Moving Object Detection Based on Background Subtraction

Ihsan Ullah[1], Hyo Jong Lee [1, 2,*]
[1]Division of Computer Science and Engineering,
[2]Center for Advanced Image and Information Technology
*Corresponding author
Chonbuk National University, Jeonju 561-756, Korea
Ihsanullah736@gmail.com, hlee@chonbuk.ac.kr

Abstract

Moving object detection is a task to identify the physical motion of an object in a specific region or area. Over the last few years, moving object detection has received much attention due to its wide range of applications like video surveillance, human motion analysis, robot navigation, event detection, anomaly detection, video conferencing, traffic analysis and security. In this paper, a framework is proposed for the evaluation of object detection algorithms in surveillance applications using background subtraction and Mixture of Gaussian. Experimental results show that our technique achieved promising accuracy.

1. Introduction

The intelligent surveillance system is widely used in the military, security control and video compression and some other areas. Because the reality scenes are complex, and objects are changeable, therefore, exploring an efficient and stable video surveillance system is still a challenging problem [1]. Moving object detection has become a central topic of discussion in the field of computer vision due to its wide range of applications like video surveillance, monitoring of security at airports, law enforcement, video compression, automatic target identification, marine surveillance and human detection [2]. Several methods have been proposed so forth for object detection, out of which Background Subtraction [3, 4], Frame differencing, Temporal Differencing [5] and Optical Flow [6] are extensively used methods as shown in Figure. 1. As the basic part of the intelligent surveillance system, object detection plays a crucial role in following object segmentation and tracking.

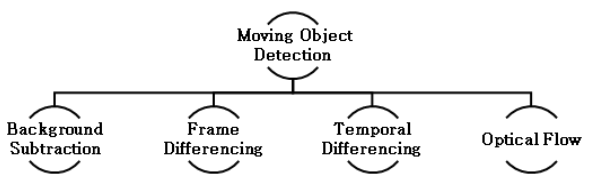

Figure.1 Approaches of Moving Object Detection

Identifying, moving objects from a video sequence is a fundamental and critical task in many computer vision applications, especially in surveillance systems, which have some special requirements. Firstly, the algorithm must be robust against changes in illumination. Secondly, nonstationary background objects such as swinging leaves, rain, snow, and the shadow cast by moving objects separated from moving objects. Moreover, its internal background model should react quickly to changes in background, such as starting and stopping of vehicles.

A lot of work has been done for moving object detection in normal video surveillance application with a stationary camera. [7] is a typical representative of such kind of work, the authors model each pixel as a mixture of Gaussians and using an on-line approximation to update the model, resulting in a stable, real-time outdoor tracker. For the method models pixels' value changes over time of background which has no regular patterns in the aerial video, it cannot be applied to detecting moving objects in a moving background directly.

The rest of the paper is organized as follows: Section 2 presents the proposed method moving object detection, Section 3 demonstrates the experimental results and conclusions are drawn in Section 4.

2. Proposed Method

In this paper, Mixture of Gaussian method is chosen due to its low rate of complexity, memory consumption and suitability for the outdoor environment along with its robustness. The proposed method is shown in Figure.2.

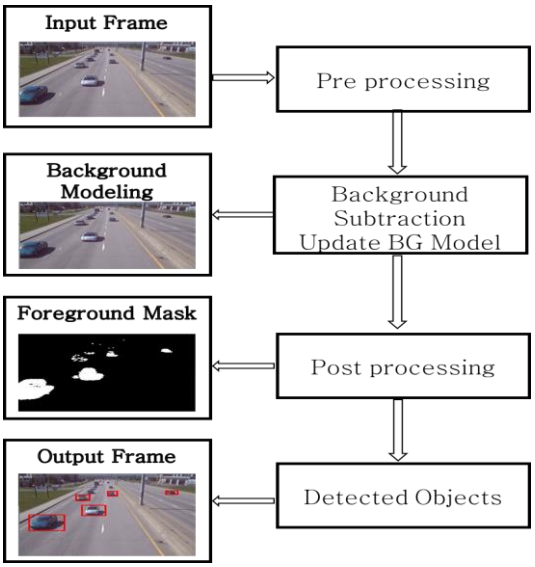

Figure .2 Flowchart of the proposed method

Firstly, pre-processing is the process of changing the raw data which is the input video sequences into a format that can be read for the next phase then 3x 3 kernel Gaussian filter is applied for smoothness and for removal of noise as in Figure.3.

In background modeling, background subtraction is performed, the new video frames are updated and calculate the background model where it provides a statistical description. An unidentified pixel in the video frame in background model will be output as binary candidate foreground mask at foreground detection step. Data validation stages function as examiner and eliminator where it examines candidate mask and eliminates pixels that are not related to target moving objects and only provide the foreground masks output. Then the system post-process the foreground mask by the opening operator to remove noise and contour algorithm is applied to the foreground mask to find the detected objects and the detected objects in successive image frames are enclosed by rectangular bounding box as shown in Figure.3.

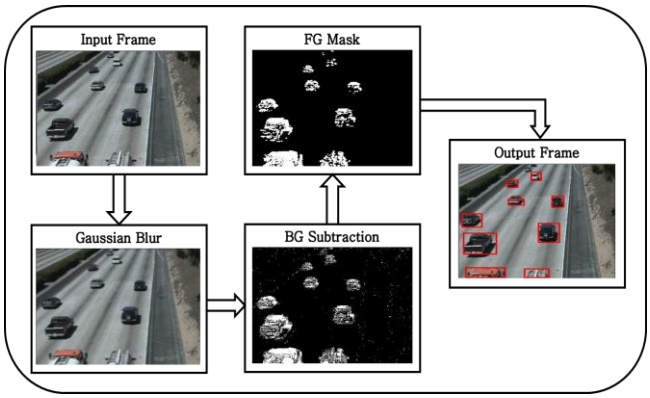

Figure .3 Processing steps

3. Results

The system used in this work is built with Intel Core i5 3.6GHz CPU, 8GB RAM. We tested our method on various sequences including vehicles. All sequences are shown in Figure. 2 and 3 are recorded on outdoor scenes that include the sky, trees, buildings, and grounds. They include several kinds of noise caused by illumination changes, a small movement in the background, and reflection. However, our results showed remarkable robustness against these environments. Our method succeeded detecting moving objects accurately in all video sequences in Fig. 2 and 3, even though these sequences had many causes of noise. We evaluated 24 frames of video as shown in Figure.4 and the total number of objects in 24 frames is 149 in which 129 is detected. The accuracy is about 86 %.

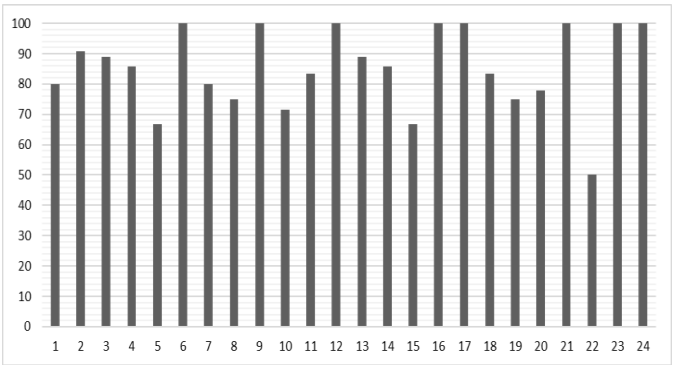

Figure .4 Accuracy of the frames

However, sometimes the contour of the two or more objects are joint together which count different object as a single object which affects the accuracy of the system as shown in Figure.5, besides this shadow is also one of the great challenge that affect the moving object detection, i.e. sometimes two or more than two objects are detected as a single object.

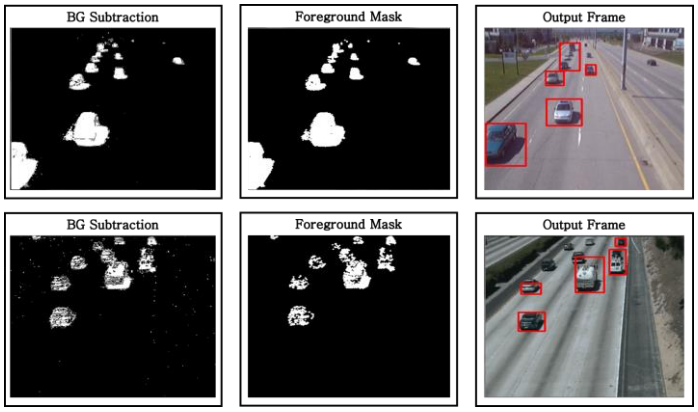

Figure .5 More than one object detection

4. Conclusion

This paper proposes a framework for the evaluation of object detection algorithms in surveillance applications using background subtraction and Mixture of Gaussian. This algorithm performs well for the outdoor environment along with its robustness. However, it still has some challenges for example when dealing with shadow. As the algorithm is performed on colored images so we can remove shadow by relighting each pixel in the luminance, chroma: blue, chroma: red (YCbCr) color space and correcting the color of the shadowed regions in the red-green-blue (RGB) color space. In addition, we intend to combine a machine learning methods to detect moving objects. We believe these will improve the accuracy of the algorithm furthermore.

Acknowledgements

This work was supported by the Brain Korea 21 PLUS Project, National Research Foundation of Korea. This work was also supported by the Business for Academic-Industrial Cooperative establishments that were funded by the Korea Small and Medium Business Administration in 2015 (Grants No. C0221114). This research was also supported by the MSIP (Ministry of Science, ICT, and Future Planning), Korea, under the ITRC (Information Technology Research Center) support program (IITP-2016-R0992-16-1023) supervised by the IITP (Institute for Information & communications Technology Promotion).

References

[1] M. Zhu, S. Sun, S. Han, and H. Shen, "Comparison of moving object detection algorithms," in *World Automation Congress (WAC), 2012*, 2012, pp. 35-38.

[2] R. Fablet, P. Bouyhemy, and M. Gelgon, "Moving object detection in color image sequences using region-level graph labeling," in *Image Processing, 1999. ICIP 99. Proceedings. 1999 International Conference on*, 1999, pp. 939-943.

[3] N. A. Mandellos, I. Keramitsoglou, and C. T. Kiranoudis, "A background subtraction algorithm for detecting and tracking vehicles," *Expert Systems with Applications,* vol. 38, pp. 1619-1631, 2011.

[4] W. M. Hu, T. N. Tan, L. Wang, and S. Maybank, "A survey on visual surveillance of object motion and behaviors," *Ieee Transactions on Systems Man and Cybernetics Part C-Applications and Reviews,* vol. 34, pp. 334-352, Aug 2004.

[5] R. Jain and H.-H. Nagel, "On the analysis of accumulative difference pictures from image sequences of real world scenes," *Pattern Analysis and Machine Intelligence, IEEE Transactions on,* pp. 206-214, 1979.

[6] S. H. Shaikh, K. Saeed, and N. Chaki, *Moving Object Detection Using Background Subtraction*: Springer, 2014.

[7] C. Stauffer and W. E. L. Grimson, "Adaptive background mixture models for real-time tracking," in *Computer Vision and Pattern Recognition, 1999. IEEE Computer Society Conference on.*, 1999.