International Journal of Design and Innovation (IJDI)

Issue 1, 2013, pg 40 - 44

ISSN 2289-7151

Real-time Periodic Motion Detection and Background Estimation

[1]S.T Syed Shazali, [1]W.L Cheong, [1]H.M Johan, [2]S. Mohamaddan, [1]A. M. N. Abg Kamaruddin, [1]M.S Osman and [2]K. Case

[1]Department of Mechanical and Manufacturing Engineering,
Faculty of Engineering,
Universiti Malaysia Sarawak

[2]School of Mechanical & Manufacturing Engineering
Loughborough University

Abstract - Motion detection is a process to detect a changing in position of an object based on its surroundings. This paper, therefore, will present a periodic motion detection and background estimation. This method focussed on outdoor illumination condition. The method used is sturdy to illumination change effect, change in background and noise. Background subtraction is used in this method and the background image is estimated every 0.8 second using timer if the sum of absolute different (SAD) is less than the motion threshold. The input image is luminance normalize before the background subtraction. The results were converted into a binary image by autothreshold and the results were enhanced with dilation and erosion. The blobs were created for each motion object. Experimental results of using a background image estimated by periodic background estimation demonstrated their sturdiness and effectiveness in real-time background subtraction.

Keywords: motion detection; periodic background estimation; autothreshold; motion threshold; luminance normalize

I. INTRODUCTION

Background subtraction, frame differencing, and optical flow segmentation are the commonly used methods to segment the motion area from sequence image. However, background subtraction is said to be the most useful yet an effective method for detecting moving objects in video images. It is by observing the images and comparing the intensity of the background of these images. Although it is a simple method to use, its applications are limited to the background scene in which it must remain motionless and unchanged (11). In real world, especially in outdoor scenes, it is impractical to be used due to the intensity change as illumination fluctuate with sunlight and weather, tree leaves waving and movement of the object from dynamic to static; e.g. an incoming vehicle into a parking space and stops moving.

(5) had proposed a background subtraction method that robustly handles various changes in the background by learning the chronological changes in the observed scene's background in terms of distributions of image vectors. (12) had used a method using background subtraction for detecting

moving objects. This method can be applied to cases in which the image is varied due to varying illumination based on two object detection methods that compares the background image and using invariant features of illumination for the observed image. This helps to estimate the illumination conditions of the observed image and normalizes the brightness before carrying out background subtraction.

While (10) have proposed a method where the background estimated from global illumination change in the observed image using background subtraction by the mapping tables between the present image and the original background. Each pixel from the background subtraction is calculated by mean and each block is calculated with variance to get better segmentation. However, there are errors of detection of background after a moving object passes through and produced a shadow. An approach using a correlation measure between two blocks in images against varying illuminations with Spatial Modulated Normalized Vector Distance (SMNVD) concept for a background subtraction method for non-stationary scene is used by (11). This method is able to detect the moving object with failure to detect some parts of the moving regions. An algorithm method based on constant characteristics of a common, 2-frame interlaced video signal is developed (8). The proposed algorithm is sturdy to lighting conditions, changes in the environment and discontinuous motion parameters. Even so, large object outside of the usual range of interest were segmented into several moving objects and the static object lost is identified.

In this research, a periodic background estimation subtraction method in motion detection is proposed. It is not likely to break to the noise and the illumination change effect of the observed image. The static objects can be used as the background, as it can be assumed to be continuously static. The background image is estimated periodically every 0.8 seconds when no or less motion using background estimation. The image of the background is estimated using median filter and were luminance normalize later with the observed image. This is done before the image is segmented using background subtraction. The segmented images were then processed using dilation and erosion. The purposed is to remove noise and connect the region of moving object which is further processed as blobs to create bounding boxes and provide centroid coordinate data of each blob. The total blob in the image can be calculated by this system.

II. ESTIMATION SUBTRACTION METHOD USING PERIODIC BACKGROUND

The first process in this method is the motion detection of the observed image. The background estimation process is enabled to process the background image every 0.8 second generated by the time by means if the sum of absolute difference of the observed image is more than the motion threshold. Then, the observed image is segmented with the background subtraction and converted into binary image by autothreshold. The segmented image is further processed in detection to create blob and a bounding box for the observed motion object. The flow chart of the proposed approach is shown in figure 1.

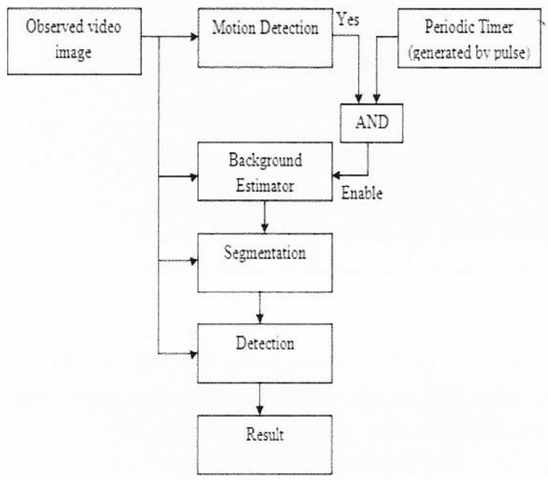

Figure 1. Proposed approach of estimation subtraction method.

III. BACKGROUND ESTIMATION AND MOTION DETECTION

Once the background estimator is initiated, the pulse will take basically five frames from the observed video images. Pixels of each frame which are at the same coordinate will be used to find the median pixel in order to produce the background image. The steps are presented in figure 2.

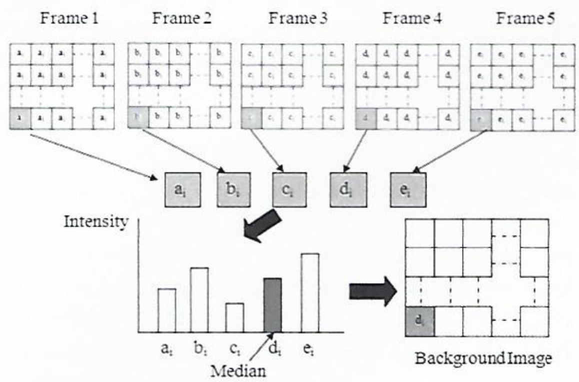

Figure 2. Median pixel for background estimation.

While in motion detection, the observed image is processed into a 2-D sum of absolute difference (SAD) as to compute by shifting the image template in single-pixel increments throughout the inside part of the observed image. The template of the image is later delayed into a frame image of the observed image. If the value of SAD is lower than the motion threshold, which is$(17x10^4/255)$ with every 0.8 second, the background estimator will be enabled. The pulse generated is a pulse with one amplitude, period of 20 and pulse width of five (5 frames samples). The generated pulse is shown in figure 3.

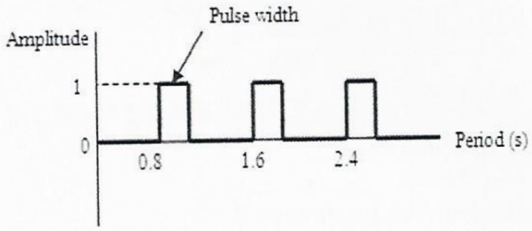

Figure 3. Pulse used as Periodic Timer.

IV. SEGMENTATION

When the input image is put in segmentation, it will then process into luminance normalization. It is subtracted to find little changes of pixels. These pixels will be normalized as background pixels to produce a normalized input image. The background subtraction method is used to segment the motion of the background. The results of the background subtraction are processed by auto threshold to produce a binary image from intensity images. A commonly used thresholding technique is the Otsu technique. It has a simple implement and time saving. Otsu technique helps to minimize the intra-class variance by splitting the histogram of the input image (13). The next process is to reduce noise in the image and connect the region of moving objects by using dilation and erosion on the binary. The results of the whole process are displayed in figure 4.

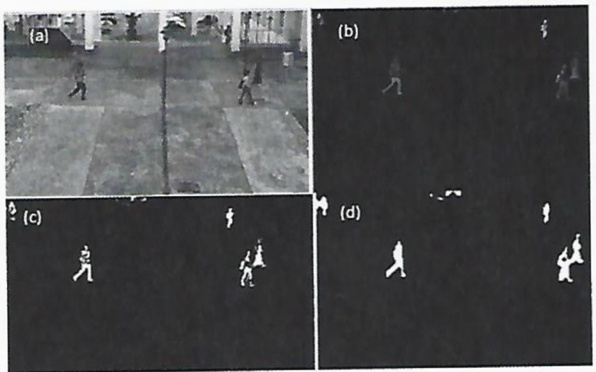

Figure 4. (a) Input video image (b) Background subtraction (c) Autothreshold (d) Dilation and Erosion.

V. DETECTION

The first process in detection is to merge the object pixels that are close to one another to create blob. The minimum of 100 pixels should be in one blob area. The pixels will be considered as noise if they are less than 100 pixels. It should be noted that the blob will be excluded in the analysis if it is in contact with the border of the image. The blob will later be analyzed by calculating the bounding box and centroid. The bounding boxes of the motion detected are drawn in the output images for each blob. The blobs drawn in the binary image and output are shown in figure 5. A blob counting system is also included to count the total blob in the image in figure 6.

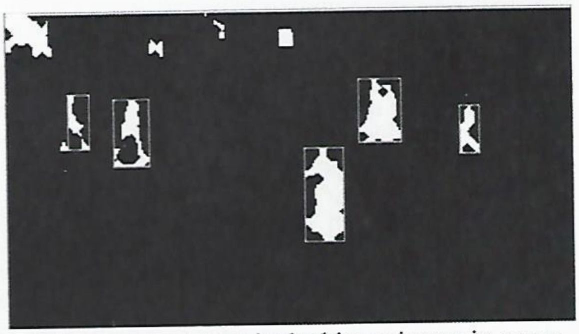

Figure 5. Blobs drawn in the binary image in green blocks.

Figure 6. Blobs drawn in the output image in red blocks.

VI. RESULTS

The experiment was carried out in Universiti Malaysia Sarawak. Apparatus used in this experiment was a digital video camera as a video recording with 1440 x 1080 pixels, 25 frames/sec. The resolution of the video image was reduced to 320 x 180 pixels for a more faster processing. The RGB images were processed into gray-scale images. The video image was taken under an outdoor illumination condition with the sunlight is taken as the light source. It is understood that the intensity of the background always changes due to the unpredictable weather condition during the experiment. From this, the system was able to count the total of blob in the output image.

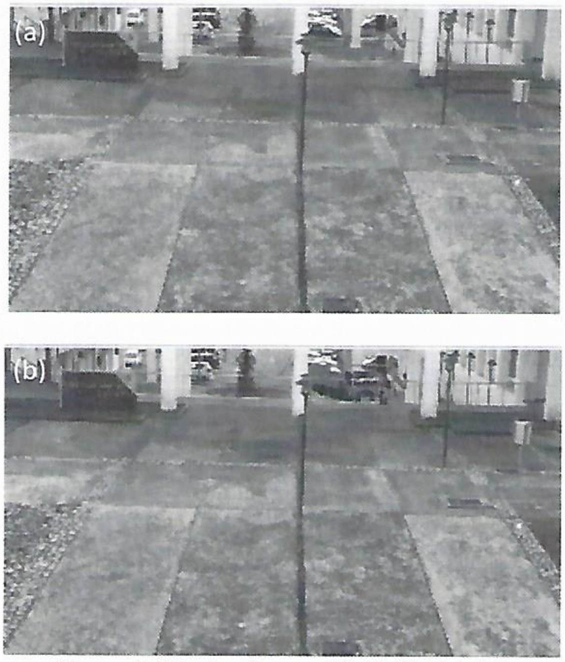

Figure 7. Moving lorry at 8:47:53AM. (a) Background image (b) Tracked image.

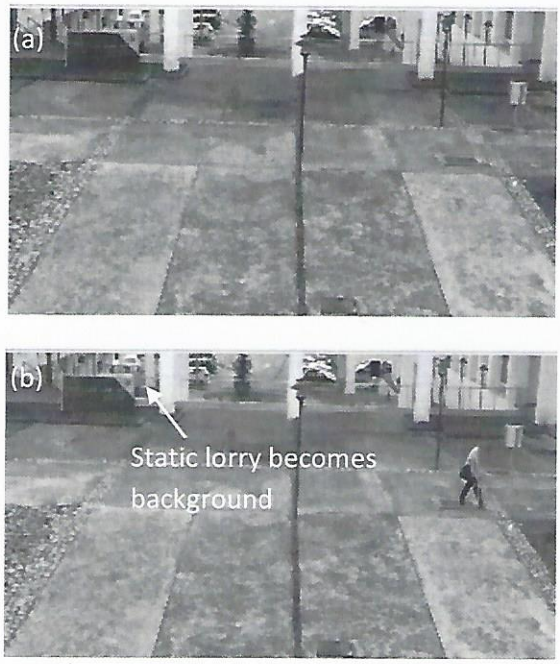

Figure 8. Moving lorry at 8:48:20AM. (a) Background image (b) Tracked image.

The system was also able to detect the moving object at outdoor condition as presented. The static object which was first in motion and stopped is taken as the background image. This can be seen in figure 7 and figure 8 where the moving lorry stopped at a place. The background estimation was estimated every 0.8 seconds. However, this system was able to detect other objects where as in this case the pedestrian which is considered as a problem. The pedestrian who is in the static were also taken as a background image until they start to move. Hence, the pedestrian that move in a group is considered as one blob in the system.

VII. CONCLUSION

The background estimation was used in the proposed approach to estimate the image of the background using a periodic median filter every 0.8 seconds. The background image is evoked when the amount of absolute difference (SAD) is lower than the motion threshold. The input image is luminance normalize which is due to illumination in order to reduce noise. The segmentation was able to segment the moving object using background subtraction. Then, it was able to convert by using auto threshold into a binary image. Dilation and erosion were used on the binary image to get a better result. The result of the object pixels is later merged to create a blob for each moving object.

The advantages of this system were that it was able to segment the moving objects under outdoor illumination condition and changed the background images every 0.8 second to reduce the noise and static objects thus updated them. However, it was unable to observe the moving object that stopped which then considered it as background. Further improvement of the system may include the improvement of detection of objects in motion and able provide an identity for each blob.

ACKNOWLEDGMENT

This research was supported by Universiti Malaysia Sarawak (UNIMAS) under the Fundamental Research Grant Scheme (FRGS) through providing good facilities in conducting the research.

REFERENCES

[1] C.P. Chong, C.A.T. Salama, K.C. Smith, "Image-motion detection using analog VLSI," Solid-State Circuits, IEEE Journal of , Vol. 27, no. 1, pp. 93,96, Jan 1992

[2] D. J. Shah, D. Estrin, "Motion based bird sensing using frame differencing and Gaussian Mixture," University of California, Riverside : UCR Undergraduate Research Journal, 2008.

[3] J. Zhang, J. Hu, "Image Segmentation Based on 2D Otsu Method with Histogram Analysis," International Conference on Computer Science and Software Engineering, IEEE Computer Society, pp. 105-108, 2008.

[4] K. Gupta, A. V. Kulkarni, "Implementation of an Automated Single Camera Object Tracking System Using Frame Differencing and Dynamic Template Matching," India, 2008.

[5] M. Seki, H. Fujiwara, K. Sumi, "A Robust Background Subtraction Method for Changing Background," IEEE Japan, 2000.

[6] M. Latzel, E. Darcourt, J. K. Tsotsos, "People Tracking using Robust Motion Detection and Estimation," Proceedings of the Second Canadian Conference on Computer and Robot Vision (CRV'05), IEEE, 2005.

[7] M. Takaki, Y. Ohgi, Y. Takahashi, "Vision Based Human Detection for the Safe Control of Robots," Science Links Japan Vol.23rd, No Page.1B16, Japan, 2005.

[8] M. Tsuchikawa, A. Sato, H. Koike, A. Tomono, "A Moving-Object Extraction Method Robust Against Illumination Level Changes for a Pedestrian Counting System," IEEE Japan, 1995.

[9] N. Otsu, "A Threshold Selection Method from Gray-Level Histogram", IEEE Trans. Systems Man, and Cybernetics, Vol. 9, pp. 62-66, 1979.

[10] T. Ishikawa, S. Fukui, "Extraction of Moving Objects from Video Sequence Using Estimated Background Brightness," IAPR Workshop on Machine Vision Applications , Nara- ken New Public Hall, Nara, Japan, Dec. 11 - 13, 2002.

[11] T. Matsuyama, T. Ohya, H. Habe, "Background Subtraction for Non-Stationary Scenes," Kyoto, Japan, 2000.

[12] T. Matsuyama, T. Wada, H. Habe, K. Tanahashi, "Background Subtraction under Varying Illumination," Systems and Computers in Japan, Vol. 37, No. 4, 2006.

[13] Z. Li, K. Yabuta, H. Kitazawa, "A New Method for Moving Object Extraction and Tracking Based on the Exclusive Block Matching," Springer-Verlag Berlin Heidelberg, PSIVT 2009, LNCS 5414, pp. 249–260, 20