Chapter-6 Conclusion

Considering limitations of the existing systems, such as conventional background subtraction, noise and illumination sensitivity, etc., in this thesis phase a novel multi-directional filtering and fusion based background subtraction model was developed that considers intensity, moving pixel orientation etc. for moving vehicle detection. The proposed multi-directional intensity strokes estimation scheme was found to be strengthening the system for better moving vehicle candidate detection and tracking so as to distinguish moving vehicle region from other background images. In addition, the implementation of the enhanced thinning and dilation based morphological process has made proposed system more robust and accurate. Performing moving vehicle detection, feature mapping was done where feature clustering and heuristic filtering approach was incorporated, which made blob analysis more efficient to detect precise candidate vehicle region. Later, the boundary box generation was facilitated precise vehicle tracking. In addition, to the efficient moving vehicle detection and tracking, in this thesis, an efficient vehicle speed estimation scheme has been developed that enables real time vehicle tracking and its speed measurement. Predominantly, this research phase focused on vehicle detection and tracking on single lane road that in future can be developed for multi-lane system. In addition, in future density estimation and vehicle classification can also be done.

Considering, the requirement of novel vehicle detection and tracking system for Intelligent Transport System (ITS), in this thesis, a novel and robust Multidirectional Filtering and Fusion Based Optical Flow Analysis (MDFOA) scheme has been developed, which has been implemented with Horn Shunck (HS) optical flow algorithm. The proposed scheme encompasses varied novelties in terms of enhanced Brightness and Intensity Gradient Constraints (BIGC) estimation, non-linear adaptive noise filtering, heuristic filtering based blob analysis adaptive threshold based segmentation and bounding box generation for vehicle tracking. The implementation of simultaneous velocity and intensity estimation at each pixel enables the proposed system efficient.
Retrieving the BIGC features, the motion and velocity vector components have been obtained which has been further applied to perform adaptive thresholding based segmentation. This novelty has enabled the proposed system to deliver optimal detection of moving vehicle. The heuristic filtering based blob analysis has exhibited efficient performance in reducing unwanted blobs from the video frame, and thus resulting into enhanced vehicle detection and tracking accuracy, even at high speed vehicle movement. Performing the boundary box generation, the tracking of the vehicle has been done. In addition, the vehicle density estimation too has been done based on the ir crossing frequency through a defined area in the frame. The comparative results between MDFOA-HS and Lukas Kanade based vehicle detection affirms better results by the proposed system. The detection accuracy of 98.96%, with relatively appreciable time efficiency affirm that the proposed MDFOA-HS based scheme can be used for high speed moving vehicle detection and hence can be a potential technique for ITS utilities.

In future, the effectiveness of the proposed scheme can be examined for night time vehicle detection and tracking and even certain vehicle classification model can also be explored.

In this research a multilevel optimization measure has been proposed for vehicle detection and classification. To enable efficient vehicle detection and classification enhancements for vehicle region detection, feature extraction, dimensional reduction and classification have been made. Considering the limitations of traditional threshold based background subtraction schemes, in this thesis an enhanced adaptive learning rate based GMM algorithm has been developed, which has enabled precise vehicle detection under varying frame background frame features and illumination. To avoid occlusion in multilane traffic conditions, vehicle’s rear features and lane dash markings have been used. The application of connected component analysis (CCA) has enabled efficient vehicle region or ROI localization. An enhanced deep convolutional neural network (DNN), named AlexNet has been applied for ROI feature extraction. The implementation of AlexNet DNN’s higher layer features (FC6 and FC7) has exhibited better accuracy, because of higher feature informative contents. As a comparative model, SIFT feature descriptors have been obtained for the ROI. The retrieved 4096 dimensional features
from AlexNet FC6, FC7 and SIFT have been processed for dimensional reduction using PCA and LDA. To perform classification, in this thesis polynomial kernel based SVM classifier has been applied that classifies vehicle data into passenger (car, taxi, sedan, SUV) and other types. Results exhibit that AlexNet FC6 features with LDA gives highest classification accuracy of 97.80%, followed by AlexNet FC6 with PCA (96.75%). The highest accuracy with AlexNet FC7 has been found lower than AlexNet FC6. Similarly, SIFT features with PCA and LDA (SVM with 10-fold cross validation) has exhibited classification accuracy of 96.25% and 96.45% respectively. The proposed scheme has outperformed other approach because of enhancements introduced in terms of adaptive learning rate based GMM. This work has exhibited that adaptive learning rate based GMM with higher layers DNN features can lead optimal vehicle detection and classification. In future, efforts can be made for implementing proposed method for not only detection, and classification but for tracking a vehicle with multiple cameras based data in real time.

Thus, employing the abovementioned approaches and its efficient implementation in this thesis the optimal vehicle detection, tracking and classification scheme has been developed.