

# A Smart Helmet for Air Quality and Hazardous Event Detection for the Mining Industry

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**Abstract:** Smart helmet is developed to detect the hazardous event in mining industry. The main three hazardous event that considered while developing the smart helmet are Air quality, Temperature, Helmet removal. In this CO, SO<sub>2</sub>, NO<sub>2</sub>, are considered as dangerous gas and the concentration level and particulate matter this is considered as first hazardous event, the air quality is checked using air quality sensor. Then the miner removing the helmet from their head is considered as second hazardous event. IR sensor is developed to check whether the miner is wearing helmet or not. The miners cannot work at high temperature so this considered as third hazardous event and temperature is measured using temperature sensor.

**KEYWORDS:** Air quality; mining; safety; wireless sensor networks.

## I. INTRODUCTION

There are several big mining present in India. Nearly eighty eight minerals produced in India, in which four minerals related to fuel, out of which ten minerals are metals, fifty minerals which are non-metallic in nature and remaining twenty four are minor minerals. In the mining industry if any wounds that occurs supervisor of that mine should take responsibility. The main aim is to develop a smart helmet and create safe circumstances for the workers. The miners are not supposed to remove helmet during work as this helmet is developed for the safety of workers[8]. This

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helmet allows the workers to know that their subordinate is in danger. Thus the main motive of this proposal is to make a safe and harmless environment for the workers of mining industry.

## II. IMPLEMENTATION

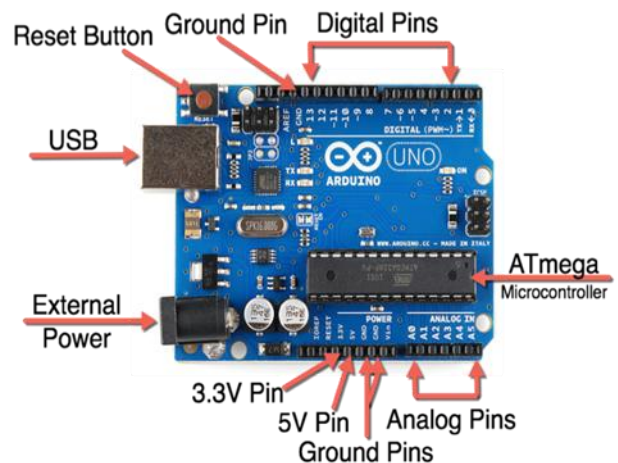
**COMPONENTS:**

1. Arduino UNO
2. GSM module
3. IR sensor
4. Air quality sensor

## III. HARDWARE DESCRIPTION

1. **ARDUINO UNO:**

The Arduino UNO comes under the type of microcontroller. The version of board used is ATmega328P. It is a 14 digital input microcontroller board with 6 pulse width modulation output pins [5].



Above Fig 1: Arduino UNO

It also has quartz crystal of 16MHz and 6 analog input pins and an In-Circuit Serial Programming header and a resetting button also placed in it. It also has USB port and one power jack [9]. The arduino is simply linked to computer using USB cable for power supply or power with DC adapter or battery for power supply. In any worst case scenario if the chip gets damaged the chip can be easily replaced for some rupees.

2. GSM Module:

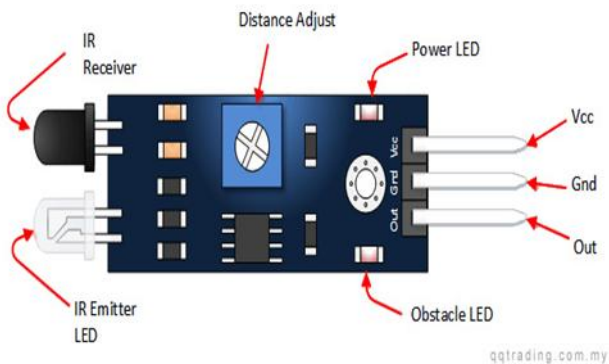
It is actually a Global System for Mobile (like SIM 900) connected to a printed circuit board. To interface the GSM Modem with a PC TTL output and RS232 output are taken from the board. The board has the pins to attach the microphone and the speaker and to take out +5V or other values of power and for ground connections. There different types of GSM modules available at the market, for our project we have chosen Arduino compatible GSM module which can be connected to Arduino and able send and receive messages, this GSM module requires TTL output [4].



Above Fig 2: GSM Module

3. IR Sensor :

For sensing the objects around a particular device INFRARED (IR) sensor is used which sends an IR signal to detect the obstacles / objects around it. It consists of an IR transmitter and IR receivers. IR transmitter sends the IR energy and detects the presence of any obstacles by their reflected energy transmitted by the receiver [6]. In our proposed system it is used for detecting the presence of the obstacles.



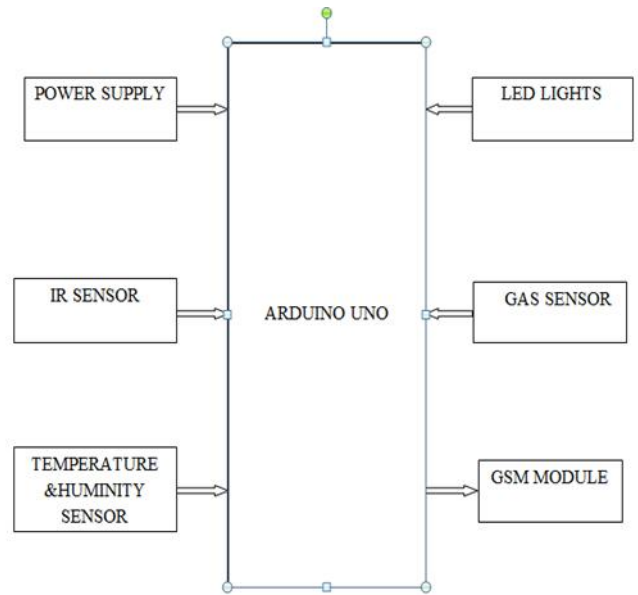
Above Fig 3: IR sensor

4. Air Quality Sensor:

In coal mines air pollution is caused due to discharges of gases contains methane (CH<sub>4</sub>), sulphur dioxide (SO<sub>2</sub>), and oxides of nitrogen (NO<sub>2</sub>) and carbon monoxide (CO). The human body will get affected when it comes in contact with these gases. These gases will cause respiration oriented diseases such as asthma, chronic bronchitis, and

cardiovascular problems. In this thing we have measured the CO, SO<sub>2</sub>, and NO<sub>2</sub>. Electrochemical gas sensor is used as air quality detectors. Regarding the concentration of Carbon Monoxide: healthy individuals may possibly able to with stand a CO level up to 6 ppm without severe health effects, but it should always be kept under 4 ppm.

IV. BLOCK DIAGRAM:



Above Fig 4: Block diagram

V. WORKING PROCEDURE:

1. Air Quality Test:

In the air quality testing process, we have used well-known gas concentration cylinder and trail the static chamber technique for the development of the Air Quality sensor. The Air Quality Test is to check the air quality of the mine industry, it detects or senses hazardous gas such as CO, NO<sub>2</sub>, SO<sub>2</sub>.

2. HR Test:

The main aim of Helmet removal (HR) test is to determine whether the worker has worn helmet or not.

If the worker removes the helmet then intimation is sent to the control room and to the co-worker with the help of IR sensor.

3. Wireless Transmission Test:

This Wireless Transmission Test is made to check whether the message is transmitted correctly or not. The wireless transmission test is carried out using the GSM module or GPRS [7]. By using these modules the message is transmitted and received by the workers. If the worker is in danger the message generated by the arduino is transmitted through GSM Module or GPRS to the control room and co-workers.

#### 4. Temperature Test:

The temperature of the mine is checked using temperature sensor. If temperature is so high then message is sent to the control room and to the co-workers.

### VI. RESULT

The serious levels of the harmful gases such as CO, SO<sub>2</sub>, and NO<sub>2</sub> in the mines industry has been specified through varying unit. The HR test was done successfully with an off the-shelf IR distance sensor. The Infrared sensor considered from first principle was a working device. It was exposed, after the system was incorporated, that the transmitted infrared signals reflects off the fake head and placed reflecting off the helmet's surface till it reached the receiver. The wireless transmission test has been done successfully if the worker is in any sort of danger the message is transmitted and received effectively using GSM module or GPRS..

signal.

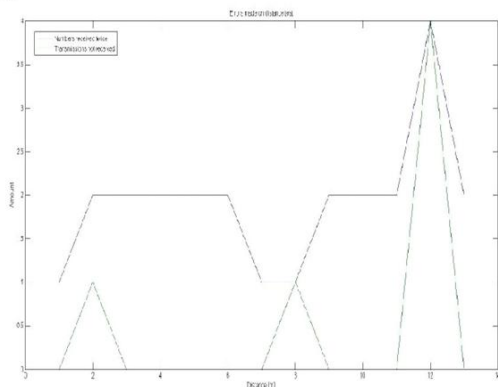


Fig. 7. Distance test error, showing a transmission that was not received and transmission received more than ones.

### VII. CONCLUSION

As the system requirement and the needed components can be simply made accessible this project can be employed easily. It will offer the safety to coal miners and transform the way of their working as well as system monitoring the several environmental changes in mines. It has been presented the original design of the minimal power GSM wireless sensor system with an extremely low cost. It is consistent system with quick and easy fitting. The system might be easily prolonged. With GSM wireless positioning devices, it will increase system scalability and prolong accurate position of underground miners in future.

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