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| Title | : | Development of Vision Based Algorithms for Autonomous Land Vehicle |
| Keywords | : | Unstructured road detection, Vehicle detection, Pedestrian detection, Traffic light signal detection, Traffic Sign Detection, Traffic sign recognition, Autonomous driving system |


**ABSTRACT**

In this work, vision based algorithms are developed for path detection, vehicle detection, pedestrian detection, and traffic sign detection.

This work suggested two different solutions for unstructured road detection. In the first proposed solution, a single nearest neighbor algorithm was trained with chromatic information from L*a*b color to divide the whole image into three regions such as road region, near back-ground region, and the far background region. The suggested algorithm worked well for sunny and cloudy weather but its detection accuracy was less for rainy weather. Therefore, a second solution is suggested for accurate results for all weather. In this method, Three nearest neighbor classifiers are trained with chromatic information from L*a*b and HSV color space that divided the road image into a drivable and non-drivable region. A soft voting approach is utilized to aggregate the output of the classifier. The nearest neighbor classifier classifies the region according to the distance from a class. The measured distance from class has been utilized to generate confidence for classifier output. The achieved results indicated that the proposed system detected road region accurately.

The second objective of this research work is, develop a vision-based algorithm for vehicle detection. In this thesis, two different approaches are suggested for vehicle detection. In the first approach, contour symmetry is used to detect the position of the vehicle. Horizontal and vertical symmetry of contour is examined to filter out the vehicles from other objects. Further, the horizontal and vertical projection of vehicle contour was plotted to localize the vehicle. Vehicle position and size vary with the motion of the camera and motion of the vehicle hence the

proposed algorithm did not work well for dynamic changes in the vehicle. So, a second algorithm is proposed to overcome the problem of dynamic changes. In this approach, two different features and two different classifiers are trained to generate the hypothesis of the vehicle and verify this hypothesis. AdaBoost classifier with Haar-like feature is trained to generate the hypothesis whereas SVM classifier with the HOG feature is trained to verify the generated hypothesis. The achieved result concluded that the performance of the vehicle detector is good as a comparison to the contour-based vehicle detector.

Pedestrian detection and accident avoidance is also a very important task for an autonomous vehicle which is the next objective of this thesis. The proposed pedestrian detection algorithm decomposed the pedestrian body into three parts as full-body, upper body, and face. The proposed algorithm can detect the pedestrian even it is partially occluded. An AdaBoost classifier is trained with aggregated features of 10 different channels to detect the pedestrian's full body. Whereas, Haar-like features are extracted from the upper body and face data set to train the cascade classifier for upper body and face detection. Outputs from these three individual classifiers were aggregated by the decision tree approach to make the final decision on pedestrian detection. The results pointed out that the performance of the pedestrian detector is adequate.

Traffic sign detection and recognition system are also one of the very important tasks in the development of an autonomous driving system to manage the traffic flow. In this work, three algorithms are proposed to follow the traffic rules by the autonomous vehicle. The first proposed algorithm detected traffic light and recognized its state and the rest of the two algorithms are proposed for traffic sign detection, recognition, and classification. Color features and template matching techniques are adopted to detect the traffic light and recognizing their state. The second algorithm is proposed for Indian traffic sign detection and recognition. Chromatic and shape information of traffic signs are used to localize the traffic sign in the image further SURF features extracted from detected traffic sign and performed the nearest-neighbor matching to recognize the traffic sign. In this work, the third suggested algorithm classifying the Indian traffic signs into three classes such as mandatory, informatory, and cautionary. SURF features are extracted from the traffic signs of each class and trained a Gaussian kernel support vector machine algorithm to classify the traffic signs. Achieved results indicate that the performance of the traffic light, traffic sign detector, and recognition and traffic signs classifier is good.