Computer Vision Based Fire Detection with a Video Alert System

G.Sathyakala, V.Kirthika and B.Aishwarya

***Abstract*—Fire is something that burns giving out bright light, heat, and smoke. Fire can be dangerous and disastrous at times causing loss of people and property. In case of such fires, there is a need to detect it at the right time and act immediately. So, we are using computer vision technology to detect fire and send an alert to a remote fire station. This alert is not only sent as an emergency message but also a video is sent along with it, considering the room is under constant surveillance. Through this video, we can know how many people are inside the room and the fire station might send sufficient rescuers based on the video to rescue people. The advantage is that we avoid using flame and smoke sensors that might give false alarms. In case there is a false alarm by using our system, we can verify it by checking the video. In this paper, we propose a fire detection method using OpenCV and Raspberry Pi to detect fire and send an alert as an alarm in the same building and a short video is sent to the remote fire alarm control unit.**

***Index Terms*—Fire, computer vision, OpenCV, Raspberry Pi, alarm, video alert.**

I. INTRODUCTION

COMPUTER vision is an interdisciplinary field that is useful in various applications like robotics to understand advanced pictures or recordings. From the point of view of designing, it tries to computerize errands that the human visual framework can do. It helps to incorporate strategies for gaining, preparing, examining and understanding computerized pictures, and extraction of high-dimensional information from this present reality keeping in mind the end goal to deliver numerical or representative data [1].

Image processing is an integral part of computer vision. Image processing is a technique to do operations on a picture, keeping in mind the end goal to get an upgraded picture or to extricate some valuable data from it. Thus, this technology is used to break the video frame by frame and operations are made on them to extract information. This information helps in sending the alert that fire has been detected.

As per world fire statistics of Center of fire statistics, every year the fire accidents that take place in the overall world are more one lakh. And the damages on property and lives of people are high. To overcome this problem many detectors are employed to identify the presence of fire in its initial stages some of them is a flame detector, heat detector, smoke detector etc [2-5]. But on usage of these detectors, there is a practical difficulty that if the area or room under consideration by these detectors is a large space then the detector will alert the user only when the fire or smoke or heat is at a considerable level. Hence, it takes a lot of time and the response of the system only occurs after the intensity of fire is considerably more.

Companies like Sasken have used the existing algorithms for fire detection through vision sensors based on the RGB and YCbCr color-space approach.

There are various papers which deal with this fire detection process. The main ideology remains same but the method and tool used for processing differ. Initially, MATLAB is used as a tool for processing though it is easy to use [4][5]; it takes more time for processing and is expensive. And from an application point of view, OpenCV is better than MATLAB. Hence, it is replaced by OpenCV.

But till now images are sent as an alert to the user if the fire is detected. Sometimes image taken will be less clarity and misinterpretation is also possible. To overcome this problem a real-time video alert is sent to the user periodically until the fire stops.

The main challenges faced in our project is that configuring raspberry pi in a way such that it should simultaneously monitor the fire zone as well as to send the processed video as an alert to the App[6-10].

The rest of the paper is organized as below. The proposed system is described in section II. At last, section III concludes the paper.

II. PROPOSED SYSTEM

All the previously existing systems either use sensors like flame sensor, gas sensors or smoke sensors to detect fire holocausts in buildings. These detector systems will cause false alarming. Sometimes, there will be a misinterpretation by the detector which leads to a false alarm and it leads to unnecessary turbulence among people in and around the fire examining the area. Also, there is a practical difficulty that if the area or room under consideration by these detectors is a

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large space then the detector will alert the user only when the fire or smoke or heat is at a considerable level. Hence, it takes a lot of time and the response of the system only occurs after the intensity of fire is considerably more.

To overcome the above-mentioned problems, a new method is proposed in which a surveillance camera can also be used for fire detection using images and videos taken by it. The video taken is processed frame-wise and fire or smoke presence is detected. Also, the alert in cases of fire is either through SMS or as an image that is sent through an App [6].

The model proposed in our system uses a webcam which is used as an alternative for surveillance cameras that keeps monitoring the interiors of buildings. This video is processed using OpenCV and Raspberry Pi using fire detection algorithms and if a fire is detected, alarm rings to alert people in that particular area and also a short duration of the live video is sent to the security of the building or the remote fire station through wireless LAN. Thus, the fire station could act immediately and send rescuers to save the people based on the number of people stuck in the fire blazing area, which is known from the video. The block diagram is shown in Fig. 1.

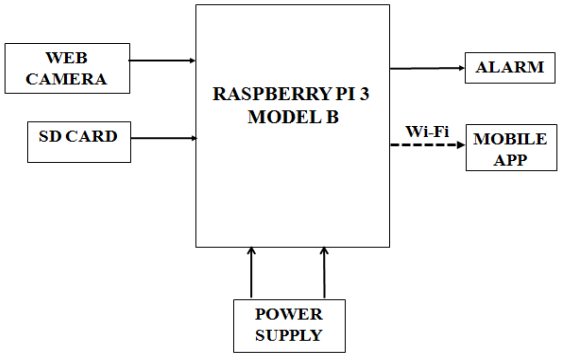

Fig. 1. Block Diagram of Computer Vision based fire detection with a video alert system.

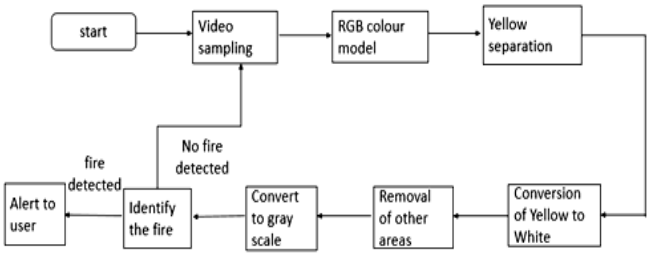

Fig. 2. Flowchart of Computer Vision based fire detection with a video alert system using HSV algorithm.

A. Capturing the video

A camera is used to keep our area under constant surveillance. The video that is taken by this camera is processed frame by frame by the Raspberry Pi and OpenCV using python programming language [7]. We utilize Raspberry Pi 3 Model B which is a Single-board computer with remote LAN and Bluetooth connectivity. The Raspberry Pi 3 is the third generation Raspberry Pi with Quad Core 1.2GHz Broadcom BCM2837 64bit CPU and 1GB RAM [8]. We use this model particularly because it has Wi-Fi connectivity and also it is good in processing images and videos at a faster rate. SD card is inserted into the Raspberry Pi to store the OS Raspbian Jessie shown in Fig. 3. Open Source Computer Vision is a library of programming functions mainly directed to real-time computer vision.

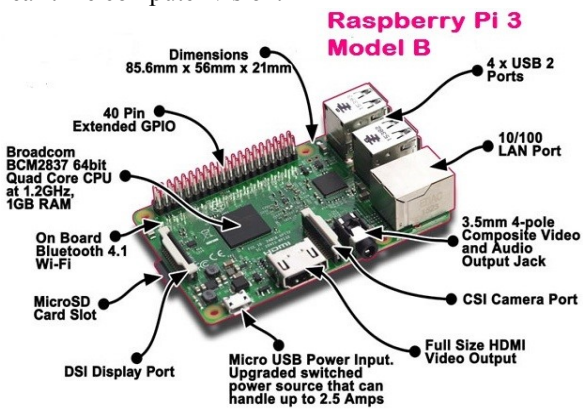

Fig. 3. Raspberry Pi 3 Model B.

B. Fire Detection and Algorithm used

The Hue, Saturation, Value (HSV) algorithm is used to detect fire in our system. The video that is taken by the web camera is analyzed frame by frame by image acquisition using python program and when a fire of more than a particular intensity that is more than a particular pixel level is detected, an alert is sent. One frame is taken and is converted into RGB color model [9]. Now red, blue and green colors are separated. Range values are specified as values for all shades of yellow and thus separating yellow from the other regions. This detected yellow region alone is converted to white color. Then the frame is converted to grayscale by grayscale conversion and contours are found by contour detection. The areas of fire are now detected and represented as red blocks and the intensity of fire can be said from these red blocks shown in Fig. 2.[10].

C. *Video and Alarm Alert*

When the fire is detected using the HSV algorithm, the alarm circuit activates immediately alerting the people inside the room is shown in Fig. 4.

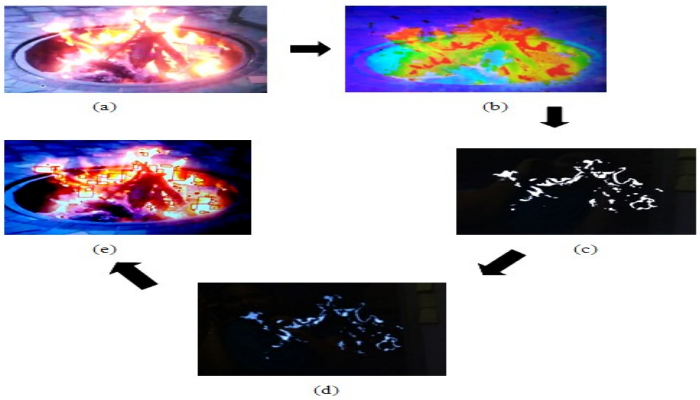

Fig. 4. (a) A frame from the Captured video. (b) RGB image. (c) Yellow regions are converted to white. (d) Changing to Grayscale. (e) Red blocks detected in the fire area.

Simultaneously, video is captured by the web camera and if fire is detected, the program runs giving the output as an alert message which sends the name of the place and its address to the App. Also, a short live video with small time intervals in-between is sent to the App until the fire is extinguished completely. This video can be reviewed by the remote fire alarm control unit and since we avoid using sensors, false alarms can be avoided. The number of people caught inside the room can be checked and rescuers can be sent to the area to rescue the people accordingly shown in Fig. 5.

Fig. 5. A picture of the video alert in the app.

III. CONCLUSION

This system is able to detect fire in the building by the use of camera and Raspberry Pi. It is also capable of differentiating fire from rest of system. Thereby the system achieves the required objectives. In future, a number of cameras can be connected to a common Raspberry pi for detection of fire in various places of the same building.

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