IOT based Fire Detection System Using Image Processing

Pratik Awari[1], Himanshu Ghatole[2], Abhishek Jain[3]

[1] *Student, Computer Engineering, Pillai HOC College of Engineering and Technology, Maharashtra, India*

[2] *Student, Computer Engineering, Pillai HOC College of Engineering and Technology, Maharashtra, India*

[3] *Student, Computer Engineering, Pillai HOC College of Engineering and Technology, Maharashtra, India*

ABSTRACT

In today's world technology is growing faster, however there are very less methods available for safety from Fire. Fire, it is a dangerous, whether it is in small amount or large amount, at an unpredicted location, state and time. Usually, each and every place can be vulnerable to the fire that will destroy the place. Nowadays the fire is mostly detected by the smoke sensors. But these smoke sensors can only detect the fire if the fire is in large amount. So to detect the early fire an system is needed. We are designing a system called Fire detection using image processing that uses a laptop and webcam as the system's main equipment. The system will detect the fire using smoke, flame and humidity sensors and it will turn on the sprinkler and also immediately send the alert message to the owner of the property using GSM module. The overall accuracy of this system is more than 90%

Keyword:- *Fire Detection, Flame Color, False Alarm, Image Processing, IOT.*

---

1. INTRODUCTION

INDIA ranks 2nd in the World in terms of population and is also one of the fast growing economy. Being an fast growing economy, so many new companies and organizations are getting established. When we consider any textile industry, fire accident can be one of the most critical issue to the workers as well as investors. So many manufacturer factories don't have proper system for recognizing and controlling the fire. Since many factories are old and they also lack fire detection technologies, they are very much vulnerable to fire breakout. Hence, we are designing an IOT based fire detecting system to detect fire at earliest & take immediate precaution using water pump. Also sending fire alert email to the Administrator & SMS to nearest fire station & saving precious human lives. We are using Raspberry pi 3 as a central control board. The system will use several sensors for detection of fire. Several surveys will be done before placing the sensors on proper locations. After deciding the perfect place for sensors, the sensors are activated. Whenever the fire is detected, the system will send captured fire image and an SMS to the registered number & it will turn on the sprinkler motor & the alarm.

2. LITERATURE SURVEY

A lot of surveys have been already done in this domain. There is proposed system called An IOT based Fire Detection, Precaution using Raspberry Pi & GSM. It uses wireless sensor technology to detect fire. The sensors used in this system were too costly. [1]

In another research paper RGB(red, green, blue) model used for detecting fire. RGB model uses fire pattern with heat signature to detect fire. It has one drawback that its fire detection range is limited. [2]

In another proposed system MES(multi expert system) used for detecting fire. It identifies fire based on the captured image subtraction. It has drawbacks such as more power consumption and time consumption. [3]

In another system CNN architecture was used to detect fire. This system was able to identify both fire and the object under surveillance. It has the drawback of limited distance and more power consumption. [4]

In one of the system Raspberry Pi was used to detect the fire. It captures the images and detects the fire based on the heat signatures of the captured image.

It has the drawback of producing false results and it cannot be used in excessive sunlight. [5]

3. METHODOLOGY

Fire patterns with Heat signature are used to detect fire and colour pattern for representing the fire. We here propose an advanced Fire detection system based image processing using raspberry pi that help to detect fire as soon as possible and take immediate precaution using Sprinkler as well as sending an alert email to the admin/owner and SMS to nearest fire station . The system makes use of several sensors to detect the symptoms of fire. Smoke and fire sensor and temperature sensor are placed on proper places.

4. PROPOSED SYSTEM

The Proposed systems consists of the following units which work according to the situation.
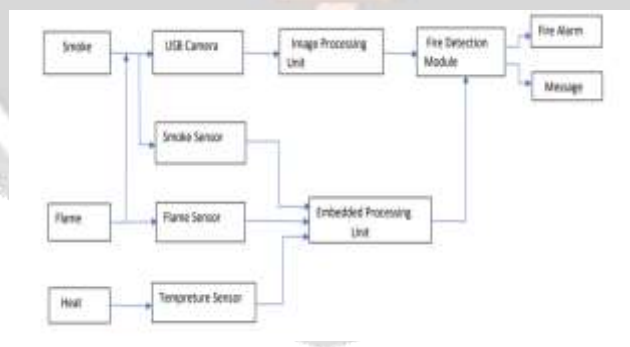

Fig 1. Proposed System

4.1. Components:

4.1.1. Arduino Nano

The Arduino Nano is based on ATmega328. It has 30 pin and Operating voltage is 5V. It has 16Mhz Clock speed, and power consumption is 19mA.

Fig 2. Arduino Nano

4.1.2. Raspberry pi B+Model

The Raspberry Pi model is the newest module in the Raspberry Pi 3 range, it operates on 64-bit quad core processor at 1.4GHz speed, also includes dual-band 2.4GHz and 5GHz wireless LAN, faster Ethernet, Bluetooth 4.2/BLE and PoE capability via a separate PoE HAT. The dual-band wireless LAN comes with modular compliance certification, that allows the board to be designed into end products with significantly reduced wireless Local Area Network compliance testing, that can improve both cost and also the time to market.

Fig 3. Raspberry pi B+ model

4.1.3 GSM Module Sim 800l

SIM800L GSM/GPRS module is used in so many IOT projects to make use of cell phone functionalities. This modem can be used to perform any task that the normal cell phone can perform be it sending text messages, make or receive phone calls, connecting to internet through GPRS, TCP/IP, and many more. This module can be used in any part of the world as it supports quad-band GSM/GPRSnetwork.SIM800L GSM cellular chip is located at the center of the module from Sim Com.

Fig 4. Gsm Module Sim800l

4.1.4 DC Motor Water Pump

Dc water pump is an useful device that can transfer water flowing at low-pressure level to high-pressure level. Basically, the pump is used to change the energy flow from mechanical to the fluid flow. This pump is mainly used in processes that requires a high hydraulic force. This process can be seen within heavy duty equipment. This equipment requires low suction and high discharge pressure. Due to the low force at suction part of the pump, the liquid will be absorbed from certain deepness, while at other side of the pump with high force, it will carry the liquid until it reaches required height. Therefore the pump is developed as a continuous range of forms, sizes, &applications

Fig 5. Dc Motor Water Pump

4.1.5. Smoke detector (MQ-2)

It is a Metal Oxide Semiconductor sensor. It uses the voltage divider method to detect the gas. Its working Voltage is 5V DC Supply.

Fig 6. Smoke detector

4.1.6. LCD Display

A liquid-crystal display (LCD) is designed with help of liquid crystals. it is a Message Screen or Text display Screen that displays text by emitting light. Liquid crystals do not emit light directly. LCD is an display module and also has a wide range of applications in IOT.

Fig 7. LCD DISPLAY

4.1.7 Buzzer

The buzzer works on 3.5V – 12V with frequency of around 500Hz and the alarm is of 95dB. The buzzer works when smoke or moisture is detected.

Fig 8. Buzzer

4.1.8 Power supply

Power supply is used for electrical power. Power Supply Unit (PSU) is used to supply electrical or any other types of energy to any device or group of devices. The Power Supply is required in almost all the electronic devices, less often in mechanical devices and rarely in others. In this application we require a 10V DC power supply for providing electrical power to all the electronics used in project.

Fig 9. POWER SUPPLY

5. RESULTS

This system is working properly, detecting fire, smoke as well as temperature. All the modules of the system are working properly as they should. The smoke sensor, fire sensor and temperature sensor are sensing perfectly and also passing the sensed information for processing to the Arduino Nano in less than 1.2 second which is very fast compared to other systems. Various switches are implemented in the system for adjusting the sensor default values. The raspberry pi which is connected to Arduino is also capturing and processing the images correctly. The relay circuits attached on the system are also working fine by producing the delay of 5 seconds each before performing actions such as Turing on the motor, sending SMS, etc.

Fig 11. IOT based Fire Detection System Using Image Processing

The LCD display used in the system is showing the current temperature as well as message sent notification properly. The GSM module attached on the system is for alerting the owner by sending the message on owner's registered number. The two fans, one for cooling the particular area where temperature is very high and other for exhausting the smoke when detected are attached in the system.

Fig 12. Components

The system also has one sprinkler motor which extinguishes the fire on detecting it. The system also has one buzzer to alert everyone around the area where the fire is caught.
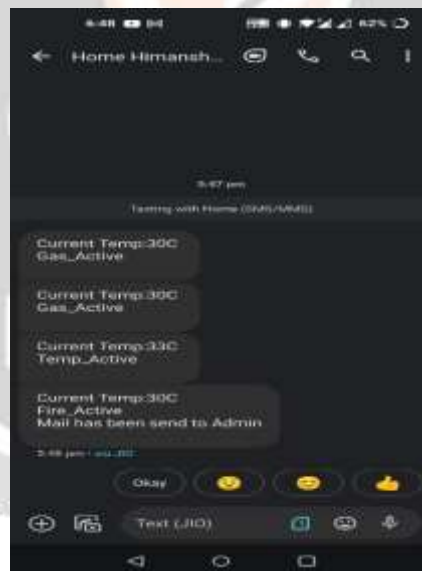

Fig 13. Message received by Admin

This system keeps track of the fire events that occurred in the past by maintaining the records in one file.
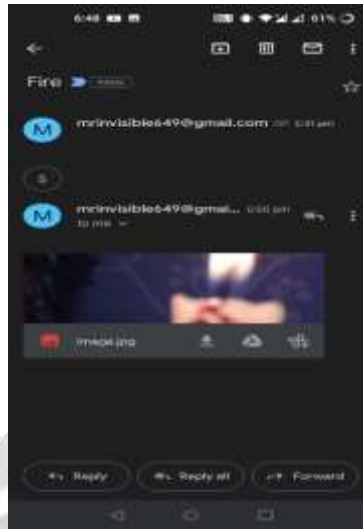
Fig 14. Mail Received by Admin

The relay circuits attached on the system are also working fine by producing the delay of 5 seconds each before performing actions such as Turing on the motor, sending Sms, etc.

Fig 15. Camera Detecting Fire

Fig 16. Records of Detected Fire

As seen from the current results, this system will be very useful in future for controlling the damage done by the fire and for saving precious human lives.

6. CONCLUSIONS

In Past, people used to detect the fire using various sensors or any methods using the smoke. But all these past methods are less effective as these methods sometimes take too much time to detect the fire, and hence damage is already done due to the fire. There is no point in detecting the fire when the damage is already done. So to overcome from such crisis, this system will be really helpful. We are still working on this project, so that sensors will replaced and the fire will be detected through internet or any other means that is cheap as well as beneficial to others. IoT is the best way to detect fire and use computer vision to detect the fire. The main idea behind this project is to make a camera work as an human eye, so that the fire will be detected at earliest. The work is still going on this system so that the rate of false alarms becomes very minimum. This fire detection system is designed using Raspberry Pi connected to camera and operates by algorithm that processes the image. The proposed system works well but we are still working on it to make this system more efficient and reduce the rate of false fire alarms. These false alarms are generated when there is object of orange colour and shapes. This system will help to control the damage and loss happened due to the fire. In future this system will be very helpful for fire fighters as it will detect the exact location of fire and then fire fighters will immediately control the fire by tracking it.

7. REFERENCES

[1]   Yamagishi, H. and Yamaguchi, J.(n.d.). A contour fluctuation data processing method for fire flame detection using a color camera.26th Annual Conference of the IEEE Industrial Electronics Society. IECON.IEEE International Conference on Industrial Electronics, Control and Instrumentation. 21st Century Technologies and Industrial, pp.824829,2000.Volume: 6, Issue: 3, March 2017

[2] Seebamrungsat, J., Praising, S., and Riyamongkol, P. (2014). Fire detection in the buildings using image processing. 2014 Third ICT International Student Project Conference (ICT-ISPC),Volume: 9, Issue: 3, January 2018.

[3]   Azmil, M. S. A., Ya'acob, N., Tahar, K. N., and Sarnin, S. S. (2015). Wireless fire detection monitoring system for fire and rescue application. 2015 IEEE 11th International Colloquium on Signal Processing and Its Applications (CSPA),Volume: 5, Issue: 3, March 2018.

[4]   Md Saifudaullah Bin Bahrudin and Rosni Abu Kassim "Development of Fire Alarm System using Raspberry Pi and Arduino Uno" in International Conference on Electrical, Electronics and System EngineeringVolume: 6, Issue: 2, May - June 2019.

[5] Noorinder, Student Member IEEE, Jaspreet Singh, Member IEEE and Ekambir Sidhu, Member IEEE/IETE Raspberry Pi based Smart Fire Management System employing Sensor based Automatic Water Sprinkler in International Conference on Power and Embedded Drive Control Volume: 11, No.8, July 2019.