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Iot Based Fire Detection And Prevention System With Wireless Communication

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Abstract: The purpose of this system is to prevent loss of property and life due to fire hazards caused by natural fire, accidental fire, and short-circuit fire. The Internet of Things (IoT) is a collection of wired, Internet-enabled computers. The wide range of sensors in this paper will be used to detect fires and watchmen and fire officials. This system includes NodeMCU with esp8266 Wi-Fi module based on microcontroller, flame sensor to detect the fire flame, humidity sensor to measure the temperature and moisture, gas sensor to sense the smokes, water pump to automatically sprinkle over the fire and blynk application to use the alerting messages on mobile phone. The problem with using the system is that the whole system stops working when the power fails.

***Key Words* - NodeMCU, Internet of Things, Blynk application, Flame sensor, Gas sensor, Humidity sensor, Water pump.**

I. Introduction

Fire is very harmful, resulting in the destruction of human life and property. Fire detection systems are important to mitigate the loss of properties caused by induced fire. The number of fire injuries has been gradually decreased with the use of more advanced fire warning devices. For preventing the hazards of fire, it is needed to know the fire alarm at the same time. The Internet of Things is a series of sensors, actuators, apps, home appliance-embedded electronics, physical devices and vehicles that attach to each other to attach and share dates, helping to improve the performance of ordinary equipment using computer-based systems. It aims not only to increase a device's performance, but also to have economic benefits (P.J. Vivek, 2014). By designing smart gadgets and using IoT communication gain better result to make for our daily life. An IoT-based fire alarm and prevention system is created with additional methods of protection and verification in this article. The flame sensor senses fire when the fire starts to burn. The gas sensor senses some CO2like flammable gas. The humidity sensor senses any unexpected changes in the temperature and humidity of the room. Using a NodeMCU, the networking and data compilation is complemented in this system. When a suspicious behavior is observed by the sensors, sends message to the user from the phone about the condition of the environment. All sensors in the vicinity area will be active when the fire is identified and order to stop the routine activity. The sensors are fitted with a limited wireless communication range. As soon as the signal is received, the data is transferred from one sensor to another. Finally, the whole system is constructed and designed for using in our daily life (Dominik Meyer, 2016).

II. METHODOLOGY

Basically, the design and development of this system are divided into two main parts: hardware architecture and software details. In the hardware architecture, the design of the circuit was constructed and the prototype of the system was built. While in the software development, the whole complete prototype was operated via programming codes.

2.1. Hardware Architecture

NodeMCU is an open source development board and firmware based in the widely used ESP8266-12E Wi-Fi module. It allows user to program the ESP8266 Wi-Fi module with the simple and powerful Lua programming language or Arduino IDE. With just a few lines of code user can establish a Wi-Fi connection and define input/output pins according to user's needs exactly like Arduino, turning user ESP8266 into a web server and a lot more. It is Wi-Fi equivalent of ethernet module. With its USB-TTL, the NodeMCU Dev board supports directly flashing from USB port. It can be used as access point and /or station, host a Webserver or connect to internet to fetch or upload data. Figure 1 shows the NodeMCU board that is used throughout the system.

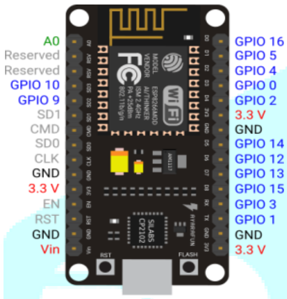


Figure.1. NodeMCU

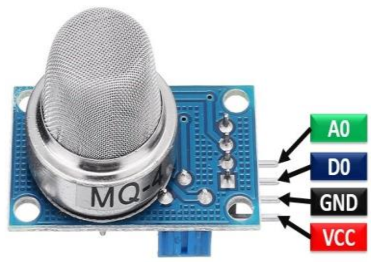


Figure.2. Gas sensor

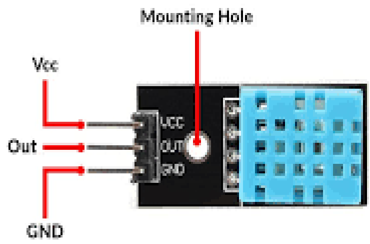


Figure.3. Humidity sensor

The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of a microcontroller. The gas sensor module is useful for gas leakage detecting in home and industry. Some modules have a built-in variable resistor to adjust the sensitivity of the sensor. The resistance of the sensor is different depending on the type of the gas. The smoke sensor has a built-in potentiometer that allows user to adjust the sensor sensitivity according to how accurate user want to detect gas. It was used in this system work for the detection of LPG and smoke in the building. Figure 2 shows the gas sensor before connecting to the NodeMCU board.

Humidity is a very important feature in detecting a fire. In case fire the air will be dry thus decreasing the humidity. This decrease in humidity can give us indication of fire. DHT-11 uses resistive type humidity measurement component. The DHT11 and DHT22 sensors are fairly easy to connect. Although supply voltage ranges from 3.3V to 5.5V, 5V supply is recommended. Humidity sensing component is used, of course to measure humidity, which has two electrodes with moisture holding substrate (usually a salt or conductive plastic polymer) sandwiched between them. Higher relative humidity decreases the resistance between the electrodes, while lower relative humidity increases the resistance between the electrodes. In the Arduino IDE, enter and will print the temperature and relative humidity values on the serial monitor. The DHT-11 sensor can be used to detect humidity in the range of 20 - 90% RH with the accuracy of ±5% RH. Figure 3 shows the humidity sensor before connecting to the NodeMCU board.

Flame sensor is a device which is used to detect the presence of fire in its surrounding. There are many types of flame sensors available such as infrared flame sensor, ultraviolet flame sensor etc. Infrared flame sensor consists of a photodiode coated with black epoxy which makes it sensitive to the infrared radiations having wavelength between 700 nm to 1 mm and can detect fire up to distance of 100 cm within 60 degrees of angle of detection**.** This photodiode is based on a three terminal photo transistor. Every object including the "fire" emits some number of infrared rays which are detected by the photodiode. An operation amplifier is attached across the photodiode to detect the change in voltage. If the voltage detected is zero it gives digital output "1" and if it detects some voltage in case of fire, then it gives digital output as "0". In this system we will be using infrared flame sensor to detect the fire. Figure 4 shows the flame sensor before connecting to the NodeMCU board.

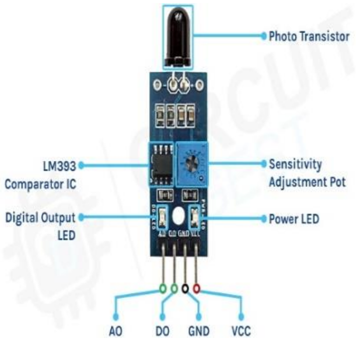


Figure.4. Flame sensor

Figure.5. Internet of things

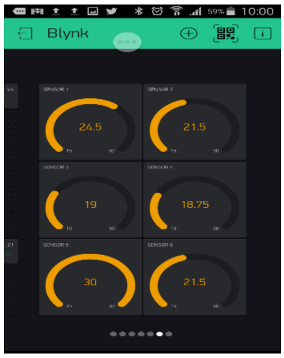


Figure.6. Blynk application

The term IoT, or Internet of Things, refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud, as well as between the devices themselves. The Internet of Things integrates everyday “things” with the internet. As computing devices shrank in size, these chips also became smaller, faster, and smarter over time. The cost of integrating computing power into small objects has now dropped considerably. A whole industry has sprung up with a focus on filling our homes, businesses, and offices with IoT devices. These smart objects can automatically transmit data to and from the Internet. All these “invisible computing devices” and the technology associated with them are collectively referred to as the Internet of Things. Figure 5 shows the internet of things which is connected to wireless communication.

Other than the main two components mentioned, another component which is essential in this system is the blynk application. Blynk is designed for the Internet of Things.It can control hardware remotely,it can display sensor data, it can store data, visualize it and do many other cool things.Figure 6 shows the Blynk application which is used to display the values of humidity and gas.It alerts alarm messages on the mobile phone while the fire burns to start anytime.

The dc water pump motor is a low cost, small size submersible pump motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 liters per hour with very low current consumption of 220 mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. It can be used to sprinkle fire in the room. Figure 7 shows the water pump before connecting to the relay module.

Figure.7. Water pump

Figure.8. Power supply

The power supplies (or 5V DC power supplies) are one of the most common power supplies in use today. In general, a 5V DC output is obtained from a 50VAC or 240V AC input using a combination of transformers, diodes and transistors. 5V power supplies can be of two types: 5V regulated power supplies, and 5V unregulated power supplies.5V regulated power supplies come in three styles: Switching regulated AC to DC, Linear regulated AC to DC, and Switching regulated DC to DC. It can be powered to the whole system. Figure 8 shows the power supply before connecting to the whole system.

Figure 9 shows the block diagram of IoT based fire detection and prevention system with wireless communication while figure 10 displays the hardware architecture of the system. The hardware design details of two main component includes that one is the connection between NodeMCU and Blynk application, and then another is the connection between NodeMCU and sensors. When the fire starts to burn in the room, humidity sensor detects the humidity and temperature, the gas sensor senses the flammable gas inside the room as well as the flame sensor senses the flame. After the sensors senses the condition of the burning, they will directly send the signals to the NodeMCU informing the condition of the fire. The sensor values will be displayed on LCD to know the user about the situation through the NodeMCU board and then the warning message will be sent promptly to alert the user know the fire alarm. At the same time, the pump will automatically sprinkle water while the burning in the room.

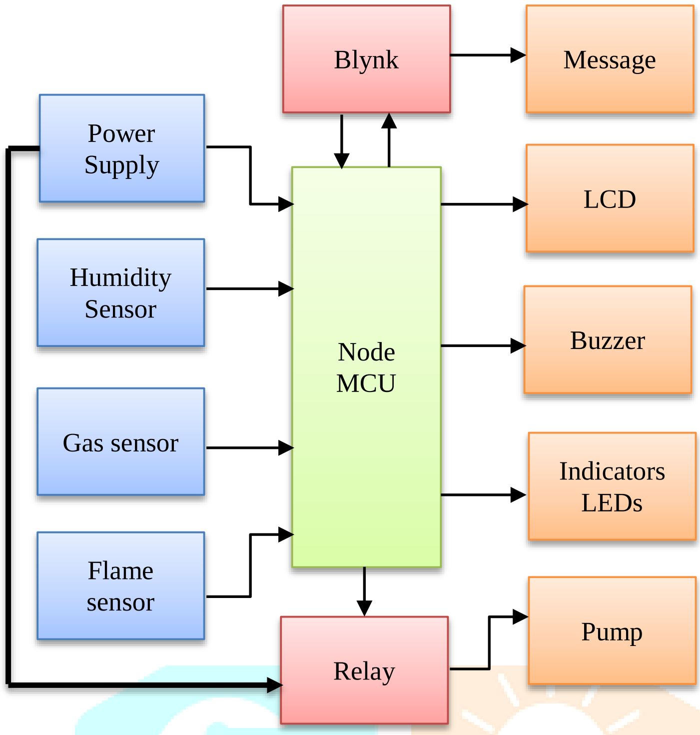


Figure.9. Block diagram of the system

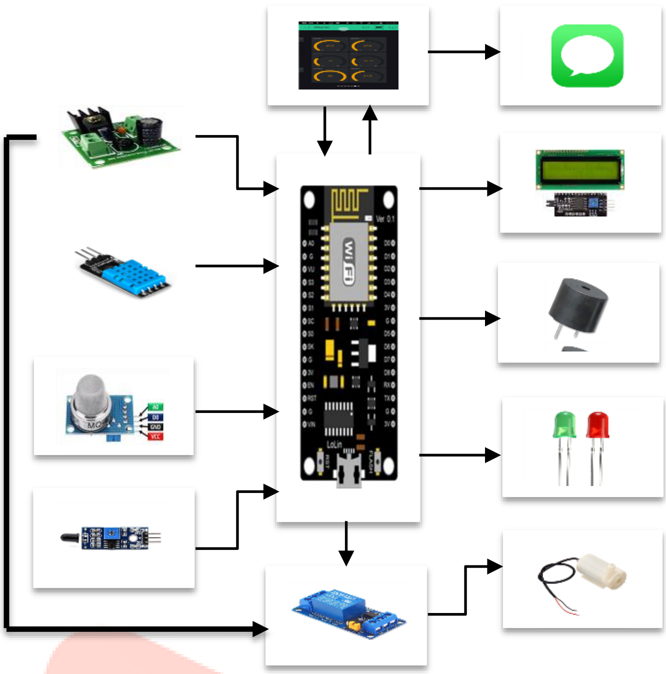
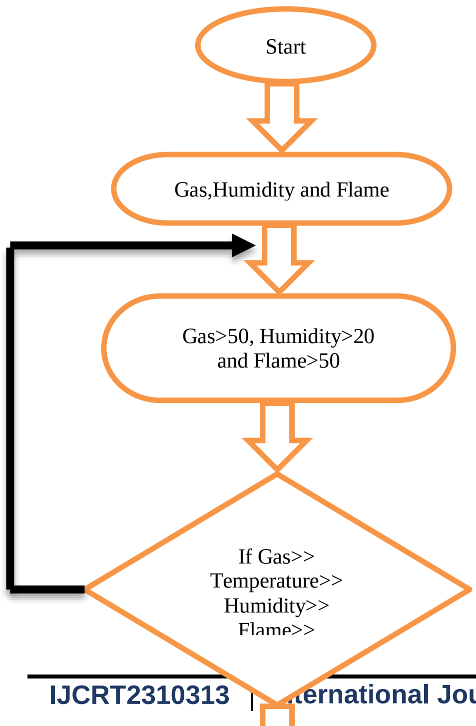


Figure.10. Hardware architecture of the system

2.2. Software Architecture

In this work, the program is written in Lua programming language to work the whole system. After the code is written in Arduino IDE, it is verified, uploaded and then the system starts. The Microsoft word is used to draw block diagram and flow chart. The program of microcontroller reads the program and sends the data to the indicator LCD display and sends the message to the phone. After connecting microcontroller USB via into computer, it will choose board and port. Then it will compile and upload the program. Figure 11 and 12 illustrate the flowchart of the system and the pseudo codes. By referring to both figures, the completed program can be constructed in later in the Arduino IDE software.




```
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>
DHT dht(D3, DHT11);
#define BLYNK_PRINT Serial
LiquidCrystal_I2C lcd (0x27, 16, 2);
char auth[] = "";
char ssid[] = "";
char pass[] = "";
BlynkTimer timer;
void setup() {
  pinMode(Flame, INPUT);
  pinMode(Gas, INPUT);
pinMode(Relay, OUTPUT);
  pinMode(Buzzer, OUTPUT);
  Blynk.begin(auth, ssid, pass,"blynk.iot-cm.com", 8080);
timer.setInterval(1000L, gassensor);
  timer.setInterval(1000L, humiditysensor);
  timer.setInterval(1000L, notifiaction);
  lcd.begin();
  lcd.backlight();
  dht.begin();}
void humiditysensor(){
  int hum = dht.readHumidity();
  int tem = dht.readTemperature();
  Blynk.virtualWrite(V0,hum);
  Blynk.virtualWrite(V1,tem);}
void gassensor(){
```

Figure.11. Flowchart of the system

Figure.14. Program code for the system

Figure 13 illustrates the connection schematic diagram between NodeMCU board and sensors. This figure shows that NodeMCU board and other components are connected in proteus. For the particular part of detecting the fire flame from the sensors, the codes are written and portrayed in figure 14. In the codes detected the fire alarm from the room is basically identified in temperature and humidity values.

```
START
VOID HUMIDITY SENSOR ()
  VIRTUAL DISPLAY HUMIDITY AND
  TEMPERATURE
  LCD DSIPLAY HUMIDITY AND
  TEMPERATURE
VOID GAS SENSOR ()
  VIRTUAL DISPLAY GAS VALUE
  LCD DSIPLAY GAS VALUE
  PUMP ON
VOID NOTIFIACTION ()
  IF FLAME == HIGH
  SEND MESSAGE
END
```

Figure.12. Pseudo code for the system based on the flowchart

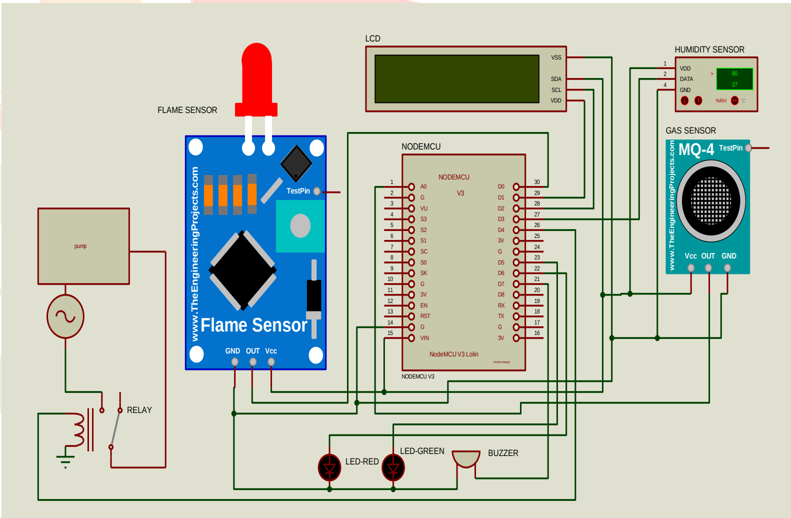


Figure.13. Schematic diagram of the system

III. Results and Discussion

Few tests were done to observe the system's performance. The tests were completed by applying the sensors. Figure 15 shows the condition with the gas sensor that senses the flammable gas while the fire burn to start. Figure 16 shows the condition with the humidity sensor that senses the burning area in the room. Figure 17 shows the condition with the flame sensor that detects the flame while the fire burn to start and the warning message will appear on the mobile phone. Figure 18 shows the condition with the pump that sprinkles automatically water the burning area in the room.

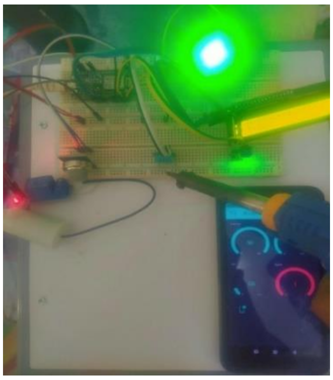


Figure.15. Testing of the gas sensor

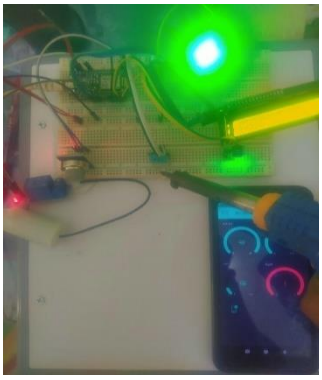


Figure.16. Testing of the humidity sensor

Figure.17. Testing of the humidity sensor

Figure.18. Testing of the water pump

Table 3.1 shows the analysis of the result values during the test measurements. The flame sensor alerts alarm messages on the mobile phone while the fire burns to start anytime. The gas sensor senses when gas leakage is detected in room and the humidity sensor detects the moisture values when the moisture level is increased or decreased in the room. After the sensors are detected, the notation of the message will be displayed the user on mobile phone “Fire Alarm! Please check your Safety System” which is synchronized with the SMS sent by the user alerting the fire existence. If the fire starts to burn in the room and building, the pump sprinkles water automatically to the fire burning areas and if the fire has not been detected in the rooms/flats, LCD display will show “Safety Now”.

Table 3.1: Analysis of the resultant values

Flame Sensor	Gas Sensor	Humidity Sensor	Water pump
LOW	50	70	Not Sprinkle
HIGH	100	20	Sprinkle
HIGH	104	18	Sprinkle
HIGH	110	13	Sprinkle
HIGH	120	17	Sprinkle
HIGH	130	24	Sprinkle

IV. Conclusion

This research paper has been made in order to prevent the damages due to fire hazards that is the burning of the room. Based on the result obtained, the system is important to protect the fire hazards. In fact, the system is cheap in value compared to other exciting alarm system in the market and easy to apply in fire prevention system. An automatic sprinkler and fire alarm is a device that detects the fire presence and changes in atmosphere relating to smoke. In some cases, a firm alarm is a part of a complete security system and operates to alert people to evacuate a location in which a fire/smoke accumulation is present. When functioning properly, a fire alarm will sound to notify the people of an immediate fire emergency. Fire alarms can be found in homes, schools, churches and function as the catalyst to saving many innocent lives. For most fire alarms, when sounded, bell or horn noise is made. This will make the users become aware of the dangerous situation and can easily prevent fire burning from happening by quick response (R.O.Okeke, 2017).

V. Acknowledgment

We wish to express our deepest gratitude to U Ko Ko Aung, Lecturer, Pathein University for his encouragement to submit this paper. Further we wish to thank to our parents for their valuable suggestion.

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