



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 6, June 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118

 9940 572 462

 6381 907 438

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 www.ijirset.com

Detection of Fire Using Color Image Processing Technique

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ABSTRACT: Fire Detection is important in nowadays in order to prevent humans and property loss. For such a fire detection, we proposed an effective color model based system for fire detection. Each and every pixel of the fire images which are captured and recorded by the camera and is checked with reference images present in the database for the presence or absence of fire using color characteristics, and periodic behaviour in fire regions is also analyzed. This method is used to detect Dynamic boundary checking is also done to detect the edges of the fire Region of Interest (ROI). Candidate fire regions are detected using the chromatic and dynamic measurements. The fire detected information will be displayed on LCD and also sends fire image to user mail.

KEYWORDS: Fire Detection, Open CV, Raspberry Pi, Background Subtraction, Image Processing. Introduction.

I. INTRODUCTION

The process of oxidation of any material in the exothermic process of combustion, releasing heat and light as by products, is called Fire. This system uses the fire parameters and the color of the fire helps in detecting fire. Based on Fire detection using color information has many applications in computer vision and other domains. In order to enhance the performance of our system, we used parameters of fire for flame detection based on a live video stream; we proposed an effective color model based method for fire detection. Each and every pixel of the fire images which were captured and recorded by the camera is checked with reference images in the database for the presence or absence of fire using color features, and periodic behaviour in fire regions is also analyzed. Dynamic boundary checking is also done to detect the edges of the fire Region of Interest (ROI). fire regions are detected using the chromatic and dynamic measurements.

The main advantages of this Image Processing based Fire Detection System is the early warning benefit. This system can be installed just about anywhere in commercial building, malls and at many more public places for fire detection. The proposed system uses camera for capturing the images to detect fires. So, we do not need any other sensors to detect fire. System processes the camera input and then processor processes it to detect fires. The heat signatures and fire illumination patterns are detected in images to determine if it is a fire and take action accordingly. On detecting fire the system enters into emergency mode and alerts the user as sound alarm. Also displays the status on the LCD display informing about the system. Our color model based method used for fire detection has many advantages over conventional methods of smoke detection such as simplicity, feasibility and understand ability.

Fire is a serious threat to life and property worldwide. It is usually caused by combustion of materials which releases heat and light in large amounts. Fire detection systems have been designed to detect fire via sensing different fire related change. Two types of fire detectors have been used so far, namely: traditional/sensor-based and vision-based systems. Former responds against smoke, heat, temperature and pressure, whereas later rely on the light detection. Among these two systems were used. Traditional detectors have several disadvantages associated with them. These include high cost, slow response time and limited detection range. Additionally, these systems are not feasible as outdoor detectors due to excessive sunlight and wind pressure.

Besides, vision-based detectors can respond flame quickly and can analyzed location of fire. In these detectors, flame which is the vision part of fire can be analyzed via its color, shape and movement based on spectral and spatial models. Although vision-based detectors have several advantages. however, false detection limit their utilities. Therefore, there is still dire to design new models that are more efficient and can solve problems associated with

previously reported models.

Mostly used systems in previous days which works in different areas in different manners. But they all are based on sensors and some of them detect fire using the heat and smoke information in different ways which were lack in quick detection of fire which lead to massive damage to lives and properties. This is the main aspect where we need to detect the fire in quick manner before it spreads rapidly. The previous systems based on sensors were not quite effective and alerts the user lately while the fire reaches its maximum level.

The main motive of using this system is to prevent from the loss of life or any other damages to the company or the organization. Few years back the system that were installed are now obsolete because they detect fire or smoke when it reaches the maximum level and until that time the loss was already done. The detection system is used to detect fire in air through camera in real time monitoring system based on Raspberry Pi. The main feature of system is to alert generation when fire is started or reached is minimum level to prevent from the loss of lives and damages of any bodies property or valuable things that are useful for the company or any place where it is installed.

II. LITERATURE SERVEY

The Author [1] in this paper discussed about the vision based fire detection system which works using Raspberry Pi and detects the visible part of the fire in remote locations. An android application has been used to alert the user immediately after identifying the fire in the location. Also in this they considered HSV color model for the detection prior to any loss or destruction.

T. Celik and Hasan Demirel et al.[2] further enhance system that uses a statistical color model with Fuzzy logic for fire pixel classification. They have designed two different types of models where first model depends on the luminance information and second method is based on Chrominance. Instead of using RGB color model they used fuzzy logic which gets the benefit of separation of chrominance from the luminance. This model achieved up to 99.00% correct fire detection rate with a 9.50% false alarm rate.

In this paper, novel models for fire and smoke detection using image processing is provided. The models use different color models for both fire and smoke. The color models are extracted using a statistical analysis of samples extracted from different type of video sequences and images[2]. The extracted models can be used in complete fire/smoke detection system which combines color information with motion analysis. We have developed two models: one for fire detection and the other is for the smoke detection. For fire detection, the concepts from fuzzy logic are used to replace existing heuristic rules and make the classification more robust in effectively discriminating fire and fire like colored objects. The model achieves up to 99.00% correct fire detection rate with a 4.50% false alarm rate. For smoke detection, a statistical analysis is carried out using the idea that the smoke shows grayish color with different illumination. The developed models can be used as pre-processing stage for fire or smoke detection systems. As a future work, region based fire and smoke recognition will be studied.

III. METHODOLOGY

The Proposed method consists of image acquisition using the pi camera later the fire is detected and recognized using the Open CV software and finally the detected information about the surrounding is conveyed to the user in the form of sound signal and sending fire image to the user mail.

The Block Diagram shown in Fig. 1.1 describes the working of our proposed project where real time images are collected by Pi Camera and fed to Raspberry Pi which processes and then compare with the reference database images. When fire is detected then user gets an alert message in the form of mail, also through LCD display and Buzzer sound. With these indication most fire accidents around us can be easily identified and safety measures can be taken in advance which prevents human and property losses.

A. Block Diagram

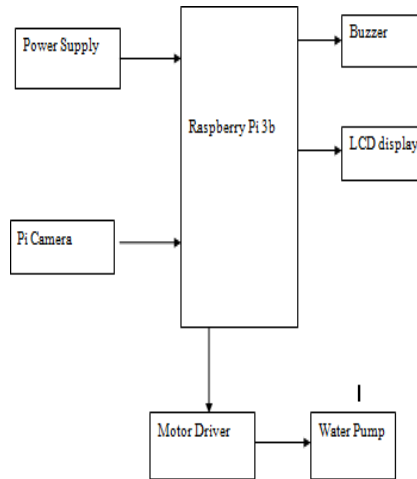
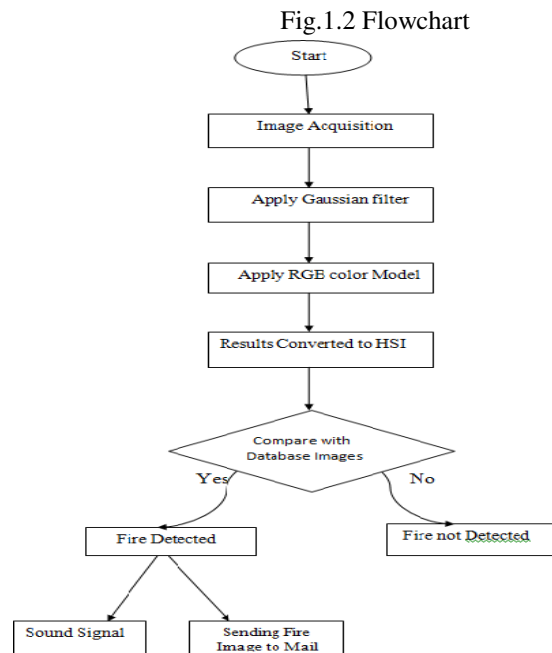


Fig 1.1 Block Diagram

B. Flow Chart



The flow chart shown in Fig 1.2 gives information about the project, In the first step different images have been collected from the scene or the real time video which is captured by the camera at the location and arranged in the database. Now, these images are fed to the Gaussian filter and the results forwarded to RGB color model. The RGB color images are then converted to HSI color model which are compared with images saved in the database.

When the images are matched with the query image two alerts have been given, one is to have a sound signal using the buzzer and second one, a mail has to be sent to the user when the fire is detected on comparing. Also the fire image which is detected is sent to the mail of the user. In this way, the immediate action after fire detection will be taken with this idea. Due to which we can save properties, humans and many more from serious damages from the fire. Since, images were taken in real time quick alerts will be done which saves many things.

IV. EXPERIMENTAL RESULTS

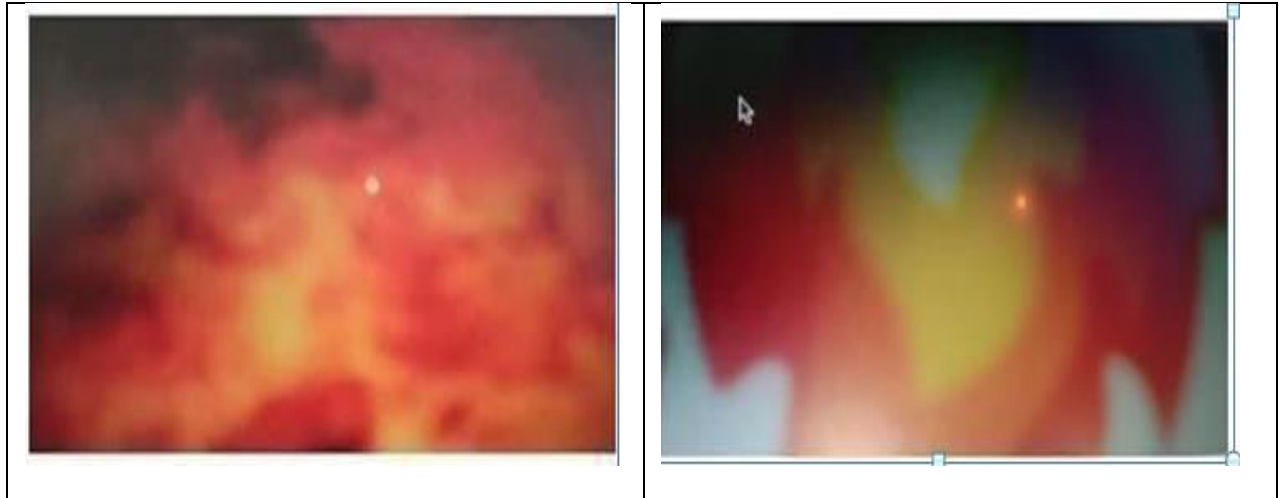


Fig. 1.3 Input Images

The above figure shows the input images which is captured using Pi camera on real time basis. And it will be sent to the Processor for further operation.

B. Output Images

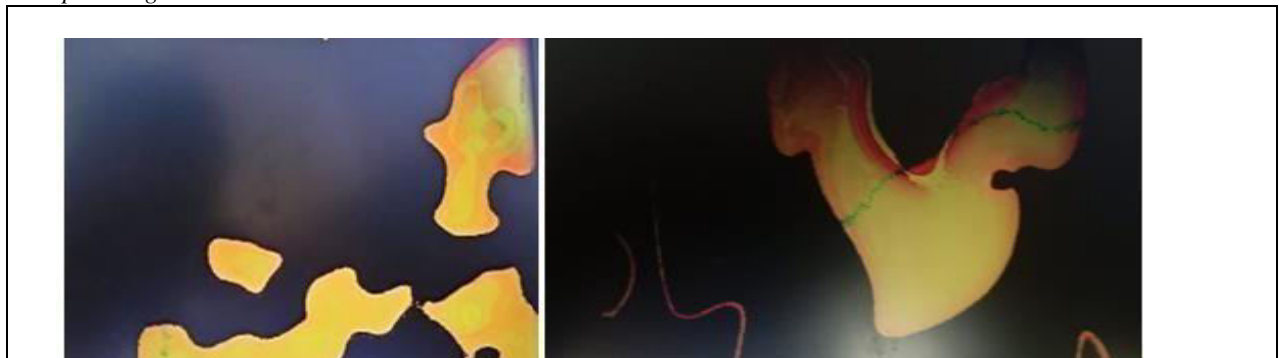


Fig. 1.4 Output Images

The input image in Fig 1.3 will send to the processor and processor performs the operations like Elimination of Noise, edge detection and produces an output image as shown in Fig. 1.4. This image is then compared with the database image and will detect the fire which alerts the user.

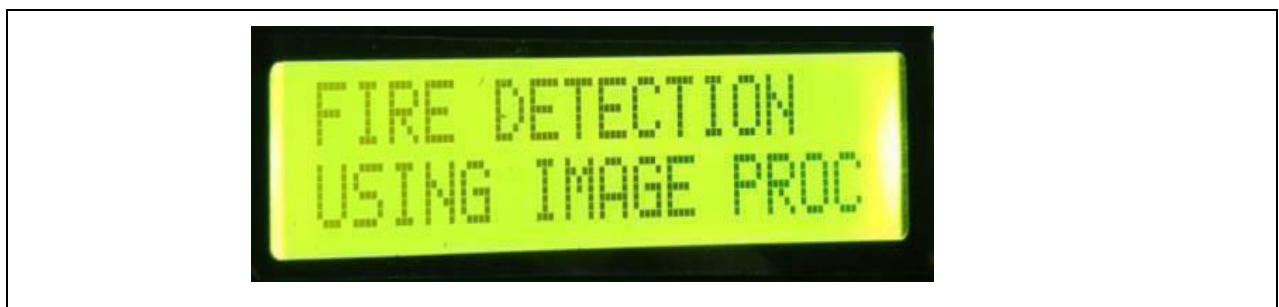


Fig.1.5 Output Display on LCD

When the output image is compared with the database image if there is match of two, fire gets detected and this will be displayed in the form of output ‘FIRE DETECTED’ message on 16*2 LCD display as shown in Fig 1.5.

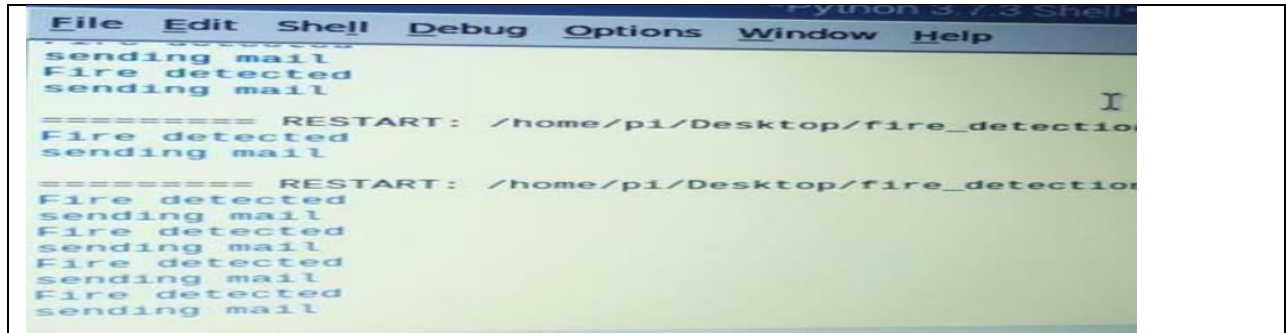
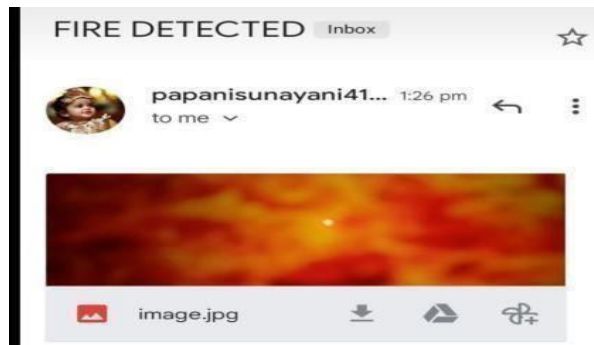


Fig. 1.6 Output Display



After Fire Detected, the FIRE DETECTED message will be sent to the mail of the attached user and the mail also contains the images of fire. From which user gets alerted and can take necessary action immediately to prevent the fire in different ways.

V.CONCLUSION AND FUTURE SCOPE

A. Conclusion

The proposed System is fire detection based on Colour processing algorithm which is free from sensors as compared to the ordinary fire detection systems. The Main objective of this project is to create a system which would be able to detect fire as early as possible from a live video Stream. This system saves cost by getting rid of expensive temperature and heat sensors etc. Based on the system performance, the system was proved to be effective at detecting fire and alerts the user immediately after fire occurred to take necessary measures and also send fire image to the user mail which can save many major accidents and property damage in advance.

B. Future Scope

This system can be made used for weatherproof Smoke detection along with fire detection can be added has a feature, System Optimization and Delay Reduction i.e. lesser latency may be achieved, System can be used to detect forest fires and may be embedded on a drone or any other UAV for surveillance purposes of property. The system can be used for future in military applications. This system can be used for rescue operations on land and in sea.

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Impact Factor: 8.118



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