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Moving Object Detection Based on Background Subtraction & Frame Differencing Technique

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Abstract: In this paper, the Detection of the Moving Object is done based on Background Subtraction & Frame Differencing techniques. A moving object can be detected by employing various methods such as, by taking the difference between two Images. In this paper, detection of a moving object is performed by using two different techniques: a Background Subtraction technique, two frame difference technique; which are implemented in Matlab. The results of these two techniques are then compared in regards with PSNR and observed that the two frame difference technique can detect the region of the moving object effectively, even in a complex background, when compared with the Background Subtraction algorithms. The PSNR of two frame difference is 72.77683 at threshold 20, at the same threshold, PSNR of background subtraction is found to be 72.76551.

Keywords: Moving Object; Frame Difference; Background Subtraction.

I. INTRODUCTION

A moving Object detection has wide range of applications Such as Automated Video Surveillance, mobile robot navigation, Robot Vision, Monitoring of Traffic, military reconnaissance, Security systems, Animation purpose, Human-Computer Interaction, etc. Now-a-days, moving object detection is a diverse topic in the Computer Vision research. Here in this paper, the two techniques are implemented in Matlab, and results were compared.

Background subtraction, is considered as the most common technique used to detect a moving object in a video sequence [1] regions by subtracting the current frame (pixel by pixel) from a reference image called background, that usually is found by means of an image selection process, which is executed during a initialization period. The issue with this technique is abrupt illumination change causes problems for detecting moving objects, because it may disturb the derived background model. And also it becomes very difficult to determine at what interval the background should be updated when considering a case with a real time video [2].

Two-frame difference, the objective of the approach is to detect the moving objects from the difference between the existing frame and the reference frame [3]. The frame difference method is the method of motion detection. This method adopts pixel-based difference to find the moving object. The first frame is captured through the continuous video and converted into grayscale image and then sequence of frames is captured at regular intervals, and converted into grayscale images. The absolute difference is calculated between the consecutive frames and the difference image is stored. The difference image is translated into binary images [4], by optimal threshold. The advantage of this technique, it can resist the interference of light to some extent when compared with the basic background subtraction technique.

In this paper, implementation of moving object detection is experimented using a video of '.avi' format, of resolution of 320x240, is applied as the input and simulation is done in Matlab. A simple constant background and complex background videos are given as input video, with the 320x240 resolution, to a PC with a 2.6 GHz processor having 2GB RAM and Matlab 2013a version.

The input RGB video is converted into grayscale because the context of computing comprises only two intensity values of the color image i.e. '0' & '1').

And also, basically background subtraction technique needs a stable background which is very complicated to extract in real time applications. Based on this, frame difference method is found to be better than background subtraction while considering implementation as a parameter.

The Experimental results of the same input video is obtained from two techniques, comparison is done in regards with PSNR.

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II. MOVING OBJECT DETECTION

A. Moving Object Detection based on the Background Subtraction Algorithm:

Background subtraction is a basic technique to detect a moving object in a video sequence. In this, a background frame is fixed and always compare with the input frame. Practically to detect a moving object using this method consider two frames, namely Background frame and Current frame [5]. Background frame is recorded during the installations and every frame is subtracted from the background frame. The resultant image is termed as difference image (Diff_image), as stated in equation 1 [6]. Apply optimal threshold value to the obtained difference image. This is the binary threshold for the image, if the pixel value of the difference image is greater than or equal to threshold, then it would be considered as a Foreground Pixel (Binary '1' would be assigned for the foreground element), otherwise as a Background Pixel (Binary '0' would be assigned for the background element), as in equation2, thereby detecting a moving object.

Diff_image = |(Current_frame) – (Background_frame)| (1)


(2)

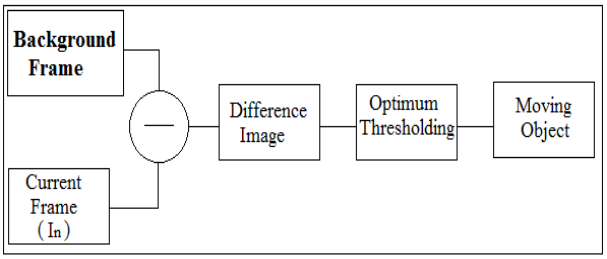

Figure1: Background Subtraction Method

Algorithm:

- Read the input Video.
- Start reading the frames and consider first frame image as background image and convert it to Gray Image format.
- Determine the size of the video.
- Read the consecutive frames in the looping mode.
- Declare the Optimal threshold value.
- Determine the absolute difference between the Background image and the current frame.
- If the difference in the pixel value is greater than the threshold level, then consider it as a Foreground Content (assign value '1' for white), else Background Content (assign value '0' for black).

B. Moving Object Detection Based on Two Frame Difference Method Algorithm:

The two frame difference is also referred to as the Inter frame difference; moreover it as also called as the Basic frame difference method. To detect moving object, consider two consecutive frames, for instance current frame and previous frame, extracted from the continuous video sequence [7].

Firstly, calculate the absolute difference between the two frames, which is given by the equation3, is referred to as the difference image. Now, apply optimal threshold value to the difference image. This threshold value is the binary threshold for the image [8]. If the pixel value of the difference image is greater than or equal to threshold, then it would be considered as a Foreground Pixel, Region of Interest (Binary '1' would be assigned for the foreground element), otherwise as a Background Pixel (Binary '0' would be assigned for the background element), as in equation4, thereby detecting a moving object.

Diff_image = |(Current_frame) – (Previous_frame)| | (3)

$$\text{Re}\,gion\_of\_Interest = \begin{cases} 1(\ if\ |Diff\_image| \geq threshold\ ) \\ 0(\ else\ ) \end{cases} \quad (4)$$

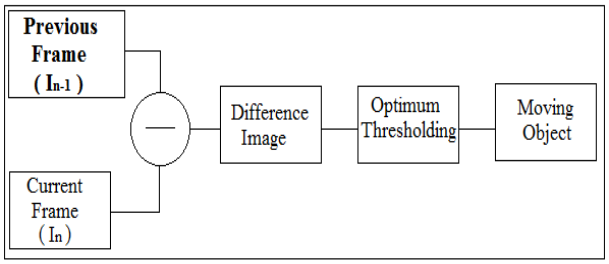

Figure2: Frame Difference Method

Algorithm:

- Read the input Video.
- Start reading the frames, read the first image and convert the first image to Gray Image format.
- Determine the size of the video.
- Now, start reading the consecutive frames in the looping mode.
- Declare the Optimal threshold value.
- Find the absolute difference between two consecutive frames.
- If the difference in the pixel value is greater than the threshold level, then consider it as a Foreground Content (assign value as 1 for white), else as Background Content (assign value as 0 for black).

III. EXPERIMENTAL OUTPUTS

A. Moving Object detection (Complex Background):

The two figures show the comparison of the outputs of the two approaches in different background conditions (simple & complex). It can be observed from figure3, when in complex background, the two frame difference technique detects region of the object more than the basic background detection approach. In figure4, the simple background conditions were considered.

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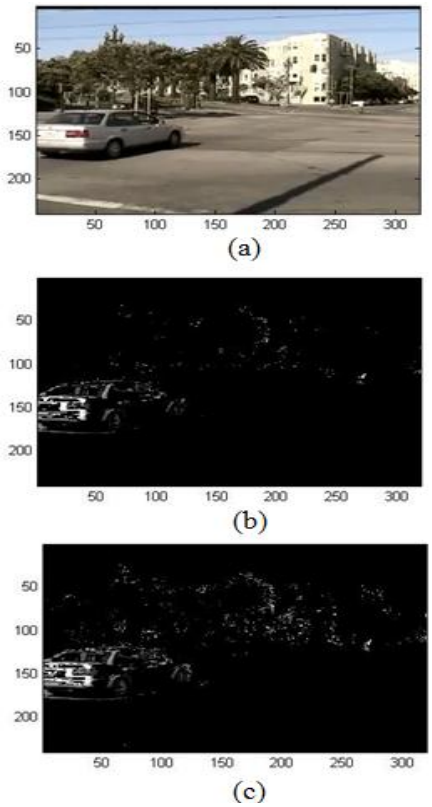

Figure3:(a)Original frame, (b)Background Subtraction method, (c) frame Difference method

B. Moving Object detection (Simple Background):

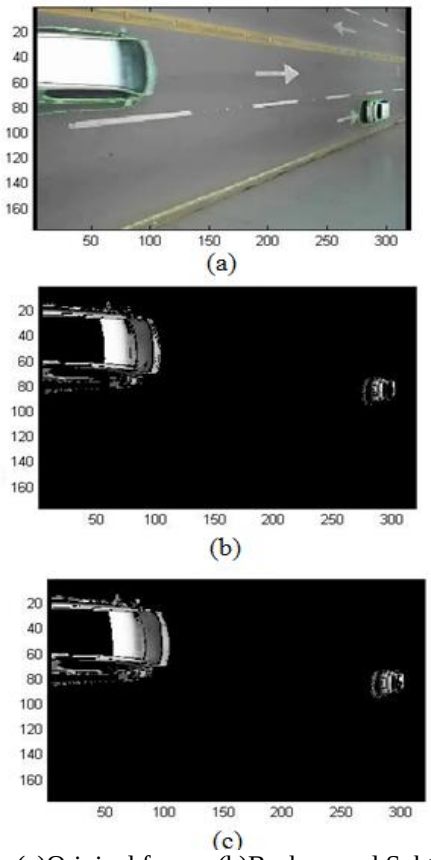

Figure4: (a)Original frame, (b)Background Subtraction method, (c) frame Difference method

Based on the outputs of the Background subtraction and frame difference techniques, PSNR values are calculated and tabulated in the table1:

TABLE1: COMPARISON OF PSNR VALUES OF BACKGROUND SUBTRACTION & FRAME DIFFERENCE METHOD

Type of Video	Threshold	PSNR (Background Subtraction)	PSNR (Frame Difference)
simple	30	72.70362	72.71131
simple	25	72.82180	72.83087
simple	20	72.90729	72.91606
complex	30	72.63986	72.64427
complex	25	72.69787	72.70131
complex	20	72.76551	72.77683

IV. CONCLUSIONS

In this paper, a moving object has been detected in a video sequence based on two different frames of the video sequence. It can be observed from the experimental results, that two frame difference techniques is more efficient than the background technique, in detecting moving object. Another advantage of this technique is that it also detects objects efficiently in complex backgrounds where there is slight movement in the background. The PSNR value of frame difference is 72.83087, while background subtraction is 72.82180, at the same threshold (threshold=20). Though by a small difference frame difference is better in detecting region interest of the object than background subtraction. Also, frame difference is easier to implement than background subtraction, Background subtraction method has an issue, when considering complicated real time videos.

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