REAL-TIME DETECTION AND TRACKING OF VEHICLES WITH LANE DETECTION

MASTER OF PHILOSOPHY

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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.

It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

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14 - February - 2011

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ABSTRACT

In this research, a computer vision based procedure for navigating an autonomous vehicle safely in a sub-urban road under an unstructured environment was described. This was analyzed in two main areas. Namely; an on road object detection method, where we are only concerned of detecting cars, and a novel method in detecting road lane boundaries. For the detection of vehicles (cars) from an on-road image sequence taken by a monocular video capturing device in real time and an algorithm of multi resolution technique based on Haar basis functions were used for the wavelet transform, where a combination of classification was carried out with the multilayer feed forward neural network. The classification is done in a reduced dimensional space, where Principle Component Analysis (PCA) dimensional reduction technique has been applied to make the classification process much more efficient.

Then, the other approach used is based on boosting which also yields very good detection rates. In general, boosting is one of the most important developments in classification methodology. It works by sequentially applying a classification algorithm to reweighed versions of the training data, followed by taking a weighted majority vote of the sequence of classifiers thus produced. For this work, a strong classifier was trained by the discrete adaboost algorithm and its variants.

In this thesis, a novel algorithm for detection of lane boundaries was presented. Initially, the method fits the CIE L*a*b* transformed road chromaticity values (that is a* and b* values) to a bi-variate Gaussian model followed by the classification of road area based on Mahalanobis distance. Then, the classified road area acts as an arbitrary shaped region or a mask in order to extract blobs resulting from the filtered image by a two dimensional Gabor filter. This is considered as the first visual cue. Another visual cue of images was employed by an entropy image. Moreover, the results from color based visual cue and visual cue based on entropy were integrated following an outlier removing process. Finally, the correct road lane points are fitted with Bezier splines which act as control points that can form arbitrary shapes. The algorithm was implemented and experiments were carried out on sub-urban roads.

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LIST OF ABBREVIATIONS

AGV	Autonomous Ground Vehicles
DARPA	Defense Advanced Research Projects Agency
PCA	Principle Component Analysis
MLFFNN	Multilayer Feed-forward Neural Network
MER	Mars Exploration Rover
ARL	Army Research Lab
LIDAR	Light Detection And Ranging
NavLab	Navigation Laboratory
MRA	Multiresolution Analysis
ii	Integral Image
Adaboost	Adaptive Boost
DAB	Discrete Adaboost
RAB	Real Adaboost
GAB	Gentle Adaboost