International Research Journal of Engineering and Technology (IRJET) e-ISSN:2395-0056
Volume: 10 Issue: 03 | Mar 2023 www.irjet.net p-ISSN: 2395-0072

Smart Safety Vest For Miners

Siddhesh Dambe[1], Anas Khan[2], Aniket Mahule[3], Asif Khan[4], Vidya Bharde[5]

[1,2,3,4]Student at Mahatma Gandhi Mission's College Of Engineering And Technology, Navi Mumbai
[5]Professor at Mahatma Gandhi Mission's College Of Engineering And Technology, Navi Mumbai

---

Abstract - *Mines are found all across the globe and are used to mine various metals, non-metals as well as other resources. The concept of mining brings along various other aspects such as accidents, flammable gasses, toxic gasses, etc. These attributes prove to be a major risk to life and health. In certain events, it has been observed that zones of high concentration of Nitrogen or Carbon dioxide are formed, or mines may even contain some zones of oxygen-deficient air in some sealed passages.The developed product is used to detect the presence of toxic and flammable gasses in the environment of the miner, the miner's pulse rate, the zonal location of the miner, and other attributes of his environment such as temperature, pressure, and humidity. The measured parameters are sent to the administrator or supervisor through the Wifi module(ESP8266-01) via the Thingspeak Channel which is used for the visualization and storage of data. The measured data is displayed on a webpage and in case of any accidents or health hazards the supervisor is informed in the shortest duration of time. The reduced time from the moment of the incident to the time the medical response team reaches the miner will prove greatly beneficial in saving the lives of the miners.*

Key Words: **IOT, Cloud, Arduino Mega 2560, Sensors, Flammable Gasses.**

1. INTRODUCTION

In any occupation safety and security of the worker is the top priority. In certain professions, the life of an employee is at high risk. In the modern day, when safety and security are the top priorities in many fundamental processes, people in the mining industry ensure similar things. Mines pose a major risk to life as it produces various gasses such as methane, carbon dioxide, and nitrogen. Methane gas and fine particles of coal when they come in contact with a heat source cause an explosion [1]. Six people passed away as a result of the episode, which took place in the Sanjdi coal mine shaft near Quetta, Balochistan. Although the Industrial Global Union and Pakistan Central Mines Labor Federation are especially aware of this problem, no appropriate solution has yet been found. The existing framework cannot meet the needs of the miners, but when monitored on a remote sensor system and then delivered to a certain potent IP, a significant number of lives can be saved at the right moment. Also, this design is unique in that it includes a large number of efficient sensors. There are a few various solutions that may be used to solve the problem, and other solutions have been used in the past as well. But, they have a big challenge in determining when the coal mine has collapsed for whatever reason. When such a tragedy occurs, the executive's authority must start laboriously excavating the entire site. In mining, there is a huge risk to the life of workers and any sudden accident under the mine can cause injury to the worker and in some cases even death. In this regard we being computer engineers can suggest an embedded system solution that may not provide life to the worker but may remove the ambiguity and may guide them a lot. Several different kinds of mine tracking systems have been created and deployed globally. For the miners' safety, a wireless sensor system is intended to monitor the health and whereabouts of miners and the surroundings around the miners inside the mine. It is simple to track the location of miners underground using such a network. In an emergency, the wireless sensor network gathers data, notifies miners via alert messages that the region is dangerous, and assists in locating lost miners inside the mines. If the miner uses this product it increases their safety and is helpful to the miners in various ways. This product constantly updates the miner's pulse rate in addition to identifying the zonal location of the miner. The product assists the rescue team in accurately digging at the proper depths to recover trapped miners.

2. LITERATURE REVIEW

"IoT enabled HELMET to safeguard the health of mine workers" published in 2022. The three-tier architecture is used to monitor the minor's health. The three tiers of architecture are the sensing unit, computing unit, and monitoring unit. This paper focuses on calculating miners' data by using an Arduino Uno microcontroller and various sensors such as MQ135, DHT11, heartbeat sensor, etc [2].

" IoT-Based Smart Kit For Coal Miners Safety Purpose" published in 2021.The primary goal of this article is to describe the proposed elements that have been gathered for the prototype product's wearable jacket design, which is intended to protect the lives of coal miners and other workers who execute their duties in underground workplaces. The microcontroller used in this model is a

Raspberry Pi. The various sensors that are used in this model are a flame sensor, smoke sensor, accelerometer, pulse sensor, and GPS module [3].

"Prototyping IOT-Based Smart Wearable Jacket Design for Securing the life of Coal Miners" published in 2019. In this research, the implemented methodology differs slightly in terms of the use of sensors. The study provides some specific recommendations for prototyping the smart wearable jacket design to protect coal worker lives. The microcontroller used in this module is Arduino Mega. The toggle switch is used as well.All of the sensors, including the Arduino Mega controller, will turn on and begin interacting with the sensors attached to them when one of them is triggered [4].

"Smart Soldier Jacket Using Internet of Things" published in 2019. In this module, LPC 2148 Microcontroller is used. The system consists of three main parts: soldier unit 1, soldier unit 2, and the base unit. The sensors used in this model are a temperature sensor, heartbeat sensor, GPS module, and thermoelectric unit. The main feature of this model is that they are using PiezoElectric material for shoes that use piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge [5].

3. METHODOLOGY

The device will be attached to the jacket of the miners. All the sensors are connected to Arduino through wires and the connections of sensors to Arduino are very strong to prevent any disconnection. The model consists of two separate gas sensors for the detection of flammable gasses and smoke. If the miner accidentally enters a zone of high methane concentration the buzzer rings alerting the miner. A pulse sensor is connected to calculate the pulse rate of the miner, it is an important aspect of constantly monitoring the health of the miner. The DHT11 sensor has been installed, it calculates the temperature of the surrounding environment at the miner's position. Location tracking using RFID is the most valuable and promising phase in the product to make the system more enhanced and useful. A BMP 180 sensor helps in monitoring the depth and pressure measurement. The ESP8266-01 - Wifi Module's main function is to configure itself with the linked router and obtain a dynamic IP address. The entire data is wirelessly transferred to the designated IP after it has been assigned. Web page data for the admin panel is retrieved from the cloud and displayed on the website using Read API requests. The RFID Tag combined with the RFID readers set up in various zones throughout the mine plays an important role as they prove helpful in determining the general location of the miners. The RFID cards are read by the RFID reader when the miner enters a particular zone in the mine and thus the last location of the miner would be updated.

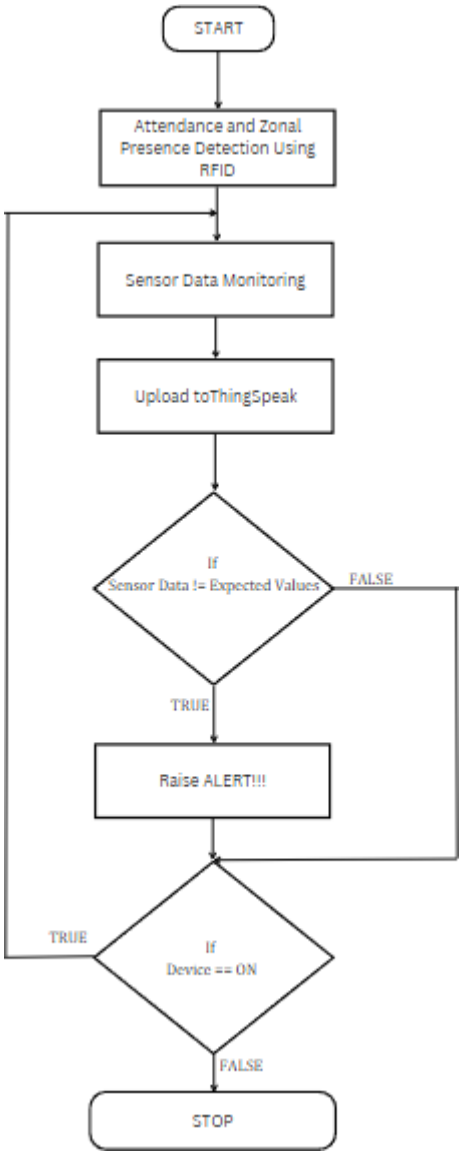


Fig -1: Flowchart

The following sensors are used for the product:

1. **Arduino Mega 2560**
   With the ATmega2560 as its foundation, the Arduino Mega 2560 is a microcontroller board. It contains 16 analog inputs, 4 hardware serial ports, a 16 MHz crystal oscillator, 54 digital input/output pins, 15 of which may be used as PWM outputs, a USB port, a power connector, an ICSP header, and a reset button. It also has a 16 MHz crystal oscillator.

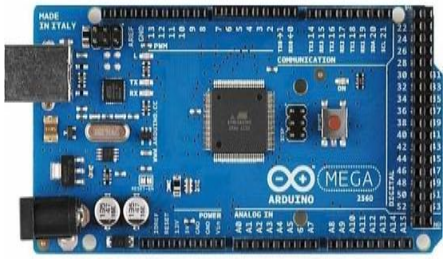


Fig -2: Arduino Mega 2560

2. **MQ-2 Smoke & Gas Detection Sensor**
Metal Oxide Semiconductor MQ2 Gas Sensor (MOS). The MQ2 Gas Sensor Module consumes around 800mW and operates on 5V DC. It has a 200–10,000 ppm detection range for LPG, smoke, alcohol, propane, hydrogen, methane, and carbon monoxide. [6].

3. **MQ-6 Methane and LPG Detection Sensor**
Liquefied petroleum gas (LPG) concentrations in the air may be detected with the MQ-6, aneasy-to-use LPG sensor. LPG is mostly made of propane and butane. Gas concentrations between 200 and 10,000 ppm may be detected using the MQ-6. This sensor offers a quick reaction time and great sensitivity.

4. **GY-MAX30100 Heart Rate and Pulse Oximeter Sensor**
It is an optical sensor that derives its readings from emitting two wavelengths of light from two LEDs a red and an infrared one then measuring the absorbance of pulsing blood through a photodetector. Input voltage: 3V to 5V DC [7].

5. **BMP180 Pressure & Depth Sensor**
BMP180 Digital Barometric Sensor Module compatible with Arduino measures the absolute pressure of the environment using a digital barometer. It works on a 1.8V to 3.6V Supply Voltage.

6. **DHT 11 Temperature and Humidity Sensor**
DHT11 is a low-cost digital sensor for sensing temperature and humidity. This sensor can be easily interfaced with any microcontroller such as Arduino, Raspberry Pi, etc. to measure humidity and temperature instantaneously. The operating Voltage: 3.5V to 5.5V [8].

7. **RFID Tag**
The RFID Tag is affixed to the jackets of the miners and used to track them. It minimizes the manual work of maintaining the records of entry and exit. The RFID Tag contains information about the user or object carrying it. RFID Tags can be read even if it is covered by the object or not visible [9].

8. **ESP8266-01 - Wifi Module**
The ESP8266 is a low-cost Wi-Fi board, that you can easily wire to a microcontroller, and connect any project you build to the internet. The board is used to send sensor data to ThingSpeak.

9. **Thingspeak**
ThingSpeak is open-source software written in Ruby which allows users to communicate with internet-enabled devices. It facilitates data access, retrieval, and logging of data by providing an API to the devices.

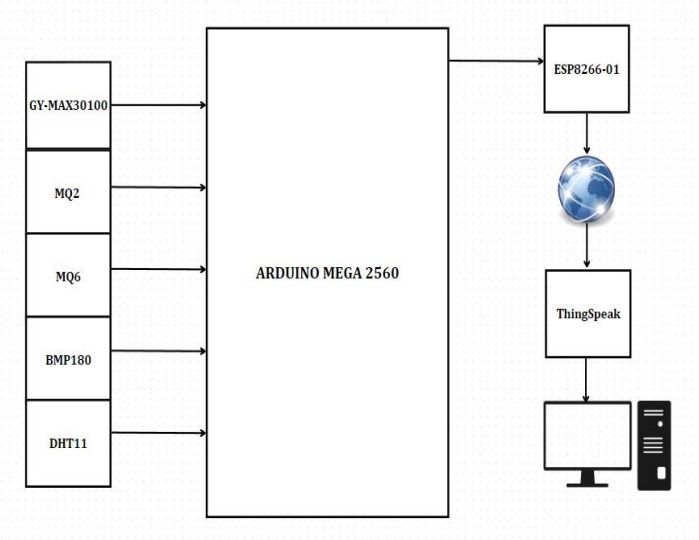


Fig -3: Block Diagram

4. RESULTS

The results are observed by testing the working of the various sensors. The MQ2 sensor is tested by lighting an incense stick to create smoke which changes the digital output of the sensor. The MQ2 sensor is also tested in the presence of LPG gas to detect any flammable gasses. The GY-MAX30100 sensor is tested by simply placing a finger over the sensor to detect the pulse rate. Other attributes such as temperature, humidity, depth, and pressure are compared with readings from the surroundings. The below-mentioned figures show the outputs from the sensor readings, visualization of data uploaded to the ThingSpeak Channel, and the display of data on the webpage.

Fig -4: RFID Attendance And Zonal Presence

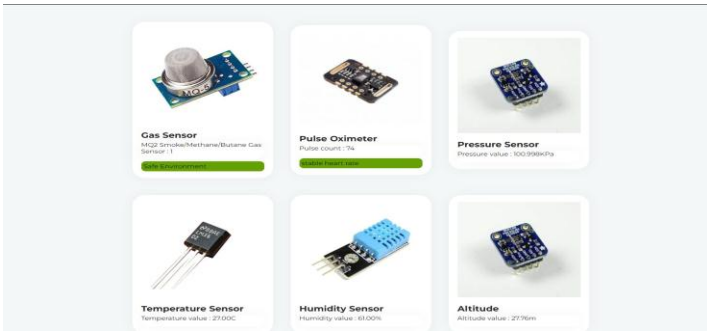


Fig -5: Sensor Readings

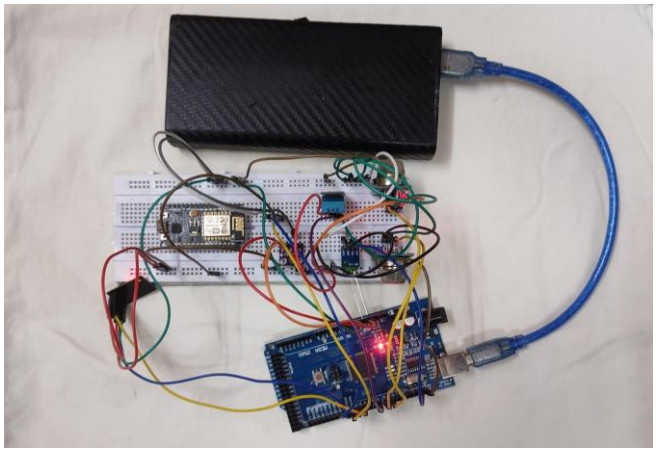


Fig -6: Connections Of Sensors (1)

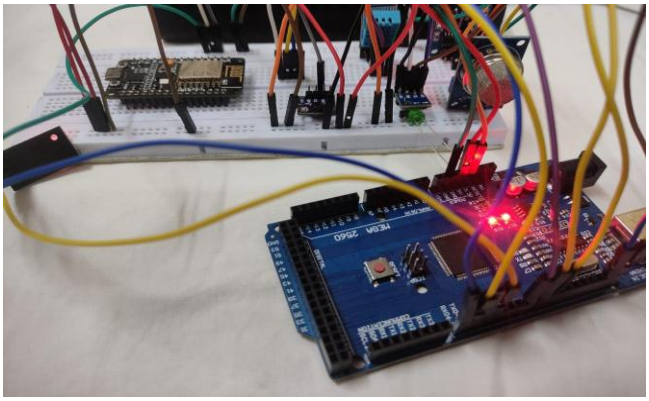
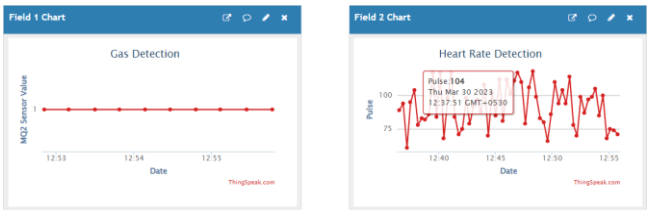


Fig -7: Connections Of Sensors (2)



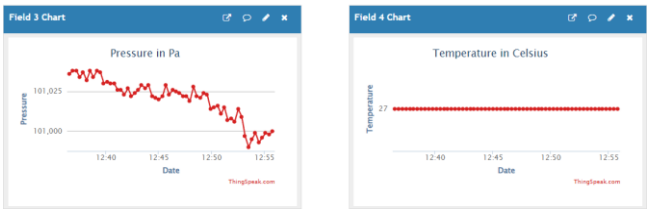


Fig -8: Data Visualization on ThingSpeak (1)

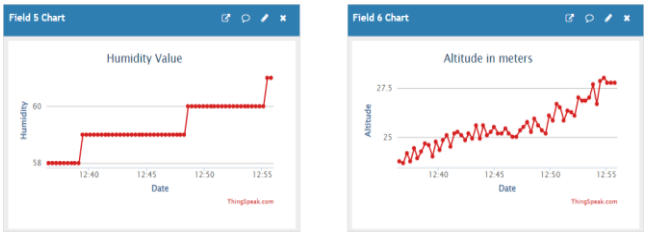


Fig -9: Data Visualization on ThingSpeak (2)

5. CONCLUSIONS

Working in mines is known to have a huge risk to the life of the worker. The health of the workers may deteriorate due to constant exposure to gasses such as methane, also the presence of oxygen-deficient zones may cause the worker to faint and/or die. The methane gas in mines forms a combustible mixture when it combines with air, when this mixture comes in contact with a heat source it causes explosions. Similarly, fine particles of coal dust when they come in contact with a heat source cause explosion. A lot of time is spent from the duration such accidents occur to the time required for the medical response team and other teams to reach the site of the accident and start the rescue procedure. The product helps in minimizing the response time of these services as well as gives a general idea of the depth and zones where the miners are present. This product can be redesigned as per the requirements of various government services such as firefighters, soldiers, etc.

REFERENCES

[1] D. Harrington, E. H. Denny, "Gasses that occur in metal mines", Bulletin 347, U.S. Department Of Commerce, Bureau of Mines.

[2] Ninni Singh, Vinit Kumar Gunjan, Gopal Chaudhary, Rajesh Kaluri, Nancy Victor, Kuruva Lakshmanna, "IoT enabled helmet to safeguard the health of mine workers", Computer Communications, Volume 193, 1 September 2022

[3] Syed Faiz Ul Huda, Chandar Kumar, Muhammad Ali Noman, Syed Yasir Shah, Muhammad Mubashir Iqbal, "IoT based smart kit for coal miners safety purpose", International Journal of Advanced Trends in Computer Science and Engineering, Volume 10, No.3, May - June 2021

[4] Engr. Ghulam E Mustafa Abro, "Prototyping IOT Based Smart Wearable Jacket Design for Securing the Life of Coal Miners", 2018 International Conference on Computing, Electronics & Communications Engineering (iCCECE), March 2019

[5] Rakshitha M., Shreyas R., Yeshas C Balaji, Rakshitha Urs S., "Smart soldier jacket using internet of things", International Research Journal of Engineering and Technology (IRJET), Volume: 06 Issue: 08, Aug 2019

[6] Kadek Nuary Trisnawan, Agung Nugroho Jati, Novera Istiqomah, Isro Wasisto, "Detection of gas leaks using the MQ-2 gas sensor on the autonomous mobile sensor ", 2019 International Conference on Computer, Control, Informatics and its Applications (IC3INA), October 2019.

[7] IEEE, "Performance assessment of MAX30100 SpO2/heartrate sensor", 2017 Medical Technologies National Congress (TIPTEKNO), October 2017

[8] Ms.Sujeetha. R/AP, K Reddy Deeraj, B Bhaskar Yeseswi, Lenin Sade, "Humidity and temperature monitoring system using IoT", International Journal of Engineering and Advanced Technology (IJEAT), Volume-9 Issue-2, December 2019.

[9] Davinder Parkash, Twinkle Kundu, Preet Kaur, "The RFID Technology and its applications: a review", International Journal of Electronics, Communication & Instrumentation Engineering Research and Development (IJECIERD), Vol.2, Issue 3 Sep 2012

BIOGRAPHIES

Siddhesh Dambe
Pursuing B.E. in Computer Engineering at M.G.M. College Of Engineering And Technology, Navi Mumbai, Maharashtra.

Anas Khan
Pursuing B.E. in Computer Engineering at M.G.M. College Of Engineering And Technology, Navi Mumbai, Maharashtra.

Aniket Mahule
Pursuing B.E. in Computer Engineering at M.G.M. College Of Engineering And Technology, Navi Mumbai, Maharashtra.

Asif Khan
Pursuing B.E. in Computer Engineering at M.G.M. College Of Engineering And Technology, Navi Mumbai, Maharashtra.

Vidya Bharde
Professor at Department Of Computer Engineering, M.G.M. College Of Engineering And Technology, Navi Mumbai, Maharashtra.