Forest Fire Detection Using Video Processing

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Abstract: *Since huge amount of wildfire burn vast forest areas every year, it results in ecological and social impacts. The best way to reduce the amount of losses is by early warning and responding as soon as possible. Research upon fire detection technologies is gaining importance day by day. Detecting forest fire using video processing technology is one of the best methods as it gives accurate results compared to other methods with less amount of time. The performance of the system can be improved by using optimal algorithms for detecting the motion area and features of fire. In this paper, Raspberry pi and python tool is used for extracting the fire.*

Keywords:Video image, Image fragmentation, RGB to HSVconversion, HSV protocol, SMTP protocol, Background subtraction method, Fire detection techniques, Mail alert and algorithms.

I. INTRODUCTION

Detection of fire is crucial parameter in surveillance systems which are used to supervise buildings and environment as part of early warning mechanism that reports start of fire. At present, almost all fire detection systems use sensors to detect the fire. They are heat sensor, flame sensor and smoke sensor. These sensors have to be placed carefully in different locations for fire detector system to obtain high accuracy. In large areas, this method is not suitable, as the sensors should be placed in close proximity; hence the requirement of sensors increases.

Computer based vision systems will replace all the conventional fire based techniques as there is rapid development in digital camera technology and video processing techniques. Fire detection is possible in large and open space by video processing technique. Closed circuit television (CCTV) cameras are installed in public places to monitor indoor and outdoor spaces. This helps to detect fire at early stages with use of fire detection software which process the output obtained by CCTV cameras. Motion in fire pixels, colour clues and edge detection of flame are required for current vision based techniques. The performance of this system can be increased by identifying gray cycle pixels and measuring flame area dispersion.

Fire detection is extremely important factor in many fields like industrial area, forest area etc. Algorithms are specially designed for this purpose by many researchers. Vipin [1] proposed an algorithm which is tested on twotypes of images; first one is the type of image which consists of actual fire and second is fire like region. This algorithm can be used for real time forest fire detection and cheap in computation comparatively. S.C.S Cheung & C. Kamath [2] explains more about backgroundsubtraction in their work. T. Celik et al. [3] proposed a system which is developed on two models; first one is based on luminance and second one on chrominance. YCbCr colour space is used by fuzzy logic for the separation of luminance from chrominance

instead of using colour spaces such as RGB. Kandilet.al [4] and Liu et.al [5] use shape and colour features to detect fire presence. Researchers have also used unusual properties of fire such as colour, motion, edge, and shape. Tareyinet.al [6] uses extracted features such as motion, edge-blurring region from a video, using wavelet transformation and background subtraction for determination of smoke. T.Chen [7] proposed an early pre alarm raising method based on video processing. The basic idea of this method is to adopt a RGB model based chromatic and disorder measurement for extracting fire pixels and smoke pixels. TurgayCelik [8] proposed fire detection algorithm, which consists of two main parts: the color modelling and motion detection. The algorithm can be used in parallel with conventional fire detection systems to reduce false alarms.

The rest of the paper is organized as follows. Section IIbriefly reviews about the existing method used for firedetection. Section III introduces the proposed method. Insection IV, we present the detailed description of theproposed scheme followed by the algorithms andbackground subtraction method. Finally in the section V,Results are discussed and conclusion is presented in thelast section.

II. EXISTING METHOD USED FOR FIRE DETECTION

Sensors and alarm buzzers are used for detecting the forest fire. Though this method is widely used, one cannot completely depend upon it. As there are chances of missing alarm rates because of lack of accurate fire information. If fire is far from the sensor then the alarm will not be sent out immediately. Temperature, humidity and smoke analysis techniques are widely used but there are chances of time delay in these methods.

III. PROPOSED METHOD

The figure 1 describes the block diagram of fire detection process. If any fire is detected within camera range, the threshold will be checked and confirmed that fire is present. Mail will be sent to nearby forest station using SMTP protocol. Simple Mail Transfer Protocol in short is known as SMTP. It was first proposed in 1982. SMTP is a standard protocol used for sending e-mail over the internet. Primary action will be provided to off the fire.

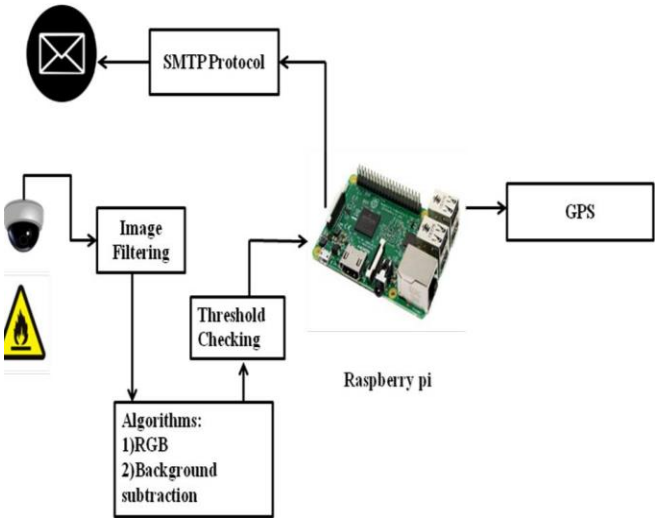

Fig 1: BLOCK DIAGRAM

IV. METHODOLOGY FOR IMPLEMENTATION

Figure 2 shows data flow diagram. A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modelling its process aspects. Here, the camera will capture the images and then this image undergoes filtering process. Foreground image will be detected and background subtraction will be done. Hence all these processes are controlled by the Raspberry pi.

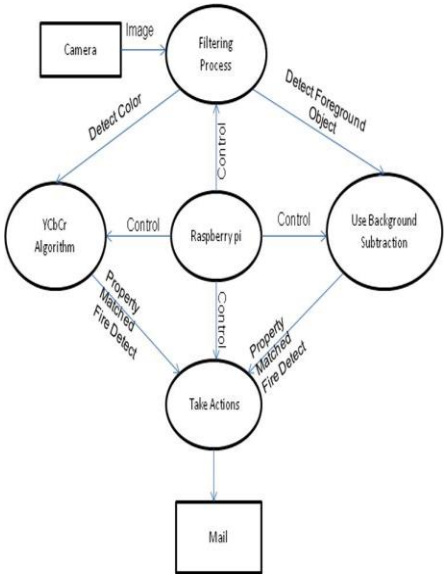

Fig 2: DATA FLOW DIAGRAM

Figure 3 is the flowchart of algorithm used to detect the fire. HSV stands for hue saturation value. Luminance describes measurement of amount of light emitted from a particular source from a solid angle. RGB to HSV conversion is used. Where fire is an image, which can be described using its color properties. This color pixel can be extracted into the individual elements as R, G, and B, which can be used for color detection. RGB to HSV is converted using HSV protocol. Here it checks the luminance and color components, when both the components are detected then it is confirmed that the fire is present.

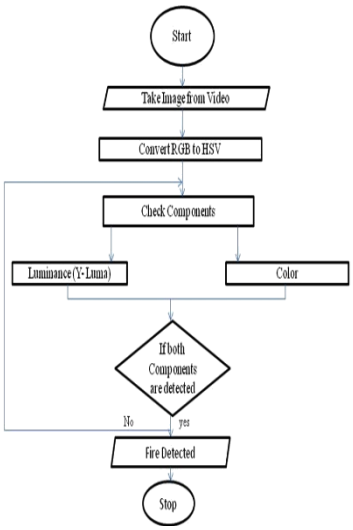

Fig 3: RGB to HSV conversion

The below figure 4 describes about the background subtraction method. Here background subtraction is the method, which is widely used for detecting moving objects in videos from static cameras. It is also known as foreground detection method. This foreground image is detected by subtracting the background frame.

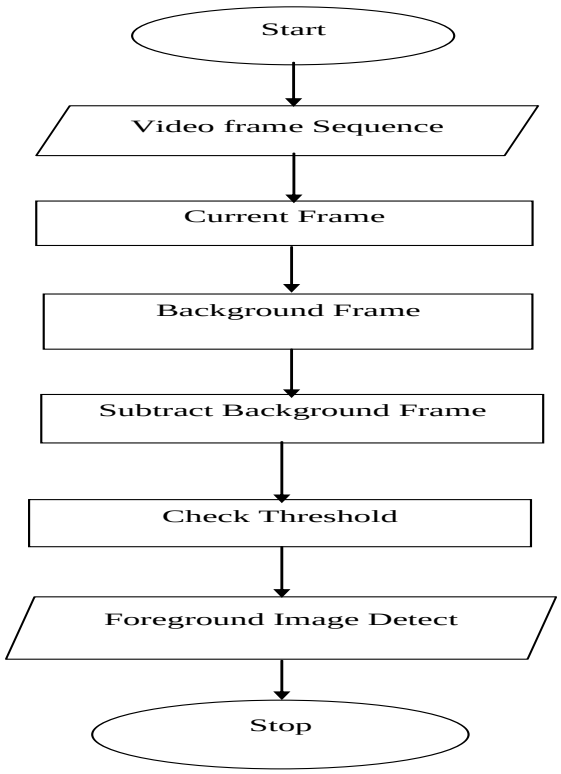

Fig 4: Background subtraction method

Edge detection is a method, which is used to detect the color variance in an image. The edge detection system compares the color difference and provides an edge based on it. From this edge detection the output provides a shape of flame. The Eq. (1), Eq. (2) and Eq. (3) which show how to find the edge in an image.

To detect vertical edges,

$Ex_{x,y} = | P_{x,y} – P_{x+1,y} |$ x 1,N-1; y N

To detect horizontal edge

$Ey_{x,y} = | P_{x,y} – P_{x,y+1}|$ x 1,N; y N-1 Combining Eq. (1) and Eq. (2), new Eq. (3)

That can detect vertical and horizontal edges together is formulated.

$Ex_{x,y} = | 2xP_{x,y} – P_{x+1,y}–P_{x,y} +1|$ x,y1,N-1

V. RESULTS AND DISCUSSION

The figure 5 is the image captured from the video. The red outline in the figure shows that fire is present in the image captured.

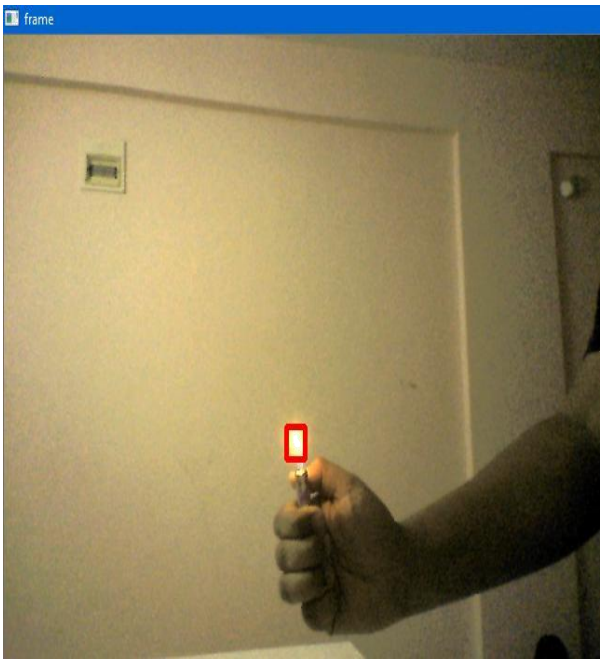

Fig 5: Image captured from video

Figure 6 is the gray scale detection. The images are capturedfrom digital camera in RGB color space, as color informationis the key feature of the process. In this proposed methodimage segmentation is done using Gray level segmentationwith global gray level threshold, which is executed manually.

Fig 6: Graycolor detection

Figure 7 confirms that fire is present after background subtraction is done. Background subtraction is popular technique for detecting moving objects across a fixed camera view .It extracts moving objects in video stream. Background subtraction affordable computationally and is one of the most widely used method.

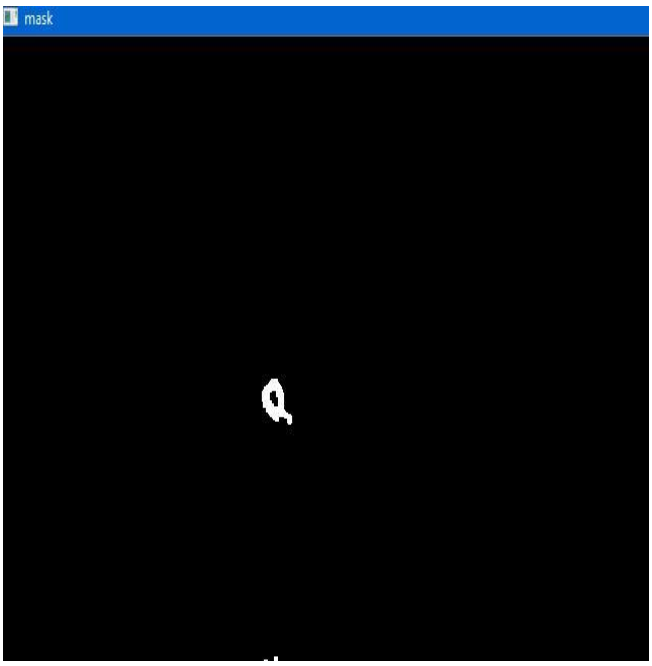

Fig 7: Foreground detection

The figure 8 and figure 9 are the images of email received at desktop and mobiles respectively. As the location will pre loaded, the location where the fire is present will send the pre loaded message to the provided e-mail id's.

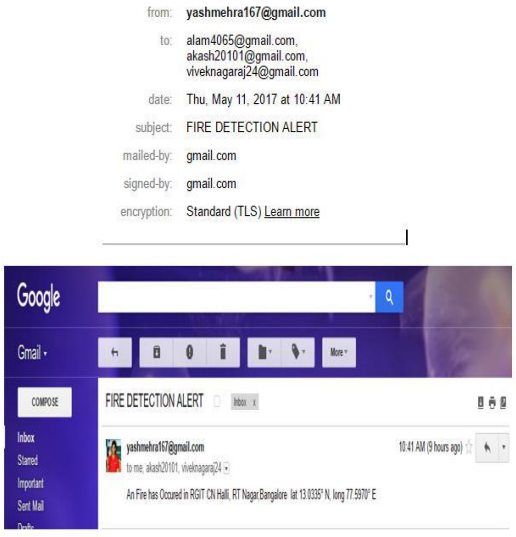

Fig 8: E-mail received at desktop

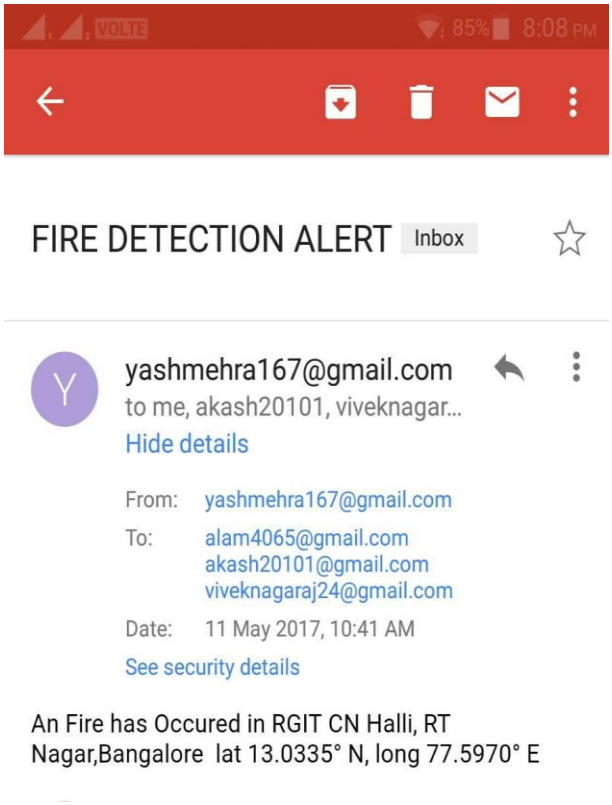

Fig 9: E-mail received at mobile.

The figure 8 and figure 9 are the images of email received at desktop and mobiles respectively. As the location will pre loaded, the location where the fire is present will send the pre loaded message to the provided e-mail id's.

VI. CONCLUSION

We have proposed a vision based fire detection algorithm based on colors and luminance properties of fire. Algorithm used detects fire with high accuracy, both in single images as well as in image sequences**.** GPS provides the exact location of forest fire and SMTP protocol helps in sending mail to nearby fire station immediately. Wildlife can be saved since fire detection is done within less span of time

VII. REFERENCES

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