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Coal Miners Monitoring System

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Abstract: ***We have designed a system that provides safety while monitoring and alerting the workers about the surrounding conditions in which they are working. The coal mine safety monitoring and alerting system is proposed for the purpose of implementing security and detection of hazards inside a coal mine. These systems monitor the conditions and report the necessary conditions to the control section.***
Keywords: ARM 7 LPC2148, GSM Module, MQ gas sensors, DHT11 sensor, Fall Detection sensor and Flame sensor.

I. INTRODUCTION

Safety is the most essential part of any industry. In the mining industry safety and security are the critical aspects. Various accidents take place in mines due to a rise in temperature, an increase in water levels, and methane gas leakage. So, to enhance safety in underground mines a reliable system is designed for monitoring the safety and alerting the control section to help the workers for their health.

Coal Mines are the world's most dangerous place to work because the explosion of the mines often happens and thus thousands of people are dying. A recent report states that in such mine accidents an average of around 12,000 people have died. Mainly such mishaps happen as a direct result of old equipment and wired devices, resulting in the end, mishandling, and leakage of toxic gases in the coal mines.

So, we have designed a system that provides safety while monitoring and alerting the workers about the surrounding conditions in which they are working. The coal mine safety monitoring and alerting system is proposed to implement security and detection of hazards inside a coal mine. These systems monitor the conditions and report the necessary conditions to the control section.

II. LITERATURE SURVEY

Nikam Rishikesh and Pooja Kadu designed an economical Zigbee-based wireless mine supervising system with early-warning intelligence explained intimately. during **this** proposed system the coal pit safety systems are fixed with gas sensor modules, temperature sensors, water level sensors, and relays. All the sensors are further integrated into the controller which monitors all the information from the sensors. The system uses a Zigbee module CC2500 which could be **a** low-cost 2.4 GHz transceiver designed for very low-power wireless applications. The modem supports various modulation formats and contains a configurable rate up to 500KBaud.

This system also contains a GSM module SIM800A chip and RS232 interface which enables easy reference to the pc or laptop using the USB to Serial connector or the microcontroller using the RS232 to TTL converter. The system also uses a water level sensor which may be a float switch device wont to sense the amount of the liquid. This switch may actuate a pump, an indicator, an alarm, or another device. Thus this is often a cheap system that has wireless connectionsecurity.[1]

Sai Phani Gopal and Pakirabad Akash proposed a coal pit safety system implemented employing a Thinger 10 platform as a medium to transmit data. this method is implemented to watch and control various parameters within the coal pit. During this system, all the sensors are integrated and regarded mutually unit, which is placed within the coal pit.

The system also has an LDR sensor to detect the presence of sunshine. Here the gas is continuously monitored if any uncertainties within the level of gas arise, then a buzzer **is** employed to alert the workers. Temperature and humidity values are continuously monitored and displayed on the serial monitor and also within the Thinger platform. The developed system **is** principally implemented to boost the working condition inside the coal mines and also to make sure workers' safety.[2]

LI Huizong and Ge Bin propose the concept of a Mine Safety Monitoring system supported ZigBee is elaborated. The hardware design of the ZigBee sensor node and system software design are discussed. A study of the self-organizing routing algorithm for ZigBee networks and also the gateway design and systems integration is finished. The ZigBee-based Mine Safety Monitoring System are able to do a range of safety factors of production and underground environment (such as gas, temperature, humidity, and other environmental indicators) for monitoring, controlling mine production, and safety management to produce an honest basis for deciding. [3]

Yongping Wu and Guo Feng implement coal pit monitoring using the Bluetooth wireless gear. As a customary of unified global short-range wireless communication, Bluetooth technology is to determine a typical low-power, low-cost wireless air interface and controlling software opening system. This paper describes the event background technical features and also the structure of the protocol stack of Bluetooth technology and also the proposed the solutions of the Bluetooth host controller interface (HCI) wireless communication for the complexity of its development. [4]

III. DETAILS OF PROPOSED SYSTEM MODULES

A. MQ 135 GAS SENSOR

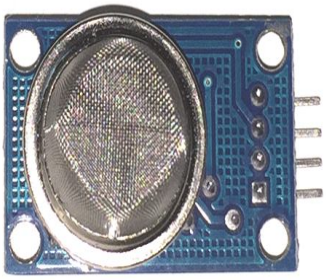
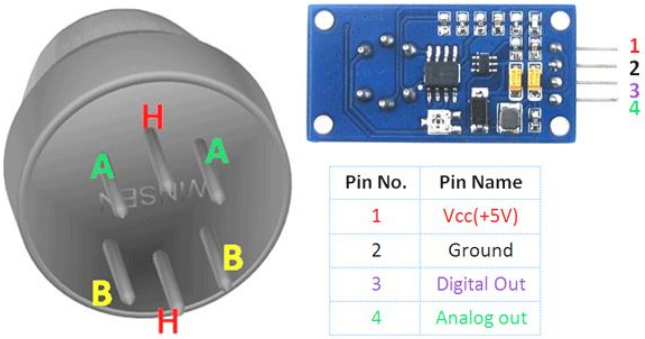


Figure 1.1 MQ135 Sensors



Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

Figure 1.1 MQ135 Sensor Pin out

The MQ-135 Gas sensors are utilized in air internal control equipment and are suitable for detecting or measuring NH3, NOx, Alcohol, Benzene, Smoke, and CO2. The MQ-135 sensor module comes with a Digital Pin which makes this sensor operate even without a microcontroller which comes in handy after you are only trying to detect one particular gas. If you wish to live the gases in PPM, the analog pin has to be used. The analog pin is TTL driven and works on 5V then may be used with the foremost common microcontrollers.

B. DHT11 Sensor

DHT11 may be a low-cost digital sensor for sensing temperature and humidity. This sensor **is** easily interfaced with any microcontroller like Arduino, Raspberry Pi, etc., to live humidity and temperature instantaneously. DHT11 humidity and temperature sensor are available as a sensor and as a module. The difference between this sensor and module is that the pull-up resistor and a power-on LED. DHT11 could be a ratio sensor. to live the encompassing air this sensor uses a thermistor and a capacitive humidity sensor. DHT11 sensor consists of a capacitive humidity device and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture-holding substrate as a dielectric between them. Change within the capacitance value occurs with the change in humidity levels. The IC measure, process these changed resistance values and change them into digital form.

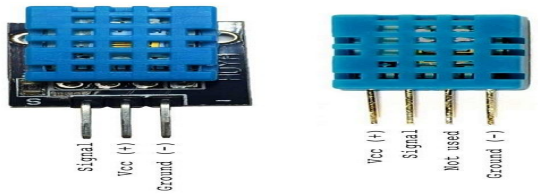


Figure 1.6 DHT11 Sensors

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with an increase in temperature. To get a larger resistance value even for the smallest temperature change, this sensor is usually made up of semiconductor ceramics or polymers.

C. Fall Detection (3 -axis Accelerometer ADLX335)

An accelerometer is an mechanical device that may measure acceleration forces. It shows acceleration, only because of the explanation for gravity i.e., g force. It measures acceleration within the g unit. On the world, 1g means an acceleration of 9.8 m/s2 is present. On the moon, it's 1/6th of earth and on mars, it's 1/3rd of earth. The accelerometer **is** used for tilt-sensing applications in addition as dynamic acceleration resulting from motion, shock, or vibration.

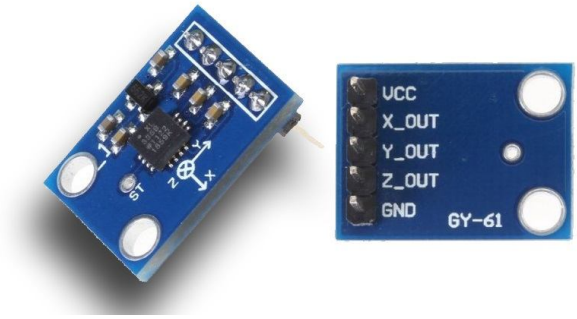


Figure 1.8 ADLX335 Accelerometer

D. GSM Module SIM900A

The SIM900A could also be a readily available GSM/GPRS module, utilized in many mobile phones and PDA. The module is also used for developing IoT (Internet of Things) and Embedded Applications. SIM900A is also a dual-band GSM/GPRS engine that works on frequencies EGSM 900MHz and DCS 1800MHz. SIM900A features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

As shown below, the communication with this module **is** finished through UART or RS232 Interface. the info is **s**hipped to the module or received from the module through the UART interface.

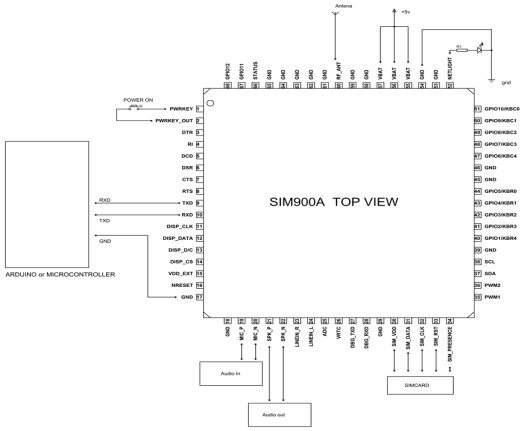


Figure 1.9 GSM Modules SIM900A

The module is usually connected to +4.0V standard power supply. It can work on +4.5V regulated power and any higher voltage may damage the module. and therefore the power source should be ready to deliver a peak current of 2A. The UART interface is established as shown in figure.

All you would like to try and do is connect RXD of module to TXD of Arduino and TXD is connected to RXD of ARDUINO. the bottom of controller and module must be connected for voltage reference. Here AUDIO IN is connected to MIC and AUDIO OUT is connected to a speaker or headset. And eventually, we want to attach a working GSM SIM card to the module. On powering the module, the NETLIGHT LED will blink periodically to state successful connection.

E. ARM7 LPC2138

LPC2138 is an ARM7TDMI-S based high-performance 32-bit RISC Microcontroller with Thumb extensions 512KB on-chip Flash ROM with In-System Programming (ISP) and In-Application Programming (IAP), Two 8-ch 10bit ADC 32KB RAM, Vectored Interrupt Controller, Two UARTs, one with full modem interface. Two I2C serial interfaces, Two SPI serial interfaces Three 32-bit timers, Watchdog Timer, Real clock with optional battery backup, Brown out detect circuit General purpose I/O pins. CPU log up to 60 MHz, On-chip quartz oscillator and On-chip PLL.

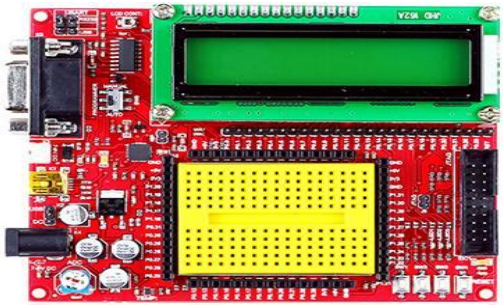
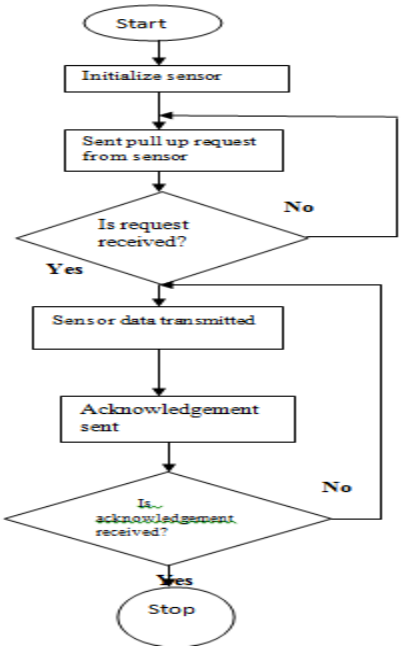


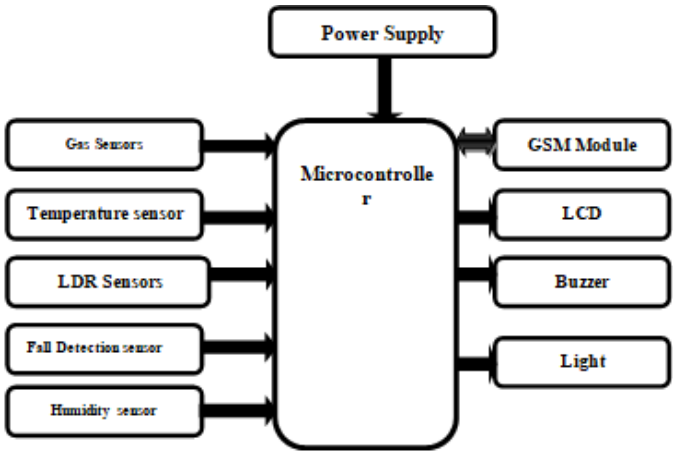
Figure 1.10 ARM7 LPC2138

IV. PROPOSED SYSTEM DESCRIPTION

The sensors embedded within the system send the information to the controller unit and it's monitored during a continuous manner employing a loop program. The controller receives the pull-up request sent by the server; it initiates the loop and sends the sensed value of the sensors to the server. Every sensor encompasses a unique pull-up request as an example “a” for methane, “b” for CO, etc. As soon because the controller receives a pull-up request from a sensor, it immediately sends an acknowledgment receipt so the info send properly. If the server denies the acknowledgment receipt, immediately it sends another pull-up request and also the process continues.

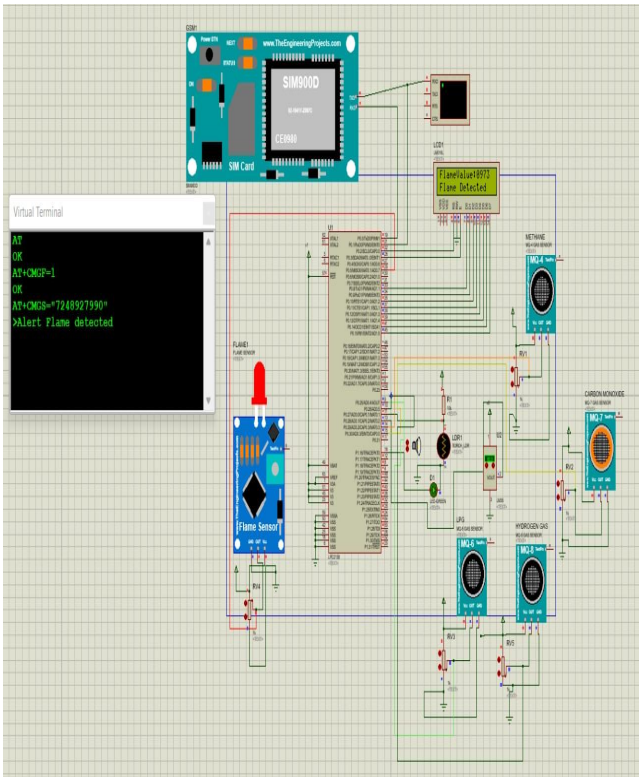


V. WORKING OF THE SYSTEM



The block diagram of the system is as shown above where the MQ 135 Gas sensor along with other sensors senses the overall environment of the coal mine. After sensing the conditions the input values are then given to the LPC2138 microcontroller which further processes the signals and based on the threshold values provided gives the output to the output devices like buzzer, LCD, GSM, etc.

VI. CIRCUIT DIAGRAM



The working of the proposed system is shown in the above figure where the software provided to the microcontroller contains the conditions related to the threshold values of the parameters measured. Based on the conditions and current parameters measured the system provides alerting signals through buzzers and messages to the workers to escape from the situation to save their life. The sensors detect and measure the gas concentration and provide it to the microcontroller then based on measured values the microcontroller provides signals for the output system by comparing it with threshold signals provided.

VII. CONCLUSION

A real-time monitoring system is developed to provide a clear perspective of the underground mine. This system displays the parameters on the monitoring unit which helps the workers in the mine to save their lives before any problem occurs. This system also provides an alerting signal when the sensor value crosses the threshold level. This system also stores the real-time parameters data which can be used for further inspection.

VIII. FUTURE SCOPE

A. The crucial parameters from inside the mine can be monitored from anywhere in the world by the supervisors and manager. Using the remote IoT platform. This can result in better management and improvement of production standards.

B. This is a safety-critical project. Therefore, this system can be improved by making it fail-safe. We can implement the fail-safe operation using redundancy in the system. If one module fails then the parallel module will take over the operation.

C. With the upcoming developments future work of this experimentation may incorporate, greater improvement of the framework by utilizing other progressed sensors for checking the underground dangers.

D. Using additional sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire, etc.,

E. Zigbee can also be used for the surveillance of mining operations such as subsidence, water leakage, etc.,

F. The other important data can be communicated through these systems making it feasible where wired communication is a hindrance.

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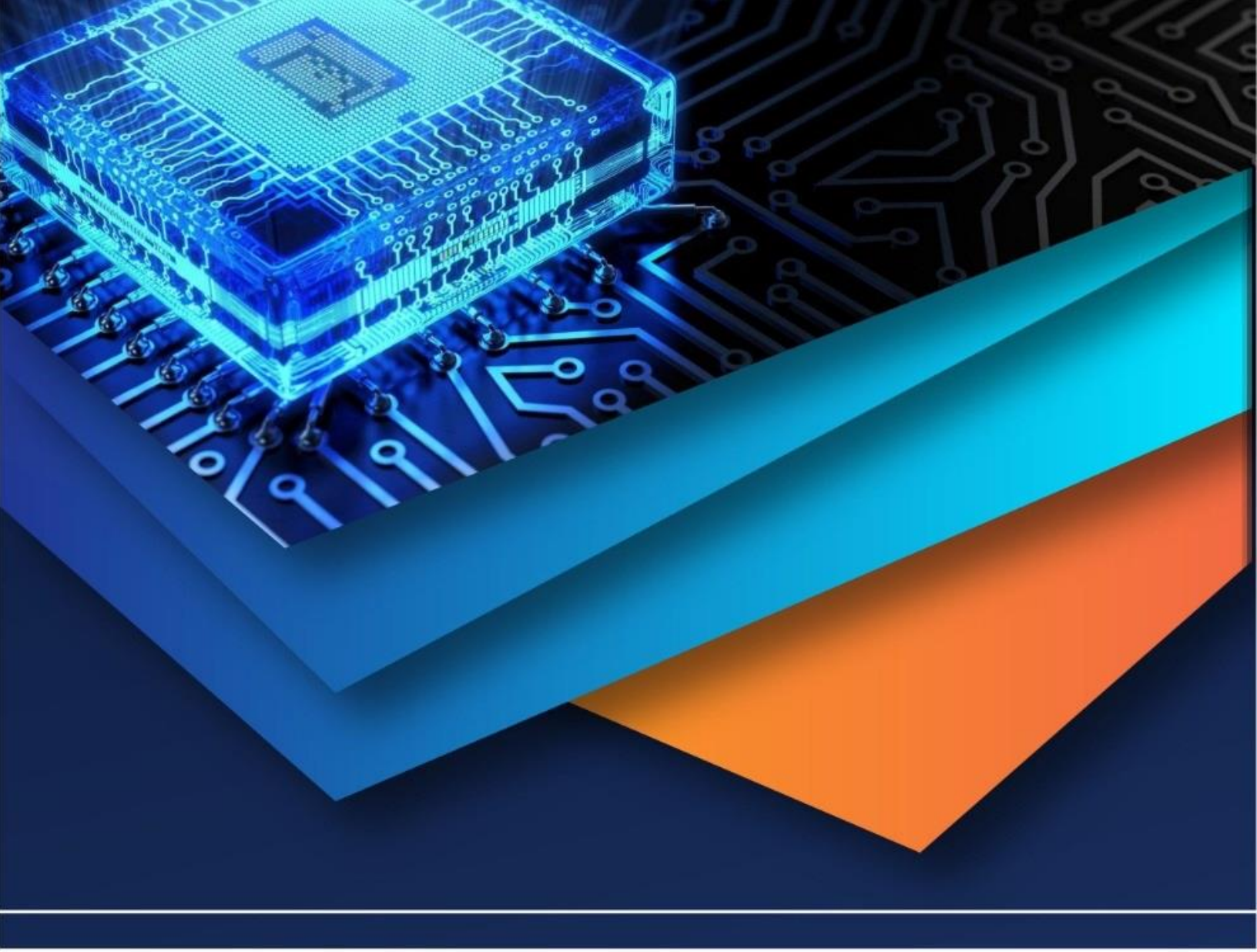

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