IOT BASED INTELLIGENT HELMET FOR MINERS

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ABSTRACT

Mining is One of the Most Dangerous Activities in the world. The Mining Industry has the Highest Incidence of Occupational deaths among all. The Safety of Miners paramount in the Mining Industry. Usually, The miners only wear a Helmet with Light for Visibility. In this paper, an Intelligent System has been developed to assist the Miners. It consists of Various Sensors to detect and Monitor any Hazardous Events and Transmit the data to the Control Station to Alert the Miners. The Transmission is done using the Zigbee Protocol and The Monitoring is done on a Control Station.

Keywords: Intelligent Helmet, Safety, Miners, Zigbee

1. INTRODUCTION

Mining is the extraction of minerals and other geological materials from the Earth Crust. Mining techniques can be divided into Two Surface Mining and Underground Mining. In Underground Mining there is a concern about the Safety of the Workers due to its Highly Changing Environment. Thousands of miners die from mining accidents each year. To Address this Problem, we have developed a prototype model - Intelligent Safety Helmet to assure extra safety among Mineworkers. This Will Help to Identify any Dangerous Changes in the Surroundings by Continuously Monitoring The Mining Environment through the Intelligent Helmet. The Sensor placed in the Helmet will help us to detect any Hazardous Changes and Alert the miners through Various Alerting Mechanism.

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2. LITERATURE REVIEW

Yongping Wu and Guo Feng proposed a Miners Safety System using the Bluetooth Wireless Transmission System. The Main Disadvantage of this System is that Bluetooth is a short Range and Unreliable Transmission. Due to this the Connection between the Control Room and Miners is not Stable and may cause loss of Connection and thus the Whole system may not work.

Hem Chandra Joshi and Satyajit Das Proposed a system That uses Zig-bee technology and Other Sensors But It Doesn't Implement a Heart Rate Sensor that will be used to monitor the Heart Rate in Realtime. Thus it is not a viable solution to the problem of the Miners.

3. PROPOSED METHOD

This Paper Focuses Mainly on the Safety of the Miners who work in Underground Mines. So This Paper Consist of an Intelligent Helmet with a Sensing Module containing Sensors Such as a Temperature Sensor, Methane Gas Sensor, Smoke Sensor, IR Sensor To Monitor the Surrounding Condition And Heart Rate Sensor to Monitor the Person Health Condition. To Transmit Data to the Monitoring Station Zigbee Wireless Protocol is used. These Collected Data is Transmitted and Monitored in Realtime to detect any Hazardous Condition in the Mining Environment. If any Hazardous Event is Detected The Ground Station and the Miners Will be Alerted by Using Buzzer and Other Emergency Protocols. This Zigbee Mesh Network Will Guarantee the Transmission of Data from Miners to the Control Station.
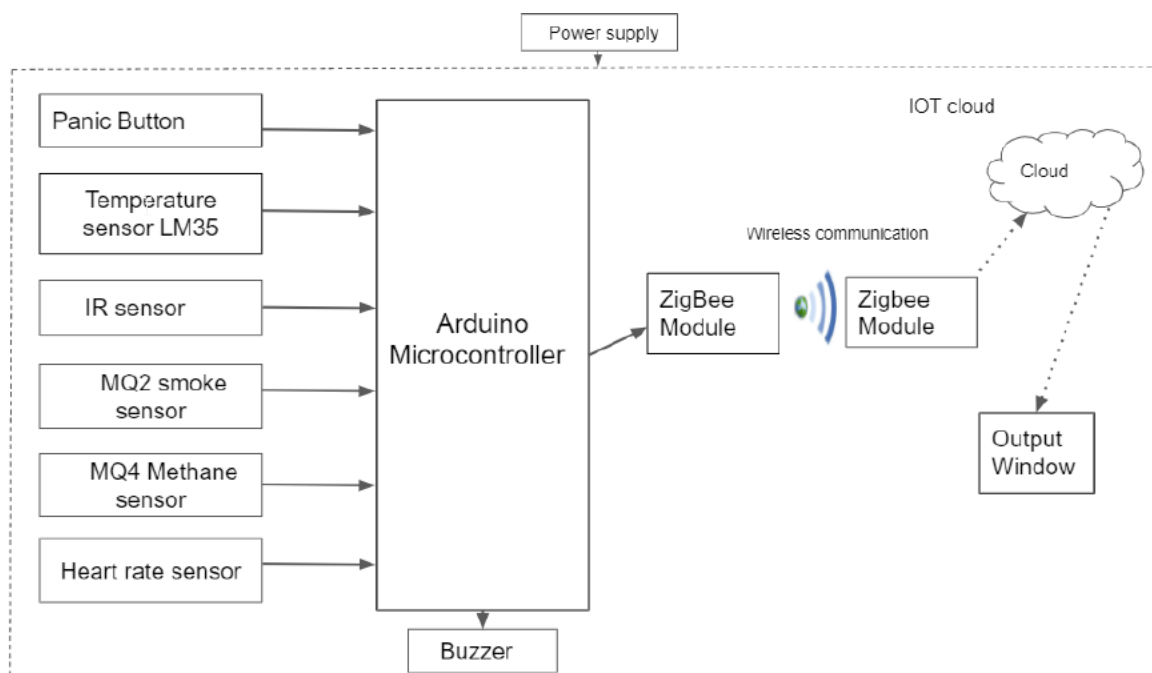
3.1. BLOCK DIAGRAM

Figure 1 Block Diagram of IoT Based Intelligent Helmet for Miners

3.2. Working

The Intelligent Helmet is integrated with a variety of Sensor including Temperature Sensor, IR Sensor, Smoke Sensor, Methane Gas Sensor and Heart Rate Sensor. The Oxygen Sensor measures the level of Oxygen in the Underground Mining Environment. The Temperature Sensor Measures the Real Time Temperature of the surroundings. The IR sensor used to detect whether the miner is wearing a helmet or not. MQ2 smoke sensor detects the concentration of gases such as H2, LPG, CH4, CO, Alcohol, Smoke or Propane. MQ4 Methane Gas Sensor

detects the Methane Concentration in the Underground Mines. A heart rate sensor is used to monitor the heart rate of miners and any drastic changes in the Heart Rate can be determined. A Panic button is placed in the helmet to trigger the Emergency Alert. whenever any hazardous events happen in the underground area buzzer will be activated. Zigbee protocol is used to transmit the data from the sensor to the Receiving Station and the transmitted data is sent to the cloud

3.3. Hardware Used

1. Arduino Uno
2. Heart Rate Sensor
3. IR Obstacle Sensor
4.MQ4 Methane Gas Sensor
5.MQ2 GasSensor
6. Buzzer
7.LM35 Temperature sensor
8. XBee

3.4. COMPONENTS

1**. Arduino UNO** is an open-source microcontroller board based on the Microchip ATmega328P microcontroller. The board has 14 digital I/O pins, 6 analogue I/O pins, and is programmable with the Arduino IDE. The Arduino can be powered by using an external 9v Battery.

In our system, it will act as a core module that is used to combine and collect all the data from the Sensors and Send it to the ZigbeeTransmitter.

2. **Heart Rate Sensor** is used to measure the Heart Pulse Rate. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast and easy to get reliable pulse readings. Here we can able to get the Real-Time Heart Rate of the Miners.

3. **Infrared obstacle Sensor** is used to detect whether the miner is wearing a helmet or not. The IR sensor consists of a transmitter infrared LED and an infrared receiver. An infrared Transmitter is a light-emitting diode that emits infrared radiations. IR Receiver will sense and detect whether the Miner is wearing a Helmet or not.

4. **MQ4 Methane Gas Sensor** detects the concentration of methane gas in the air and outputs its reading as an analogue voltage. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection.

This sensor can detect if the Methane is Leaked in the Underground Mines

5.**MQ2 Gas Sensor** is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke and carbon monoxide. MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas.

6. A **Buzzer** or beeper is an audio signalling device that is Activated when a Voltage is applied to it. The Buzzer will be Activated when the Emergency Protocol is Activated.

7. **LM 35 Temperature Sensor** is a precision integrated-circuit temperature device Whose output voltage linearly- proportional to the Centigrade temperature. Here it measures the Temperature of the Surrounding Environment.

8. **XBee** is a Wireless Radio Frequency Module based on Zigbee Protocol for data transmission. It has Mesh Network Functionality which can be utilized for long-distance communication with the help of Intermediate Nodes.

4. METHODOLOGY

The System Will Consist Of Three Main Modules
- Sensing Module
- Transmission Module
- Monitoring Module

4.1. Sensing Module

The Sensing Module will contain a variety of Sensors Including a Temperature Sensor, Smoke Sensor, Heart Rate Sensor and IR Obstacle Sensor. Also, there is a Panic Switch That will Alert the Monitoring Station in case of Any Emergency.

4.2 Transmission Module

The Collected data from the Sensing Module will be Transmitted Using an IEEE 802.15.4 based high-level communication protocols called Zigbee. To improve the Connectivity Zigbee uses multi-hop mesh networking to eliminate single points of failure and expand the reach of networks.

4.3 Monitoring Module

The Transmitted Data is received by a Zigbee Receiver in the Monitoring End of the System. The Received Data will be processed and in case of any Emergency, The System will follow an Emergency Rescue Protocol that will Alert the Miners. Thus this will Save the Lives of Miners who are Continuously working in a Dangerous Environment.
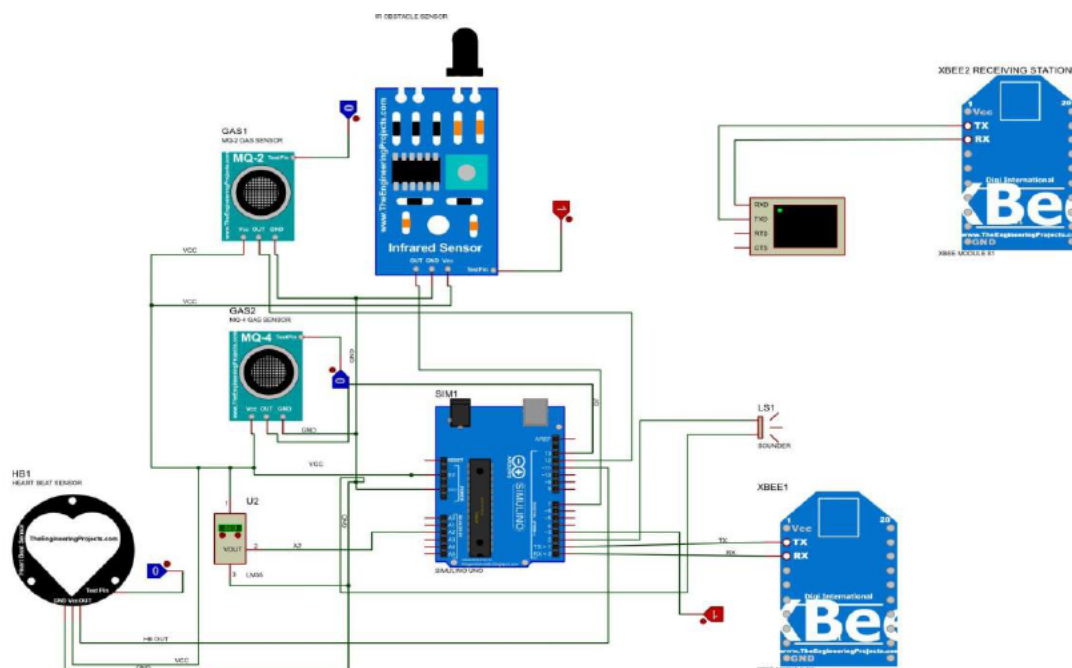
5. SIMULATION

Figure 2. Simulation diagram

5.1. Simulation Output

The Below Fig 3 Shows the Output of the Simulation Under Normal Condition. Here all the Sensors output are normal thus the Buzzer is in Off Condition.

Figure 3. Simulation Output Under Normal Condition

The Below Fig 4 Shows the Output of the Simulation Under Abnormal Condition. Here even if any one of the sensor's output crosses the Threshold Value or If Panic Button is pressed, the Buzzer is turned on and the Control Station is Alerted and Thus Emergency Rescue protocol can be followed to save the miner.

Figure 4. Simulation Output Under Abnormal Condition

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6. CONCLUSION

IoT Based Intelligent Helmet for Miner Project's Simulation is Done using Proteus Software. This paper Solves the Problem of Alerting the Miners in Case of Any Emergency Conditions. The Sensors in the Miners Helmet Monitors all the Information in Realtime and In case of any Value Crosses the Threshold Value the Buzzer is Activated and the Emergency Rescue Protocol is followed. We can see that the Alarm is triggered Instantly and thus miners' lives can be saved through this.

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