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 [ijirset@gmail.com](mailto:ijirset@gmail.com)

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# Fire Exigency Diagnosis and Notification Using Open CV

**Dhiraj Attarde, Laxman Desai, Aditya Motghare, Ankit Mohapatra, Prajakta Shirke**

U.G. Student, School of Computer Science and Engineering, Sandip University, Mahiravani, Maharashtra, India

U.G. Student, School of Computer Science and Engineering, Sandip University, Mahiravani, Maharashtra, India

U.G. Student, School of Computer Science and Engineering, Sandip University, Mahiravani, Maharashtra, India

U.G. Student, School of Computer Science and Engineering, Sandip University, Mahiravani, Maharashtra, India

Associate Professor, School of Computer Science and Engineering, Sandip University, Mahiravani, Maharashtra, India

**ABSTRACT:** Fire has mainly featured in the field of natural and man-made disasters. Over the years the external impacts of fire related disasters have gradually changed.” “In the twentieth century in particular, due to industrialization, urbanization, population growth, and military conflicts, as well as due to an increase in the number of extreme weather conditions and global warming effects; there has been rapid transformation in fire incidences and deaths. The majority of fire detection systems on the market use slow-responding temperature or smoke sensors. Also, if a fire is located distant from the detectors, these systems are ineffective. This existing system is expensive. The proposed model suggests a method to use surveillance cameras in order to monitor occurrences of fire anywhere within the camera range. This study aims to develop Fire Exigency Diagnosis and Notification using Open-CV system that can do real-time fire diagnosis and send alert notifications to the relevant authorities for immediate action. The video analysis is done in real-time. Once a fire is detected, the system triggers an alert and sends notifications to relevant authorities such as fire departments and building management. The system is designed to be scalable and can be deployed in various settings such as homes, commercial buildings, and industrial facilities. The project aims to contribute to the development of more effective fire safety systems, which can minimize the risk of property damage and save lives. The fire detection system is developed based on this method aims to detect fire efficiently and generate immediate alarm and send alert notification along with GPS location to the fire stations.

**KEYWORDS:** Open- CV, surveillance cameras, Alert Notification, Real Time Diagnosis, fire pixels, alarm, GPS location.

## I. INTRODUCTION

In most cases, fire accidents cause material and environmental damage, and pose a threat to people's lives as well. Many fire-detection methods were developed to stop the disasters caused by fire through early detection. Several methods have been so far developed for the purpose of detecting early the occurrence of fire hazard based on particle sampling methods, relative humidity sampling, air transparency testing, smoke analysis methods, in addition to traditional ultraviolet and infrared fire detectors. However, detecting fires using these apparatuses is still inadequate. At the areas having greater risk of catching fire, we cannot wait until the detection of fire. At this place traditional fire detection systems are not beneficial. At that situation we can implement more advanced fire detection systems which are compatible with wide range of area such as Open-cv techniques [1].

Fires are distinguishable by their specific brightness, colour, spectral flicker, spectral texture and edge trembling from other visible stimuli. Particle and temperature sampling, humidity and air transparency testing and smoke analysis are ordinarily applied in detecting fires, but they are not always reliable or accurate [3]. The majority of classic fire detection methods rely on particle sampling, temperature sampling, relative humidity sampling, air transparency testing, and smoke analysis in addition to the standard ultraviolet and infrared sampling. Close proximity to the flames is necessary for these techniques. As they don't always find the fire itself, these techniques are also not always trustworthy. For instance, these methods often do not detect the fire itself but instead identify smoke or other byproducts of the fire. As a result, conventional methods can generate false alarms or provide delayed responses. In this situation, CV based fire detection system used in conditions in which conventional methods cannot be adopted [3],[4].

We rely on Open-cv techniques to get results that are better than what conventional systems are capable of since visuals are more trustworthy. Fire emergencies can be found and identified whenever they occur by using advanced computing techniques like brightness analysis, color detection and matching, flicker detection from spectral analysis or flicker detection from spectrography and edge trembling detection [5] in a computer vision-based fire detection system.

The main motive of our work is to provide solution by making use of security cameras to spot fires, produce alarms, and send notifications that include alert messages and the incident's GPS location to the fire station within the short duration of time to save the life and property [5]. This work is also useful to save the Wild life and fauna during the forest fire. It is also useful to reduce the property loss which causes because of the fire accidents.

## II. MOTIVATION AND OBJECTIVE

Currently We are using fire exigency system consisting of different types of sensors. A study has uncovered that 80 % of fire-related losses could have been averted had the fire been noticed promptly and sensor-based fire detection makes use of different sensors to discover fire. These sensors are inclusive of smoke sensors, temperature sensors, gas sensors and flame sensors.. The sensors are integrated into a network that monitors the environment for changes in temperature, smoke, gas, or other indicators of a fire.

Sensor-based systems can detect changes in temperature or smoke levels that may indicate a fire before it has a chance to spread. However, it's highly flexible and adaptable to different environments and can be configured to detect fires in specific locations, such as kitchens or server rooms, or to monitor large areas, such as warehouses or factories in real-time monitoring with response capabilities. One of the challenges of sensor-based fire detection is ensuring the accuracy and reliability of the sensors. False alarms can be a significant problem, especially in environments that are prone to dust, steam, or other contaminants that can trigger false readings. Sensors must be regularly calibrated and maintained to ensure they are operating correctly. Another challenge is the integration of the fire detection system with other building systems. Sensor-based fire detection systems may need to be integrated with HVAC systems, security systems and other building automation systems,

The central objective of this study is to offer a camera driven system of fire detection in place of the conventional sensor alarms. In this thinking line, options such as computer vision as well as image processing means became handy. As one of the least expensive methods that can work efficiently, being able to relay information about an incipient combustion could involve the utilization surveillance cameras. The detection of fire involves colour of flame and light parameter. The proposed study offers a technique for using security cameras to keep an eye on fires that occur anywhere in the camera's field of view. The proposed system utilizes computer vision techniques to detect and diagnose fire emergencies in real-time, providing early detection and alert notifications to relevant authorities. The system aims to reduce the response time and increase the accuracy of fire emergency diagnosis, thereby potentially reducing damage and saving lives

## III. METHODOLOGY

In a vision-based fire detection system, at first the image is captured. This work focuses on a low-cost solution, it suggests to use normal video surveillance camera to use the video data. Then the captured video is sampled into set of image frames and colour space then noise reduction is performed on the image. Then based on the detection algorithm various information of the image is analysed [5]. Colour and motion information of the image is analysed in our fire detection system. Different fire detection algorithms are invented based on this information [5].

To detect the fire, we are employing cameras in place of sensors. Our suggested approach uses a straightforward algorithm to identify fires. The visual frame is initially obtained from the live video feed. The frame is then given the Red, Green, Blue (RGB) colour model. The final RGB frame is changed into an Hue Saturation Value (HSV) frame then we apply Gaussian blur algorithm on the HSV frames [6]. The technique finds the moving area boundary in a color-segmented picture by calculating the number of fire pixels within it. This approach has been used to enhance performance characteristics for identifying fire flames from streaming video clips. RGB stands for red blue green; they refer to primary additive colors used for display devices because they are made up only three components such as red greenness or blueness. Then we convert RGB colour to HSV [6],[7]. HSV is a cylindrical colour model that describes colours based on their hue, saturation, and brightness. Converting an RGB colour to HSV involves the following steps like:

- 1] Normalize the RGB values to a range of [0, 1] by dividing each component by 255
- 2] Determine the maximum and minimum values among the RGB components
- 3] Calculate the value (V) component, which represents the brightness of the colour
- 4] Calculate the saturation (S) component, which represents the purity of the colour

5] Calculate the hue (H) component, which represents the colour itself

6] The resulting HSV colour values will be in the range of H = [0, 360], S = [0, 1], and V = [0, 1]

Then Gaussian blur is applied to this frame (to remove noise). The Gaussian blur operation can be expressed mathematically as a convolution between the input image and the Gaussian kernel.

The formula for the kernel is given by

$$G(x, y) = \left(\frac{1}{2\pi\sigma^2}\right) \cdot e^{\left(\frac{-(x^2+y^2)}{2\sigma^2}\right)}$$

where x and y are the distances from the centre of the kernel. The amount of smoothing applied to an image is controlled by the standard deviation ( $\sigma$ ) parameter, which determines the width of the kernel. A larger value of  $\sigma$  results in a wider kernel and more image blurring [7],[8],[9].

We merged motion and color detection of flame as the first step of fire preprocessing. Following this the pixels that possibly constitute fire are selected therefore screening the fire candidate pixels. It means, despite that flame appears irregularly, images of the flame are somewhat ordered. For every frame of an image, the center point of flame zone has been analyzed; later-on this flame was provided with temporal properties so as to get spatiotemporal data on its positioning. In line with such an attribute, a new technique regarding stability criterion for flame point has been developed [8],[9].

As soon as fire is detected, an alert buzzer sounds, an acceptable answer is shown on the window monitor, and the notification is issued. Notifications of alerts include the alert message and the fire station's GPS position. Throughout the years, fires have been a greater danger to people's lives and property. This conventional fire detection's high rate of incorrect alerts has led to a new detection method through multi-feature fusion of flame [10].

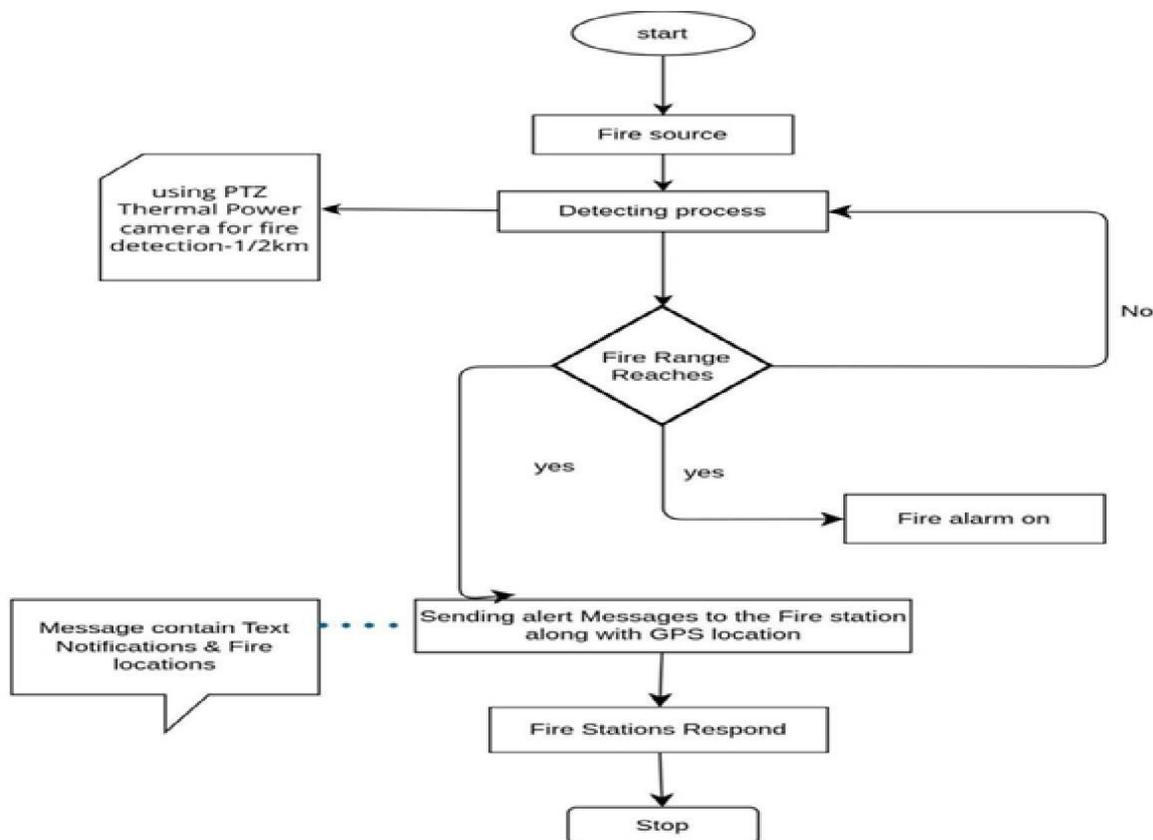


Fig.1 Flowchart representing the working flow of fire detection system



IV. RESULT AND DISCUSSION

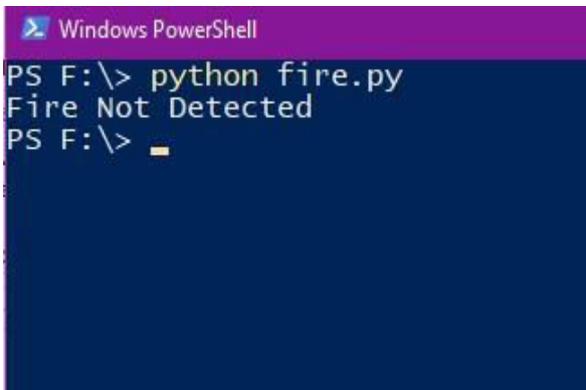


Fig.2 Testing a code on the video not containing fire

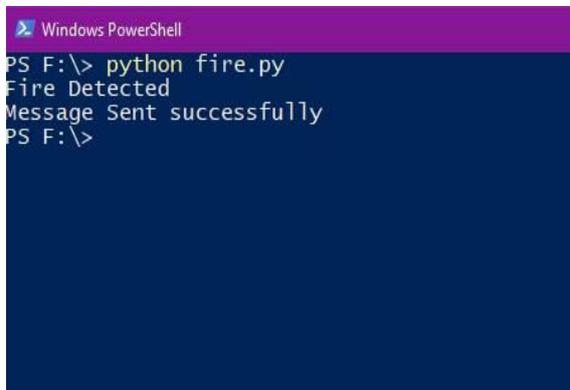


Fig.3 Testing a code on the video containing fire

In above figures, in fig (a) we tested the project code on the CCTV footage that does not contain fire. It simply returns the statement of "Fire Not Detected". In the fig (b) we tested the project code on the CCTV footage that contains fire. It returns the message of "Fire Detected" and send the message notification with GPS Location of the place on our device

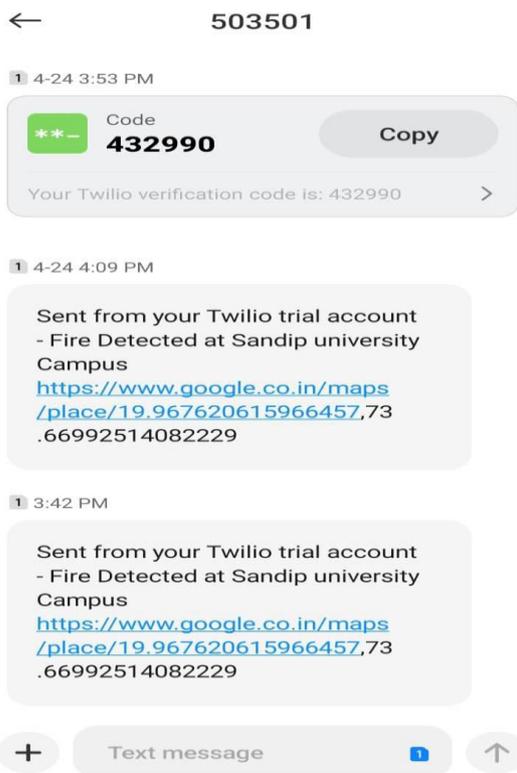


Fig.4 Notification of fire emergency received

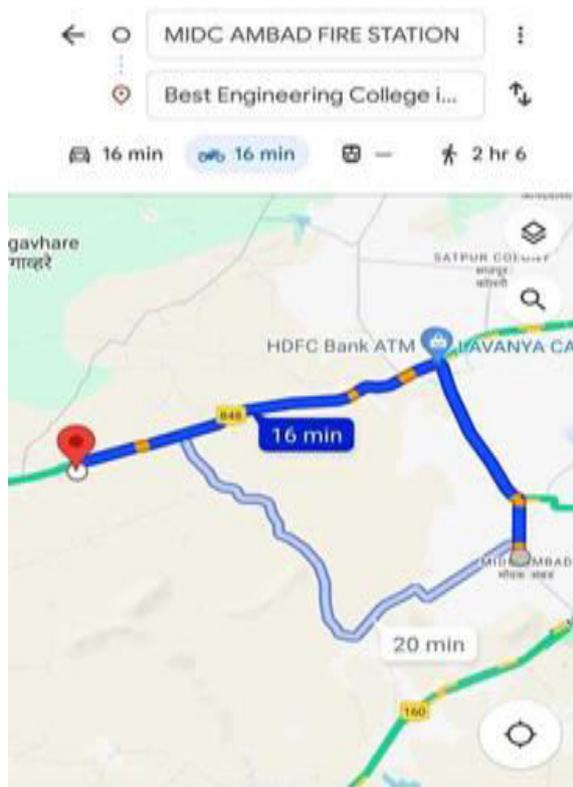


Fig.5 location of fire place from nearest fire station

In above figures, in fig.4 when fire is detected in The CCTV footage, message containing the fire place location and its coordinates has been sent to user's device from the twilio account, As in Fig.5 we can see the location and distance between fire station to fire place.

Advantage of the fire detection system using CV technique is then can provide early and accurate fire detection methodology by continuous(live) and remote(cloud) monitoring using surveillance cameras. System is expected to detect fire while it is small and has not grown too large. It also saves cost by getting rid of expensive heat and smoke sensors etc and can be integrated with other systems like IoT, cloud, Machine learning to improve accuracy.

## V. CONCLUSION

The project proposes an innovative fire detection algorithm that does not require any sensors that are commonly found in traditional fire detection systems. Instead, the algorithm is designed to analyse live video feeds and detect fire at its earliest stages. The system is designed to detect fire while it is still small and has not grown too large, allowing for a quick and effective response to prevent any significant damage.

One of the primary advantages of this algorithm is that it requires minimal hardware, which saves costs by eliminating the need for expensive temperature and heat sensors that are commonly used in traditional fire detection systems. By leveraging live video feeds, this algorithm can detect fires in a more cost-effective and efficient manner.

The results of the project demonstrate the effectiveness of the system in detecting fires. The algorithm is able to analyse live video feeds and identify potential fire risks early on, allowing for a timely response to prevent any significant damage. This innovative approach to fire detection has the potential to revolutionise the way fire detection systems are designed and implemented, making them more accessible and affordable for a wider range of applications.

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