Emerging Methods for Early Detection of Forest Fire

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Literature Survey

Surapong Surit, Watchara Chatwiriya [8] proposed a method to detect fire by smoke detection in video. This approach is based on digital image processing approach with static and dynamic characteristic analysis. The proposed method is composed of following steps, the first is to detect the area of change in the current input frame in comparison with the background image, the second step is to locate regions of interest (ROIs) by connected component algorithm, the area of ROI is calculated by convex hull algorithm and segments the area of change from image, the third step is to calculate static and dynamic characteristics, using this result we decide whether the object detected is the smoke or not. The result shows that this method accurately detects fire smoke

P. Piccinini, S. Calderara, and R. Cucchiara [2] proposed a method based on the wavelet model and a color model of the smoke. The proposed method exploits two features: the variation of energy in wavelet model and a color model of the smoke. Smoke is detected based on the decrease of energy ratio in wavelet domain between background and current. The deviation of the current pixel color is measured by the color model. Bayesian classifier is used to combine these two features to detect smoke.

R.Gonzalez proposed a method to detect fire based on Wavelet Transform. Stationary Wavelet Transform is used to detect Region of Interest. This method involves three steps preprocessing, SWT, histogram analysis. In preprocessing unwanted distortions are removed and image is resized and transformation of resized image is performed. High frequencies of an image are eliminated using SWT and the reconstruction of image is done by inverse SWT. Image indexation is performed to group the intensity colors that are closed to each other. Histogram analysis is used to determine the various levels of indexation. After analysis a comparison is made with non-smoke frame and non-smoke images are eliminated. These three are combined and fire is detected.

Osman Gunay and Habiboglu [4] proposed a system based on Covariance Descriptors, Color Models, and SVM Classifier. This system uses video data. Spatio-temporal Covariance Matrix (2011) [13] is used in this system which divides the video data into temporal blocks and computes covariance features. The fire is detected using this feature. SVM Classifier is used to filer fire and fire-like regions. This system supports only for clear data not for blur data.

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Dimitropoulos (2015) [1] proposed an algorithm where a computer vision approach for fire-flame detection is used to detect fire at an early stage. Initially, background subtraction and color analysis is used to define candidate fire regions in a frame and this approach is a non-parametric model. Following this, the fire behavior is modeled by employing various Spatio temporal features such as color probability, flickering, spatial and spatiotemporal energy. After flame modeling the dynamic texture analysis is applied in each candidate region using Linear Dynamical Systems, Histogram and Mediods. LDS is used to increase the robustness of the algorithm by analyzing temporal evolution of pixel intensities. Pre-processing is done after this to filter non-candidate regions. Spatio temporal analysis is done to increase the reliability of the algorithm. The consistency of each candidate fire region is estimated to determine the existence of fire in neighboring blocks from the current and previous video frames. Finally, a two-class SVM classifier is used to classify the fire and no fire regions.

Hamed Adab [6] proposed another system which is based on Indexing. GIS techniques and remote sensing [10] provides further assistance. The indexing may be structural fire index, Fire risk index, Hybrid fire index. Depending on the geographical condition of the area the indexing differs. Validations of indices are based on hot spot data. Structural fire indices show static information and it does not change over short time span and used to predict the risk in advance. Fire risk index changes as the vegetation or climate changes. Hybrid index is a combination of Structure and Fire index. The disadvantage of this indexing is that way of combining.

Akshata & Bhosale [7] proposed another method where Local Binary Pattern acts as a base for fire detection and Wavelet Decomposition is used to detect fire. Pixel level analysis is required in this method. This method uses YCbCr color model to detect fire. Detection is based on three phase. The first phase involves segmentation of image using LBP. LBP is a texture operator whose value is computed using image's center and neighboring pixel values. Further accuracy is improved using Wavelet Transform and complicated data is classified using this approach. 2D Discrete Wavelet Transform is used for decomposition in this system. 2 images should be used as input and the sub bands of every image are compared with the other, if sub bands are equal the images are same else different.

Celik (2007) [3] proposed a generic model for fire and smoke detection without the use of sensors [15]. Fuzzy based approach is used in this system. Color models such as YCbCr, HSV are used for fire and smoke detection. The fire is detected using YCbCr color model samples because it distinguishes luminance and chrominance. Y, Cb, Cr color channels are separated from RGB input image. A pixel is more likely a fire pixel if intensity of Y channel is greater than channel Cb and Cr.

Cheng (2011) [5] proposed a fire detection system based on Neural Network; here neural network is used in detection information for temperature, CO concentration, and smoke density to determine probability of three representative fire conditions. RBF neuron structure is used, the information regarding temperature, CO concentration, and smoke density are collected and data fusion is used to generate fire signal decision. The

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detectors have continuous analog outputs, when detection limit is exceeded the hardware circuit sends a local fire indication to fusion center, this force the system detectors to generate final decision. Single-sensor detector is used to generate the final decision.

Zhanqing (2001) [9] proposed another method using NN and Multi-threshold algorithm. In this method the NN not only classify the smoke, sky, background but also generates a continuous random output representing mixture of these. NN consumes time in case of large areas so multi-threshold algorithm also used as well. These two approaches may be combined or used separately depending on the size of the area. Multilayer Perceptron Neural Network is used here. The number of neurons in the output layer is equal to the number of desired parameters of the output vector, which are "smoke," "sky," and "background". The degree of separation between pixels is identified by Euclidean Distance. Multi threshold algorithm is based on channel wise approach, reflectance of each channel value is used for threshold assumption and is applied to each and every pixels of the image, smoke pixels are marked and false pixels are removed. Threshold value is set as 0.9 <= channel 1 reflectance / channel 2 reflectance<= 1.5. Pixels which reach this threshold are smoke pixels else are false pixels and are removed.

Paulo Vinicius Koerich Borges [11] proposed a fire detection method based on probabilistic method and classification. Computer vision based approach is used in this approach. Though this approach is used surveillance it is also used to automatic video classification for retrieval of fire catastrophes in databases of newscast content. There are large variations in fire and background characteristics depending on the video instance. The proposed method observes the frame-to-frame changes of low-level features describing potential fire regions. These features include color, area size, surface coarseness, boundary roughness, and skewness within estimated fire regions. Bayes classifier [12] is used for fire recognition. In addition, apriori [12] knowledge of fire events captured in videos is used to significantly improve the results. The fire region is usually located in the center of each frame. This fact is used to model the probability of occurrence of fire.

Refrences

[1] Kosmas Dimitropoulos, Panagiotis Barmpoutis, and Nikos Grammalidis (2015). Spatio Temporal Flame Modeling and Dynamic Texture Analysis for automatic video-based fire detection, IEEE transactions on circuits and systems for video technology.

[2] Surya.T.S, Suchithra.M.S. Survey on Different Smoke Detection Techniques Using Image Processing. International Journal of Research in Computer and Communication Technology,

[3] Turgay Celik, Huseyin Ozkaramanl, and Hassan Demirel (2007). Fire and Smoke detection without Sensors: Image Processing based approach.15th European signal processing conference (eusipco 2007), Poznan, Poland, September.

[4] Osman Gunay, A. Enis C ,   Etin, Yusuf Hakan, Habiboglu. Flame Detection method in video using Covariance descriptors, IEEE transactions, 1817-1820.

.

[5] CHENG Caixia, SUN Fuchun, ZHOU Xinquan (2011). One Fire Detection Method Using Neural Networks, Tsinghua Science and Technology, ISSN 1007-0214 05/17 31-35Volume 16, Number 1.

[6] Hamed Adab, Kasturi Devi Kanniah, Karim Solaimani. Modeling forest fire risk in the northeast of Iran using remote sensing and GIS techniques, Springer Science+Business Media Dordrecht.

[7] Akshata Patil, Varsha Bhosale 92014). Survey of Local Binary Pattern for fire & smoke using Wavelet Decomposition. International Journal of Research in Engineering and Technology.

[8] Surapong Surit, Watchara Chatwiriya. Forest Fire Smoke Detection in Video Based on Digital Image Processing Approach.

[9] Zhanqing Li, Alexandre Khananian, Robert H. Fraser, and Josef Cihlar. Automatic Detection of Fire Smoke Using Artificial Neural Networks and Threshold Approaches Applied to AVHRR Imagery, IEEE transactions on geosciences and remote sensing, vol. 39, no. 9, September 2001.

[10] S. A. Christopher, M. Wang, T. A. Berendes, and R. M. Welch (1998). The 1985 biomass burning season in South America: Satellite remote sensing of fires, smoke, and regional radiative energy budgets, vol. 37, 661– 678.

[11] Paulo Vinicius Koerich Borges (2010). A Probabilistic Approach for Vision Based Fire Detection in Videos, IEEE transactions on circuits and systems for video technology, vol. 20, no. 5.

[12] Jiawei Han, Micheline Kamber, Jian Pei (2012). Data Mining Concepts and Techniques, Third edition, 248-253, 350-351.

[13] Yusuf Hakan Habiboˇglu, Osman Günay, A. Enis Çetin (2011). Covariance matrix-based fire and flame detection method in video", Springer-Verlag, 17.

[14] Rafael C. Gonzalez and Richard E. Woods. Digital Image Processing. Pearson publication, Third Edition.

[15] Prerna B. Pagar & A. N. Shaikh (2013). Real Time based Fire & Smoke Detection without Sensor by Image Processing, International Journal of Advanced Electrical and Electronics Engineering (IJAEEE),

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