International Journal of Computer Science and Software Engineering (IJCSSE), Volume 6, Issue 8, August 2017
ISSN (Online): 2409-4285 www.IJCSSE.org Page: 186-188

Smoke Detection Algorithm for Outdoor Environment Based on Image Processing

Ngo Tung Son[1] and Bui Ngoc Anh[2]

[1, 2] ICT Department, FPT University, Hanoi, Vietnam

[1]Sonnt69@fe.edu.vn, [2]Anhbn5@fe.edu.vn

ABSTRACT

At this point, the conventional smoke detection often requires many smoke sensors but they have weakness in wide coverage area and low response time. In order to overcome these shortcomings, this paper presents a method based on image processing techniques, capable to detect the smoke from video taken from camera. The proposed detection method consists of the following steps: slow motion detection, smoke color detection, inverse edge detection, AND operator and then classification phase. This will provide early warnings such as fire, thus reducing economic losses and casualties. In addition, it will help to improve the rate of smoke detection, as well as reducing the false detection rate of other suspected object.

Keywords: *Smoke Detection, Moving Region Detection, Smoke Features.*

1. INTRODUCTION

Fire smoke accidents frequently put in danger our life at the same time causing economic and ecological damages and the scarcity of automatic fire detection systems continues to be a problem that really needs a serious attention to save human lives by preventing injuries and/or deaths. To avoid the smoke disasters, many early smoke detection techniques have been explored and most of them are based on particle sampling, temperature sampling, relative humidity sampling, and air transparency testing, in addition to the traditional ultraviolet and smoke sensors [1]. Thus, they are not always reliable because energy emission of non-smokes or by products of combustion, which can be yielded in other ways, may be detected by misadventure. This usually results in false alarms. To provide more reliable information about fires, stereo vision based approach is becoming more and more helpful. The newest innovations are continuing to use cameras and computer algorithms to analyze the visible effects of smoke and its motion in their applications [2]. As their approaches present some drawbacks when working in spatial domain, the main difficulty is still to identify objects if they do not occur at the expected position. In this paper, we propose the new algorithm for early smoke detection for outdoor environment such as forest or street based on smoke features slow motion, growth and color information [3-4].

2. THE PROPOSED ALGORITHM

The block diagram of proposed algorithm is described as figure 1. The input data is sequence frame. These frames are used to detect slow motion, inverse edge and smoke candidate regions as figure 1. Output of blocks are binary images, and continuously they are performed by AND operator to find remain regions of AND operation. Finally, we remove noise by median filtering and verify detected regions to detect smoke objects.

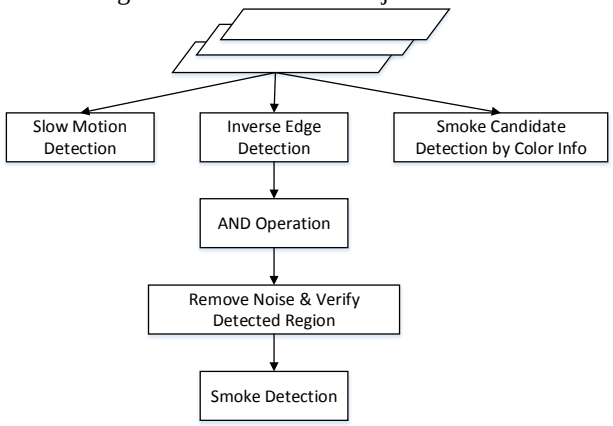

Fig. 1. The block diagram of proposed algorithm

2.1 Slow Motion Detection

In order to detection slow motion of smoke, we used the subtraction method with seven continuous frames to six different frames. Then we add six different frames to get the slow motion in total frame. This method is also called the accumulated foreground.

2.2 Inverse Edge Detection

The smoke region tends to remove the edge components of image. Thus we used edge detection method for ith frame. And we can find the candidate of edge region by gathering the edgeless region. In this paper, we receive the inverse edge image of obtained binary image which is out of edge detection using Sobel mask.

2.3 Smoke Candidate Detection by Information

Also we are able to detect possible smoke region using the color information of i^{th} input frame $F_{input}(x,y)$. Equation (1) shows transformation of pixel value of each input image when it is within specified region. C(x, y) is output image.

$$C(x,y) = \begin{cases} 1 & 100 \le F(x,y) \le 240 \\ 0 & Otherwise \end{cases} \quad (1)$$

3. EXPERIMENTAL RESULTS

We implement the proposed algorithm by using Visual Studio C++ and image processing library Open CV 2.4.9. We used smoke video with outdoor environment street and forest [5-6] and some others (Personal property) as input to experiment our system and evaluate accuracy. We experimented on 150 videos. The results show by figures from 2 to 5, and accuracy get to over 90%.

Fig. 2. The experimental result on street.

Fig. 3. The experimental result at forest with near smoke

Fig. 4. The experimental result at forest with far smoke

Fig. 5. The experimental result on outside

4. CONCLUSIONS

In this paper, we proposed and implemented the novel algorithm for fire/smoke detection system based on image processing using the single camera. Experimental results showed the proposed algorithm detected smoke in almost cases. Future, we will implement and experiment with a large capacity of video to evaluate the accuracy of algorithm.

REFERENCES

[1] Ashish A. Narwade1, Vrishali A. Chakkarwar, "Smoke Detection In Video For Early Warming Using Static and Dynamic Features", International Journal of Research in Engineering and Technology, Vol. 2, pp. 610-615, Nov. 2013.

[2] Chen-Yu Lee, Chin-Teng Lin, and Chao-Ting Hong, "Smoke Detection Using Spatial and Temporal Analyses", International Journal of Innovative Computing, Information and Control, Vol. 8, No. 6, pp. 1-11, June 2012.

[3] Vipin, "Image Processing Based Forest Fire Detection", International Journal of Emerging Technology and Advanced Engineering, Vol. 2, pp. 87-96, Feb. 2012.

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

Computer and Communication Technology, pp. 16-19, 2014.
[5] http://imagelab.ing.unimore.it/visor/video_categories.asp.
[6] http://mivia.unisa.it/database/mivia_smoke.zip.

AUTHOR PROFILES:

Ngo Tung Son is currently working at Computing Fundamental Department, FPT University as a Lecturer and R&D engineer at Panasonic Hanoi Laboratory, Vietnam .He graduated a Bsc in Computing since 2011 and master degree in computer science at University of Avignon, France since 2014. His researches mainly focus on intelligent and adaptive system.

Bui Ngoc Anh is an IT specialist. He is working at FPT University as IT lecturer. He had more than 15 years of experience in IT System consultant and development. He graduated a master degree in computer science at Hanoi University of Technology, Vietnam. His researches lies on Mobility Technology, Information Assurance, IoT applications.