# Project Report

## Project Title

Robust Driver Assistance System based on Computer Vision

## Abstract

Advanced Driver Assistance System (ADAS) are systems developed to enhance vehicle safety and assist the driver in avoiding collisions and unwanted accidents by providing alerts and/or warnings whenever required. The development of autonomous or self-driving vehicles depends on the development of ADAS. Various features are being offered in personal and commercial vehicles which are currently available, such as adaptive cruise control, autonomous navigation which is used in applications like self-parking, driver drowsiness detection, and collision avoidance systems, to name a few. Some of the above-mentioned features are dependent on less complex computations like traffic sign detection and recognition, lane detection and departure warning, and vehicle proximity warning systems, each of which are developed using the concepts of Computer Vision in real-time.

This paper attempts to develop a robust lane detection and tracking system, which identifies the lane in which the vehicle is currently traveling with the help of lane markings on the road, and tracks them in real time. The system should be capable of handling challenging scenarios such as worn-out markings or other distracting objects like shadows and other vehicles. This will be achieved with the help of footage imported from a front-facing dashboard camera. A variety of different algorithms have been developed over the years in various journals and conferences on computer vision and intelligent vehicles and this paper will compare the implementation and results of a few of these to find the most robust one based on criterion that will be clearly laid out.

Key Terms: Driver Assistance System, lane tracking, edge detection, Hough transform

## Introduction

One of the most challenging and innovative problems currently is that of endless traffic blockages in metropolitan cities. Cars have been built to go as fast as 100 miles per hour but which are barely being driven at such high speeds. In 2014, we spent 29.6 billion hours in commuting in the US alone [1]. For a long time the solution has been expanding current roads and building more roads, something which is becoming more and more impossible to do due to space restrictions leading from the ever-growing population.

The concept of a swarm of interconnected driverless vehicles that can interact with each other and effortlessly take commuters for point A to point B is something that has been touted as a possibly viable solution to this problem. What this would look like is as follows. The commuter would enter the vehicle and type the required destination and the vehicle would perform a few calculations to figure out the fastest route to that point. It would seamlessly integrate into gaps in traffic along the major roadways at speeds which a human would never be able to manage and smoothly maneuver to the destination. This would lead to advantages in the form of dramatically reduced commuting times, infinite possibilities for the driver who would not really have anything to do and most importantly, a huge reduction in driving related accidents and injuries. But this is a vision of the future and to achieve these a few important building blocks need to be designed and implemented on a smaller scale.

A few of these building blocks like optimized route mapping and autonomous driving have been implemented but many them are yet to be developed. One of these building blocks include implementing a robust system to detect the current lane and track it as required to be able to, in the future, implement lane departure warning or detect other vehicles moving into the current lane for an accident-free commute. A lot of work has been done already on the topic of lane detection and a lot of algorithms have been developed including but not limited to fixed-width line pairs [2], fusion of forward-looking vision and radar sensors [3], geometric constraint model [4], deformable template model [5], pattern analysis & local co-occurrence measures [6], shadow analysis model [7], steerable filters [8], frequency domain feature detection [9], stereo and monocular modalities [10], probabilistic fitting [11] and Hough transform [12].

## Methodology

The methodology that I plan to follow is loosely based on that implemented by X. Miao et al [13] which has been summarized below:

1. Identify possible lane markings and develop lane hypotheses based on their calculated confidence
2. Grouping together various lane hypotheses and curve fitting a line through the most probable hypothesis to display the left and right lane boundaries, thus displaying the current lane
3. Similarly, identify possible traffic signs by applying a classifier algorithm on a dataset of images
4. Recognize and display the identified traffic sign as a warning

This will be done by comparing between various detection and tracking algorithms to find the most optimal one based on higher detection rates and lower false-alarm rates on a series of images obtained from a dashboard camera. A few online sources have been identified for these images which could be used for training purposes [unknown]

The above-mentioned detection and tracking algorithms will be implemented using OpenCV library functions which are based on C++. The comparison will be done based on higher detection and lower false alarm rates, which are defined respectively as the number of frames with lane markings/traffic signs detected accurately per unit time and number of frames with lane markings/traffic signs detected incorrectly per unit time, on a series of test case scenarios to find the most optimal one.

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