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Wireless Safety System for Mine Workers Based On WSN

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Abstract-*Today Safety of miners is a major challenge. Miner's health and life is vulnerable to several critical issues, which includes not only the working environment, but also the after effect of it. Mining activities release harmful and toxic gases in turn exposing the associated workers into the danger of survival. This puts a lot of pressure on the mining industry. To increase the productivity and reduce the cost if mining along with consideration of the safety of workers, an innovative approach is required. Miner's health is in danger mainly because of the toxic gases which are very often released in underground mines. These gases cannot be detected easily by human senses. This thesis investigates the presence of toxic gases in critical regions and their effects on miners. A real time monitoring system using wireless sensor network, which includes multiple sensors, is developed. This system monitors surrounding environments parameters such as temperature, humidity, atmospheric pressure and multiple toxic gases. This system provides an early warning, which will be helpful to all miners present inside the nine to save their life before any casuality occures. The system uses Wi-fi module technology to establish wireless sensor network.*
Keywords-*Wireless sensor network, Wi-fi technology, Coal mine safety.*

I. INTRODUCTION

Underground coal mine operation has always proved to be a very dangerous and hazards environment due to the presence of coal dust, methane and other toxic gases. It has reported that approximately 33.8% of deaths that happen in the mining sector are a consequence of coal dust or methane gas explosions.During the years of 1990 to 2015, 1601 cases of mine fires were reported in the United states(U.S) alone. Recently, a report by the inspectorate of mines punjab, pakistan showed that a high number(38%) of underground mine accidents were due to gas accumulation in the coal mines of salt-range region. Although the combustible range of methane gas in 5-15%, exposure to even low concentration of methane can critically damage the human body. In addition to methane gas, other toxic gases exit in underground coal mines, including carbon monoxide(CO), carbon dioxide(CO2). Short-term exposure to these gases may not have any damaging effects, but long-term exposure always results in severe damage to the body. Therefore, the accurate monitoring of the underground mine environments is of prime importance for the safety of miners and mine property. Over the last decades, the development of control system gateway fir the Internet of Things(IOT) in various fields is redefining how the internet extends to everyday life with uniquely identification objects in the wireless sensor networks(WSNs). The Objective of this study is to investigate the isolated safety aspects of underground mines, to study their inter-dependencies to integrate wi-fi based seperately identifiable systems to build a comprehensive monitoring and safety system specifically for underground mines. In this study, we are intrested in the cost-effective integration of technologies, such as standard monitoring intelligent event detection and identification, miner localization and real-time information sharing for Wi-fi system. We have overall goals of better understanding the harsh and real underground application domain and enhancing overall mine safety.

II. LITERATURE SURVEY

Now a day's due to global warming and climate changes there are challenging situations in fields of coal mine. To reduce the cost and improve the productivity along with product quality the atomization in the field of coal mine is indeed necessary, which will also reduce the mine workers efforts. This paper proposes a design of a wireless sensor network(WSN) with the help of ATMEGA328 microcontroller which is able to monitor the temperature,humidity,gas and status of smoke is an underground mine. This system also controls the ventilation demand to mine workers depending upon present climate conditional within the mine field. This system utilizes low power, cost effective microcontroller Atmega328, a temperature sensorLM35, humidity sensor, Smoke detector, gas sensor for sensing the mine climate parameters and a wireless Wi-fi transceiver for remote logging of data at central location to control the climate state with the help of motor and valve control circuitry. This paper designs a monitoring system for coal mine safety based on wi-fi wireless sensor network. The monitoring system collects temperature, humidity and methane values underground of coal mine through

wi-fi sensor nodes around the mine, and then transmits the data to information processing terminal based on Atmega328. The terminal sends the data to the ground through Net and then the monitoring center monitors the data and publishes them to the LAN for for remote users to inquire. This system has realized the real-time monitoring of working surface. Developed a coal mine safety monitoring system. In this work, a safe coal mine monitoring system which replaces the traditional coal mine monitoring systems which tend to be wired network systems. This play an important role in coal mine safety production. With continuous enlarging of exploiting areas and extension of depth in coal mine, many laneways become monitoring blind areas, where are lots of hidden dangers. Moreover, it is inconvenient to lay cables which are expensive and consumes time. In order to solve the problems.

III. DESCRIPTION OF THE SCHEME

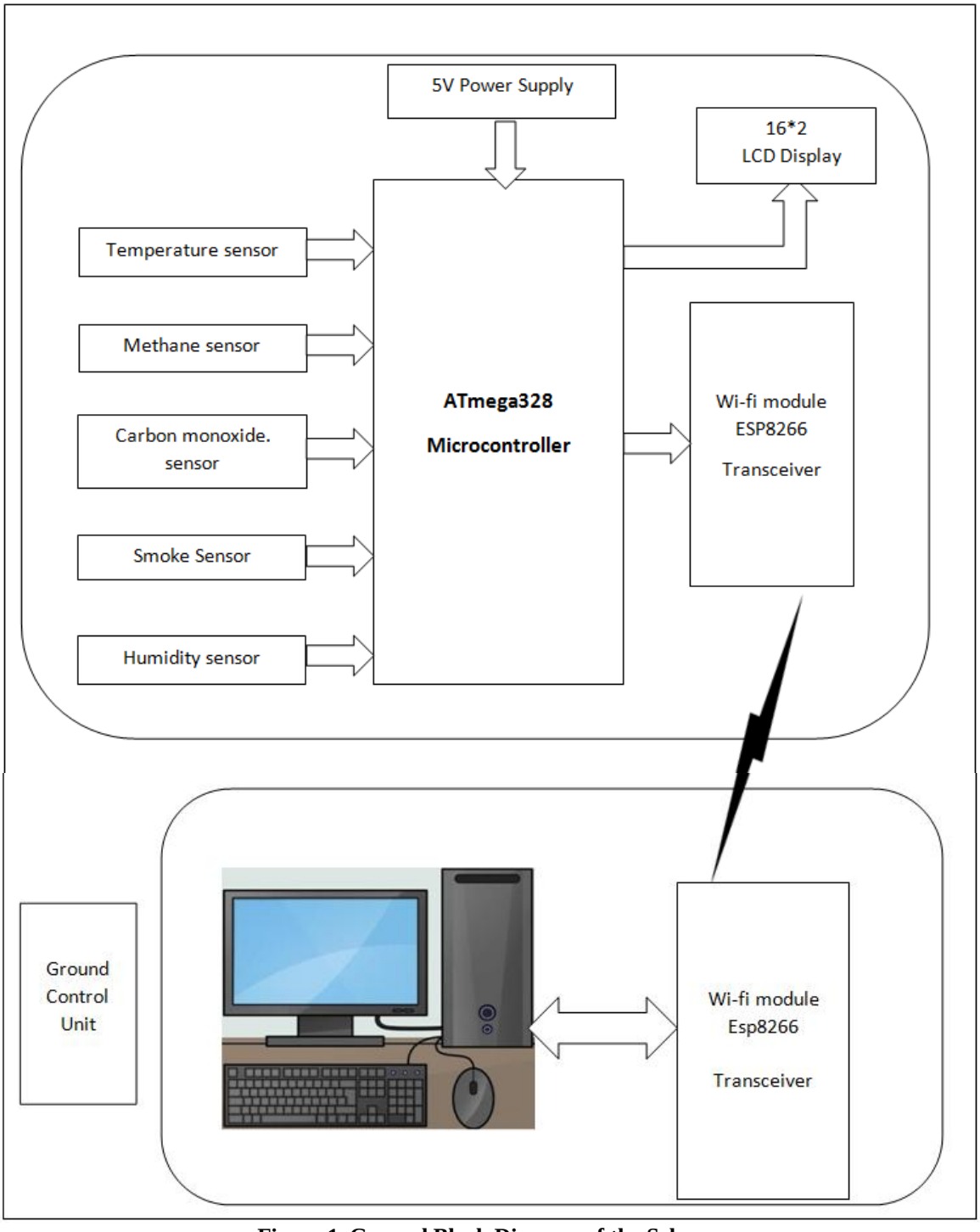

Figure 1. General Block Diagram of the Scheme

The proposed system is divided into two segments. First is a hardware circuit that will be attached with the body of the Mineworker's. It may be preferably fitted with the safety helmet of the workers also. This system has a sensor module consisting of some sensors that measures real-time underground parameters like temperature, Humidity, smoke, methane sensor and carbon monoxide sensor.. Excess Gas concentration is meant for the harmful gases like Methane, Carbon-monoxide,Butane and Propane. Microcontroller is used with the sensors to receive the sensor outputs and to take the necessary decision. If temperature is more than the safety level pre-programmed at microcontroller, the controller decodes beep alarms through the speaker connected with controller. Once the measured humidity value is more than the safety level pre-programmed at microcontroller; it decodes different type of beep alarms.

Similarly when gas concentration crosses the safety level, microcontroller decodes siren alarms. When person falls down for any reason accelerometer will give alert through wi-fi module and alarm will give corresponding beep alerts. sensor senses the light intensity and depending on the light intensity lights are turn-on or turn-off. Fire Sensor plays a role of detecting fire accidents and gives alert to base station which helps in taking necessary precautions. A 16x2 character LCD module is interfaced to show all the parameters like temperature, humidity etc., at underground MINER‟S module. Wi-fi module is interfaced to the Module to send message to the fire station whenever there is fire accident in underground mine and also sends message to ambulance service if the person remains in Fall Position for large duration.

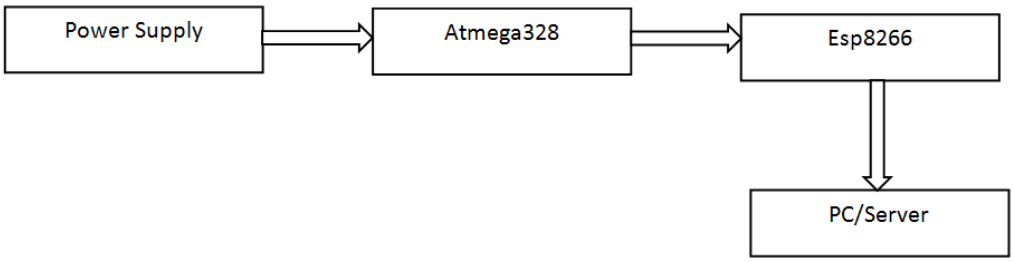

Figure 2. Ground Control Station

The Overall project we spitted the units working in following steps. They are:

a. The persons who are in the coal mining have to face various environmental parameters in their mining. They have the danger from methane, carbon monoxide and temperature. So we need to improve a strong security for the people who are working in the coal mining.

b. The purpose of this project is to provide a solution to mining a wireless communication and safety monitoring. The person must use the gadgets while working in the coal mining.

c. Here we have to arrange the circuit within the kit to provide a safety to the person who is working in coal mining. We are going to use microcontroller and sensors like temperature, humidity, fire, proximity, gas sensor.

IV. HARDWARE DESCRIPTION

A. Sensor network-

1) Temperature Sensor (LM35):

LM35 sensor uses the basic principle of a diode ,where as the temperature increases, the voltage across a diode increases at a known rate. By precisely amplifying the voltage change, it is easy to generate an analog signal that is directly proportional to temperature. LM35 is an analog, linear temperature sensor whose output voltage varies linearly with change in temperature. LM35 is three terminal linear temperature sensor from National semiconductors. It can measure temperature from-55 degree Celsius to +150 degree Celsius. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 can be operated from a 5V supply and the stand by current is less than 60uA. The pin out of LM35 is shown in the figure below.

Figure 3.Temperaure sensor(LM35)

2) Methane Sensor(MQ4):

This semiconductor gas sensor detects the presence of methane (CNG) gas at concentrations from 300 ppm to 10,000 ppm, a range suitable for detecting gas leaks. The sensor's simple analog voltage interface

requires only one analog input pin from your microcontroller. This methane gas sensor detects the concentration of methane gas in the air and output's its reading as an analog voltage. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection. For example, the sensor could detect if someone left a gas stove on but not lit. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

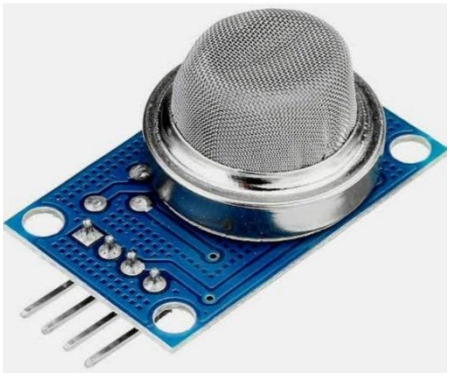

figure 4.Methane Sensor(MQ4)

3) Carbon Monoxide Sensor(MQ7):

This Carbon Monoxide (CO) gas sensor detects the concentrations of CO in the air and outputs' its reading as an analog voltage. The sensor can measure concentrations of 10 to 10,000 ppm.The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V. The heating (H) pins are meant to be operated in a dual voltage cycle: 5 V across the pins for 60 seconds to heat the sensor and then 1.5 V for 90 seconds while reading the sensor. Connecting 5 V at either the A or B pins causes the sensor to emit an analog voltage on the other pins. A resistive load between the output pins and ground sets the sensitivity of the detector. The resistive load should be calibrated for your particular application using the equations in the datasheet, but a good starting value for the resistor is 10 kΩ.

Figure 5.Carbon-monoxide sensor(MQ7)

4)Smoke Sensor(MQ2):

This is a robust Gas sensor suitable for sensing LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations in the air. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm. Depending on the level of concentration, the sensor observes the potential difference and this changes the resistance of the material inside the sensor. The output voltage value gives us the type of gas.

Figure 6.Smoke Sensor(MQ2)

5) Humidity Sensor(DHT11):

DHT11 sensor measures and provides humidity and temperature values serially over a single wire. It can measure relative humidity in percentage (20 to 90% RH) and temperature in degree Celsius in the range of 0 to 50°C. It has 4 pins; one of which is used for data communication in serial form. Pulses of different TON and TOFF are decoded as logic 1 or logic 0 or start pulse or end of a frame.

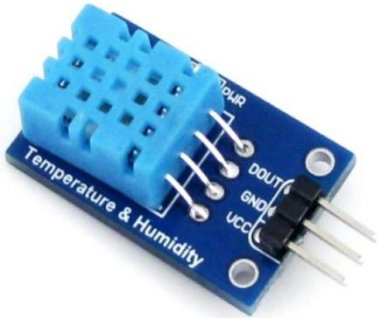

Figure 7.Humidity Sensor(DHT11)

B. Wi-fi Module(ESP8266)-

The ESP8266 is a low-cost and simple to use computer that can allow internet connectivity for your projects. This module will act as both an access point (capable of creating a hotspot) and a station (capable of connecting to Wi-Fi), making it very simple to obtain data and transfer it to the internet, resulting in a broad implementation of the Internet of Things.

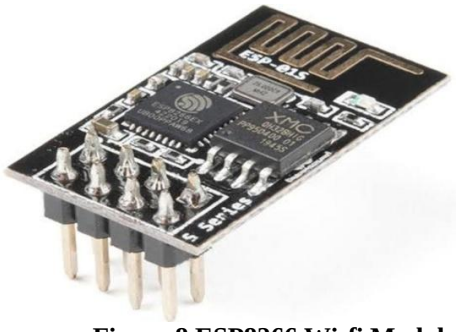

Figure 8.ESP8266 Wi-fi Module

V. RESULT AND DISCUSSION

The sensors can used to detect different types of gas whether the concentration of gases are dropping or not. Surrounding atmosphere is sensed by humidity sensor and if the detected sensors value is High, the light is turned on automatically. The ambient temperature is detected by a temperature sensor, and if the sensor senses high temperature, the website will be automatically modified, and a buzzer will sound. Additionally, a gas sensor is used to detect the leakage of hazardous gas. If any of the sensors is found to be malfunctioning, the page will be modified automatically.

VI. CONCLUSION

Traditional mine security system can be effectively replaced by the real time monitoring safety system proposed in the project. A larger area and more depth inside hazardous underground mines are now can be covered and potential accidents can be controlled effectively. The system combined the low power, low cost, based on high frequency wired data transmission technology based on small size sensors. The sensor can be preferably installed over the helmets and other gadgets of mine worker. Proper monitoring and conversation is possible between the workers and the ground staff which can help to take appropriate actions more rapidly and smartly. The system was communicated with Wi-fi wireless transmission. This scheme also can be extended with Bio-Medical Analysis facility in future; it will improve scalability of underground environment and extend accurate position of miners.

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