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Moving Object Detection from Surveillance Videos Using Background Subtraction

Dhanashri Tambe[1], Prof. Raskar V.B. [2,]

ME Student, Department of Electronics & Telecommunication , JSPM'S Imperial College of Engineering & Research (Wagholi), Pune, Maharashtra, India[1]

Professor, Department of Electronics & Telecommunication, JSPM'S Imperial College of Engineering & Research (Wagholi), Pune, Maharashtra, India[2]

ABSTRACT: Detection of moving objects in video sequences is the prime step of information extraction. Background subtraction is one of the method used in video surveillance system for detecting the moving objects from video. In this proposed system a simple method of background subtraction using frame differencing is implemented. The first frame of the video is considered as a reference or background frame. The foreground or the moving objects are extracted by subtracting the next consecutive frames from the background frame. The results are tested on various video sequences which proved that the method is the simplest & accurate.

KEYWORDS: moving objects, background subtraction, frame differencing

I. INTRODUCTION

Now a days Video surveillance is widely used all over the world for its applications in areas such as traffic monitoring & control, crime prevention, medical care, public security etc. As there is a rapid growth in the captured videos, the manual operations on surveillance videos are somewhat difficult. Automatic operations such as object detection, tracking, monitoring & controlling has become significant research areas of machine vision. Background subtraction is a common method in image processing and computer vision. Background subtraction means Foreground Detection, in which the foreground of the image is extracted for further processing. Usually a region of interest (ROI) of any image can be various objects like humans, phones, texts, etc. which are present in foreground. Background subtraction treats moving objects as foreground part and everything else as background. The goal of background subtraction is to distinct the foreground from the background.

The difficult problems for the accuracy of result of background subtraction are because of the diversity in background scenes such as, dynamic background, lighting changes, occlusions, shadows, cluttered background, environmental conditions such as snow fall, rain, change in sunlight etc. The other problem is changes originated from the camera itself such as camera jitter, auto-iris, sensor noise etc. There are many methods for background subtraction with different strengths and weaknesses in terms of simplicity, accuracy, computational requirements & performance. In the proposed system a simple method of background subtraction using frame differencing is used, where the first frame of video sequence is considered as a background or reference frame & the foreground is extracted by subtracting the consecutive frames from background frame.

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II. LITERATURE REVIEW

After studying different IEEE papers, I have collected some related papers and documents. Some of the points are discussed here:

1. **Yuanyuan Wu & other, "Moving Objects Detection with Freely Moving Camera via Background Motion Subtraction , IEEE Transaction On Circuits & systems for video Technology, 2015.**
   Today in computer vision, recognition of moving objects in a video taken by a freely moving camera is a challenging task. Instead of the conventional approaches which assumes that the background can be approximated by dominant single plane/multiple planes, this system propose a computationally effective algorithm that can identify moving objects exactly and robustly in a general 3D scene. In this work they have performed reduced singular value decomposition (RSVD) on block of particle trajectories to extract coarse foreground region. From the extracted coarse foreground region the background motion of pixels are restored by a fast inpainting technique. For solving the problem of various moving objects situations, an adaptive thresholding method is used to segment the fine foreground. Lastly the mean-shift segmentation method is used for further refinement of detected foreground. Experimental results shows the effectiveness of the proposed method.

2. **C. Stauffer and W.E.L. Grimson, "Adaptive Background mixture Models for Real-time Tracking"**
   This paper has presented a novel, probabilistic method for background subtraction. This paper discusses modeling each pixel as a mixture of Gaussians and using an on-line approximation to update the model. The Gaussian distributions of the adaptive mixture model are then evaluated to determine which are most likely to result from a background process. Each pixel misclassified based on whether the Gaussian distribution which represents it most effectively is considered part of the background model. They have implemented a real time approximate method which is stable & robust. This method deals with slow lighting changes, multi-modal distributions caused by shadows etc. This system has been successfully used to track people in indoor environments, fish in a tank & remote control vehicles in lab setting. All these situations involved different cameras, different lighting & different objects being tracked.

3. **Sherin Cherian & others, "Implementation of Real Time Moving Object Detection using background subtraction in FPGA**
   For the detection of moving objects from the video sequence background subtraction is mostly used method in surveillance videos. In this method the current input frame is compared with reference frame for extracting foreground from the background. They have implemented a system for the detection of moving objects based on FPGA. The real time video is taken by VmodCAM. The experimental results shows that the detection of moving objects is done in a very fast manner & the output of background subtraction is good even if camera is in motion. Illumination variation is the main challenge for the proposed method.

4. **Bingshu Wang & others, "Background Subtraction Using Dual- Class backgrounds", International Conference on Control, Automation, Robotics & Vision. 2016.**
   The proposed background subtraction method uses both candidate background & working background. According to adaptive mechanism both of these can be transferred to each other. For detection of the foreground objects the input video frame is compared & evaluated with dual class backgrounds. A background updating method is implemented for robust background modeling that is based on life-value. The existing time of background sample is represented by this life-value. The number of valid visits of a background sample are given by access-time. The experimental results shows that the proposed approach is robust & effective than the conventional methods.

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III. METHODS OF BACKGROUND SUBSTRACTION

Background subtraction, also known as Foreground Detection, which is a technique of foreground extraction from the video sequence for further processing. Various methods of background subtraction are discussed in this section.

1. Background Subtraction Using Frame Differencing:

It is particularly a commonly used technique. It will detect moving regions by subtracting the current image pixel-by-pixel from a reference background image that is created by averaging images over time in an initialization period.

2. Median Filtering:

It is the commonly used background subtraction method. In this method previous N frames of video are buffered & then the median of buffered frames is calculated to find the background. If pixel of current frame is greater than background pixel, then background pixel is incremented by one & vice versa. Thus the background eventually converges to an estimate where half of pixels are less than background & half of pixels are greater than background. The benefits of this method are simple construction, very fast process and easy to use. The drawback is the accuracy & dependent speed of target.

3. Gaussian Mixture Model:

In this method each pixel from the frame is modeled into Gaussian Distribution. Initially all the pixels are divided by their intensity in RGB color space. Then the probability of every pixel is calculated to decide whether to include it in foreground or in background. For each Gaussian if it is bigger than the designated threshold, it is considered as a background & remaining all distributions are considered as a foreground

IV. PROPOSED METHOD

The proposed method uses the frame differencing method for background subtraction. The basic idea of background subtraction method is to initialize a background firstly where no suspicious object is present, and then by subtracting current frame in which the moving object present that current frame is subtracted with background frame to detect moving object. This method is simple and easy to realize, and accurately extracts the characteristics of target data, but it is sensitive to the change of external environment, so it is applicable to the condition that the background is known. The method of Background Subtraction Using Frame Differencing is implemented by taking an image as background and take the frames obtained at the time t, denoted by I(t) to compare with the background image denoted by B. Here using simple arithmetic calculations, we can segment out the objects simply by using image subtraction technique of computer vision meaning for each pixels in I(t), take the pixel value denoted by P[I(t)] and subtract it with the corresponding pixels at the same position on the background image denoted as P[B]. In mathematical equation, it is written as:

$$P\,[F(t)] = P\,[I(t)] - p\,[B]$$

The background is assumed to be the frame at time *t*. This difference image would only show some intensity for the pixel locations which have changed in the two frames. Though we have seemingly removed the background, this approach will only work for cases where all foreground pixels are moving and all background pixels are static A threshold "Threshold" is put on this difference image to improve the subtraction.

$$[P\,[F(t)] - P\,[F(t+1)]\,] > \text{Threshold}$$

This means that the difference image's pixels' intensities are 'thresholded' or filtered on the basis of value of Threshold. The accuracy of this approach is dependent on speed of movement in the scene. Faster movements may require higher thresholds.

Figure 1 shows the actual process of background subtraction, where the reference frame is subtracted from current frame to get the moving foreground.

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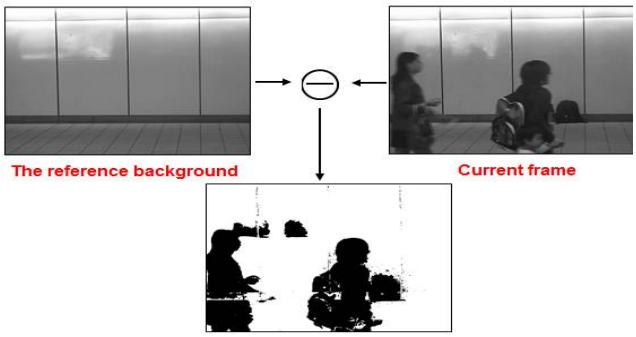

Fig. 1 Process of Background Subtraction using frame differencing

V. EXPERIMENTAL RESULTS

The results are tested on various video sequences. Here the result is shown for the video of suspicious object detection from CCTV. Initially the video is converted into number of frames. The first frame with plane background ie. Without any moving object is considered as the background or reference frame. Then every successive frame is subtracted from the reference frame to extract the moving foreground. The results are shown in fig.2 & fig.3

Fig 2: Background Image without moving Object

Fig 3: Human with moving object (Foreground Extraction)

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VI. CONCLUSION

In this proposed system, the technique of background subtraction using frame differencing is implemented. The video for moving objection is divided into number of frames. The first frame without any moving object is considered as background frame. Then every next frame is subtracted from the background frame & the moving object or the foreground is separated from the background. From the results obtained, it is clear that the method of frame differencing for background subtraction is simple, accurate & with less computations as compared to other methods.

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