

# IOT Based Smart Helmet for Air Quality Used for the Mining Industry

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## ABSTRACT

A brilliant helmet has been created that can distinguish of dangerous occasions in the mines. In the advancement of head protector, we have considered the primary danger that is air quality. The first is the fixation level of the risky gasses, for example, CO, SO<sub>2</sub>, NO<sub>2</sub>, and particulate issue. The wellbeing head protectors don't have any innovation added to it to tell excavators when a kindred digger has experienced an unsafe occasion. Lately, gathering innovation has assumed an essential part in the territory of mine applications. The writing on mines innovation is accessible yet exceptionally restricted. This project focuses on a mine supervising system monitor using IOT. Our project aims at developing a wireless sensor networks, realized real-time surveillance with early-warning intelligence on harmful gases in mining area and used GPRS to monitor potential safety problems in coal production using a IOT technology. In addition to that it gives alarm sound using buzzer when any harmful gas is detected and person not wear helmet. In the LCD the data is displayed.

**Keywords :** Arduino, Gas Sensors, GSM Module, Internet of Things, IR Sensor, Mining and Safety

## I. INTRODUCTION

Air pollution and gas explosion are increasing day by day and become foremost crisis in the coal mines and other industries. Safety of the human being is an essential aspect in any industry, especially in the field of mining and underground industry. Mining is the extraction of valuable minerals or other geological materials from the earth. Mining is required to obtain any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory. Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas or even water. India is a country, which is renowned for its extensive and distinct mineral reserves and big mining businesses. India produces about eighty eight minerals, out of which it has four minerals related to fuel, ten

minerals that is of kind metals, fifty minerals that is of non-metallic in nature and remaining twenty four includes minor minerals. According to current estimation 100 million landmines, mostly antipersonnel mines laid in over 60 countries, kill over 20,000 persons a year, India is the fourth largest producer of coal in the world, producing 536.5 million metric tons of coal per year. There are around 3,33,097 miners working in India. many organizations and universities in different countries have increasingly recognized the significant of low cost and sustainable technologies for mine detection and extraction. A mining helmet needs to be modified to improve miner safety by adding intelligence to the helmet. The problem addressed for the improvement of a mining helmet in order to ensure more safety awareness between miners. When working with noisy equipment, being aware of one's surroundings

can sometimes be challenging. In the mining industry miners tend to remove some of their safety gear because the gear is too heavy, warm or uncomfortable to work with. However, miners generally do not remove their helmets. The wired communication network technology system will be not so effective. Under the mines due to uncomfortable situation the installation cost as well as maintenance cost is high for wired communication networks. For the successfully wireless data transmission, in this work a low cost GPRS module with cloud IOT technology is used. A cost effective based wireless mine supervising system with early-warning security system on carbon monoxide, carbon dioxide in mining area is proposed and Helmet remove sensor, which is used to detect the miner, is wearing the safety helmet or not is achieved through the IR sensors.

## **II. LITERATURE REVIEW**

D Kock et al.[1] formulated automation for the coal mining industry in South Africa considering that of productivity, health and safety They conjointly investigated the coal interface detection (CID), to do this they used two well-known techniques such as vibration analysis and natural gamma radiation. Communication channels- they also considered infrared, power line carrier radio and optical fiber communication channels for transmission of data in the coal mines. Cheng Qiang et al. [2] have proposed an intelligent helmet for coal mines based on Zig bee wireless communication, their main idea is to detect the humidity level, methane concentration and the temperature of the mining area. These sensed data will be transmitted to the ground station wirelessly through Zigbee. The person who is monitoring in the ground station alerts the miner through voice communication about the event occurred. Shishir et al. [3] have proposed a safety helmet for miners based on ZigBee wireless technology; here they are monitoring gas concentration, humidity and temperature of the surrounding. The sensed data is

transmitted wirelessly through Zigbee to control centre. When the sensed data is out of normal values the alert is sent through Zigbee by lighting up different LED's and blowing up alarm. Pranjali Hazarika et al.[5] presents implementation of safety helmet for coal mine workers. This helmet is equipped with methane and carbon monoxide gas sensor. This sensor sense the gas and the data is transmitted to the control room wirelessly, through a wireless module called Zigbee connected with the helmet. Yongping Wu and Guo Feng et al.[4]implement coal mine monitoring using the Bluetooth wireless transmission system. As a standard of unified global short-range wireless communication, Bluetooth technology is to establish a common low-power, low-cost wireless air interface and controlling software opening system. This paper describes the development background, technical features and the structure of the protocol stack of Bluetooth technology, and proposed the solutions of the Bluetooth host controller interface (HCI) wireless communication for the complexity of its development. At the same time, the system uses CAN bus technology maturely, has realized the combination of wired and wireless data transmission system. The main difficulty of this system is that the Bluetooth is short distance wireless technology and use of cabling is difficult. When a natural calamity or a roof fall occurred, the cabling is damage. So the reliability and long life of conventional communication system is poor.

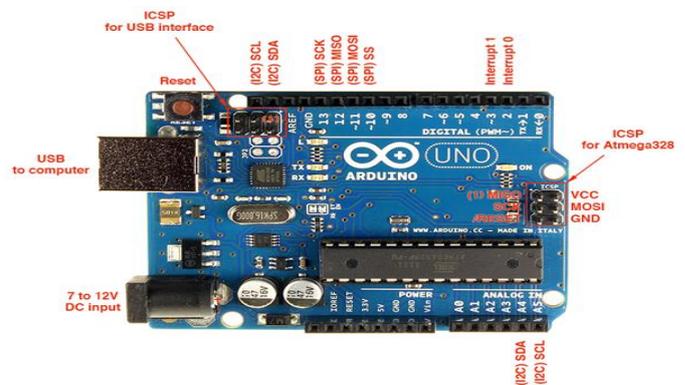
## **III. EXISTING SYSTEM**

Presently mining safety helmet only have the purpose of protecting the miner's head against potential hazardous bumps. The safety helmets do not have any technology added to it. In recent years, harvesting technology has played an important role in the area of mine applications. The literature on mines technology is available but very limited.

## **IV. ROPOSED WORK**

In order to explain the proposed system, there are six units. Helmet remove sensor, which is used to detect the miner, is wearing the safety helmet or not this is achieved through the IR sensors. Air quality sensor, which is used to detect air pollution from coal mines. It is mainly due to emissions of particulate matter and gases include carbon monoxide (CO), Carbon dioxide (CO<sub>2</sub>). Data processing unit is the Arduino Uno microcontroller, which is used to get all the data from the above all sensors and concludes whether need any intimation to wireless unit or the user wearing it. Wireless transmission and alerting unit is used to transfer the data obtained from the processing unit. Wireless transmission is achieved through GPRS module with cloud IOT technology through this the information regarding the gas levels are uploaded in to a server and the server store the data, the stored data is displayed in a server login channels through this we can see previous recorded gases level and can decide work place is safe or not and to take different protection methods will be made easy. Alerting unit is used to give the alarm sound to miner using buzzer when any harmful gas is detected and person not wear helmet. In the LCD the data is displayed.

connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the micro controller simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.6.5 The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform for an extensive list of current, past or outdated boards see the Arduino index of boards.



the sensor, heated by 5V it reaches at high temperature, it cleans the other gases not adsorbed under low temperature. The MQ-7 have 6 pins in which 4 of them are used to fetch signals and other 2 are used for providing heating current.



Figure 2. MQ7 gas sensor

Sensitive material of MQ-6 gas sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. When the target combustible gas exist, the sensor's conductivity is higher along with the gas concentration rising. Please use simple electro circuit, Convert change of conductivity to correspond output signal of gas concentration. MQ-6 gas sensor has high sensitivity to Propane, Butane and LPG, also response to Natural gas. The sensor could be used to detect different combustible gas, especially Methane; it is with low cost and suitable for different application. Used in gas leakage detecting equipment's for detecting of LPG, iso-butane, propane, LNG combustible gases. The sensor does not get trigger with the noise of alcohol, cooking fumes and cigarette smoke.



Figure 3. MQ6 gas sensor

### 3. HELMET REMOVAL SENSOR [IR SENSOR]

To recognize whether a mine worker has removed his protective helmet or not, a helmet removal technique based on infrared ray sensor is used. An Infrared sensor is laid out to transmit a continual signal from one end, if the signal is obstructed, then it means that the miner is wearing a helmet else he is not wearing it

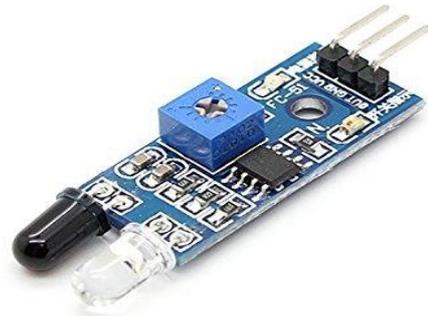


Figure 4. IR sensor

### 4. WIRELESS TRANSMISSION [GSM]

A GSM modem is a wireless modem that works with a GSM wireless network. It is a specialized type of modem which accepts a SIM card and operates over a subscription to a mobile operator Here we are using SIM800L GPRS chip works on frequencies 900/ 1800 MHZ. The baud rate is configurable from 9600-115200 through AT command. The GSM/GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet etc. through simple AT commands. it has 3G PCB antenna. To intimate to responsible authorities who are at long distance. Meanwhile GSM based wireless sensor network are investigated due to their remote environmental monitoring capabilities. By using GSM based technology we can make the system based on IOT

## **INTERNET OF THINGS**

The Internet of Things (IOT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. IOT has evolved from the convergence of wireless technologies, micro-electro mechanical systems (MEMS), micro services and the internet. The convergence has helped tear down the silo walls between operational technology (OT) and information technology (IT), allowing unstructured machine-generated data to be analyzed for insights that will drive improvements

### **5.ALERTING UNIT [ PIEZO BUZZER]**

Buzzer will be turned on when the sensor output crosses the threshold level detected by sensor. Here piezoelectric sensor is used. Piezo buzzer is the handy sound generator used in electronic circuits to give audio indication. It is widely used as alarm generator in electronic devices. A Piezo buzzer has a Piezo disc and an oscillator inside. When the buzzer is powered, the oscillator generates a frequency around 2-4 kHz and the Piezo element vibrates accordingly to produce the sound. An ordinary Piezo buzzer works between 3 – 12 volts DC

### **6.LIQUID CRYSTAL DISPLAY [LCD]**

A Liquid Crystal Display (LCD) is a flat panel display, electronic visual display or video display that uses the light modulating properties of liquid crystal. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in color or monochrome. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden such as preset words, digits and seven segment displays as in digital clock. They use the same basic technology except that arbitrary images are made up

of a large number of small pixels, while other displays have larger elements. Results are displayed on LCD.

### **7.POWER SUPPLY**

The ac voltage, typically 230V RMS, is connected to a transformer, which steps that ac voltage down to the level of the desired de output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

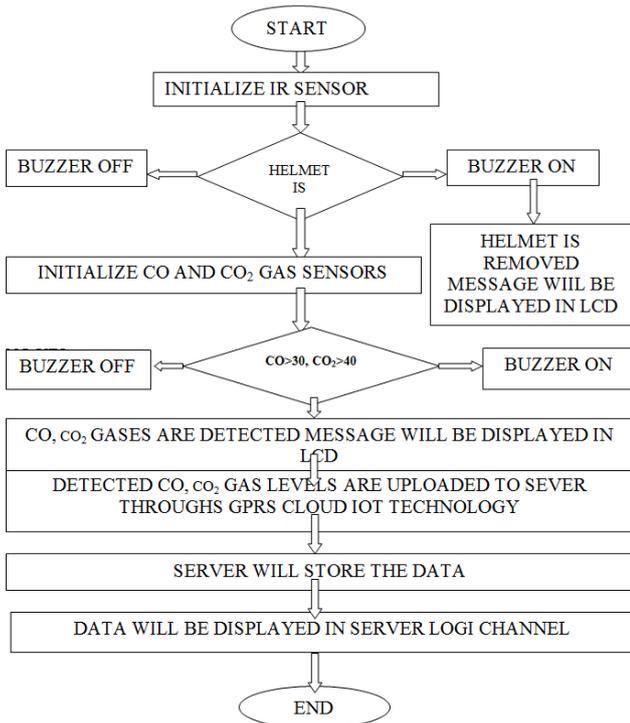
### **8.MONITORING SECTION**

The Monitoring section of the system comprises of:

#### **1] THINGSPEAK APPLICATION**

**THING SPEAK** is an open source Internet of Things (IOT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. Thing Speak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates Thing speak is a cross platform application written in Ruby language. Thing Speak has integrated support from the numerical computing software MATLAB from Math Works, allowing Thing Speak users to analyze and visualize uploaded data using Mat lab without requiring the purchase of a Mat lab license from Math works. Thing Speak has a close relationship with Math works, Inc. In fact, all of the Thing Speak documentation is incorporated into the Math works' Mat lab documentation site and even enabling registered Math works user accounts as valid login credentials on the Thing Speak website. The terms of service and privacy policy of Thing Speak com are between the agreeing user and Math works

## VI. FLOW CHART



## HARDWARE SNAP



## VII. RESULT AND DISCUSSION

Safety helmet removal test is done by using infrared sensor. When helmet is removing then helmet removal event is detected and displayed in LCD as “HELMET REMOVED” and it has been indicated through alerting unit [buzzer]. This test given satisfactory and 100% result is obtained as shown in the fig 4

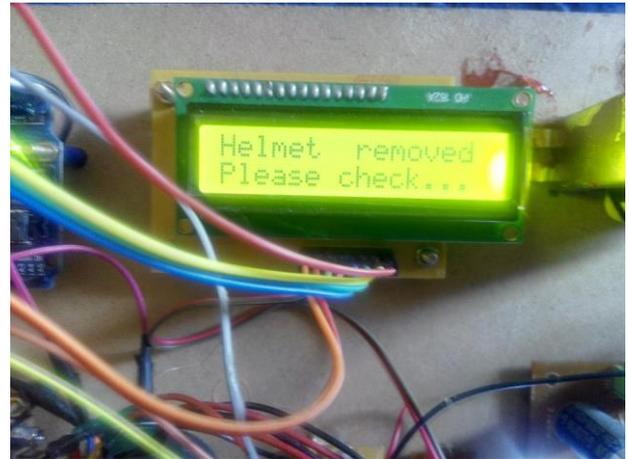


Fig 4 Helmet Removal Test Result

Air quality sensor test is done by using MQ6 and MQ7 measures a wide range of gases like LPG, CO and CO<sub>2</sub>. This sensors detect critical levels of dangerous poisonous gases which are hazardous for human health in the mining industry and it has been indicated through alerting unit and the data is displayed in LCD as shown in the fig.5 and fig 6 .The data is transmitted to monitoring section by using gprs with IOT technology fig 8

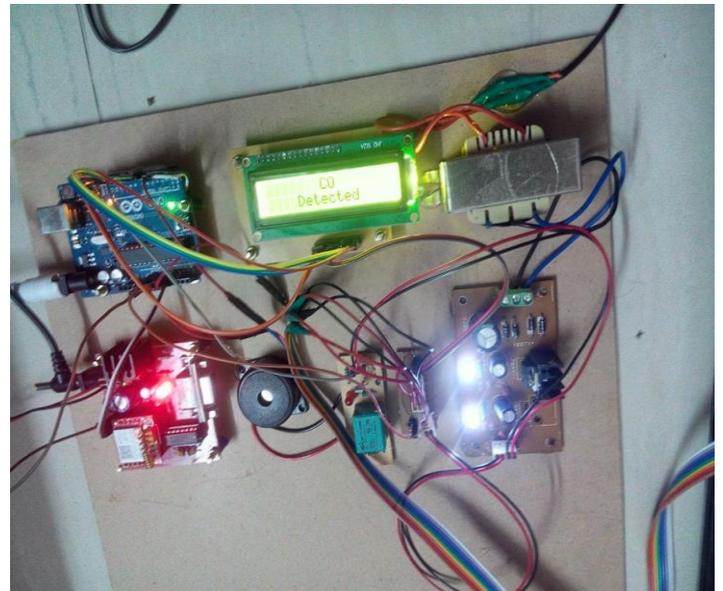


Fig 5 Detected CO Result

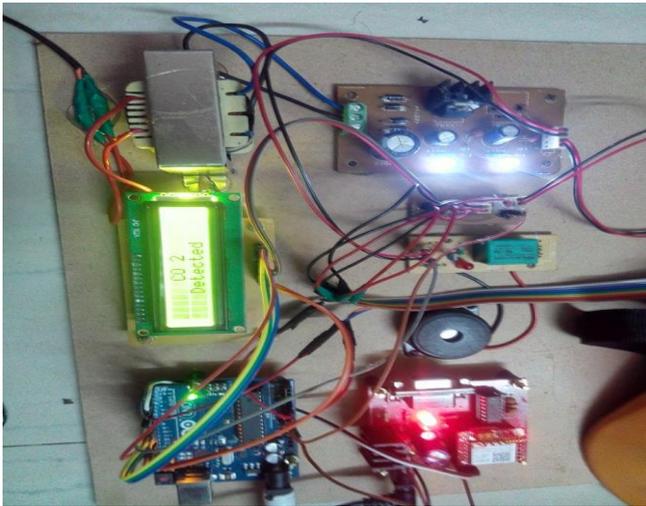


Fig 6 Detected CO<sub>2</sub> Result

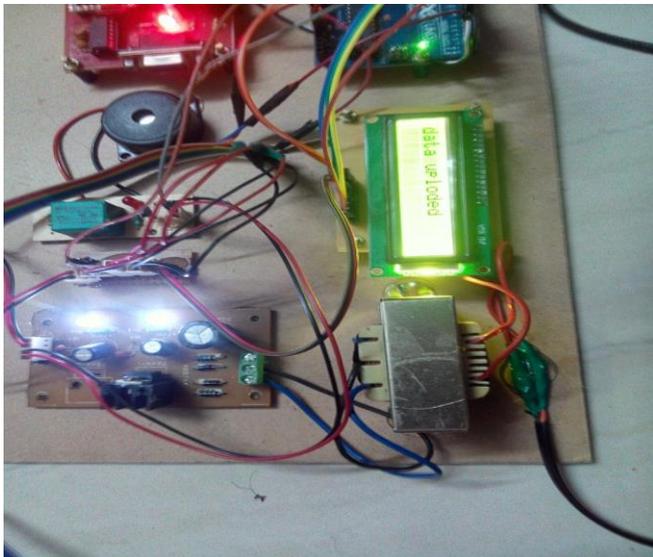


Fig 7 Air Quality Sensors Value Upload to Server

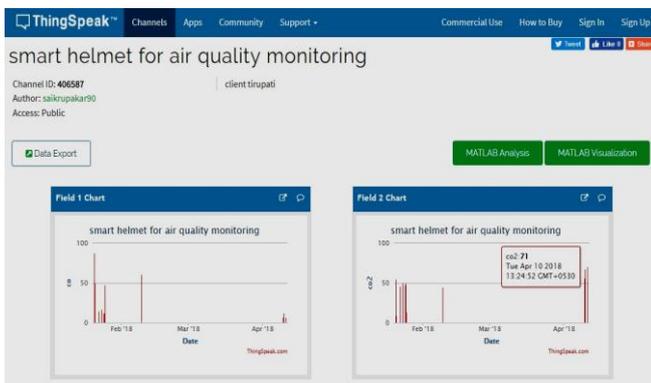


Fig 8 Monitoring Section

## VIII. CONCLUSION

An intelligent helmet is designed to detect the harmful CO and CO<sub>2</sub> gases that elaborate in the mines. By using this helmet the miner can easily get alert about the harmful gas. This system can also alert the miner when helmet is removed while mining in the mining industry. In this system we use GPRS to transmitting the data from the mining industry to server. The IOT technology is a widely used technology for transmitting the data.

## IX. FUTURE SCOPE

The framework can be enhanced by adding all the more estimating gadgets to check the excavator's circulatory strain and heart rate. In future, it could likewise be considered if such modules can likewise be utilized for auxiliary administrations, for example, restriction of specialists in respect to each other

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