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Object Detection and Tracking Techniques: A Review

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ABSTRACT: Object detection is challenging problem in vision based computer applications. It is used to identify whether object is present in the video or not. It has become a critical part in many applications like image processing, artificial intelligence, security surveillance, detection of vehicles in traffic and many more areas. Three phases of data processing in video surveillance are: object recognition, object extraction and object tracking. In this review paper the various techniques for object detection and tracking have been analyzed and compared with respect to each other.

KEYWORDS: object detection, object tracking

I. Introduction

Videos are basically sequences of images, which are called a frame, displayed in high frequency so that human eyes can perceive the continuity of its content. Image processing is a term which indicates the processing of video frames or images which are taken as an input to object detection system which is followed by object classification and then tracking of objects in video scenes and the result set of processing is set of related parameters of an image. However the contents of two consecutive frames are closely related. Therefore to track the status of objects in the scene as moving or still, two adjacent frames can be used. The detection of moving objects and tracking from video is a fundamental and very difficult task as it requires abstraction from rest of the objects from the video scene and is further required for processing in surveillance as
well as differentiating the interested object from other objects becomes a critical problem.

The detection of an object in a video camera scene is almost new topic of research in computer science and, because of its broad relevancy in real life this has been growing more and more. Object detection is performed to check presence of objects in video frame and to detect that object. The process of object tracking is to separate a region of interests from video frames and keep the track of its motion and position. The important part in video analysis is: detecting moving objects, tracking objects from one frame to another frame and analyzing their behavior.

For object recognition, navigation systems and surveillance systems, object tracking is a crucial first step. Various algorithms for detecting moving objects have been designed in recent years. Moving object detection in a video streams is an essential step in video supervision applications. Object tracking has inference in real time applications as it provides the various applications to find the people and provide the security by having eye on them.

Object detection has importance in many applications like retail space instrumentation to analyze shopping behavior of customer, medical therapy, and traffic management. Motion detection and object tracking algorithms consists of building blocks of high-level techniques for motion analysis which comprises of tracking and classification of trajectories and are the base for applications such as target classification, targets tracking and target behavior understanding.

The literature review is structured as follows: Section 1 gives introduction to object detection and object tracking in video surveillance systems. Section 2 describes about the object detection system, various techniques available for

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detection and comparative study of those techniques. Section 3 consists of detailed study on object tracking methods with comparison among various tracking methods and Section 4 provides conclusion.

II. OBJECT DETECTION METHODS

Dynamic object detection is an essential step in video surveillance applications. Object detection is to identify objects of interest in the video sequences and to cluster pixels of these objects. The object in the video can be found by processes processing, segmentation, foreground and/or background extraction, feature extraction.
The various methods of object detection are shown in fig 1 given below and are defined respectively.

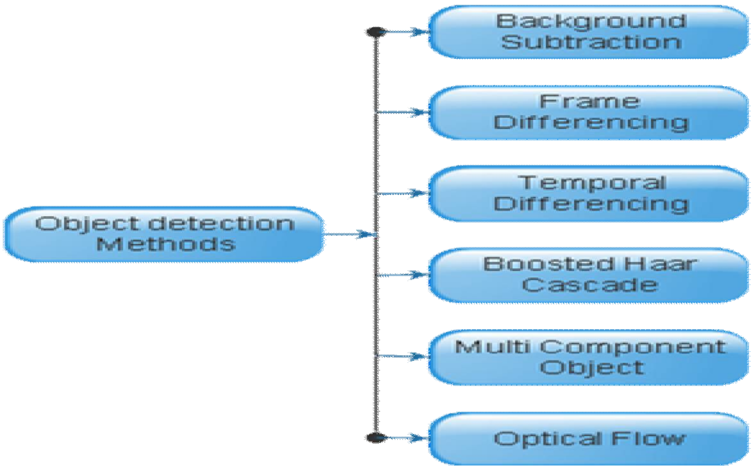

Fig 1. Object detection methods

III. BACKGROUND SUBTRACTION

Background subtraction is called foreground detection. It is a technique used in image processing and computer vision where foreground is extracted from the image for object recognition. Regions of interest in image are objects like humans, text, vehicles etc. in the foreground. After image extraction or image preprocessing (which may include removing noise from image, post processing like morphology etc.) localization of object is required which may make use of this technique.

It is approach used for detecting moving objects in videos from static cameras. The hypothesis in this approach is detecting the dynamic objects from the difference between the current frame and a reference frame which is called background image.

Background subtraction is based on a static background localization which is often not applicable in real environments. The indoor scenes, reflections or animated images or motion of objects on screens results to background changes. The changes brought by weather (rain or wind) static backgrounds methods have difficulties with outdoor scenes.

It is technique particularly used for object detection in static images. The technique computes background and then subtracts current frame in which dynamic object is present to detect moving object. The technique finds an thorough difference for each pixel. If the difference is below a certain threshold and the observed pixel is regarded as if it belongs to the background then there is no change in scene. If the difference is above a certain threshold value then there is a change and the pixel belongs to the object.

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The process of the background subtraction initializes from the background modeling which is the main part of the background subtraction algorithm. Background modeling results in the reference model which is in turn required in background subtraction process, where each of the video sequence is compare with the reference frame in terms of the pixels in order to find out the possible variation. Mean and Median filters are used in the background modeling. The main approaches of the background subtraction are listed below in fig 2 and are defined respectively.

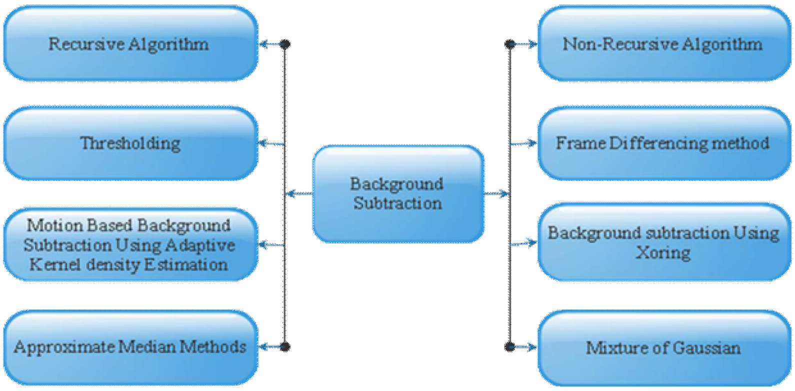

Fig 2. Background subtraction methods

i. Recursive algorithm

The concept behind the recursive techniques is that they do not maintain any buffer for the background estimation. But they recursively update the single background model on the basis of each of the input frame. The positive part of this approach is that it requires less amount of the memory or storage space but also suffers from a drawback that if any error occurred in the background model that it continues to have its effect for the longer duration to time. This concept involves methods like approximate median, adaptive background, etc.

ii. Non-recursive algorithm

Non-Recursive techniques are based on the concept of sliding-windows for the background estimation. It makes use of buffer for the storage of the previous video frames and will estimates the background image on the basis of the temporal difference of each pixel within the buffer. These techniques are more appropriate although the large buffer is requires to store the information regarding even the slow-moving traffic. These methods are simple in terms of implementation but they lack in terms of accuracy. Accuracy can be achieved by recursive techniques. Speed is also a major factor.

iii. Thresholding

The effects of dynamic changes such as shadow, unwanted movement etc should not be sustained and the desired region should be detected. A simple thresholding based background subtraction technique under the condition of illumination variation segments the object. A method called thresholding extracts the relevant information from the frame and remaining is discarded and is denoted by value’0’.

iv. Frame differencing method

The value of the previous frame is compared with the captured frame. Simultaneously the values of the frames are also updated. The difference of two frames gives the detected region the value will differ on intensity basis and that by variation of pixel by pixel. The major disadvantage of this technique is speed. If the speed of moving object is almost imperceptible then the difference of two values of frames will not be easily identified which will not be able to detect objects properly.

It is simplest method in which present frame is subtracted from the background frame. If the difference in pixel values for every pixel is greater than the threshold value, then the pixel is considered part of foreground otherwise it is consider as background. It is used for static camera.

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v. Mixture of gaussian

The method uses Gaussian probability density function to figure out the pixel intensity value. It finds the difference between the cumulative average of the previous values and current pixel's intensity value. So it keeps the cumulative average of the recent pixel values. If the difference between cumulative pixel value and current image's pixel value is greater than the product of constant value and standard deviation then it is classified as foreground else it is considered as background.

It is simple and easy to realize and accurately extracts the characteristics of target data. Extraction from the fixed background and moving object detection in the analyzed scene is done by subtracting the current image and background image. It has been mostly used for detecting and tracking of objects in a video from static camera. The techniques for subtraction should be robust under change in illumination and intensities. The background subtraction method initializes a background through modeling and subtracting current frame from background frame to detect motion of objects. This method is sensitive to the change of external environment. This method is highly inaccurate and gives false rate detection.

IV. FRAME DIFFERENCING

Frame differencing method is in which the difference between video frame at time t and the frame at time t-1 was computed. In two-frame differencing method, two consecutive frames were chosen and subtracted as per the pixel. The pixel is expressed as background pixel if the examined pixel was greater than the predefined value.

For the video sequence f, the frame at k and frame at k + 1 are considered. Then the frame difference between these frames was computed. The presence of moving objects is estimated by calculating the difference between two succeeding images. The algorithm is given as:-

1. Convert the incoming frame (here we assume a color RGB sensor) into grayscale.
2. Subtract the current frame from the background image (the previous frame).
3. The pixel is considered as foreground if the difference between the current frame and previous frame is greater than threshold value.

Background image having multiple moving objects is taken as the reference image. Then the pixel value for each co-ordinate (x, y) of the background image is computed. The obtained value is subtracted from the corresponding pixel value of the input image. If the determined value is greater than an expressed threshold value, then we assume that there is change in the foreground pixel otherwise its background. A frame difference using online K-means approximation is one of the most known methods. In this technique, memory required and cost is less. However, the foreground splitting up affects accuracy due to the loss of color information.

V. TEMPORAL DIFFERENCING

Temporal differencing [12] makes an effort to detect moving regions by making use of the pixel-by-pixel difference of progressive frames (two or three) in a video sequence. It is based on the principle of - subtraction of current and background frame pixel wise. The temporal difference [7] of two consecutive frames has the same principle of the background subtraction method (subtracting current frame from the reference image), but in this case previous frame is the reference image (in contradiction with the background method, in which the reference image is fixed). This method is manageable and smooth to implement with respect to the other methods.

This method uses two adjoining frames [4] to subtract and gets difference images based on time series image; it's similar to background subtraction method in terms of its working. It gives moving target information through the threshold value after the subtraction of image. This is very flexible to the dynamic changes in the scenes; sometimes it fails in detecting appropriate pixels of some types of dynamic objects. Further methods need to be endorsed in order to detect stopped objects for success of higher levels that are complex to compute and which cannot be used in real-time without specialized hardware. This method uses several neighboring frames [6] to subtract and gets difference images based on time series image. After the subtraction, it gives affective target information through threshold value.

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It is highly sensitive to dynamic scenes; it mostly fails in detecting relevant pixels of some types of moving objects. Temporal differencing method fails in detecting a change between sequential frames and loses the object when a foreground object stops moving. This method [9] can be used only to detect the possible moving object area to detect real object movement which is for the optical flow computation. This method is not applicable for still object detection: cannot be used for real-time applications. Temporal differencing is very flexible to dynamic environments, but provides a poor means of extracting all relevant feature pixels mostly when the object moves slowly or has uniform texture as the previous frame was used as a reference image.

The gray-level intensity value at pixel position x is represented by In(x) and video image sequence I at time instance of n, which is in the range [0, 255]. The threshold value is initially set to a pre-determined value T. Lipton et al [5]. Two-frame temporal differencing scheme is developed which suggests that a pixel is moving if it satisfies the following condition:

|I n(x) I n1(x)| > T [5] |

Extraction of moving pixel is simple and fast in temporal difference technique. Temporal differencing is farther sensitive to the threshold value when determining the changes within difference of sequential video frames. It requires special supportive algorithm to detect static objects. The temporal difference is a straightforward method for detecting moving objects in an immobile environment and the adaptive threshold *d T* can constrain the noise very well. When a foreground object becomes constant then this method cannot be used to detect a change between consecutive frames and results in losing the object.

VI. BOOSTED HAAR CASCADE TECHNIQUE

This technique is used for sliding window object detection without spatial clustering. This is exceptional technique due to its flexibility with significant detection performance. It provides the significant means for vehicle detection making use of multiple cascaded Haar classifiers. For the utilization in vehicle detection, four independent Haar-cascade classifiers were trained based on sample vehicles classified into four different orientations as per their positions to the horizontal line 0, 45, 90, 135 degrees are the resulting clockwise offsets.

The training set was thereby divided into dislocate subsets based on the nearest observed angle of the vehicle wheelbase. A discrete cascaded Haar-classifier was trained for each of the subsets. This technique fails to achieve due to its inadequate correctness and incorrect localization. It can detect the object thoroughly while securing the information.

VII.MULTI COMPONENT OBJECT DETECTION METHOD

Multi-component model when combined with object window selection provides the better results for object detection. Each component characterizes subcategory of an object and objects within each component are conserved in configuration and appearance. Accordingly component models are both easy to learn and highly selective. A second layer classifier is trained to combine the outputs of component models into final scores.

There are three primary challenges that have to be addressed in order to come up with our selective component-based object model.

1. How to know about a component classifier when only an object label is given.
2. How to learn about multiple component classifiers given a method for learning a single component classifier.
3. Given multiple diverse component classifiers, combine these classifiers properly into an overall classifier for the object of interest.

Several influential approaches shaping multiple components of objects, i.e. subcategories, have been introduced in order to deal with necessary variations that cannot be handled by monolithic models. Mixture components were combined into the deformable part models either based on appearance k-means clustering or bounding. The number of mixture components is pre-defined and are not implied from data.

There are two phases:- training phase and detection phase. A two layered model is prepared to capture and accumulate the components of object category from data in training phase. First layer model is a binary classifier prepared with a

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seed and a list of aligned objects with the seed based on keypoint. The output of these component classifiers is given as an input to second layer classifier, and output is a final category level classification score. Bounding boxes are generated for each image using selection scheme in the detection phase. A non maximum suppression is applied to produce final results after scoring these boxes with two layer model. A second layer classifier is trained to sum the outputs of component models into final scores.

VIII. OPTICAL FLOW

The comparative motion between an observer and a scene causes the pattern of illusive motion of objects surfaces and edges in a dynamic scene which is known as optical flow. The motion target of the vector characteristics is used in this method to detect moving area in video which changes with time. It is difficult to meet requirements of real time video processing as it needs special hardware support as well as the computation is very complicated. The image optical flow field is calculated by this method and clustering processing is done as per the image optical flow distribution characteristics. The sensitivity to noise or anti-poor noise performance and the large amount of calculation makes it not to be used for real time applications. The motion target of the vector characteristics is used by this method, which changes with respect to time to detect motion area in image.
This method is very complicated and includes difficult computation but it provides with the almost accurate results when the camera is moving. It can't be used in real time applications without specialized hardware as it is very sensitive to noise.

It has been assumed that the neighboring pixels of each frame in an video will have same motion. The motion in video is estimated by matching points of objects over each image frame, as optical flow is a vector based approach. Optical flow is used to describe the coherent motion of features or points between the frames of image under the assumption of illumination being constant and spatial smoothness. The characteristics of flow vectors are used for optical flow-based motion segmentation to detect the moving regions in an video sequence of moving objects over time. Optical flow is robust to multiple and simultaneous cameras and object motions which make it ideal for conditions which contain dense movements and analyze the crowd analysis. The optical flow-based methods can also be used to detect moving objects even in the presence of camera movement independently.

Table 1. Comparison of object detection methods

Object detection method	Advantages	Disadvantages
Background subtraction method	• Simplest and easy to implement. • Exactly extracts the characteristics of target data. • Reprogramming is not required. • Memory requirement is least. • Fast recovery is supported	• Can be applied when background is known due to sensitivity issues related to peripheral environment. • Do not give the accurate results. • Do not give exact results in case if any obstacle is present like shadow. • With multidimodal background it cannot be sustained
Frame difference	• Simple and easy to implement. • Gives better results for static background. • Highly accurate	• Cannot be used in environment which changes dynamically. • Not suitable for real time applications. • Time required varies from low to moderate.
Temporal difference	• Simplest and easy to implement. • Flexible to dynamic changes.	• Static background is needed. • Not suitable for real time applications without suitable hardware.

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Optical flow	• Flexible under moving camera. • Gives complete movement information of the object. • Accuracy is high	• Very complex. • High computational time is acquired. • Requires special hardware and is difficult to deal with real time video processing.

IX. OBJECT TRACKING METHODS

Object tracker estimates the movement of an object to be tracked by observing its position in each frame of the video. Several algorithms have been proposed which can be used to detect the interesting object and then tracker is used to track the object across frames. They are as follows

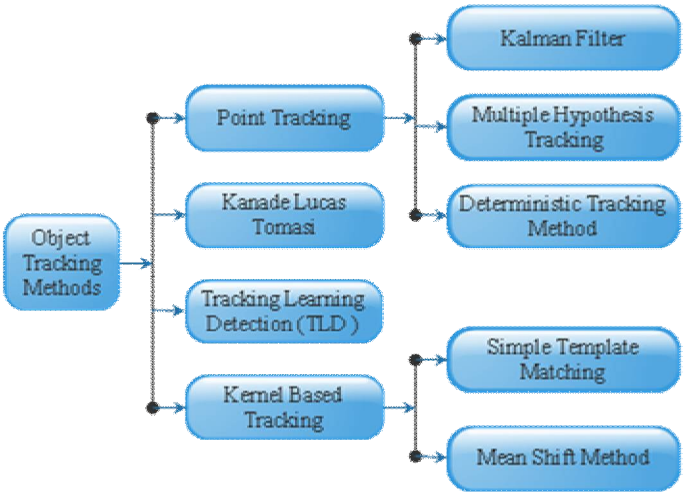

Fig 3. Object Tracking methods

X. POINT TRACKING

Point tracking intensify the ambiguity regarding the object of interest position in the frame as it is based on a particular one individual point. It can be accomplished with various moments which describe the shape distribution, such as the divergence of pixels in the object of interest. Points are also used on some individual objects to generate heuristics. Optical flow use the concept of points for calculations: because of the large number of vectors are needed to be evaluated; the point representation can only have the means for.

Objects detected in chronological frames are personified by points, and the combination of the points is based on the motion and position of the object in the previous object state. To detect the objects in every frame this approach needs an extraneous mechanism. Tracking can be expressed as the comparability of detected objects characterized by points across frames. Point comparison is a sophisticated problem-specially in the presence of misdetections, occlusions, entries, and exits of objects. Point tracking methods can be figured on the basis of whether they bring forth faultless point trajectories. The performance can be figured out by computing precision and recall measures. In the reference of point tracking, precision and recall measures can be expressed as:

$$\text{Precision} = \frac{\text{Correct comparability/correspondences}}{\text{Established comparability correspondences}}$$

$$\text{Recall} = \frac{\text{Correct match/comparison}}{\text{Actual match/comparison}}$$

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where actual match denotes the comparison available in the ground truth. A qualitative match of object trackers can be made based on their ability to

i. To deal with entries and exits of new objects, existing objects respectively,
ii. Handle the occlusions, and
iii. To deal with the cost function minimization problem in an optimum manner used in establishing comparison.

i. Kalman filter

A Kalman filter is an optimal (If all noise is Gaussian, the Kalman filter minimizes the mean square error of the estimated parameters.) estimator - infers parameters of interest from indirect, inaccurate and uncertain observations. The new measurements can be worked upon as they arrive. (batch processing where all data must be present).

Advantages of kalman filter

· Convenient form for *online real time* processing.

· Easy to make and implement given a basic understanding.

· Measurement equations need not be inverted.

The basic concept of a Kalman filter is to remove noise from the noisy data. The applications of a Kalman filter are numerous: Tracking objects (e.g., missiles, faces, heads, hands), fitting bezier patches to (noisy, moving, ...) point data, economics navigation, many computer vision applications, stabilizing depth measurements, feature tracking, cluster tracking, fusing data from radar, laser scanner and stereo-cameras for depth and velocity measurements and many more The Kalman filter is a set of mathematical equations with calculative means to evaluate the state of a process, in a way that minimizes the mean of the squared error.

Kalman filter was accomplished for optimal control of navigation, because of the potential which it possesses it has been used for various engineering applications including real-time imaging [2]. The filter is very predominating, it supports assessment of past, present and even future states and, in particular, can do so even when the precise nature of the noise is unknown. The algorithm provides a running average of fusion of pixels. It consists of the following two phases-Prediction of the next state using the current set of observations and update the current set of measurements which are predicted. The second updates of the predicted values give a much better approximation of the next state.

ii. Multiple hypothesis tracking

Multiple hypothesis methods are more powerful because the result of tracking is identical to the state sequence which increases the joint state-observation probability. This technique is computationally thorough/in-depth, and computes the every possible update hypothesis. This is a handpicked technique in modern multiple target tracking systems for solving the data association problems. Its usage in bio-imaging applications is not possible because of the excessive cost stimulated by the large number of objects that are required to be tracked and the bad quality of images due to which false detections are numerous.

The principle of the MHT is to postpone the association step to a time after the decision is made simpler by the knowledge of succeeding frames. It depends on building all possible associations between detections and tracks for a number of succeeding frames and contrasting them. The MHT is adopted as the method of allusion for solving the problems related to data association in modern collective target tracking systems.

MHT formulation (FMHT), integrates the assumptions of target being recognizable, which is the capability of a target to accomplish analysis in the future, and prove its effects on the thorough performance of the algorithm. The model allows the early detection of a track termination and the initiation of tracks identical to real targets only and compliment good quality tracks. Because of this algorithm is very rough to false detections, and hence reduce the complexity. It uses efficient breadth-first search process intensified on the construction and pruning of hypothesis trees to solve the multiple dimensional assignment problem.

iii. Deterministic tracking method

The qualitative motion heuristics is used in the deterministic methods to constrain the correspondence problem. Deterministic methods for point comparison define a cost of related objects in frame $t-1$ to a particular object in frame t using a set of dynamic constraints. Minimization of the comparison cost is developed as a combinatorial optimization problem. A solution, which consists of one-to-one comparison among all possible combinations, can be obtained by optimal assignment methods. The comparison cost is frequently defined by using a conjunction of the following obligations.

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1. The location of the object will not change exceptionally from one frame to the other, it is assumed.
2. An upper bound on the object velocity is defined by maximum velocity and limits the possible comparisons to the circular proximity around the object.
3. Small velocity change (smooth motion) ascertains the direction and speed of the object does not change immediately.
4. The velocity of objects in a small proximity is to be similar. This obligation is preferred for objects represented by multiple points.
5. These obligations are not specified to the deterministic methods, and they can also be used in the conditions of point tracking using statistical methods.

XI. KERNEL BASED TRACKING

Embryonic object region represents the computation of the moving object used for performing the Kernel Tracking from one frame to the other. Parametric motions such as conformal affine translation etc define the motion of the object. Diversion in algorithms takes place in a manner of the presence representation used, the number of objects tracked and the method used for approximation of the object motion. Mostly object is illustrated using the geometric shape. But one of the major drawback of the geometric shape is that all portions of the object background do not leave the defined shape where as some parts of the object may be left outside of the defined shape. This can be figured out in rigid and non-rigid objects. The shape of the object, object features appearance and the representation of the object can be tracked down using these high tech methods.

Kernel tracking here depicts the ellipsoidal or rectangular shape representations of the object and the appearance of the object. On each frame the tracking is done by the calculation of the motion of the kernel. The major difference between algorithms is of the appearance, the number of the objects and the method used for approximation of the object motion. Usually geometric shape is used for the representation of the objects. Geometric shapes method is limited in the same way as many parts of the object may be left outside the definite shape whereas the parts of the background may remain inside.

i. Simple template matching

Wit reference image is usually detected by Simple Template Matching. The region of interest in the video is examined by the brute force method, which is the template matching itself. Template matching plays a major role in the verification of the frame that is being separated from the video. In case of tracking, the overlapping of the object is done partially can be done for single object in a video, Digital images can be processed to find small parts of the image which is similar model with an image or to find small parts of the image that matches. For all possible positions in source image, there is an image template in the matching procedure and numerical index is calculated that gives the specification of how neatly the model fits the picture in that position. Pixel by pixel matching is done in simple template matching system. Video gives the required reference image and comparison with frames is done respectively. Implementation of simple template matching is done using OpenCV only. Comparison for each frame is done with regards to the reference image and is done pixel by pixel. Tracking is done till the object disappears from the frame.

ii. Mean shift method

It helps in figuring out the area of a video frame which is most equivalent to a previously initialized model. Histogram is used for the representation of the tracked image region. With the process of gradient ascent tracker is moved at the location that maximizes an similar score between the present image region and the model. In object tracking algorithms, the representation is usually rectangular or elliptical region. It includes the target candidate and the target model.

The characterization is done through color histogram. The representation of target is done using probability density function known as pdf. Asymmetric kernel with spatial masking is used to regularize the target model. The peaks or modes in a probability density function in this algorithm is determined if we have a set of samples. The applications of this algorithm are in clustering, tracking, segmentation, etc. It is more robust with respect to other trackers and can

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track for a longer time as it is an iterative process. The first step of the algorithm is to detect the moving objects in the visuals. The second step of this will track the objects which are detected in first phase.

The properties of Mean-Shift algorithm are explained as:

I. It is a tool used for finding the peaks in a set or distribution of data samples within the region of interest.
II. It has the direction same as that of gradient of the density estimate and its size also depends on the gradient.
III. It uses the concept of iterative process for finding the maximum density in the local neighborhood.
IV. Steps are small and reined near maxima.

Set of data points is taken and weight is assigned, summed up and the average weight is calculated and then it is subtracted from the initial estimate in mean shift method. The highest mode is considered in the window.

XII.KANADE LUCAS TOMASI

The KLT algorithm automatically scans a distributed set of feature points having sufficient consistency for tracking them reliably. Later on for each point translation estimated detected points are tracked that reduces the dissimilarity between current feature point position of centered windows and the position of translation. KLT algorithm is extensively used in comparison with other methods because it is operated completely in an automatic manner and its performance is opposing in specifications of feature point quality. It is another source of potential counterpart as each calculation of these parameters is uncontrolled.

It is possible to calculate the movement of head from the tracked points. This method is used to track the feature points on the face. For example, all the points will have same direction and displacement if we twist to left but some points will move faster than others. This helps to find the head movement between two frames of the point within video using optical flow. It works i.e. tracks the face in two steps: finds the traceable features of the face in the starting frame, then track these features in rest of the frames using the concept of displacement. It finds the region of interest and they are followed through image sequence which can be used in problems like recognition of object, tracking of object.

Table 2. Comparison of object tracking methods

Object Tracking methods		Advantages	Disadvantages
Point Tracking	Multiple hypothesis tracking	• It deals with new object entries. • Handles the exit existing objects. • The MHT is adopted as the method of allusion for solving the problems related to data association in modern collective target tracking systems	• Reckoning integrally in memory as well as time • Its usage in bio-imaging applications is not possible because of the excessive cost stimulated by the large number of objects that are required to be tracked and the bad quality of images due to which false detections are numerous.
	Kalman filtering	• Points can be tracked even in the presence of noise • Good results in practice due to optimality and structure. • Convenient form for online real time processing. • Easy to make and implement given a basic understanding. • Measurement equations need not be inverted.	• The state variables are distributed by Gaussian.

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	Deterministic tracking	• The qualitative motion heuristics is used in the deterministic methods to constrain the correspondence problem. • Deterministic methods for point comparison define a cost of related objects in frame t − 1 to a particular object in frame t using a set of dynamic constraints	• Minimization of the comparison cost is developed as a combinatorial optimization problem.
Kernel based Tracking	Mean shift method	• Requires less amount of calculations to be done hence can be used in real time applications. • It find the peaks in a set or distribution of data samples within the region of interest. • It is more robust with respect to other trackers and can track for a longer time as it is an iterative process.	• Iterations go into the local maximum easily
	Simple template matching	• Wit reference image is usually detected by Simple Template Matching • It is robust to distractions, clutter and occlusions. • Template matching plays a major role in the verification of the frame that is being separated from the video	• If object and background has same color then it cannot give good results.
Knade Lucas Tomasi		• It finds the region of interest and they are followed through image sequence which can be used in problems like recognition of object, tracking of object. • KLT detects face based on the eigenvectors detected from the first frame and uses features for tracking but it fails to track if displace is large	• It is another source of potential counterpart as each calculation of these parameters is uncontrolled.
Tracking Learning Detection (TLD)		• Long-term tracking of erratic objects in unconstrained conditions TLD has been designed. • TLD tracks the object, learns its appearance and detects it whenever it appears in the video. The result is a real-time tracking .	• Tracking becomes a difficult task under the following agile moving objects, in the presence of dense background clutter, probabilistic algorithms are essential.

XIII. TRACKING LEARNING DETECTION

Tracking Learning Detection (TLD) method became a favored visional tracking algorithm as it provides long term tracking results. For long-term tracking of erratic objects in unconstrained conditions TLD has been designed.

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The visual object was tracked and concurrently accomplished in order to build a detector which supports the tracker which has failed once. The detector was framed by the information provided by the tracker as well as information from the first frame. It is used in Long-term tracking of erratic objects in unconstrained conditions TLD has been designed.

XIV. CONCLUSION

This paper presents the study of various object detection and object tracking methods and their comparative analysis and every method has its own advantages and disadvantages. So this clearly indicates that in order to accurately detect and identify the object one approach is not enough so mix approach in this field will result the better estimates.

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