IMAGE PROCESSING BASED FIRE DETECTION SYSTEM

Abstract— Image processing is a type of processing in which the input image is transformed into another image as output with certain techniques applied to it. In this concept, we will create a fire detecting device using a USB camera and a Raspberry Pi and apply the concepts of IoT and Image Processing to get real time fire detection results. When the device is switched on, it continiously monitors the area infront of camera for fires. This is done by using HAAR Cascade Classifier Algorithm. Once detected the system could be hooked up with either fire extinguishers to make them work independantly or it could just set an alarm or send a notification to the users mobile device via GSM. The after processing possibilities are endless.

Keywords— Fire detection, Image Processing, OpenCV, Python, IoT, Raspberry Pi

I. INTRODUCTION

As we all know, nowadays the occurrence of disasters are increasing day by day. One of the major disasters include Fire starting in homes/offices, etc. The current fire-fighting technology includes use of manual work, i.e. Fire Extinguishers. Till the time someone goes to cease the fire, it has already been spread out. In our concept, we are planning to make an automated fire extinguisher system, which would activate as soon as a fire starts.
Quoted from https://www.who.int/ ,according to a study in 2016, there were 1,80,000 serious cases of burns due to fire. This include household fires, office fires, industrial area fires, etc.

To put out fire, traditionally use of Fire Extinguishers is done. The user goes to the area effected, and manually uses the fire extinguisher there. The time required the user to reach the place may result in increase in the intensity of fire or spreading of fire around the place.
The project aims at creating an advanced device based on Image Processing to cease the fire as soon as it starts. The system would be fully automated and hence no need of any human interference is required.

Some of the reasons for fire breakout are as follows:

- Low ceiling heights.
- No short circuit protection in household wiring.
- No safety equipments kept available for emergencies.
- Excess amount of flammable objects like wood, paper, plastic stored at one place.
- No Fire prevention measures are taken.

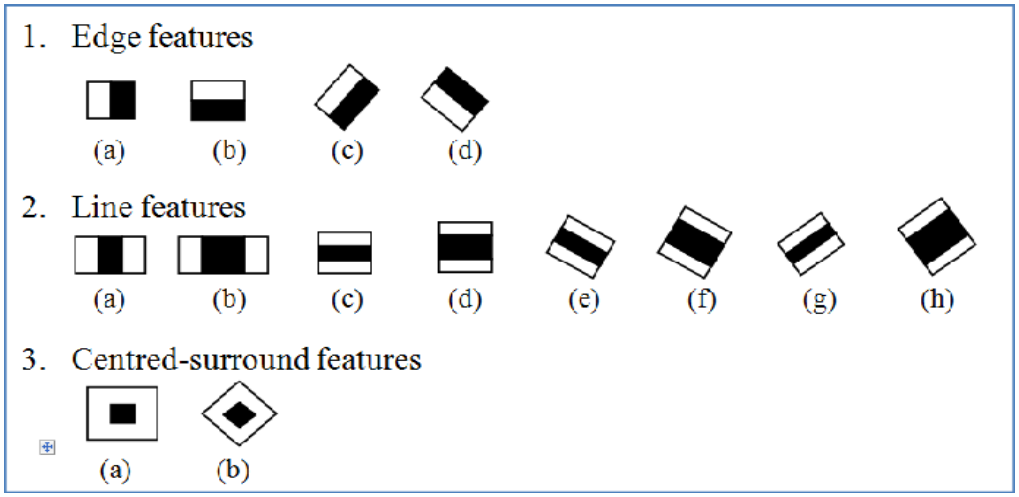
II. CONCEPT

While doing computer vision tasks like in this project, we can get the information about the object by various techniques such as image processing, image models, RGB/HSV conversion methods and HAAR cascade classifiers.

The Algorithm we use in this project is Haar Cascade Classifier, which is a method for detecting objects in an image easily. The Haar Cascade Classifier is an object detection method developed by Viola & Jones. This method is based on Haar-like features, combined with the classifier which results in the cascade becoming strengthened. Haar-like features are features that are widely used in detection of objects, offering rapid extraction process and are able to represent a lower resolution image. This method has been successfully applied in many object detection applications.

The classifier is made with training a cascade file from a number of positive & negative images, which have the same size. After assesment of the image is done, the area which are similar to the object are marked as 1 whereas its marked as 0 for the areas that do not match. After the training, the cascade is now ready to examine further input images. The classifier goes on to look across the entire image in order to find similar features as the cascade of the object to be detected.

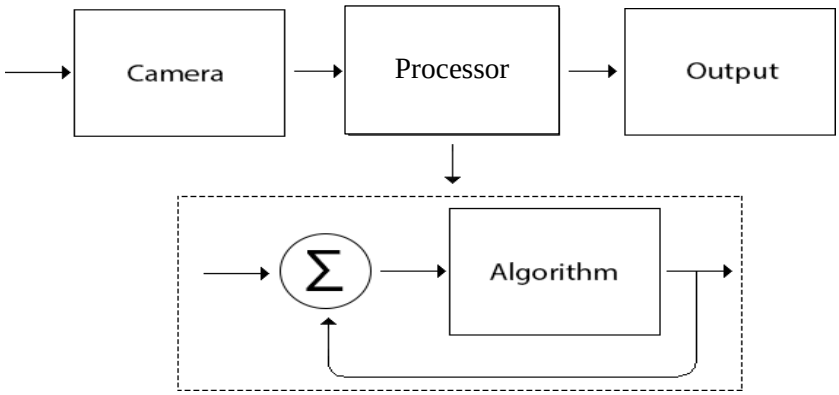
To detect the target area more accurately and to reduce the time taken to scan every image, the scanning window size is changed adaptively by the classifier. During the process of classification, the model features the optimal rectangles in accordance with the objects and the scanning window.



III.

SYSTEM DESIGN

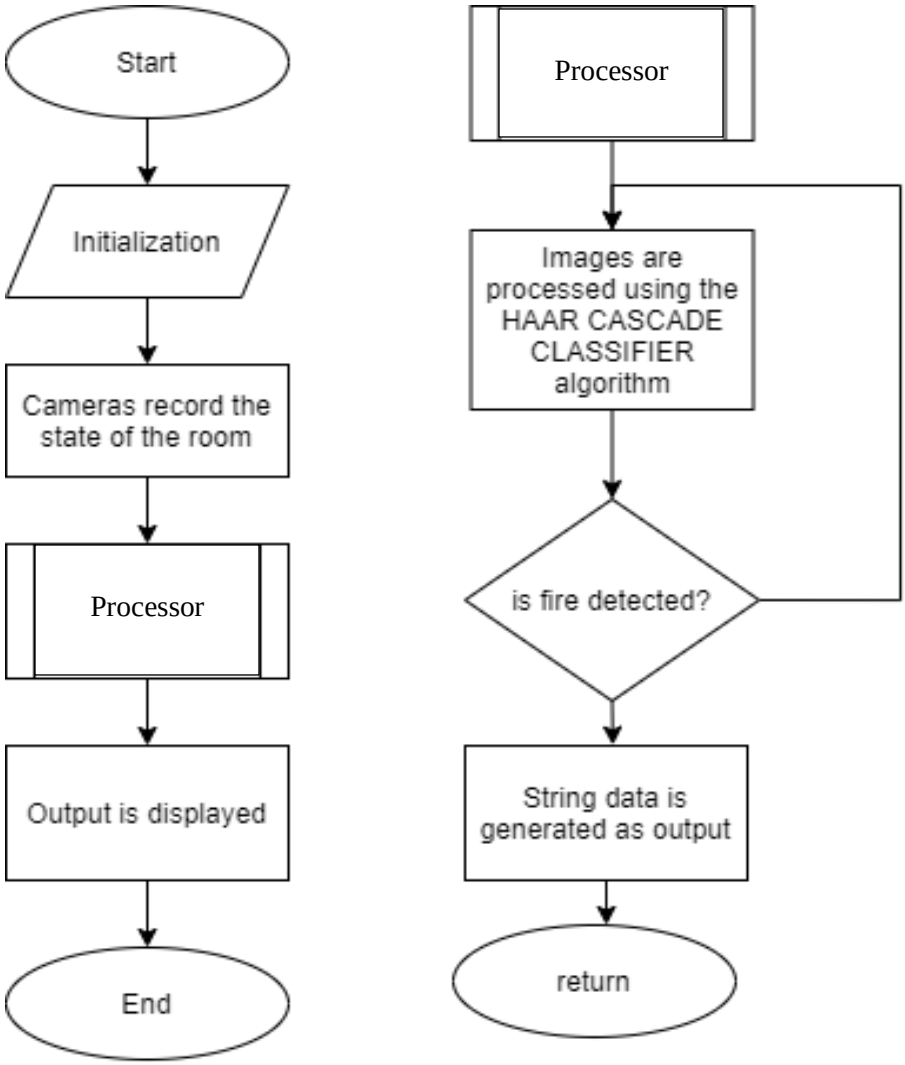
The device used for Image processing is Raspberry Pi.



We are using Raspberry Pi camera for the input, as it is a bit faster than the regular USB camera bcos the USB cameras require the cpu to work with the USB interface which takes more time rather than just the on board camera. The image data would then be supplied to the python script that we are running with opencv in order to detect fire by using Haar Cascade Classifier algorithm. Additionally, if required, we can send the data to servers in order to track multiple fire detections at the same time.

IV. FLOWCHART SYSTEM

The flowchart of the system working is shown in the figure below. First the camera is set up with raspberry pi. Image from the camera would be processed in the pi with the HAAR Cascade, and if the image contains fire, the system will recognise the fire and will give the output as fire detected.



V. PREPARING THE HAAR CASCADE

In order to start the detection, we need to make the cascade file for detection of fire. To train a boosted cascade of weak classifiers, we need to use a bunch of positive and negative images. Positive images are the ones in which the images contains the object that we are trying to detect, while negative images are the ones which strictly does not contain the object that we are trying to detect. We are using the software Cascade Trainer GUI by Amin .

There are around 300 positive images and 600 negative images in our Classifier and the

efficieny of the classifier was more than 95%. After the training process, the trained cascade was saved in xml format and was ready to use.

VI. RESULTS

VI.I Results of tests at distance 50 centimeters.
For the very first test, we decided to keep the distance short. We varied the intensity of fire by using various different sources of fire at different angles and the accuracy of the system was as follows:

Table: Result at 50 centimeter distance

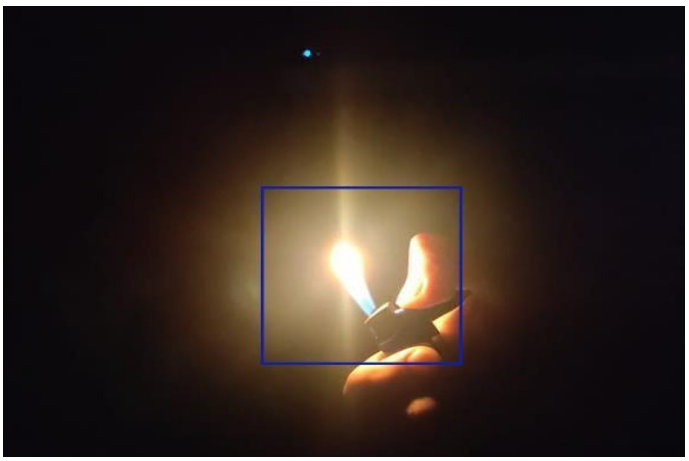
Distance	Test no.	Real fire	Other light sources	Accuracy
50 cms	1	Detected	Not Detected	100%
	2	Detected	Not Detected	
	3	Detected	Not Detected	
	4	Detected	Not Detected	
	5	Detected	Not Detected	

VI.II Results of tests at distance more than 100 centimeters.
Then we changed the distance to more than 1 meter for detecting fires at long distances. the distances and angles of the fire were different this time. The accuracy of the system was as follows:

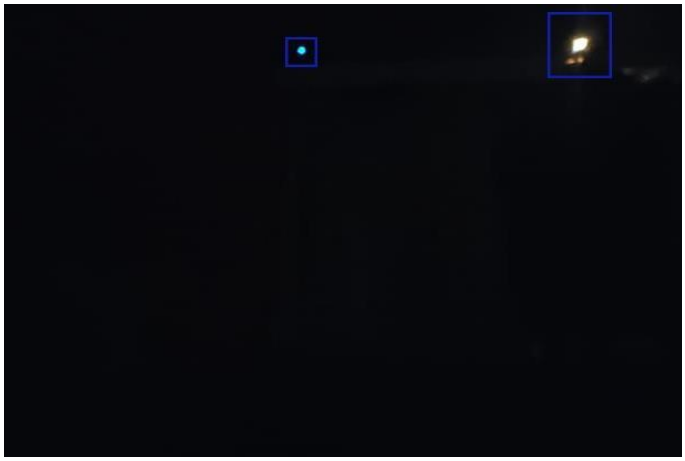
Table: Result at more than 1 meter distance

Distance	Test no.	Real fire	Other light sources	Accuracy
>100 cms	1	Detected	Not Detected	90%
	2	Detected	Detected	
	3	Detected	Not Detected	
	4	Detected	Not Detected	
	5	Detected	Not Detected	

VI.III Images of the test.



VII. CONCLUSION



In this concept paper, a fire detecting system has been proposed which is more accurate and reliable way of detecting fires in small houses or officeplaces, rather than conventional methods such as smoke detectors. Our 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 includes using this system along with fire extinguishers to make them automated.

VIII. REFERENCES

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