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Forest Fire Detection: A Survey.

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ABSTRACT

Due to fire many people die and it destroys their properties. We have to decrease this loss and protect our life from fire. As the growth of fire increase rapidly, we need to detect and control over that fire. There are many studies for early fire detection techniques. Technical developments in this area have been reviewed among the researchers for the past few years. This survey classifies detection of fire based on Segmentation, Clustering and classification, and by using Time series.

Keywords fire detection, segmentation, clustering, classification, Time series.

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INTRODUCTION

Early Fire detection is more important which causes a big loss to human life and properties. In order to protect our property and warning of fires, we need to detect the smoke, fire, and temperature. There are two methods for fire detection. One is sensor based methods and another is a vision based fire detection methods. The sensor based fire detection method has more disadvantages: 1) having a transmission delay; 2) to monitor a large area they are valid for indoor regions and cannot be used for outdoor regions. The vision based fire detection method has more advantages: 1) a large area can be monitored; 2) the exact location of the fire can be located. To avoid the loss and monitor the property from fire we need to detect and monitor the fire so this survey of fire detection is based on image segmentation, color segmentation, clustering and classification and using time series are shown in fig: 1. The Table: 1 depicts the survey analysis.

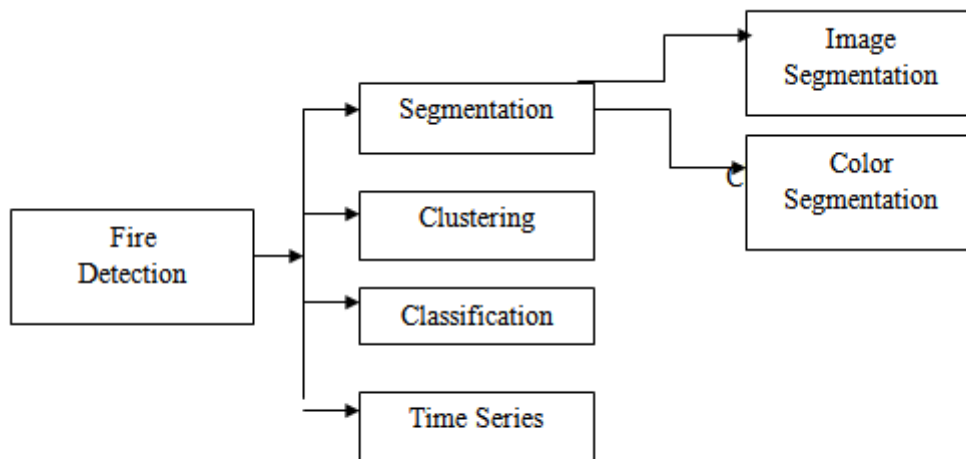


Fig 1: Fire Detection Methodology

TABLE 1: SURVEY ANALYSIS

Methods	Authors (Year)	Remarks
Color Segmentation	Celik and Demirel et. Al., (2009)	Uses the algorithm of RGB and YCbCr color space
	In Juan Chen et. Al., (2010)	The flame flickers detection algorithm
	Seebamrungsat J, (2014)	Uses sensor, multi-feature fusion, edge detection, color models with given conditions.
Image Segmentation	Chen et al., (2004)	Uses RGB model for fire detection
	Celik T, (2007)	Fuzzy logic technique for pixel of fire classification
	Chunyu et al, (2009)	Back propagation of neural network technique is utilized

Cluster and Classification	Lasaponara et al. (2005)	Uses the term-fractal techniques to illustrate the distribution of temporal.
	Wang et al. (2009)	Fuzzy C-means clustering algorithm to identify dangerous flame
	Chakraborty and Paul, (2010)	Proposed hybrid clustering algorithm based and uses the modify k-mean clustering algorithm.
	Bahrepour et al, (2010)	Self-organizing of Kohonen map for decreasing the feature in wide fire.
Time Series	Chuvieco, E (2005)	Coarse remotely sensed images, including both NOAA AVHRR and MODIS are used.
	Geotz et al [2006]	NDVI time series data technique

SEGMENTATION

IMAGE SEGMENTATION

Smoke and fire pixel has to be extracted by using the RGB model in 2004 by Chen et al. [1]. The proposed decision task of fire pixel is inferred by using saturation of the R component. When the smoke and fire pixel is extracted and it has to be verified. This model employs repetitive checking the ratio of flame. Fire alarm triggered when the alarm set up condition is met. The result of this experiment effectively describes the very early fire alarm established using video processing.

In 2007, Celik T. [2] describes the pixel of fire by using fuzzy logic. This model divides the luminance part of fire from the chrominance. It divides more efficiently than the color spaces of RGB. To make the division it uses the YCbCr color. Fuzzy logic concepts are used to change the previous rules of heuristic to provide the classification as strong. It also efficiently describes the fire and resembling of fire objects. Further inequity is done among the fire and resembling of fire pixels are completed by a model of chrominance. It is working under the two sets of images such as fire and with no fire, but having the section close to fire color. At last it achieved a precise detection of fire.

In 2007, Li et al. [3] this paper evaluates the fuzzy segmentation algorithm to plot various regions of fire from the statistic. It uses the hidden Markov random field for the process of image segmentation. It considers each of the pixels has an individual class which belongs to limited approved set. The problem in the pixel can be concentrated by the membership of fuzzy model. The outcome of this model is generated by using the two images of airborne visible/infrared imaging spectrometer because of this it is robust to noise and changes in features of fire. While the segmentation algorithm is evaluated with the k-means algorithm, expectation maximizing algorithm, and an algorithm of MRF-MAP. By comparison with other algorithms, fuzzy algorithm is more suitable for the segmentation.

In 2009, Chunyu et al. [4] evaluate the images to be sliced into blocks and each texture of image block is evaluated through the co-occurrence of gray level matrices and by using the Back propagation neural network model. The outcome of this experiment can be analyzed under the smoke texture. By this results it has a clear difference between the images of without smoke. The experimental outcome clearly shown the differentiate between the videos of smoke and without smoke.

In 2012, Chu et al. [5] clearly shows the detection of flame in two steps. The initial step is to find the brightest object from the images. The next step is to find the sparkling state of brightest object. Sequential images in the instant are employed to validate the flame existence by applying similar steps are concerned with them. After this action, the flame is detected with the positive results.

COLOR SEGMENTATION

Novel approach using image processing technique by using the color spaces of RGB and YCbCr algorithm is proposed in 2009 by Celik and Demirel et. Al., [6]. The advantage of using YCbCr color space is to split the luminance part from the chrominance part more effectively than the RGB. The performance of the proposed algorithm evaluated under two sets of images such as fire images and fire resembling images. Standard methods are evolved for calculating the algorithm performance. The proposed method has a detection rate as higher and false alarm rate as low. Since, the fire pixel classification algorithm is very cheap in the computation so it preserve for real time forest fire detection.

In 2010, Juan Chen et. Al., [7] describes the video of flame detection. By using a flame flickering detection algorithm into the scheme, we can detect the fires in the video. The filtering of flame algorithm is used by the Gaussian model for identifying the moving of foreground and objects to separate the candidate and non candidate regions of flame. This algorithm is based on the statistical frequency.

In 2014, Seebamrungsat J [8] Fire detection system for analysis and detection of light is proposed. Here they used different techniques such as sensor, multi-feature fusion, edge detection, color models by partitioning into orange, yellow, and high brightness. This method uses the color model of HSV and YCbCr. Growth of fire is analyzed and evaluated by frame differences.

In 2015, the proposed model gives an accurate detection of fire location and less false rate. It has been concluded that all the techniques are fine for detection of fire which having their own advantages and disadvantages, but the color segmentation which is used to illustrate the fire image clearly.

CLUSTER AND CLASSIFICATION

In 2005, Lasaponara et al. [9] has proposed is about the forest fire dynamics. They believe that this is the scientific challenges to the environment. By using time fractal approaches they described the temporal distribution, identified in Italy. Their findings reveal with a great degree of clustering.

The hybrid clustering algorithm is represented by Chakraborty and Paul in 2010 [11] and established in color samples. K-means clustering algorithm, which is modified is used to develop the algorithm. Hybrid algorithm is the combination of the hierarchical and partitioning clustering. The analyzed outcome of the threshold method of color is taking into consideration of RGB and HSI color models. In general, the practice of this algorithm is very fast to identify the flame. The significant factor of video surveillance requires a speedy reaction.

The clustering algorithm of fuzzy C-means are used to develop the dominant flame color lookup tables for identifying the dangerous flame. This system uses a vessel of dangerous flame intensities as represented in 2009 by Wang et al. [10]. In order to reduce the false flame amount and smoke alarm the intended method outperforms Chen's decision rule. Smoke shape is considered to identify the dangerous smoke.

The investigation of spatial data by the techniques of data mining established under the fire detection of wireless sensor network in 2010 by Bahrepour et al [12]. They explore some qualities of data in fire data. They investigate the characteristics to develop the fire applications. Self-organizing map of Kohonen is used for decreasing the features of wildfire. Data analysis is considered for the residential fire. This system uses the naive Bayes classifiers, and decision tree classifiers, and neural network for evaluating and computing the suitable combination of sensor category in fire detectors.



TIME SERIES

Time series analysis is used for early identification and observes the speed of the fire. In general, time series data have been engaged for different purposes. The frequent application is considered as plotting of burned scar. Common remotely sensed images works well under the NOAA AVHRR and MODIS in 2005, Chuvieco, E [13].

Forest fire has been considered through the time series technique. The concept of the time series algorithm is developed from the Maximum value composite in Holben [14]. In general, maximum value composite is less consistent and it provides lesser values of NDVI. Through the time series method we can decrease the radiometric issues.

In 2006, Goetz et al [15] showed that NDVI patterns are useful for studying post-burn recovery in case of both burned and unburned areas. Fire was considered as a remarkable outcome at the time series of NDVI data. They recommended this technique to validate the fire initiation time.

CONCLUSION

In general, the papers which are discussed in this survey have used different features for detecting the fire. This study of fire detection is done based on segmentation, clustering and classification and time series. It has been concluded that all the techniques are good for detection of fire which having their own advantages and disadvantages. For this study the time series model is used to clearly describe the fire image and it reduces the radiometric problems of local atmospheric interruptions. This method which can further improve the fire detection and predicts the fire accurately than the previous method.

DECLARATION

The manuscript is original and is not published or communicated for publication elsewhere, either in part or full.

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