Smart Helmet for Miners

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Abstract**—** *Smart helmet for miners offers a device for the coal mine workers which is easy to use and reliable. This device includes a basic monitoring system, which monitors the environment of the mine and help us know if it is suitable for miner to works in or not. The monitoring system installed on the m=helmet help us to collect the live data from the mine using radio transmission and this data is then transferred to the admin side for analysis and to monitor it briefly. The helmet id also installed with a GPS tracker, which would help us to locate the miner during the time of any accident or calamities. The accuracy of information is of the utmost, which helps us to safeguard the miner's life. This device also includes a panic button, which can be used by the miner to alert the workers outside in case of any emergency.*

Keywords**—** *Coal mines, Sensors, Safety, Miners, Smart Helmet, Internet of Thing (IoT)*

I. INTRODUCTION

Mining plays a pivotal role in any country's economy, offering numerous opportunities across various sectors. Our society greatly benefits from the materials and products extracted through mining processes. In the past, coal miners worked under harsh conditions, with minimal protection and rudimentary tools. Today, the mining industry remains a cornerstone of development, responsible for uncovering and extracting valuable resources like iron, gold, coal, and diamonds. Safety stands as a paramount concern in any industry, but especially in mining. Rigorous safety measures are adhered to, utilizing advanced technology to monitor factors like temperature, humidity, and gas levels through sensors. These measures mitigate potential hazards, triggering alerts via buzzers to avert accidents. India, for instance, houses approximately 11 coal mines, facing elevated safety risks due to ventilation issues, gas exposure, rockfalls, and head injuries. To address these challenges, we've developed an IoT-based Smart Helmet for miners. This innovative solution incorporates an array of sensors to monitor miners' health, ambient temperature, and gas concentrations. These features are pivotal in preventing accidents and promoting a safer work environment.[1]

The integration of IoT technology within mining operations has transformative potential, offering real-time data for informed decision-making and proactive safety protocols. The helmet's built-in interface allows supervisors to monitor miners' well-being effectively. While embracing IoT's advantages, it's crucial to ensure sensor reliability, user-friendliness, and the helmet's overall durability within the demanding mining setting. Regular maintenance will be essential to sustain the system's functionality. In essence, the IoT-based Smart Helmet holds promise for revolutionizing miner safety and productivity. It showcases how technology can be harnessed to elevate safety standards, enhance operational efficiency, and contribute to the overall growth of the mining sector.[2]

II. LITERATURE SURVEY

In 2016, Pranjal Hazarika and his co-workers proposed the development of smart safety helmet for mining people. The helmet is fit out withMQ3 and MQ4gas sensor. The gasses sensed by using sensor. The X-Bee which is connected with the helmet is used to transmit the information to the control room, the microcontroller in the control room initiates an alarm signal when methane and carbon monoxide gas is in critical level. It is very useful technique in mining industries because of its ability, cheap in cost and stable. In 2018, Rohith Revindran and his co-workers has implemented the smart helmet for safety in mining to help the miners. The wireless sensor network (WSN) can be implemented to keep a check on people who are at work. Distance Vector Routing (DVR) based routing protocol. Whenever threshold value is more than the force sensor, the helmet in the mote sends a trouble message by the saved route to the room manager. To check the status of rooms the Graphical User Interface (GUI) gives the centre to supervise all the mine workers. It takes the instant and the required take actions. In 2016[4]

C.J. Behr and his co-workers developed a smart helmet in order to detect hazardous in mining industry. The primary types of danger are air moisture, helmet removal and collision. This software used Contiki operating system to calculate the measured values to control the detecting sensors. When mine worker put the helmet on the head in order to determine successfully and Infrared sensor is used. This system can be used to determines the miners blood pressure and heart rate and the gas values of mine workers as well. In 2018 Akshunya Mishra, Samayammalhotra, Suchitra, Pallavichoudekar and H.P. Singh proposed a project that can be used on helmets of these underground coal mine working people and would supervise some major hazards criterion found in the mine working people in real time. It contains humidity and temperature(lm35) sensor. These sensors would give the measurements of methane and sulphur oxide. In this project will find these criterion, analyse them in real time and help the ground control and the miners about condition by using a buzzer. In 2014 Shabina. S proposed a brilliant sensing and alerting system. In this they using radio frequency and wireless sensor network to detect the temperature, pressure, humidity and gases measurements. Using these two technologies together a smart helmet is designed. The wireless sensor network contains many sensors senses mine worker's environment. The radio frequency technology is used to locating system and also used to locating the mine workers. This proposed system provides the safety and good wireless connection inside the underground mining areas.[5][6]

III PROPOSED METHODOLOGY

This project has two section. They are transmitter section and receiver section. The transmitter section consists of ATmega328 microcontroller, collision sensor, MQ5 gas sensor, humidity sensor and RF transmitter. In receiver section, ATmega328 is interfaced with buzzer, LCD Display and RF receiver.

The transmitter section is placed in the underground mining areas. In transmitter section, collision sensor, MQ5 gas sensors and humidity sensor are interfaced with ATmega328 microcontroller and then ATmega328 microcontroller connected with RF transmitter. The humidity sensor, gas sensor and collision sensor collect information and send it to receiver section through RF transmitter.[4]

The receiver section is placed on the person's helmet. In receiver section, buzzer and LCD display is interfaced with ATmega328 microcontroller and RF receiver also connected with ATmega328 microcontroller. The transmitted information from RF transmitter is received by using RF receiver. If the detected values are higher than pre-defined limit, then buzzer gives warning signal and LCD display shows status. The advantage of placing transmitter section on the underground mining areas, we can know gases level and temperature level of that transmitter section placed area before we can go in there. The another advantage we don't need sensors to be placed in every individual person's helmet.[2]

IV Architecture Diagram

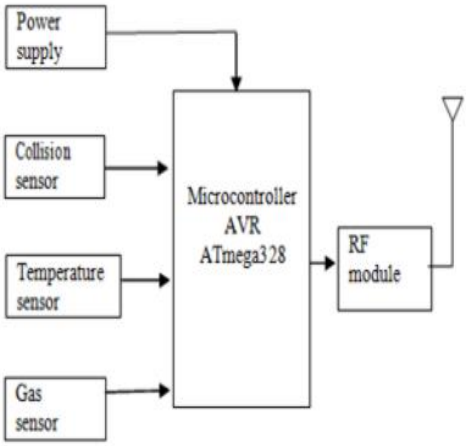

Fig 1. Transmitter Section

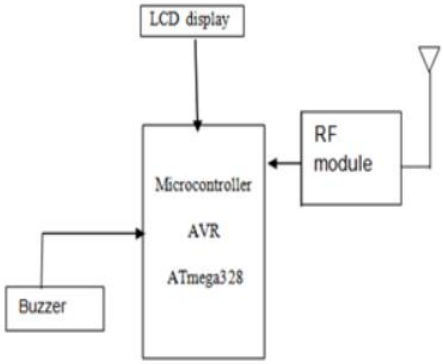

Fig 2. Receiver Section

V . SYSTEM COMPONENTS

A] SENSOR NETWORK

1. Collision Sensor-

The IR Sensor-Single is a general purpose proximity sensor. Here we use it for collision detection. The module consist of an IR emitter and IR receiver pair. The high precision IR receiver always detects an IR signal The module consists of 358 comparator IC. The output of sensor is high whenever it receives IR frequency and low otherwise. The on-board LED indicator helps user to check status of the sensor without using any additional hardware .The power consumption of this module is low.

2. Gas Senor:-

In this project MQ-4/5 sensor is used as a gas sensor. It is able to identify various gases in the air like CO, CH4, LPG and natural gases. MQ-4 sensor is highly sensitive to LPG . Methane gas is released from coal beds to the surrounding atmosphere. It is odourless, colourless, flammable and lighter than air thus difficult to detect its presence in air. Sensor composed by Micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net. The heater provides necessary work conditions for work of sensitive components. The enveloped MQ-4/5 have 6 pin,4 of them are used to fetch signals, and other 2 are used for providing heating current.

3 Temperature And Humidity Sensor:

The DHT11 is a basic, ultra-low-cost digital temperature andhumidity 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

VI METHODOLOGY

The smart system divided into two parts. The transmitter part consists of Arduino, DHT11 sensor, MQ 02 gas sensor, LoRa communication, GSM sim800a, Vibration sensor, IR sensor, power supply, The receiver part consists of LoRa communication, Microcontroller , power supply, laptop.

1. MQ 02 the Gas sensor is used to detect the levels of poisonous gas in the mine. If the value is greater than 990 ppm it sends a message saying "gas alert".

2. DHt11 detects the temperature and humidity. If the value of temperature is greater than 36 it sends a message saying "temperature alert". If the value of humidity is greater than 94 it sends a message saying "humidity alert".

3. Vibration sensor detects sudden changes in movements. If c==0 it sends a message saying “vibration alert”.

4. IR sensor detects the obstacles and these sensors are interfaced with Arduino. If b==1 it sends a message saying “obstacle alert”.

5. The threshold for each of the readings of these sensors is set and if any value crosses the threshold, a buzzer is activated and alerts are sent to the receiver module and the mobile phone.

6. The receiver part receives the alerts along with mobile phone and specific action will be taken.[6]

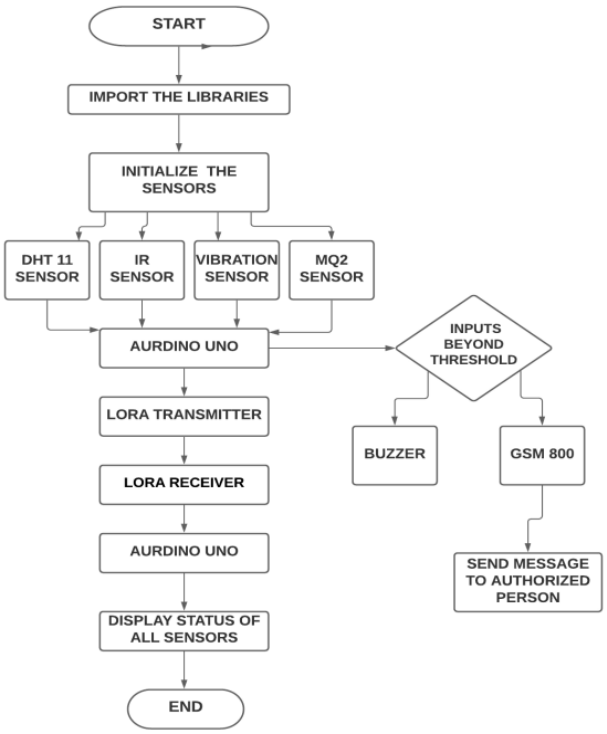

Fig 3. Flowchart of Smart System

VII. RESULTS AND DISCUSSION

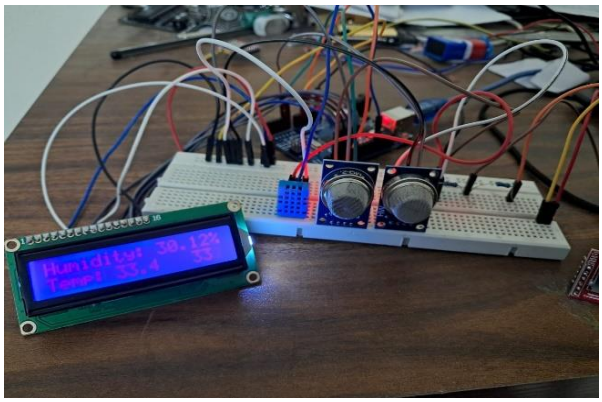

Fig 4.Output of Humidity

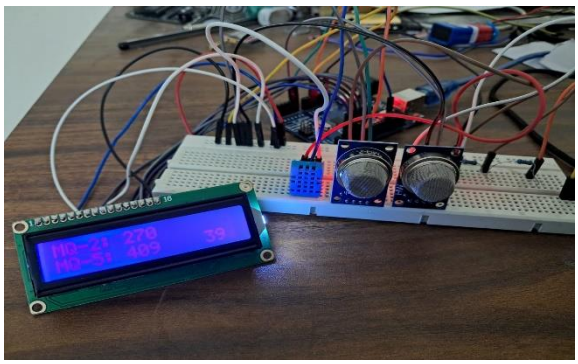

Fig 5.Output of Detection

When the gas sensor MQ5 detects the gas level of the surrounding environment in the transmitter section, if it is high level of hazardous or dangerous gases then the transmitter section sends “GAS DETECTED” alert signal to helmet, then the helmet shows status on the LCD, as well as buzzer is activated.

VIII CONCLUSION AND FUTURE SCOPE

The smart helmet for miners has been designed specifically for coal miners. The helmet is capable of detecting a range of events that occur inside the mines, the events that could be dangerous for the life of a miner. Some events and accidents go unrecognized by the workers outside the mines because of lack of information of what goes under the mine. The helmet will help the workers outside the mine to keep a close eye on what is the condition under the mine and if it is suitable for a miner

to work under or not. The helmet gives a live status of different parameters like temperature under the mine, presence of any poisonous gases. Along with this the helmet has a GPS module, so that one can easily locate the miner's location under the mine and can be rescued in time. The panic button attached to the helmet helps miners to ask for help in case of any accident, the miner can simply press the button once that would warn the workers outside the mines. The IR sensors enable us to know if the miner is wearing the helmet or not. The helmet is a low-cost, efficient and reliable prototype designed and tested properly.[7]

Thus, a sensible helmet for unsafe event detection, watching the encompassing environmental conditions and change data like GPS location and device information to the central console for simple pursuit and providing chemical element supplements to avoid the inhalation of toxic gases is intended. The system may also be more developed with the implementation of web of Things (IOT). The information is created that monitors the device modules unceasingly.

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