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Research Paper

Algorithm to read various sensors to detect the hazardous parameters in industry

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Abstract

In the construction and coal mine industry various accident statistics indicates the fatalities and serious injuries due to the hazardous confined areas. The most cases occurs due to the lack of the oxygen, poisonous gases and temperature extremes shown in the review of international safety regulation review which has the major contribution to make these area hazardous. In order to reduce these health and safety hazards the works proposed is based on the wireless sensor area network technology to monitor various parameters which may lead to hazardous condition so that the early warning of hazards can give and casualties which occurs unknown parameters may reduce. The developed model having the database design with management to monitoring system with the help of desktop application. The hazardous indication warning is transmitted to base station by different wireless node and received at base station.

Keywords: *WSN; Arduino; Hazard Monitoring; Zigbee.*

1. Introduction

In the major industry which works under various accidental prone areas, the health and safety hazards experiences rates in these area are very high. International safety regulation report shows that the coal mine and construction industry experience the highest accident rates among all of the other industry [1]. One of the report shows that some of the accident that occurs due to the unique nature of the industry where workers need to be work in predefined hazardous environment [2]. There are another numerous condition like human behavior, bad safety management, unsafe work method, wrong procedure and difficult side condition [3]. The main emphasis need be done over the comprehensive health and safety program and deployment of the communication technologies to improve the safety performance of the coal mine and construction industry [4]. The major accident that occurs in the coal mine industry are lack of oxygen or some poisonous gases which initially do not effect human body till the human body reaches to the highest malfunction level so these gases parameter need to be monitor at initial level [5]. Coal mining has been a very dangerous activity, underground mining hazards include gas explosions and suffocation which leads to death of coal miners every year and figures are very alarming [6]. There are another parameter like automatic fire detection is very important for the industry and there are ample studies investigating the best sensor combination and numbe o0f techniques to provide early warning of the fire [7]. There is an inverse modeling approach with a two zone model that is used for the forecasting of the compartment fire. Sensor observation are assimilated in to model in order to estimate invariant parameter [8]. Technische Universität Darmstadt present a new serious gaming approach based Building Information Modeling for the exploration of the various effect of construction company on human behavior during the evacuation process. In some studies the data provides that the CO sensor in the detection provides the faster response than that of the fire sensor to real fire and at the same time provide the batter nuisance alarm immunity compares to the other type of fire sensor [9]. The system developed with multiple individual node and a combined single node that monitor the various hazardous parameter in the industry and provide the data of these sensor over the display and at the same time warn against or provide pre indication of the hazardous condition. The individual data is display over the individual node with indication system like RED or GREEN lamp that provide the current state of the condition and real time actual data displayed over the Liquid Crystal Display. The major combine d node comprises of the all the multiple sensor embed over a single node and their data display over the LCD and warning provided by mean of the alarm. In addition the proposes system sends the data of these nodes to a remote location through zigbee and warning system at the base station.

2. Hardware development

For the design of the whole network there are number of data nodes requires which detect the hazardous parameters and sends the data to the base station.

2.1. Node1 intrusion detection

In the hardware development the various wireless sensor nodes are developed with the open source Arduino Uno open source platform. The fig. shows the schematic diagram of the wireless sensor node in which the PIR sensor is connected with the module. This node is placed in the area where human are not allowed to enter which may lead to hazard to human so in order to avoid the accident whenever any person enter the restricted area the PIR sensor detect the intruder and send signal to the base station through the zigbee. At the same time there are indicator over the circuit that intruder gets warning through the Red Light indication that the area is restricted to any person.

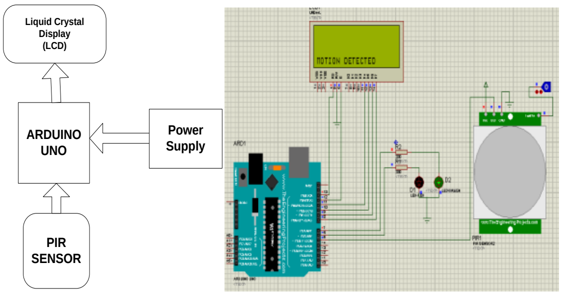

Fig. 1: Individual Block Diagram to Read Pir Sensor and Circuit Schematic.

2.2. Node2 fire detection

The figure below shows the second node that detects the fire in the vicinity of the device. This type of sensors are placed in various location that monitor the fire and in case due to any accident the fire occurred it sends the data to base station and at the same time an indicator like buzzer or Red light indication may warn the base station or the worker about the fire. The system is designed using Arduino Uno and fire sensor is connected across the digital pin of the controller so whenever the fire occurred the controller detect the status of the pin and sends data to the base station and at the same time provide warning at the node by the alarm or any means of indication.

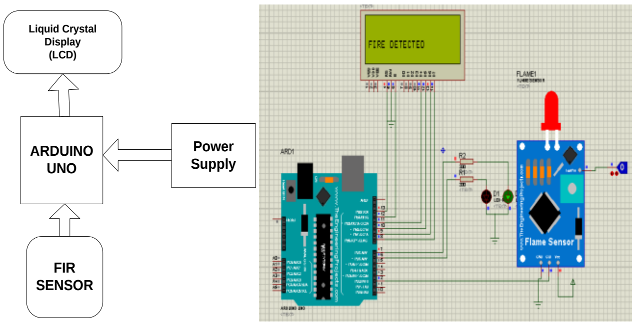

Fig. 2: Individual Block Diagram to Read FIRE Sensor and Circuit Schematic.

2.3. Node3 temperature detection

The third node is developed across the Arduino Uno which detects the temperature of the hazardous environment. For the temperature measurement there are numbers of industrial sensor available that detect the data. The temperature is analog in nature and provides the analog value so controller needs to convert this analog value to the digital by means of the ADC. The ADC of Arduino Uno is 8 bit wide so it divide the incoming data into 1024 levels and provide these levels corresponds to the measured temperature. In this module the measured temperature data is provide over the Liquid Crystal Display (LCD) and at the same time sends the data to the base station. So in case the hazardous temperature level reached it may triggered an alarm so that capsulitis do not occurred.

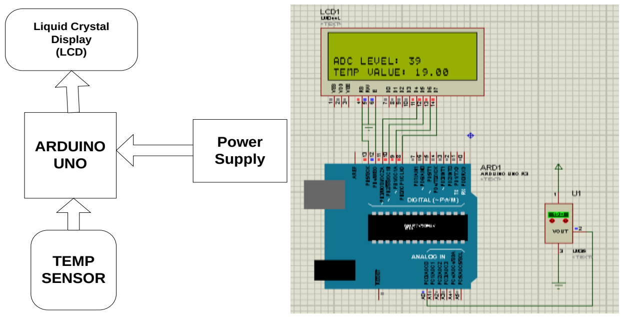

Fig. 3: Individual Block Diagram to Read TEMP Sensor and Circuit Schematics.

2.4. Node4 alcohol detector

The node 4 is designed to detect the alcohol. In many cases the workers enter to the work area in drunk condition and which may cause to the large accidents so to avoid these type of situation this node is need to place at the entry level so that whenever any such case occurs the system detect the alcohol and warned the safety authorities to avoid that particular person to enter into the work area. The system having alcohol sensor which can be read as analog or at the digital level. In digital case system set a threshold value of the alcohol and if the alcohol found above the threshold level then system triggered the device and provide the indication of the drunk or alcoholic state.

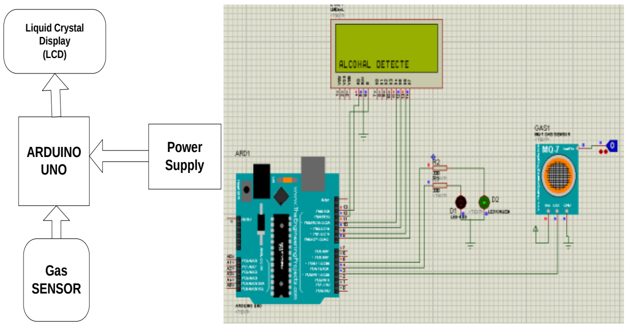

Fig. 4: Individual Block Diagram to Read Alcohol Sensor and Circuit Schematic.

2.5. Combined major node

The combined major node consists of all the sensors with a single Arduino Uno System. The multiple sensors provide the different data that is read by the system through different pins. Analog sensors read by ADC and digital sensors read at digital pins. In the more system the control algorithm become a bit complex due to a large data is generated by the system. In order to handle this large data the system need to be very accurate and efficient so that no legacy occurs in the system. The collected by the system ids stored in the EEPROM of the system until it stored in the external storage unit or transmit to the remote location through serially. Once the dat is stored or sent to the external world the system refresh its memory location erase the previous dat and stored the newly generated data.

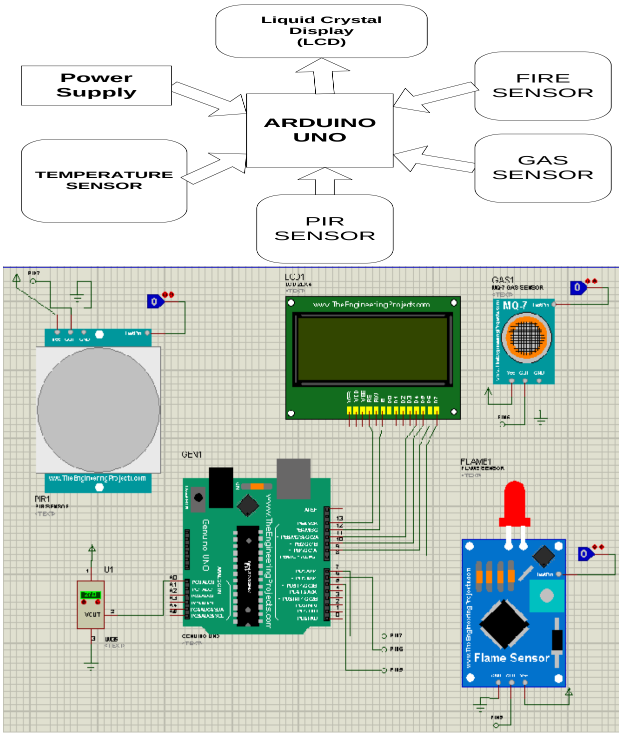

Fig. 5: Block Diagram of Combined Sensor in One System and Its Schematic.

3. Software development

In the software development the system required the precise and accurate algorithm to be developed for the appropriate working of the system. Figures below shows the algorithm for the individual node and for the combined node.

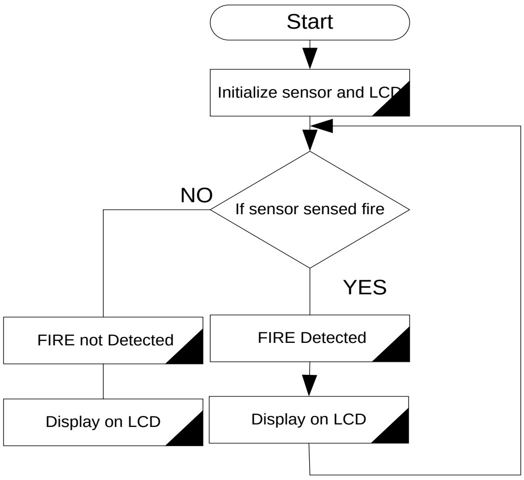

Fig. 6: Flow Chart of FIRE Detection.

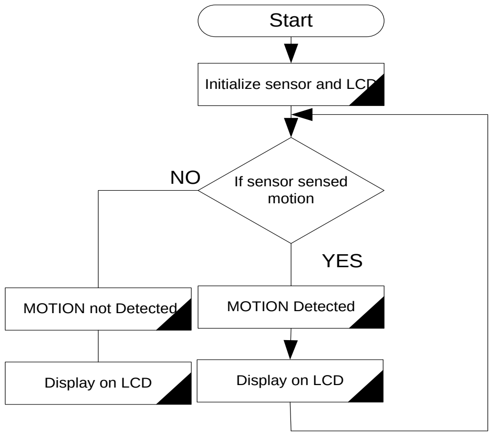

Fig. 7: Flow Chart of Motion Detection.

In the fire detection the algorithm checks for the fire data and display it over the LCD. If the fire occurred then its display and at the same time may warned through the alarm. Same algorithm occurred in the case of Motion detection but in this case the digital data need to be measured and if motion detected then warned the intrusion detection.

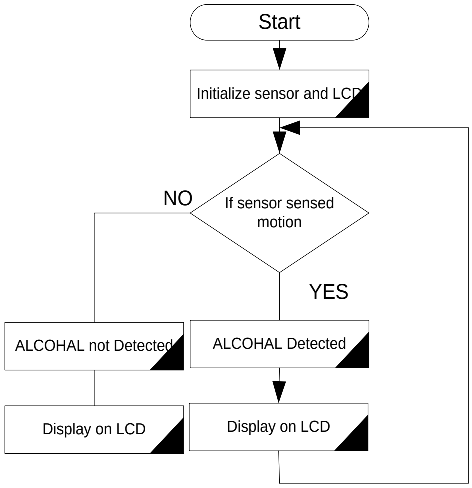

Fig. 8: Flow Chart of Alcohol Detection.

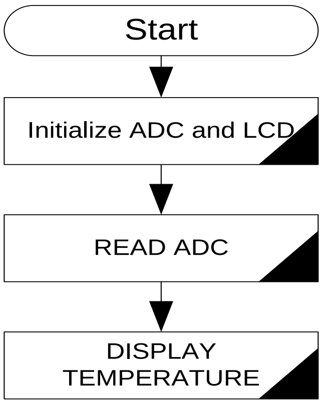

Fig. 9: Flow Chart of TEMP Detection.

In the alcohol detection and temperature detection the system read the analog level and display these levels over the LCD and set a limit of these values if the levels increased above the defined levels then warning may provide.

3.1. loop () function to read fire sensor

```
void loop ()
{
```

```
int FIRE_SENSOR_LOW_READ = digitalRead(FIRE_SENSOR_LOW);//read the pushbutton value into a variable
if (FIRE_SENSOR_LOW_READ == LOW)// Read PIN 5 as LOW PIN
{
lcd.clear();
lcd.setCursor(0, 2);// set cursor to column0 and row2
lcd.print("FIRE DETECTED ");// Print a message to the LCD.
digitalWrite(RED_LED, HIGH);//High PIN3
digitalWrite(GREEN_LED, LOW);// Low PIN2
delay(20);
}
else //otherwise
{
lcd.clear();
lcd.setCursor(0, 2);// set cursor to column0 and row2
lcd.print("FIRE NOT DETECTED ");// Print a message to the LCD.
digitalWrite(GREEN_LED, HIGH);//High PIN2
digitalWrite(RED_LED,LOW);//Low PIN3
delay(20);
}
}
```

3.2. loop () function to read PIR (motion) sensor

```
void loop()
{

int PIR_SENSOR_LOW_READ = digitalRead(PIR_SENSOR_LOW);//read the pushbutton value into a variable
if (PIR_SENSOR_LOW_READ == HIGH)// Read PIN 5 as LOW PIN
{
lcd.clear();
lcd.setCursor(0, 3);// set cursor to column0 and row2
lcd.print("MOTION DETECTED ");// Print a message to the LCD.
digitalWrite(RED_LED, HIGH);//High PIN3
digitalWrite(BLUE_LED, LOW);// Low PIN2
delay(20);
}
else //otherwise
{
lcd.clear();
lcd.setCursor(0, 3);// set cursor to column0 and row2
lcd.print("MOTION NOT DETECTED ");// Print a message to the LCD.
digitalWrite(BLUE_LED, HIGH);//High PIN2
digitalWrite(RED_LED,LOW);//Low PIN3
delay(20);
}
}
```

3.3. loop () function to read alcohol sensor

```
void loop()
{

int ALCOHAL_SENSOR_LOW_READ = digitalRead(ALCOHAL_SENSOR_LOW);//read the pushbutton value into a variable
if (ALCOHAL_SENSOR_LOW_READ == LOW)// Read PIN 5 as LOW PIN
{
lcd.clear();
lcd.setCursor(0, 3);// set cursor to column0 and row2
lcd.print("ALCOHAL DETECTED ");// Print a message to the LCD.
digitalWrite(RED_LED, HIGH);//High PIN3
digitalWrite(GREEN_LED, LOW);// Low PIN2
delay(20);
}
else //otherwise
{
lcd.clear();
lcd.setCursor(0, 3);// set cursor to column0 and row2
lcd.print("ALCOFHAL NOT DETECTED ");// Print a message to the LCD.
digitalWrite(GREEN_LED, HIGH);//High PIN2
digitalWrite(RED_LED,LOW);//Low PIN3
delay(20);
}
}
```

3.4. loop () function to read temperature sensor

```
void loop()
{
TEMP_sensor_ADC_Value = analogRead(TEMP_sensor_Pin); // read the value from the sensor
float TEMP_sensor_Value_ACTUAL=TEMP_sensor_ADC_Value/2;
lcd.setCursor(0,2);
lcd.print("ADC LEVEL:");
lcd.setCursor(11,2);
lcd.print(TEMP_sensor_ADC_Value);
lcd.setCursor(0,3);
lcd.print("TEMP VALUE:");
lcd.setCursor(12,3);
lcd.print(TEMP_sensor_Value_ACTUAL);
}
```

4. Result and conclusion

The developed system provides the various parameters of the hazardous environment with different nodes developed and provide the application to improve the health and safety hazards in the accidental confined area in coal mine and construction industry. The developed system is not responsible for parameter monitoring but it also provides the early warning and the alarm system to reduce the causalities. The whole prototype developed with the individual node and with combine node and the result checks with each individual node and combined node. Fig4 shows the APP on cloud using BLYNK to detect fire and corresponding on the hooter.

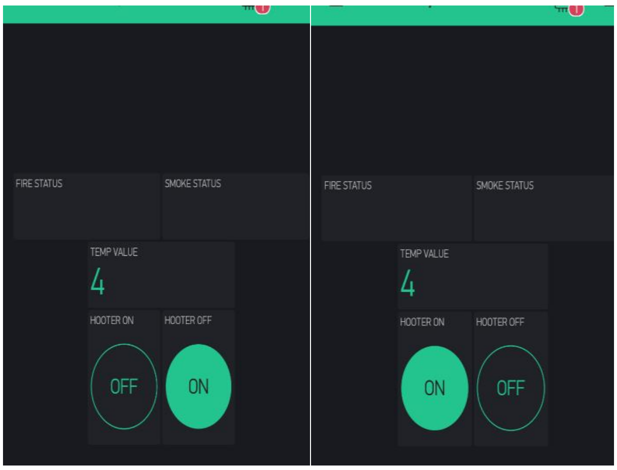

Fig. 4: APP on Cloud Server.

5. Conclusion and future scope

In the developed system the practical nodes deployed and their feasibilities checked by real time data acquisition. The various nodes data is measured and the hazardous situations developed to check the result of the nodes and the system provide the 97% accuracy at the various hazardous condition

The proposed research has a vast future scope like the data from the individual sensor and from the combined module may monitored at remote location through various wireless protocol or in latest trends of cloud computing this data may upload to the cloud so that the monitoring of the system can done throughout the world wherever the internet facilities is available.

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