

# A Novel Filtering Approach for Tracking Visual Objects

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**Abstract:-** Visual object tracking of moving objects is a dynamic area of research in computer vision. In developing video surveillance systems, it requires fast, consistent and robust algorithms for poignant object detection, classification, tracking, and activity analysis. Kalman filter to track visual objects of variant sizes such as cars, ball and humans by varying few factors. Gaussian Mixture Model (GMM) is used for object detection using background subtraction. A blob analysis is carried for calculating area and centroid of detected objects. These, parameters are used for predicting and updating the location of tracked object using a Kalman filter. The proposed Kalman filter uses a constant acceleration model, as it is capable of tracking objects in all possible conditions of occlusions. Experiments using MATLAB show that the simulated results of proposed algorithm are accurate and can be used for real time multiple visual object tracking.

**Keywords:** *Blob Analysis, Cost Function, Gaussian Mixture Model (GMM), Kalman Filter, Visual Object Tracking*

## INTRODUCTION:

Visual object tracking includes tracking of targets under occlusions and maneuvers. Moving object detection is the rudimentary step for further analysis of video. Two or more objects interfere and appear as a new single object defines a merge condition and later separate from each other known as split. A Kalman filter is at its best in tracking of objects with maximum accuracy. There are many ways of defining its optimality. It processes all existing measurements of input data and processes them to predict next location of target. Irrespective, of their precision, to calculate nearest value of the variables of interest, it uses data of the system and measuring device dynamics, system noises, dimension errors, and ambiguity in the system dynamics.

## RELATED WORK:

Qingyong Hu proposed correlation filter-based technique. Yayu Zhai used correlation particle filter based on RGBD data. To deal with occlusions Jiyan Pan proposed a content-adaptive progressive occlusion analysis (CAPOA) algorithm. Yulong Xu for occlusion detection used one step back tracking. Xingping Dong advised Integrated Circulate Structure Kernels (ICSK) for online tracking in occlusion conditions. Shehzad used k- means for long occlusions Chao Zhu specified Boosted Multi-Task Model to detect and track pedestrian .in comparison to above algorithms, the proposed method is comparably effective and accurate in occlusion handling. This paper is organized as follows; overview of methodology used in section II, detailed

description of proposed algorithm in section III, simulated results and analysis in section IV and concluded in section V.

## METHODOLOGY:

An algorithm for object tracking is stated which is robust to occlusions by processing a continuous video as input from a static camera (surveillance system). The video is segmented into n number of frames to detect object using GMM for object detection. The obtained features of object should be enhanced to remove noise using image processing techniques. A kernel based rectangular template matching is used. The object parameters such as centroid and area are obtained from blob analyzer and fed as inputs to Kalman filter for tracking the object.

## METHODOLOGIES FOR PROPOSED ALGORITHM:

- Object detection: Back Ground Subtraction based on Gaussian Mixture Model (GMM)
- Object tracking: Kernel Tracking and Kalman filter (constant acceleration model)

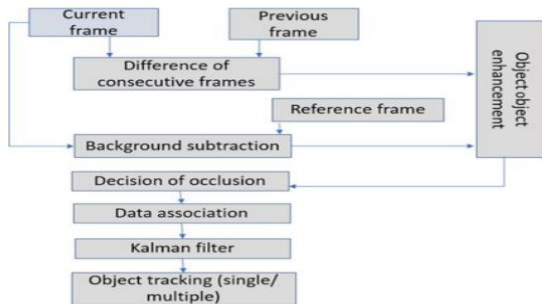
## PROPOSED ALGORITHM:

In visual object tracking, one of the challenging tasks is to overcome occlusions. These can be of short term, medium term and long-term durations. The proposed algorithm is capable of tracking more than one object of various sizes in a single frame accurately. Initially, a continuous video from a static camera such as CCTV is taken as input. The video is then divided into successive frames, back ground subtraction is carried by subtracting two consecutive frames based on.

Gaussian Mixture Model. GMM is used for object detection by choosing the connected components by assigning binary '1' and '0' for unconnected regions. In the next step a foreground rectangular mask is obtained by using foreground detector.

Blob analyzer is used for calculating area, centroid and bounding box of the detected object. A Kalman filter is used for tracking by predicting and updating object location based on above mentioned parameters. The Kalman filter uses an initial location to predict the next state by adjusting the measurement noise and process noise [3]. In the proposed method, both noises are assumed to be Gaussian with initial parameters as defined, Motion model is a constant acceleration which has initial location as centroid, initial estimate error =  $[1 \ 1 \ 1] * 1e6$ . Process noise =  $[10, 10, 10]$ . Measurement noise = 5. By choosing a suitable initial noise values, the accuracy of the algorithm can be

increased. The algorithm can track visual objects of different sizes by adjusting the blob area. The less is the blob size the more are the chances of detecting small sized objects. Most of the human's travel in linear fashion but a ball generally moves faster than humans and it is more advisable to consider a constant acceleration model of Kalman filter



FLOW CHART OF THE PROPOSED ALGORITHM

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**A. FEATURE MATCHING:**

This technique used for multiple object tracking. Each moving object is defined by its centroid (a<sup>i</sup><sub>k</sub>, b<sup>i</sup><sub>k</sub>) and tracking window area (A<sup>i</sup><sub>k</sub>). The distance between centroids of two objects is given as,

$$D(i, j) = \frac{\sqrt{(a_k^i - a_{k+1}^j)^2 + (b_k^i - b_{k+1}^j)^2}}{\text{Max}_n \sqrt{(a_k^i - a_{k+1}^n)^2 + (b_k^i - b_{k+1}^n)^2}}$$

Area between tracked object is calculated as:

$$S(i, j) = \frac{|A_k^i - A_{k+1}^j|}{\text{Max}_n |A_k^n - A_{k+1}^n|}$$

J<sup>th</sup> object corresponding to i<sup>th</sup> frame and k<sup>th</sup> object w.r.t l+1th frame. Where n, frames analyzed, l and h are length and height of window, where, A<sup>i</sup><sub>k</sub>=4likhik, which signifies the area of tracking window. After the tracking of object,

the next step is dealing with occlusions and data association. We use a distance-based discrimination method to detect occlusions and also capable of successful and accurate tracking. For the data association we used a cost function.

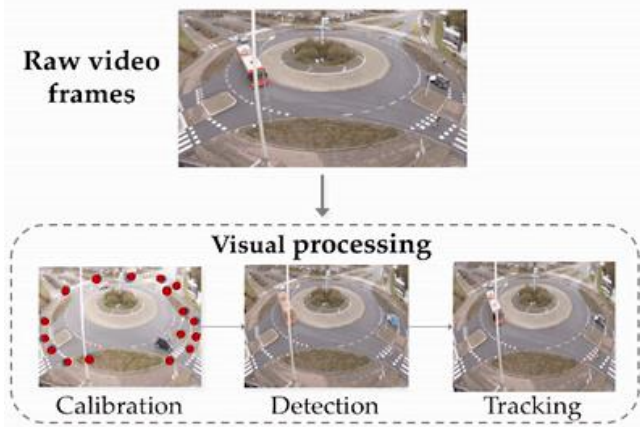
**B. OCCLUSION HANDLING:**

Occlusion is a two-step process, two objects merge and appear as a new object and then objects split from a merged object. In above two cases, it is difficult to track object exactly. Hence, a major research is focused to solve this problem. Our proposed novel technique is able to cope up in detecting and solving occlusions efficiently. The distance between two centroids of the objects is calculated, if the value is larger than a threshold then there assumed to be no occlusion. If, the measured value is near or equal to zero, then they are in merge condition. This method is best suited for tracking few objects. In order to track multiple objects. We use a cost function that relies both on distance between centroids and area of the detected objects. Cost function is defined as, C= αD+βS. For object i<sub>k</sub><sup>i</sup> in j<sub>k</sub><sup>i</sup> frame, the smaller the value of cost the function, the measurement probability true is also high. Based, on cost function, we can define number of assigned and unassigned tracks for multiple objects tracking.

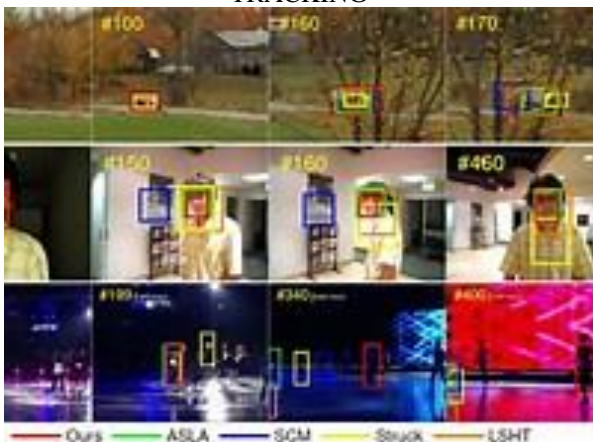
**EXPERIMENTAL RESULTS AND ANALYSIS:**

The proposed algorithm is verified by using MATLAB 2017.b on Microsoft Windows 10 and Intel Core i3 7th Generation Processor with 4GB RAMS. The results are estimated based on three videos and are shown to be efficient and accurate. It can be observed that a car and a person riding bicycle are tracked simultaneously. The template is of rectangular shape which fits exactly according to the object size. All the tracked objects are travelling in linear direction. The ball is moving in an inclined direction, we can conclude that our algorithm is capable of tracking linear inclined moving visual objects. do not balance dimensionally. If you must use mixed units, clearly state the units for each quantity in an equation.





ACCURATE SCALE ESTIMATION FOR VISUAL TRACKING



LEARNING FROM DEMONSTRATION IN THE WILD



EYE TRACKING AND HEAT MAPPING AND PINTEREST

FUTURE SCOPE:

The proposed method is effective for static cameras only hence in the future work; an algorithm for dynamic video based visual object tracking can be obtained. Object tracking is a challenging aspect of in presence of occlusions. Hence, more efficient algorithms can be derived to improve visual object tracking.

CONCLUSION:

We proposed an algorithm based on Gaussian Mixture Model (GMM) for object detection and Kalman filter for visual object tracking. Foreground detection, image enhancing for noise removal and data association in case of multiple objects are discussed in detail. Our suggested cost function effectively solves the occlusion problem and also helps in analysis of data associated with multiple objects by calculation of their areas and centroid positions. The objects are tracked in very less time even under complex situations. In the above work, various scenarios of occlusions are considered and proposed algorithm has tracked variant visual objects with good accuracy.

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