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FOREST FIRE DETECTION USING COLOR MODEL AND OTSU THRESHOLDING TECHNIQUE

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ABSTRACT

The common hazards in forest is forest fire. For the prevention of fire there are many methods used now a days. Image processing technique is used for the forest fire algorithm. This algorithm does not need any sensors It is depends only on the quality of camera used. In this proposed method we use both RGB and IR images. From the RGB image the fire location can be obtained from RGB model. In IR image otsu method of thresholding is used for fire localization. Finally taking the common segmented fire region in RGB and IR image, fire can be finally tracked. Also the extract certain features of fire and percentage of its spread can be determined.

Keywords: Detection Of Fire, Color Model, Image Otsu Thresholding.

I. INTRODUCTION

Most of the calamity in forest is forest fire. It causes thousands of peoples are die every year. Forests fires are as old as the forests themselves. It is very harmful for the natural resources and it resulting unmeasured loss in ecosystem. Forest fires are large uncontrolled fires that take place in the forest. Forest fires are a type of wildfire. Many methods are innovated for forest fire operation with image processing method. To capture forest fire cameras are connected to computer system. Forest fires that are common in tropical wizened forests are the main cause of wild mortification. When forest fires occur, thousands of acres of trees and vegetation will be destroyed. Forest fires are informant in assorted forest areas every year, and the quality of certain forest functions such as ecosystems, biodiversity, soil fertility are destroyed. The proposed system use an image processing technique to make forest fire detection. Implementing this proposed system using a method is called fire pixel classification input as a RGB image. This project is does not need any type of sensors.it only require the quality of camera is used. The sensors are not applicable for open-air environment and in vast foundation. The invention of improved computerized camera based image processing. In this proposed system use both RGB and IR images of same scene. In RGB image, fire can be localized by using RGB model and fire localization from IR images using ostu method of thresholding. Using RGB and IR images used to reduce the false detection of any fire thread.

II. LITERATURE REVIEW

Jorge Moragues, Ignacio Bosch, Luis Vergara [1] – This is the perfect system for the forest fire detection. The system uses infrared image processing technique. Picture element matrix are correlated to each infrared image. Every picture element related to a resolution cell. In a resolution, it is decided to presence the fire it notify the automatic alarm sensing. The energy level of the picture element which reaches a threshold value. A pixel to pixel processes is used with the captured image. This proposed system is based on the infrared image processing which can be detects any earlier sensing of any fire. This system is to detect the presence or absence of fire. Using the theoretical and practical results are obtain to obeying control of false alarm.

The aim of conforming the Fire, the algorithms carryout the unification of detectors which dissimilar foreseeable characteristic of fire, Similar resolve and grow. To conform the jurisdiction of the system related to probability of false alarm given out by using conceptual outcome and empirical simulations. If calculate the possibility of detection depends on signal to noise ration SNR.

J. Xiao, Jie Li, Junguo Zhang [2] – Sleuthing the forest fire is postulate unequivocal fire monitoring alarm and control function because of characteristic unforeseen, stochastic in forest fire which is very hard to existent time proctor. Now a days existent time proctoring obtained by remote monitoring system based on network video camera. The mechanization level of the fire detection system and considerably ameliorate the technological content are processed by the fire designation with digital image. In this fire monitoring system establish on digital image. It can fount the design plan and practical application. In this algorithm, based on a

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CCD camera catch incessant image in this approach of digital image processing it determine the characteristic of fire region that are color information dynamic characteristic and constellation characteristic, then to recognize the result of this algorithm it can effectively identify and track the fire zone.

C. Yuan [3] – This method is used for detect the forest fire d based on an unmanned aerial vehicle and track the fire zone. In early the forest fires are track by uses the videos. Step by step the researcher are used cameras for the detection of fire. Fire motion and geometry are the three dominant features of fire is uses vision based fire detection. In this system IR images are captured from IR cameras. Hot object can be successfully segmented by using ostu method of thresholding. After this method segmenting the fire zone or region, next step is applying an optical flow method for detection the motion objects. Also use morphological operation for the elimination of noise. After applying a blob counter for detect the exact fire zone. This can successfully detect the fire.

III. METHODOLOGY

The algorithm to detect forest fire in digital images based on color characteristic. To recognize if a picture element is fire or not various regulation have been constituted and to separate picture element as fire. This technique operate based on color exemplary because of its less multifarious nature and visibilness, uses both RGB and IR images as an input.

Stage 1: RGB color model

A fire image express by using its color characteristic. The color picture element have three dissimilar components that are Red, Blue and Green, that is RGB. Applying RGB model, RGB image that can separate into three planes, Red plane, Green plane and Blue plane which is make the use for color identification. Red plane of the image data that can take for the further step. The intensity level of red color is greater than green and intensity level of green color greater than blue color to distinguish the correlation between the three colors. In fire image, the identification of Red color to be more distinguish around than other portion of the image .The condition for Red color is greater than red R_{th}, R_{th} will make the system improved one. The conditions for fire picture element in the fire image are,

Condition one: Red>R_{th}
Condition two: Red>Green>Blue

Stage 2: Histogram based segmentation

IR cameras are capture images, it will measure the intensity level in the captured scene and it make a one channel images. From IR images, we can observe that hot areas are display as brighter region and cold area are represented as darker area. The fire picture element seems as greater intensity area in captured IR images, for the fire picture element classification utilize the maximum brightness of IR images. The histogram based segmentation technique is uses to segment the hot objects which represent as fires in the IR images captured by IR cameras. Otsu method of thresholding is use to segment the hot region from IR images. This thresholding technique is depict in the following. This images have two type of picture element: one is foreground picture element and other is background picture elements.

In Otsu thresholding method that intra-class variance as sum of variances of two category:

$$\sigma^2{}_s\,(t) = \omega_0\,(t)\,\sigma^2{}_0\,(t) + \omega_1\,(t)\,\sigma^2{}_1\,(t) \quad (1)$$

ω_0 and ω_1 are the weight of the two categories (foreground picture element and background picture element) separate by a threshold range t, $\sigma^2{}_0$ and $\sigma^2{}_1$ are variances of these two categories. The weight probabilities ω_0 (t) and ω_1 (t) are measured by using the L histograms:

$$\omega_0(t) = \sum_{t=0}^{t-1} p(i)$$
$$\omega_1(t) = \sum_{i=t}^{L-1} p(i) \quad (2)$$

To boost interclass variance, keep down the intra-class variance by using ostu method:

$$\sigma^2{}_e\,(t) = \sigma^2 - \sigma^2{}_s\,(t) = \omega_0\,(\mu_0-\mu T)^2 + \omega_1\,(\mu_1-\mu T)^2$$
$$= \omega_0\,(t)\,\omega_1\,(t)\,[\mu_0(t) - \mu_1(t)]^2$$

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Where μ is the class mean, class means $\mu_0(t)$, $\mu_1(t)$ and μT (t) are following below,

(3)

$$\mu_0(t) = \sum_{i=0}^{t-1} i\frac{p(i)}{\omega_0}$$
$$\mu_1(t) = \sum_{i=t}^{L-1} i\frac{p(i)}{\omega^1} \quad (4)$$
$$\mu T = \sum_{i=0}^{L-1} ip(i)$$

The undermentioned equations can be acquired:

$$\omega_0\,\mu_0 + \omega_1\,\mu_1 = \mu T$$
$$\omega_0 + \omega_1 = 1 \quad (5)$$

The threshold t is obtained by calculate the class prospect and class average. Let A signifies the actual image, the segregate binary image α from A can then be represented as

$$\alpha(x,y)=\begin{cases}1, & if(A(x,y) > T)\\ 0 & otherwice\end{cases} \quad (6)$$

Using Otsu method, obtain a threshold value T, A is the image plane and (x, y) is the picture element in A. The picture element values of image A are set to 1 if the picture element value outweighs T; or, the picture element values are set to 0. To distinguish high intensity region in image β from A, the following description is used:

$$\beta(x,y)=\begin{cases}A(x,y), & if\ (a(x,y) = 1)\\ 0, & if(\alpha(x,y) = 0)\end{cases} \quad (7)$$

Stage 3: pixel classification

The fire detection in RGB image and histogram based segmentation method is compile together for the outcome to be valuable and control of the incorrect alarm.

IV. IMPLEMENTATION AND RESULTS

This algorithm is used to segment the picture element from input image. The correctness investigation of the algorithm will be stated in following; Figure 4.1(a) shows the RGB input image. There are many sub images with dissimilar color component .This algorithm segment from input image frames having hot region. Figure 4.1(b) shows Red plane of input image, Figure 4.1(c) having blue plane of input image, figure 4.1(d) having green plane of input image, and with the system use two condition; Red>R_{th} and Red>Green>Blue the red component was extracted more than other component.

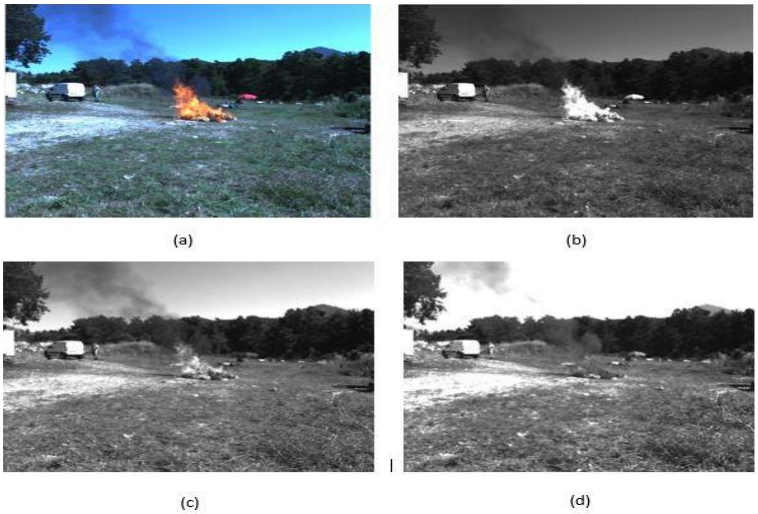

Figure 4.1. (a) RGB image, (b) R plane of input image, (c) G plane of input image, (d) B plane of input image.

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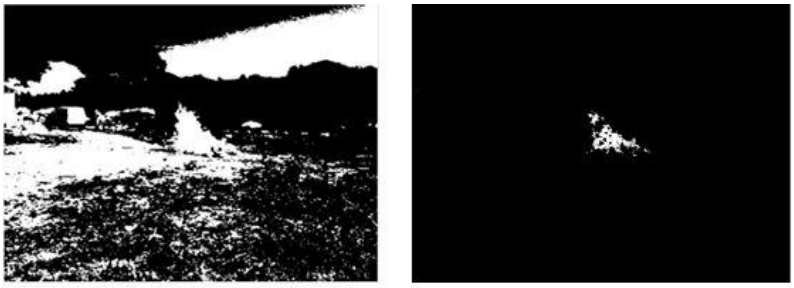
Figure 4.2 (a) shows the red domain area of input image by using ostu method of thresholding. And figure 4.2. (b) Shows the detected intermediate fire pixel region. Having 2 conditions.

Condition 1: R>G,

Condition 2: G>B+40



(a) (b)

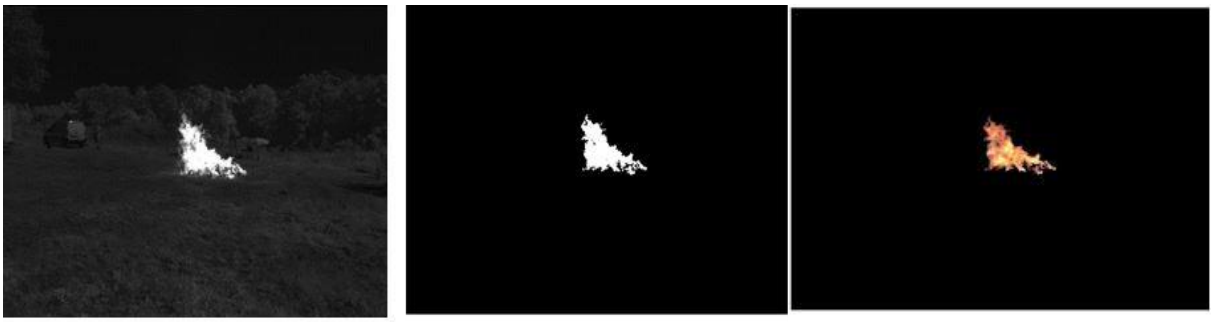
Figure 4.2. (a) Red domain area of input image, (b) Detected Intermediate fire pixel region.

Figure 4.3. (a) Fire pixel classification, which is detect the common region from intermediate fire pixel Region and Red domain region. Next Figure.4.3.(b) fire Region segmentation, multiplying the fire pixel localization with the RGB image.

(a) (b)

Figure 4.3. (a) Fire pixel localization. (b) Fire region Segmentation.

Figure 4.4 (b) shows that segmentation result of the hot region. Using ostu method of thresholding the high intensity region is successfully segment from the image. Figure(c) hot region segmentation, multiplying the fire pixel localization with the IR image. Next we find out the common fire region in RGB and IR images.



(a) (b) (c)

Figure 4.4.(a) IR image of fire, (b) fire pixel localization, (c) segmented fire region from IR image

Figure 4.5 shows the result of both fire pixel localized images of both IR and RGB image and multiply. Result of this multiplication gives the actual fire location in the image. The common fire region in RGB and IR image is multiplied with original RGB image.

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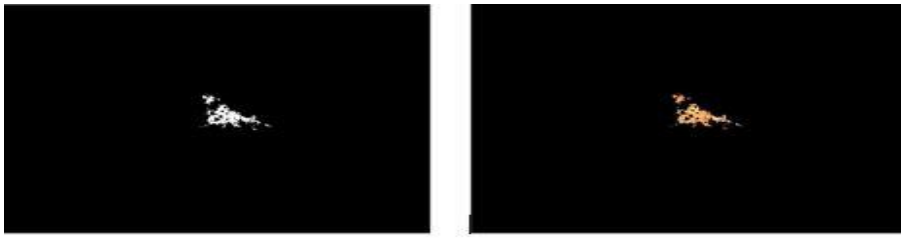

Figure.4.5. (a) common fire region in RGB and IR images. (b) Segmented common fire region.

The observation outcome shows that the system is efficient in sleuthing and segmentation. Fire features can be extracted from the segmented fire image. Region props math lab code can used for extracting many features of fire. Bounding box gives the feature, that is the height and width of white space contained in the segmented image of fire and x, y co-ordinate. Also calculate the percentage of fire spread area in image by taking the ratio of fire spread to the total number of pixel in percentage. Figure 4.6 shows that the final output of this algorithm.

```
Command Window
Height =
    171

Width =
    121

Fire_Spread_Percentage =
    1.2609
Fire presence detected
```

Figure 4.6. Fire feature and percentage of fire spread.

V. CONCLUSION

The detection method used can be further used as a standard detection algorithm for any system. The algorithm shows that fire region detection rate in 92% correctness. A fire detection algorithm it can be used for detecting fire equal to the maximum false detection of the system. Using of RGB and IR images are reduce the false detection of fire. The histogram-based segmentation technique is used to segment the hot region from the IR images. Ostu method of thresholding separate the high intensity region from the less intensity region of IR images. Also using fire pixel classification for the accurate fire detection.

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