

Coal Mine Safety System Using Wireless Sensor Networks and Arduino

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Abstract— IOT based coal mine safety monitoring and alerting system. Project is proposed for the purpose of implementing security and detection of hazards inside a coal mine. This project is one of the important IOT projects. The project consists of two modules that are the receiver and the transmitter modules. The transmitter module has Temperature, Smoke, and Ldr sensors installed in it. The transmitter module also carries an Wifi-Module. The receiver module consists of an LCD display. All the sensor data is transmitted to the remote IOT server every 2 minutes through wifi module. The circuit also contains an alarm buzzer, which alerts when there is an increase in threshold limit. Mining is one of the most dangerous trades all over the world. In some countries, underground miners lack safety, social guarantees and in case of injury may be left to cope without assistance. There are negative social impacts as well, such as displacement and lost livelihoods. The mining industry has the highest incidence of occupational deaths among all industries. Common causes of occupational deaths include rock falls, fires, explosions, methane intoxication, and electrocution. There are many case studies behind underground mines, a recent case study in china reveals that underground mining in China is the world's deadliest industry. To overcome this, we have developed this project using IoT and Arduino. Apart from this, it consists of Gas sensor, Temperature and Humidity sensor which are used to monitor the underground hazards. In this paper, we mainly focused on the hazards monitoring, all the sensor values compared with the received data from the sensor with safety limits and if any hazards detected, the ground section will be given the necessary alert.

Indexed Terms-- Arduino, Server, Nodemcu

I. INTRODUCTION

Coal is one of the most important commodities and raw materials for a number of industries. It is used for power generation as well as the extraction of many by-product chemicals and materials. The extraction of coal from the coal mine is, however, a complex and dangerous process. Many accidents take place in the coal mines world over which causes fatalities and economic losses. The dangers and hazards can be reduced significantly by making use of the latest smart technologies. In this project we create a new system which has high range and we can access the situation in any of the servers and we can constantly monitor the underground values.

II. COMPONENTS USED IN THE SYSTEM

1. ARDUINO UNO:

Arduino is fundamentally an open-source stage utilized from building electronic ventures (Fig. 1). UNO is the most well-known board utilized [6]. It chips away at 5V supply at 16MHz clock speed and the processor is ATmega328. ATmega328 is a 8-piece AVR RISC-based microcontroller which has 32KB glimmer memory, 1KB EEPROM, 2KB SRAM, 23 GPIOs, 32 universally useful registers, three adaptable clock/counters with look at modes, inner and outer intrudes on, sequential programmable USART, a byte-arranged 2-wire sequential interface, SPI sequential port, 6-channel 10-piece A/D converter (8-diverts in TQFP and QFN/MLF bundles), programmable guard dog clock with inward oscillator and five programming selectable force sparing modes. Arduino IDE is a product used to type the code and transfer it on to the load up (Fig. 2). Arduino board can be controlled in two different ways. One, utilizing the USB link from the PC and two, from the AC mains utilizing the force barrel jack. The board has a voltage

controller for giving balanced out DC voltages to all components. It has a precious stone oscillator to give the 16MHz clock recurrence, a reset catch to reset the framework, a 3.3V and a 5V yield supply pins and a ground pin.



Figure 1: Arduino uno

Arduino UNO has six simple pins for perusing information from simple sensors and to change over it to computerized structure for comprehensibility of the microcontroller. It has 14 computerized I/O sticks in which 6 are PWM age pins and 1 is UART pin. Arduino UNO board additionally comprises if the Tx and Rx LEDs and force LEDs. It gives a standard structure factor that breaks the elements of the smaller scale controller into an increasingly available bundle.

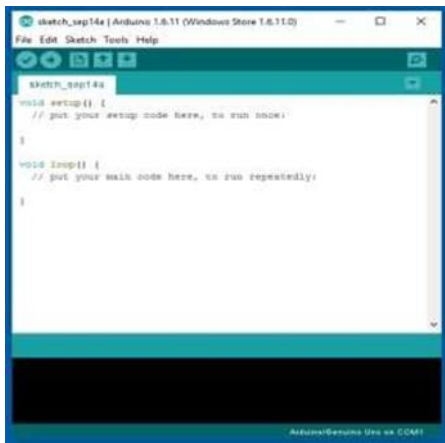


Figure 2: Arduino IDE.

2. WIFIMODULE(ESP8266)

ESP8266 is a powerful, low price Wi-Fi module appropriate for adding Wi-Fi practicality to associate degree existing microcontroller project via a UART serial affiliation. The module will even be reprogrammed to act as a standalone Wi-Fi connected

device—just add power. The ESP8266 extremely integrated chip, together with antenna switch balloon, power management device, thus with bottom external electronic equipment, and includes front-end module, together with the complete resolution designed to attenuate the area occupied by PCB. The system is provided with ESP8266 manifested leading options are: energy saving VoIP quickly switch between the sleep / wake patterns, with low-power operation adaptation radio bias, front-end signal process functions, troubleshooting and radio systems be characteristics eliminate cellular / Bluetooth / DDR / LVDS / alphanumeric display interference. ESP8266 may be a complete and self-contained Wi-Fi network solutions which will carry code applications, uninstall all Wi-Fi networking capabilities. ESP8266 once the device is mounted and because the solely application of the appliance processor, the non-volatile storage will be started directly from associate degree external Move. Intrinsically cache memory can facilitate improve system performance and cut back memory necessities. Another scenario is once wireless net access assume the task of Wi-Fi adapter, you'll be able to add it to any microcontroller-based style, and the affiliation is easy, simply by SPI / SDIO interface or hardware AHB bridge interface.

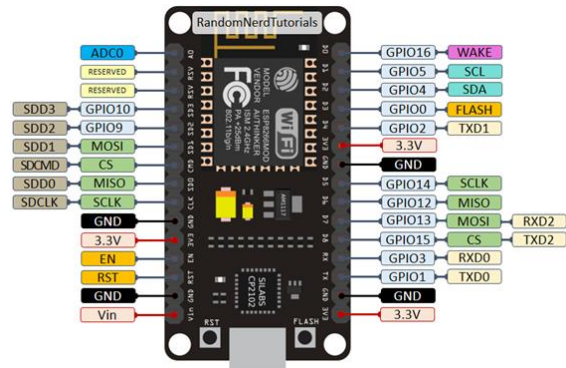


Figure 3: Wifi Module

3. GAS SENSOR(MQ2)

The Grove - Gas Sensor (MQ2) module is helpful for gas run detecting (in home and industry). It will discover H₂, LPG, CH₄, CO, Alcohol, Smoke, and Propane. Supported its quick reaction time. Measurements are taken as shortly as attainable. Conjointly the sensitivity is adjusted by the potentiometer.

1. Air quality monitoring.

2. Used to detect the presence of gases in air such as lpg, methane, smoke, butane.
3. Wide detecting range
4. Stable, long life and high accuracy.



Figure 4: Gas sensor

4. TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from its 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 to $+150^{\circ}\text{C}$ temperature range. Low cost is assured by trimming and calibration at the wafer level. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.

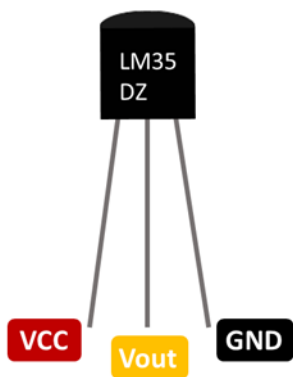


Figure 5: LM35 Temperature sensor.

5. HUMIDITY SENSOR(DHT11)

Humidness is that the presence of water in air. The number of water vapor in air will influence human comfort also as several producing processes in industries. The presence of vapor conjointly influences varied physical, chemical, and biological processes. Humidness activity in industries is crucial as a result of it's going to have an effect on the business price of the merchandise and also the health and safety of the personnel. Hence, humidness sensing is extremely vital, particularly within the management systems for industrial processes and human comfort. The DHT11 is a commonly used Temperature and humidity sensor that comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data.



Figure 6: DHT11 humidity sensor

6. TILT SENSOR

The tilt detector module is a handy tool for detecting the position of our machine and also find if any particles is falling or not. Though these simple tasks are made available in various ways, the end result is still the same. They conducted an operation to find out if the plane change from horizontal to vertical had occurred, and when they found it, they sent a symptom. The module we're planning to speak about in this section are sensors which can recognize even small plane shifts but we intend to be more interested in touch sort tilt detector modules. this is used for rocks detection and know the position of our circuit



Figure (6.a): - Tilt sensor

7. LCD DISPLAY

Liquid crystal display (Fig. 7) is one of the advancements normally utilized as screens in screens, telephones, workstations and so forth. It is a mix of two conditions of issue, strong and fluid. LCD utilizes fluid gem to show an obvious picture. In contrast to CRTs and LCDs permit presentations to be a lot slenderer. As opposed to discharging light, they use backdrop illumination to create pictures in shading or monochrome. An LCD contains backdrop illumination which gives lights to the pixels. It has red, blue and green sub pixel which can be turned on or off utilizing pixels. The presentation seems dark when every one of the pixels and sub pixels gets off and it seems white when all the sub pixels are turned on. The backdrop illumination in the fluid precious stone showcase spellbinds the light by sending just 50% of the light through the layers. By applying voltages, the strong and fluid parts in the presentation can be curved. This aids in actuating and deactivating the lights of the showcase.



Figure 7: 16x2 LCD display.

III. EXPERIMENTAL SETUP

The Arduino UNO board is utilized for controlling the total system with esp8266 wifi module. Situation of underground can identified utilizing sensor modules and the wifi module for sending the data to server. The LCD show is utilized for showing the status of the

underground sensor values. Fig.8 shows the. This system is basically used for performing operations i.e monitoring the underground situation.

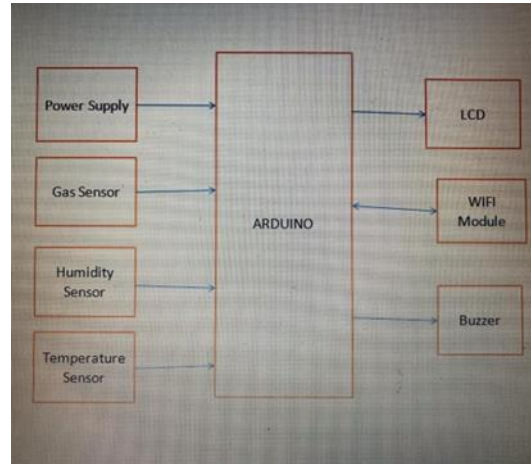
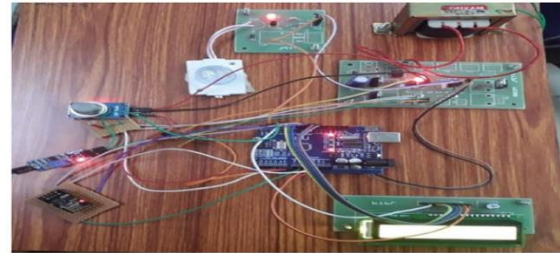


Figure 8: Block diagram of coal mine safety system using wireless sensor networks.

IV. EXPERIMENTAL SETUP



V. APPLICATIONS

1. Coal mines.
2. Oil minings.
3. Restricted Areas.
4. Power Plants.

VI. ADVANTAGES

1. Fast Data Transfer.
2. Wireless Communication.
3. Low Power Consumption.
4. Life Security.
5. Multi to One Data Received.

VII. CONCLUSION

By using this device we can implement the security of our mine workers. This new system we put in place built on IOT for coal mine safety. The tilt sensor is used to detect whether rocks are falling or not. The temperature and humidity is detected by dht11 and LM35 sensor if any rise in temperature it will be intimated in website and the buzzer will sound. Additionally, a gas sensor is used to detect the leakage of hazardous gas. From this we get major accuracy values and faster access of data in server and we display the values on parameter screen for monitoring. When sensing element values have crossed the alarm threshold the buzzer will switch on

REFERENCES

- [1] Xiaolong Feng, Jiansheng Qian, Zhenzhen Sun, Xing Wang, "Wireless Mobile Monitoring System for Tram Rail Transport in Underground Coal Mine Based on WMN," *cason*, pp.452-455, 2010 International Conference on Computational Aspects of Social Networks, 2010.
- [2] Tanmoy Maity and Partha Sarathi, "A wireless surveillance and safety system for mine workers based on Zigbee", 1st Int'l Conf. on Recent Advances in Information Technology RAIT-2012
- [3] Pranjal Hazarika, "implementation of safety helmet for coal mine workers", 1st IEEE International Conference on Power Electronics Intelligent Control and Energy Systems, pp.1-3, 2016.
- [4] G. Y. Jeong, K. H. Yu, and Kim. N. G. Continuous blood pressure monitoring using pulse wave transit time. In *International Conference on Control, Automation and Systems (ICCAS)*, 2005.
- [5] Majer, L., Stopjaková, V., Vavrinský, E.: Wireless Measurement System for Non-Invasive Biomedical Monitoring of PsychoPhysiological Processes. In: *Journal of Electrical Engineering*. - ISSN 1335-3632. - Vol. 60, No. 2 (2009), s. 57-68.