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ROBUST APPROACH FOR OBJECT TRACKING VIA COLLABORATIVE OBSERVATION MODEL

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ABSTRACT

Object tracking aims to establish correspondence of objects and object parts between consecutive frames of video. It is a significant task in most of the surveillance applications since it provides cohesive temporal data about moving objects which are used both to enhance lower level processing such as motion segmentation and to enable higher level data extraction such as activity analysis and behavior recognition. In this paper a Robust approach for object tracking via Collaborative Observation model that integrates Pixel-Based Change Detection method and Pattern Classification based-Adaptive Background Update method is proposed. Proposed system effectively reduce tracking drifts problem and provide accurate and robust approach for tracking movements of objects from video.

Keywords- *Object detection, object tracking, background, Foreground.*

I. INTRODUCTION

Object tracking is an important task within the field of computer vision. The proliferation of high-powered computers, the availability of high quality and inexpensive video cameras, and the increasing need for automated video analysis has generated a great deal of interest in object tracking algorithms. There are three key steps in video analysis: detection of interesting moving objects, tracking of such objects from frame to frame, and analysis of object tracks to recognize their behavior. Object tracking has wide range of applications - some of which are surveillance, activity analysis, classification and recognition from motion and human-computer interfaces. The aim of object tracking and detection is to establish a correspondence between objects or object parts in consecutive frames and to extract temporal information about objects such as trajectory, posture, speed and direction [1].

The basic steps for tracking an object are object detection, object classification, object tracking**.** Object Detection is to identify objects of interest in the video sequence and to cluster pixels of these objects. Object detection can be done by various techniques such as frame differencing, Optical flow and Background subtraction**.** In object classification, object can be classified as vehicles, birds, floating clouds, swaying tree and other moving objects. The approaches to classify the objects are Shape-based classification, Motion-based classification, Color based classification and texture based classification. Object Tracking can be defined as the problem of approximating the path of an object in the image plane as it moves around a scene. The approaches to track the objects are point tracking, kernel tracking and silhouette. In point tracking, objects detected in consecutive frames are represented by points, and the association of the points is based on the previous object state which can include object position and motion. This approach requires an external mechanism to detect the objects in every frame. In kernel tracking, kernel refers to the object shape and appearance. For example, the kernel can be a rectangular template or an elliptical shape with an associated histogram. Objects are tracked by computing the motion of the kernel in consecutive frames. This motion is usually in the form of a parametric transformation such as translation, rotation, and affine. In Silhouette tracking, tracking is performed by estimating the object region in each frame. Silhouette tracking methods use the information encoded inside the object region [2].

Occlusion is one of the most challenging problems in object tracking. Due to large appearance changes caused by varying illumination, camera motion, occlusions, pose variation and shape deformation it is a challenging problem to develop a robust algorithm for complex and dynamic scenes. Online update schemes of tracking algorithms which are used to reflect appearance variations of the target object and the background causes tracking drifts especially when occlusion occurs. Frequent updates in tracking results may gradually result in drifts due to accumulated errors. In the existing system errors are likely to accumulate during update scheme and can cause tracking failure. While trackers based on holistic appearance models are able to track objects in many scenarios, they are less effective in handling drifts. The main reason is that these trackers typically focus on learning target appearance rather than the background. Not equipped to discriminate the foreground from the background, these trackers usually do not recover from drifts as a result of accumulated tracking error. Thus existing system cannot deal effectively with tracking drifts problem.

To address this problem, a Collaborative Observation model that integrates Pattern Classification method and Pixel-Based Change Detection method for robust object tracking is proposed. Pixel-Based Change Detection method will take binary images and gives pixel-wise changes in it to overcome the tracking drifts problem.

II. LITERATURE SURVEY

There is a rich literature in object tracking and feature extraction and change detection. Here we discuss the most related work.

Wei Zhong et al. [1] present a robust object tracking algorithm based on a sparse collaborative appearance model. Within the collaborative appearance model, author develops a sparse discriminative classifier (SDC) and sparse generative model (SGM) for object tracking.

In the SDC module, a classifier is used that separates the foreground object from the background based on holistic templates. The target object is represented by positive templates, background and images with part of target object are represented by negative templates. So system effectively deals with cluttered and complex background.

In the SGM module, a histogram-based method is presented that takes local appearance information of patches and occlusions into consideration. In this module, overlapped sliding windows are used on the normalized images to obtain collection of all patches and each patch is converted to a vector. Then the dictionary is generated with cluster centers of all the collected patches using the k-means algorithm and the sparse coefficient vector of each patch is normalized and concatenated to form a histogram. Histogram segments of occluded patches are not taken into account when computing the similarity between histograms of candidate and template histogram. SGM module effectively estimates and rejects the occluded patches to improve robustness.

David A. Ross et al. [2] present an appearance based tracker that incrementally learns a low dimensional subspace representation of target object for robust object tracking while target undergoes pose, illumination, appearance changes. Although it has been shown to perform well when target objects undergo lighting and pose variation, this method is less effective in handling heavy occlusion or non-rigid distortion as a result of the adopted holistic appearance model.

S. Avidan et al. [3] present an ensemble tracker that provides pixel based binary classification to differentiate between target and background. Ensemble tracker maintains an implicit representation of foreground and background using classifiers. Although this method is able to differentiate between target and background, the pixel-based representation is rather limited and thereby constrains its ability to handle heavy occlusion and clutter.

Mahebub Murshed et al. [5] present an Edge Segment based tracking algorithm that is used to identify moving objects in image sequence. In this algorithm, edge segment based on Canny edge map is used by utilizing the edge structure in the moving object region and curvature based features are used for moving edge registration. Although this method is able to track moving object or part of it effectively under varying illumination and partial occlusion, it cannot deal with full occlusion.

Mei and Ling [6] present a visual tracking algorithm based on a generative sparse representation of templates. In this method, the target candidate is represented as a linear combination of the learned template set composed of both target templates and the trivial template which has only one nonzero element. Liu *et al*. [7] propose an online robust and fast tracking algorithm using a two stage sparse optimization approach. This tracking method selects a sparse and discriminative set of features to improve efficiency and robustness. As the number of discriminative features is fixed, this method is less effective for object tracking in dynamic and complex scenes.

III. PROPOSED APPROACH

The proposed system consists of a collaborative observation model that integrates Pixel-Based Change Detection method and Pattern Classification-based Adaptive Background Update Method for Feature Extraction and Change Detection.

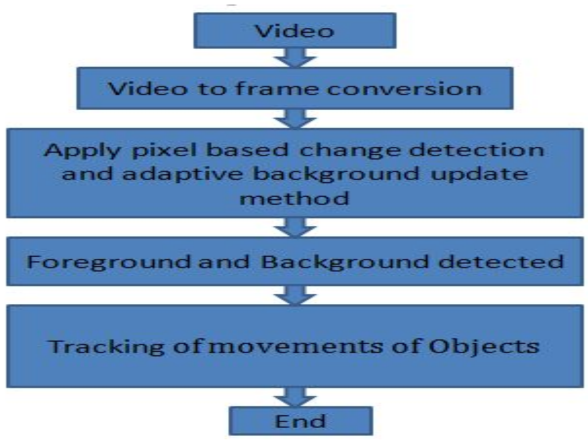

Fig .1 Flow of implementation

A. Collaborative Observation model:

In Collaborative Observation model, Pixel-wise Fuzzy XOR Operator and Pattern Classification-based Adaptive Background Update Method are used to obtain foreground and updated background. Collaborative Observation model is a robust approach for object tracking for drastic appearance changes and to overcome the tracking drifts problem.

Here video is converted into frames using video reader function in matlab. Video is taken as input and frames are obtained as output. For video data, file format refers to container format or codec. Video reader function is used to read the video files. It recognizes the container format such as avi, mpeg etc and access codec associated with particular file. Feature Extraction and Change Detection of two Input Images using Pixel-based change detection method is done. Here, Pixel-wise Fuzzy XOR Operator is used for change detection. In this method, the binary XOR operation is taken as a benchmark. Its fuzzy version is used for change detection. . Assume that we have two binary images (composed of only ones and zeros) and we want to detect the changed pixels in these. The change detection is done by XOR-ing the two binary images pixel-wise. This operation gives '0' for pixels having same value in both images, and gives '1' for pixels having different values. And detected changes will be the foreground image.

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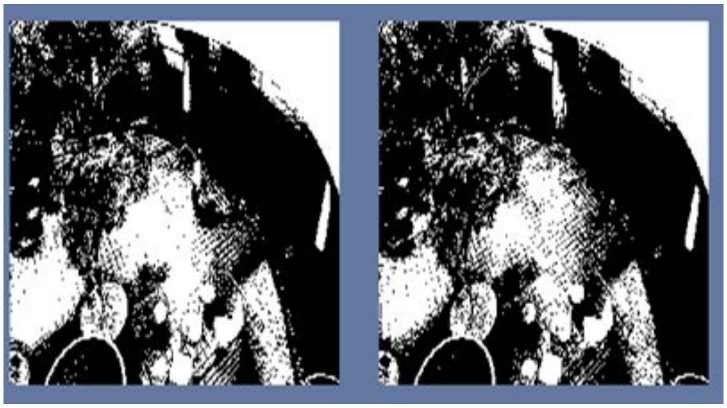

Fig 2. Input two binary images

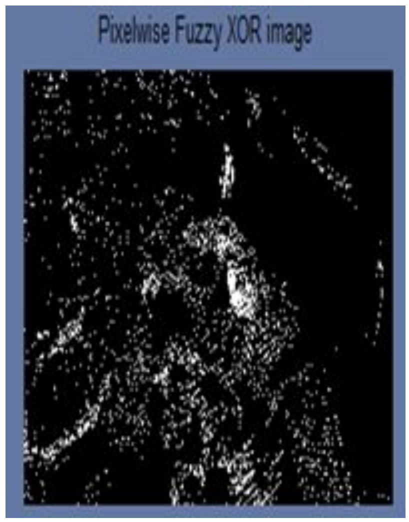

Fig 3.change detection obtained using Pixel-wise Fuzzy XOR Operator

Pattern Classification-based Adaptive Background Update Method is used to retrieve the background from a noisy video stream. In this method all moving objects are eliminated and provide updated background. With the acquisition of an image, the first step is to distinguish objects of interest from the background. In surveillance applications, those objects of interest are usually humans. Their various shapes and different motions, including walking, jumping, bending down, and so forth, represent significant challenges in the extraction of foreground pixels from the image. In this method, Difference frame is calculated using background frame and current frame. Difference frame is used to update the background frame.

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Fig4. Updated Background Obtained using Pattern Classification-based Adaptive Background Update Method

B. Tracking movements of Objects from Video:

In this module, moving objects will be detected and tracked from video. Here two approaches are discussed for tracking movements of objects from video. In first approach, video segmentation is done via collaborative observation model to obtain foreground and background. Blob analysis is applied on the foreground obtained from pixel based change detection method. Blob detection refers to mathematical methods that are aimed at detecting regions in a digital image that differ in properties, such as brightness or color, compared to areas surrounding those regions. A blob is a region of a digital image in which some properties are constant or vary within a prescribed range of values; all the points in a blob can be considered in some sense to be similar to each other. Blob Analysis is used to calculate statistics for labeled regions in a binary image. The block returns quantities such as the bounding box, label matrix, and blob count. The Blob Analysis block supports input and output variable size signals. Objects are tracked based on the statistics obtained using blob analysis.

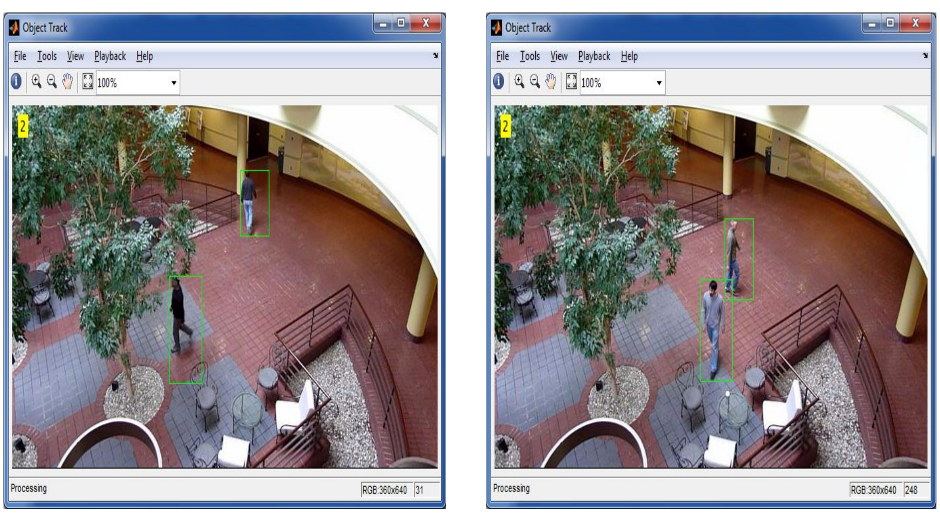


Fig 5. Objects tracked from video based on the foreground obtained from pixel based change detection method

In second approach, the updated background obtained from Pattern Classification-based Adaptive Background Update Method is used for tracking movements of Objects from Video.

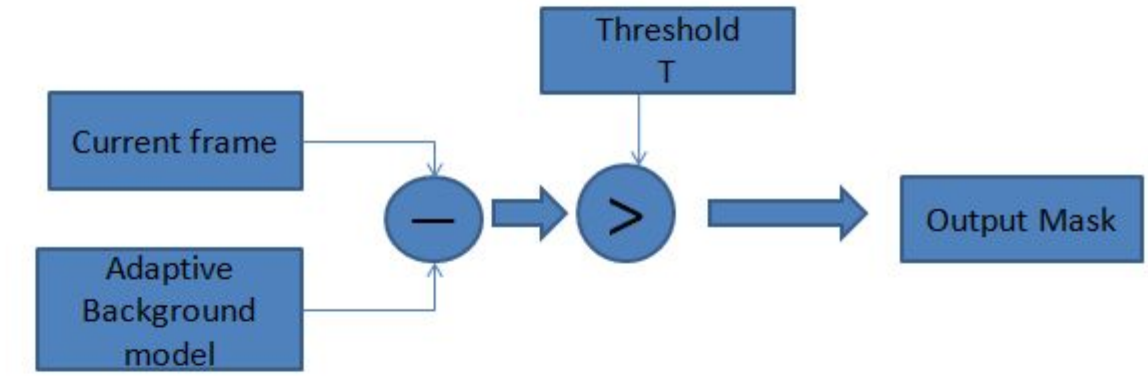
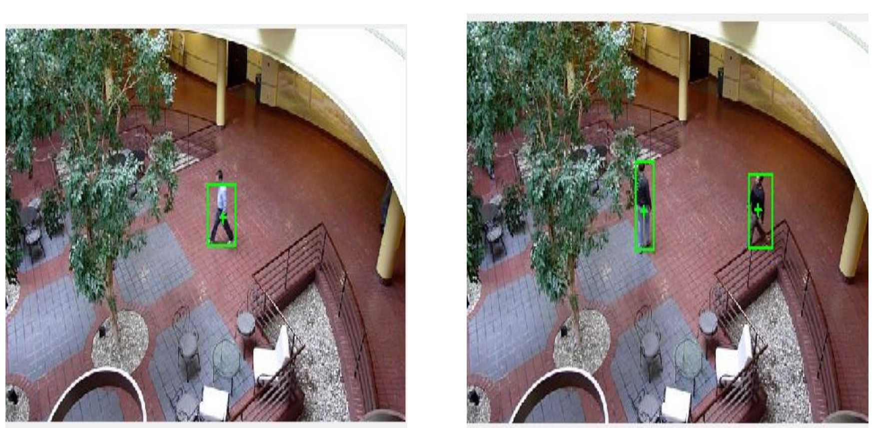


Fig 6. Background subtraction

The basic scheme of background subtraction is to subtract the image from a reference image that models the background scene. Typically, the basic steps of the algorithm are as follows:

- Background modeling constructs a reference image representing the background.
- Threshold selection determines appropriate threshold values used in the subtraction operation to obtain a desired detection rate.
- Subtraction operation classifies the type of a given pixel, i.e., the pixel is the part of background (including ordinary background and shaded background), or it is a moving object.



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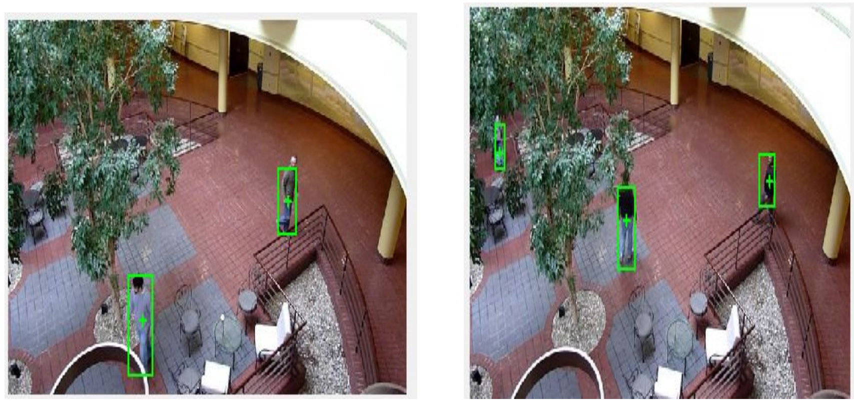

Fig 7. Objects tracked from video based on result obtained from Pattern Classification-based Adaptive Background Update Method

IV. CONCLUSION

To improve the robustness and to overcome the tracking drifts problem a robust approach for Feature Extraction and Change Detection via Collaborative Observation model that integrates Pixel-Based Change Detection method and Pattern Classification based-Adaptive Background Update method is proposed. Proposed system effectively reduce tracking drifts problem and provide accurate and robust approach for tracking movements of objects from video.

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