

## Investigation and Design of Helmet for Coal Miners

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### ABSTRACT

The aim of the project is to design a wireless helmet for coal miners using ZigBee wireless mine supervising machines. Nowadays coal miners are facing various problems. Workers safety in underground coal mines has always remained a challenging task. Several fatal and non-fatal accidents take place worldwide resulting in casualties and injuries of coal miners. Study aims to develop a wearable safety device comprising of gas sensor, temperature sensor, oxygen sensor, opguard, ultrasonic sensor, ultraviolet sensor. The values of different sensors are continuously transmitted by wireless transmitter to the remote monitoring unit which is placed outside the mine and received by the receiver module (PC).

Keywords: Wireless Helmet, Zigbee Wireless Mine Supervising Machines and Remote Monitoring Unit.

### 1. INTRODUCTION

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. The aim of the mission layout a monitoring and protection device for tracking and protection machine for underground employees primarily based on ZigBee wireless network. The safe production level of coal mine is still low, especially in recent years, disasters of coal mine occur frequently, which lead to great loss of possession and life, the safety problems of coal mine has gradually become to the focus that the nation and society concern on. Mining accidents can have a variety of causes, including leakage of poisonous gas, increasing in atmospheric temperature, humidity level. So it is important to monitor the mine environment condition and miners health. The Smart Helmet is in use to detect the poisonous gases by using different gas sensors and detecting the temperature level by using temperature sensor. By integrating these features we design a smart helmet which continuously monitor the environmental parameters such as poisonous gas level and other external parameters of the miner. When the measured level is higher than the threshold level, the sensor senses the level and alerts the miner by buzzer.

### 2. WORKING

In this project, a continuous monitoring system, which monitors the environmental parameters such as the presence of poisonous gases, temperature, oxygen level, ultraviolet rays? The different sensors such as methane sensor, carbon monoxide sensor, carbon dioxide sensor, temperature sensor, ultraviolet sensor, ultrasonic sensor are placed in the helmet. The machine is a value powerful ZigBee-based wireless mine supervising machine. Software adopted ZigBee technology to build wireless sensor networks, determined out real-time surveillance with early-warning intelligence on temperature, leakage of gasoline in mining place, and alerting the manage station the use of wireless zigbee technology. The device is used to reduce capacity protection troubles in coal manufacturing. Zigbee is a WPAN era primarily based on the IEEE 802.15.4 popular. This technique allows the quick range of a person node to be accelerated and improved, covering a far larger region. This machine has transmitter phase

interfaced to microcontroller to the helmet. The gadget has fuel sensor temperature sensor and the usage of Zigbee generation. The machine also monitors the LPG gas leakages the usage of fuel detection sensor, fireplace the use of temperature sensor, in the mines and if it exceeds the threshold degree, it alerts via alarm the usage of buzzer and also displays on LCD to the person. This sensors output is given to the Microcontroller for similarly processing to ship the alerting message to the station the use of Zigbee module.

### 3. BLOCK DIAGRAM

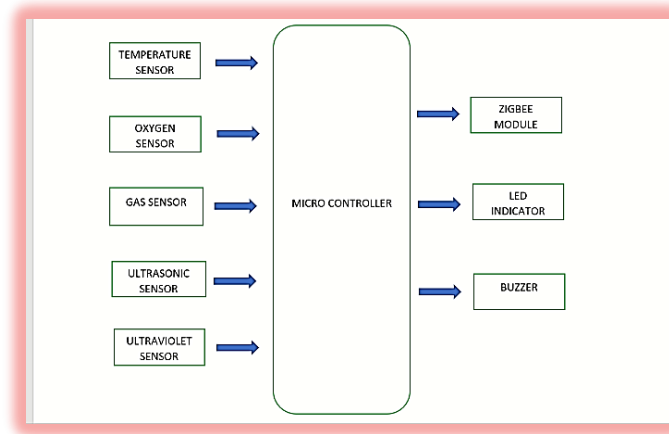


Figure: Schematic diagram

#### 3.1 Block Diagram Explanation

This block diagram consist of various sensors such as gas sensors, temperature sensor, oxygen sensor, ultraviolet sensor, ultrasonic sensor, OpGuard are given as the input to the microcontroller MSP-EXP430G2553.the output is connected to buzzer ,ZigBee module and LED indicator.

HARDWARE COMPONENTS:

#### 3.2 MSP430G2553 Microcontroller

The microcontroller used here is MSP430G2553. PIC16F877A have enough I/O (Input/output) lines for current need. It is capable of initiating all intersystem communications. The master controller controls each functions of the system with a supporting device. It is also responsible for reception of commands from the host and taking necessary actions. MSP430G2553 is Low-power 16-bit MSP430 microcontroller with an 8-channel 10-bit ADC, it has on-chip comparator, touch-sense enabled I/O's, universal serial communication interface, 16kB flash memory, and 512 bytes of RAM (preloaded with a sample program). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

#### 3.3 OPGUARD

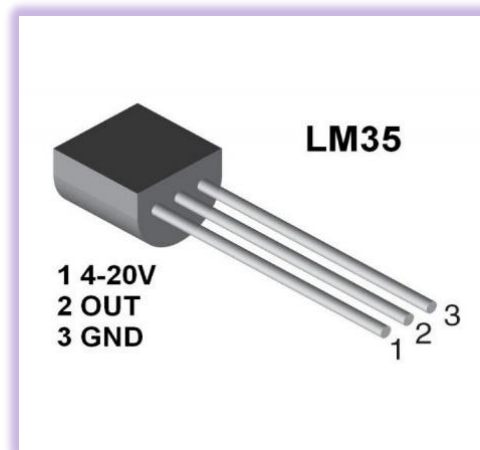
Operator condition detection utilizing in-cab sensors and detection equipment, Opguard is a non-intrusive fatigue and distraction solution that continuously monitors operators to pro-actively prevent mining accidents. Opguard's infrared camera continuously monitors the operator for eyelid closure, facial and head movements of the miner.

Miners are monitored in real time allowing them to receive immediate notification if a fatigue related events occur. Upon hearing the audible alarm the miner is able to take the appropriate action to regain control of their equipment.



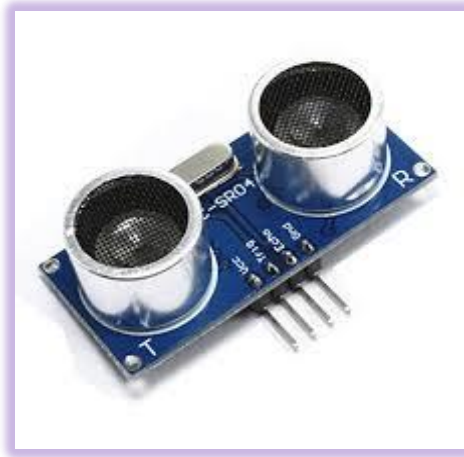
### 3.4 Temperature Sensor

Temperature sensors are used to measure temperature in underground mines. The LM35 series are precision blanketed-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (centigrade) temperature. The LM35 does not require any out of doors calibration or trimming to offer popular accuracies of  $\pm 1/4$  deg Celsius at room temperature and  $\pm 3/4$  deg Celsius temperature over a complete -55 to +150 deg Celsius temperature variety.



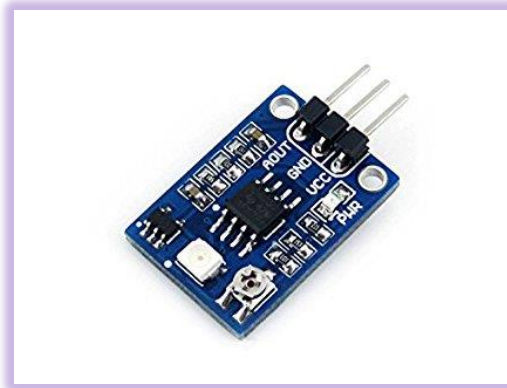
### 3.5 Ultrasonic Sensor (HC-SR04)

It is a low cost non-contact sensor which generates high frequency echo which is received back. It operates at 5v and it is used to avoid collision between the obstacle and the miner. HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.



### 3.6 Ultraviolet Sensor

Ultraviolet sensor is used to measure ultraviolet radiations. This module is based on the sensor GUVVA-S12SD opamp. Detect the entire visible light spectrum, accurately measuring photonic and scotopic energy. Such measurements enable lighting engineers to specify the optimum light level for human comfort, eliminate excess lighting, and ultimately save energy. It uses UV photodiode which can detect the intensity of incident UV radiation in the range of 240-370nm.



### 3.7 Gas Sensor

#### Carbon monoxide sensor (MQ-7)

MQ-7 semiconductor sensor is mainly used for detecting carbon monoxide (CO). MQ-7 gas sensor composed of micro Al<sub>2</sub>O<sub>3</sub> ceramic tube and Tin Dioxide (SnO<sub>2</sub>). Electrode and heater are fixed into a crust.



When the sensor, heated by 5V it reaches at high temperature, it cleans the other gases 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.

### **3.8 Methane gas sensor (MQ-4)**

MQ-4 gas sensor composed of ceramic tube and Tin Dioxide. Electrode and heater are fixed into a layer. The heater provides required work conditions for the work of sensitive components. SnO<sub>2</sub> is used as a sensing element. When the target combustible gas present, the conductivity of sensor is higher along with the gas concentration rising.



### **3.9 Carbon Dioxide Sensor (MG811)**

The MG-811 sensor is highly sensitive to CO<sub>2</sub> and less sensitive to alcohol and CO. The MG-811 sensor has low humidity and temperature dependency. Its structure same as MQ-7 but parts material are different. This sensor composed by solid electrolyte layer, Heater, Platinum Lead, Gold electrodes, Porcelain Tube, 100m double-layer steeliness net, Nickel and copper plated ring .



### **3.10 Oxygen Sensor**

Mining companies are constantly facing the challenge of protecting their workers in underground mines from oxygen depletion. Oxygen sensor used to measure oxygen level around mining environment. CM42951 module is used here. When the oxygen goes below threshold level, sensor alerts the miner by using led.

### 3.11 Zigbee Module

ZigBee is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee is a specification for a suite of high-level communication protocols used to create personal area networks built from small, low-power digital radios. ZigBee has a defined rate of 250kbit/s, best suited for intermittent data transmissions from a sensor or input device. ZigBee, a specification for communication in a wireless personal area network (WPAN), has been called the "Internet of thing". ZigBee is an open, global, packet-based protocol designed to provide an easy-to-use architecture for secure, reliable, low power wireless networks. ZigBee are low data rate wireless networking standards that can eliminate the costly and damage prone wiring in industrial control applications. Flow or process control equipment can be place anywhere and still communicate with the rest of the system. It can also be moved, since the network doesn't care about the physical location of a sensor, pump or valve. Though its low power consumption limits transmission distances to 10–100 meters line-of-sight, depending on power output and environmental characteristics, ZigBee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones.



## 4. CONCLUSION

Hence by using this zigbee technology and by using various sensors and opguard technology, we could design a safety helmet for coal miners. This project will help to alert the miners who are working in a hazardous area under coal mines from many external parameters such as temperature, poisonous gas, oxygen level, ultraviolet radiations, etc. Proper monitoring can help to take appropriate actions more rapidly and smartly if any abnormal situation occurs. The system also can be easily extended with ZigBee wireless image transmission facility in future.

## REFERENCES

- [1] Sumit Kumar & Srivastava “Real Time Monitoring System for Mine Safety using Wireless Sensor Network (Multi-Gas Detector)”, International Journal of Science, Engineering and Technology Research (IJSETR), January 2016 .
- [2] Shirish Gaidhane, Mahendra Dhame & Prof. Rizwana Qureshi “Smart Helmet for Coal Miners using Zigbee Technology” Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-6, 2016.

- [3] Binisha Balan and Neethu Varghese and Reshma Gangadharan “Intelligent safety system for coal miners” International Journal of Engineering and Innovative Technology (IJEIT) Volume 4, Issue 9, March 2015.
- [4] Pranoti Anandrao Salankar, Sheeja S. Suresh “Zigbee Based Underground Mines Parameter Monitoring System for Rescue and Protection” IEEE 2013.
- [5] Abhishek Pal, Sachin Kumar “Health Monitoring Device for Underground Coal Miners” International Journal of Technology Enhancements and Emerging Engineering Research, Vol 3, Issue 07.
- [6] Kiran Kishore V, E Narasimha and Y Shruthi “Smart Helmet for Coal Miners Using Zigbee Technology International Journal for Research in Science & Advanced Technologies, Issue-2, Volume-2