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REAL-TIME FIRE AND SMOKE DETECTION

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Abstract: Fire is one of the hazardous, unwanted and sometimes uncontrolled events. Urban fires generally occur because of short-circuits in electrical devices, leakage on LPG gas cylinder ducts, or due to human ignorance itself. But at present, the system that is generally used in the community is a smoke sensor that is affixed to the ceiling of the room to detect a fireplace.
Apart from the matter of early fire detection, present fire alarm systems are inefficient in terms of the false triggering of the alarm systems. Traditional Fire detection methods that is. Sensor-based and Color Based Flame detection have high false rate and low accuracy.
Real-time Fire detection using Convolution Neural Network will overcome many problems in traditional fire identification. Convolutional Neural Network (CNN) is an algorithm which classifies images with a high degree of accuracy and good performance. The proposed system will be using the Convolution Neural Network, YOLO v3 (You Only Look Once Version 3) algorithm, OpenCv, Keras deep learning library.

Index Terms **- Deep Learning, Fire and Smoke Detection, Convolution Neural Network, YOLO, artificial intelligence.**

I.INTRODUCTION

The fire detection covers a very large field. The focus in this proposed system is fire detection using a low-cost camera. The cameras that are required to work with this program are the CCTV cameras, such as those in shopping complexes or malls. One factor that needs to be taken into consideration is that, unlike other fire detectors, this system is not a point type detector. It will be able to detect fire in large open spaces, so that the whole area must be considered, and not just a single point on the image from the video feed. This system can also be used in aggressive environments as well as in hazardous areas.

The proposed system is aimed at detecting fire by using the image processing technology that will alert people by early detection of fire. There are many automatic fire alarm systems already existing like the sensor method, but they have limitations. The proposed system is designed to detect fire along with smoke detection.

II.LITERATURE REVIEW

A. *Amit Hatekar, Saurabh Manwani, Gaurav Patil, Akshat Parekh* proposed Fire Detection on a Surveillance System using Image Processing. They proposed a simple fire detection algorithm. initially the image frame is taken from the live video feed. The frame is then applied to the RGB color model. The resultant is then converted to a HSV frame. Then thresholding, median blurring (to remove noise), Background Subtraction, Sobel edge detection, and motion detection windows techniques are applied. The resultant is then combined using Bitwise AND operation. Finally, the Segmentation techniques are applied to produce the final result.

B. *Mrs. P. Subhasini, Sashank Konathala, Bhargav Sai, Sudheer Thota4, Sai Charith Vadla* proposed Fire Detection Using Image Processing. They proposed a fire detection method using RGB Color model, YCbCr color model. Drawback of this system was that it was detecting all fire-like objects.

C. *Jareerat Seebamrungsat, Suphachai Praising, Panomkhawn Riyamongkol* have developed Fire detection systems using image processing. The input is real-time video. First, the subtraction model is applied to separate the expected fire location and the background. Then two consecutive fire location frames are visualized to check fire growth. If fire growth continues even after five frames, the system gives an alarm and the computer screen will display the video with the red box superimposed on the detected fire.

III.OBJECTIVES

The main objective of the proposed system is to develop a fire detection technique in real time. The main points of the proposed system objectives are given below:

- To detect fire at an early stage.
- To develop a low cost real-time fire detection system.
- A system that detects a fire earlier and more accurately than conventional fire detectors.

IV.METHODOLOGY:

A. CNN (Convolution Neural Network):

A convolutional neural network (CNN) is a model of deep learning. It is mainly used for processing structured arrays of data for example images. Convolutional neural networks detect patterns in the input image. It can easily detect lines, circles, or even eyes and faces. Therefore, convolutional neural networks are used for computer vision. Convolutional neural networks directly operate on raw images that do not require any pre-processing.

B. YOLO Algorithm (You Only Look Once):

YOLO means 'You Only Look Once'. The YOLO algorithm uses convolutional neural networks (CNN) to detect real-time objects. As the name suggests, the algorithm requires only a single forward propagation through a neural network to detect objects. Therefore, the prediction in the entire image is done in a single run.

YOLO algorithm uses three techniques:

- Residual blocks
- Bounding box regression
- Intersection Over Union (IOU)

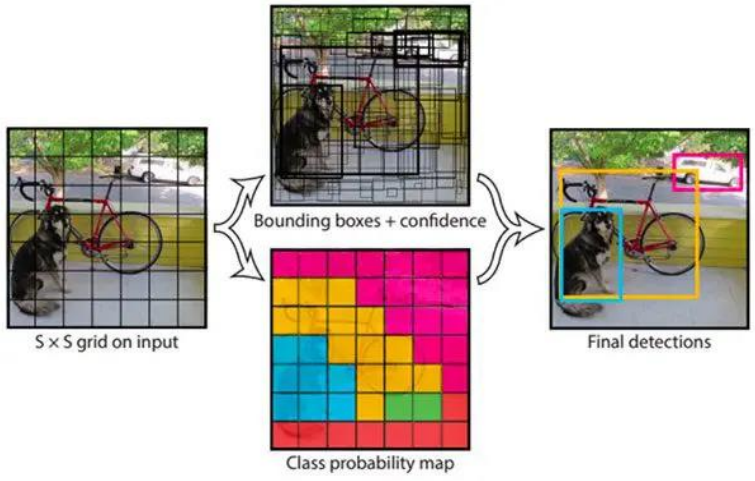
Residual blocks: First, the image is divided into various grids. Each grid has a dimension of A x A. Every grid cell detects objects that appear within them.

Bounding box regression: A bounding box is an outline that picks out an object in an image. YOLO uses a one bounding box regression to predict the height, width, centre, and class of objects.

Intersection over union (IOU): Intersection over union (IOU) in object detection describes how boxes overlap. YOLO uses IOU which gives an output box that surrounds the objects in an image perfectly. If the predicted bounding box is similar to the real box then IOU is equal to 1. This eliminates bounding boxes that are not equal to the real box.

These three techniques are applied to produce the final detection results. The final detection will consist of unique bounding boxes that fit the objects perfectly.

The image below shows how YOLOv3 works:



C. Open CV:

It stands for Open-Source Computer Vision Library. OpenCV is used for developing real-time computer vision applications. It can process images and videos to identify objects, faces, or also handwriting.

Currently OpenCV supports a large variety of programming languages like C++, Python, Java etc and is available on different platforms including Windows, Linux, OS X, Android, iOS etc.

D. Keras model:

Keras is a simple and easy-to-use open-source library in python for designing and developing deep learning models. It was developed for fast experimentation. Keras have the ability to go from idea to result as quickly as possible is the main reason for doing good research.

The proposed system will be using 2 datasets. One dataset will contain different images of fire and smoke and the second dataset will contain all the non-fire images. We are implementing a Convolution Neural Network built with the help of keras deep learning framework. For fire/smoke detection we are using YOLOv3(You Only Look Once version 3), a deep learning model designed for faster object detection and OpenCV, an open-source library for machine learning and image processing.

The proposed system will tell the location of fire and also all the exits of the room. It will send alert messages to the admin about fire detection. The objective is to identify fire in the captured infrared image based on the colour-based segmentation of the images. Other objects other than fire in the input images will be removed by the application of frame differencing. To improve the accuracy of the proposed method further compared to the existing methods.

The proposed system is using a fire detection algorithm which will be free from temperature and heat sensors as the ordinary fire detection systems contain. It will also save the cost by getting rid of expensive temperature and heat sensors etc.

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