Image Processing Based Fire Detection and Extinguish System using Raspberry Pi

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Abstract— Internet of things (IoT) is the network of entities that consists of electronics, programmable software, sensors, and communication facility that enables these entities to gather and transfer data. The objective of the proposed system is to alert the remote user while the fire accidents occur and automatically submersible motor will be started. This system can be installed at any remote premise which has threat of fire accidents. Using this system we can detect the fire by camera. So sensors are not required to detect fire and automatically spray water on fire the Water sprinklers are embedded to this system. The Raspberry Pi controller processes the camera input and detects fire using heat signatures. By using image processing method, the report is automatically generated and sends to the person immediately after the fire is detected in any part of the frame using Wi-Fi/GSM. On detecting fire, the system will go into emergency mode. The major advantages in this method are: sending the information to the person at any time, any place and remote monitoring for immediate actions.

Keywords: Flame Detection; Fire Video; Conflagration; Color Segmentation; Image Processing: Automatic Water Spray

I. INTRODUCTION

Fire is dangerous that could bring the great loss for human life. To prevent these losses various alarm system has been developed. As technologies involved the various automatic fire alarm system is used in existing method, sensors are used to find the fire. But the major disadvantage in sensor method is sensing fire only when it reaches the programmed level of the temperature and also it cannot generate any report for analysis process. To obtain a cost effective fire alert solution, we use image processing system and raspberry pi to detect the fire .By using raspberry pi, it consumes low power, low cost and execute faster to detect the fire. The main advantage of the System is the early warning and automatically water sprayed on fire. This system can be installed anywhere for fire detection. So we do not need any other sensor. Here, the camera will capture the video and separate the image into frames. And then the frames are compared to the original image. This is already booted in the raspberry pi system. And then it search for the heat signatures and fire patterns, if it is a fire then it will on the emergency mode. On detecting fire, the system will send the MMS to the remote use,

Due to rapid developments in digital camera technology and video processing techniques, there is a major trend to replace conventional fire detection methods with computer vision based systems. In general, computer vision-based fire detection systems employ three major stages: fire pixel classification, moving object segmentation, and analysis of the candidate regions. This analysis is usually based on two figures: the shape of the region and the temporal changes of the region. The fire detection performance depends critically on the effectiveness of the fire pixel classifier which generates seed areas that the rest of the system will exercise. The fire pixel classifier is thus required to have a very high detection rate and preferably, a low false alarm rate. There exist few algorithms which directly deal with the fire pixel classification in the literature

II. RELATED WORKS

In this section discusses various fire detection methods using image processing and using raspberry pi Md Rifat Hasan [1] They designed by using sensor, fuzzy logic, Data fusion. The purpose of this system is to avoid panic inside the building. The main disadvantage in this system is multiple sensor, false alarm and false message. M.Malathi [2] designed by using Raspberry pi, artificial neural network, RGB colors and the Purpose of this system is to avoid the false alarm. The main disadvantage in this method is it will not send any message to the person and also it does not find the location of the fire. Cao Shunxia et.al [3] designed a system with single chip microcomputer (SCM) AT89C51 and ISD1420a, a voice chip .The purpose of this system is to detect fire. When the sensor detects smoke, a voice message will be send to the relevant department. And the disadvantage of this is false alarm will be submitted .RakeshV S et.al [4] they designed the system y using Zigbee and FTP Web server. Purpose of this system is to avoid false alarm when smoke or intruder movement are detected, the system sends warning message through SMS. And the disadvantage in this method is does not take any action to stop the fire. Moreover, the single board computer is used, and it is expensive and has lower technical specification compare to raspberry pi

III. ISSUES TO BE ADDRESSED

An important point in smoke and fire detectors are typically used to detect the particular particles is generated by smoke and fire by using ionization or photometry. And then sensors are used to sense particles. The main weakness of point detectors is that they are in limited distance and used in open or large spaces. By using sensor many of them meets the false alarm. And then sensors not cover large space while detecting the fire. Many sensor are costly when compare to the raspberry pi

IV. PROPOSED WORK

The proposed system uses Image processing; strength of using image processing in fire detection is the ability to serve large and open spaces. Proposed system consists of three stages: In the first stage, camera will capture the image and it will send that image to controller for further evaluation. And then the process of further detection has been started. In the second stage, the images are converted into frames and it will

compare those images into already booted images. In the third stage, MMS will be sent to the user.

V. MODULE DESCRIPTION

We segmented our system design into five modules. Video recording and transferring to controller is first module of our system design. In this module the camera captures continuous frames from the area of its coverage. All the captured images or frames transfer to the controller for applying image processing function. Second module is Color based segmentation in this module after separating the frames as single image it is subjected to standard color base segmentation. The segments are further divided into constant sized blocks. Third module is Fire pattern recognition in this module the blocks of the segmented image will be examined for the presence of heat signature or fire patterns. Emergency trigger is our four module here, if any peculiar pattern is identified in any of the blocks for a particular period of time, it will switch on the emergency mode for the purpose of MMS send to the remote user. Multimedia message transmission is our fifth module in this module the multimedia message is created with its content using messaging API and alert message with image will be send to the recipient

VI. METHODOLOGY

Fire is detected using fire patterns with heat Signature. Heat signature is color patterns to represent the fire.

The first stage in our algorithm is the conversion from RGB to CIE L*a*b* color space. Most of the existing CCTV video cameras provide output in RGB color space, but there are also other color spaces used for data output representation. The conversion from any color space representation to CIE L*a*b* color space is straightforward [10]. Given RGB data, the conversion to CIE L*a*b* color space is formulated as follows.

A fire in an image can be described by using its visual properties. These visual properties can be expressed using simple mathematical formulations. In Fig. 2, we show sample images which contain fire and their CIE L*a*b* color channels (L*, a*, b*). Figure 2 gives some clues about the way CIE L*a*b* color channel values characterize fire pixels. Using such visual properties, we developrules to detect fire using CIE L*a*b* color spac

There are three filters are used to find the heat signature. They are:

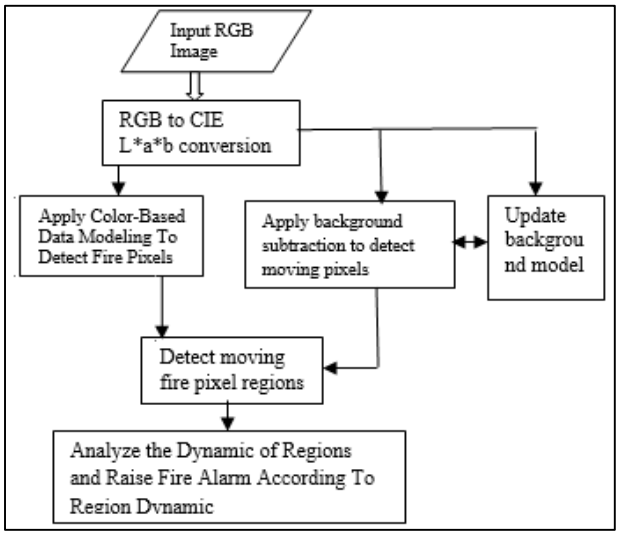

Fig. 1: Flow Chart of Proposed Algorithm for Detection Image Sequences.

There are three filters are used to find the heat signature. They are:

- RGB filter
- cieLAB filter
- RGB filter 2

A. RGBfilter [1]:

RGB filter is used to Extract Red (R) Green (G) and Blue (B) component of each pixel. And then in every pixel two conditions are verified. They are

- If R >G>B
- If R> Rt (Rt is the red threshold value between (0,255). This is based on light in the image. Here value 125 is used.

B. CIE LAB filter [2]:

Here the LAB color model is used cieLAB color model are Highlights red, yellow and related colors like orange. For all pixels in the frame the mean value of L, A and B components are identified. For every pixel four filters are used.

- If L>L mean
- If A>A mean
- If B>B mean
- If B>A mean

- Whose values run from 0 (black) to 100 (white).
- The central vertical axis represents lightness (signified as L*)
- The color axes are based on the fact that a color can't be both red and green, or both blue and yellow, because these colors oppose each other.
- On each axis the values run from positive to negative.
- On the a-a' axis, positive values indicate amounts of red while negative values indicate amounts of green.
- On the b-b' axis, yellow is positive and blue is negative. For both axes, zero is neutral gray

Both: To satisfy various lighting conditions both the RGB and cie LAB filters are used. If any one of the filter passes a pixel, it is a fire signature.

C. RGB filter [3]

Another filter that uses RGB components. It will works well at night mode. In this method the R, G, and B components are compared with threshold values.

– rt=140, gt=100, bt=100
– Three conditions are checked:

- R>rt
- G>gt
- B<bt

VII. RESULTS

The proposed method was implemented using Raspberry Pi 2[5], OpenCV 3 and python3.4. Figure 1. Shows output of the filter where no fire is found.

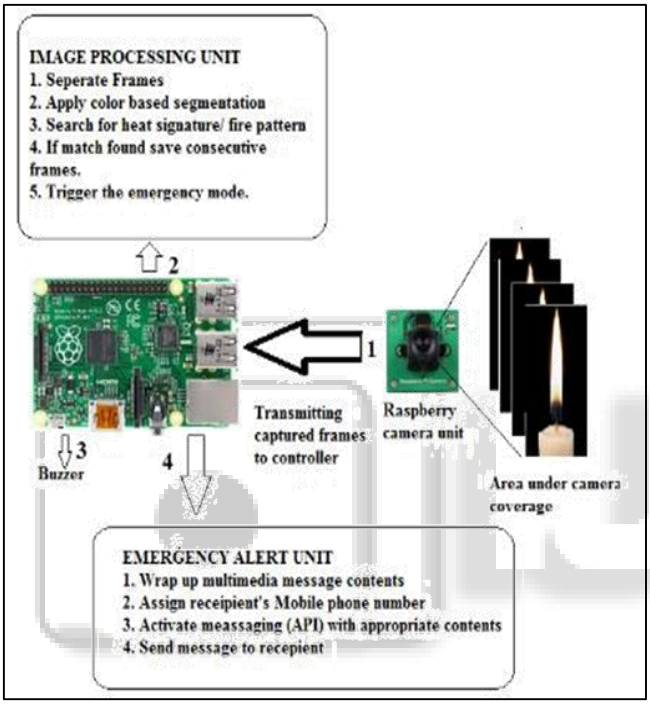

Fig. 2:working process of raspberry

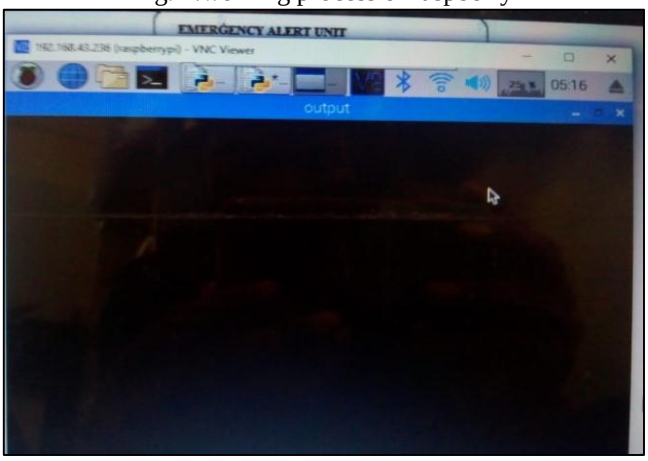

Fig. 3: Output of filter without fire

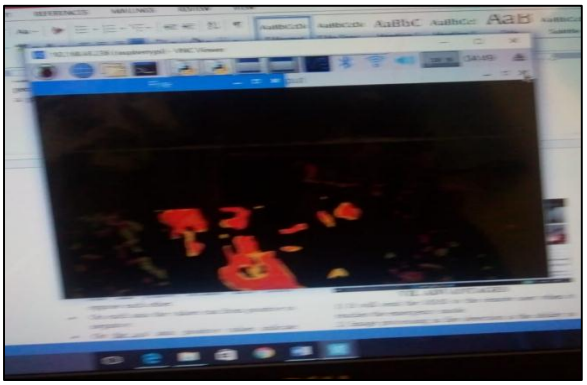

Fig. 4: shows output of filter where fire occurs.

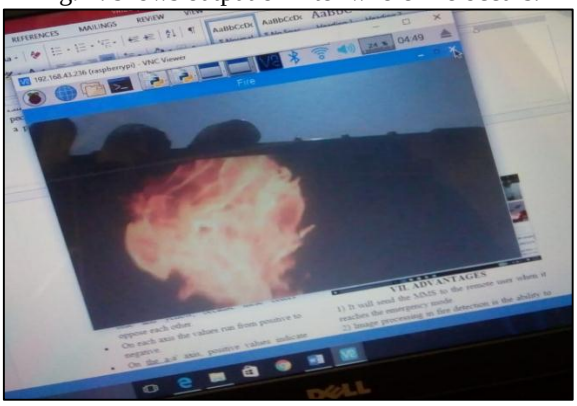

Fig. 5: Fire detected image

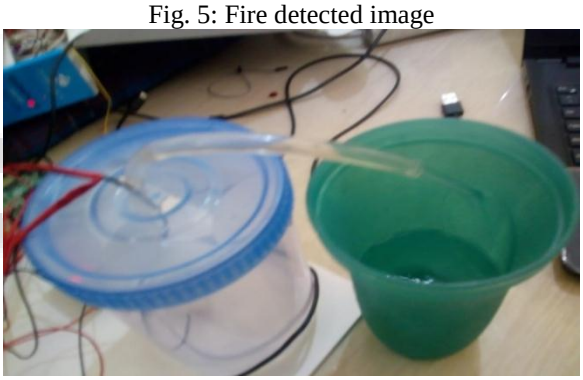

Fig. 6: Fire extinguish (using submersible motor and Water sprinklers)

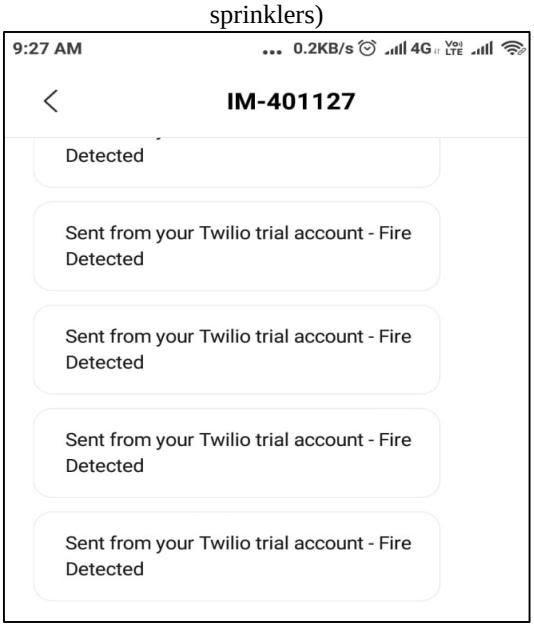

Fig. 7: Sms send to register phone number.

VIII. ADVANTAGES

1) It will send the MMS to the remote user when it reaches the emergency mode.
2) Image processing in fire detection is the ability to serve large and open spaces.
3) Raspberry pi has higher specification and low cost
4) Automatically water sprayed on fire using submersible motor

IX. CONCLUSION

We implement the algorithm to detect the fire and then it will send the image to remote user and water sprayed on fire. In the form of enhanced an image in different enhancement degree using raspberry pi. It was found that algorithm developed for raspberry pi executed successfully.

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