# Automatic Fire Detection

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**Abstract : Generally fire detection systems use physical sensors to detect fire. Chemical properties of particles in the air are acquired by sensors and are used by conventional fire detection systems to raise an alarm. However, this sensors only focus one point and fire would have already grown after raise an alarm. The automatic fire detection system was developed using image processing on matlab. The method of detection decided fire image and smoke image. Fire detection and signaling system configurations commonly can be used industrial, factory,storage and high hazard occupancies as well as some specific areas which need special protection from fire and smoke.**

**Keywords** ***: fire detection; digital filter design; automatic fire detection;***

## Introduction

The automatic fire detection is a system that recognizes when a fire occuring and activates the fire alarm system. This Project is aimed to detect fire automatically and alert occupants-people with electronic devices by using cameras and relevant applications( webcam or pictures ). The automatic fire detection will be limited by camera view but by increasing camera numbers angle of view could be increased. Also program might applied existed cameras and in addition to other of fire detectors. The main objective is to detect fire automatically when it's on early stages and to make fire extinction easier for controlling the fire and smoke.[1]

## I. The Algorithm

So that manage unexpected alarms of conventional fire detection systems, therefore a computer vision-based fire detection algortihm is needed. he algorithm can be used in parallel with conventional fire detection systems to reduce false alarms. It can also be deployed as a stand-alone system to detect fire by using video frames acquired through a video acquisition device. A novel fire color model is developed in red, green and blue color space to identify fire pixels.

### Operation sequence of this system:

I. Input RGB image
II. RGB to CIE L*a*b*conversion
III. Apply color-based data modeling to detect fire pixels
IV. Detect fire pixel and analyze

### RGB to CIE L*a*b Color Space Conversion

Where, Xn, Yn, and Zn are the tri-stimulus values of the reference color white. The data range of RGB color channels is between 0 and 255 for 8-bit data representation. Meanwhile, the data ranges of L*, a*, and b* components are [0, 100], [–110, 110], and [–110, 110], respectively.

### Color Modeling for Fire Detection

The range of fire color can be defined as an interval of color values between red and yellow. Since the color of fire is generally close to red and has high illumination, we can use this property to define measures to detect the existence of fire in an image. For a given image in CIE L*a*b* color space, the following statistical measures for each color channel are defined as,

Where Lm*, am* and bm* are a collection of average values of the L*, a*, and b* color channels, respectively; N is the total number of pixels in the image; and (x, y) is spatial pixel location in an imaging grid. The numeric color responses L*, a*, and b* are normalized to [0, 1]. It is assumed that the fire in an image has the brightest image region and is near to the color red. Thus, we use RGB color range:

```
R = foto(:, :, 1);
G = foto(:, :, 2);
B = foto(:, :, 3);
```

Where, R, G, B, are binary images which represent the existence of fire in a spatial pixel location (x, y) by 1 and the non-existence of fire by 0. Red, green and blue binary images seperated.

Then we select binary yellow for a final fire pixel detection equation can be defined as,

```
yellowness = (single(R) + single(G))/2 - single(B);
binaryYellow = yellowness > 120;
```

Where, binaryYellow is the final decision on whether a pixel located at spatial location (x, y) results from fire or not. Then we check if binaryYellow big enough for detect fire.

```
if tesbit1>1500
h = waitbar(0, 'Fire Detected');
set(h,'Name', 'Picture 1')
else
h = waitbar(0, 'No fire');
set(h,'Name', 'Picture 1')
end
```

### Matlab Implementation

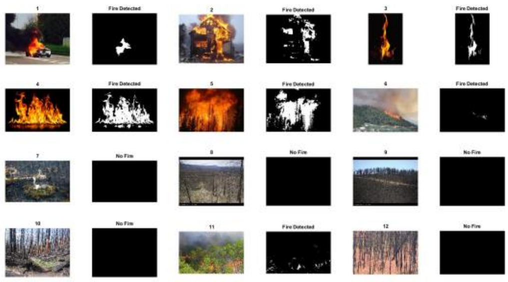
Our matlab implementation uses RGB range matrix which explained above. We take the images as input and convert it to RGB color range. For each red, green and blue colors a matrix created which contians information of density of these colors for every pixel.

After binerization of the image we seperate blue color and we look for certain yellowness at the image. For this we use a threshold. If yellowness bigger than that threshold it is selected and stored. Then we count the binary yellow and look if it is enough for us to say there is fire.

Above we see the binarized image. The selected yellow can be seen and that it percieved as fire. Then system give fire alert to user.

## II. Experimental Results

We test our algorithm more than 20 images. For all of them successfully detected if there is fire or not. But unfortunately we did not have the time to test for more images to be more accurate.



### Limitations

First limitation is the coverage area limited to camera frame. Which can be very large for satellite images but small for a security camera. Also because of cost we could not work with thermal cams, thermal cams will certainly make it easier and more accurate to detect fire.

## III. Fire Models

Fire has unique visual signatures. Color, geometry, and motion of fire region were all essential for recognition. A region that corresponds to fire can be captured in terms of (1) spectral characteristics of the pixels in the region, and (2) the spatial structure defined by their spectral variation within the region. A fire in motion has a relatively static general shape (determined by the shape of burning materials) and rapidly changing local shape in the unobstructed part of the border.

The shape of a fire region usually keeps changing and exhibits a stochastic motion, which depends on surrounding environmental factors such as the type of burning materials and air flow.[1]

Low frequency components of fire region boundary are relatively steady over time, and the higher frequency components change in a stochastic fashion. Accordingly, we use a stochastic model to capture the characteristic random motion of fire boundaries over time.

## IV. CONCLUSION

Fire detection and signaling system configurations commonly could be used in industrial, factory, storage also high hazard occupancies as well as some specific areas which need special protection from fire and smoke. Using matlab implemeted image prossesing has benefits. It can easily put to use. While other conventional systems needs additional hardwares we can use security cams and MOBESE cameras with out extra cost. By implementing code to satellite cameras we can cover large areas like forest, other wise we are unable to watch with other methods. Also we could improve accuracy and early detection if we use thermal cameras. It is less costly, can easily applied existing cameras only using code. Also we can use it additon to other detection systems such as smoke detector.

## V. REFERENCES

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