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Hazards Detection Using Smart Helmet Sensing Technology In The Mining Industry

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Abstract—***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 raise 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 .

Index Terms—DHT-11 sensor ,MQ-135 sensor ,MQ-7 sensor ,Arduino.

[1] INTRODUCTION

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[1] . As of 2014 Apr India has over three hundred Billion Tonnes coal holds. Generation of coal in the year 2012 and 2014 remained at five hundred and forty Million Tonnes and five hundred and fifty seven Million Tonnes respectively.

Coal mining is a relatively dangerous industry. Employees in coal mining are may be killed or may face major injuries and compared to the workers in private industry coal miner injuries will be severe. Supervisors will be held accountable for all the wounds that take place below their management, and thus they need to consider the probable unsafe circumstances. The issue that we are addressing in this work is to develop a prototype of a safety helmet so as to assure extra safety alertness among mine workers. At the point while they are on job with machinery which produces loud noise, being alert to ones surroundings will typically be difficult.

The present mining helmets are so simple that can protect miner only from physical damages to head it doesn't have special features to let workers know when he or his associate worker has experienced a dangerous event. In this way the motivation of the project is to specialize a current protective helmet for mine workers to make it still safer and technologically advanced by including a sensors, micro controllers and wireless communicating capabilities.

IoT technology is an environment that transfers data through Internet in real time to attach sensor to object. Until now, devices connected to Internet needs some adjustment by humans to exchange data, But IoT enables to exchange data between humans and objects and among objects connected with Cloud and big data technology without the adjustment. Low Power Wide Area Network (LPWAN) technology was suggested to transfer object's data efficiently. It is a mobile radio communication network and a low power broadband convergence network for devices of IoT.

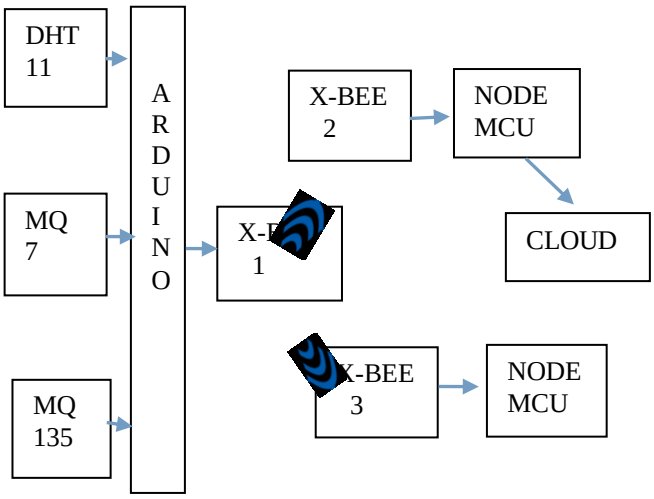
The Internet of Things (IoT) is a vital innovation in building and industry circles ,it has progressed toward becoming feature news in both the prevalent media and the strength press. This innovation is a wide range of arranged frameworks, items, and sensors which exploit head ways in processing power, gadgets scaling down to offer new capacities are unrealistic beforehand. A plenitude of meetings, reports and news articles examine and wrangle about the forthcoming effect of the "IoT upset"— from the new market openings and plans of action to worries about security, protection and specialized interoperability

The vast scale usage of IoT gadgets guarantees to change numerous parts of the way we live. For customers new IoT items like Internet-empowered machines, home mechanization parts and vitality administration gadgets are moving us towards a dream of the "keen home", which is putting forth greater security and vitality proficiency. Other individual IoT gadgets like wearable wellness and well being observing gadgets and system empowered medicinal gadgets are changing the way human services administrations are

conveyed. This innovation guarantees to be valuable for individuals with inabilities and the elderly empowering enhanced levels of freedom and personal satisfaction at a sensible cost. IoT frameworks like organized vehicles, keen activity frameworks, and sensors installed in streets and scaffolds draw us nearer to "savvy urban communities" which help limit clog and vitality utilization. IoT innovation offers the likelihood to change horticulture, industry and vitality creation and conveyance by expanding the accessibility of data along the esteem chain of generation utilizing organized sensors. Nonetheless, IoT raises many issues and difficulties that should be considered and tended to all together for potential advantages to be figured it out.

Various organizations and research associations have offered an extensive variety of projections about the potential effect of IoT on the Internet and the economy amid the following five to ten years. For instance, Cisco, extends more than 24 billion Internet– associated questions by 2019; Morgan Stanley, however extends 75 billion organized gadgets by 2020. Watching out further and upping the ante higher, Huawei figures 100 billion IoT associations by 2025.

II .SYSTEM OVERVIEW



The system consists of the mainly sensors ,Arduino board, X-Bee and Node MCU.

The three types of sensors are DHT-11,MQ-7 and MQ-135.

1.DHT-11 Sensor

The DHT11 is a Temperature and Humidity Sensor which senses the temperature & humidity levels with a digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it assures high reliability and excellent long-life stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness.

Each DHT11 element is strictly verified in the laboratory that is extremely accurate on humidity and temperature detection. The calibration values are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The component is a single-wire serial interface which makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The structure of the component is a single row pin package with 4-pins. It is easy to connect and based to user's requests special packages can be provided.

2. MQ-7 Sensor

MQ-7 is a semiconductor gas sensor which is used to detect the presence of Carbon Monoxide at concentrations from 10 to 10,000 ppm. The sensor requires only one analog input pin from micro controller as it has a simple analog voltage interface.This Carbon Monoxide (CO) gas sensor detects the concentrations of CO in the air and output is a reading as an analog voltage. The sensor has a capacity to measure concentrations of 10 to 10,000 ppm. The sensor is not temperature sensitive and can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

Connecting five volts across the heating (H) pins keeps the sensor hot enough to function correctly. Connecting five volts at either of A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. The resistive load used should be calculated for particular application based on the application requirements using the equations in the data sheet, but a referred value for the resistor is 10 kΩ.

3. MQ-135 Sensor

MQ135 is an alcohol sensor. An alcohol sensor detects the attentiveness of alcohol gas in the air and the output reading is an analog voltage. The sensor is not a temperature sensitive can work at temperatures ranging from -10 to 50° C with a power supply less than 150 MA to 5V. The sensing range of MQ135 sensor varies from 0.04mg/L to 4mg/L, which is suitable for breathalyzers. The MQ135 gas sensor has high sensitivity in ammonia, sulfide, benzine steam, smoke and in other harm full gases. It is low cost and suitable for different applications. Ideal for use in office or factory with simple drive and monitoring circuit.

4.Arduino

Figure.2. Arduino board

Arduino/Genuino Uno is a micro controller board based on the ATmega328P micro controller. Arduino has 14 digital input/output pins, 6 can be used as PWM outputs, 6 analog inputs, a 16 MHz quartz crystal, a USB 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.

5.X-Bee

X-Bee is a remote correspondence attempted to the ZigBee standard. X-Bee is a microcontroller made by Digi which uses the ZigBee tradition. Digi X-Bee is the brand name of a gathering of shape factor culminate radio modules from Digi International. The primary X-Bee radios were displayed under the Stream stamp in 2005 and relied upon the IEEE 802.15.4-2003 standard planned for point-to-point and star trades at over-the-air baud rates of 250 K bit/s.

X-Bee interfacing module is used to interface X-Bee remote module to any change board easily because of clear dispatch affiliation. It has locally accessible 3.3V low drop voltage controller and LED markers for RSSI, Associate and Power. Relationship with RX, TX, VIN and GND of the X-bumble bee Adaptor module are available particularly on the relimate. It can be particularly connected with headway sheets by methods for relimate connector.

6.Node MCU

Node MCU is an open source IoT stage. It incorporates firmware which keeps running on the ESP8266 Wi-Fi SoC from Espressif Systems, and equipment which depends on the ESP-12 module. The expression "Node MCU" as a matter of course alludes to the firmware as opposed to the dev units. The firmware utilizes the Lua scripting dialect. It depends on the eLua venture, and based on the Espressif Non-OS SDK for ESP8266. It utilizes many open source ventures, for example, lua-cjson, and spiffs. Node MCU was made not long after the ESP8266 turned out. On December 30, 2013, Espressif Systems started generation of the ESP8266. The ESP8266 is a Wi-Fi SoC incorporated with a Tensilica Xtensa LX106 center, broadly utilized as a part of IoT applications.

Node MCU began on 13 Oct 2014, when Hong conferred the primary document of node MCU-firmware to GitHub. After two months, the task extended to incorporate an open-equipment stage when engineer Huang R submitted the Gerber document of an ESP8266 board, named devkit v0.9. Soon thereafter, Tuan PM ported MQTT customer library from Contiki to the ESP8266 SoC stage, and focused on Node MCU venture, at that point Node MCU could bolster the MQTT IoT convention, utilizing Lua to get to the MQTT dealer. Another vital refresh was made on 30 Jan 2015, when Devsaurus ported the u8glib to Node MCU venture, empowering Node MCU to effectively drive LCD, Screen, OLED.

III. RESULT

The Temperature and Humidity levels are found through the sensor. The critical levels of the hazardous gases such as CO, SO2, and NO2 in the mines industry has been indicated through alerting unit.The Temperature and Humidity levels are found through the sensor.

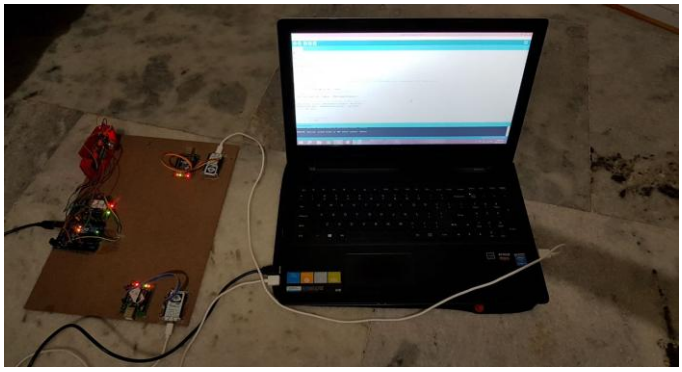


Figure 3 Module Device using Smart Helmet

```
temp :0
humidity :0
mq135  :82
mq7  :330
&field1=0&field2=0&field3=82&field4=330
temp :29
humidity :63
mq135  :447
mq7  :367
&field1=29&field2=63&field3=447&field4=367
temp :29
humidity :63
mq135  :324
mq7  :577
&field1=29&field2=63&field3=324&field4=577
temp :29
humidity :63
mq135  :219
mq7  :676
&field1=29&field2=63&field3=219&field4=676
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Figure 4.Displaying values of temperature and gases

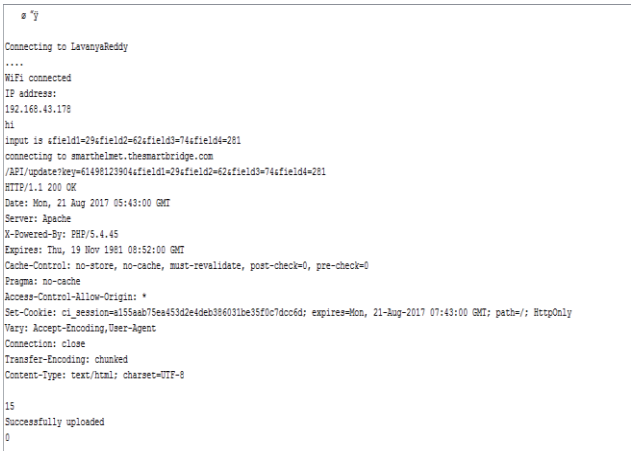

Figure 5.connecting WiFi

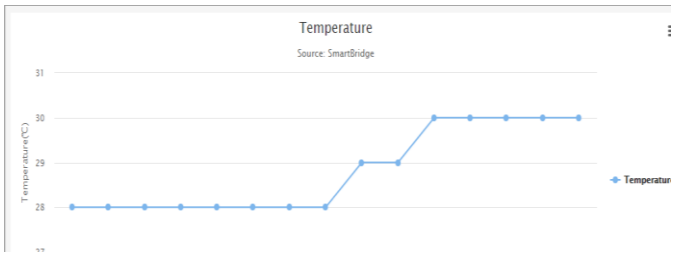

Figure 6 Temperature values for the different timings

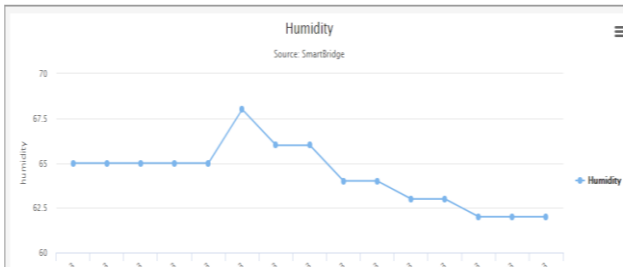

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Figure 7 Humidity values for the different timings

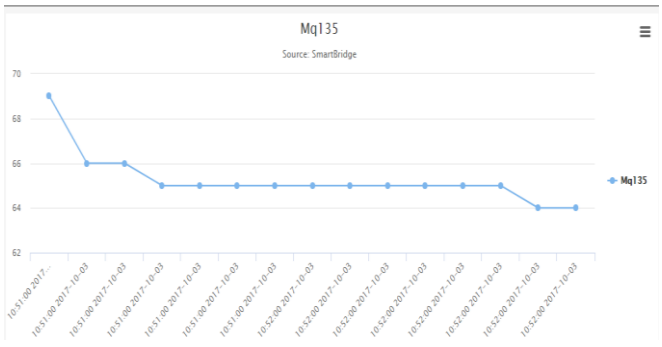

Figure 8 MQ-135 values for the different timings

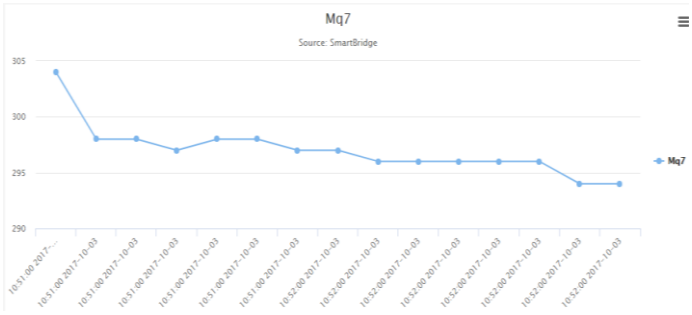

Figure 9 .MQ-7 values for the different timings

IV.CONCLUSION AND FUTURE SCOPE

The Present work, coal mine security observing brilliant head protector framework in light of remote sensor systems. Equipment and programming outline of remote sensor organize are depicted in detail, this framework can identify centralization of the gas,temperature,humidity and follow the area of mine workers in underground mine passages. Remote sensor systems connected in observing coal mine security gets through the customary strategies and thoughts, which enhances the pragmatic capacity and adaptability of checking framework. 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.Therefore, the coal mine Safety Monitoring framework set forward in this article very addresses the issue of coal mine security monitoring.Traditional mine security framework can be adequately supplanted by the observation and security framework proposed in the paper. Alongside Temperature and Humidity utilized get the cautions with respect to dampness and risky gasses if identified at the Site of the Sensor hub. This System can reached out for various passages by utilizing sensor systems.

The system can be easily extended with X-Bee wireless image transmission facility in future. It will improve scalability of underground environment and extend accurate position of miners. In future, with the help of X-Bee module and GUI (software part), we can avoid railway accidents, road accidents, submarine accidents etc.

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