

Fire Alert System using Real-Time Video Processing

Arpan Singh, Christy Jackson j

Abstract: *The aim of this work is to develop a fire alert system using some parts of Internet of Things (IOT) and video processing to ensure the fire breakage and notify fire-station with a SMS. It uses different types of sensors to detect the breakage. Existing system contains work which is individually developed system that uses sensors and camera respectively. The proposed system contains sensors with camera and Raspberry Pi board, Arduino Uno microcontroller, by the use of this above-mentioned things this system tends to overcome the false rate of fire alert which helps in making people safe who might get nerd. In this project, there we are try to use Global Positioning System (GPS) Module for sending a current location to the fire-base station for further rescue process to save life. This paper also uses a Short Message Service (SMS)provider called as "twilio" that is used to send a SMS alert to the people.*

Keywords—*Raspberry Pi, Arduino Uno, Fire Alert, video processing, image processing, Pi Camera, IOT, GPS Module.*

I. INTRODUCTION

Fire is one of the most dangerous things in the world. Within a short time, a fire can spread to a large area. Fire is also one of the essential needs of human life as millions of years back humans used it to cook food and to keep animals away from them but after sometimes there was a change in human nature as they came to know about the uses of fire. Many a time they find it to be useful but they had also used it for some different purpose. Fire also causes a tremendous effect on nature as forest fire is caused with the friction of trees which later causes a fire and in some amount of time it's spread over a large area which cause a large amount of destruction. This paper is about fire caused in office areas where person's life is at risk at any high rate. Offices are places where there might be a high risk and loss of human life as well as documents, etc., which are to be evacuated as soon as possible. So, to overcome, an implementation is done to save life of persons present there and to react as soon as possible by triggering a right alarm rather to make people fooled with false alarm. This system uses some algorithms to overcome with fire caused by detecting an area that caused fire rather to trigger without confirmation and then trigger a SMS to make people alert.

II. LITERATURE REVIEW

In [1], Authors had stated in their paper that they had used servomotor, BT [1], Smoke sensor, Global System for Mobile (GSM) [1] module and PIR sensor. Their main work is to detect a fire and smoke and Liquefied Petroleum Gas (LPG) [1] gas with smoke sensor and when PIR detects anything from it, will trigger an alarm.

With the help of GSM module, they were sending an alert remotely [1] to the people. Their entire system is connected to Bluetooth which controls the entire system by an app. Servomotors [1] are also used as at the peak time of occurrence of smoke/fire the gates will open automatically. In [2], Authors had stated in paper that they have propounded a structure which is fit to recognize fire and can give the zone of the affected area. Arduino which are facilitated with a couple of sensors and camera. A 3600-exchange motor [2] is accumulated with the camera so it can snap the image in whatever point the flame is recognized. We have given an assertion of the fire hypothesizing structure [2] to keep up a vital separation from any bogus caution. The system will rapidly convey something explicit close by the image of the affected spot and Arduino's territory. A head can check or invalidate the indictment and if the manager insists the condition as a breaking out of fire, by then the structure will instantly raise an alert and a modified message will be sent to the near to fire separation [2]. In [3] Authors said that interconnection of physical gadgets introduced with equipment, programming, sensor which is prepared for gathering data from the incorporating and sending data over web is called IOT. We recognize three key classes: Smoke disclosure [3], Flame recognizable proof [3] and Temperature acknowledgment [3]. Modified fire ready structure gives steady perception, checking and customized In [4], Authors had stated in their paper that their method of fire detection is much more feasible [4], simple and understandable as compared to other domains [4]. Their main idea is to detect fire using some methods like Contour analysis, background subtraction and Open Computer Vision(OCV) [4]. By the use of these methods they had performed fire detection. In [5], Authors had stated in paper that they castoff the Global System for Mobile (GSM)[1] and some sensors to avoid false alarm. According to them, Wireless Sensor Network (WSN) is not suitable for fire detection as it sometimes didn't able to detect fire as a consequence of system failure, as WSN consists of some tiny and cheap chips. As a result of using of Fire Dynamic Simulator [5] in home, they found a rise in bar graph which was calculated in alarm per year and lower in mortality rate. With use of GSM module, they were able to send SMS for alerting people about occurrence of fire. Their proposed work was to detect the fire occurred was detected without any false alarm [5] and to send the data as SMS to people to alert them about the fire. They tested it in 2 areas that shows the fire and alert them with SMS.

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Arpan Singh, SCSE, Vellore Institute of Technology, Chennai
Christy Jackson, SCSE, Vellore Institute of Technology, Chennai

III. PROPOSED APPROACH

The main proposed work of this paper is to overcome the false alarm rate with pre-fire detection using camera to alert people with an SMS on their mobile and to alert fire-base station with a location in notification. The sensors are also used to detect fire and smoke and rise in temperature with humidity. The connection is setup between Arduino and Raspberry Pi for getting the values of sensor from Arduino for checking the detection. A camera is used as a confirmation of fire and/or smoke detection. A SMS service provider known as Twilio is used as an alert message for people. A GPS Module known as Neo6m is used to get the current location of that place where fire and/or smoke is occurred that is then send to fire-base station for rescue.

The main work of this project is to detect the fire as soon as possible with the use of pre-fire detection technique and to alert people with it. Our system also uses OpenCV to detect real-time video fire detection. This project uses Canny Edge algorithm to detect the fire and to trigger an alarm. Canny Edge algorithm is an algorithm that is used in Python OpenCV for detecting an edge using some measurements. This paper uses this algorithm to detect the edges of fire to confirm occurrence of fire.

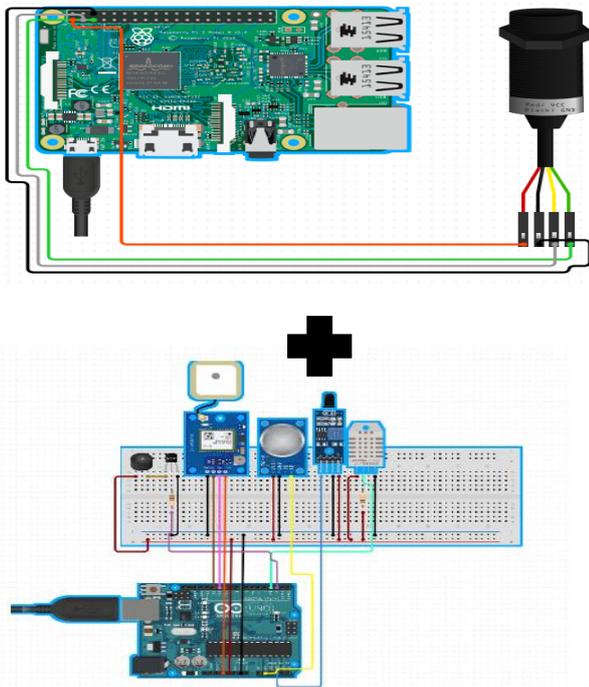


Fig. 1 Circuit Diagram of Hardware parts

Fig. 1 shows the use of Raspberry Pi Board with Arduino Uno microcontroller respectively. Raspberry Pi is connected with camera and Arduino Uno is connected with Buzzer, Neo6m GPS Module, MQ-2 Smoke Sensor (senses any type of smoke), Flame Sensor, DHT-11 Sensor (senses temperature and humidity). Arduino takes the reading from the sensor and gives it to the Raspberry pi. Raspberry pi then processes it and activates camera to trigger an alarm.

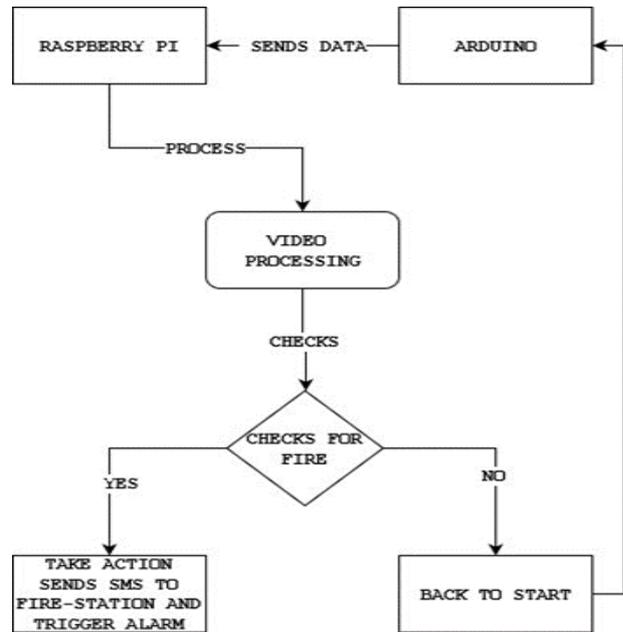


Fig. 2 Data Flow Diagram of Hardware parts

Fig. 2 interprets the flow of data in the process. Arduino starts to take the reading from the sensor and gives it to the Raspberry pi. Raspberry pi then processes it and activates camera. Camera checks for fire. If it finds fire, then camera will trigger and alarm and sends SMS to the users and location to the fire-base station automatically. If camera doesn't sense any type of fire/smoke, the process will again get back to the starting part i.e. starts to take data from Arduino.

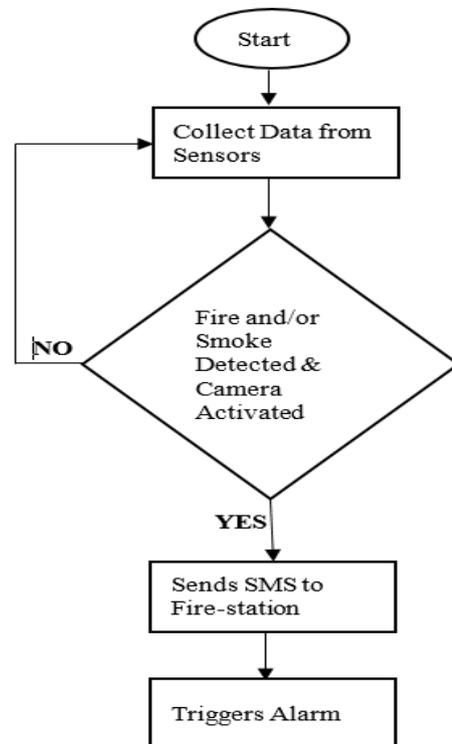


Fig. 3 Working Process of Sensors and Camera in Fire Alert System using Real-time Video Processing (Flow Chart).

Fig. 3 states that, the process when starts it collects data from sensor. If any sensor detects fire/smoke, it will send SMS to the people and firebase station (with current location) for rescue respectively and triggers and alarm to alert people around them. Algorithm for the proposed work is given below:

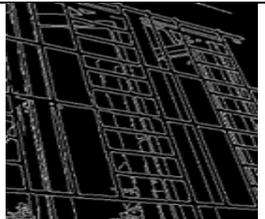
Algorithm 1: Canny Edge Detection Algorithm

- Apply Gaussian filter to smooth the image in order to remove the noise.
- Find the intensity gradient of the image.
- Apply non-maximum suppression to get rid of spurious response to edge detection.
- Apply double threshold to determine potential edges.
- Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

IV. EXPERIMENTAL RESULT

Edge Detection for Fire Detection: Table below states about the example of original and edge detected image that explain the use of Fire Detection with the use of Canny Edge Detection algorithm.

Table 1. Example of Canny Edge Algorithm

Canny Edge Detecting Example		
Experiment	Original Image	Edge Detected Image
1.		
2.		

The above table shows the use of Canny Edge Algorithm. The images in the table depicts that with the help of Canny Edge Algorithm, we can detect the fire easily.

Resultant Output

Original Image	Edge Detected Image
	

Resultant Output explains about the detection of fire using Canny Edge algorithm.

Twilio is a cloud communications platform as a service (CPaaS) company that allows software developers to make and receive phone calls, sends and receive text messages and

perform other communication functions using its web services API.

Smoke sensor senses the smoke (any type of smoke). The sensor that is used in this paper is MQ-2.

Flame sensor is used to measure the intensity of fire.

The sensor that is used in this paper is infrared Flame sensor.

Humidity and Temperature Sensor is used to measure the temperature risen and humidity of the current thing. The sensor used in this paper is DHT11 Sensor.

GPS Module is used to get the current location. The sensor used in this paper is Neo-6m Module.

Pi Camera is used to capture and record video. In this paper, Pi Camera is used to work on real-time image to detect Fire and Smoke and to trigger an alarm.

V. CONCLUSION

Fire is one the major cause of destruction and fire detection is one of the parts to save the destruction before happening. In a case of fire detection mechanism, camera is one of the major players. Fire detection isn't an easy task to handle. Many a times we have to go through a phase of false fire alarm which isn't a good sign. So, to overcome the situation, we have to go for the use of camera. This paper introduces a concept of pre-fire detection using camera for real-time video for fire detection with triggering a buzzer if and only if camera founds the fire to be getting spread in larger area.

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