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INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY
DESIGN OF IOT BASED COAL MINE MONITORING SYSTEM

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ABSTRACT
Safety of miners is a major challenge nowadays. So we are using IOT based wireless system for monitoring the coal mines and health of the workers. We use two modules which are directly connected to the CLOUD SERVER. In first module we use several SENSORS to monitor and control the various parameters in the coal mines such as temperature and humidity conditions, light detection, leakage of toxic gases and flame detection. Likewise, in next module we use heartbeat sensor and temperature sensor for monitoring the health of the miners. The data which are collected from these modules are stored in the cloud. The alarm warns during unfavorable condition in the coal mine.

KEYWORDS: IOT, Cloud Server, Sensors.

1. INTRODUCTION
Many hazards will occur during mining operations in underground coal mines, which is very risky to the safety and health of the workers. These problems happen due to extraction of coal from the mines. Coal which is very indispensable mineral plays major role in power production. In India we have 430 coal mines at present. There may be mischances occur in mines and it leads the workers to put their lives into critical situation. We are using Node MCU controller for monitoring the mine areas and workers safety. It's a low-cost open source IOT platform and has inbuilt Wi-Fi connection. Sensors which are used here are temperature and humidity sensor, heartbeat rate sensor, flame sensor, LDR sensor, gas sensor. For measuring temperature and humidity in the coal mine we are using DHT11 sensor. During mining leakage of toxic gases such as carbon monoxide and methane are detected by the gas sensors and also it warns in dangerous situations. Light is very essential for deeper mining operations so we are using LDR sensors for measuring light intensity. Alarm is used in emergency situations, likewise heartbeat sensors are used to monitor the workers heartbeat. The data's collected from the sensors are stored in the cloud server directly.

2. EXISTING METHODOLOGY
Due to some unfavorable atmosphere in the underground coal mines, it's necessary to prohibit the entry of workers in to the coal mines**.** At present wired systems are used for monitoring the coal mines which is very expensive. It's used only for primary safety purposes. Wired system cannot be used to transmit for long distances. In wired systems they use various sensors for monitoring purposes. The controller used in the existing methodologies are Arduino Uno, MSP430 embedded processor. GSM technology is used to transmit the data to the end user.

3. PROPOSED METHODOLOGY
In this proposed system the coal mine safety systems are fixed with gas sensor modules, the light dependent resistor (LDR sensor), temperature/humidity sensor, fire sensor, heart beat sensor, buzzer and LED. We connect all the sensors to the Node MCU.

The Node MCU which has inbuilt Wi-Fi module is used to send the sensed data to cloud for storage and analysis. It is suitable for various IOT based applications and   plug and play mode and it has Arduino like software and hardware tools. Gas sensor detects the gas in the coal mine environment, if the gas level exceeds the normal level then the buzzer gets high so that the mine workers gets notified. The temperature and humidity values are also be monitored inside the coal mine. LDR sensor is used to measure the intensity of the light by varying its resistance

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value. If there is an obstacle to the LDR sensor then led gets ON automatically. This ESP8266 Node MCU also uses Lua programming language. The account which is created in the dashboard will able to connect different sensors and actuators .The data's are finally stored in the data buckets which could also able to communicate with many devices and sends HTTP request and also for e mails.
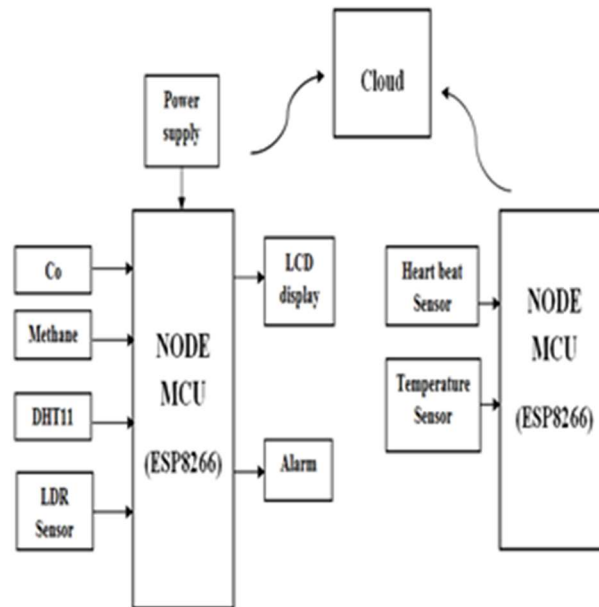
Fig.1 Block diagram for design of Iot based coal mine monitoring system

4. NODE MCU

Node MCU is a low cost open source IOT platform. It runs on ESP266 WI-FI SoC, and hardware is also based on ESP12 module. It also uses Lua programming language. It has 4MB of flash memory and 50 k of useable RAM. Node MCU is a software that gets installed in ES88266 and it uses the Lua programming language. Also, ESP8266 that comes with Node MCU can be reprogrammed through the Arduino IDE. This module is one among the most cost effective available WIFI-modules within the market. V3 or Version3 is that the latest version of this module. This tutorial, however, will facilitate you to attach all the versions of ESP8266 Node MCU, i.e. V1, V2 or V3.

Fig.2 Node MCU

- Arduino-like hardware IO Advanced API for hardware IO, which may dramatically reduce the redundant work for configuring and manipulating hardware. Code like Arduino, but interactively in Lua script.
- Nodejs style network API Event-driven API for network applications, which facilitates developers writing code running on a 5mm5mm sized MCU in Nodejs style. Greatly speed up your IOT application process.

- Development Kit the event Kit supported ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all on one board. Power your development within the fastest way combination with Node Mcu Firmware.
- The Node Mcu is an open-source firmware and development kit that helps you to prototype your IoT product with few Lua script lines. the event Kit supported ESP8266, integrated GPIO, PWM, IIC, 1-Wire and ADC.

Fig.3 Node MCU pin diagram

5. SENSORS

Temperature and humidity sensor (DHT11)
DHT11 Sensor is used to check the temperature and humidity values inside the coalmines. DHT11 is a moisture holding substrate with the electrode applied to the surface. It calculates relative humidity by measuring the electrical resistance between two electrodes.
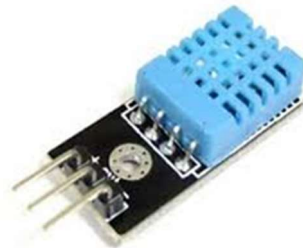

Fig.4 Temperature and Humidity Sensor

Methane sensor (mq-4)
MQ-4 gas sensor has high sensitivity to Natural gas, Methane sensor could be used to detect both Methane and Propane. The sensor could be used to detect different combustible gas especially Methane, it's low cost and suitable for different applications.

Fig.6 Methane gas Sensor

Carbon Monoxide Sensor
The carbon monoxide detector is a semiconductor gas sensor tuned to detect carbon monoxide. It is in the same family of devices as the smoke detector sensor, measuring the change in surface conductivity of tin dioxide in the presence of carbon monoxide. This sensor has a high sensitivity and fast response time. The sensor's output is an analog resistance.

Fig.7 Carbon monoxide Sensor

LDR sensor
LDR sensor is used to detect the presence of light. The LDR which also measures the intensity of light when the resistance value is get changed. Generally, the Selenium or cadmium telenium LDR are also used. When lights fall on the LDR then the resistance decreases and increases in the dark. When the LDR resistance increases then automatically light gets ON and can be controlled using the LED button.
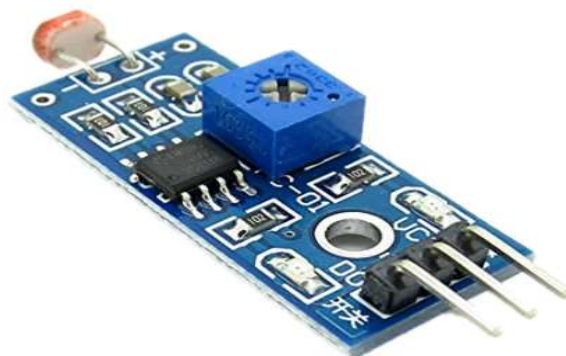

Fig.8 LDR Sensor

Pulse Sensor Module

Pulse sensor module is employed to find live heart rates. It's widely applied for college kids, artists, athletes, inventors, games or mobile terminal developers to develop pulse related interactive works. you'll wear the sensor on your finger or earlobe and connect it to Arduino. It also has an open source APP program which will display your pulse real-time in graph. It's briefly , a pulse sensor integrated with optical amplifier and noise elimination circuit.

Specification

- LED peak wavelength: 515nm
- Power supply: 3.3V/5V
- Output type: analog
- Output signal: 0~3.3 (at 3.3V power supply) / 0~5V (at 5V power supply

Fig.9 Pulse Sensor

Power supply

A power supply which supplies electric power to electric load. It also converts one type of electric power to another form. The rectifier which converts Alternating current(AC) into Direct current(DC).It can also designed by using transformer connected to the ac supply line to step the ac voltage to desired amplitude, and rectifying that AC voltage, filtering with a capacitor and RC filter. The voltage regulator maintains the voltage in the circuit relatively close to a desire value. They can also be in electronic devices where they stabilizes the DC voltage used by the processor and other elements. They also helpful for controlling the output of the panel. It includes negative feedback and uses a simple feed-forward design. It could also generate fixed output voltage that remains constant for any changes in any input or load conditions.
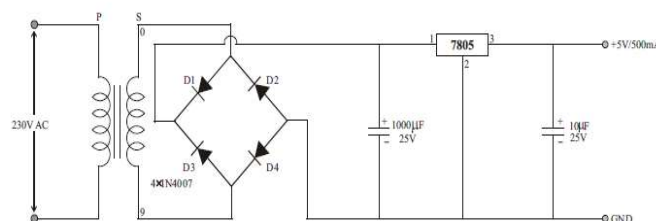

Fig.10 Power Supply

Buzzer
Buzzer is an electronic device generally used in automobiles household appliances like a microwave, or game shows. The connected sensor and switches are used to determine the warning sound and typically illuminates a light-weight on the acceptable button or instrument panel .The connected electromechanical system which resembles the electrical bell without the metal gong (which makes the ringing noise).
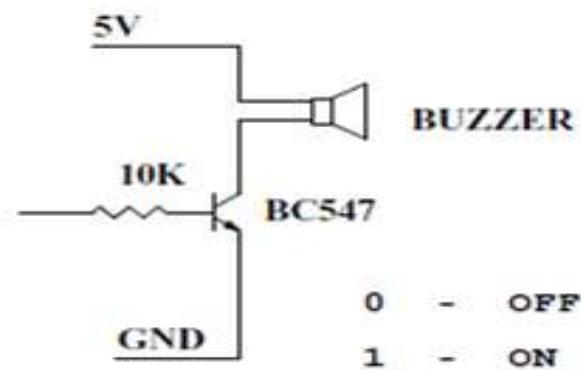

Fig.11 Buzzer

LCD Display
LCD (Liquid Crystal Display) screen is an electronic display module and find a good range of applications. A 16x2 LCD display is extremely basic module and is extremely commonly utilized in various devices and circuits. These modules are preferred over and other multi segment the explanations being. LCDs are economical; easily programmable; haven't any limitation of displaying special & even (unlike in seven segments then on). A 16x2 LCD display   16 characters per line and it has also few lines. During this each character in LCD is displayed in 5x7 pixel matrix. Command and data are the two registers used in LCD. Initializing, clearing the screen, setting the cursor position, and controlling display are performed by LCD when it receives the information from the command. The info register stores the info to be displayed on the LCD. Finally, the ASCII characters are to be displayed on the LCD.

6. EXPERIMRNTAL RESULTS
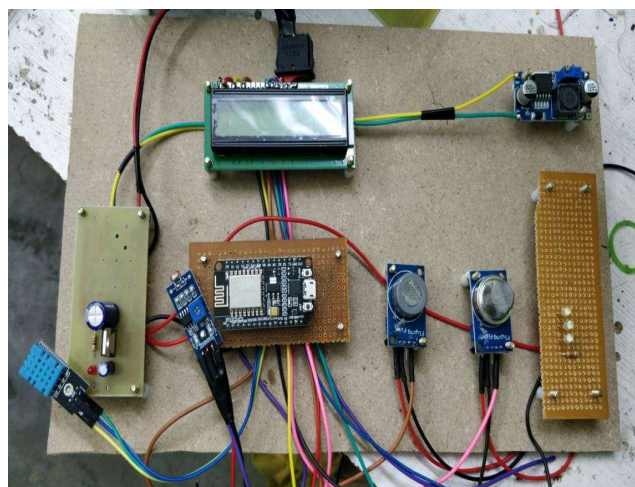
This above figure shows the experimental setup of IOT based coal mine monitoring system. Temperature and humidity sensor, LDR sensor, CO sensor, Methane sensor is connected to Node MCU. The output values from the sensors are displayed in LCD. Buzzer is used for alerting the persons in coal mine.

co2	:	NORMAL
ch4	:	NORMAL
temp	:	33.00
hum	:	51.00
ldr	:	NORMAL
heart	:	76
temp1	:	32

The above result shows the real value of Co2, CH4, temperature, humidity, LDR, Heart rate when the worker is present in the coal mine. If any of the value goes above the threshold then the indication is given to the person in coal mine through Buzzer.

7. CONCLUSION

The Internet of Things which is the widespread in information technology connects us to the real world of things. Thus, the safety of workers is made possible by different sensors such as the fire sensor, gas sensor, LDR Sensor, heartbeat sensor and so on. Wireless system makes our work simpler and also its cost efficient. Node Mcu the controller which collects and senses all the data from sensors and passes to the cloud server. The cloud which performs greater action when it receives the data it automatically adjusts the sensors and warns the coal mine workers without the need of the user. All these things save the workers from the dangerous situations and helps them to work without stress. It also saves their valuable time and protect their mine from any unwanted losses.

REFERENCES

[1] Nagolu Sainadh, P. Dass "Health Monitoring System for Mine Areas", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-8 Issue-6S, August 2019
[2] Madhu "Coalmine safety monitoring system", International journal of Mech animal Engineering and Technology (IJMET) Volume 8, Issue 12, December 2017.
[3] Wakode "Coalmine safety monitoring and Alerting system", International research journal on Engineering and Technology (IRJET) Volume 4, Issue 3, March 2017.
[4] O. Bello and S. Zeadally, "Intelligent Device-to-Device Communication in the Internet of Things," IEEE Systems Journal, vol. 10, no. 3, pp. 1172-1182, Sept. 2016.
[5] Aarthi "Coal Mine safety Monitoring system using ARM 9", International Journal of Science and Research (IJSR), Volume-3, Issue-11, November 2014.
[6] Kumarsagar "Design of Monitoring system for Coal mine safety based on MSP430", International Journal of Engineering Science Invention (IJESI) Volume2, Issue 7, July 2013.
[7] Ashish "Coalmine safety monitoring using Wireless sensor Networks", International Journal of Scientific Engineering and Technology (IJSET) Volume 2, Issue 10, October 2013.
[8] Dong "Coal Mine safety Monitoring system based on Zigbee and GPRS", Applied Mechanics and Material Volume 422, 2013.
[9] Kumar "Design and Implementation of Portable health monitoring system using PSOC mixed signal Array chip". International Journal of Recent Technology and Engineering (IJRTE), ISSN, 2277-3878, 2012

[10] LiHui "Design of Monitoring system for Coal mine safety based on Wireless sensor Networks" 2008 International Conference on Mechatronic and Embedded systems and Applications.