

Smart Safety Helmet For Coal Mine Workers

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Abstract- *The most important part of any type of industry is safety. In the mining industry safety and security is a first aspect of all. To avoid any types of unwanted conditions, every mining industry follows some basic precaution. Communication is the most vital key factor today, to monitor different parameters such as temperature, increasing humidity level, and carbon monoxide gas continuously using sensors such as LM35, gas sensor MQ2 and humidity sensor to take necessary actions accordingly to avoid any types of hazardous conditions and gives an alert using buzzer. To achieve safety in underground mines, a suitable communication system must be created between workers, moving in the mine, and a fixed base station in this paper we are going to save the coal mine workers by implementing the smart safety helmet. The sensor information is collected by the node mcu and they are stored in cloud. And the alert message is passed to the Gmail and mobile phone using IOT.*

Keywords- Internet of Things (IOT), LM35, MQ2, Safety helmet, Communication system.

I. 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 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, Roof fall and insufficient oxygen level. Sometimes during mine disasters miners who are alive get trapped by roof fall occurrence lost their lives due to lack of or delay in rescuing operation. So it is important to monitor the mine environment condition and miners health. The environment under underground coal mine is bad and complex, so it is more prone to accidents and natural disasters. The Smart Helmet is in use to detect the poisonous gases by using different gas sensors and there is a prototype to get to know that how many miners alive under the mine during accidents by using heart beat sensor. By integrating these two features we design a smart helmet which continuously monitors the environmental parameters such as

poisonous gas level, surrounding oxygen level and pulse of the miner. It provides an early warning, which will be helpful to all miners present inside the mine to save their life before any casualty occurs. This system is highly beneficial for rescue and protection of miners.

1.1 ARDUINO UNO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicating with software running on your computer. The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free. The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

II. RELATED WORK

This is section we discuss about literature survey, existing system, proposed system and architecture framework. The most important part of any type of industry is safety. In the mining industry safety and security is a first aspect of all. To avoid any types of unwanted conditions, every mining industry follows some basic precaution. Communication is the most vital key factor today, to monitor different parameters such as temperature, increasing humidity level, and carbon monoxide gas continuously using sensors such as LM35, gas sensor MQ2 and humidity sensor to take necessary actions accordingly to avoid any types of hazardous conditions and gives an alert using buzzer. To achieve safety in underground mines, a suitable communication system must be created between workers, moving in the mine, and a fixed base station.

III. LITERATURE SURVEY

A. Hazards Detection Using Smart Helmet Sensing Technology In The Mining Industry

In recent days coal mining has become a very dangerous activity that can result in a number of dangerous effects on the environment such as leakage of dangerous gases like methane, a known greenhouse gas, may be released into the air. Mining is one of the most dangerous trades in the world. Every day miners has to work in dark environment where there is possibility of raise in temperature and leakage of dangerous gases. Underground mining dangers effect miners include gas poisoning, suffocation, gas explosions and roof collapse .The improved safety features in our system increased the safety of the coal miners by alerting them about the upcoming dangerous hazards. The smart helmet has been developed which is able to detect the dangerous gases and rise in temperature levels in the mining industry Various parameters like Methane gas, Carbon monoxide gas, Nitrogen Dioxide, Temperature and Humidity are monitored for the safety of coal miners. These sensors should be fitted in the helmet of the coal miners. With the help of Arduino microprocessor we designed and developed a Smart Working Helmet that can save their lives. The leakage is detected with the help of DHT11 sensor, MQ-135 and MQ-7 gas sensors. Sensor sends a signal to micro controller. Then micro controller sends an active signal to other externally connected devices. A quick response rate is provided by this system Arduino/Genuino Uno is a micro controller board based on the ATmega328P micro controller. This framework not exclusively can screen a wide range of parameters under the coal mine, yet additionally can alert consequently when condition parameters are strange to surpass the confinement, which help enhance the level of checking well being generation and decrease mischance in the coal mine.

B. Coal Mine Accidents Detection and Automation System

The accidents in coal mines are increased day by day. There are numerous life losses of many skilled workers and labourers. There is no advent precaution measure to detect the alarming cause of the coal mine accidents and provide an alert system. Occupational accidents and occupational diseases are common in the mining. The most common causes of accidents in coal mining are firedamp and dust explosions, landslips, mine fires, and technical failures related to transport and mechanization. An analysis of occupational accidents in the consideration of social and economic factors reports that the real causes behind these accidents, which are said to happen inevitably due to technical deficiencies or failures. Thus an

automated alarming coal mine accident detection system is employed to rescue and protect the workers from the hazards. This system incorporates the combined action of the temperature, pressure and gas sensor and IOT module to detect the temperature, pressure and atmosphere in the coal mine and log every data onto the cloud using data logging. Then these data are accepted by a admin controlled sever page through data acquisition. The data processing takes place at a server page and the alert is send to the device to glow the alarm and to to the concerned officials and rescue stations for taking the prevention measures. The major problem identified is that there are numerous accidents occurring in the coal mines due to improper maintenance and inadequate monitoring of the mining activities. These led to numerous life losses and immeasurable resource loss.

C. IoT based Smart Helmet for Ensuring Safety in Industries

Industrial safety is one of the main aspects of industry. Working environment hazards include suffocation, gas poisoning and gas explosion. Hence air quality and hazardous event detection is very important factor in industry. In order to achieve those safety measures, the proposed system provides a wireless sensor network for monitoring real time situation of working environment from monitoring station. It provides real time monitoring of harmful gases like CO, CH₄ and LPG and also temperature and humidity. To overcome those hazardous situation, this system provides emergency alert to the monitoring station . Some workers are not aware of safety and they did not wear helmet properly. For this purpose, a limit switch was used to successfully determine whether the workers had worn their helmet properly or not. The system uses Wi-Fi technology for transmission of data from working environment to the monitoring station. There is an alert switch at working environment for emergency purpose. The collected information is sent to long-distance monitoring centre by cable. So the reliability and long life of conventional communication system is poor.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. This system does not working conditions of the workers and whether the workers wear the helmet or main difficulty of the system is the usage of zigbee technology .Zigbee technology has small area coverage and hence transferring to the monitoring agent is difficult to transfer data from the working area long distance monitoring unit.

D. IoT in Mines for Safety and Efficient Monitoring

In this paper we are designing an IoT (Internet of Things) monitor, a safety measures for mine workers which

are most essential in underground mining areas. In this project, the system is build using different sensors network based on MEMS used to monitor the surroundings parameters of underground mine place and drives all sensed parameters/values to /values to ARM7 based Microcontroller Unit (MCU). The MCU unit is used to build a completely automated evaluating system with high accuracy, smooth control and reliability. When a critical condition is detected alert is given by the system and the same statistics is communicated to web server by initiating ESP8266 module based on Wi-Fi communication. The detected variations in the values are displayed on web server page that makes easier for the underground control centre to monitor and to take essential instantaneous action to prevent severe damage. We use an ARM7 based microcontroller which is important in processing instructions given as a firmware. The MCU sense the change in physical parameters and process them to convert into digital form. The conversion can also be from analogy data or an interrupt in data signal or a digital signal. If temperature exceeds a safety level pre-programmed at microcontroller, alert is sent to ground station controller make sense of, alarms the speaker interfaced with MCU. intensity.

IV. EXISTING SYSTEM

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 x-bee connected with the helmet when the methane or carbon-monoxide gas concentration is beyond the critical level, controller in the control room triggers an alarm and keeps the plant and the workers safe by preventing an upcoming accident.

V. PROPOSED SYSTEM

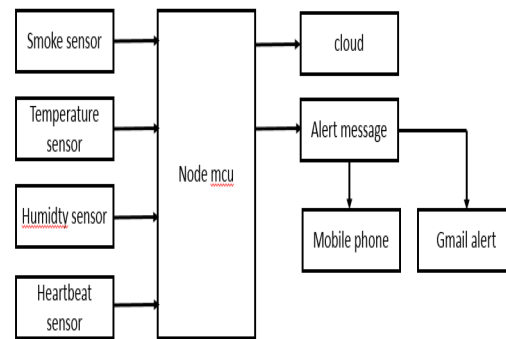
In the proposed project we are going to implement the temperature sensor to sense the temperature of the workers, humidity sensor to check the humidity. Gas sensor to check whether any poisonous gas came out during coal mining and heartbeat sensor to monitor the condition of the workers. When the information are gathered they are monitored by using node mcu, IOT etc. The message is also passed to the mail also.

Drawbacks:

- The proposed system is done by using internet of things
- It is automatically stored the values in cloud

VI. SYSTEM ARCHITECTURE

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to collect and exchange data.



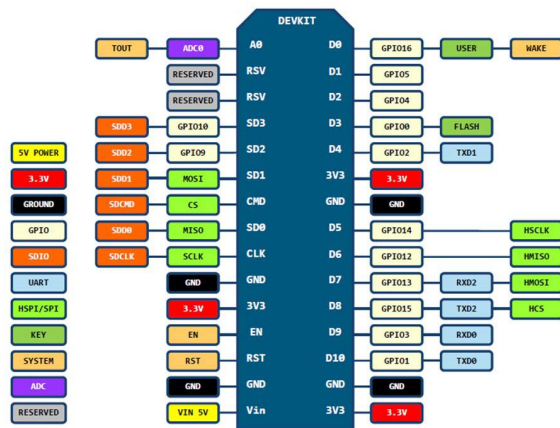
VII. HARDWARE REQUIREMENTS

a) Node MCU

ESP8266 NodemcuWi-Fi Devkit



The most basic way to use the ESP8266 module is to use serial commands, as the chip is basically a WiFi/Serial transceiver. However, this is not convenient. What we recommend is using the very cool Arduino ESP8266 project, which is a modified version of the Arduino IDE that you need install on your computer.



D0(GP1016) can only be used as gpio read/write, no interrupt supported, no pwm/i2c/ow supported.

b) Temperature Sensor(LM35)

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus the LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies of $\pm 1/4^\circ\text{C}$ at room temperature and $\pm 3/4^\circ\text{C}$ over a full -55°C to $+150^\circ\text{C}$ temperature range.

c) Heartbeat Sensor

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.

$$\text{BPM(Beats per minute)} = 60 * f \quad \text{Where } f \text{ is the pulse frequency.}$$

d) Pressure Sensor

A pressure Sensor measures pressure, typically of gases or liquids. Pressure is an expression of the force required to stop a fluid from expanding, and is usually stated in terms of force per unit area. A pressure sensor usually acts as a transducer; it generates a signal as a function of the pressure imposed. For the purposes of this article, such a signal is electrical.

e) Gas Sensor

Gas sensors are available in wide specifications depending on the sensitivity levels, type of gas to be sensed, physical dimensions and numerous other factors. This Insight covers a methane gas sensor that can sense gases such as ammonia which might get produced from methane. When a gas interacts with this sensor, it is first ionized into its constituents and is then adsorbed by the sensing element.

VIII. SOFTWARE REQUIREMENTS

ARDUINO

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicating with software running on your computer (e.g. Flash, Processing, MaxMSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free.

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