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Fire Detection System using RGB Color Model

Supriya Sameer Nalawade
Assistant Professor
Department of Computer Science
SSPM College of Engineering Kankavli, Mumbai University, Maharashtra, India

Abstract:
Earlier there was loss of life and property due to fire. So to alert people an early warning is must. Some systems used temperature and smoke detectors to detect fire. And it uses to take more time to detect fire. Our system is based on light detection analyzing light is proposed here in our project. Techniques like segmentation, extraction of frames from videos, minimizing frame frequency, frame difference calculation and checking growth of fire is done in our project. RGB and YCbCr color models are used in our system. From given conditions it is used to separate yellow, orange and high brightness light from background and surrounding light. By using frame difference we calculate fire growth. A video containing re is given as input. An audible alarm will trigger to show the fire.

Keywords: Video frame, RGB Color model, YCbCr color model, background subtraction

I. INTRODUCTION

Fire detection systems are among the most important components in surveillance systems used to monitor buildings and the environment. Fire is one of the a natural serious phenomenon that is out of control due to that it can cause irreversible serious loss of human life and property. It is also a cause of atmospheric pollution once it has occurred. Fire is a great threat when it affects highly populated area or an area of high environmental value. In last few decades it is found that human activities have enhanced the fire rate. As a part of early mechanism, a detection system should generate an alert at earlier stages of fire. Currently, almost all fire detection systems in use have built-in sensors in these the detection depends mainly on the location and density of sensors. It is essential that for a high precision fire detection system these sensors should be densely distributed. In some fire detection system sensors are used to cover large area for over an external environment, coverage of large areas is impractical due to the necessity of a regular distribution of sensors in close proximity. Due to rapidly growing technology digital camera and video processing techniques, there is a major trend to replace conventional fire detection methods with vision based systems. Fires are usually easy to extinguish in an early stage; once a fire has reached a fairly large size, operations for fire-fighting become very complicated and the control of the fire depends largely on the meteorological conditions that determine fire spread. In sparsely populated areas, where fires are not extinguished, fire detection is only needed for monitoring the environmental impact. So it is of prime importance to detect occurrence of fire at early stages. These all circumstances need development of a reliable system which can detect an occurrence of fire at early stage so that the losses can be reduced. Existing fire detection automated system cannot detect fire at early stage because it require some input to sense which is one of the most considerable disadvantage. These systems for the purpose of the sensing, sensors have to be placed at appropriate locations and the system needs some specific level of these inputs to sound alarm. Also as the area to be sensed increases the density of sensors is also to be increased due to which the cost of the system increases. The proposed fire detection system will take input as video from the web cam. It will start capturing frames from the video. Color segmentation code will be used to obtain frames. RGB and YCb Cr color models will help to get high frame image .Then frame difference between consecutive frames will be calculated using frame difference. The fire alarm will display the alert message fire detected with an alarm which will aware the people present in the buildings. The process flow of the proposed method that consists of three processes: Capturing frames, Color segmentation, frame differences are the main process of our system. This system is to reduce the human effort as it is an automatic way to detect fire. Web cam takes the video as input and convert into frames. Whereas frames then are used under RGB and YCbCr color model which will help to know whether the flame is exactly of fire or not. After that the frame difference is calculated which will show the there is any difference in two frames . If the difference appears to be greater than it is a fire. Thus the fire is detected. An alert message with alarm is displayed on the screen to show the fire

II. MODEL FOR FIRE DETECTION

In this section we will discuss the techniques proposed for fire detection. In order to create the color model for fire we analyzed several images having fire. Since the color of fire is generally closer to red and has high illumination, and we can use this property to derive the required color model.

RGB COLOR MODEL

A fire image can be described by using its color properties. There are three different element of color pixel: R,G and B. From the original image color pixel can be extracted and represented in three seperate elements R,G and B, which is used for color detection. RGB color model is used to detect red color information in image. In terms of RGB values, the corresponding inter-relation between R, G and B color channels: R>G and G>B. The combined condition for the captured image can be written as: R>G>B. In fire color detection R should be more stressed then the other component, and hence R becomes the domination color channel in an RGB image for fire. The above equation decided that R as to be over some pre- determined threshold value R_{TH}.[1]

All of these conditions for fire color in image are summarized as following:

Condition1:$R > R_{TH}$ Condition2: R > G>B

Where R_{TH} is the Red color threshold value for fire.

YCbCr color model

YCbCr color space is used in our model rather than other color spaces because of its ability to distinguish luminance information from chrominance information more effectively than other color model. In order to create Y, Cb, Cr components from obtained RGB Image. We will use color space transformation equation to transform each RGB pixel in corresponding Y Channel, Cb Channel, Cr Channel pixel to form a corresponding Y, Cb, Cr image. When the image is converted from RGB to YCbCr color space, intensity and chrominance is easily discriminated. YCbCr color space can be easily model as following for the fire:

Y = 16 + R * 65.481+ G * 128.553 + B * 24.996;
Cb= 128 + R * -37.797 - G * 74.203 + B * 112.0;
Cr = 128 +R * 112.00 + G * -93.7864 + B *
-18.214;

In YCbCr color space, Y′ is the luma component (the "black and white" or achromatic portion of the image) and Cb and Cr are the blue-difference and red-difference chrominance components, will be chosen intentionally because of its ability to separate illumination information from chrominance more effectively than the other color spaces. [1] m In YCbCr model color space and analysis can be performed. For a fire pixel,

Y(x, y) >= Cr(x,y) >= Cb(x, y),

where a non-fire pixels don't satisfy this condition, where (x,y) is spatial location of a fire pixel. Such system can be useful for detecting forest fires where we can't put sensors at each location .So we can summarize overall relation between Y(x, y), Cb(x, y) and Cr(x, y) as follows:

Y(x, y) >= Cr(x, y) >= Cb(x, y)

Now, we can have some rules for fire detection:

Rule1: R1(x,y) = 1 , if ((R(x,y) > G(x,y)) &&(G(x,y) > B(x,y)))
0 , otherwise

Rule2: R2(x,y) = 1 , if (R(x,y) > 190) && (G(x,y) >100) && (B(x,y) < 140)
0 , otherwise

Rule3: R3(x,y) = 1 ,if Y(x,y) >= Cb(x,y)
0, otherwise

Rule4: R4(x,y) = 1 ,if (Cr(x,y) >= Cb(x,y)[1]
0, otherwise

III. PROPOSED SYSTEM

Detect fire before it becomes a disaster for the society is very important task. Proposed system detect the fire in very less time, using low cost camera and Detect fire faster than the existing system. Due to the drawbacks of sensor based fire detection system and due to rapid development of image processing techniques vision based fire detection system came into existence. Proposed vision based fire detection system having several advantages. Firstly installation cost of this system is low as CCTV cameras are required. Secondly it has faster response time as it does not have to wait for the products of combustion to come near it this was not the case with sensor based systems. Thirdly in case of false alarm, confirmation can be done from the room by person without rushing to location of fire. Fourthly these systems can be used in open environment and on increasing the area to be covered the cost of the system is not much affected. Lastly fire detection technology based on video image can extract much more information from smoke and flame which is helpful for the detection. User of system is everyone who wish to secure his place from fire or want to be always alert about incident like fire. This system is useful in areas where we can install camera.i.e. Bank
Residential place
Office and Workplace
School and Colleges
Home
Bank ATM
Shopes
Streets

IV. SYSTEM DESIGN

To improve the reliability of detection usually distinguish sudden movements of flames, changeable shapes etc. In this proposed system, continuous frames of images are captured by camera. Thus it has faster response time. These video is monitored by software and extract multiple images from video. From these images required YCbCr components are extracted and detect Cb,Cr frames. After the algorithms are applied on the video and if the specific properties of fire pixels are detected by the image processing in an image, then the software will give command and alarm is raised. The proposed method consists three main stages: - extract images from video, extract Y,Cb,Cr component and detect moving fire pixel region in an image. The proposed method is applied on video sequences and then fire is detected. Thus smoke pixels and gases are monitored continuously. This, in turn, will increase the efficiency of the system and provide safety to the environment.[4].

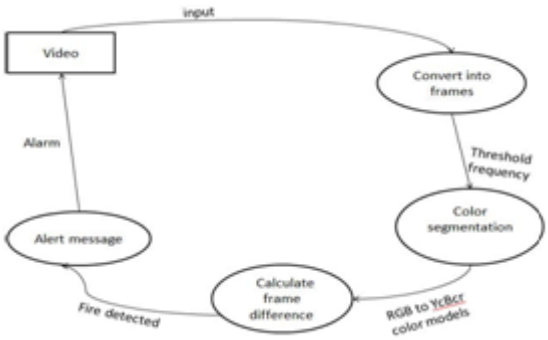

Figure.1. Proposed algorithm for fire detection

V. RESULTS AND EXPERIMENTS

In the output Fig 2 First window shows the original RGB image captured. The Video to frame conversion is obtained and shown in fig2 window

Figure.2. Video to frame conversion

After that fig 3 shows different frames. Using different rule of YCbCr color model difference in the frame is calculated.

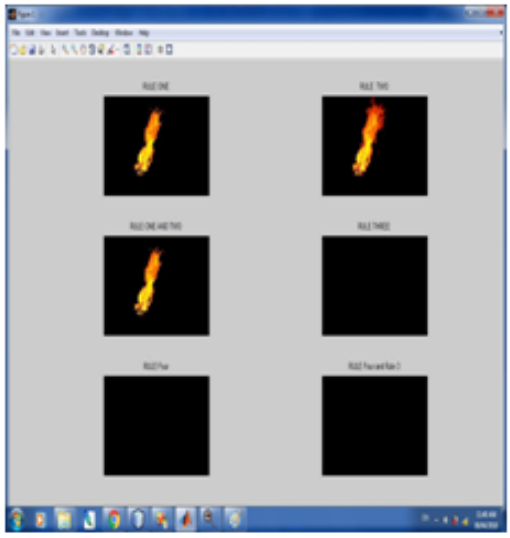

Figure.3. frame differences

Fig 4 shows the output window indicated that "FIRE DETECTED". Testing information represented in the test case table 1

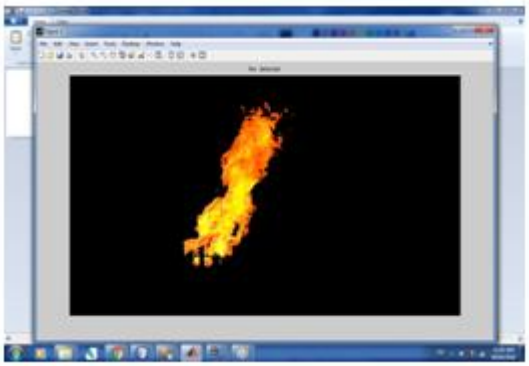

Figure.4. Fire detected

Table.1. Test cases

Sr No.	Test Description (Input)	Expected output	Actual Output	Result
1	Incorrect fire image	Not a Fire	Fire not detected	Pass
2	Correct fire image	Not a fire (just an image)	Fire not detected	Pass
3	Video containing candle fire	Not the fire as flame is constant	Fire not detected	Pass
4	Video containing Matchstick fire	Not the fire as flame is constant	Fire not detected warning a	Pass
5	video having fire	Fire detected	Fire detected	Pass

VI. CONCLUSIONS

We have proposed are detection system for buildings. The system uses grayscale, RCB and YCbCr color models with given condition that separates orange, yellow and high brightness from the background. Frame difference is the technique used to check the fire growth. Frame difference algorithm is used here to calculate frame difference. Our system works well enough when there is fire by providing significantly faster detection based on light detection and its analysis. Outcome of our project is significant reduction of loss of life and property. As the fire alarm will help to take immediate action to the people present in the building. This system will detect fire in faster way. High brightness intensity color will be de ned here using this model technique. The change in the size and intensity caused by relative proximity to the camera may cause false alarms which will be avoided here.

VII. FTURE WORK

The detection method used can be further used as a standard detection algorithm for any system. As this is a fire detection algorithm it can be used for detecting fire equal to the maximum false detection of the system. In future work, objects and shapes, such as shirts, bags, or other objects with orange color, which are approaching the camera will be analysed without any false detection. Human effort of watchman or any security guards may get reduced. If any damaged caused in building they may not be blamed for it. Also it will not be necessary for them to continuously sit in the camera or control room.

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