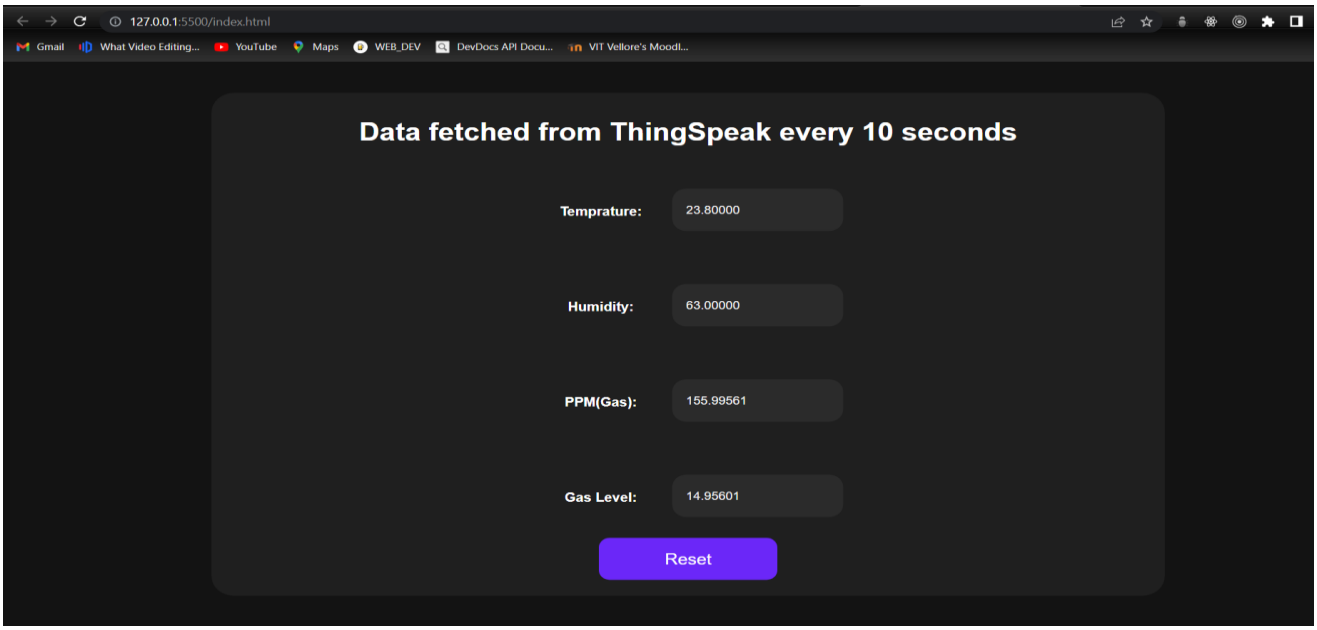
CHANGE IN PPM:



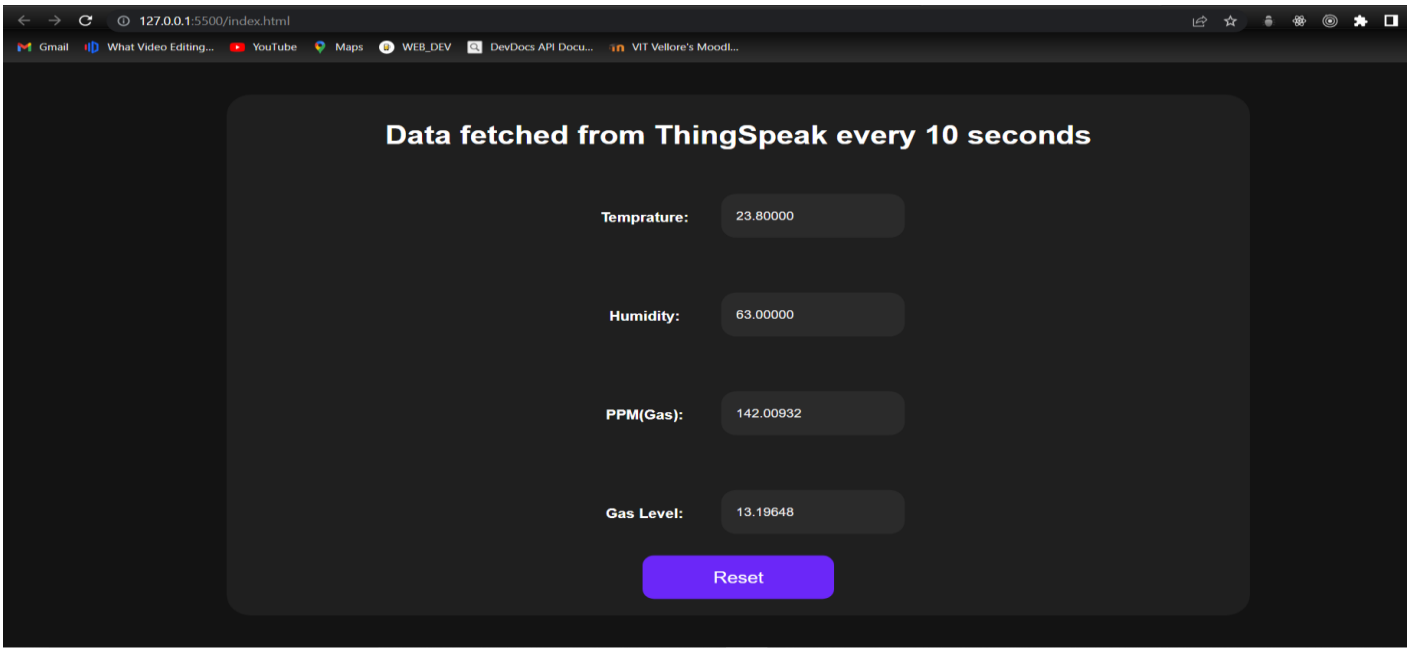
CHANGE IN GAS LEVEL:



UPDATION OF DATA EVERY 10 SEC ON TO THE SERVER SIDE (testcase):

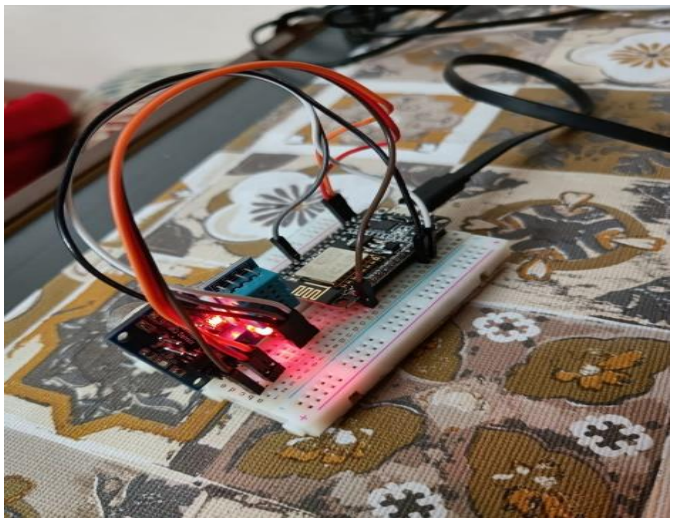


AFTER SOME TIME:



Photographs of the Project

The MCU:



Helmet:

Final Project (Integrated)

Methodology And Proposed Outcome:

Constantly monitor the concentration of some specific gases that are known to be harmful to the miner's health such as carbon monoxide, Alcohol, Benzene, etc. and keep processing their concentrations to check if it's below a safe threshold or not, in case it is harmful for the miner, a proper response/alert must be given to him as well as in the control centre about the condition of the area and also give a mechanism to alert all the nearby workers.

The proposed project will be made using mq135 sensor to get the concentration of the gases present in the air and will be processed on an esp-32-wroom-32 microprocessor.

Basically, materialising a safety system for the miner embedded in his helmet, telling him if the area he is working on is safe for him or not, and also inform the central server about the same.

Novelty Of The Proposed Project:

The response and the alert in case of some hazardous event highly depends on the general layout of the mine, and hence the solution or the design for it is unique depending to the targeted location or structure of the mine which may use different hardware depending on the physical constraints presented in the working environment.
There have been projects which can detect gases in a mine but they are used only for data collection and survey purposes but in this given project we will be using real time computation to tell the miner if he is safe or not, all of this via his helmet and no additional load.
Furthermore the Helmet can alert other miners of the alert as well using secure ad-hoc network since the network is implemented using ESP now, which needs initial pairing of the ESP82 devices for establishing a communication between them.

Relevance And Importance Of Proposed Project:

To the public and to the mining industry. There haven't been much innovations to improve the conditions of the miners despite the fact that it is one of the most hazardous workplaces to be in.

The life of a miner is at risk all the time, we are set to diffuse this issue with the help of this project to some extent. Even one life saved would justify all the time and effort invested in this project Rather than going for a project that maximises profits in other domains The project will be a great help in ensuring the safety of all the miners working in the mining field, and hence will be highly relevant to the miners and their family.

APPLICABILITY OF THE PROJECT:

The applicability of a project depends on how economical it is to materialise and also on the ease of use it offers to the industry it is introduced to.

The proposed project will be made using mq135 sensor to get the concentration of the gases present in the air and will be processed on an esp-32-wroom-32 microprocessor.

Which is quite economical considering all the other options available in the market, also all of the mechanisms and workings of the entire project will be embedded in the helmet of the miner which means that he does not need to carry any additional load or any technical expertise to be safe.

Short Term Applicability:

Can help in saving lives of many miners in case of some emergencies.

Long Term Applicability:

Based on the frequency of the hazardous gases leaked, a proper evacuation route could be made for some particular locations based on the past records of alert in the mine.

GAP IDENTIFIED:

The embedded software for the wearable device will vary depending on the structure of the mine and the kind of alert we plan to issue and hence the model could vary vastly depending on the general layout of the mine and hence will affect the availability and economical factor of the final product. The current cost of the microcontroller used (ESP8266) Is not that feasible for the mining industry if the cost of production of a single helmet is concerned adding to that would be the cost of the sensors and software components used in this project.

SUMMARY OF PROJECT:

Background of work:

The main purpose of the work is to design a smart helmet system for mining industry.

It will constantly monitor the different concentration of the gases in the environment of the miner and will alert him as well as the control centre of any hazardous event such as gas leaks or mine collapses in which case the miner is left completely alone and unaware, a small example being

Carbon monoxide which is a completely tasteless gas and also has no smell but one of the most poisonous and harmful gases that exists in a mining environment, which means that a miner cannot detect the gas on his own using his natural senses of smell or taste. In these situations, it becomes absolutely necessary that there must be some mechanism to save his life, this is where our device comes in, The **MINECO** smart helmet.

CONCLUSION AND FUTURE WORK:

Main significance of this project is in mining sector and the lack of a wearable device / assistant to the miner, where we can monitor the real time status of the mining environment around the miner and can raise appropriate alert to others depending on if some hazardous situation has occurred thus adding the necessary safety lacking in the current industry for the miners.

The given project is in its genesis or origin state which means that there will be a vast scope of improvement in it with time given that a community collaborates on this and highlights shortcomings and suggests improvements on the same making the product feasible Since the product greatly depends on the layout or structure of the mine, we can work towards making it more flexible or general in nature in future.

END