ISSN (Print): 0974-6846 ISSN (Online): 0974-5645

Fire Accident Detection System in Industries

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Abstract

Background/Objectives: Occurrence of natural disasters is unpredictable and needs very high attention. This paper mainly focuses on fire accident detection in Industries and houses and to reduce their severities. Methods/Statistical Analysis: This method has been implemented to detect fire accidents in industries which occur due to increase in temperature, decrease in humidity, release of hazardous gas like methane, butane, propane etc.; we have used DHT 11 sensor to detect temperature and humidity. MQ-2 sensor is to detect gas leakage. GSM module is used as a mode of communication for this method. Findings: We found that the statistical data available from these sensors can be used as a safety parameter and we can set the alert values depending upon the existing readings which we have obtained from the sensors used in the application. Previously we have observed that DHT11 sensor is interfaced to PIC16F877 Microcontroller. Temperature and humidity is monitored by LCD. We have introduced GSM module for Communication purpose. Whenever the Pre-set values are exceeded GSM module is activated through AT Commands sends the alert messages to mobile phones which we have already pre-loaded in the program. So that it can detect the fire accident occurred at particular location where we place the sensors. For this, we use ARDUINO UNOR3 development board which consists of ATMEGA 328 P-PU a 16 Bit Microcontroller programmed using ARDUINO IDE. All the sensors are interfaced to ARDUINO board and testing and verification is done several times to observe the accurate readings from the sensors. Applications/Improvements: By using this method, temperature and humidity measurements are monitored and the problem can be detected very easily. So we can take necessary precautions to reduce the fire accident.

Keywords: DHT11, Gas, Humidity, MQ-2, Temperature

1. Introduction

The main objective of this system is to prevent Fire accidents which may cause loss of Property and human life. So, we proposed a system which measures and records the parameters like temperature, humidity, and gas levels using appropriate sensors like DHT11 and MQ2 without any human intervention. The data is collected by ARDUINO and displayed on the liquid crystal display continuously. We used ARDUINO UNO R3 development board because of its simple programming, low cost, less power consumption, memory, on chip ADC, on chip PWM, In System Programming (ISP). The communication between Arduino and PC is done through serial communication using serial communication port

of the computer. The present work is the extension of earlier developments to develop a fire accident detection system. GSM is mainly based for remote monitoring and sensing purpose to use efficient parameters to attain maximum automation of system.MQ2 gas sensor has gained its popularity due to its low cost and efficient performance. A cycle of temperature and gas variant values are observed in Real time by which we can send the alert depending upon those values. In previous research, temperature monitoring system was developed to monitor a server room which just acquires data and monitored on PC. In¹ proposed GSM BASED Temperature and water level monitoring system to detect the water level and temperature in the industries using PIC microcontroller. This paper represents the temperature level of water in par-

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ticular tank. The message of temperature level in water is sent to mobile phones using GSM modem. In² proposed a system for remote monitoring and control based on GSM and Bluetooth technology and used efficiently to monitor and control the field parameters required for automatic irrigation. In³ Proposed an Environmental effect system caused by Humidity and temperature. This shows how Temperature, Humidity factors will change the strength of Signal. The accuracy is calculated by depending upon the different points. In⁴ proposed a Micro Controller based room temperature monitoring system using GSM and GPRS Interfacing. In⁵ explained the working of weather monitoring and controlling system using ARDUINO by connecting to web. In proposed a greenhouse monitoring system using DHT11 and Soil Moisture sensor. In⁷ proposed a system for greenhouse monitoring system which controls the temperature using fan and sends the alert SMS using GSM module.PIC16F877 is used to develop this system. In proposed a system for the implementation of weather monitoring and controlling. It works on ARM module used by DHT11 Sensor and sends the Reading through GSM module. In⁹ Proposed a real time weather monitoring and controlling system. Pressure sensor and humidity sensor used as main components to display the values and send the message using GSM module. LM 35 and DHT11 sensors were used to detect temperature and humidity. This is limited to small area and it is not an alerting system. This is an alerting system using GSM Module. LM35 which is unnecessary is removed as temperature and humidity can be measured using DHT11 and a gas sensor is included. All the data is collected by the micro controller and displayed on LCD continuously and whenever there is change in pre-set values alert message will be sent to the given mobile numbers in the codes. Whenever

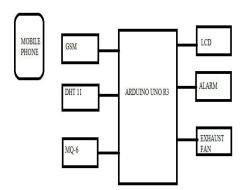


Figure 1. Block Diagram.

gas is detected EXHAUST FAN will be ON. Alert using GSM is implemented by maintain certain mobile numbers using AT commands. This activates the network in between the GSM module and Prototype. Whenever the message is sent it again checks for Fire Shutdown and sends safe message.

2. Block Diagram

The typical block diagram is explained as shown in Figure 1.

2.1. DHT11 Sensor

DHT11 is used for sensing Temperature and Humidity. It has a thermistor and capacitive humidity sensor to measure the humidity and surrounding air. Sensor readings can be 2 seconds old.

Features

- Low Cost.
- 3-5Volts Power and I/O.
- 2.5mA maximum current is used.
- Good of 20-80% Humidity with accuracy of 5%.

DHT11 sensor module is shown in Figure 2.



Figure 2. DHT 11 Sensors.

Temperature and humidity parameters are observed from Table 1.

Table 1. Importance of different parameters

Item	Properties		
	Measuring Range	Humidity Ranger	Package
DTH11	20-90%RH	±5%RH	4 Pin

2.2. MQ-2 Sensors

The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. This produces an analogue output signal. MQ-2 Gas Sensor is widely used in home and industries for detecting the gases like LPG, butane, propane, methane, alcohol, hydrogen and smoke with accuracy of 2%.

Gas Detection Sensor MQ-2 is represented as shown in Figure 3.

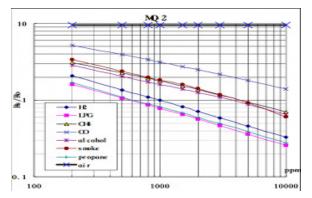


Figure 3. Variations of Gas sensing Element.

2.3. Arduino Uno R3

Arduino Uno R3 consists of a microcontroller ATMEGA 328 P-PU which has 14 digital I/O pins where 6 pins can be used for Pulse Width Modulation (PWM).it has 16 MHz crystal oscillator on-board. The communication between Arduino and computer is done through serial communication. It is a plug and play device which functions with both USB cable and +12 V DC power supply. Arduino is reliable and low cost. ARDUINO IDE is open source software to program the microcontroller. It has many other special features like On-Chip ADC. I2C Communication support built in RX and TX pins used for communication purpose. ATMEGA328 P is an AVR 8-Bit microcontroller which is used in Arduino for programming. It supports Advanced RISC Architecture which can support up to 131 high end instructions with Fully Static Operation. This RISC Architecture has 20 MIPS Throughput at 20 MHz Frequency. It has High End Non-Volatile Segmented Memory. It has 4/8/16/32/64 Self-Programmable. In System Flash Memory. It also provides programming Lock for Software Security. It has 2 8-bit Timer/Counter with Separate Pre-Scalar Compare mode and 16 bit Timer/counter with capture mode. It has 6 and 8 channel temperature measurement unit. Programming process is done as Master/Slave SPI Interface. It has On-Chip Brown out Reset, Interrupt and Wake Up on Pin change. Internal calibrated oscillator is available with six sleep modes like: Idle, Power Down, ADC Noise reduction, Power saver mode and both Standby mode and Extended Standby

modes. It consumes less power while compared to 8051 and PIC Microcontroller of 1.8 to 5.5V which is approximately equal to 25 degrees Centigrade.

Typical Arduino Uno R3 Pin out is shown in Figure 4.

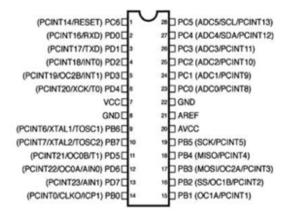


Figure 4. Pin out Diagram of ATMEGA 328 P-PU.

2.4. GSM Module

GSM modem is used for the wireless communication process in typical embedded systems. It sends and receives the SMS through the module. We can update the statuses of the devices by enabling the commands. Output power class is up to nearly 850/900MHz frequency. Supply voltage is very less for the operation. It has a built in microphone and Tran's receiver to receive the voice calls too. We can communicate same as a mobile phone using regular carrier charges. It has an antenna connector through which it acquires the network of ranging 50 OHM. It has 10 general I/O ports and a bidirectional port of using CMOS technology. External sim slot is provided with the unique hardware IMEI number to activate the network that which the modem works accordingly. GSM Module uses RS-232 communication to connect with embedded devices. Power supply may be driven from battery on 12 volts DC adapter. Using the general career the GSM module activates the network and transfer call and message functions are done. Incoming message of GSM modem is observed in the virtual terminal or serial monitor of the PC. Specific IMEI is assigned to differentiate the modem. We have different features like

- Conditional Call Bearing Forward.
- Charge Advising.
- Wait and Hold of Calls.
- Calling Line Identifier Presentation.

- Calling Line Identifier Restriction.
- Unstructured Sequence Shift Mobile.
- User Group with Closed Access.

2.5. LCD

The LCD controller is a cathode device which displays the data for some typical embedded systems. LCD screens are manufactured in several standard preferred configurations. Common sizes are 16X2, 20X2; 20X4.Basic cathode display and VCC connections are added for activating the cursor lines. Data can be scrolled and changed on the air by programming the appropriate LCD data code.16 characters in 2 rows can be printed so the data can be scrolled from one end to another end. Generally we have 16X2 and 16X4 LCD's for displaying the long characters. We can observe the multiple lines of data in single LCD which makes the interface easy and Precise.

3. System Software

We have used ARDUINO IDE for programming and PROTEUS professional 8 for simulating the system. The PROTEUS design suite is unique software which has the ability to simulate any kind of microcontrollers either high end or low end using the concept of mixed mode SPICE simulation. This is a virtual system which yields better design cycle of the designed system which helps in reducing the time to design and complex developing environment. It means, VSM helps to increase efficiency, quality and flexibility throughout the design process. PROTEUS is popular because almost all the microcontrollers are available in it and any device can be included into the software if needed by including the library files

of the required device. So that, the library files acts as an interface between the simulator and complier. Using this PROTEUS software we can design any kind of hardware circuit virtually and then we can implement that on board after verifying the simulation.

4. Methodology

This flow chart represents the complete functionality of the data acquisition system that we have proposed using Arduino. The water level and temperature level is observed through Arduino and the status will be displayed in a 16X2 LCD. Hardware mapping is done with respect to the code we have developed for Arduino. Testing and debugging is done several times to obtain exact response. This method reduces the errors and increases efficiency due to monitoring the system several times. The detailed flow chart representation of the module is explained in Figure 5.

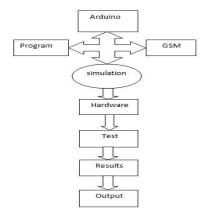


Figure 5. Flow Chart.

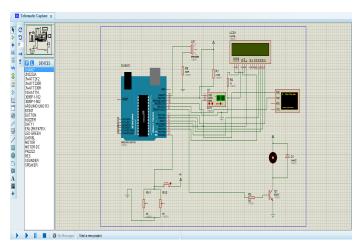


Figure 6. Circuit Design in Proteus.

5. Simulation

Circuit Diagram of Fire Accident Detection System is shown in Figure 6.

Proteus simulation checks for the temperature and gas leakage as shown in Figure 7.

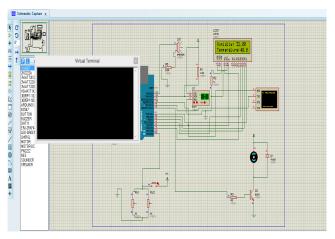


Figure 7. Before Fire Accident and Gas Leakage.

Fire accident detection is observed and message is sent through virtual as shown in Figure 8.

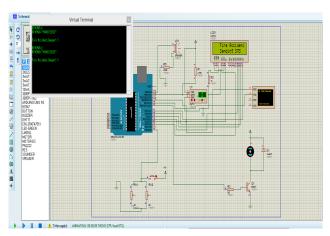


Figure 8. Fire Accident detection with SMS.

Gas Leakage Detection is observed and message is sent through Virtual terminal as shown in Figure 9.

6. Conclusion

The number of sensors is not limited and we can extend this application using more number of sensors with the help of serial communication protocols like I2C, CAN, etc. also, this values can be monitored from anywhere in the world using IOT technology by interfacing our system to the web.

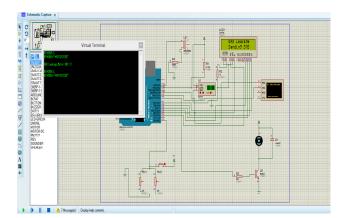


Figure 9. Gas Leakage Detection with SMS.

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