Advanced Smoke Recognition of Forest Wildfire using PCA Algorithm

Ms. J. Maheswari
Assistant Professor
Department of Computer Science and Engineering
Dhirajlal Gandhi College of Technology, Salem- 636309

Ms. Divya Roshini
UG Scholar
Department of Computer Science and Engineering
Dhirajlal Gandhi College of Technology, Salem- 636309

Ms. Indhuja
UG Scholar
Department of Computer Science and Engineering
Dhirajlal Gandhi College of Technology, Salem- 636309

Ms. Kirithika N
UG Scholar
Department of Computer Science and Engineering
Dhirajlal Gandhi College of Technology, Salem- 636309

Abstract

This research uses Machine learning (image mining techniques) for detecting smoke through an image or frame using difference in luminance and chrominance of the red and blue color. The smoke generated usually has peculiar color which can be used for it to be differentiated between a fog and smoke. This paper uses the color model and principal component analysis to effectively differentiate between smoke and other background objects. The methods used for color modeling is YCbCr and the algorithm proposed. This article considers an image as linear blending of smoke component and background component. Under this assumption this paper discusses a model and its solution using the concept of PCA.

Keywords: Machine learning, YCbCr, PCA, Data set, Feature Extraction

I. INTRODUCTION

Early smoke detection is the most important key to prevent the fire event. There are several techniques to identify the smoke, however those techniques require some constraints. For example, photoelectric and ionization detection techniques detect some specific particles produced from smoke and fire [4]. Photoelectric detectors use the photometry to detect the fire.

Ionization detects fire using the quantity of ionized air molecules. Both of the detectors require the specific amount of particles around them. In other words they can detect the smoke or fire if they get surrounded by enough smoke particles from at least certain distance. So these techniques are highly dependent on many parameters. May be photoelectric and ionization detectors are good enough for enclosed spaces, house, shopping mall, etc.

These techniques also detect the location and intensity of the fire or smoke. Vision- based smoke detection techniques require pattern recognition procedure where the images are divided into small windows. Then those small windows are classified as smoke or non-smoke. These techniques depend on the quality of the visual features for classification. Vision-based smoke detection is a challenge because of the quality or characteristics of the smoke. Vision-based smoke detection technique depends on the shape, color, motion, air quality, degree of transparency and a lot of different parameters. There are a lot of drawbacks of this technique. For example, texture feature extraction from an image along with thin smoke will get the visual characteristics of both smoke and background.

II. SYSTEM ANALYSIS

A. Existing System

The existing methods for smoke detection involves use of some kind of hardware and these hardware vary from fancy smoke detector to infrared sensors .Optical smoke detectors have a very high response time though they generate good results but the results are not cheap as installing them in public areas could be expensive and would require proper hardware management as they are easy to get tempered.

There are other methods, visualization methods, which do not suffer similar draw- backs. Real-time video-based surveillance techniques detect the smokes and fire at the early stage. Vision- based smoke detection techniques require pattern recognition procedure where the images are divided into small windows. Vision-based smoke detection technique depends on the shape, color, motion, air quality, degree of transparency and a lot of different parameters. There are a lot of drawbacks of this technique.

B. Disadvantages

1) Texture feature extraction from an image along with thin smoke will get the visual characteristics of both smoke and background.

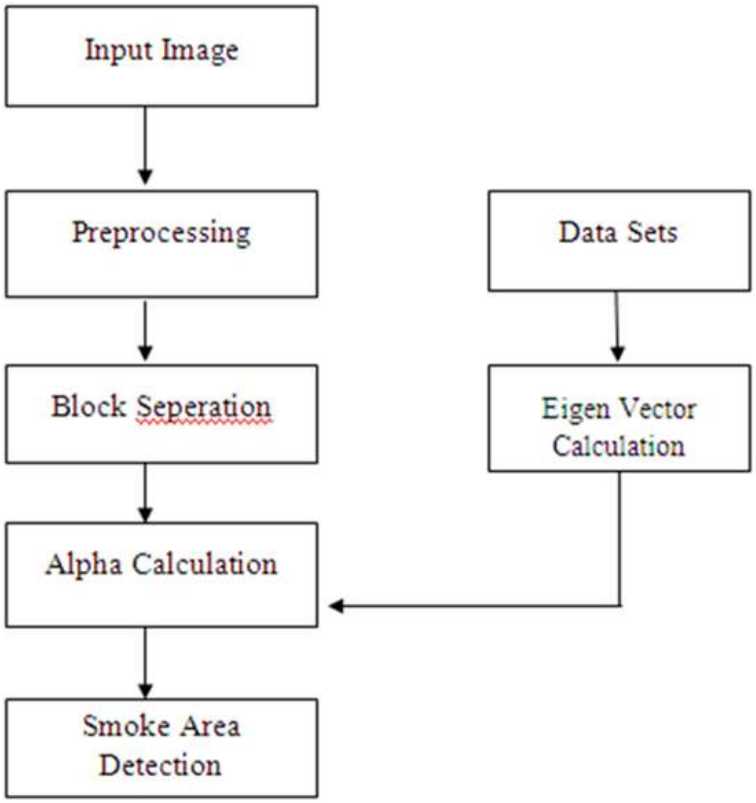
III. PROPOSED SYSTEM

In this paper, a method we done by using image mining techniques. It was achieved namely by implementing color modeling and the Principal component analysis for detection of smoke. Both techniques when implemented independently have some flaws as the color modeling generates excellent results when there is light smoke in the atmosphere but if the smoke is dense the accuracy is greatly affected and PCA always require some kind of dimensional modeling so that it can detect smoke which can be achieved by using color models . This paper is only for detecting the presence of smoke in an image and not in a video as it does not take into consideration the temporal characteristics of the smoke.

A. Advantages

1) Accuracy is high.
2) Quite Efficient quite e and cost effective at the same time than the traditional methods.

IV. SYSTEM ARCHITECTURE



V. CONCLUSION

In this paper we discuss considering an image is a linear blending of smoke component and background component. Under the above assumption we model the problem and solve the corresponding optimization problem. Basically we focus on the characteristics of the blending parameter, α assuming that $\alpha = 1$ indicates the solid object instead of smoke. The method, PCA matting, depends on many parameters to determine whether there is any smoke in the window or not. First, training pure smoke windows play the most important character in this procedure. To get the PCA vectors of the pure smoke for training purpose we use white, gray and black colored smoke (user defined). Because of that most of the time it classifies the white, gray and black color as smoke regardless of the existence of smoke. Second, setting the bar for α is another key to get the smoke location. Relatively high value of α gets the more success. Third, number of iterations to get the optimal value of α and s is not unique. It depends on the quality and the intensity of the smoke. Fourth, calculation is not always quite correct since most of the time the matrix αPTP is singular. Fifth, selecting the size of the window plays potential character. For small window it shows relatively good result. Sixth, searching by overlapping windows appears good result instead of non-overlapping window. Seventh, the position of the smoke on the image plays another role. There are some other factors which control the result of this method. Finally, it seems if there would have pure smoke database and if the water, sky, and snow from the images could be removed then the method would work better.

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