Sensor Based Multipurpose Mine Detection Robot and Industrial Environmental Parameter Monitoring System with IoT

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Abstract – **This paper addresses the massive surveillance of industrial monitoring parameter and detection of mine through a portable device. The problem encountered is that ,using different device for individual purpose which leads to high cost and the other drawback is that using LCD module to display the monitoring parameter .The best solution for this problem is presented in this paper which gives a qualitative approach by providing a multipurpose portable device that can be used either as industrial monitoring device or as a mine detection robot. The prototype built and tested in all functionalities that are required for the system .It also monitors the parameters of electrical energy such as gas leakage, temperature and the other parameter concerning the operation and the efficiency of the cooling system . According to underground environmental demand of metals in coal mine, the wireless communication method is proposed and an optimum transmission frequency is analyzed and selected. This system displays the motions of mobile robot such as moving forward, turning right and turning left using ultrasonic waves and also detects the human movement in the tunnel field. This project helps in high real-time, stability, reliability, safety measures when compared to other running subsystem .In this paper, the methods and principles of interaction between embedded system as server and client browser using Ardiuno UNO and Node MCU. This system monitors through the low cost advanced wi-fi technology**

,statistical analysis, computational analytic program and creation of automatic reports that are displayed in the webpage which provides added value in the modern industry.

Keywords - MQ-6 Gas sensor, LM35 temperature sensor ,metal sensor ,sound sensor, ultrasonic sensor ,PIR325 sensor, arduino UNO , embedded C, proteus VSM,GSM module .

I.   INTRODUCTION

In industries , the toxic gas release and temperature increases in the working zone are the major cause for the huge disasters
.For example ,in the power plants there is a possibility of increase of temperature and the toxic gas leakage which cause the reactor to burst and damage the plant and harm the workers

Protection functions are normally separated from monitoring and control facilities in traditional industrial and commercial power systems. They were designed by different suppliers with separate databases and separate human–machine interfaces. Today, communicating devices and computer software are available that make it possible to integrate protection, monitoring, and control in a more cost-effective system. The architecture of integrated systems makes it possible to configure a system for one or more purpose. The architecture is easy to expand the system after it has been installed to add more of the same functions or to add additional functions. For example, it may be desirable to do monitoring at first and add control later. It should be helpful when considering any new monitoring, protection, or control system.

Wireless sensor-based controls have drawn industry attention on account of reduced costs, better power management, ease in maintenance, and effortless. They have been successfully deployed in many industrial applications such as maintenance, monitoring, control, security, etc.

In various industries ,the technological processes are conducted in the air of the working zone and various toxic gases are released. For example, in air boilers it is often possible to detect excess concentrations of carbon monoxide and nitrogen oxides, and in the air of sewage pumping stations can repeatedly exceed the maximum allowable concentration of ammonia. In flats or offices located on the ground floor, the source of toxic substances in the air can be exhaust gases from
parked cars in the courtyard. The source of hydrogen sulfide, ammonia in flats may be a faulty sewage system, and in new buildings from walls and ceilings, ammonia can be released, which is used in construction to increase the frost resistance of concrete.

Many harmful substances do not have a smell and cannot be felt, but in high concentrations affect health and

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well-being. The method of monitoring the air state in continuous monitoring system of harmful gases and vapors which determines their concentration.

It is known that carbon monoxide is one of the most deadly poisonous gases of all gases. It is often referred as "silent killer". It is colorless, tasteless and odorless compound
. It is 200x stronger than oxygen. So it is virtually not detectable without using detection technology and mostly people do not realize they are being poisoned.

On the other hand, measurement of ambient temperature and object temperature can give us a better idea of a place without going there. This paper exhibits the ideas of temperature detection, motion detection and gas detection which is possible and will open a new possibility of introducing modern technology to real life motion detection is a basic method to identify moving object or person. It is a process of detecting the IR radiations emitted by the object.

Coal mine safety problem is an important problem to be resolved. In order to prevent the occurrence of coal mine accidents, coal mine invested a lot of manpower, material and financial resources to construct a variety of monitoring systems to monitor various data about coal mine safety.

Through these monitoring data, coal mine safety can be judged.

As one of the largest coal production and consumption countries in the world, China is also one of the related accidents occurred frequently countries such as gas explosion, flood, breaking out of fire during the exploitation of coal mine. Coal Mine Detection Robot can be substituted or partial substituted for emergency workers to enter the mine shaft disaster site and detect hazardous gas and do some environmental exploration . Mine Detection Robot uses gas sensor to absorption way to detect methane, carbon monoxide gases.

The surface of those places is uneven due to fallen trees and rocks, and could be severely uneven and terrains were shaped by rain, roots of trees, rocks, and other effects. Secondly, the size must be small enough to pass through between rocks. In underground, mines are usually extensive labyrinths ,in which the tunnels are generally long and narrow with a few kilometers in length and a few meters in width. Thousands of miners die from mining accidents every year. It is now widely approved that the underground mining operations are of high risk. However, underground coal mines mainly consist of random passages , branch tunnel and toxic gases .

In order to avoid human to be exposed in such environment, robot systems have been being developed for the last decade. This robot system has been built to be used in real minefields. In order to be suitable for minefields, the system must be faster than manual operation of human. Since the aim of this system is development of a commercial mine detection robot system must be faster than human.

For a process system, alarm signals can be generated in the respective controller system based on the information received from the sensors as well as from other relevant devices. The process signal can represent any measured signal of interest In such case, the utilization of a wireless sensor network (WSN) and other sensing devices are used for realizing the automation of underground monitoring**.**

In this paper is that light weight sensor like temperature sensor, gas sensor, noise sensor, metal sensor and PIR sensor are connected to monitoring the environmental change in both the industry monitoring and mine detection robot system and all the data are continuously monitor through the web page.

The main goal of the work is to develop the hardware and software of the information- measuring system based on the inexpensive Arduino platform which detects toxic gases and gas leakage in the air, when exceeding their maximum permissible concentration in industries and mine fields and it gives the output in web page along with alarm indication.

I. HARDWARE AND SOFTWARE DESIGN

Figure 1, is the proposed model of the arduino based monitoring system for industrial and as a robot for the mine field The following components and the sensors are used:

- Arduino UNO
- MQ-6 gas sensor
- LM35 temperature sensor
- PIR325 sensor
- Ultra sonic sensor
- Noise sensor
- Metal detector sensor
- Node MCU

The software used for monitoring the system are
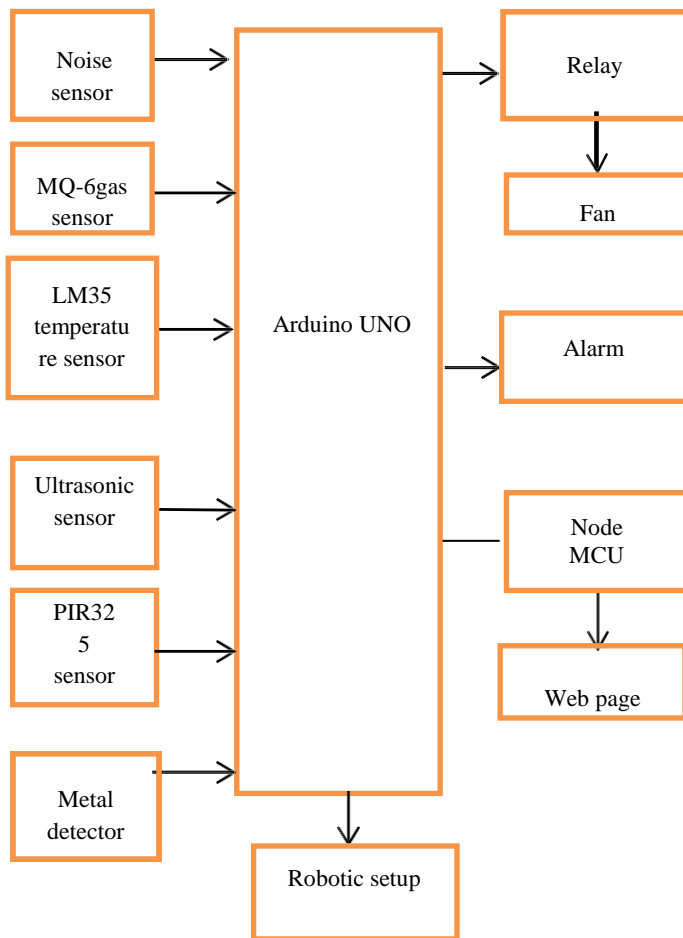
- Embedded C
- Arduino IDE

Fig 1.industrial monitoring and mine detection system built on the Arduino board

The Arduino UNO microcontroller board processes the received data from the sensor and the outputs the results to the web page module .In fig.1 different types of sensors are connected to the Arduino board .In the circuit the toxic gas leakage detection is detected by MQ-2 gas sensor and it connected to the analog pin in the arduino board and to the alarm. LM35 temperature sensor is connected with the Arduino in the analog pin ,through the data pin in sensor sends the temperature variation and connected with a alarm.

The PIR325 sensor or the motion detection sensor it detect sudden change in the temperature that maintain constantly then it sends the data through data pin to the digital pin of the Arduino board and connected to the alarm . The metal detector also connected with the digital pin in the Arduino UNO and the noise level in the industrial can be monitored according to the decibels when it exceed the set value then the data are send to the data pin to the Arduino

board and connected to the alarm as for indication purpose.

The ultrasonic waves are passing through the mines by the ultrasonic transmitter after the trigger the sensor and it get reflected sensed by the ultrasonic receiver then the distance of the object is calculated according to the velocity and the time. By this the motor driver 8299 to move the robotic setup either left or right

II.   LITERATURE REVIEW

TITLE: LIGHT WEIGHT MASHUP MIDDLEWARE FOR COAL MINE SAFETY MONITORING AND CONTROL AUTOMATION

AUTHOR : BOCHENG,SHUAI ZHAO

The main objective of this paper is to improve the coal mine monitoring and control automation by using the zigbee wireless sensor network (WSN) and open service gateway initiative based on uniform device access with the help of visualization technology and analyzed the data with an efficient cost.

TITLE : A COST EFFECTIVE WAY TO BUILD A WEB CONTROLLED SEARCH AND CO DETECTOR ROVER

AUTHOR : ALI ADIB ARNAB

This paper describes the combination of surveillance, motion detection and poisonous gas detection. It detects the presence of carbon monoxide gas in order to prevent the carbon monoxide poisoning in small area , cave ,mine in an area of hazardous accident .It also includes detecting movements , distance and temperature and enhanced with the robotic setup.

TITLE: DEVELOPMENT OF ARDUINO BASED EMBEDDED SYSTEM FOR DETECTION OF TOXIC GASES IN AIR

AUTHOR : ANDIRY HOLOVATYY

In this paper the device monitor the real time monitoring system and detects the concentration of toxic gases and vapor in air ,when the system changes its state the device gave the output as alarm and the alarm message to the LCD module and also sends SMS to the mobile device via GSM module.

TITLE: ELECTROMAGNETIC ENVIROMENTAL OF INDUSTRIAL FREQUENCY INTELLIGENT MONITORING SYSTEM IN CITY

AUTHOR : PING LIU

This system is used to monitor the electromagnetic environment of industrial frequency in city for eliminating industrial frequency radiation harm to peoples .It automatically acquire , analyses the measured data and interfaced with PC this system can operate normally in wicked environment and is low loss of power rating and it is fit for distributed and remote monitoring.

TITLE: MONITORING AND ALARM SYSTEM FOR COAL MINE SAFETY BASED ON THE WIRELESS SENSOR NETWORK

AUTHOR : JIANMIN WANG

This paper is describes the monitoring of coal mine safety based on wireless network For the purpose of meeting the requirements of monitoring the signals

,nRF2401 is used for short range wireless communication and GPRS is used for the long distance wireless communication MSP430F149 microprocessor is used to find the disaster happen in coal mines and uses the GPRS to transmit the SMS to the mine command center METHODS AND PROPOSED TECHONOLOGY

The proposed methodology is that a portable device that can be used either as a robot in the mine field or a monitoring system that helps to monitoring the industrial environment condition by using the light weight sensors.

In addition to introducing solution for a remote monitoring of the mine and industries through this device it is an wireless device and send the data that can analyzed through the node microcontroller unit and viewed on the web page that can be created.

IV. RESULTS

In industries the level of temperature increased detect to by comparing ambient air temperature and surface temperature the sensor detects and the cooling fan ON automatically, when sound has exceeded a set point the sound sensor detects it and gave the alarm as indication.

In industries or mine if the toxic gas is detected by the sensing element in the gas sensor it get ionized and it gave an alarm as indication and the cooling fan ON automatically.

In industries at the particular restricted area if there is a

sudden change in ambient condition the sensor detects that and gave the alarm as indicator.

In mines the ultrasonic waves is emitted and the reflected wave is received from the object and the robot turn right or left, the metal detector detects if there is any metallic element is detected and gave an indication as alarm.

All the data that acquired from the system is viewed by using the webpage.

V. CONCULSION

The developed system monitors the real- time concentration of toxic gas , increase in temperature, observing the IR radiation emitted by the object and it is used in mine field to detect the metal and ambient condition . In the absence of sudden environmental changes ,the system is in the normal operating mode of monitoring. When it goes beyond the set values, the system goes to the alarm mode. In the alarm mode, it sends the data to GSM module. It is cost effective and also used a portable device that can be used either as a robot or an industrial

Fig.2 compiled output of wi-fi –Arduino code and get IP address.

Then node MCU is connected to the module and its baud rate is about 9600 bits of data are transmitted per second and the sensed values are given to the IP address of the web page that can be created .

Then the Arduino code is complied the data are transferred

to the IP address of the web page that we created then the wifi
- Arduino code is complied to get the data in the web page the we created as shown in the fig 2 in this the code is complied and it transferred the data that are monitored by the sensor are send to that particular IP address we connected for

the webpage.

Fig.3 output of the module in the node MCU web server.

In the fig .3 the output of the module is viewed that we connected to the webpage through the IP address by the Node MCU (microcontroller unit) interface with the Arduino UNO and all the sensor detail that can be monitored for a particular delay in seconds is received by the web server.

VI.   FUTURE ENCHANCEMENT

We can use surveillance camera in mines to monitor the environmental conditions and get the data about the mines without the direct interaction of humans.

We can use a moist sensor to detect the moisturizing content in the soil to prevent the sudden floods in the mines.

We can use the wireless underground sensor network (WSN) to transmit and received the data through the soil in mines to improve the network facilities in the underground mines.

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