Smart Safety Helmet For Coal Miners Using IOT

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Abstract- *The Smart Safety Helmet for coal miners is to enhance the safety of miners in hazardous environments like coal mining with the help of IoT and sensor technologies. The helmet includes different parts such as Arduino and NodeMCU microcontrollers, air quality, carbon monoxide, temperature, and humidity sensors, a GPS module, and an SOS panic button. The system keeps a regular check on the environment and feeds real time data to the ThingSpeak cloud platform which can be monitored remotely by supervisors. This way, preventive safety measures and emergency response can be taken. The helmet is designed to withstand the severe conditions of an underground mining operation. Future improvements might be AI enabled hazard prediction, biometric health monitoring and better connectivity to increase the safety of the miners and the productivity of the operations. This solution shows how IoT can define a new standard of workplace safety in high-risk industries.*

Keywords- Air quality sensor, Temperature sensor, GPS Module, Arduino Microcontroller.

I. INTRODUCTION

Coal mining is one of the most a risk sectors, exposes miners to risks such as toxic gases, high temperatures, and structural collapses, but being crucial to the the entire world's energy generation. Hard helmets and other traditional protective equipment often fail to provide real-time protection. In order to overcome these barriers, this project introduces a smart safety helmet that incorporates sensor and Internet of Things technology.

The helmet's sensors for temperature, humidity, carbon monoxide, air quality, and a GPS module for tracking its location guarantee early hazard detection. While data is processed by Atmega328p and NodeMCU microcontrollers and delivered to the ThingSpeak cloud platform, miners can provide emergency alerts via an SOS panic button.This solution aims to revolutionise miner safety and operational efficiency, defining a new standard for enhancing safety in one of the world's most risky professions. The helmet's ergonomic design ensures comfort during extended use, and advanced alert systems enhance visibility in low-light environments.

II. LITERATURE REVIEW

The improvement of miner safety and emergency response capabilities is the purpose of integrating GPS tracking and Internet of Things technologies into mining safety helmets. These helmets contain sensors that track crucial conditions including temperature, humidity, and gas levels along with to the miners' wellness. In an emergency, the data is transmitted in real time to a centralised system, resulting in immediate notice and faster response times. Successful rescue operations rely on being capable of to monitor miners' locations, which is made easy by GPS technology. The higher power consumption of advanced sensors in these systems, however, has been recognised as a challenge that might reduce battery life during long shifts.

To address this, solutions have been proposed, such the development of energy-efficient components and low-power communication protocols. The helmets also have an SOS button, which enables miners to send immediate distress signals in critical situations, improving response time. Despite of the benefits, false warnings from non-critical incidents, such as minor falls, have been acknowledged as a potential issue. Refining the warning generation algorithms to discriminate between emergencies and common incidents would improve the system's usability and reliability.

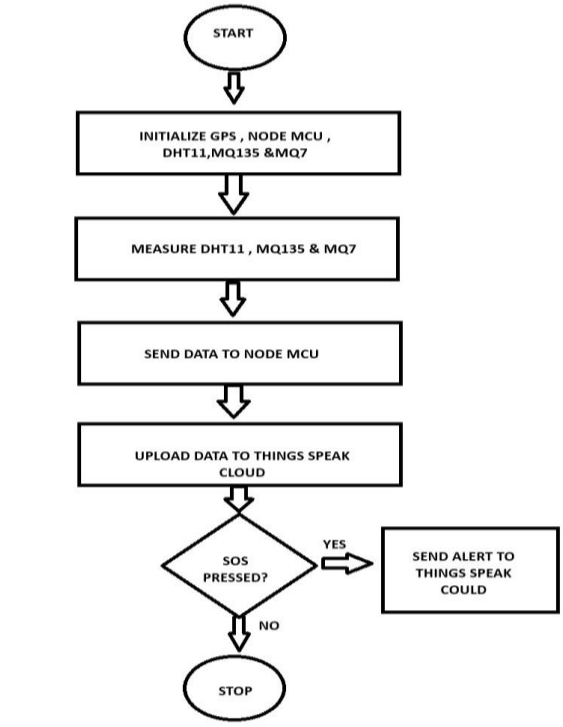
In addition, GPS tracking in deep underground environments can be challenging due to inadequate signal reception. To solve this, hybrid tracking technologies such as Bluetooth and Wi-Fi, and also mesh networks, are suggested to ensure exact positioning. Advanced signal processing techniques are also proposed to improve tracking accuracy in low-signal areas. By optimizing power consumption and improving communication methods, these systems have the potential to revolutionize miner safety, setting new standards for the industry.

III. METHODOLOGY

The methodology of the smart safety helmet for coal miners consista number of components are integrated into the system to make sure seamless operation. The primary controller, an Arduino Uno, interfaced with a range of sensors,

which included the DHT11 for temperature and humidity monitoring, the MQ135 for air quality, and the MQ7 for carbon monoxide detection. Miners can send alerts via an SOS button, along with a GPS module tracks their location in real time. For remote monitoring, the Arduino Uno analyses data before transmitting it to cloud platforms like ThingSpeak via NodeMCU. The entire system is powered by battery for reliability in underground locations, and a buzzer offers immediate sounds alarms in hazardous conditions.

A graphical representation of a system demonstrating how data transfers between various components and processes is called a data flow diagram (DFD). The purpose of this diagram is to give a brief, glance of the system's data collection, storage, processing, and transmission processes. The DFD represents the data flow from various sensors, the MQ135 for air quality monitoring, the MQ7 for carbon monoxide detection, and the DHT11 for temperature and humidity, in the context of the Smart Safety Helmet. The Arduino Uno microcontroller analyses the real-time environmental data generated by these sensors. The NodeMCU receive the processed data and formats it for cloud communication. The NodeMCU stores, evaluates and shows the data by sending it to the ThingSpeak cloud platform via its built-in Wi-Fi module. Supervisors can obtain real-time insights into the safety circumstances of miners through dashboards that display information gathered on the cloud platform. In addition, when important criteria are raised, alerts appear. By providing remote access to crucial data at all times, this simplified approach maintains efficient surveillance and enhancessafety measures.



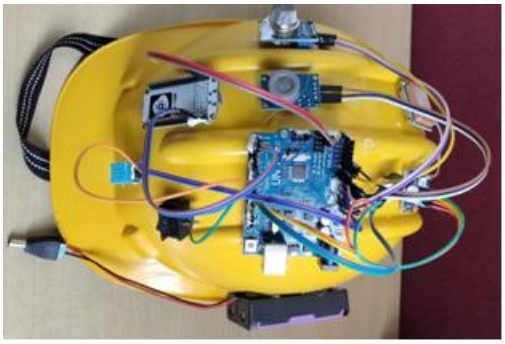
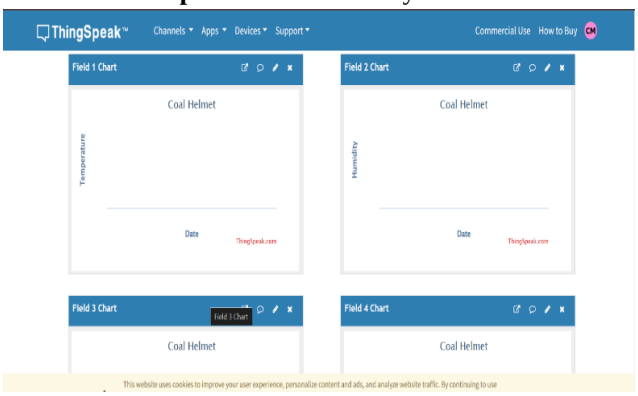


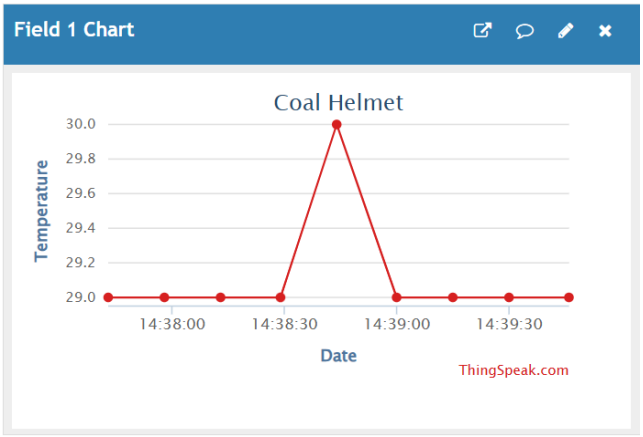
Figure 1:Methodology of Smart Safety Helmet For Coal Miners

IV. SNAPSHOTS

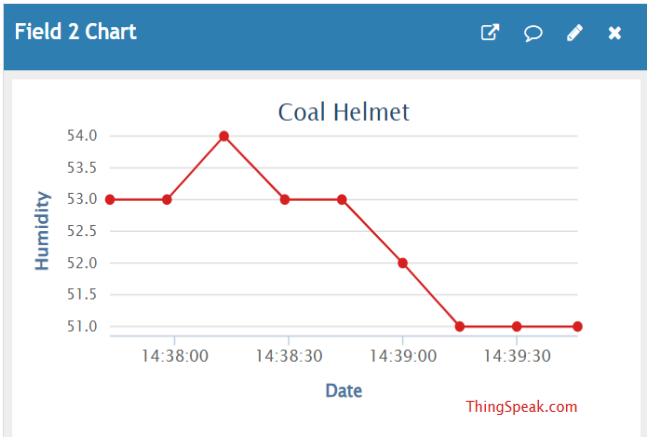
Snapshot 1: Smart Safety Helmet



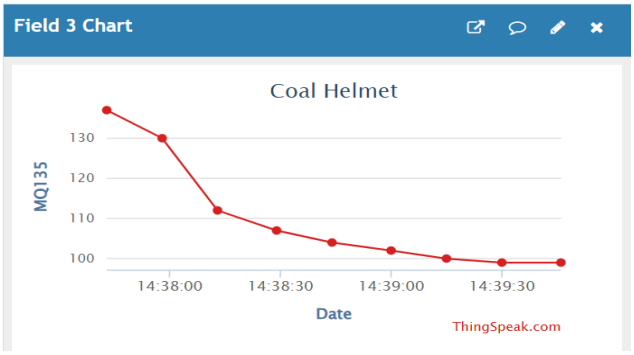
Snapshot 2: Home page of "Thinks Speak" web page



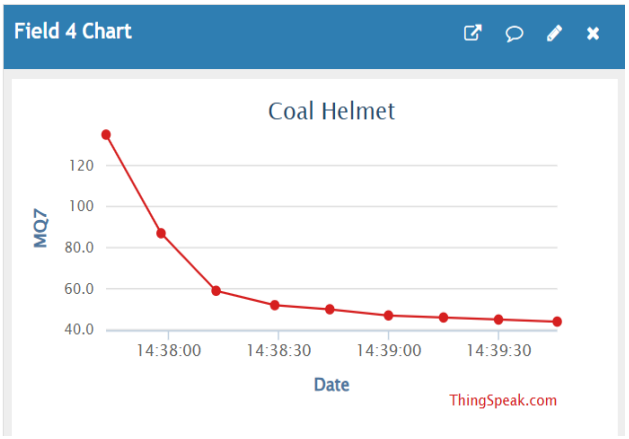
Snapshot 3: Field 1 chart Temperature



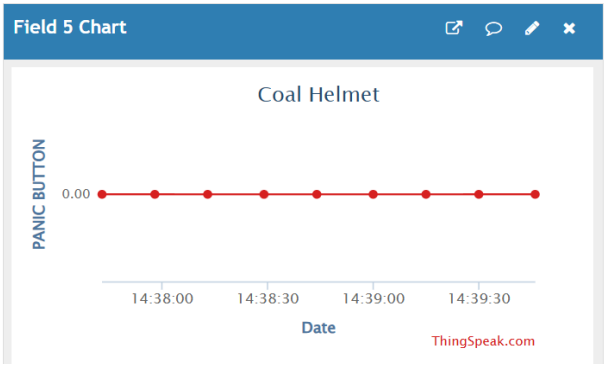
Snapshot 4: Field 2 chart Humidity



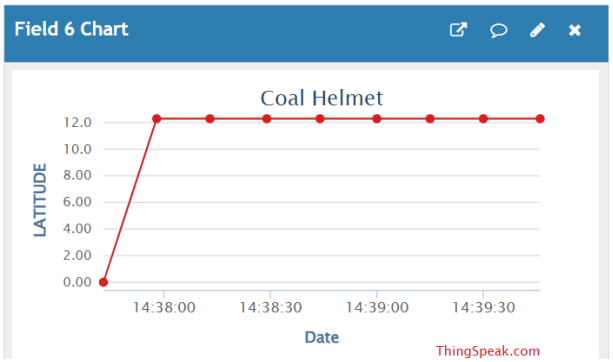
Snapshot 5: Field 3 chart MQ135



Snapshot 6: Field 4 chart MQ7



Snapshot 7: Field 5 chart Panic Button



Snapshot 8: Field 6 chart Latitude

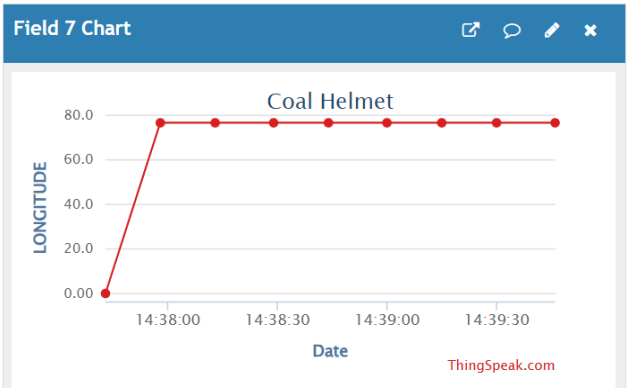


Fig 11:Field 7 chart Longitude

V. CONCLUSION

The developing of smart safety helmets is an innovative approach for improving the health and safety of coal miners. Advanced sensors, GPS tracking, and Internet of Things technology allows real-time monitoring of dangerous circumstances like as temperature, humidity, and gas levels. via an SOS panic button, the system provides quick emergency notifications, ensuring immediate action in critical situations.Supervisors can keep updated on miner locations and collect useful data via cloud-based applications. The project has a lot of potential to enhance the overall work environment, improve safety compliance, and decrease the number of accidents. due to its flexible modular architecture, it can also be used in other dangerous sectors. Testing revealed areas requiring enhancement, especially in regards to GPS accuracy in difficult conditions and battery performance. However, the project provides excellent opportunities for more development and represents an important advancement in mining safety. This system provides an example of how IoT-based solutions have the ability of changing standard safety measures. This project's success illustrates how it can transform worker safety in harmful fields.

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