

Industrial Safety System using Internet of Things

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Abstract – The aim of this work is to mitigate the destruction engendered due to fire outbreaks in industries like petroleum, chemicals, oil which leads to loss of life and property. It is very important to have some system that can keep the industry premises secure and also to notify the authorized people within the stipulated time in case of an emergency. Industrial safety system using Arduino (UNO) is designed in such a way that it detects fire using flame sensor, CO leakage using MQ-7 gas sensor, smoke and methane detection using MQ-2 gas sensor, to record temperature and humidity we use DHT-11 sensor, Light Dependent Resistors (LDRs) to know the intensity of light and Global System for Mobile Communications (GSM) is used to send messages and to make calls to the concerned person to alert him about the situation. All these sensors constantly provide their input to the micro controllers connected to them. The micro controller constantly processes this data.

Keywords – IoT, DHT11, GSM, MQ-2, MQ-7, LDR.

I. INTRODUCTION

Internet of Things (IoT) is a network in which all physical objects are connected to internet through network devices or routers and exchange data. IoT allows objects to be controlled remotely across existing network infrastructure. It mollifies human effort and enables easy access to physical devices. It also has autonomous control feature by which any device can control without human interaction. The versatility of IoT has become very popular in recent years because of its low power embedded system, cloud computing, availability of big data networking condition. IoT can be any device with any kind of built-in-sensors with the ability to collect and transfer data.

An industrial safety system is a counter measure crucial in any hazardous plants such as oil and gas, nuclear plants. They are used to protect human, plant and environment in case the process goes beyond the control margin. Mechanical Engineering is primarily concerned with industries and their applications. This prototype will benefit the above requirements. The best way of preventing accidents is to be aware of your surroundings. The environmental care has become one of the prime concerns for almost every country in the last decades.

Even though the number of industrial accident has been increasing in the last few decades, the current scenarios in the industry have not improved. They tend to be more a dangerous environment rather than a safe one even with a wide range of modern technologies. Recently the current industries have been demanding sophisticated instrumentation for monitoring and control of environmental risk parameters in the danger-prone areas. Human safety and property losses are the essential to maintain a balance between industry and industrial environments.

Five main components are the reasons for an accident to occur: the fire, gas leakage, radiation, over voltage and high temperature. An industrial accident usually occurs individually to the above mentioned factors or as the result of their combined effects. In this paper propose, combining the virtual monitoring technology with hazardous risk management together, a wireless multi-sensory monitoring system of hazardous site environment. The function of real-time monitoring is to provide remote-distance hazardous parameters information, display the data, analyze, identify when the parameter cross threshold, provide warning in case of an accident.

II. LITERATURE SURVEY

Accidents occurring in most Indian industries are a source of concern to everyone. Industries that take worker's safety and health issues into consideration have a long run. Palanivelu Rajmohan [1], in his paper a survey was initiated in different industrial sectors to obtain reliable data for the research. The results show that the main criteria "Human safety acquired a weight of 72.5% while the respective weights of primary criteria machine security and work environment safety fall to 8.9% and 18.4%."

It is not only used in industries but also in cold storages. Due to increase in concerns of food safety, supply chain management has been developed to integrate with the refrigeration and environmental monitoring especially in the storage and transportation.

Y. P Tsang, K. L. Choy [2] propounded the IoT model to ensure occupational health and safety, the limited duration exposure and monitoring review cycle can be customized according to the personal health status of worker. In order to ensure the occupational health and safety in cold storage facilities, the IoT environment is

essential to develop the appropriate occupational safety management with real time information exchange and information.

A paper by S. Arun Mozih [3] has demonstrated the feasibility of wireless conditioning monitoring system for application in high voltage electrical substations. This system can be used as a device to measure leakage current and voltage in a variety of equipment.

A paper by Kartik Srinivas [4] in which he implemented industrial safety automation using IoT by successfully integrating industry safety to the digital world.

III. PROTOTYPE

1. Design:

The system consists of a base station and a wireless sensor node. An Arduino UNO open-source micro controller acts as a base station. The board is equipped with sets of digital and analog input or output pins that may be interfaced to various expansion boards and other circuits. Temperature, fire, gas leakage sensors with associated signal conditioners attached to the Arduino controller. The figure.1 shows the block diagram of the system. In this project we are measuring the vital parameters. Any leakage of poisonous gases can be detected and if temperature is increased beyond certain limit it will intimate the concerned person. Similarly, if fire accidents occur then it will intimate to the owner through GSM. GSM, global system for mobile communication, is an open and widely used digital cellular technology. It is basically used for transmitting mobile voice and data service operators at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose.

A GSM digitizes and reduces the data, then it sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 mbps of data rates.

In addition to this we use a buzzer and an LED for intimating the other workers about the accidents.

IV. HARDWARE DESCRIPTION

The Arduino controller consists of main parts of the embedded system. The main characteristic being real time emulation and embedded trace support with an embedded high speed flash memory. The controller processes the incoming data from the sensors and displays the necessary information on the serial monitor.

1. Temperature Sensor—DHT11:

It is a commonly used temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit micro controller to output the

values of temperature (in degrees centigrade) and humidity as serial data.

2. Gas Sensors:

The analog Smoke/ LPG /CO gas sensor (MQ-2) module utilizes an MQ-2 as the sensitive component and has a protection resistor and an adjustable resistor on board. This sensor is sensitive to LPG, i -butane, propane, methane, alcohol, hydrogen and smoke. It could be used in a gas leakage detection equipment in industry. The resistance of a sensitive component changes as the concentration of the target gas changes. MQ-7 sensor is used to detect carbon monoxide concentration in the air anywhere between 10 to 500 ppm. It has high sensitivity and fast response time. The sensor's output is an analog resistance.

3. Fire Sensor:

Flame sensor is the most sensitive to ordinary light that is why its reaction is generally used as flame alarm purpose. This module can detect flame or wavelength in 760 nm to 1100 nm range of light source. The sensor and flame should keep a certain distance to avoid high temperature damage to the sensor.

If the flame is bigger, test it with farther distance. The detection distance is up to 100 cm. The detection angle is 60 degrees so the flame spectrum is especially sensitive. The Flame sensor can output digital or analog signal. It can be used as a flame alarm or in fire fighting robots.

4. Exhaust and Fan:

It is a wiring mechanism used for the circulation of air. It works on the principles of a DC motor. Any leakage of gases is drawn out by the exhaust to the outside. Similarly the fan is used to bring the temperature down if it goes beyond a particular threshold value.

5. Sprinkler and Buzzer:

The sprinkler is a device that is triggered on whenever fire is detected to diffuse the fire. The sprinkler used in the project is required to be immersed in water. As long as the fire sensor is detection the flame, the sprinkler keeps running. The buzzer however will be triggered by every sensor when something is detected. The main purpose of the buzzer is to intimate to the owner about the accident.

6. LED:

It is used as a photo diode light sensor/detector. An LED is a light-emitting diode is a semiconductor light source that emits light when current flows through it.

V. SOFTWARE DESCRIPTION

1. The GSM gets initialized and sends a message to the owner about proper initialization
2. When gas leakage is detected in the industry, the exhaust fan is turned ON and a message is sent to the

user through the GSM system along with warning message on the LCD and buzzer.

3. When the flame sensor detects fire, the controller first displays the warning on the LCD followed by a buzzer, turning ON the sprinkler and finally a message to the owner via GSM system
4. If LDR reaches a value greater than 80 then led will be switched ON
5. If the ppm level of LPG is greater than 4900 then the buzzer and fan will be switched on
6. If the CO levels in the industry are greater than 490 then fan along with led will be switched on
7. If the smoke levels reach a ppm greater than 300, fan and buzzer are switched on and a message along with a call is sent to the concerned person.
8. If flame is detected, buzzer gives out noise and a pump is also included in the arrangement by which the intensity of the accident can be reduced .LED switches on when this happens and a message along with a call is sent to the person in charge.

Block Diagram:

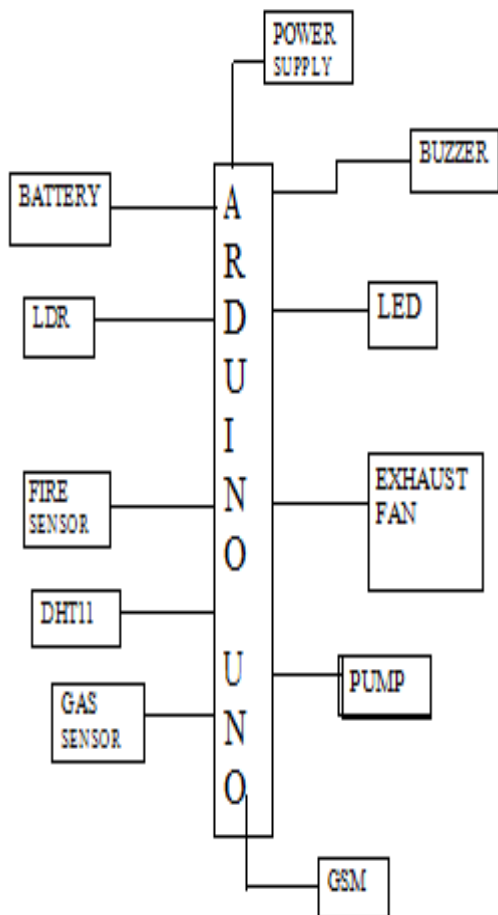


Fig. 1. showing the block diagram.

VI. EXECUTABLE CODE

```
// REQUIRES the following Arduino libraries:
// - DHT Sensor Library:
https://github.com/adafruit/DHT-sensor-library
// - Adafruit Unified Sensor Lib:
https://github.com/adafruit/Adafruit_Sensor
#include "DHT.h" #define DHTPIN 2
#define DHTTYPE DHT11
#include <SoftwareSerial.h> SoftwareSerial mySerial(9,
10); // RX, TX DHT dht(DHTPIN, DHTTYPE);
int smokeA0=A5; int lpg=A4;
int co=A3; int buzzer=8; int led=7;
int flame_sensor=4; int pump=3;
int fan=5;
int flame_detected;
void setup() { Serial.begin(9600);
Serial.println(F("DHTxx test!")); mySerial .begin(9600);
dht.begin(); pinMode(smokeA0,INPUT);
pinMode(lpg,INPUT); pinMode(co,INPUT);
pinMode(flame_sensor,INPUT);
pinMode(buzzer,OUTPUT); pinMode(led,OUTPUT);
pinMode(pump,OUTPUT); pinMode(fan,OUTPUT);
}
void send_sms(String no,String msg){
mySerial.println("AT"); //Handshaking with SIM900
// delay(1000);
mySerial.println("AT+CMGF=1");// Configuring TEXT
mode
Serial.println("AT+CMGF=1");
// delay(1000);
mySerial.println("AT+CMGS=\""+no+"\"");
Serial.println("AT+CMGS=\""+no+"\""); delay(1000);
mySerial.print(msg); delay(1000); mySerial.write(26);
}
void send_call()
{mySerial.println("ATD +919866841244;\r");
Serial.println("ATD +919866841244;\r"); delay(5000);
}
void loop() { delay(2000);
float h = dht.readHumidity();
float t = dht.readTemperature(); if (isnan(h) || isnan(t)) {
Serial.println(F("Failed to read from DHT sensor!"));
return;
}
Serial.print(F("Humidity: ")); Serial.print(h);
Serial.print(F("% Temperature: ")); Serial.println(t);
//////////////////////////////////// int
LDR//////////////////////////////////// int
sensorValue = analogRead(A0);
int ldr = map(sensorValue,3,973,0,100);
Serial.print("LDR: "); Serial.println(ldr);
//////////////////////////////////// int
analoglpg=analogRead(lpg);
int lpgdetect=map(analoglpg,100,10000,300,5000);
Serial.print("lpgdetect: ");
```

```

Serial.println(lpgdetect);

////////////////////////////////////
///
int analogco= analogRead(co);
int codetect= map(analogco,20,2000,10,500);
Serial.print("codetect: "); Serial.println(codetect);

////////////////////////////////////
int analogSensor= analogRead(smokeA0);
int smoke=map(analogSensor,200,10000,300,10000);
Serial.print("smoke: ");
Serial.println(smoke);

////////////////////////////////////
//flame_detected=digitalRead(flame_sensor);
Serial.print("flame: "); Serial.println(flame_detected);

////////////////////////////////////
//
if (ldr>=80)
{digitalWrite(led,HIGH);
}
else
{digitalWrite(led,LOW);
}

if(lpgdetect>=4900)
{digitalWrite(buzzer,HIGH); digitalWrite(fan,HIGH);
}

else
{
digitalWrite(buzzer,LOW); digitalWrite(fan,LOW);
}

if(codetect>=490)

{digitalWrite(fan,HIGH); digitalWrite(led,HIGH);
}
if (smoke>=300)
{digitalWrite(buzzer,HIGH); digitalWrite(fan,HIGH);
send_sms("919866841244","SMOKE DETECTED!!
TAKE NECESSARY ACTION");
delay(5000); send_call();
}

if (flame_detected==1)
{
digitalWrite(buzzer,HIGH); digitalWrite(pump,HIGH);
digitalWrite(led,HIGH);
send_sms("919866841244","FIRE DETECTED!! TAKE
NECESSARY ACTION");
delay(5000); send_call();
}

else

```

```

{digitalWrite(fan,LOW); digitalWrite(led,LOW);
digitalWrite(buzzer,LOW);
}
}

```

VII. RESULTS

The implemented system as shown in fig2 was tested efficiently and tested for proper working. The initialization of the GSM and working of the sensors were verified. Messages were obtained after each alert and corresponding data uploaded on to the cloud storage. The buzzer and sprinkler also worked efficiently.

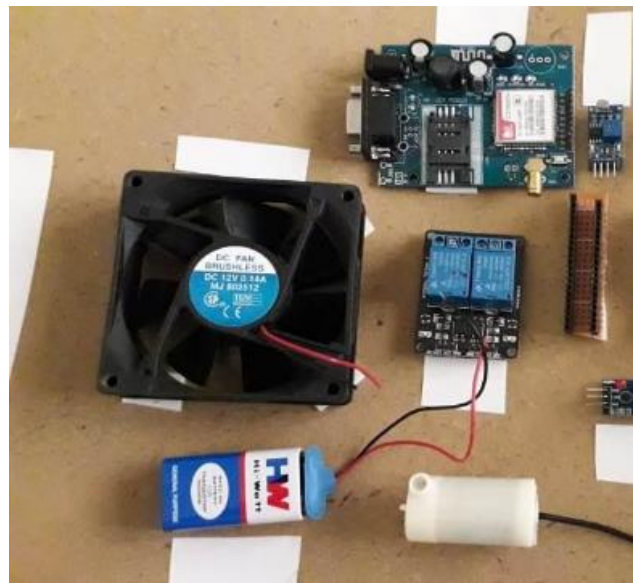


Fig.2. Our prototype.

VIII. CONCLUSION

Industrial Safety Automation using IOT has been implemented successfully. The project is cost effective and can be easily implemented for other real time applications. It can be realized with the usage of less power. This project is secure and user friendly and can be employed by the government in large scale to help industries too. By automating an industry, a safe working environment can be created with the available advanced mechanism and the entire system integrated into one network. The industry is substantially safe from fire accidents, voltage fluctuations and gas leakage.

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