

# A Review on Multiple Vehicle Detection and Tracking in Dynamic Environment

D. Sudha\*, J. Priyadarshini\*\*

**Abstract:** In this paper we review a novel algorithm Supervised Learning which is AI based approach and giving the system to training using Haar training algorithm and Clustering algorithm for tracking multiple vehicle objects in dynamic environments wherein under illumination conditions and the surrounding infrastructure is known. The proposed technique relies on trained and tested data provided by a haar training algorithm from processing features in each frame and simultaneously detecting background and foreground vehicles to ensure robust detection without collision. The method AdaBoost classifier is to classify its different features based on appearance and its motion based extraction from the region of interest. Unlike other existing methods that track rigid objects using rigid representations and also we reviewed object tracking used an enhanced particle filter-based method for multiple vehicle tracking based on appearance-based free-form obstacle representations. During this process, the particle state is described by two components, i.e., the object's dynamic parameters and its estimated geometry. In order to solve these issues, an extended kalman particle filter is used. By accurately modeling the multiple object geometry using the rectangular box instead of a 3-D box and at the same time, separating the position and speed tracking from the geometry at the estimator level, the proposed method combines the efficiency of the robust detection and handles occlusion and collision in a dynamic environment.

**Keywords:** Supervised Learning; AdaBoost Classifier; Haar Training; Dynamic Environment; Particle Filter

## 1. INTRODUCTION

Due to the vehicle based multiple moving object tracking and detection is one of the vital missions in the field of computer vision such as visual surveillance, human computer interactions, Intelligent Transportation systems etc. In general, Multiple Object tracking [5] is a hot challenging problem. Researches and scientists put more efforts on account of vehicle tracking which is usually performed in the location and/or shape of the object in every frame. While consideration of multiple vehicles tracking is an object which can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. [4]Despite, a tracker assigns reliable labels to the tracked objects in different frames of a given video. Difficulties in tracking objects can arise due to abrupt object motion, changing appearance patterns of the object and the scene, non-rigid object structures, object-to-object and object-to-scene occlusions, and camera motion and changing environments as of different kinds dynamic, cluttered and complex etc.

Tracking objects is more complex due to loss of information caused by projection of the 3D world onto a 2D image, noise in images, complex object motion, non-rigid or articulated nature of objects, partial and full object occlusions, complex object shapes, scene illumination changes and real-time processing requirements[13][14].

The benefits over multiple vehicle tracking is applicable in the tasks of predicting the traffic flow, real-time monitoring based on motion-recognition, that is, human and vehicle identifications based on its posture and appearance respectively, automatic object detection; automated surveillance and extend the applications

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\* Research Associate, School of Computing Science and Engineering, Vellore Institute of Technology, Chennai, Email: dsudha.89@gmail.com

\*\* Associate Professor, SCSE, Vellore Institute of Technology, Chennai, 600127, Email: priyadarshini.j@vit.ac.in

use of 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, 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.

Single object detection is much easier to detect as well as track than multiple vehicle detection because of its different parameters and collisions among them. In order to solve these issues of collisions and occlusion is used a technique is clustering algorithm / Supervised Learning Algorithm [3][4] along with haar training algorithm for system automation to detect the object which is a region of interest and also enhance the process of applied over the techniques are particle and kalman filter is to apply the processes of vehicle detection in both linear and non-linear motion of the given input video i.e. an input of 20 frames per second.

Almost most of the related works reviewed by the several scientists and researchers in the field of intelligent transportation systems are suggested these two as a challenging problem such as collision and occlusion for predicting traffic flow and monitors lane changing. It occurs in the circumstances of multiple object detection and tracking which are used to solve these kinds of problems are taken for the technique of multiple tracking algorithm, collision avoidance algorithm, potential and kinetic energy

A necessity of object tracking is more for various applications especially in the field of Intelligent Transportation systems because to reduce the traffic flow, Collision avoidance, Occlusion Handling etc. In this Paper mainly concentrates the review work on giving the training to system using Haar training algorithm for detecting the objects in a region of interest and Multiple Layer Perceptron with Multiple object tracking algorithm use to tracking multiple vehicle objects in dynamic environments with illumination condition.

The following section 2 describes detailed related works which is most relevant for detection as well as tracking and in section 3 contains the work of detailed methodologies for detection and tracking and its process representation follows the section 4 conclusion and future work.

## 2. RELATED WORK

A.Alahi et.al (2014) [1] contributed a method for detecting pedestrians by used the monocular automotive setting. The benefit of this monocular pedestrian detection was to optimize the transmission bandwidth and is also reduced computational time by 76.2%. Pedestrian detection is applicable only in the urban environments with limited resources for tracking the multiple vehicles is the major drawback for the system. The proposed work does not limit the tracking resources and pedestrian detection is also possible.

Feng You et.al (2015) [2] gave a new approach Advanced Driver Assistance System (ADAS) for detecting both trajectory planning and trajectory tracking. This approach displayed a polynomial curve with continuous curvature which is simple to be followed during the lane change was the major advantage. For continuous lane change the polynomial curve could not be developed was the major drawback.

Harish Baskar et.al (2015) [3] presented a method of autonomous multiple target detection and tracking for dynamics scenes. This method gave exact solutions for detection and tracking in spite of various illuminations changes, by Dynamic Reverse Analysis and Enhanced Rao-Blackwellized particle filter. However, this was achieved only through a series of assumptions made on the background modeling with a limited number of available targets. In the proposed method, training is given for the object detection and hence no assumptions and limitations are made for object detection and tracking.

Motion and appearances of moving objects in roundabouts, based on monocular system was stated by Hamid Hassannejad (2015) [6]. The method used to detect Haar-like features along with soft-cascade AdaBoost was used for detecting the moving vehicles. The detection rate yielded more accuracy but it

limits to the maximum speed (i.e.) 6 km/hr. The proposed method supports Haar training algorithm and AdaBoost classifier for detection of vehicle and there is no limitation on the speed.

A system for vehicle tracking and classification from data-driven approach was stated by Sebastiano et.al (2015) [7]. The main intention of this method was to monitor traffic flow. The drawback was limits the application are occlusion, collision were not handled by this method. The proposed work handles occlusions and collisions in dynamic environment.

Nazhao et.al (2015) [8] presented adaptive partial occlusion segmentation method of locating the regions, optical flow and line scanning method for multiple vehicles tracking. The advantage of these methods was that the candidate regions of occluded vehicles were predicted effectively. This method failed in collision detection and collision avoidance. The proposed methodology concentrates on collision avoidance system.

Chieh-Ching Wang et.al (2015) [9] introduced a techniques Interacting Multiple Model (IMM) estimation algorithm and multiple hypothesis tracking algorithms are used for tracking. The main intention of this method was covered limited area, i.e., urban area. The demerit of this method consumed very high power when simultaneous localization and mapping done. In the proposed methodology concentrates on multiple object detection in dynamic environment.

Taewung Kim and Hyun-Yong Jeong (2014) [10] done a method on detection of imminent collision in road scenes by multiple model particle filter. The benefit over the method is false-positive alarms and nuisance was reduced. The drawback of these method was insensitive warning times when beyond 150 km/hr. The Proposed methodology concentrates on multiple tracking and occlusion handling in dynamic environment.

Xiao Liu et.al (2015)[11] addressed a problem of tracking multiple objects by detection framework with the help of online tracking. The benefit over the method was incorporated to track multiple objects accurately. Tracking can be done for a particular area where camera is fixed and does not deal with collisions was the major limitation. The proposed work focused on tracking and detection using Supervised Learning and collision avoidance is been worked on.

Divya Desiraju et.al (2015) [12] addressed the problem of lane – change maximization to minimize the traffic flow caused by lane changes. The merit of this method was reduced traffic flow and this method failed in occlusion. The proposed methodology resolves the issues by given system training to detect and track multiple vehicle objects automation and taken care of collisions also been worked in dynamic environment.

B.Fortin, R. Lherbier and J.C. Noyer (2013) [15] done the problem of detection and tracking used by scanning laser range data. The benefit of this method was managed for multi target problem. The proposed method concentrates multiple vehicle detection and tracking of given training to the system automation with filtering algorithms.

Bin Tian, Ye Li, Bo Li, and Ding Wen(2014) [16] addressed the process of rear-view vehicle detection and tracking methods based on multiple vehicle salient parts used by a stationary camera. This method is limited to only partial occlusion. Apart from partial occlusion the proposed work concentrates on full occlusion and collision avoidance for multiple vehicles.

A new video-based traffic data collection system for multiple vehicle types is developed by Shuguang Li, Hongkai Yuet.al (2014) [17] and concentrates only on few numbers of parameters like shape, textures and color. The proposed methodology collects these parameters and trained the system so that accuracy of detection and tracking is attained.

Taewung Kim and Hyun-Yong Jeong(2014) [18] delivered the problems of detection and tracking by a Novel Algorithm for Crash Detection under General Road Scenes Using Crash Probabilities and an Interactive

<i>Author</i>	<i>Proposed Work</i>	<i>Advantages</i>	<i>Disadvantages</i>	<i>Solution</i>
<b>A. Alahi et al. [1]</b>	<ul style="list-style-type: none"> <li>– Pedestrian detection</li> <li>– Monocular automotive method</li> </ul>	Computational time reduced	<ul style="list-style-type: none"> <li>– Limited resources are available</li> <li>– Fails when environments in rural areas</li> </ul>	<ul style="list-style-type: none"> <li>– Automation of pedestrian detection through system learning</li> </ul>
<b>Harish et al. [3]</b>	<ul style="list-style-type: none"> <li>– Dynamic Reverse analysis method</li> <li>– multiple target detection</li> </ul>	<ul style="list-style-type: none"> <li>– Detects target object under illumination condition</li> </ul>	<ul style="list-style-type: none"> <li>– Fails in case of limited number of targets</li> </ul>	<ul style="list-style-type: none"> <li>– Bus topology approach</li> <li>– Superposition estimation for tracking</li> </ul>
<b>Meikuan et al. [5]</b>	<ul style="list-style-type: none"> <li>– Multiple event detection</li> <li>– Principle of compositionality</li> </ul>	<ul style="list-style-type: none"> <li>– flexibility and develop a new domain knowledge for complex representation of variables</li> </ul>	<ul style="list-style-type: none"> <li>– Lack of testing data</li> <li>– Performance evaluation decreases when lacks of testing data</li> </ul>	<ul style="list-style-type: none"> <li>– Adaboost strong classification method</li> </ul>
<b>Hamid Hassannejad et al. [6]</b>	<ul style="list-style-type: none"> <li>– Moving object detection</li> <li>– Haar-like features along with soft-cascade AdaBoost method</li> </ul>	<ul style="list-style-type: none"> <li>– Detection rate is higher under collision</li> <li>– Provides more robust to track multiple objects</li> </ul>	<ul style="list-style-type: none"> <li>– Limited speed access i.e 6 km/hr</li> </ul>	<ul style="list-style-type: none"> <li>– Clustering algorithm and filtering techniques</li> </ul>

**Figure 1: Comparison with Existing Methodologies for Object Detection**

Multiple Model Particle Filter”. The benefits of this work was it, appropriately adjusted warning times depending on the road scenes so that the collision can be avoided. The proposed work deals with occlusion as well as collision handling in dynamic environment.

In Fig.1.Multiple Object Detection represents the detailed Comparison with their existing algorithms/methods. In these scenarios, various states of existing methods were used, in that there is no standard algorithm for multiple vehicle detection in the field of intelligent transportation system. We also integrate the methods of several algorithms to detection and tracking as shown in the outline of related work. From the above existing works, it is noticed that the detection of objects are attained with greater accuracy. The proposed work plans to execute the automation in detection for multiple moving vehicles and pedestrians, so that the detection and tracking will have more accuracy than the existing systems. The proposed work also includes the occlusion handling and collision avoidance.

### 3. PROPOSED METHODOLOGIES

In this paper, our proposed framework methods consists of five different roles such as input layer, object detection engine, Particle grouping, Object Tracking, Occlusion handling mechanisms. With the help of these five different processes, various methods are incorporated such as frame splitting algorithm, supervised learning approach for automatic detection and tracking using state prediction and updation using Filtering techniques named as kalman filter. Background subtraction is to achieve the accuracy of multiple vehicles tracking in dynamic environment. While considering multiple vehicles are in motion, the occurrence of occlusions raises higher in between the objects and its background.

In Fig. 3. Multiple Object Tracking represents the detailed Comparison with their existing algorithms/methods. In these scenarios, various states of tracking in their existing methods were discussed, in that there is no single algorithm for tracking multiple vehicles in the field of intelligent transportation system. We also integrate the methods of several algorithms to detection and tracking as shown in the outline of related work.

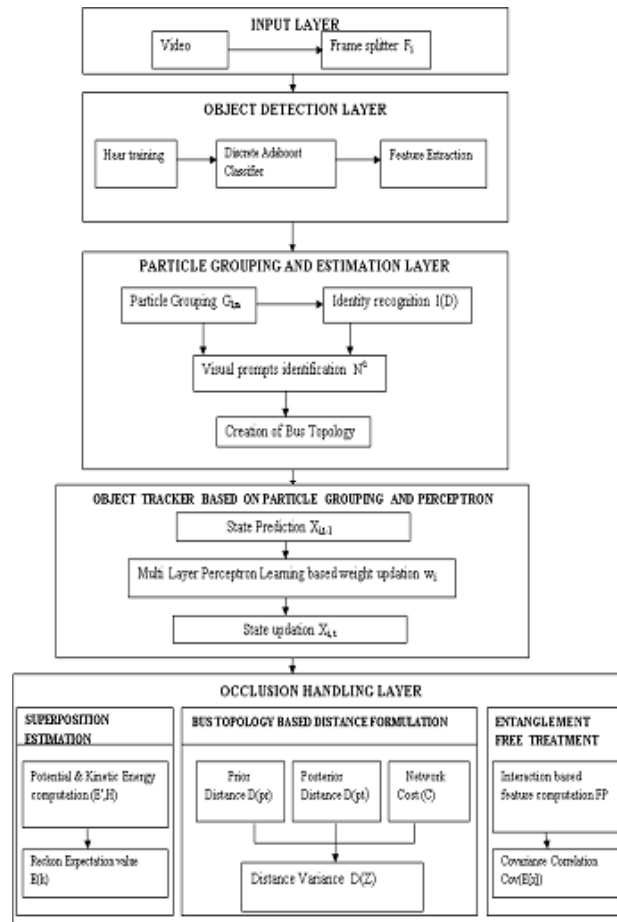


Figure 2: Proposed Methodologies

Author	Proposed Work	Advantages	Disadvantages	Solution
Sebastiano et al. [7]	<ul style="list-style-type: none"> <li>– vehicle detection</li> <li>– Data driven approach method</li> </ul>	Traffic flow id reduced up to 83.6%	<ul style="list-style-type: none"> <li>– Application purposes are limited</li> </ul>	<ul style="list-style-type: none"> <li>– Automation of system detection through AI and clustering Algorithm</li> </ul>
Nazhao net al. [8]	<ul style="list-style-type: none"> <li>– Multiple object tracking</li> <li>– Adaptive partial occlusion segmentation method</li> </ul>	<ul style="list-style-type: none"> <li>– Detects target object under illumination, collision</li> <li>– flexibility in appearance and motion based features</li> </ul>	<ul style="list-style-type: none"> <li>– Fails in case of Day time environment</li> </ul>	<ul style="list-style-type: none"> <li>– Feature based approach i.e. optical flow</li> <li>– Multiple Perception layer algorithm for tracking</li> </ul>
Cheth-Ching Wang et al. [9]	<ul style="list-style-type: none"> <li>– Interacting Multiple model estimation</li> <li>– Multiple hypothesis tracking method</li> </ul>	<ul style="list-style-type: none"> <li>– Covered Urban areas from ground vehicle at high speed attenuation using odometer and laser scanner</li> </ul>	<ul style="list-style-type: none"> <li>– Lack of publicly available datasets</li> </ul>	<ul style="list-style-type: none"> <li>– Adaboost strong classification method</li> </ul>
Xiao Liu et al. [11]	<ul style="list-style-type: none"> <li>– Tracking multiple objects</li> <li>– Online tracking by detection framework method</li> </ul>	<ul style="list-style-type: none"> <li>– Detection rate is higher</li> <li>– Provides more accuracy</li> </ul>	<ul style="list-style-type: none"> <li>– Covers only less areas i.e. covers only 5 meters around</li> </ul>	<ul style="list-style-type: none"> <li>– Particle filters and Extended/ Unscented Kalman filters</li> </ul>
J.C. Noyer et al. [15]	<ul style="list-style-type: none"> <li>– Detection and tracking approach of multiple vehicles</li> <li>– used scanning laser range method</li> </ul>	<ul style="list-style-type: none"> <li>– Achieves multi target problem by particle filter method</li> </ul>	<ul style="list-style-type: none"> <li>– Occlusion and collisions are excluded</li> </ul>	<ul style="list-style-type: none"> <li>– Bus topology, Occlusion handling prediction for using Superposition estimation method</li> </ul>

Figure 3: Comparison with Existing Methodologies for Object Tracking.

#### 4. CONCLUSION

This paper has reviewed a novel approach for detecting and tracking multiple vehicles and the techniques employed using a frame splitting algorithm, multiple tracking algorithm, adaboost classifier with haar training algorithm to detect the multiple vehicle detection objects are car, bus, truck, lorry based on shape, features based appearance dataset etc., order to solve the high-dimensionality state-space problem, an extended kalman particle filter is used. By accurately modeling the object geometry using the rectangular box instead of a 3-D box and, at the same time, separating the position and speed tracking from the geometry tracking at the estimator level, the proposed solution combines the efficiency of the robust detection model with the benefits of a dynamic environment model.

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