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Automatic Safety and Alarming System for Coal Mines

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***Abstract*- This paper addresses a safety system for Coal Mine which replaces the traditional coal mine monitoring systems which tend to be wired systems. It is unreliable and ineffective to lay cables in mine area which are expensive and also time consuming. In order to solve these problems, we have designed a new system which can improve the level of monitoring, provide safety and reduce accident in the coal mine. For exploitation of coal from different working faces a huge number of miners enter into underground mine. The emissions of toxic gases like methane and carbon monoxide always occur in coal mine. If a concentration of these gases is above safety level than it creates risk about mine worker's health and life [1]. Hence a continuous monitoring of such values is necessary. The underground system can collect temperature, humidity, gas and water level values of mine through sensors and a microcontroller is used for collecting data and making decision, The received data is compared with the predefined values, if the received values are more than the predefined values then the mine worker is informed through alarm as well as alert message is send to the corresponding member [3]. It will also collect the number of personnel inside the mine with the help of an RF transmitter and receiver, and then transmits the data to terminal.**

Keywords: RF Transmitter and Receiver, wireless, miners' safety, tracking and monitoring

I. INTRODUCTION

The project "Automatic Safety and Alarming System for Coal Mines" contains the features which will provide safety for the people working in mine area. In case of disaster, it is very difficult for the mine management to identify the actual person trapped, their number and exact location [2]. Some miners are coming out from underground mine before completion of the scheduled shift time. There is no track of early adjourns of duty by such miners and the mine managements are always in doubt about how many persons are trapped. In most of the developing countries, coal mining plays very important role to meet the energy demands, but at the same time mining industries are facing many problems which mainly include the mine worker's safety [1]. Especially the underground mine environment is very complex. The emissions of toxic gases like methane and carbon monoxide always occur in coal mine. If a concentration of these gases is above safety level than it creates risk about mine worker's health and life [1]. Hence a continuous monitoring of such values is necessary.

A mine safety monitoring system to achieve the safety factors will be developed. The system can collect different environmental parameters from underground mine with the help of sensors and transmits that data for processing. If the environment is so harsh beyond working condition, the alert messages can be informed to the concern people to take control measures and keep safety standards. Generally, underground miners are unknowingly going to the danger area like unsupported area where chances of roof fall frequent, near blasting area, gaseous area etc. These unsafe practices cause several accidents in underground mine. Therefore, a continuous monitoring and warning system must be implemented in the underground mines to avoid such common accidents.

II. ARCHITECTURE

In this paper, we are proposing an advanced system for mines to update the underground situation of mines to the base station immediately and updating it to the web server and sending alert messages to the authorized person immediately. In the underground section first step is to initialize the RFTxRx .Next is to monitor the temperature, humidity, gas sensors and water level in order to sense the corresponding Sensor levels in the mining places. If the sensor values exceed the threshold values then an alarm will be fire in the mine to alert the miners who work in the underground mining regarding the emergency.

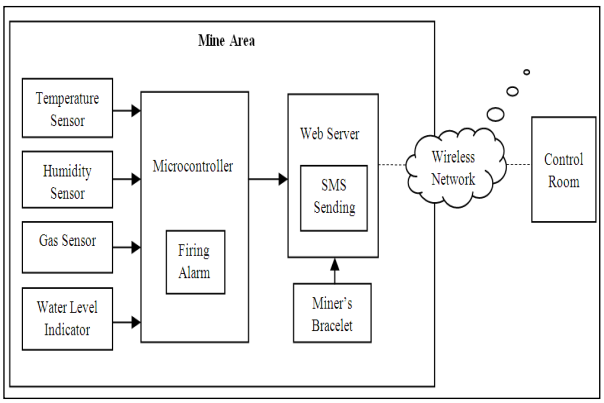

Fig. 1. Block Diagram

The developed system can be divided into two sections. First is a hardware circuit which contains RF transmitter and receiver that will be attached with the body of the mine workers through Bracelet. The circuit has a sensor module

consisting of some sensors that measures real-time underground parameters like water level, temperature, humidity and gas concentration.

A. *Microcontroller*

The microcontroller is the heart of the embedded system. It checks if any corrective action is to be taken for the condition at that instant of time. Input to the microcontroller is information of Gas sensor, Water level indicator, Humidity sensor, Temperature sensor. If the sensor value exceed the threshold value then microcontroller fire the alarm and send the information to the control room, through we can take some decision about to provide the safety to the underground miners.

B. *Temperature Sensor*

In the proposed system thermistor is used as temperature sensor. The word thermistor is an acronym for thermal resistor, i.e. a temperature sensitive resistor [1]. This sensor is used to detect very small changes in temperature. The variation in temperature is reflected through appreciable variation of the resistance of the device.

C. *Humidity Sensor*

Humidity is the amount of water vapor in the air. In daily language the term "humidity" is normally taken to mean relative humidity. Relative humidity is defined as the ratio of the partial pressure of water vapor in a parcel of air to the saturated vapor pressure of water vapor at a prescribed temperature [1]. The humidity sensor is of resistive type.

D. *Gas Sensor*

In the proposed system, MQ-7 gas sensor is used for detection of methane and carbon monoxide which are the major toxic gases in underground coal mines. This sensor is composed by micro AL2O3 ceramic tube, Tin Dioxide (SnO2) sensitive layer, measuring electrode and heater are fixed into a crust made by plastic and stainless steel net [1]. The heater provides necessary work conditions for work of sensitive components.

E. *Water Level Indication*

There is no any special sensor for water level indication. For this we will consider one normal level and another extreme level. When water will cross the extreme level then LED will be glow.

F. *Buzzer*

In mining or underground section, the different sensors collect data related to environment of underground mine. If the values from these sensors exceed certain threshold level, then there should be alert message to all the mine workers to leave that place. Hence we have interfaced a simple buzzer to microcontroller. The proposed project work has used three sensors viz. temperature, humidity and gas sensor. The system is programmed to such threshold values that the mine worker can work with safety and good health if the values from sensors are below that threshold level.

III. ALGORITHM

The microcontroller reads an analog input pin, maps the result to a range from 0 to 255 and prints the results to the serial monitor. The circuit potentiometer connected to analog pin 0.The center pin of the potentiometer goes to the analog pin and side pins of the potentiometer go to +5V and ground. The values are read from the port. If any of the sensor values are greater than set points then an alarm will be fired and alert messages are sent to the concern people. The real time results are continuously printing to the serial monitor after every 2 milliseconds.

Procedure Environmental_Monitoring (setpoint1, setpoint2, setpoint3)

```
1.  const int analogInPin1 = A0;
2.  const int analogInPin2 = A1;
3.  const int analogInPin3 = A2;
4.  int sensorValue1 = 0;
5.  int sensorValue2 = 0;
6.  int sensorValue3 = 0;
7.  loop()
8.  Begin
9.    sensorValue1 = analogRead(analogInPin1);
10.   sensorValue2 = analogRead(analogInPin2);
11.   sensorValue3 = analogRead(analogInPin3);
12.   If sensorValue1 > setpoint1 or
        sensorValue2 > setpoint2 or
        sensorValue3 > setpoint3 Then
13.       Fire alarm
14.       Send alert messages to the concern person
15.   End if
16. End
```

Every miner will be assigned with the unique id through Radio Frequency Transmitter and Receiver through bracelet. If the miner is present in the mine area i.e. RFTxRx is active then the miners' computerized attendance is maintained.

Procedure Identity (Miner_id)

```
1.  If Miner_id = active Then
2.      Miner is present in mine area
3.  Else
4.      Miner is absent in mine area
5.  End If
```

IV. CONCLUSION

Thus this paper proposed safety system to monitor different environmental parameters in real-time from underground mine and transmits that data for processing. If the environment is so harsh beyond working condition, the alert messages can be informed to the concerned person to take control measures and keep safety standards. It will track and monitor miners in case of disaster for speedy rescue operation. It will also identify the miners entering in underground mine to keep the track of the miners and maintain computerized attendance.

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