PRECISE VEHICLE LOCALIZATION USING FUSION OF MULTIPLE SENSORS FOR SELF-DRIVING

Undergraduate graduation project report submitted in partial fulfillment of
the requirements for the
Degree of Bachelor of Science of Engineering
in

The Department of Electronic & Telecommunication Engineering
University of Moratuwa.

Supervisor:
Dr. Peshala Jayasekara

Group Members:
S. P. Dissanayake (160134U)
G. M. C. P. Jayathissa (160188L)
S. H. P. H. P. Jayawardana (160246N)
A. S. R. Kumara (160318M)

March, 2021

Declaration

This declaration is made on March 21, 2021.

Declaration by Project Group

We declare that the dissertation entitled "Precise Vehicle Localization Using Fusion of Multiple Sensors for Self-Driving" and the work presented in it are our own. We confirm that:

- this work was done wholly or mainly in candidature for a B.Sc. Engineering degree at this university,
- where any part of this dissertation has previously been submitted for a degree or any other qualification at this university or any other institute, has been clearly stated,
- where we have consulted the published work of others, is always clearly attributed,
- where we have quoted from the work of others, the source is always given,
- with the exception of such quotations, this dissertation is entirely our own work,
- we have acknowledged all main sources of help,

. . . . . .
Date

. . . . . .
S. P. Dissanayake (160134U)

. . . . . .
G. M. C. P. Jayathissa (160188L)

. . . . . .
S. H. P. H. P. Jayawardana (160246N)

. . . . . .
A. S. R. Kumara (160318M)

Declaration by Supervisor

I have supervised and accepted this dissertation for the submission of the degree.

....

Dr. Peshala Jayasekara Date

Abstract

PRECISE VEHICLE LOCALIZATION USING FUSION OF MULTIPLE SENSORS FOR SELF-DRIVING

Group Members: S. P. Dissanayake, G. M. C. P. Jayathissa, S. H. P. H. P. Jayawardana, A. S. R. Kumara

Supervisor: Dr. Peshala Jayasekara

Keywords: Self-Driving, State Estimation, Localization, Sensor Fusion, Bayesian Filters.

This project focuses on creating a mechanism for estimating the state of a self-driving vehicle, including its location, speed and orientation relative to a coordinate frame fixed to earth, using sensors such as Inertial Measurement Unit (IMU), Global Navigation Satellite System (GNSS) receivers, stereo camera pairs and Light Detection and Ranging (LiDAR) sensors. The main objective is to deliver a well-documented software stack which includes the state estimator running on Robot Operating System (ROS). The estimator should be capable of providing uninterrupted state estimations with enough accuracy and frequency to facilitate self-driving.

The main drawback observed in current state-of-the-art work is the dependency of the solution on pre-generated highly-detailed maps of different forms, which in-turn reduces the scalability of the solution. This dependency reduces the feasibility of those solutions in the long run due to the fact that it is hard to maintain such highly-detailed maps in midst of constantly and unexpectedly changing environments prevailing in countries such as Sri Lanka. It is the intention of this project to mitigate this dependency through means of improving the state estimation algorithm. We also intend to implement the solution in a modularized architecture to facilitate easy modifications, which in-turn will allow the solution to be used in different applications.

While self-driving is itself a novel concept in Sri Lankan context, this project aims to facilitate the state estimation under constrained resource availability (such as excluding highly-detailed maps, enhanced GNSS technologies such as Differential Global Positioning System (DGPS) or Real Time Kinematics (RTK) Global Positioning System (GPS), reliable road features such as consistent lane markings and curbs etc.), which is the condition experienced in developing countries like Sri Lanka.

Other than the self-driving research communities, we expect the outcome of this project will benefit different parties such as robot developers and navigational solution providers, who have similar requirements.

Dedication

TODO.

Acknowledgements

TODO.

Contents

List of Figures

List of Tables

Acronyms and Abbreviations

DGPS Differential Global Positioning System

GNSS Global Navigation Satellite System

GPS Global Positioning System

IMU Inertial Measurement Unit

LiDAR Light Detection and Ranging

ROS Robot Operating System

RTK Real Time Kinematics

References