Particle Filter Tuning Using Continuous Opinion Dynamic Optimizer for Object Tracking

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Abstract - Object tracking is a technique that is being used from past centuries. This technique includes an application called surveillance that helps to detect the threats on public places that may be the crowded public place or a mall or public transport with the help of CCTV cameras. In the surveillance system, several vision based methods are utilized for various objects. Some of the methods which are used for tracking includes background modeling, particle filter etc. The proposed method combines the background modeling and particle filter to track multiple objects. In the object tracking process the object is considered to be in motion if its location is changing with respect to its background. By using background subtraction method the change of frame is detected, in case if there is no difference between the two frames then the object is considered to be in a static position. The proposed work is to use human opinion dynamic algorithm for particle filter tuning in order to make the prediction more effective. As the proposed algorithm involved solving the minimization problem for each drawn sample with the proposed model, the proposed system has been planned for real-time applications. The results will be presented to verify the same.

Keywords **- Tracking, prediction, computer vision, background subtraction etc.**

I. INTRODUCTION

Now a day's vision based techniques are units used for tracking several objects. But it's still a difficult task for a few reasons like occlusion or incomplete foreground extraction. It's thus essential to adopt few probabilistic models with some learning method to discover and track the item. During this, a way is introduced to trace multiple objects mistreatment each the background modeling and particle filter. Security is being a major issue in this era. Following this there are various ways to secure people from the security threats. Video surveillance at public places is contributing in a large extent to secure people from these evil threats. Video surveillance is an application of real-time multiple object tracking which includes the detection of objects by comparing it with the background. The detection of object's motion does not require the person to stay isolated for the process. And hence, there is a requirement of an efficient system for tracking multiple people in object tracking system. The first part, a speeded up method is presented for background subtraction to handle various scene changes. The video is used to estimate a model of the background based on background subtraction algorithm, also known as foreground detection that is then used to perform background subtraction image. Small blobs are eliminated after area analysis and resulting in saving the foreground area. In order to minimize the noises at large scale affected by background clutter, the track prediction module has been associated to build hypothesized tracks. The second part is a combination mechanism is associated to detect splitting and merging events, using object tracking and segmentation result. Methods to explain the occlusion issue in multiple interacting objects tracking have been formerly presented. Cucchiara presented probabilistic masks and look of models to handle with numerous shape variations and large occlusions. Eng presented a dynamic Bayesian network which contains a hidden method for partial occlusion handling. It used appearance models to track occluded objects. Siebel proposed a tracking system with three co-operating parts: an active shape tracker, a region tracker and a head detector.

It proposed a template matching algorithm and updates template using appearance features smoothed by kalman filter. Tao presented dynamic background layer model. It tracked the complete object and developing the contour from frame to frame by reducing some energy functions. Even though several algorithms have been presented in the prose, the issue of multiple interacting objects tracking is still far from being completely solved. Multiple camera based tracking methods cannot handle complete occlusion. Moreover, some of those algorithms are developed to handle with short-duration partial occlusion, or fail at severe and complete occlusions and when a partial occlusion lasts for a long time. Probabilistic approaches such as Monte Carlo filter is valuable in handling with the issue of background clutter as it lets for the tracking of multiple hypotheses. Although, the measure of object have been identified by an autonomous approach this may not be obtained in heavy occlusion. Several process using motion models to execute robust tracking can handle with some illustration of occlusion. These processes require need specific motion modeling and fail at the nonlinear motion of interacting objects.

A. Object Representation/Segmentation

It is the method of dividing a digital image into multiple segments. The main aim of segmentation is to change the depiction of an image into somewhat which is more significant and simpler to examine. The adopted background subtraction approach presents two levels of background maintenance algorithm for the real-time segmentation and background updating. This is to avoid problems associated with the mixture Gaussian background modeling. The scheme of the pixel level surroundings updating is depend on a statement that the pixel value in the moving object's position changes faster than those in the real background. It is a valid statement in various application areas. Under this statement, the foreground and background can be differentiating

accurately by a simple frame-to-frame difference method that could detect the fast changes of pixel. However, this approach will fail that the inside color of object is uniform and pixel values don't change within the object. To deal with this problem, a dynamic matrix D (k) method is used to analyze the changes of detection result of the frame-to-frame difference method, where as the motion state of each pixel is stored in the matrix.

B. Foreground/Background extraction

Background subtraction techniques are commonly used to separate foreground moving objects from the background. This process identifies the moving object in image and extracts it. It will use 3-frame differencing method for background subtraction. The system includes two parts object segmentation, merging and splitting detection, or feature correspondence. In this part, a fast algorithm is proposed for background maintenance to handle several scene changes, including ghosts and illumination changes, running at 20 fps. The input video is used to estimate a background model based on a two level pixel motion analyze algorithm, which is often used to perform background subtraction image. After connected area analysis, the small blobs will be removed and the resulting foreground regions will be saved. To minimize the large scale noises due to background clutter, the tracking management module of the second part associates foreground regions in consecutive frames to construct hypothesized tracks, only those blobs which have been correctly corresponded for several frames will be considered as a valid target.

In part two, a combination mechanism is embedded to detect splitting and merging events, using object tracking or segmentation result. In the integration and dividing module, the detected object is categorized into four sections:1. Existing object, 2.New object 3. Merge object and 4. Split object. The first two class objects will be directly used to revise the tracker in the tracking management module. A set will be produced for the merge object that include the trajectory and color feature of the objects in it. The split objects, the feature correspondence modules are engaged to allocate a correct label to every split object depend on Kullback-Leibler distance. In the following, it explains the details of the system. Extensive experiments with video sequences under different conditions indoor and outdoor show that the system is effective and efficient in multiple objects tracking in complex scenes. It is accurate yet highly computationally effective.

The aim of an object tracker is to generate the trajectory of an object over time by locating its position in every frame of the video. But tracking has two definition one is in literally it is locating a moving object or multiple object over a period of time using a camera. Another one in technically tracking is the problem of estimating the trajectory or path of an object in the image plane as it moves around a scene. The tasks of detecting the object and establishing a correspondence between the object instances across frames can either be performed separately or jointly. In the first case, possible object region in every frame is obtained by means of an object detection algorithm, and then the tracker corresponds objects across frames. In the latter case, the object region and correspondence is jointly estimated by iteratively updating object location and region information obtained from previous frames.

II. RELATED WORK

D. Hari Hara Santosh, P. Venkatesh, P. Poornesh, L. NarayanaRao, N. Arun Kumar in 2013 [1] Better video acquisition devices which are less costly is the demand of the advanced technology. For effectively utilizing digital video we should increase the number of applications. Video sequence provides more information about objects and their changing scenarios over time as compared to the still images. Before using any navigation system or surveillance system object tracking is always the first indispensable step. In this research paper the proposed algorithm consist of three stages i.e. color extraction, foreground extraction using Gaussian mixture model and object tracking using blob analysis.

Dong Wang, et al. in 2013 [2] proposed a novel online object tracking algorithm with sparse prototypes, which exploited both classic principal component analysis (PCA) algorithms with recent sparse representation schemes for learning effective appearance models. The l1 regularization was introduced into the PCA reconstruction, and developed a novel algorithm to represent an object by sparse prototypes that account explicitly for data and noise. For tracking, objects were represented by the sparse prototypes learned online with update. The method was presented in order to reduce tracking drift that takes occlusion and motion blur into account rather than simply includes image observations for model update. Both qualitative and quantitative evaluations on challenging image sequences demonstrated that the proposed tracking algorithm performs favorably against several state-of-the-art methods. The paper presented a robust tracking algorithm via the proposed sparse prototype representation. The work explicitly took partial occlusion and motion blur into account for appearance update and object tracking by exploiting the strength of subspace model and sparse representation. Experiments on challenging image sequences demonstrated that their tracking algorithm performs favorably against several states-of-the- art algorithms. As the proposed algorithm involved solving l1 minimization problem for each drawn sample with the proposed model, to explore more efficient algorithms were planned for real-time applications.

Hamid Rajabi and ManoochehrNahvi in 2013[3] proposed a modified **Rajabi and Nahvi** contour-based multiple object tracking algorithm using point processing. This approach has the advantage of multiple objects tracking. Their system can detect and track the peoples in indoor environments videos. In their method they have used Gaussian mixture model (GMM) based background modeling for background estimation.

JifengNing, Wei Yu and Shuqin Yang in 2013 [4] in this research paper background subtraction model can be used for detecting multiple objects having different color contrasts. There are various filters that can be used for subtraction of background in real time object tracking i.e. mean shift and kalman filters. Thresholding technique is the widest used technique for extracting the background and foreground of the image. In this method unnecessary details can be removed from that image and we can easily extract the required things from a real time image. Algorithms analyze the moving objects frames and output of the location

of the object within that video frame. In early pre processing stage temporal or special smoothening is used to eliminate various noises present in the video frame or the image under consideration. There are various environmental changes so we also use the technique of background modeling against those environmental changes occurring in the video frame.

R. Manikandan and R. Ramakrishnan in 2013 [5] in this research paper the main topic of concern is the movement of object (Player) in sports video analysis. To obtain a more complete behavior of moving player a dynamic optimization threshold method is used. Players are detected on the ground by using background subtraction when a player is moving on the ground than the motion of the player in video stream is studied and detection of velocity is done for analyzing the position of a moving object or human body centroid is computed. In this research paper background subtraction and foreground subtraction both are done on video frames while detecting the object (human bodies, Players).

BargaDeori and Dalton Meitei Thounaojam in 2014 [6] in this paper the demanding research area is tracking the motion of an object in a video in the domain of computer vision and image processing. This review paper states various tracking methods by categorizing than into different categories. Background subtraction is used for object segmentation in most of the methods. Various other methodologies are used in tracking strategies like mean- shift, particle filter, kalman filter etc. Background information of an image is responsible for the performance of any tracking method. In this research paper tracking methods are classified into three different groups providing detailed description and their positive and negative aspect i.e. contour-based object tracking model, region-based object tracking model and feature point-based tracking algorithm.

VishwadeepUttamraoLandge in 2014 [7] in this research paper movement of any object is the most important part in detecting and tracking any object. In a video sequence the main purpose is to detect the movement of object from the background image of the video and for its tracking. This research paper establishes an updating model of reliable background using background subtraction method. Tracking an object in a video stream and detecting the motion of a moving object is studied in this paper. To analyze the position of any moving human body the centroid is computed. The results show that this proposed method fits for real-time detection which runs quickly and accurately. The applications discussed under this research paper are visual surveillance, precise analysis of athletic performance and content based video retrieval.

Xinchao Wang, EnginTuretken, Francois Fleuret, Pascal Fua in 2015 [8] proposed a Multi-object tracking that may be attained by identifying objects in separate frames. This type of algorithm may be made robust to detection failure. A correct trajectory will never produce when an object is not detected in a frame. When there will be several multiple target issues, then linking steps resulting in complex optimization problem. Combining frame-by-frame detections to approximate the trajectories of unknown number of targets.

FuyuanXu, GuohuaGu in 2016[9] present a novel object tracking method based on two-dimensional PCA. The low quality of images and the changes of the object appearance are very challenging for the object tracking. The representation of the training features is usually used to solve these challenges. Two-dimensional PCA (2DPCA) based on the image covariance matrix is constructed directly using the original image matrices. An appearance model is presented and its likelihood estimation has been established based on 2DPCA representation in this paper. Compared with the state-of-the-art methods, our method has higher reliability and real-time property. The performances of the proposed tracking method are quantitatively and qualitatively shown in experiments.

III. METHODOLOGY

In the proposed method each object is tracked using particles on object. The performance of particle filter attains to deteriorate as the total number of objects increases in the scene. To decrease the issue, it is desirable to restrict the region where the particles are placed. In the defining region, the foreground was released from each frame using background subtraction or particle filter was applied to track the objects. For the experiment, these three objects have been tracked in video. Each object has individual colored particles to differentiate the object in the tracking that shows in the flow diagram of proposed method.

A. Background Subtraction
B. Particle Filter

Particle filters have become one of the most famous techniques for stochastic dynamic estimation problem including tracking. Decision making is a process of an individual in a society which is governed by his own considerations or the opinions of others. Opinions are formed by the direct or indirect influence of cultural interactions, norms and mass media. Social influence is a combined effect of these influences, due to these; individuals act in accordance to the expectations and beliefs of others. This forms the third rudiment of an algorithm. However, for simplicity of the modeling, only local dynamics representing is a social influence which has been considered in this work. Therefore, the social influence has been formulated by considering two factors example distance between two individuals and the social ranking of the individuals. The social ranking of the individuals is determined by their respective fitness values. These fitness values are the output values of an objective function to be reduced. The individual with minimum fitness value is assigned the largest SR, the highest possible SR being the number of individuals. The individuals with same fitness values are assigned the same SR.

Algorithm

1. Input frame
2. Subtract the background
3. Extract foreground
4. Apply particle filter
5. Generate random particles (positions)
6. Make objective function from social rank and calculate fitness value
7. Update social rank
8. Find position with minimum fitness

9. Display the result

IV. RESULTS

The experimental results display the tracking information of several objects when there is similar color object placed in background. Results are accepted from both methods of one is background subtraction and second is without subtracting background. Results show the without background subtraction in particles that are disturbed because of presence of yellow strip in background. It displays the phenomenon in other particles which are spreading too much. It shows the obtained conclusion with background subtraction in all the particles which are on the object. When the background is subtracted, apart from disturbance due to existence of similar colored object in background has removed and particles focus only on foreground. In another problem of particle filter is to specify the accurate blob's centroid value. The blob's centroid value has affected by minimum variation of light. If blob's centroid value, which has not specified correctly, the particles, can be disturbed because of taking equivalent weight in particles that are spreading too much because of few blob's centroid values exist in the background. In this, problem can minimized because the particles can get the weight either from foreground or 0 from the background. As there is high difference in weight so particles can be moved on object.

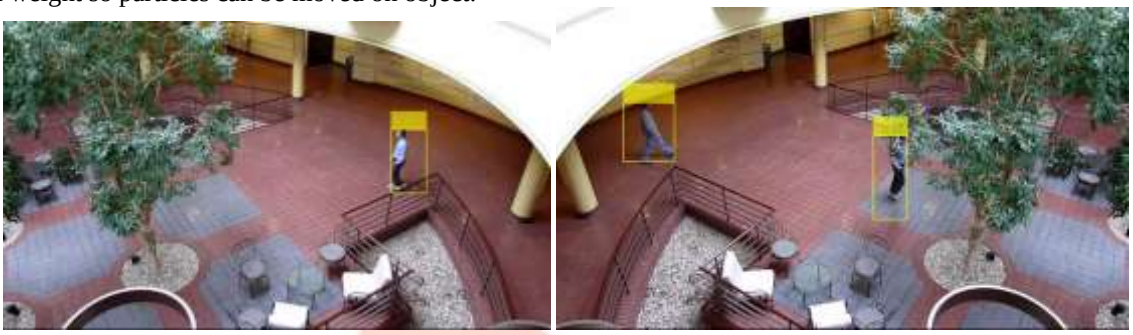

Fig.1: Frames with detected and tracked objects

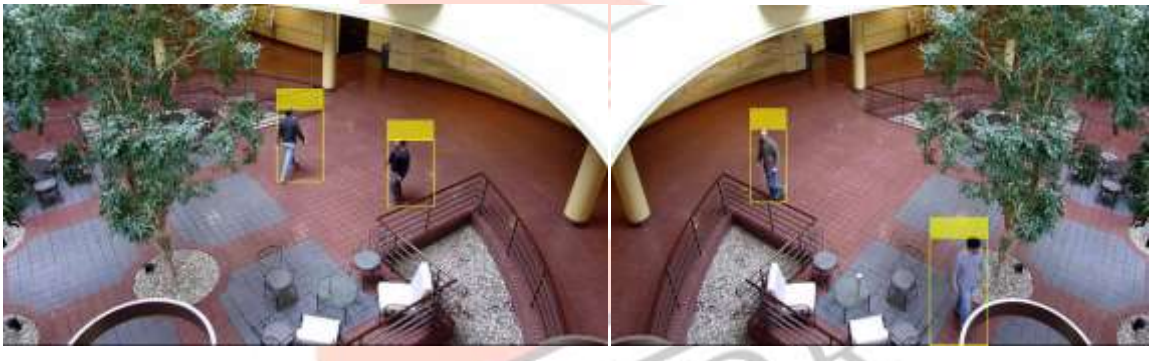

Fig.2: Frames representing the continuity of the tracking method

Fig.3: Representing Background Subtracted from the Frame

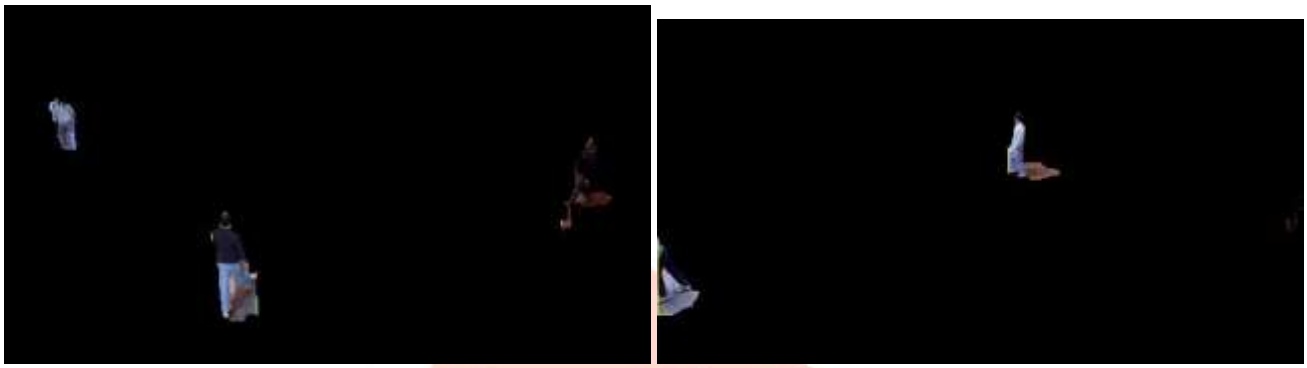

Fig4**:** Frames representing the continuity of the background subtraction

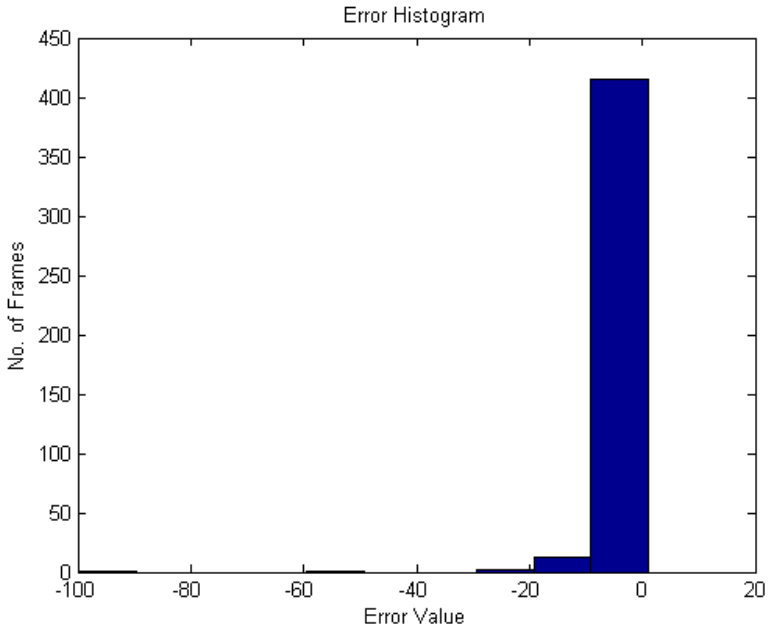

Fig 5:Error histogram

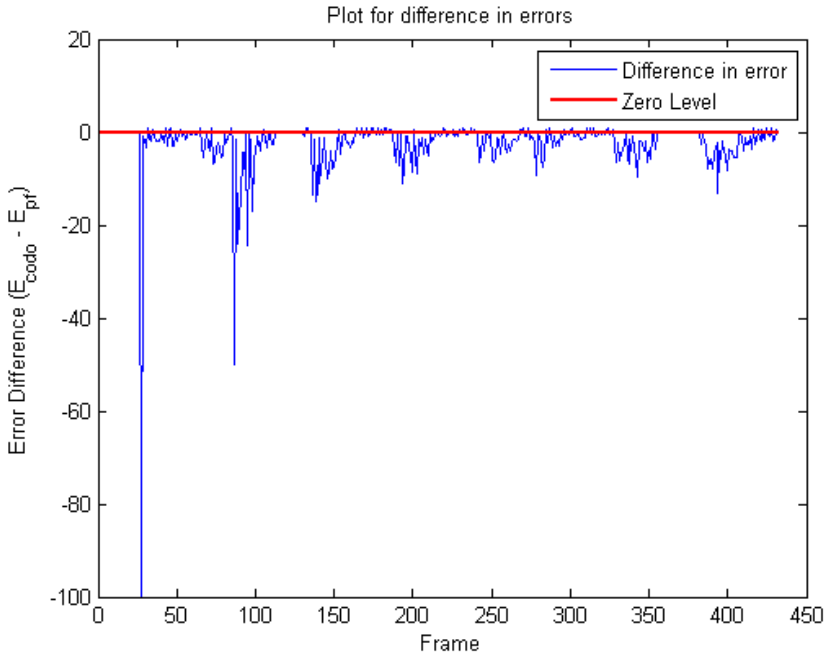

Fig 6**:** Error plot

Figure 5 is an error histogram for error differences in terms of pixels for each frame. Error histogram gives the distribution of error. If the mean is less than 0 then the proposed method has less error than the base method. This is because Error=Error(HOD) - Error(MLE).

V. CONCLUSION

Utilizing the human opinion dynamic, we introduce an enhancing dynamic optimization into particle filtering for multiple object tracking. It combines opinion operator into continuous dynamic optimizer. Optimization-seeking procedure of human opinion dynamic can shift particles to the local maxima of the subsequent density and reduce implicitly the particle failure problem at the same time. The experimental results on multiple target or object tracking with noises demonstrate that compared to the conventional particle filter, the proposed algorithm can produce more robust tracking and has smaller computation cost. The experiments demonstrate that the proposed method has performed well in some complex scene. In future, we need to enhance the efficiency of the Human Opinion Dynamic or CODO algorithm in the particle filter so as to guide the particles to distribute reasonably when occlusion occurs, which is our next research.

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