Object Motion Detection and Tracking for Video Surveillance

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Abstract— *An Automated Video Surveillance system is used to monitor security at sensitive areas such as banks, highways, crowded public places, borders, forest and traffic monitoring areas. The system we develop aims at detecting and tracking a moving object. The making of video surveillance systems "smart" requires fast, reliable and robust algorithms for moving object detection and tracking. The algorithm includes background subtraction in the image sequences thus detecting the moving objects in the foreground. The task of object detection in surveillance video first is the background subtraction and the second one is the Foreground mask sampling. This paper proposes the use of cascade classifier for object detection.*

Keywords--- *Motion detection, Background subtraction, opencv, Cascade classifier.*

1.Introduction

Today with the increasing advancement in technology, a growing concern for safety and security is arising everywhere. To address this concern, the numbers of surveillance cameras have increased in the recent past. Data collected is nevertheless difficult to store and monitor manually on a continual basis. There are several approaches to do this job without human intervention. The underlying principle of all these methods is detection, segmentation and tracking objects in the live video. The steps involved are

- Object Detection: To detect and identify suitable objects in the Video.
- Object Classification: Based on their size and shape objects are classified into birds, buildings, trees, vehicles etc
- Object Tracking: Tracking involves figuring out the path followed by the vehicle as it moves. This is a very challenging step as the noise, object occlusions and their complex structures are also taken into account.

OpenCV (Xianghua Fan, 2012), is an open source library for image processing and Computer vision applications, is having the predefined library of various Back ground subtraction methods (Piccardi.M, 2004). So we choose OpenCV with Microsoft Visual Studio is as the development platform.

A. Motivation and present state of research

The various methods today being used for video processing are Frame differencing, Optical flow and Background subtraction. To detect the moving objects the Frame differencing method uses subtraction of successive frames [1].This approach is straightforward to implement and easily adaptable to dynamic environments, but it cannot always extract the complete edges of the object. Another popular technique is the optical flow method [2]. This method has two steps. First finding the image optical flow and then performing clustering process with the obtained optical flow characteristics. It performs accurately well in the detection process but the downside is the increased number of computations.

The third method is background subtraction [3]. The principle used in background subtraction algorithm is to model a background and compare it with the current frame to detect objects i.e., zones where significant changes occur [4] [5]. Thus the background subtraction algorithm separates the moving objects i.e., the foreground part from the static part of the frame i.e., the background.

There are two forms of background subtraction method, the recursive and non recursive. The recursive method is more of a direct approach which does not depend upon temporary storage buffers but recursively models a background with the current frame. Few examples include adaptive background, approximate median and Gaussian mixtures. The non recursive method [6] uses a buffer to model the background taking the past frames using the variation of pixels inside the buffer. This method is highly adaptive.

The extracted moving region from the video sequence is classified into different objects like trees, birds and humans etc. Classifiers for objects are based on Shape, Motion, Color and Texture [7].

B. Proposed Video Surveillance System

This paper presents a novel combination of an Adaptive background Modeling system and the cascade classifiers based object detection system for application in video surveillance. The surveillance system presented in this paper can detect and track moving objects in a video sequence, and is resilient against temporal illumination changes. The system also adapts itself to long lasting changes in the background over time. Surveillance (ODS) System. A brief overview of the system is given in Fig. 1.

The foreground is extracted from the video scene by learning a statistical model of the background, and subtracting it from the original frame. The background model learns only the stationary parts of the scene and ignores the moving foreground. The system uses the Gaussian Mixture Model for modeling the background adaptively. Hence the motion regions are identified in the frame, which constitute the regions of interest (ROI) for our ODS system. The ROI might consist of a human figure, an animal or even a vehicle.

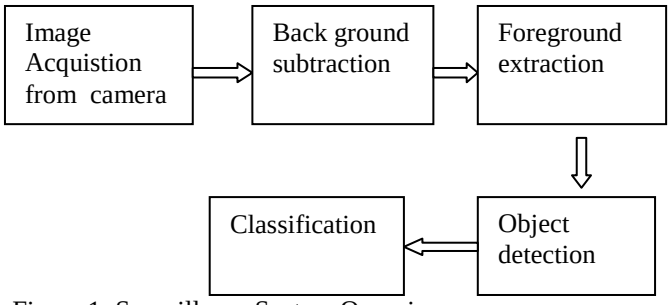

Figure 1: Surveillance System Overview

2. Motion Detection Methods

The video surveillance has long been in use for monitoring security sensitive areas for examples banks, department stores, traffic monitoring on highway, public places which are crowded. Due to the advanced technology the large capability of storage devices are available. The motion detection methods are classified according to the method of finding moving object. Different motion detection methods are described as follows:

Frame differencing: The Frame differencing method uses the two or three adjacent frame based on time series image to subtract and gets difference images, its working is very similar to background subtraction after the subtraction of image it gives moving target information through the threshold value. This method is simple and easy to implement, and also it is similar to the background subtraction. But this method is highly adaptive to dynamic scene changes, however, it generally fails in detecting whole relevant pixels of some types of moving objects. Additional methods need to be adopted in order to detect stopped objects for the success of higher level are computationally complex and cannot be used real-time without specialized hardware.

The basic principle in the background subtraction technique is separating the estimated image from the observed image. The observed image is modeled as the background while the estimated image contains suitable objects known as foreground. This foreground process divides the image into two complementary sets of pixels, a foreground containing suitable objects and a background containing static area.

There are certain criteria which every detection algorithm must fulfill. Any background detection algorithm must adapt itself to sudden changes like illumination changes, motion changes, high frequency objects and their geometry especially while catering to outdoor surveillance scenes[8]. These include unfamiliar changes in light intensity, camera oscillations, objects like trees and parked vehicles. Most challenging applications require the algorithms to be implemented and incorporated in the camera itself to reduce the computational load later on.

Let Image be represented as F(x,y,t) and Background as K(x,y,t) at time t. Using Frame Differencing method, background frame is represented as

$$K(x,y,t) = F(x,y,t-1) \quad (1)$$

The background can thus be estimated if

$$|F(x,y,t)-F(x,y,t-1)| > Thr \quad (2)$$

Median filter uses the median of n previous frames as the background model

$$K(x,y,t) = median\{F(x,y,t-i)\}$$

$$|F(x,y,t) - median\{F(x,y,t-i)\}| > Thr \quad (3)$$ Where i = {0,1…n-1}

2) Background subtraction: it is particularly a commonly used technique for motion segmentation in static images. 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. The basic idea of background subtraction method is to initialize a background firstly, 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.

Background subtraction methods operate on pixels independently. One such method described in [9] advocates that neighboring pixels of background models must remain constant or show similar variations over time. This theory holds good as long as the pixels neighboring to each other belong to a single background object. For different background objects it poses a difficult task for pixels distributed in their borders. All the pixels are divided into groups first of N ×N blocks and every block is processed as a N^2 component vector. Principal Component Analysis (PCA) model is computed for each block by collecting few samples over time [10]. Pixels are then classified based on the threshold difference between current image and backspace projection of its PCA coefficients as either background or foreground. Independent Component Analysis (ICA) is similar to the above approach and is described in [11]. This method uses a demixing vector and compares it with a new image to separate foreground from background image taken as reference. This method is proved to be robust to indoor illumination changes.

3) Optical flow: The optical flow method uses the motion target of the vector characteristics which changed with time to detect motion area in image sequences. It gives better performance under the moving camera, but this algorithm is very complex and complicated computation and also it needs special hardware support, so it is difficult to meet the requirements of real-time video processing.

Artificial neural networks [12] are also seen to be used by background models to learn its motion patterns through self organization. Compressive sensing techniques based Background subtraction algorithms are also seen to be actively used in areas concerning to medicine [13]. This framework allows background to be represented in compressed form. This method detects object without the need for image reconstruction and allowing the foreground objects to occupy a small portion in front of the camera for correct detection. Evolving from this technique, sparse recovery problem is formulated [14] where each color channels in the video, which is modeled independently as a linear combination of the same color channel for different

video frames. Each color channel's scaling is found separately maintaining the general structure of the frame composition thus making it highly adaptive to illumination changes.

3. Cascade Classifier

Haar-like features have scalar values that represent differences in average intensities between two rectangular regions. They capture the intensity gradient at different locations, spatial frequencies and directions by changing the position, size, shape and arrangement of rectangular regions exhaustively according to the base resolution of the detector. The Haar basis functions are a set of rectangular 2D features derived from the Haar wavelet sets. Haar-feature said to be present if subtracting the average dark-region pixel value from average light-region pixel value is above a threshold (set during learning). Ada-Boost combines many weak classifiers to create one strong classifier. Object detection via Haar-like Features with Cascade of Boosted Classifiers.

4. Experimental results

In this experiment we use the background subtraction algorithm for the detection of the moving object in the surveillance area. The demonstration system has the set up for the implementation of proposed system in the opencv software.

Here the reference image is initialized in the code and then the subtraction of the current frame is done. And after the subtraction of the both frame the subtracted image is display on the screen. The following figure shows the reference image, current image and the subtracted image. The subtracted image shows the moving object in the white colour and the background is black. The video frames gets subtracted from the reference image. The reference image is nothing but the background image in which the object is not present

This image is referred as background image because there is no any moving object. In the real time extraction the background image processing approach is used to provide the most complete feature dataset, but it is extremely sensitive to dynamic scene changes due to lighting and extraneous events. Background image is not fixed and it must adapt to motion changes like tree branch move, changes in background because of objects entering in a scene, stay for longer period without motion .object detected and classify.

Fig.2. a. original image b. motion segment c. output image

5. Conclusion

The application provides efficient "Object motion Detection". For this to happen the algorithm involved includes background subtraction of the video and foreground detection of objects. The system finds its applications where real time surveillance is required such as bank ,traffic monitoring , forest etc. This project proposes the sampling by calculating the intersection of a number of background-subtracted frames which are sampled over a period of time. The paper aims at tracking an object motion.

6. References

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