Abstract

The exponential growth of the usage of vehicles on roads in India leads to a major burden on the traffic surveillance. A National Crime Records Bureau (NCRB) report 2011 revealed that every year, more than 135,000 traffic collision-related deaths occur in India, which has the highest number in the world. The Road safety measures such as the widening of the roads not only sufficient to solve the problems. So, there is a need to develop an efficient Intelligent Transportation System (ITS). This has attracted the attention of industries as well as academics in recent years to develop more efficient solutions for computer vision based applications ranging from civil applications, industries till defence utilities. Especially considering the importance of ITS, the vision based supervision has the significant contribution for efficient traffic monitoring and control of a moving vehicle detection, speed estimation, tracking and classification.

In this thesis work, primarily emphasizes on developing an optimal system for moving vehicle detection, tracking, classification. The overall research work has been performed in three sequential phases, where in the first phase, an enhanced vehicle detection and tracking system has been developed by considering the limitations of the existing systems, such as conventional background subtraction, noise and illumination sensitivity. Here, a novel multi-directional filtering and fusion based background subtraction model has been developed that considers intensity, moving pixel orientation for moving vehicle detection and tracking. Also, an efficient vehicle speed estimation scheme has been developed that enables real time vehicle tracking and its speed measurement.

In the second phase, a novel Multi-Directional Brightness-intensity Gradient Constraints (MBIGC) estimation and Fusion Based Optical Flow Analysis-Horn Schunck(MDFOA-HS) technique have been developed that performs simultaneous pixel’s intensity and velocity estimation in a moving frame for detecting and tracking the moving vehicle. The detection accuracy in this approach is 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 the third phase of research work, a Multi-layered AlexNet Deep Neural Network (DNN) has been applied to extract higher layer features preceded by an adaptive learning rate based Gaussian Mixture Model (GMM) algorithm for background subtraction of multilane traffic data. The extracted 4096- higher dimensional features have been processed for dimensional reduction using Principle Component Analysis (PCA) and Linear Discriminant Analysis (LDA). The features have been mapped for Support Vector Machine (SVM) based classification.

The classification results have exhibited that AlexNet-FC6 features with LDA give the accuracy of 97.80%, followed by AlexNet-FC6 with PCA (96.75%). AlexNet-FC7 feature with LDA and PCA algorithms has exhibited classification accuracy of 91.40% and 96.30%. On the contrary, 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 results revealed that enhanced GMM with AlexNet DNN at FC6 and FC7 can be significant for optimal vehicle detection and classification.

Thus, the overall research efforts and respective contributions affirm that the proposed vehicle detection, tracking, and vehicle classification system can play vital role for real time ITS applications.