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Multiple persons tracking and counting in surveillance videos

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Abstract— **This work describes a method for accurately tracking persons in indoor surveillance video stream obtained from a static camera with difficult scene properties including illumination changes. First, moving objects are precisely extracted by determining its motion, for further processing. The scene illumination changes are averaged to obtain the accurate moving object during background subtraction process. The paper proposes an efficient motion detection and object velocity determination based on background subtraction using dynamic threshold and morphological process .In dynamic threshold based object detection, morphological process and filtering also used effectively for unwanted pixel removal from the background. Then object is tracked by plotting a rectangular bounding box around it in each frame. Based on the rectangular boxes persons counting is possible. The velocity of the object is determined by calculating the distance that the object moved in a sequence of frames with respect to the frame rate that the video is recorded. The algorithms developed can also be used for other applications (real time, object classification, etc.). The method is able to identify moving persons, track them and provide unique tag for the tracked persons. The effectiveness of the proposed method is demonstrated with experiments in an indoor environment.**

Index Terms—**counting, Motion detection, object tracking, velocity determination, Video surveillance.**

I. INTRODUCTION

Moving Objects Detection and tracking are widely used low-level tasks in many computer vision applications, like surveillance, monitoring, robot technology, gesture recognition, object recognition etc. Many approaches have been proposed for moving object detection and tracking from videos, mainly dedicated to traffic monitoring and visual surveillance.

Although the exact requirements vary between surveillance systems, there are issues that are common to all. Usually, an operator is interested only in certain objects in the scene. For instance, in surveillance of a public area, one may be interested only in monitoring the people within it rather than the entire scene

In general motion detection algorithms are classified broadly into two main categories: feature based and optical flow based. Our approach is feature based. Detection of moving objects in video streams is the first stage in any automated video surveillance. Aside from the intrinsic usefulness of being able to segment video streams into moving and background components, detecting moving blobs provides a focus of attention for recognition, classification, and activity analysis, making these later processes more efficient since only "foreground" pixels need be considered. Tracking aims to describe trajectories of moving objects during time. The main problem to solve for tracking is to find correspondences of the same physical objects in different frames.

II. RELEVENT WORK

We survey the techniques and method relevant to object tracking, specifically approaches that perform feature based tracking and handle occlusions. For accurate tracking, the motion must be accurately detected using suitable methods, but they are affected by a number of practical problems such as shadow and lighting change over time. Many researchers have given their contributions to Motion based object detection and tracking under both indoor and outdoor scenes and provide solutions to the above mentioned problems.

A. Generalized Stauffer–Grimson background subtraction for dynamic scenes:

We propose an adaptive model for backgrounds containing significant stochastic motion (e.g. water). The new model is based on a generalization of the Stauffer–Grimson background model, where each mixture component is modeled as a dynamic texture. We derive an online K-means algorithm for updating the parameters using a set test2 of sufficient statistics of the model. Finally, we report on experimental results, which show that the proposed background model both quantitatively and qualitatively outperforms state-of-the-art methods in scenes containing significant background motions.

B. Tracking and Counting People in Visual Surveillance Systems:

In this work, we present a scheme to automatically track and count people in a surveillance system. First, a dynamic background subtraction module is employed to model light variation and then to determine pedestrian objects from a static scene. To identify foreground objects as characters, positions and sizes of foreground regions are treated as decision features. Moreover, the performance to track individuals is improved by using the modified overlap

tracker, which investigates the centroid distance between Neighbouring objects to help on target tracking in occlusion states of merging and splitting.

On the experiments of tracking and counting people in three video sequences, the results exhibit that the proposed scheme can improve the averaged detection ratio about 10% as compared to the conventional work.

C. Real-Time Human Motion Detection and Tracking:

This paper describes a real-time system for human detection, tracking and motion Analysis. The system is an automated video surveillance system for detecting and monitoring people in both indoor and outdoor environments. Detection and tracking are achieved through several steps: First, we design a robust, adaptive background model that can deal with lightning changes, long term changes in the scene and objects occlusions. This model is used to get foreground pixels using the background subtraction method. Afterwards, noise cleaning and object detection are applied, followed by human modeling to recognize and monitor human activity in the scene such as human walking or running.

D. Tracking:

R. Cucchiara et al. proposed Sakbot system which is a robust and efficient detection technique based on Statistical and knowledge-based and use HSV colour information for shadow suppression. This method is capable to deal with luminance condition changes. The mixture of Gaussians is a popular and promising technique to estimate illumination changes and small movement in the background. Tracking process consists of establishing the correspondence between consecutive frames using pixels, points, lines or blobs. In the early generation, C. Wren et al. proposed P finder method which tracks the single entire human body in the scene without occlusion. This method modelled pixel colour disparity using multivariate Gaussian.

III. PROPOSED METHODOLOGY

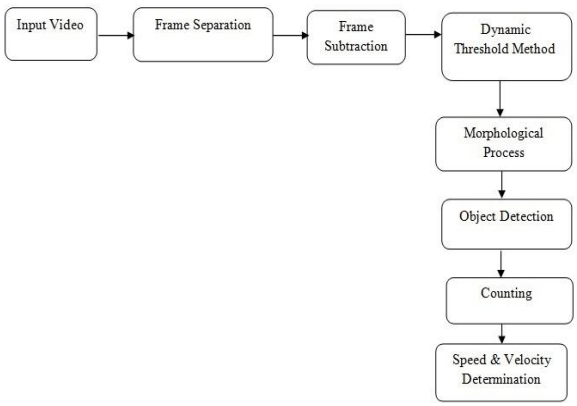

Figure 1: Block Diagram

Our algorithm aims to assign consistent identifier to each object appears in scene when individual merge into or split from the group and involves several methods to obtain the lowest possibility of false tracking and tagging. In tracking interested object (human), shadows affect the performance of tracking and leads to false tagging. Firstly, video captured from a camera and then video is converted into frames for processing the moving object detection and counting.

The background subtraction method is the common method of motion detection. It is a technique that uses the difference of the current image and the background image\ to detect the motion region. Its calculation is simple and easy to implement. Background subtraction delineates the foreground from background in the images.

$$D_k(x,y) = \begin{cases} 1 & if\ |F_k(x,y) - B_{k-1}(x,y)| > T \\ 0 & otherwise \end{cases} \rightarrow (1)$$

Where Dk(x,y) is the resultant difference, Fk(x,y) is the current frame and Bk-1(x,y) is the background Initialized frame and T is the threshold which suppress shadow depending on the value assigned.

There are many ways to initial background image. For example, with the first frame as the background directly, or the average pixel brightness of the first few frames as the background or using a background image sequences without the prospect of moving objects to estimate the background model parameters and so on depending on the application. Among these we prefer the image sequence having no objects as background image since we use indoor videos (has less illumination change). The drastic changes in pixel's intensity indicate that the pixel is in motion.

The background subtraction step generates a binary image containing black (represents background) and white (moving pixels). Then a post processing step is applied on the binary image to label groups motion pixels as motion blobs using connected component analysis. The key idea of connected component analysis is to attach the adjacent foreground's pixel (i.e. white pixels) in order to construct a region. Connected component labelling is used in computer vision to detect connected regions in binary digital images. Blobs may be counted, filtered, and tracked.

Accuracy in motion detection is important for efficient tracking. The threshold should be set in such a way to avoid shadow to a greater extent also the blob size should be maintained properly and it depends on the application.

Morphological operations are applied on segmented binary image for smoothening the foreground region. It processes the image based on shapes and it performs on image using structuring element. The structuring elements will be created with specified shapes (disk, line, square) which contains 1's and 0's value where ones are represents the neighbourhood pixels. Dilation and erosion process will be used to enhance (smoothening)the object region by removing the unwanted pixels from outside region of foreground object. After this process, the pixels are applied

for connected component analysis and then analysis the object region for counting the objects These morphological operations are performed on images based on shapes. It is formed by structuring element. It is a matrix containing 1's and 0's where 1's are called neighbourhood pixels.

The output pixel is determined by using these processing pixel neighbours. Here, the 'line' structuring element is used to dilate and erode the image for tumor extraction. Dilation: It is the process of adding a pixel at object boundary based on structuring element. The rule to find output pixel is the maximum of input pixels neighborhoods matrix. Erosion : It is to remove the pixel from the object boundary depends on structuring element. The rule to find output pixel is the maximum of input pixels neighborhoods matrix. The Clustering Process is useful to partitioning the image into different sub regions in which one cluster contains the sufficient information about the foreground object. person tracking is done based on then rectangular boxes in red, green and blue color. based on these rectangular boxes persons counting is possible.

The parameters can be evaluated by the following formulas.

Speed :
The speed of object will be determined by ratio between distance travelled by object and total travel duration.
Speed = Distance travelled / Time
Velocity :
The velocity of object is evaluated based on distance travelled by an object and frame rate
Velocity = Distance travelled / Frame rate

IV. RESULTS AND DISCUSSIONS

The experiment was implemented in MATLAB Version 7.12.0.635 (R2011a). In GUI script the program was running in GUI script first of all we create push buttons for experiment. We take push button as input video, frames, motion detection, parameters, clear and close buttons. Next we take two axes for displaying the input video, background subtraction, morphological filtering. Next we take four static texts for display the frame number, count and the parameters speed and velocity.

After creating the push buttons, axes , static text, control panel, button group the following fig. exist.

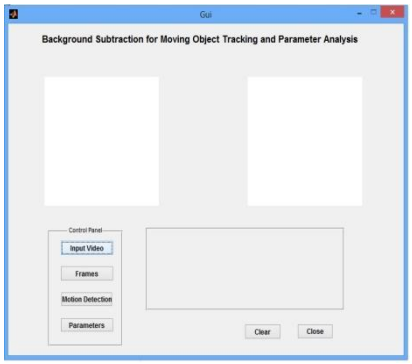

Figure 2: Gui formation

If we click push button input video, then the program will ask 'select an input video'.

Then we select an input video the following fig will exist.

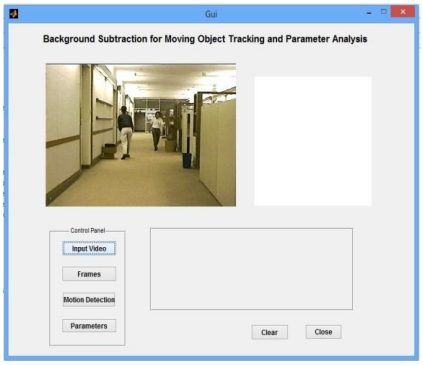

Figure 3: Input video taken.

The next step is input video is converted into frames. By clicking the frame button the following results will come. It is a time taken process so we use 'please wait' for processing.

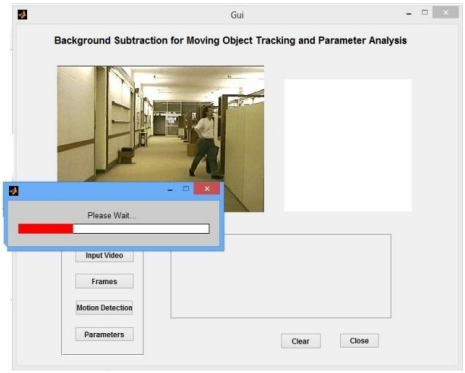

Figure 4: Frames convertion

The next step is background subtraction process. It is used to differentiate the fore ground frame and the back ground frame by dynamic threshold method. Then morphological filtering is used to remove the noise in back ground

subtraction process. The following figure will exist if we click the motion detection button.

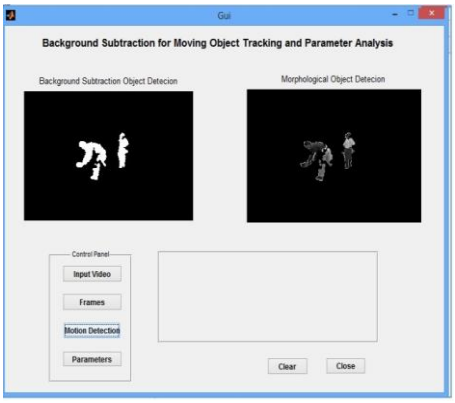

Figure 5: Background substraction and morphological object detection.

The next step is to track the person by comparing frame by frame using rectangular boxes. based on these rectangular boxes persons counting is possible.

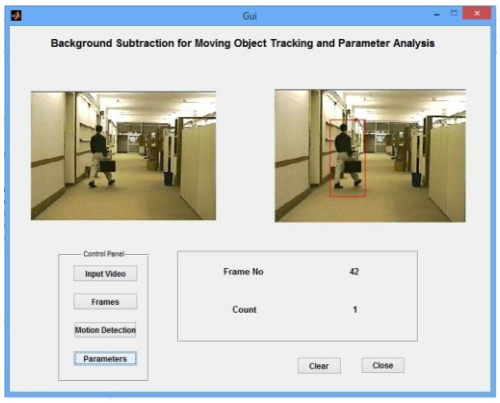

Figure 6: Counting the persons in frame 42

Figure 7: Counting the persons in frame 100

The parameters (Speed and Velocity) can be displayed in the following figure.

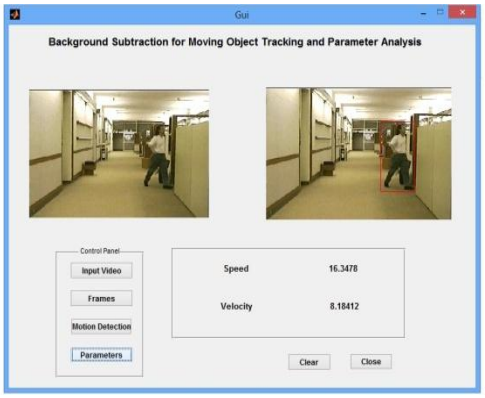

Figure 8: Calculation of speed and velocity.

V. APPLICATIONS:

- Video surveillance:-

Surveillance is very useful to governments and law enforcement to maintain social control, recognize and monitor threats, and prevent/investigate criminal activity.

- Object detection:-

Well-researched domains of object detection include face detection and pedestrian detection. Object detection has applications in many areas of computer vision, including image retrieval and video surveillance.

- People counting:-

A people counter is a device used to measure the number and direction of people traversing a certain passage or entrance per unit time.

VI. CONCLUSION

The paper presented multiple persons tracking and counting based on background subtraction using threshold process and morphological process. In this method, morphological process and filtering also used effectively for unwanted pixel removal from the background. The labelling process effectively used for counting objects. The velocity of the object is determined by calculating the distance that the object moved in a sequence of frames with respect to the frame rate. Finally the object detection and tracking with parameters count, speed and velocity were determined and analyzed.

VII. REFERENCES

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