# Current Scenario of Object Tracking: A Survey

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*Abstract*— **In current scenario,a computer system has been taken as the most efficient system to detect and overcome the limitations in any technical field.In this survey paper,object tracking is taken into consideration. As the number of cameras used in the wide area video surveillance increases, multi-camera object tracking plays a more important role in understanding and analyzing the scenes. It is challenging problem.An object tracking is simply a problem of finding the different positions of the object in each frame of a video. Object tracking quality usually depends on video scene conditions.If we are able to detect and find the solution to the limitations,object tracking process will be successful without any lacunas.**

***Keywords: Bounday, Contour Tracking, Illumination, Occlusion.***

## 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. Therefore, the use of object tracking is pertinent in the tasks of:

—motion-based recognition,that is, human identification based on gait, automatic object detection,etc;

—automated surveillance, that is, monitoring a scene to detect suspicious activities or unlikely events;

—video indexing, that is, automatic annotation and retrieval of the videos in multimedia databases;

—human-computer interaction, that is, gesture recognition, eye gaze tracking for data input to computers, etc.;

—traffic monitoring, that is, real-time gathering of traffic statistics to direct traffic flow.

—vehicle navigation, that is, video-based path planning and obstacle avoidance capabilities.

In its simplest form, tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. In other words, a tracker assigns consistent labels to the tracked objects in different frames of a video. Additionally,depending on the tracking domain, a tracker can also provide object-centric information, such as orientation, area, or shape of an object. Numerous approaches for object tracking have been proposed. These primarily differ from each other based on the way they approach the following questions: Which object representation is suitable for tracking? Which image features should be used? How should the motion, appearance, and shape of the object be modeled? The answers to these questions depend on the context/environment in which the tracking is performed and the end use for which the tracking information is being sought. A large number of tracking methods have been proposed which attempt to answer these questions for a variety of scenarios. The goal of this survey is to group tracking methods into broad categories and provide comprehensive descriptions of representative methods in each category. Our survey is focused on methodologies for tracking objects in general and not on trackers tailored for specific objects.In the next section we will discuss about the challenges faced in object tracking.

## II. CHALLENGES IN OBJECT TRACKING

There are lots and lots of challenges in object tracking which leads to difficulties in proper and error free tracking.Few of those challenges are listed below:

—loss of information caused by projection of the 3D world on a 2D image,

—noise in images,

—complex object motion,

—nonrigid or articulated nature of objects,

—partial and full object occlusions,

—complex object shapes,

—scene illumination changes,

—real-time processing requirements

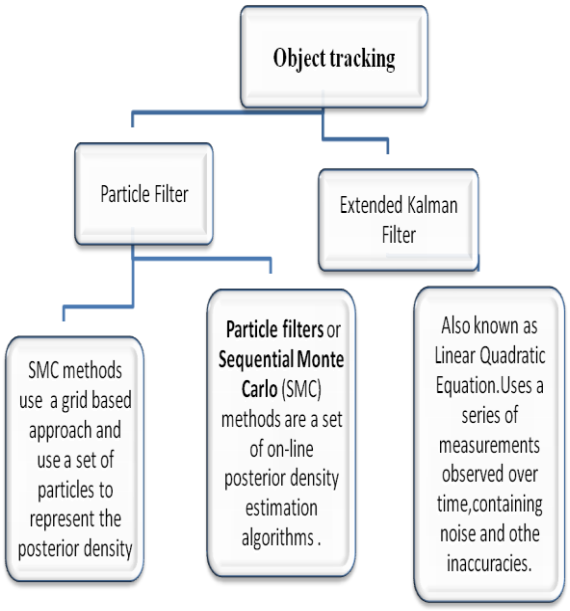
— No sudden changes in the background

—Gradual changes in the appearance of object

— Fixed camera

—Number and size of objects

III. METHODS/ALGORITHMS OF OBJECT TRACKING




IV. PAPERS USING THE ABOVE METHODS

In this section we will discuss about the proposed schemes by different authors using the methods and algorithms mentioned in section 3.

*A. A Particular Object Tracking in an Environment of Multiple Moving Objects*

Multiple object tracking has many practical applications in scene analysis for automated surveillance. If we can track a particularly selected object in an environment of multiple moving objects, then there will be a variety of applications. In this paper,Hyung-Bok Kim et al. has introduced a particular object tracking in an environment of multiple moving objects. When tracking, we need to analyze video sequences to track object in each frame. In this paper,they used a differential image of region-based tracking method for the detection of multiple moving objects. In other to ensure accurate object detection in unconstrained environment, we also use a method of background image update. There are problems in tracking a particular object through a sequence of video. It can't rely only on image processing techniques. In this paper, the 'particle filter' provides a robust object tracking framework under ambiguity conditions and greatly improved estimation accuracy for complicated tracking problems. Particle filter provides a robust object tracking framework under ambiguity conditions and estimation accuracy for particular object trackin problems.Particle filter have been widely introduced as a powerful and flexible tool.Particle filter provides an accurate estimate with low error variance, which is critical in object motion tracking. They are sensitive to background distraction,clutter, occlusions, and quick moving objects. There are difficulties related to particular object tracking, such as erratic object motion, cluttered background and other moving objects.It can't rely only on image processing techniques. Thus these problems were solved using a Particle filter. Particle filter has been proven to be a robust algorithm to deal with the nonlinear, non-Gaussian problems.It provides a robust object tracking framework under ambiguity conditions and estimation accuracy for particular object tracking problems.

*B. Continuously Tracking and See-through Occlusion Based on A New Hybrid Synthetic Aperture Imaging Model*

A novel hybrid synthetic aperture imaging model is proposed by Tao Yang et al. to solve this problem. The main characteristics of this approach include:
(1)This algorithm is the first time to solve the occluded people imaging and tracking problem in a joint multiple camera synthetic aperture imaging domain.
(2)A multiple model framework is designed to achieve seam-less interaction among the detection, imaging and track-ing modules.
(3)In the object detection module, a multiple constraints based approach is presented for people localiz-ing and ghost objects removal in a 3D foreground silhou-ette synthetic aperture imaging volume.
(4) In the synthetic imaging module, a novel occluder removal based synthetic imaging approach is proposed to continuously obtain object clear image even under severe occlusion.
(5) In the object tracking module, a camera array is used for robust peo-ple tracking in color synthetic aperture images. A network camera based hybrid synthetic aperture imaging system has been set up, and experimental results with qualitative and quantitative analysis demonstrate that the method can reli-ably locate and see people in challenge scene. The proposed foreground synthetic aperture detection, the camera array synthetic aperture imaging and tracking module achieve low false alarm rate and good imaging and tracking result in challenge crowded scene. The proposed scheme doesnot remove the occlusion problem in total rather it lowers the false alarm rate.So,a better approach can be made to remove the occlusion problem. A novel hybrid synthetic aperture imaging based algorithm for automatically detection, tracking and seeing multiple people through occlusion with multiple surrounding cameras and a camera array is proposed in this paper.This approach is designed for complex scene where significant occlusions occur frequently. Extensive experiments show that the proposed foreground synthetic aperture detection, the camera array synthetic aperture imaging and tracking module achieve low false alarm rate and good imaging and tracking result in challenge crowded scene.But,the proposed scheme doesnt result in total removal of occlusion and complex intersection among objects.So,further a better approach can be made to remove the mentioned problem.

*C. Fuzzy control for obstacle detection in object tracking*

To solve the occlusion problem a combined tracking system based on optical flow and adaptive filters is proposed by Eduardo Parrilla et al**.**. The critical point of the system is the coupling between optical flow and predictive algorithms. This coupling is governed by parameters such as tolerance, the absolute value of the difference between the value of velocity calculated by the optical flow and the estimated value. In this paper, we propose the use of a fuzzy control system to solve this coupling problem between the different velocities. This method is able to correct possible errors in the optical flow calculation, besides handling occlusion. This fuzzy system provides a great robustness and a low computational cost. This technique also can detect and correct errors in the object tracking. Lenthy process. The use of a fuzzy controller to combine the velocities calculated by an optical flow algorithm and the ones estimated by an adaptive filter in order to predict the target movement is done and approximate its trajectory when the target disappears. This fuzzy system provides a great robustness and a low computational cost and detects errors and corrects them in object tracking.

*D. Multiple object tracking with partial occlusion handling using salient feature points*

A multiple object tracking method in the presence of partial occlusion using salient feature points is proposed by M.M. Naushad Ali et al**.** .First the prominent feature points from each target object is extracted, and then a particle filter-based approach to track the feature points in image sequences based on various attributes such as location, velocity and other descriptors is used.Then the feature points that have been tracked incorrectly are detected and revised. The main idea is that, even if some feature points are not successfully tracked due to occlusion or poor imagin condition,the other correctly tracked features can collectively perform the corrections on their behalf.

Robust tracking in the presence of partial occlusion. Appropriate human tracking and occlusion handling. The proposed algorithm does not successfully track feature points with different velocities (different in either speed or direction). In the proposed method,the incorrectly tracked feature points are detected through the outlier analysis and revised according to their previous relative locations. To track the SFPs in the occluded part of an object, the velocity of an overlapped SFP is replaced with the object velocity, thus achieving robust tracking in the presence of partial occlusion.But ,there are some limitations in the proposed method like it cannot successfully track feature points with different velocities.To handle such situations, more flexible representation of objects is needed.Moving camera based application may overcome the limitations.

*E. Object Tracking System Based on Invariant Features*

Modern Tracking algorithms treat tracking as a binary classification problem between the object class and the background class. Difficulties in tracking objects can arise due to abrupt movement of object, changing appearance patterns of the object and the scene, structure-less object, object-to-object and object-to-scene occlusions and camera motion. In this paper, the use of Distance Metric Learning (DML) in combination with Nearest Neighbor(NN) classification for object tracking is proposed by S. Mahendran et al. .An object tracking system has been modeled to track an object present in a video. This kind of technique is very much useful in systems where the video surveillance is needed the most. It performs well for action, expression, illumination and varying background. It also improves the accuracy of the tracking device. The learning system provides the trace of the object and detects the error occurring in frame to frame. The proposed tracking system fails when person skin colour is not identified.

The combination of the Nearest Neighbor and Distance metric Learning algorithm is compared with the accuracy results of the LEGO algorithm and MIL tracking algorithm. The result produced by the proposed model is more accurate than the already trained and compared algorithms.The system is tested in real time object tracking. It tends to extract the feature and identifies the person in database.The database is used to store the person's images which are needed to be tracked. As the system works on the skin colour the black & white videos can be used but when the background is similar to that of the image it fails to track the object. Tracking can be made easier for multiple persons in a video by designing an effective algorithm. It also improves the accuracy of the tracking device. The learning system provides the trace of the object and detects the error occurring in frame to frame.

*F. Object Tracking Using Joint Enhanced Color-Texture Histogram*

Object tracking is an important task within the field of computer vision. In this paper which is proposed by Manoj Diwakar et al., color information of object are extracted as well as texture information is also extracted by using local binary pattern technique to represent the object. In joint color-texture histogram region of interest is extracted and then edges and corners are extracted from the region of interest. Local Binary Pattern method is used which is much more efficient than colour histogram. Combination of color feature and texture feature enhance feature extraction quality. It overcomes the problem of color aberration caused by light changing.. All formats of video are not supported by this system. In proposed technique, object tracking is done using features of target object. For feature extraction color and texture features of the target object are used.Combination of color feature and texture feature enhance feature extraction quality. To overcome the color aberration problem texture features are used. Texture features extract edges and corner features of the target effectively in the target region, which characterize better and represent more robustly the target.The

proposed method can be improved for tracking multiple objects in one frame simultaneously.

*G. Object Tracking with Serious Occlusion Based on Occluder Modeling*

Occlusion is one of the challenging problems in object tracking, and plenty of tracking methods have been proposed to cope with this issue. To cope with this problem,in this paper Peng Wang et al. proposed a novel method for object tracking with serious and long-time occlusion in image sequences based on occluder modeling. Occluder is modeled by detecting and evolving its rough partial contour represented by snake points, through minimizing the proposed energy function in which two novel terms are introduced: the push force and constraint force. Then**,**we search the tracked object around the neighborhood of the occluder contour until the object reappears. Works effectively on real sequences with total and long-time occlusions in image sequences acquired from both stationary and moving cameras. Its confusing when it comes to differentiate between two similar colours.For eg. the face is tracked with complete and long-time occlusion, but it is easy to be confused by the hand which has the similar colour feature with the face. This paper proposes a method for tracking object with serious and long-time occlusion in image sequences based on occluder modeling. It aims at not only modeling the object,but also modeling the occluder using improved snake algorithm, when occlusion happens. Occluder is modeled by detecting and evolving its rough partial contour which is represented by snake points, through minimizing the proposed energy. Then, we search the object in the neighbourhood of the occluder contour until the object reappears. The experimental results demonstrate the robust performance of the proposed method under total and longtime occlusion in image sequences acquired from both stationary and moving cameras.

*H. Robust object tracking using a context based on the relation of object and background*

Object tracking is complicated by perspective changes to both the object and background caused by object and the camera motion, object-to-object and object-to-background occlusion and illumination changes. A context aware tracking by a collaborative model of both the object and its surrounding background is proposed by Takayoshi Yamashita et al**.** in this paper.In this model the "probability of tracking failure" that determines the feature similarity and the spatial relationship of the target and the surrounding background, as the "target-surrounding context",which appears effective to predict the likelihood of a tracking failure is introduced. The target-surrounding context prevents tracking failure where the background has similar object. The proposed method can track an object even in complex scenes with similar objects occluding or in the near vicinity. There is less probability of tracking failure . Tracking fails for objects with similarities to the background or when occluded by similar objects as it is difficult to discriminate the target from the background.

A novel tracking model that focuses not just on the target object but also on target-surrounding context defined by surrounding regions as a new object-tracking technique is proposed.The proposed method seeks to understand the context in regions surrounding the target object and to change tracking behaviour accordingly so that similar objects or background regions are not erroneously track.

*I. Robust real-time object tracking under varying illumination condition*

A novel method is proposed here for extracting target objects from real time video and then tracking them under varying illumination condition by Deepak Kumar Panda et al..This method uses homomorphic filtering to overcome varying illumination condition. The illumination component of an image has slow spatial variations. Homomorphic filter is employed to reject very low frequency components that usually represent illumination variation. A good control over the illumination and reflectance components can be done with homomorphic filter. This system requires less data storage for storing the video files in the memory. It is cost-effective. Robust and efficient object tracking system. Inability to perfectly judge the distance between the background and the foreground.

A novel method for multi-camera detection and tracking using smart sensor network is proposed The algorithm works fine with all kind of video data set taken. The system uses no color information and works on the grayscale video imagery. Each video camera is connected to a separate sensor and it starts acquisition only when the sensor gives trigger signal to the video camera. So this system requires less data storage for storing the video files in the memory.The proposed system is implemented using low-cost webcams.The proposed method is tested and demonstrated to perform well with 2-D imagery. The limitation of the scheme is its inability to perfectly judge the distance between the background and the foreground.So,to overcome such limiations a new scheme can be proposed in 3-D imagery.

*J. A graph-based, multi-resolution algorithm for tracking objects in presence of occlusions*

One of the main difficult problem in video analysis is to track moving objects during a video sequence, especially in presence of occlusions.In this paper a novel method of tracking objects through occlusions that exploits the wealth of information due to the spatial coherence between pixels, using a graph-based, multi-resolution representation of the moving regions is presented by Donatello Contea et al.. An efficient algorithm**.** Robustness and the speed of the process is not upto the mark. A novel approach to object tracking in presence of occlusion. The paper base itself on a graph pyramid representation of moving regions. The tracking is performed by a comparison between regions of adjacent

frames. The comparison is performed at different resolution levels to label multiple objects regions (case of occlusion).Though the proposed algorithm is efficient but lacks in speed and robustness, more development is needed in this process.

*K. Automatic illumination correction for scene enhancement and object tracking*

An important challenge for any vision system is to accommodate varying illumination conditions.Arvind Nayak et al. deviced an automatic correction scheme that transforms images under some unknown illumination to match an illumination model learnt for a known illumination.This method tests the scheme on
both color and gray level imaging scenarios. Skin color based hand tracking is the reference problem for testing the scheme in color imaging scenario. This approach enables a reliable tracking of hand in image sequences with wide variations in illumination.
Provides robustness to the tracker against variations in illumination.

Usefulness in developing a contrast transform mechanism to improve contrast in poor quality images. Change in illumination conditions may lead to failure of this method. A neural network based approach to maintain color constancy for assisting a skin color based tracker is proposed. The neural network implements a back propagation learning rule. The performance of color constancy approach is verified using a Condensation based tracker for sequences in both uncluttered and cluttered environments.This method is having many advantages but in changing illumination condition it fails.So,a better approach can be made in order to overcome the limitation.

*L. Handling occlusion in object tracking in stereoscopic video sequences*

In this paper,simple algorithms for three-dimensional tracking objects in a stereo video sequence, by combining optical flow and stereo vision is proposed by Eduardo Parrilla et al**.**. This method is not able to handle the occlusion of the moving objects when they disappear due to an obstacle. To improve the performance of this method, the use of adaptive filters and neural networks to predict the expected instantaneous velocities of the objects is proposed.In the previous works, this system has been successfully proved in two-dimensional tracking. Handles occlusion of moving objects. If velocities change then its difficult to track the object. In this method,a system to track objects in the three-dimensional space by combining optical flow and stereo vision is proposed.Occlusion problem in object tracking in a stereo video sequence has been analysed. The use of adaptive filters and neural networks to predict the velocity of the object in the left and right sequences is proposed.A RLS filter to work with two correlated signals simultaneously has been adapted.

*M. Handling occlusion in optical flow algorithms for object tracking*

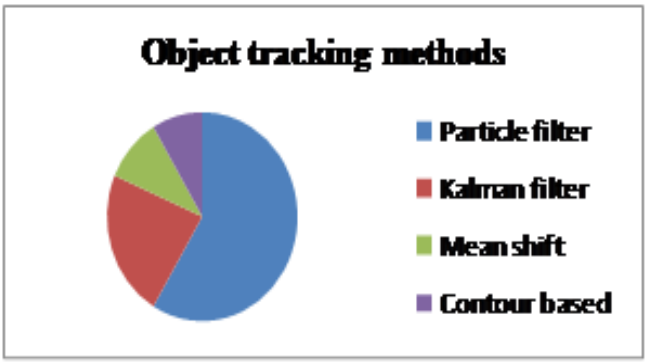
In this paper,simple algorithms for tracking objects in a video sequence is proposed by Eduardo Parrilla et al**.**, based on the selection of landmark points representative of the moving objects in the first frame of the sequence to be analyzed. The movement of these points is estimated using a sparse optical-flow method.The use of adaptive filters and neural networks to predict the expected instantaneous velocities of the objects, using the predicted velocities as indicators of the performance of the tracking algorithm.The efficiency of these strategies in handling occlusion problems are tested with a set of synthetic and real video sequences. Fast method**.** Less adaptability and tolerance to noisy data. In this method,the occlusion problem in object tracking in a video sequence has been analysed.The use of adaptive filters and neural networks is proposed to predict the target movement and approximate its trajectory when the target disappears.On the other hand,the effect that parameter values produce in the performance of the method, obtaining an optimal tolerance value is proposed.But,due to less adaptability and tolerance to noisy data,a better approach can be made to overcome the limitation.

*N. Hierarchical fuzzy logic based approach for object tracking*

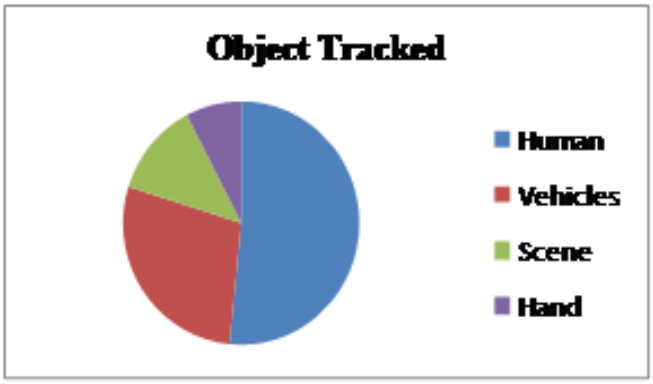
In this paper a novel tracking approach based on fuzzy concepts is introduced by Nuno Vieira Lopes et al.. A methodology for both single and multiple object tracking is presented. The tracking task is performed through the fusion of these fuzzy models by means of an inference engine. This way,object detection and matching steps are performed exclusively using inference rules on fuzzy sets. In the multiple object methodology, each object is associated with a confidence degree and a hierarchical implementation is performed based on that confidence degree. Maintains the needed accuracy, reduce the complexity usually involved in object tracking problems. Less robustness, Computational efficiency over different image sequences is low. A new fuzzy tracking system is introduced. Both single and multiple tracking methodologies are presented. Possible implementations of such methodologies are presented. Through the construction of three fuzzy sets related either with kinematic and non-kinematic properties of the object and with a construction of an inference engine with three rules the proposed fuzzy single object tracking methodology is implemented.The proposed method is having some advantages but there are few limitations also.So,futher approach can be made to overcome the limitations like performance evaluation of different distinctive object properties such as shape, texture and other object descriptors, in order to construct suitable fuzzy sets and introduce new rules in the inference engine.

## V. DISCUSSION

According to me,the most efficient method for tracking of objects is particle filter method.Though there are many other methods which are having much more advantage than this method but if we see these methods are having some limitations too which is less in particle filter with respect to other methods. **Particle filters** or **Sequential Monte Carlo** (SMC) methods are a set of on-line posterior density estimation algorithms that estimate the posterior density of the state-space by directly implementing the Bayesian recursion equations. SMC methods use a grid-based approach, and use a set of particles to represent the posterior density. These filtering methods make no restrictive assumption about the dynamics of the state-space or the density function. SMC methods provide a well-established methodology for generating samples from the required distribution without requiring assumptions about the state-space model or the state distributions. Particle filters are incredibly versatile and robust.Particle filters can model any probability distribution - continuous or discrete. Against this, Kalman filters - while orders of magnitude faster - only work with approximate gaussians under approximate linearity.So,according to my view particle filter method is the most efficient one.




**Pie chart showing which object tracking method is being implemented the most.**




**Pie chart showing which object is being tracked the most.**

## VI. CONCLUSION

This paper is intended to give an idea about a number of major object tracking methods and algorithms.There are different type of methods available.But,as we see,the particle filter method is mostly used here.In this paper, effort has been made to discuss about advantages and diadvantages of each different method minutely.We have also analyzed which object has been tracked the most.Though there are many approaches having their own advantages and limitations,there is a lot of scope and opportunities to analyze and develop more an effective method for error free object tracking.

**A short and simple representation of the above discussion is given in this following table.**

| Name Of Author | Year of publication | Object tracking Method | Object Tracked | Advantage | Disadvantage |
|---|---|---|---|---|---|
| Hyung-Bok Kim et al.[1] | 2010 | Particle filter | Multiple moving objects | Particle filter provides a robust object tracking framework under ambiguity conditions and estimation accuracy for particular object tracking problems.It has been widely introduced as a powerful and flexible tool.It provides an accurate estimate with low error variance, which is critical in object motion tracking. | They are sensitive to background distraction, clutter, occlusions, and quick moving objects. |
| Tao Yang et al.[2] | 2011 | Kalman filter | Human | The proposed foreground synthetic aperture detection, the camera array synthetic aperture imaging and tracking module achieve low false alarm rate and good imaging and tracking result in challenge crowded scene | The proposed scheme doesnot remove the occlusion problem in total rather it lowers the false alarm rate. |
| Eduardo Parrilla et al.[3] | 2010 | Optical flow | vehicles | This method is able to correct possible errors in the optical flow calculation, besides handling occlusion. This fuzzy system provides a great robustness and a low computational cost.This technique also can detect and correct errors in the object tracking. | Lenthy process |
| M.M. Naushad Ali et al.[4] | 2014 | Particle filter | vehicles | Robust tracking in the presence of partial occlusion. Appropriate human tracking and occlusion handling. | The proposed algorithm does not successfully track feature points with different velocities (different in either speed or direction). |
| S. Mahendran et al.[5] | 2013 | DML NN | Human | It performs well for action, expression, illumination and varying background. It also improves the accuracy of the tracking device. The learning system provides the trace of the object and detects the error occurring in frame to frame. | The proposed tracking system fails when person skin colour is not identified. |

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|---|---|---|---|---|---|
| Manoj Diwakar et al.[6] | 2013 | Mean shift algorithm | vehicles | Combination of color feature and texture feature enhance feature extraction quality.<br>It overcomes the problem of color aberration caused by light changing. | All formats of video are not supported by this system |
| Peng Wang et al.[7] | 2012 | Contour tracking | Human | Works effectively on real sequences with total and long-time occlusions in image sequences acquired from both stationary and moving cameras. | Its confusing when it comes to differentiate between two similar colors.For eg. the face is tracked with complete and long-time occlusion, but it is easy to be confused by the hand which has the similar colour feature with the face. |
| Takayoshi Yamashita et al.[8] | 2013 | Kernel based tracking | Human | The target-surrounding context prevents tracking failure where the background has similar object.<br>Can track an object even in complex scenes with similar objects occluding or in the near vicinity.<br>. | There is less probability of tracking failure |
| Deepak Kumar Panda et al.[9] | 2011 | Differential method-Homomorphic filtering<br>- Gamma Correction<br>- Frame Differencing<br>- Image Labeling<br>- Object Representation | Human | A good control over the illumination and reflectance components can be done with homomorphic filter.<br>This system requires less data storage for storing the video files in the memory.<br>Cost-effective.<br>Robust and efficient object tracking system | Inability to perfectly judge the distance between the background and the foreground |
| Donatello Contea et al.[10] | 2006 | Feature Extraction method | Scene | An efficient algorithm. | Robustness and the speed of the process is not upto the mark |
| Arvind Nayak et al.[11] | 2006 | Contour Method | Hand | Provides robustness to the tracker against variations in illumination.<br>Usefulness in developing a contrast transform mechanism to improve contrast in poor quality images. | Change in illumination conditions may lead to failure of this method |
| Eduardo Parrilla et al.[12] | 2009 | Optical flow | 3-D Objects in stereo video sequence | Handles occlusion of moving objects. | If velocities change then its difficult to track the object. |

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|---|---|---|---|---|---|
| Eduardo Parrilla et al.[13] | 2008 | Optical flow Lucas and Kanade algorithm | vehicles | Fast method.<br>. | Less adaptability and tolerance to noisy data |
| Nuno Vieira Lopes et al[14] | 2013 | Kalman filter | Human | Maintains the needed accuracy, reduce the complexity usually involved in object tracking problems. | Less robustness, Computational efficiency over different image sequences is low. |

## REFRENCES


[1] P. Salesmbier, L. Torres, F. Meyer and C. Gu, "Region-based Video Coding Using Mathematical Morphology," Proc. of the IEEE, Vol. 83, No. 6,pp. 843-857, 1995. Harris C. & Stennett C. "Rapid - A Video Rate Object Tracker", Proc. British Machine Vision Conference, BMVC-90, Oxford, pp.73-77, 1990.

[2] A. Yilmaz, X. Li, and M. Shah. Object tracking: A survey.ACM J. Computing Surveys, 2006.X.G.Wang, K.Tieu, and W.E.L.Grimson. Correspondencefree activity analysis and scene modeling in multiple camera views. *TPAMI*, 32(1):56-71, 2010

[3] B.K.P. Horn, B.G. Schunck, Determining optical flow, Artificial Intelligence 17 (1_3) (1981) 185_203.B.D. Lukas, T. Kanade, An iterative image registration technique with an application to stereovision, in: Proceedings of Imaging Understanding Workshop, 1981, pp. 121_130.

[4] J. Allen, R. Xu, J. Jin, Mean shift object tracking for a SIMD computer, in: Proc. Int. Conference on Information Technology and Applications, Sydney,Australia, 2005, pp. 692–697.
E. Amer, E. Dubois, A. Mitiche, Real-time system for high-level video representations: application to video surveillance, in: SPIE International Symposium on Electronic Imaging, 2003, pp. 530–541.

[5] A.Yilmaz, and O.Javed, and M.Shah, "Object Tracking –A Survey,"ACM computer surveys, vol. 38, No. 4, pp. 1-45, 2006.
L.Wang, W.hu, and T.Tan," Recent Development in human motion analysis,"pattern recognition,vol. 36, no. 3, pp.585-601, 2003.

[6] Zhiyu Zhou, KaikaiLuo, Yaming Wang, Jianxin Zhang,"Object Tracking based on Multi-feature Fusion and Motion Prediction", Journal of Computational Information Systems 7: 16 (2011) 5940-5947D. Comaniciu, V. Ramesh and P. Meer, "Kernel-based object tracking", IEEE Trans Patt. Anal. Mach. Intell. **25**(5) (2003) 564–575.

[7] A. Senior, et al. "Appearance Models for Occlusion Handling", In *Second International workshop on Performance Evaluation of Tracking and Surveillance systems*, 2001.
T. Yang, S. Z. Li, Q. Pan, J. Li, "real-time multiple objects tracking with occlusion handling in dynamic scenes", In Proc. IEEE Conference on Computer Vision and Pattern Recognition, 2005.

[8] M. J. Black and A. D. Jepson. Eigentracking: Robust matching and tracking of articulated objects using a view-based representation. International Journal of Computer Vision, Vo1.26, No.1, pp.63-S4, 1995.M. Isard and A. Blake. CONDENSATIONConditional Density Propagation for Visual Tracking.International Journal of Computer Vision, Vo1.29, No.1, pp.5-2S, 1995

[9] Hanna Goszczynska, Object Tracking, Intech publication. R. Collins, A. Lipton, T. Kanade, H. Fujiyoshi, D. Duggins, Y. Tsin,D. Tolliver, N. Enamoto, and Hasegawa, "System for Video Surveillance and monitoring, Technical Report CMU-RI-TR-00-12," Robotics Institute, Carneige Mellon University, 2000.

[10] T.J. Olson, F.Z. Brill, Moving object detection and event recognition algorithm for smart cameras, Proceedings of DARPA Image Understanding Workshop, 1997, pp. 159–175.
D. Conte, P. Foggia, C. Guidobaldi, A. Limongiello, M. Vento, An object tracking algorithm combining different cost functions, Lecture in Computer Science, vol. 3212, Springer, Berlin, 2004, pp. 614–622

[11] J.P. Mammen, S. Chaudhuri, T. Agrawal, Hierarchical recognition of dynamic hand gestures for telerobotic application, IETE Journal of Research Special Issue on Visual Media Processing 48 (3/4) (2002)245–252.J.B. Martinkauppi, M.N. Soriano, M.H. Laaksonen, Behaviour of skin color under varying illumination seen by different cameras at different color spaces, in: M.A. Hunt (Ed.), Proceedings of the SPIE, Machine Vision in Industrial Inspection IX, vol. 4301, San Jose, CA, 2001, pp. 102–113.

[12] E. Trucco, K. Plakas, Video tracking: A concise survey, IEEE Journal of Oceanic Engineering 31 (2) (2006) 520–529. C¸ .E. Erdem, A.M. Tekalp, B. Sankur, Video object tracking with feedback of performance measures, IEEE Transactions on Circuits and Systems for Video Technology 13 (4) (2003) 310–324.

[13] S.D. Cochran, G. Medioni, 3-D surface description from binocular stereo, IEEE Transactions on Pattern Analysis and Machine Intelligence 14 (10) (1992)981_994.E. Parrilla, J. Riera, M.H. Giménez, J.R. Torregrosa, J.L. Hueso, Cálculo de velocidades mediante un sistema estereoscópico y algoritmos de flujo óptico,Congreso de Ecuaciones Diferenciales y Aplicaciones (2005).

[14] W. Hu, T. Tan, L. Wang, S. Maybank, A survey on visual surveillance of object motion and behaviors,, IEEE Transactions on Systems, Man, and Cybernetics,Part C: Applications and Reviews 34 (2004) 334–352. M. Liu, C. Wu, Y. Zhang, A review of traffic visual tracking technology, in:Proceedings of the International Conference on Audio, Language and Image Processing ICALIP, 2008, pp. 1016–1020.