

IOT BASED SAFETY HELMET FOR MINING INDUSTRY

Ms.C.Ramya ASP, Department of EEE, SNS College of Technology, Coimbatore, India. faculty1@snsct.o rg	Arun.K ,UG Scholar, Final Year, Department of EEE, SNS College of Technology, Coimbatore, India. m.joshva21@gmail.co m	Gokul.M, UG Scholar, Final Year, Department of EEE, SNS College of Technology Coimbatore, India. gokulkris77@gmail.co m	ShriGunaRaj.S, UG Scholar, Final Year, Department of EEE, SNS College of Technology Coimbatore, India. shri2212.s.eee.2019@snsct. org	Gokul.G, UG Scholar, Final Year, Department of EEE, SNS College of Technology Coimbatore, India. gocool.382@gmail.co m
--	---	--	---	---

Abstract—A smart helmet is created to save the miners from the hazardous situation. The miner workers working in the mine are unaware of the temperature and level of dangerous gases present there which can lead to critical health conditions. The helmet being used does not provide any safety against such fatal circumstances. So some innovation has to be added to the helmet to further safeguard the mine workers. Our project's aim is to develop a smart helmet that could do the surveillance of the working environment of the miners using IOT. The helmet has wireless sensors network and GPS which will perform real time surveillance and early warnings on the detection of any potential threat. The sensed data will displayed on the LCD of the receiving end. Additionally, there is a RF transmitter and receiver affixed to alert at the receiver end.

Keywords: **Arduino, Gas sensor, Temperature sensor, Wireless transmission, GPS, NodeMCU.**

I. INTRODUCTION

Mining is an important industry for the any country for its infra structural development & for its Economic development, Mining is extraction of basic raw materials/minerals/Valuable materials from the deep below surface of the Earth. These materials/minerals are natural by origin and that they cannot be reproduced artificially in any lab or elsewhere, this includes extraction of very basic essential resources like Petrol, Coal, Water, Expensive materials like Gold, Diamond , Basic Materials like Mica, Silica, Felspar, Granites, Marbles and Very important Nuclear basic materials like Uranium, Titanium, Plutonium and so on. India's contribution in the Mineral Production in World is remarkable: 4. India Produces 86 Minerals inclusive of 4 Fuels, 10 Metallic, 46 Non – Metallic, 3 Atomic, & 23 Minerals. In mines, there is a health hazard & risk to the mine workers mainly due to un-safe and polluted working conditions at the work place resulting into health hazards and occupational diseases. b) The persons employed in the mines are exposed to a number of hazards at work, which adversely affect their health. Some of the important Hazards are: Dust, mine gases, noise, Heat and humidity, resulting into occupational diseases. The helmet is the only thing which the miners wears for their safety is helmet. So, the helmet wore has to be modified in a better way to

provide a better security by adding intelligence to it. When the miner is working the mine, the environment would be noise with equipment being used. The miner to be aware of his surrounding could be challenging. However, the miner workers won't remove their helmet. So, using IOT based helmet the with GPS and a wireless cost-effective technology as Lora can be used for supervising the mine's environmental conditions. The proposed system would provide warning inn detection of any threat in the mine as gas detection, temperature increase and so on. And also if the helmet is removed it will detected which is achieved using IR sensor affixed to the helmet.

II. LITERATURE REVIEW

Sara Abasi [1]. does address the hazards in the mining field and the hazards for the miner. And also states that the mining industry is the most dangerous place to work. There are many hazards due to dust, air, temperature which all will be discussed. Other safety precautions and ways to reduce the challenges.[2]The situation where a miner faces danger is when the miner is unaware of the environment, the miner is working in. Instead of just wearing a helmet to safeguard miners against the potential bump. The smart helmet must indicate the environment in the mine by adding sensors and other technologies which could have a long run life on battery.

The module is configured in a way where the conditions of environment and miner will be communicated to the control room. In case if the miner removes his helmet, the miner is more viable to physical injuries even, thus a helmet removal sensor must sense and warn the helmet is not worn. The vibrations and other gases as CO, methane etc. must be detected and the data must be transmitted.[3] In this paper proposed a wireless transmission technology Zigbee is used to transmit data serially. The helmet is equipped with the different sensor to sense various gases and will transmit the data of air composition continuously of the workplace which will be displayed on PC. If any of the gas exceeds the threshold limit and if could cause harm to the miner, the data will be sent wirelessly and makes buzzer alert for warning. It will also alert if the miner falls down or gets unconscious. [4] The Zigbee is used to transmit workplace environment data, using a Zigbee module will transmit data

up to a distance to further increase the distance of transmission. So Zigbee mesh has been implemented. In order to reduce the helmet which had several sensors. Each helmet will be affixed with one or two sensors along with Zigbee end device. Then the data from the Zigbee end device will be transmitted by Zigbee routers to Zigbee coordinators this paper the data will be plotted and will have a comparative view on the conditions of workplace.[5]The microprocessor has been used to collect the sensor data and transmit it to the base station using Zigbee technology. The paper uses things speak to view the data received. And the data will also be stored in the cloud. But the alert will be sent as mail to a person.[6] This paper implemented a helmet which could detect accident on road as well as in the underground mine. In case the person falls down a message will be sent to a related person's number which is done using the GPS technology. The alcohol detector sensor and helmet removal sensor will detect if the person has consumed alcohol or not after wearing the helmet. More and more advancement are being implemented for the miner's helmet.

III. EXISTING SYSTEM

In the existing system the helmet is equipped with methane, carbon monoxide gas and temperature sensor. Sensors are sensing the data and transmit to the control room in wireless communication using Zigbee technology. There is one main disadvantage of the existing system is scalability. ZigBee devices tends to transmit the small amount of data over the small distance while consuming very little power. When the gases or temperature increases beyond the critical level, the controller in a control room triggers an alarm thereby save the workers from upcoming accident. The data transmission range is small which is around 30 meters, it may leads to less distance coverage or sometimes to the loss of the data, and it may leads to the delay of data transmission.

IV. PROPOSED WORK

Our proposed work consists of two sections: the helmet section and the receiver section. The helmet section has six components. The helmet removal can be detected by the IR sensor present in the helmet. The MEMS sensor present in the helmet can recognize the moments of the person wearing it. So if the person collides against or bumps into something, the MEMS could sense it by the tilt of the helmet. There is a heartbeat sensor affixed to helmet will have a check over the heart beat rate of the miner and also to check if the miner is alive in case of any emergency situation.

The gas sensor detects the hazardous gases such as carbon monoxide, methane, carbon dioxide. Increase in the level of these gases will send an alert to receiver end. It also includes the decrease in the level of oxygen level which is the way in which the sensor would sense that other gases have increased. The processing unit in this helmet is arduino uno which is a microcontroller. The arduino has 20 digital I/O pins, ICSP, USB port and a reset button .The arduino will read the sensor data as its input which is analog data and the

Helmet Section:

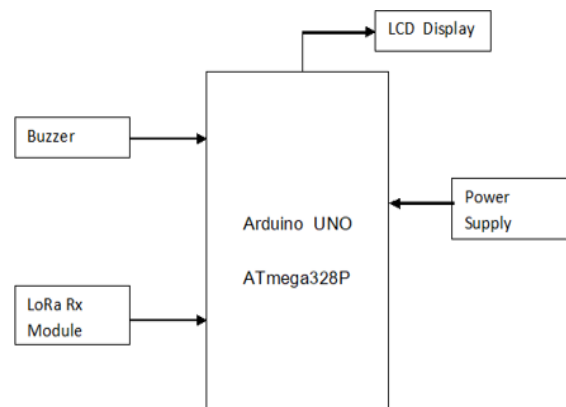
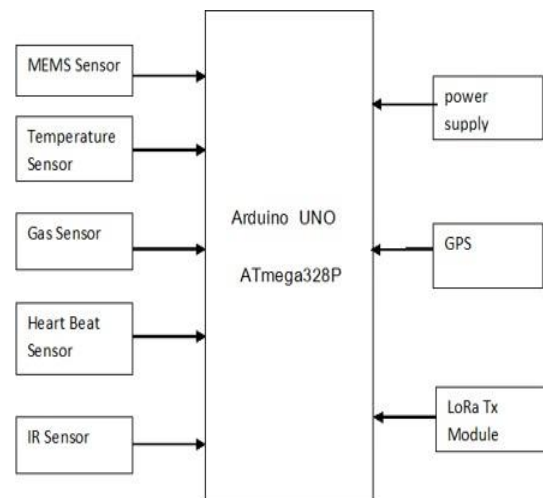
Arduino:

The Arduino Uno is a single microcontroller board based

LoRa is best suited for this transmission. LoRa transceiver thereby does the communication between the helmet and the receiver section which is in the base control station. The receiver end consists of arduino, LCD and buzzer. The 16*2 LCD will display the data about the environment as the helmet removal status, gas detection, temperature, heart rate, the GPS would locate the miner's position. The buzzer will alarm to alert if there are any abnormal changes in the environment of the miner so that immediate action could be taken to save the miner from the hazardous situation.

Block Diagram:

Sender:



on ATmega328p. Uno means one in Italian and is known as to mark the upcoming release of Arduino 1.0. It's 14 digital input/output pins, 6 analog input pins, USB connection,

power barrel jack, ICSP header and push button. Each pin operates at 5V and will provide or receive a maximum of 40mA current, and has an interior pull-up resistor of 20-50 K Ohms which are disconnected by default. Rx(0) and Tx(1) are serial pins wont to receive and transmit TTL serial data. Arduino Uno board is often powered via the USB connection or external source like batteries. This board can operate with an external supply of 7-12V by giving voltage reference through the GND pin or through the Vin pin. It consists of two

memories like to program memory and data memory. The code is stored within the flash program memory, and therefore, the data is stored in data memory. The Atmega328 microcontroller board has 32kb of non-volatile storage, 2kb of SRAM 1kb of EPROM and operates with a 16MHz clock speed.



Arduino Board

A. Heart Beat Sensor:

The Pulse Sensor SEN 11574 is a plug-and-play heart-rate sensor for Arduino. It is used by artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. It essentially combines a simple optical heart rate sensor with amplification and noise cancellation circuitry making it fast. Also, it sips power with just 4mA current draw at 5V so it's great for mobile applications as well, which is implemented to sense miners heart rate.



Heart Beat Sensor

NodeMCU:

The NodeMCU (Node *Micro*Controller *Unit*) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a

modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the -computerl on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.



NodeMCU

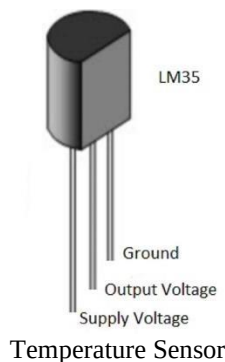
B. MEMS Sensor:

MEMS stands for micro-electro-mechanical systems, this sensor uses a chip-based technology. It's a package of micro-actuators, micro structure, micro electronic and micro sensors. The working principle is when a tilt is caused then a balanced mass makes a difference within the electric potential. When sensor starts to work in an electrical way, potential rises between them. So the changes appear in the mass of capacitor. The difference between the original position and the changed position is measured by these sensor to know its acceleration. MEMS are low-cost, and high accuracy inertial sensors. MEMS device size will determine 20 Micrometre to a millimetre range. Power consumption is extremely low. This is affixed to the helmet, which detects the person fall.



C. Temperature

LM35 is a precision IC temperature sensor, in which the output voltage varies, based on the temperature around it. It is a small and cheap IC which can be used to measure temperature anywhere between -55°C to 150°C. It can easily be interfaced with any microcontroller or development platform like Arduino. There will be an increase of 10mV for every degree temperature. The application of LM35 is to measure temperature of a particular environment, to provide thermal shut down for a circuit/component to monitor temperature of battery, to see temperature for HVAC applications. There are three pins in LM35 which are connected to Vcc, analog out and ground of the circuit. This is affixed to the helmet and senses the temperature. Once it exceeds the threshold level an alert is sent to the control room.



Gas Sensor:

MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the atmospheric air such as LPG, propane, methane, hydrogen, alcohol, and other gases. It is also known as chemi resistor and the resistance changes to the concentration of gas. MQ2 is a metal oxide semiconductor type gas sensor. Concentrations of gas in the gas is measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm. This sensor contains a sensing element, mainly aluminium-oxide based ceramic, coated with Tin dioxide, enclosed in a stainless-steel mesh. Sensing element has six connecting legs attached to it. The two leads which are responsible for heating of the sensing element, the other four are used for the output signals. The application of MQ 2 sensor is to detect propane, butane, methane etc. This can be used without interfacing to any microcontroller. The sensor is fixed with a helmet where it detects the harmful gases. It will give an alert message once harmful gases are detected.



D. GPS

Ublox NEO 6M is a GPS module used as a great launch pad to get navigation around anywhere in the world. This can track 22 satellites on 50 channels, this shows that it has the highest level of sensitivity i.e., 161 dB tracking while consuming only 45 mA supply current. This is inexpensive and low current consuming. At the centre of the module is a NEO-6M GPS chip from u-blox. The chip measures less than the size of a post stamp but has many special features in it. It can update 5 locations in a second with a 2.5 horizontal position accuracy. It has TIME TO FIRST FIX under 1 second it's 6 positioning Ublox engine. Its special feature is the power saving mode which selectively switches on and off of the receiver parts. It can reduce power consumption to 11mA making it suitable for power sensitive things like GPS wrist watch. The necessary data pins of NEO-6M GPS chips are broken out to 0.1 pitch headers. This includes pins required for communication with a microcontroller over UART. The module supports baud rate

from 4800bps to 230400bps with default baud of 9600. There are 4 pins which are Vcc, GND, Tx, Rx. Tx means transmitter, Rx means receiver and Vcc means power supply.



GPS

E. LoRa

Gas Sensor: LoRa is a spread spectrum modulation technique derived from chirp spread spectrum (CSS) technology. LoRa (Long Range) is a wireless technology or wireless modulation used for long range communication. It is used because of its long range. It consumes low power and also provides secure data transmission. It will cover distance up to 10 kms. The main disadvantage is it operates on low bandwidth. The maximum bandwidth is 5.5 Kbps. With this bandwidth only small amount of data can be sent. As there is a low bandwidth the audio and video cannot be sent through this technology. But can efficiently transmit the sensor data as electromagnetic waves. Its resistance to channel noise, Doppler effect and damping effect. The transmission is based on the spreading factor, it will increase as the distance increases. It will use the full bandwidth to transmit the data so that the data is received without any changes. For transmitting data the LoRa module is connected with Arduino UNO. It consists of 16 pins, 8 pins on each side, through which data is taken as input and transmitted wirelessly. Number equations consecutively.

V. RECIEVER END**A. LCD:**

An LCD is a basic module and is very commonly used in various devices and circuits. It can display 16×2 characters on 2 lines. Each LCD screen contains a matrix of pixels that display the data on the screen. This LCD consists of two pieces of glass plates each coated with a tiny oxide, inside with transparent electrodes separated by a liquid crystal layer of 5um. It consumes less power and less in price.

B. Buzzer:

Buzzer is an electronic device that can generate the sound like beeps and tones. A piezoelectric buzzer consists of an electric ceramic plate which has electrodes on the both sides and a metal plate. An electric ceramic plate is attached to a metal plate. Piezoelectric buzzers are very effective in creating good sound effects, and also able to work in low voltage. It can be used to alert a user of an event corresponding to a sensor input. It requires 5volts for its proper operation.

Result:

The template is designed for, but not limited to, six authors. A minimum of one author is required for all conference articles. Author names should be listed starting from left to right and then moving down to the next line. This is the author sequence that will be used in future citations and by indexing services. Names should not be listed in columns nor group by affiliation. Please keep your affiliations as succinct as possible (for example, do not differentiate among departments of the same organization).

Conclusion:

A smart helmet is designed to detect gases as Co and methane. It also detects temperature increase. It detects if the miner removes his helmet, thus provides the miner with utmost protection. In this wireless technology LoRa is used for data transmission along with IOT technology.

Further scope:

This framework can be enhanced by adding more estimating gadget as such as noise decibel checking, automatic flash light and so on. More enhanced gadgets can

be and the helmet can be modified in a better way to save the lives of mine workers.

REFERENCES

- [1] Sara Abbasi –Defining Safety Hazards & Risks in Mining Industry: A Case-Study in United States| June 2018
- [2] Sunil E. Waghmare, Prof. Ashish Manusmare –Microcontroller Based Smart Helmet for Coal Miners Safety| Volume 6 Issue IV, April 2018 ISSN: 2278 -7798
- [3] S. R. Deokar , V. M. Kulkarni, J. S. Wakode –Smart Helmet for Coal Mines Safety Monitoring and Alerting| Vol. 6, Issue 7, July 2017 ISSN: 2319 5940
- [4] K. Harshitha , K. Sreja , N. Manusa , –Zigbee Based Intelligent Helmet for Coal Miners Safety Purpose| January-June, 2018 Volume.06, Issue 01 ISSN 2321-8665
- [5] Jagadeesh R, Dr. R. Nagaraja –IoT based Smart Helmet for unsafe event detection for mining industry| Volume: 04 Issue: 01, Jan -2017, -ISSN: 2395 -0056
- [6] Swetha. B, Bhavya Shree. R, Disha. K. V –Smart Helmet for Accident Prevention and Coal Mines Safety Monitoring and Alerting System| Volume 9 Issue No. 5, 2019
- [7] Tanmoy Maity, Tanmoy Maity, –A Wireless Surveillance and Safety System for Mine Workers based on Zigbee, 1st Int'l Conf. on Recent Advances in Information Technology | RAIT-2012
- [8] C. Qiang, S. Ji-ping, Z. Zhe and Z. Fan, –ZigBee Based Intelligent Helmet for Coal Miners,| IEEE World Congress on Computer Science and Information 31 Mar. -2 April 2009, vol. 3, pp. 433–435, 2009.
- [9] W.R. Heinzalman, A. Chandrakasan, H. Balakrishnan, –An application specific protocol architecture for wireless microsensor networks|, IEEE Trans. on Wireless Com., 2001, vol. 1, pp. 660-70
- [10] R. Prudhvi Raj, Ch. Srikrishna Kanth, A. Bhargav, K. Bharath, –Smart-tec helmet|, Advance in Electronic and Electric engineering, Vol 4, Issue No 5, 2014.
- [11] C. j. Behr, A. Kumar and G. P. Hancke, „A Smart Helmet for Air Quality and Hazardous Event Detection for the Mining Industry“, IEEE, PP. 2028-2031, 2016.