DETEKSI API MELALUI DATA VISUAL MENGGUNAKAN LBP-TOP

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Abstrak

Fire is one of disaster that often happens in the daily life. Some of preventive action that usually conducted is by using smoke or heat detector. Nowadays, fire detection system can be deployed on CCTV. Some methods has been developed to detect fire on the video file, with the main focus is to extract the fire features such as color and moving pattern, so the accuracy can be increased and can accelerate the process. Some of research based on the serial filtering principle on the detection step. It makes the detection process become time consuming. To accelerate the process, it needs a new approach to analyze the fire features from spatial and temporal domain in the same time

One of the feature extraction method on the dynamic texture domain is able to produce object features on the video that represents spatial and temporal features at once. The method is LBP-TOP (Local Binary Pattern-Three Orthogonal Plane). LBP-TOP can produce spatial and temporal features from object in video by analizing three planes: XY(spatial), XT and YT(temporal). The fire features produced by LBP-TOP was modeled by using clustering K-Means method as the reference model when the classification process was done by using K-NN method. By using LBP-TOP as the feature extraction method, K-Means as the modeling feature, and K-NN as the classificator, the accuracy of the detection process can reach 92% with less complexity.

Kata Kunci : Keywords— LBP-TOP, feature extraction, fire detection

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CHAPTER 1: THE PROBLEM

This chapter discusses the background of this study; it includes the following subtopics: rationale, theoretical framework, and conceptual framework/paradigm, statement of the problem, hypothesis, assumption, scope and delimitation, and importance of the study.

1.1 Rationale

Fires are frequent disasters in human life. Based on the data from the Ministry of Home Affairs of Indonesia, 15% of the disaster that occurred in Indonesia was wildfire damages. On 2011 alone, about 16.500 wildfire damages on 498 cities and districts in Indonesia has been recorded. These disasters are often caused by the delay of handling the fire before it is getting wild. Therefore, some early warning mechanism should be developed to detect a fire before it becomes dangerous.

As the development of technology, some preventive measures has been developed, for example installing temperature detectors, smoke detectors, or fire detectors in certain places. Besides using these devices, in the development of research in the field of Fire Detection, there are other media that can be used to detect the presence of fire, namely the Video Camera. Detection process is performed by utilizing image processing. Several studies have been conducted, including [1] [2] [3]. One of those studies utilized spatio temporal approach [1] . The fire detection process in this study was divided into 4 parts: motion detection, color detection, motion detection frequency, and detection of the dynamic color value of an object. This detection process is performed serially. In each stage, the candidate pixels suspected as fire are evaluated and selected and will continue to decrease in each step until final stage. In general, the focus of all stages is in two cases, to analyze the motion and the pixels color. The weakness of the serial filtering concept is in term of accuracy and time consumption. The feature that passing through every filter will be reduced so it will be difficult to analyze the overall object in spatial domain. It will also affect the detection accuracy. Moreover, the process is slow because the feature must pass several steps before final analysis. So, improvement on the detection method that can extract the two important features correctly with a little amount of time is necessary.

This study aims to build a fire detection system using video camera. The input to the system is offline video and the output of the system is the decision of fire detection, whether there is a fire in the video or not. Detection process utilizes the method of Dynamic Texture Recognition using LBP-TOP as the feature extraction method for fire on the video. Further,

these fire features are analyzed using k-means and will be classified in testing stage using k-NN algorithm.

1.2 Theoretical Framework

The characteristics of fire on a video is an object which has irregular moving patterns, a certain range of color and the non uniform color distribution across the frame. This fire's characteristics become one of the studies in the field of pattern recognition, called dynamic texture analysis.

Dynamic Texture (DT) is a texture that moves [4]. There are a lot of DT in everyday life, such as ocean waves, smoke, water fountains, windmills and fire. The key issues in the dynamic texture recognition is how to combine the motion features with spatial features and how to produce features that are not influenced by the geometric transformation.

In the dynamic texture recognition, a method called VLBP (Volume Local Binary Pattern) [5] has been proposed. VLBP is the development of LBP (Local Binary Pattern) method [4] which is a method to display a histogram of the texture models into a common form of histograms. LBP is a simple method yet able to recognize the texture. VLPB is developed in order to recognize the moving texture at video.

VLBP takes LBP features of objects in the video with volume/3D shaped area of concern. Spatial features are analyzed during a certain time. This leads to increased computation and the resulting features are enlarged. To overcome this problem, a method called LBP-TOP (Local Binary Pattern – Three Orthogonal Plane) [6] has been suggested. LBP-TOP merges LBP features not on every frame, but just in 3 orthogonal planes XY (spatial), XT and YT (temporal). T indicate frame number.

1.3 Conceptual Framework/Paradigm

The purpose of this research is to develop the fire detection system on the offline video. The conceptual framework of this study is illustrated in figure 1.1. The system consists of 3 stages: Fire Color Detection, Feature Extraction, and Classification. In the first stage, simple color look up is used to determine the fire colored pixel location in the frame. The principle of this method is to compare the pixel value in the frame with the fire pixel values in the database. The purpose of this method is to determine the ROI on the frame so that the searching area can be localized. The fire characteristics that can be captured by the camera are pixel intensity and color distribution pattern. By utilizing LBP-TOP method, the characteristics could be analyzed.

The main principle of LBP-TOP is to extract the pixel intensity pattern on the spatial domain and temporal domain by capturing the fire feature on the three planes, those are fire color pattern (spatial) on the front side (XY plane), fire moving feature (temporal) during T-time on the horizontal plane (XT plane) and vertical plane (YT plane).

For the classification, K-NN method is selected because in [7] it is said that k-NN rule owes much of its popularity in the Pattern Recognition community to its good performance in practical applications.

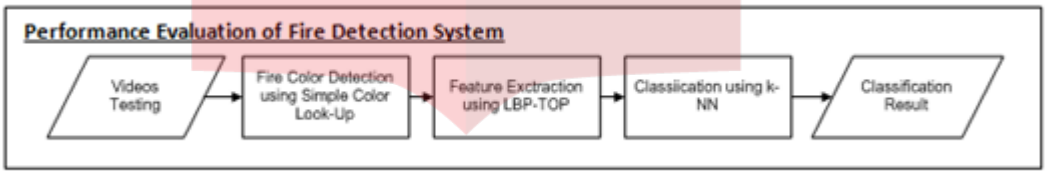

Figure 1.1 Conceptual Framework

1.4 Problem Statement

The idea of LBP-TOP only describes a mean to extract 3 planes of data from a volumetric 3D data and perform LBP mechanism to extract another set of data in a compact format. There are still open issues to be explored in order for the method to perform effectively. Therefore, the first step of this research is to analyze the parameters needed on the LBP-TOP to extract the fire feature correctly. The parameters can be seen on table 1-1. The analysis is conducted by combining the three parameter values on the LBP-TOP extraction process on the various video with the fire and non-fire class. The feature produced from the extraction process is modeled by using K-Means algorithm. The combination of parameters that could produce the best cluster model is the most optimum ones and would be used in the testing step.

Table 1-1 LBP-TOP paramaters

Variable	Variable's Information
LBP Threshold	Threshold difference between the center point with its neighboring points in analyzing the texture of fire.
Frame Sampling	Minimum number of frames that will be used in analyzing the object to check whether it is a fire or not.
Neighboring Point	Number of neighboring point needed

1.5 Hypothesis

The main features of fire are in spatial and temporal domain represented by color and moving pattern, respectively. Moreover, the other important character of fire is the irregular moving pattern with the frequency of about 5 Hz [8]. With those features and utilizing the optimal parameters achieved from the experiments, LBP-TOP method is considered effective to be adopted for feature extraction and help in making the detection more accurate. Moreover, because this system use only one method to extract the spatial and temporal method, the system will be fast.

1.6 Assumption

The assumption used in this research are:

1. The color range of detected fire is red to yellow in RGB color system.
2. The video is taken offline.
3. There is no disturbance from the camera setting, such as vibration and noise.

1.7 Scope and Limitation

The scope and limitation of this research are:

1. The accuracy of the detection system is only based on the existence of the fire in the video, the fire locationis not measured.
2. The algorithm is developed to detect fire with irregular motion. However, the experiment would include scenes with static fire.

1.8 Importance of the study

Two indicators that must be covered by the fire detection system are the detection accuracy and low computational cost. By adopting LBP-TOP as feature extraction method, the later indicator can be achieved and by using the optimal parameters in the method the first indicator can be achieved. Furthermore, the proposed LBP rule modification to expose color changes more clearly is a contribution of this work to achieve better fire detection performance.

CHAPTER 5: CONCLUSION AND RECOMENDATION

5.1 Conclusion

Based on the 1st experiment, the optimum parameters value for LBP-TOP method to differentiate fire from non-fire object are THR=80, Frame Sampling=5, and Neighbor Points=4. It means that only with 11 frames, our proposed method can detect fire object in video. With those optimal parameters, LBP-TOP can give 92% detection accuracy for LBP-TOP performance. False detection occurs when there are only a small number of fire pixels. In fire detection system evaluation that utilizing the combination of Simple Color Look Up and the LBP-TOP feature extraction method gave 80% detection accuracy. The false detection was because the incorrectness of Simple Color Lookup to determine the ROI. In the complexity analysis between the proposed method with one of the previous method using 4 serial filtering stages it can be concluded that the proposed method give less processing complexity compared with the previous one.

5.2 Recomendation

From the experiment, it was found that some errors occurs in the early stages of the process, i.e: in the determination of ROI. This work adopted the method from the previous work of [8]. It used Simple Color Lookup to decide the candidate areas for further processing. However, the false detection on this stage likely influence the detection accuracy on the next stage. Therefore, a better ROI determination method is preferable.

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