Arduino based helmet for coal mine worker

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Abstract- coal has proven to be very dangerous and has caused many accidental deaths over the years. Keeping this in mind we have designed an intelligent system which can be used on helmets of these underground coal workers and can monitor/analyze a few major hazardous parameters found in these mines in real time. A helmet has been developed which includes various features such as the communication, detection of the hazardous gases, providing notification in the case of helmet removal, collision (miners are struck by an object), panic switch for emergency situations, continuous monitoring of the environmental conditions such as temperature in the mining industry in the miner. Once the poisonous gas is detected the helmet gives the signal. Panic switch is provided for the safety of the miners and it is used to provide alert signal to the control room during any emergency situations. Temperature sensor is used for the continuous monitoring of environmental conditions. The information are sent to the control room through wireless networking the control room with the help of a NRF Module.

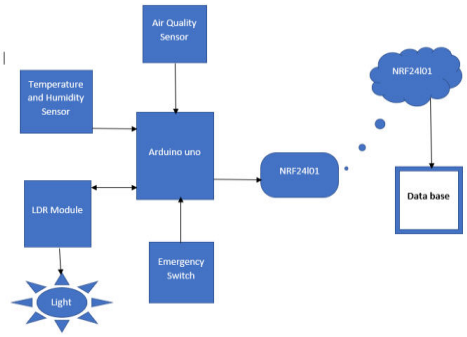
Keywords- DHT11, MQ4 ,NRF24L01, LDR Module, Switch.

I. INTRODUCTION

Sometimes Miners collide with the heavy objects like mining objects, hard rock which risks their life. Another factor that affects the miners is the inhalation of hazardous gases that provokes them in danger and sudden increases of temperature. In this situation miners are not able to communicate with the outside world. In this case, the smart helmet system becomes an essential and helpful measure to protect the miners from various accidents. This project aims at designing a smart helmet for hazardous event detection, monitoring the surrounding environmental conditions and updating information like sensor data to the central console for easy tracking and to avoid the inhalation of poisonous gases and temperature increase. This secures the life of miners in mining industries. Whenever the accident is to happen, we may rescue or evacuate all the workers. So the workers can anticipate for their lives in this drastically changing dangerous situation and we also attach the switch which is for emergency situations. Then Ldr module is used for the automatic head light operation.

II. SYSTEM ARCHITECTURE

To overcome this We have implemented an ultimate protective helmet that comes with some sensors for various detection and analysis. Firstly, the hazardous gases are detected using gas sensors. Whenever the poisonous gas is detected the warning will be send to the monitoring unit. The second thing is to find temperature and humidity level in the mine and they are sent to the control station via NRF24l01 wireless transmitters for continuous monitoring. Panic switch is manually operated by the miner to seek help from the central console in highly emergency conditions.

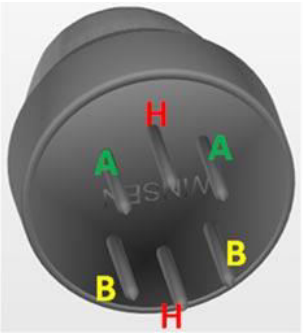


III. HARDWARE IMPLEMENTATION

The overall block diagrams of transmitter and receiver sections of this projects are

1. MQ4(Air quality sensor)

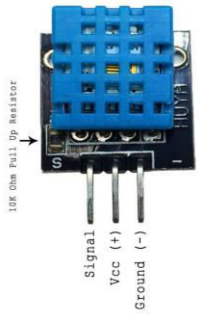
MQ sensors are special sensors designed to have sensitivity for to detect some gas like LPG, CO, Propane etc. In Chinese, 'sensitive' means 'Mǐngǎn' and 'Gas to' means 'Qìlai'. So I think, more or less, MQ stands for the sensors having sensitivity towards (or to) gas. The MQ4 is a simple-to-use compressed natural gas (CNG) sensor, suitable for sensing natural gas (composed of mostly Methane [CH4]) concentrations in the air. The MQ4 can detect natural gas concentrations anywhere from 300 to 10000 ppm. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

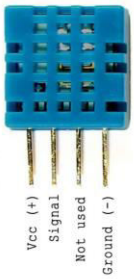


Pin No.	Pin Name
1	Vcc(+5V)
2	Ground
3	Digital Out
4	Analog out

2. DHT11(Temperature and humidity sensor)

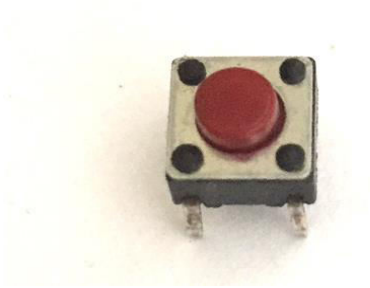
The temperature range of DHT11 is from 0 to 50 degree Celsius with a 2-degree accuracy. Humidity range of this sensor is from 20 to 80% with 5% accuracy. The sampling rate of this sensor is 1Hz .i.e. it gives one reading for every second. DHT11 is small in size with operating voltage from 3 to 5 volts. The maximum current used while measuring is 2.5mA.DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.





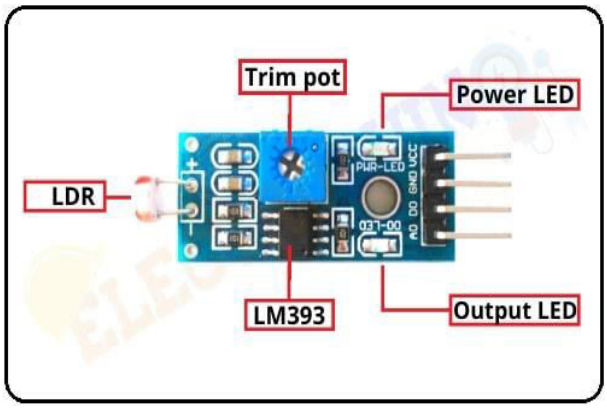
3. Push switch

Many switches are designed to function as both push to make and push to break switches. For these switches, the wiring of the switch,determines whether the switch functions as a push to make or as push to break switch.



4. LDR Module

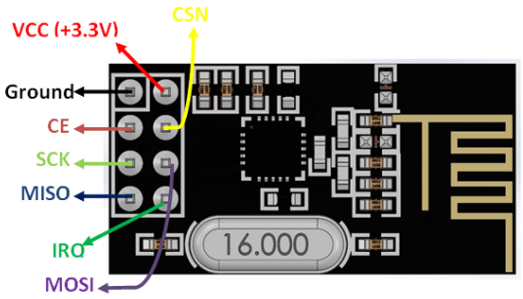
LDR sensor module is a low-cost **digital sensor** as well as **analog sensor** module, which is capable to measure and detect light intensity. This sensor also is known as the **Photoresistor sensor**. This sensor has an onboard LDR(Light Dependent Resistor), that helps it to detect light. This sensor module comes with 4 terminals. Where the "DO" pin is a digital output pin and the "AO" pin is an analog output pin. The output of the module goes high in the absence of light and it becomes low in the presence of light. The sensitivity of the sensor can be adjusted using the onboard potentiometer.



IV. SOFTWARE IMPLEMENTATION

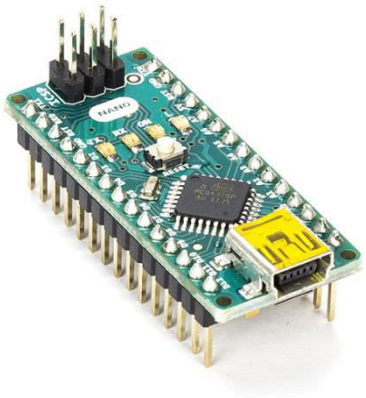
1. NRF24L01

The n**RF24L01 is a wireless transceiver module**, meaning each module can both send as well as receive data. They operate in the frequency of 2.4GHz, which falls under the ISM band and hence it is legal to use in almost all countries for engineering applications. The modules when operated efficiently can cover a distance of 100 meters (200 feet) which makes it a great choice for all wireless remote controlled projects. The module operates at 3.3V hence can be easily used with 3.2V systems or 5V systems. Each module has an address range of 125 and each module can communicate with 6 other modules hence it is possible to have multiple wireless units communicating with each other in a particular area. Hence mesh networks or other types of networks are possible using this module. So if you are looking for a wireless module with the above properties then this module would be an ideal choice for you.



2. Arduino IDE

IDE stands for Integrated Development Environment. It is a text editor that lets you upload code on to arduino. Every program file is called a sketch and contains all the code that you write for your projects. Every file has an extension of .ino which used to be a.pde The code is written in basic c++ format and is human readable. So if the code is written in the readable form, how does the machine understand it? Well, that is precisely what the IDE is responsible for. The internal process of compiling translates the code that you write to a format that the machine understands.



V. CONCLUSION

A smart mining helmet was developed that is able to detect two types of hazardous events such as danger level of hazardous gases and temperature level. Then we add automatic head light and we also attached panic switch for monitoring and reduction of the number of casualties and providing immediate help to the miners in distress were the main goals of this project.

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OUTCOME

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