Vision Based Wild-Fire and Water-Level-Change Detection for Drone Applications

저자 (Authors): Yunfan Chen, Han Xie, Jingchun Piao, Jameel Ahmed Khan, Hyunchul Shin

출처 (Source): 대한전자공학회 학술대회 , 2017.1, 927-928 (2 pages)

발행처 (Publisher): 대한전자공학회
THE INSTITUTE OF ELECTRONICS ENGINEERS OF KOREA

URL: http://www.dbpia.co.kr/Article/NODE07110726

APA Style: Yunfan Chen, Han Xie, Jingchun Piao, Jameel Ahmed Khan, Hyunchul Shin (2017). Vision Based Wild-Fire and Water-Level-Change Detection for Drone Applications. 대한전자공학회 학술대회, 927-928.

Vision Based Wild-Fire and Water-Level-Change Detection for Drone Applications

Yunfan Chen, Han Xie, Jingchun Piao, Jameel Ahmed Khan, Hyunchul Shin
Department of Electronics and Communication Engineering, Hanyang University, Korea
shin@hanyang.ac.kr

Abstract

In this paper, a novel wild-fire and water-level-change detection method are proposed for drone applications. First, image alignment is performed for a reference and a target image to obtain image difference. Then, a color model is designed to extract fire-colored pixels on interest regions. Finally, the directional gradient calculation method is proposed to detect the water level. The experimental results validate that the proposed method can effectively detect fire and water-level-change for drone images.

Keywords: Fire; Water level; Drone; Color feature; Gradient; Image alignment.

1. Introduction

Wild fire and flood detection are the important part in natural disaster detection. Existing methods of fire detection rely almost exclusively upon spectral analysis using rare and usually costly spectroscopy equipment. This limits the fire detection to those individuals who can pay high prices for expensive sensors. Most of the existing flood methods like [1] use stationary surveillance cameras which detect the flood when flood water already comes out to the ground. This is usually too late to prepare for the flood. Thus we detect the water level of the bridge image to predict the flood.

2. Related works

The fire detection system based on the input color usually gives the heuristic threshold values to find the fire to the RGB input color [2,3]. For a generic fire color model, if the color of fire is changed, the fire detection is not easy, they should be replaced with automatic threshold values using the statistics color model. For flood detection, the common methods mainly rely on the color feature. In [1], the detection based on the color probability was proposed. Another typical approach is the HSV color feature-based technology presented in [4].

3. Proposed methods

In this paper, we begin with the alignment of the two images taken by the drone, then detect the fire and water lever by using color model and directional gradient calculation respectively.

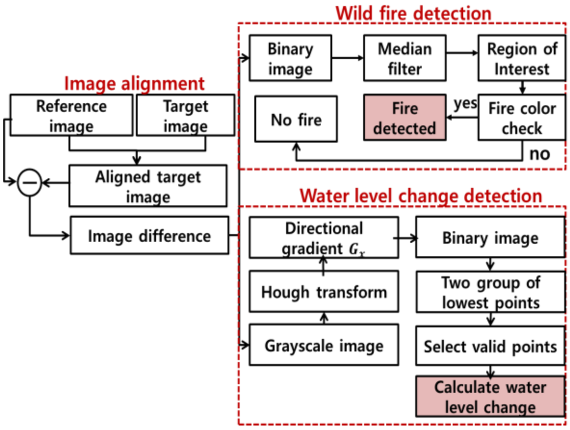


Fig. 1. Flowchart of the proposed method

3.1 Image alignment

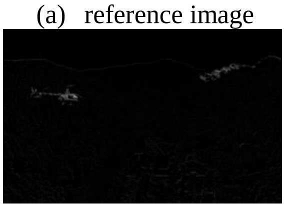
In the preprocessing step of image alignment, we carried out a perspective transform by estimating homography matrix between two images. For feature extraction and descriptor generation, we utilized FAST and BRIEF methods.

3.2 Wild fire detection

After we get the aligned target image, there might be the fire-like color region in a scene. Therefore, first, it needs to remove the fire-like color region of background from the fire candidate regions.


(a) reference image


(b) aligned image


(c) difference image

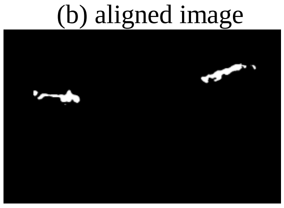

(d) ROI

Fig. 2. ROI generation.

Our proposed method subtracting Fig.2(a) from Fig.2(b) to get the difference image. Then, we get the binary ROI by using Otsu threshold, median filtering, and morphological processing.

For fire pixel detection, Chen et al. [2] proposed the RGB and HSI color model as follows:

$$R(x) \geq G(x) \geq B(x) \tag{1}$$

$$R(x) \geq R_t \tag{2}$$

$$S(x) \geq (255 - R) \times S_t / R_t \tag{3}$$

where $R(x), G(x), B(x)$ and $S(x)$ are Red, Green, Blue, and Saturation value, R_t, is the threshold of pixel's Red component, S_t is the threshold of pixel's Saturation component. We combine this color model with the ratios of R-G, R-B, and G-B color channels, and the rules described in (4). This new fire color model is more accurate and robust.

$$\begin{aligned} 0.25 \leq G(\mathrm{x})/(\mathrm{R(x)}+1) \leq 0.65 \\ 0.05 \leq \mathrm{B(x)}/(\mathrm{R(x)}+1) \leq 0.45 \\ 0.20 \leq \mathrm{B(x)}/(\mathrm{G(x)}+1) \leq 0.60 \end{aligned} \tag{4}$$

3.3 Water level change detection

We obtain the ROI under the bridge by using Hough transform based on the line structure of the bridge.

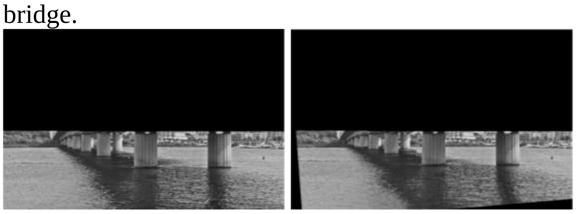


Fig. 3. Left: ROI of the reference image. Right: ROI of the aligned image.

We calculate the directional gradient along the x-axis to find the edge of the bridge pier, then set a proper threshold $\mathbf{T}$ to get the column lines in the binary image.

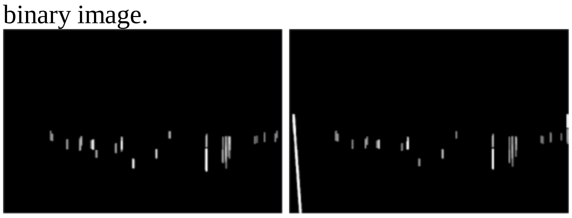


Fig. 4. Left: Column lines in the binary image of the reference image. Right: Column lines in the binary image of the aligned image.

To find out the bottom point of each line, we compare two groups of these points to get the change of water level.

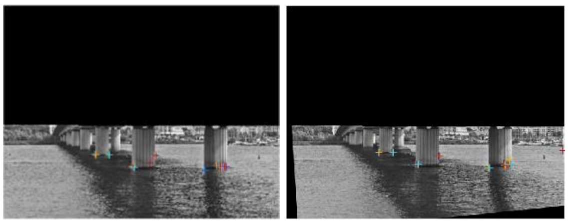


Fig. 5. Left: Points stand for the water level in the reference image. Right: Points stand for the water level in the aligned image.

4. Experimental results

Fig. 6 and Fig.7 shows the examples of fire and water lever detection results on different conditions.

(a) (b) (c) (d)

Fig. 6. Examples of fire detection. (a) reference images (b)aligned target images (c)ROI (d) detection results

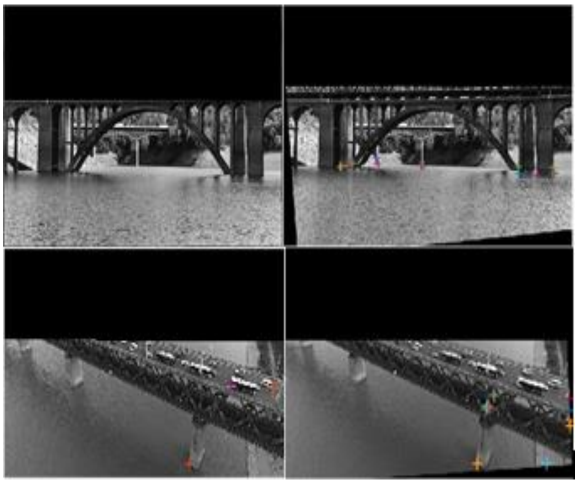


Fig. 7. Top row is bridge A. The water level has risen 6 pixels. Bottom row is bridge B. The water level has risen 4 pixels.

5. Conclusion

In this paper, we proposed drone vision based detection method to monitor the wild-fires and water-level-changes for floor warnings.

References

[1] A. Filonenko, Wahyono, D. C. Hern´andez, D. Seo, and K. H. Jo, “Real-Time Flood Detection for Video Surveillance”, *IECON2015-Yokohama*, 9-12, November 2015.

[2] B. H. Cho, H. J. Sung, “Image Processing-based Fire Detection System using Statistic Color Model”, *International Conference on Advanced Language Processing and Web Information Technology,* 2008.

[3] T. Celik, H. Demirel, H. Ozkaramanli, and M. Uyguroglu, “Fire Detection using Statistical Color Model in Video Sequences,” *Journal of Visual Communication & Image Representation*, vol. 18, pp.176-185, 2007.

[4] C. L. Lai, J. C. Yang, and Y. H. Chen, “A real time video processing based surveillance system for early fire and flood detection”, *in GInstrumentation and Measurement Technology Conference Proceedings,* Warsaw, Poland, pp. 1 – 6, May 2007.