

Fire Detection Using Image Processing and Sensors

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ABSTRACT

In today's world we find it is mandatory to have a fire extinguisher in every building according to the norms of government. But when there is fire breakout there is chaos and confusion of either vacating the area or turning on the fire extinguisher on and extinguishing the fire. Also proper training must be given to the employees or personal residing in the building in order to turn on the extinguisher. So we have come up with a system which would detect the fire automatically and directly turn on the extinguisher on its own. We would be placing camera at various location in the building or campus. Using camera we would be detecting the fire using image processing. For higher accuracy we are using smoke and temperature sensors. We are developing an intelligent system by which we detect fire. For doing this first we need to train the system to identify fire. Using advance color recognition algorithm we would be training the system to identify fire. Once the system has learnt to identify fire it can easily detect the fire on its own and turn on the extinguisher on its own. Also the system would check the intensity volume of fire break and accordingly would sent alert to the fire brigade which currently has to be done manually.

Keywords:– Machine learning, Pattern matching, Thresholding, RGB color model etc.

I. INTRODUCTION

Fire, especially in buildings, can spread quickly and cause great loss of life and property. Therefore early fire detection and warning is imperative. Fire detectors, smoke detectors and temperature detectors have been widely used to protect property and give warning of fires. However, smoke and temperature detection is slower than light detection, in order to facilitate earlier detection of fire, and to monitor the spread of the fire. We are including a method in which we are using camera for capturing images of fire. We train our system for recognizing fire, then that capture images are taken for color recognition. In color recognition we are doing RGB to GREY and then GREY to BINARY code conversion. After identifying fire we are performing two operations that is turning ON pump (extinguisher) and sending message to fire brigade depending on threshold values. The proposed method will be useful for detecting fire automatically and put off it automatically i.e. without any help of people the system will put off the fire.

II. RELATED WORKS

Fire flame detection is an important issue which is related to human life and social security. Image processing based system does very fast detection, as human eyes do, depending on camera.

Four ways to put out a fire

- Cool the burning material
- Exclude oxygen
- Remove the fuel
- Break the chemical reaction [6]

Today most of the fire detection systems are based on detecting smoke, gas and flame and depend on sensors. However sensors are not smart thing to do this job because of its speed. It depends on distance between fire area and sensor location. Earlier systems were based only on sensor.

Flame colors used to detect fire are described by Wenhao and Hong extracted flame objects by iterative adaptive techniques, and then used fire flame color as a part of characteristic information analysis to detect fire. Juan et al.[4] proposed the analysis and extraction of fire flame colors in the RGB – color space. Celik and Demirel [5] used YCbCr color space to separate luminance from chrominance. It is possible for a false detection if only color characteristics have been used.

III. SYSTEM OVERVIEW

Camera is used for capturing images of fire. First we train our system for recognizing fire, In terms of shape, size, color, intensity etc. then camera captures images, then that capture images are taken for color recognition. In color recognition we are doing RGB to GREY and then GREY to BINARY code conversion. This will detect the color, mainly specific colors of fire such as red , yellow, orange etc. after that we are taking inputs from sensors such as smoke sensor and temperature sensor. Inputs from these two sensors will help to more clearly identify fire. After identifying fire we are performing two operations that is turning ON pump (extinguisher) and sending message to fire brigade depending on thresholding values. Advantages of our system:-

Early fire detection and warning.

RGB color model and image processing provides higher accuracy.

Assurity of safe environment.

Installing fire alarms is the early warning benefit.

IV. METHODOLOGY

A. Image processing:

Image processing is a technique in which any image captured by camera is taken for processing, processing in term comparing that image with the sample images. A manually segmented fire set is used to train a system that recognizes fire like color pixels. The training set like fire images, flame of fire are used to form a look-up table for the fire detection system. The main concept involves:-Color recognition. For the purpose of image processing we are using camera

Camera:-

A webcam is a video camera that feeds or streams its image in real time to or through a computer to computer network.



Fig:-Camera

Feature:-

- 1) Support up to 30 Mega Pixels, the frame rate up to 30 FPS.
- 2) Excellent quality and fashionable styles.
- 3) Plug and play easy USB interface.
- 4) Daily designed to work well both Laptop and Desktop.

B. Color recognition:

In fire detection color plays an important role. Fire has unique color range which can be estimated in RGB and HSI separately. Hardware generally display or deliver color via RGB. So a pixel is associated with a three dimensional vector(r, g, b). HSI (Hue, Saturation and Intensity) is the way of display which follows that how human sees. Here hue represents the perceived color like orange or purple. Saturation measures its dilution by white light. HIS extract intensity information, while hue and saturation correspond to human perception. In our proposed system these two color models are considered to retrieve color information of fire flame from video frames.

Hardware's used for sensing purpose:-

1) Temperature Sensor: LM-35

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in oC).

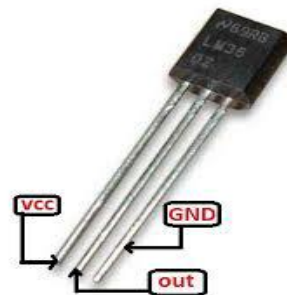


Fig:-Temperature sensor (LM35)

2) Smoke Sensor: MQ-2

The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature. The output is an analog signal and can be read with an analog input of the Arduino. The MQ-2 Gas Sensor module is useful for gas leakage detecting in home and industry.

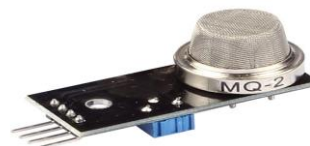


Fig:-Smoke sensor (MQ 2)

3) Arduino Board:-

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason.

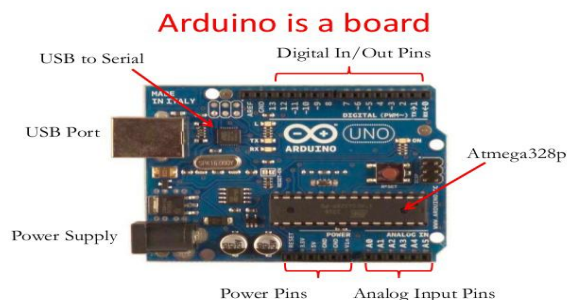


Fig:- Arduino Board

C. Algorithms:

Algorithm of machine learning

- 1) Start.
- 2) Initialize the Camera.
- 3) Capture Frame.
- 4) Convert RGB to Grey.

- 5) Convert Grey to Binary.
- 6) Train for fire image.
- 7) Stop.

Algorithms of system

- 1) Start.
- 2) Initialize the Camera.
- 3) Capture Frame.
- 4) If fire is not detected goto 2.
- 5) Convert RGB to Grey.
- 6) Convert grey to binary.
- 7) Detect Fire.
- 8) Get reading from sensors.
- 9) If readings > Threshold goto 10.
- 10) Send message to fire brigade and turn on pump.
- 11) Stop.

D. Architecture diagram:

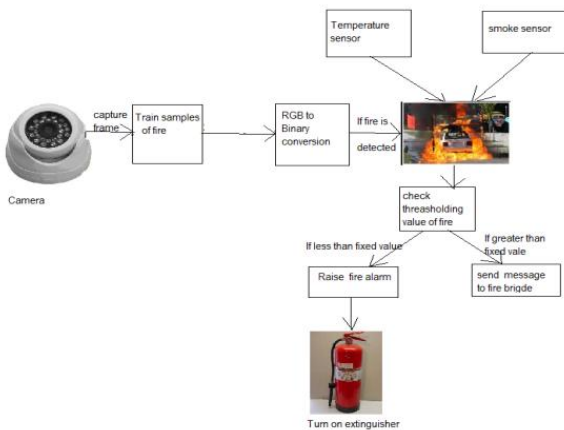


Fig: Architecture diagram of system

IV. EXPERIMENTAL RESULT

Test case ID	Test Data	Expected Results	Actual Results
1	If any material or element is burning	Detect it as fire and according to threshold value perform operation. i.e turn on extinguisher or send message	yes
2	Poster of fire is taken in front of camera	Don't detect it as fire	yes
3	Shirt having image of fire	Don't detect it as fire	yes
4	candle	Detect is as fire	yes

5	Short circuit	Detect it as fire and Perform operation.	yes
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V. CONCLUSION

In this paper, we adopt method of fire detection based on image processing and sensors. This research is about the developing the automatic fire detection using the RGB color model as well as we are using sensors for accurate result. The stated method is useful for detecting fire automatically and put off it automatically i.e. without manual help the System put off the fire.

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