



## Fire Detection Using Machine Learning

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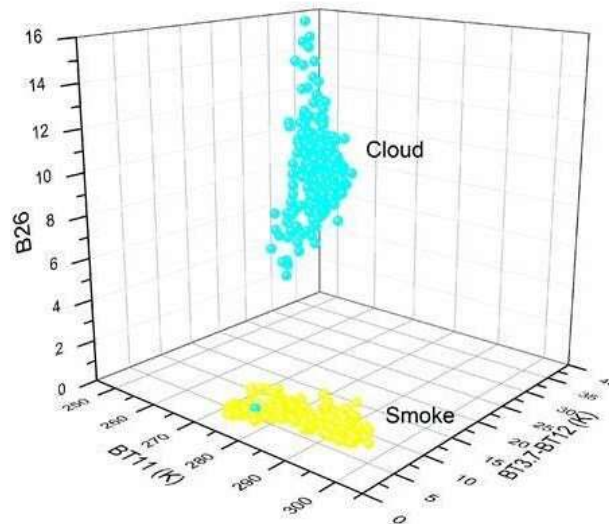
### ABSTRACT –

Computer Vision based and using image processing has the potential to be useful in conditions in which conventional methods cannot be adopted. The fire detection algorithm uses visual characteristics of fires like brightness, spectral texture, spectral flicker, and edge trembling to discriminate them from other visible stimuli. There are various fire detection techniques such as infrared sensors, thermal detectors, smoke detectors, flame detectors, and optical smoke detectors. These methods are not always reliable as they do not always detect the fire itself but one or more phenomena resulting from fire, such as smoke, heat, infrared, ultraviolet light radiation, or gas, which could be produced in other ways hence, produces many false alarms. With the help of computer vision and image processing techniques, it is possible to get better results than conventional systems because images can provide more reliable information.

**Keywords—** computer vision, detection, image processing system and techniques

### Introduction

Fire detection is based on Machine and Deep learning under computer technology. It is the name for detection-related sensors and motors. Example: Fire Alarm. The spread of fire throughout the forest is prevented numerically. Wild Fire is a natural disaster that leads to serious conditions for human lives, property, and ecosystems. Satellite Remote Sensing gives more opportunities with the advantage of observation, and detection at low cost. But it is challenging because fire smoke has various spectral overlapping. It is a complex land to cover types of clouds, dust, and haze. Now, a day there are many sensors are used in many industrial fields and Information technological fields.



### I. Fire Detection in Deep Learning

It is the main objective of this project besides surveillance. The project aims to early detection of fire apart from preventive measures to reduce the losses due to hazardous fire. with fires spreading increasingly around the world due to increasing global warming, it has become imperative to develop an intelligent system that detects fires early, using modern technology. Therefore, we used one of the artificial intelligence techniques, which is deep learning, which is one of the popular methods now. Professionals have done a lot of research, experiments, and coding software to detect fires using deep learning. In this essay, we examine current approaches taken by experts in the field, data sets, and the effectiveness of each approach in detecting fires. - The light parameter and the colour of the flame help in detecting fire. Fire detection using colour information has many applications in computer vision and other

domains. Our colour model-based method used for fire detection has many advantages over conventional methods of smoke detection etc., such as simplicity, feasibility, and understandability. To enhance the performance parameters of fire flame detection based on a live video stream, we propose an effective colour model-based method for fire detection. Every pixel is checked for the presence or absence of fire using colour features, and periodic behaviour in fire regions is also analysis. Additionally, a dynamic boundary check is performed to identify the fire region of interest's edges (ROI). Candidate fire regions are detected using chromatic and dynamic measurements.

## II. Image Processing in Machine Learning

The existing system uses a statistical colour model with Fuzzy logic for fire pixel classification. The system develops two models; one based on luminance and the second based on chrominance. Instead of employing colour spaces like RGB, fuzzy logic separates luminance from chrominance using the YCbCr colour space. Current historic rules are replaced with Fuzzy logic to make the classification more robust and effective. It was difficult to work in various lighting situations. Another factor that created difficulty was when the colour of the fire and some similar fire colour objects overlapped because of light or for some other reasons. On a day with intense sunshine, it might also be difficult to spot a fire at its earliest stages. The biggest challenge was to complete the project and increase its accuracy. In the first approach first, video is captured using a webcam or surveillance camera. Then the captured frame is converted to grayscale and the noise is removed. After that colour property of fire is used to identify possible fire regions in the foreground image. This approach has low performance when there is an extremely fire-coloured object in the monitored area. So, to improve this, another approach is used to detect fire. This approach tries to find the moving areas of the image. Because in the real world, fire regions grow and spread as time passes. Finding the movement in the image reduces the candidate regions to detect fire colour pixels. Contour detection is performed to find the moving regions of the image which is already segmented using the colour property. Then the boundary of the moving region is found and the amount of fire pixels in this area is calculated. Since fire region varies to a great extent, based on this system can find whether there is a fire in the moving fire-coloured region or not.

## III. Fire Detection module and Fire alarm

The procedure for detecting fire classifies images based on the value of simple features from an image. To detect the fire the image has to be converted to RGB. As OpenCV can convert the image to BGR, the Mat-plot library is used to convert the image to RGB. The captured video is converted into 2D images using the show module. The captured pixels are arranged in rows and columns. Then to convert the image to BGR the pixels are arranged in the x, y, and z matrix. Then the matrix pixels are compared with each other and the layers are masked using bitwise\_AND. Using Morphological transform the imperfections are corrected by the process of Dilation and Erosion. The Absolute difference between the colour models is found. Simple thresholding is applied to find the intensity. The procedure for detecting fire classifies pics primarily based totally on the value of easy features from a picture. The frames are then converted into BGR using CV2 and by using the Mat-plot library the image is converted into RGB. The detected fire images are stored in a folder and the fire images are sent via mail. Along with small steps, the box detects the features like edges, and brightness level from the image of fire, and then data collected by pixels are put together, which helps to determine where the fire is located.



### Mat-plot

OpenCV can change the image into BGR but to process the frames the image has to be converted into RGB. To work on the colour models the Mat-plot library is used. First of all the frames are converted to BGR. The BGR is then converted to YCR\_CB, the luma component, and the Cb, Cr is the blue-red difference of the chroma components. In the final stage, the YCR\_CB is converted to RGB. Comparing source 1 and source 2 of the images. If the source1 is greater than source2 then the operations proceed

### Masking the layers

Masking means limiting a certain layer or adjusting in visible areas. A mask allows an image to adjust a certain portion of your image while leaving the rest completely aside. It is masking a brighter subject while leaving the background unedited. The bitwise AND operator computes the bitwise conjunction of the two arrays.

### Morphological Transformation

Morphological transformation is used to remove all the imperfections from the binary image. It helps to achieve smoothness in the image. The two operations are Opening operations and Closing operations. The operations are carried away in two steps. There are Eroding and Dilation Erode operation removes the pixels from the edge of the objects. Dilate operation adds extra pixels to the edges.

### Thresholding:

Basic thresholding is the technique known as Binary thresholding. For every pixel, the same threshold value is applied. If the pixel value is smaller than the threshold it is set to zero, otherwise, it is to the maximum value is 255.

### Future Enhancement:

Currently, we did not use the systems like smoke detectors and sprinkler water discharge systems, but in the future, they can be included. In the future, a fire-detecting system can be proposed which is a more accurate and reliable way of detecting fires in small houses or office places, rather than conventional methods such as smoke detectors. The approach was limited due to the devices used and it can be improvised to be even more accurate than the system already is. Future scopes include using this system along with fire extinguishers to make them automated.

## IV. Open-source computer vision library

Library is written in C and C++ and runs under Linux, Windows, and Mac OS X. There is active development on interfaces for Python, Ruby, Mat-lab, and other languages. It was designed for computational efficiency and with a strong focus on real-time applications. OpenCV is written in optimized C and can take advantage of multi-core processors. If you desire further automatic optimization on Intel architectures [Intel], you can buy Intel's Integrated Performance Primitives (IPP) libraries [IPP], which consist of low-level optimized routines in many different algorithmic areas. OpenCV automatically uses the appropriate IPP library at runtime if that library is installed. One of OpenCV's goals is to provide a simple-to-use computer vision infrastructure that helps people build fairly sophisticated vision applications quickly. The OpenCV library contains over 500 functions that span many areas in vision, including factory product inspection, medical imaging, security, user interface, camera calibration, stereo vision, and robotics. Because computer vision and machine learning often go hand-in-hand, OpenCV also contains a full, general-purpose Machine Learning Library (MLL).

This sub-library is focused on statistical pattern recognition and clustering. The MLL is highly useful for the visual tasks that are at the core of OpenCV's mission, but it is general enough to be used for any machine-learning problem OpenCV Library is mainly aimed at real-time computer vision. Some example areas would be Human- Computer Interaction (HCI); Object Identification, Segmentation, and Recognition; Face Recognition; Gesture Recognition; Motion Tracking, Ego Motion, Motion Understanding; Structure From Motion (SFM); and Mobile Robotics. The OpenCV Library software package supports many functions whose performance can be significantly enhanced on the Intel architecture (IA), particularly. It is a collection of low-overhead, high-performance operations performed on images. This manual explains the concepts as well as specific data type definitions and operation models used in the image processing domain. It implements a wide variety of tools for image interpretation. It is compatible with Intel Image Processing Library (IPL) that implements low-level operations on digital images. Despite primitives such as binarization, filtering, image statistics, and pyramids, OpenCV is mostly a high-level library implementing algorithms for calibration techniques (Camera Calibration), feature detection (Feature), and tracking (Optical Flow), shape analysis (Geometry, Contour Processing), motion analysis (Motion Templates, Estimators), 3D reconstruction (View Morphing), object segmentation and recognition (Histogram, Embedded Hidden Markov Models, Eigen Objects). The essential feature of the library along with functionality and quality is performance. The algorithms are based on highly flexible data structures (Dynamic Data Structures) coupled with IPL data structures; more than half of the functions have been assembler optimized taking advantage of Intel Architecture (Pentium MMX, Pentium Pro, Pentium III, Pentium 4). It is a way of establishing an open-source vision community that will make better use of up-to-date opportunities to apply computer vision in the growing PC environment. The software provides a set of image processing functions, as well as image and pattern analysis functions. The functions are optimized for Intel architecture processors and are particularly effective at taking advantage of MMX technology. The OpenCV Library has platform independent interface and is supplied with whole C sources. It is designed to be used together with Intel Image Processing Library (IPL) and extends the latter <https://search.yahoo.com/search?fr=mcafee&type=E211US885G91738&p=deep+learning> functionality toward image and pattern analysis. Therefore, OpenCV shares the same image format (Ipl Image) with IPL. Also, OpenCV uses Intel Integrated Performance Primitives (IPP) on the lower level, if it can locate the IPP binaries on start-up. IPP provides a cross-platform interface to highly- optimized low-level functions that perform domain- specific operations, particularly, image processing and computer vision primitive operations. Exists on multiple platforms including IA32, IA64, and Strong ARM. OpenCV can automatically benefit from using IPP on all these platforms.

## V. Conclusion

As technology is getting better and better as to keep it up with the technology and minimize limitations also, a new system has been created. By using image processing technology for detecting the fire, these limitations can be reduced because in this system camera acts like a human eye, as it detects a fire, the video is captured, and the image is processed using the software. It can be used everywhere such as Hospitals, railway stations, forests, etc. The designed prototype successfully detects fire gives the review analysis, designing system, and algorithm, test, and result.

## VI. References

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