Table of Contents

Autonomous Vehicle Design

Introduction

Autonomous vehicles are driverless cars that are considered an essential part of future smart cities. They are classified in levels from L1-L5, with increasing driving capacity. L5 is considered as equivalent to human level driving or better.

keywords: automated driving, computer vision for autonomous vehicle, AI navigation, auto computer vision for autonomous vehicle, AI navigation, auto control, autonomous car sensors

Autonomous Vehicle Features

The three most important features that were identified after research are given below:

Navigation and Maps

To go from point to another, the vehicle needs to know its current location and destination on a map. Without the map, there is no way for an autonomous vehicle to reach its destination. The map and navigation features of an autonomous vehicle is linked with the GPS sensor to determine the current location, speed, direction etc. Additionally, the navigation features works better with internet as maps can be displayed with live traffic and the vehicle can make advance and intelligent AI based decisions to re-plan and re-reoute the journey in case of an accident etc.

Human Computer Interface

To interact with the driverless vehicle, the vehicle must provide some human computer interface (HCI). The HCI usually comes in the form of an LCD screen fitted on the dashboard and allows the user to interact and instruct the vehicle for things like setting the destination, monitoring the vehicle progress, settings for music, window controls, vehicle controls, temperature etc

AI Vision

AI Vision is the most important component that allows the Autonomous vehicle to see. This allows the vehicle to have a 360 view using various cameras that are fitted on the body of the vehicle. Cameras and other sensors can detect hardware issues, collisions with other traffic and provide warnings. The AI vision allows the vehicle to navigate safely in unknown environment and traffic scenario. The basic function of this feature is to detect road lanes, signals, pedestrian crossings, accidents, other traffic etc.

Research Terms

While researching for autonomous vehicles, we used some terms to have a better understanding of autonomous vehicles. The terms and their reasons for selecting are given below:

Navigation in autonomous vehicles: To know who, why and how does the autonomous vehicle navigation work without a driver.
Autonomous Vehicle Sensors: To see which sensors like cameras, temperature, humidity, gps are equipped and their function in autonomous vehicles.
Safety of Autonomous Vehicle: To know the mechanism and features for the safety and security in an autonomous vehicle.
Design of Autonomous Vehicle: To know what design considerations are important during design and development of an autonomous vehicle.
Definition of Driverless Car: To know, how an autonmous vehicle is defined, what are the characteristics that define an autonomous vehicles, what are autonomous vehicle levels L1-L5.

Use Case Diagram

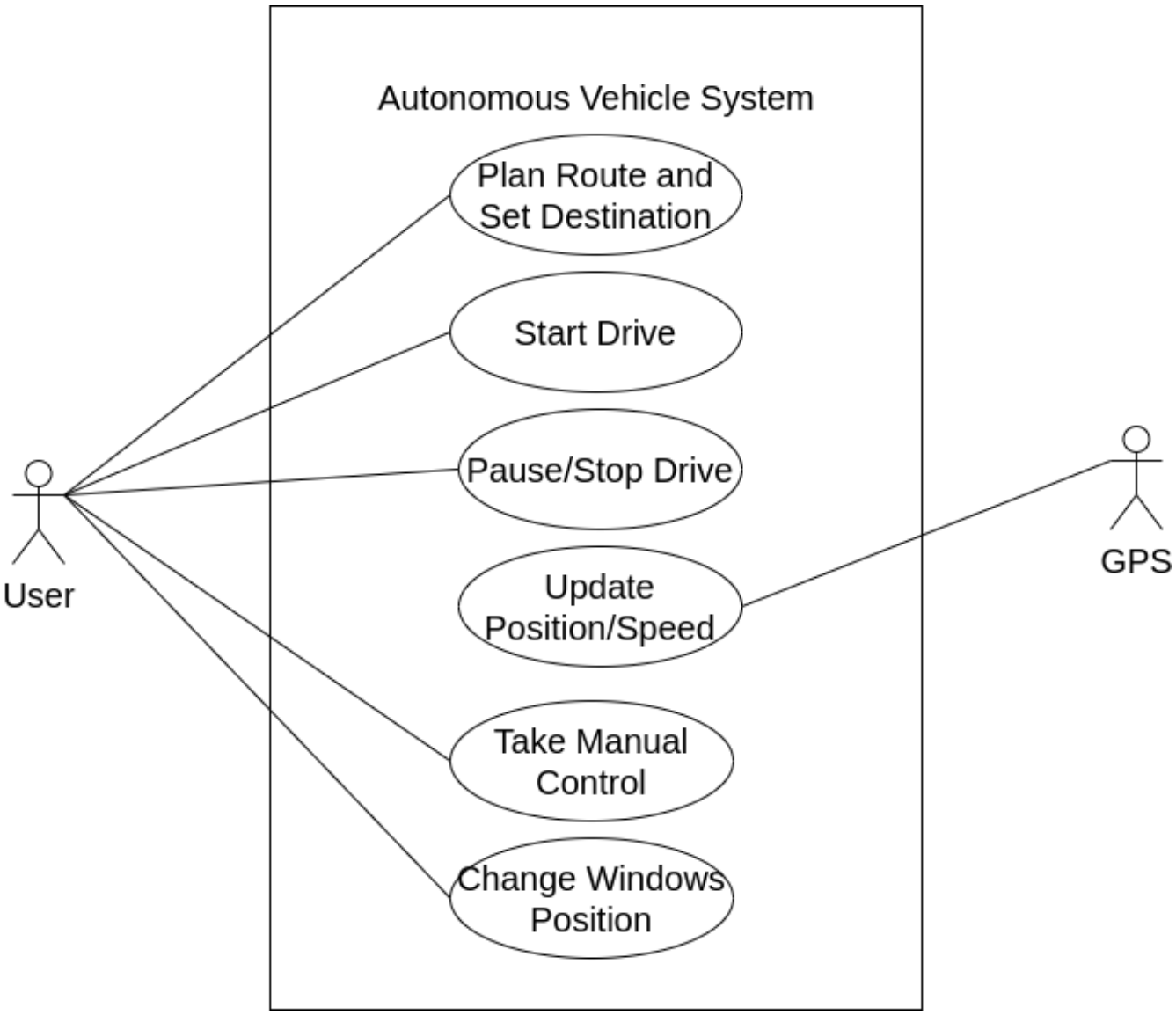

Fig 1: UML Use Case Diagrams with six use cases

UML Diagrams

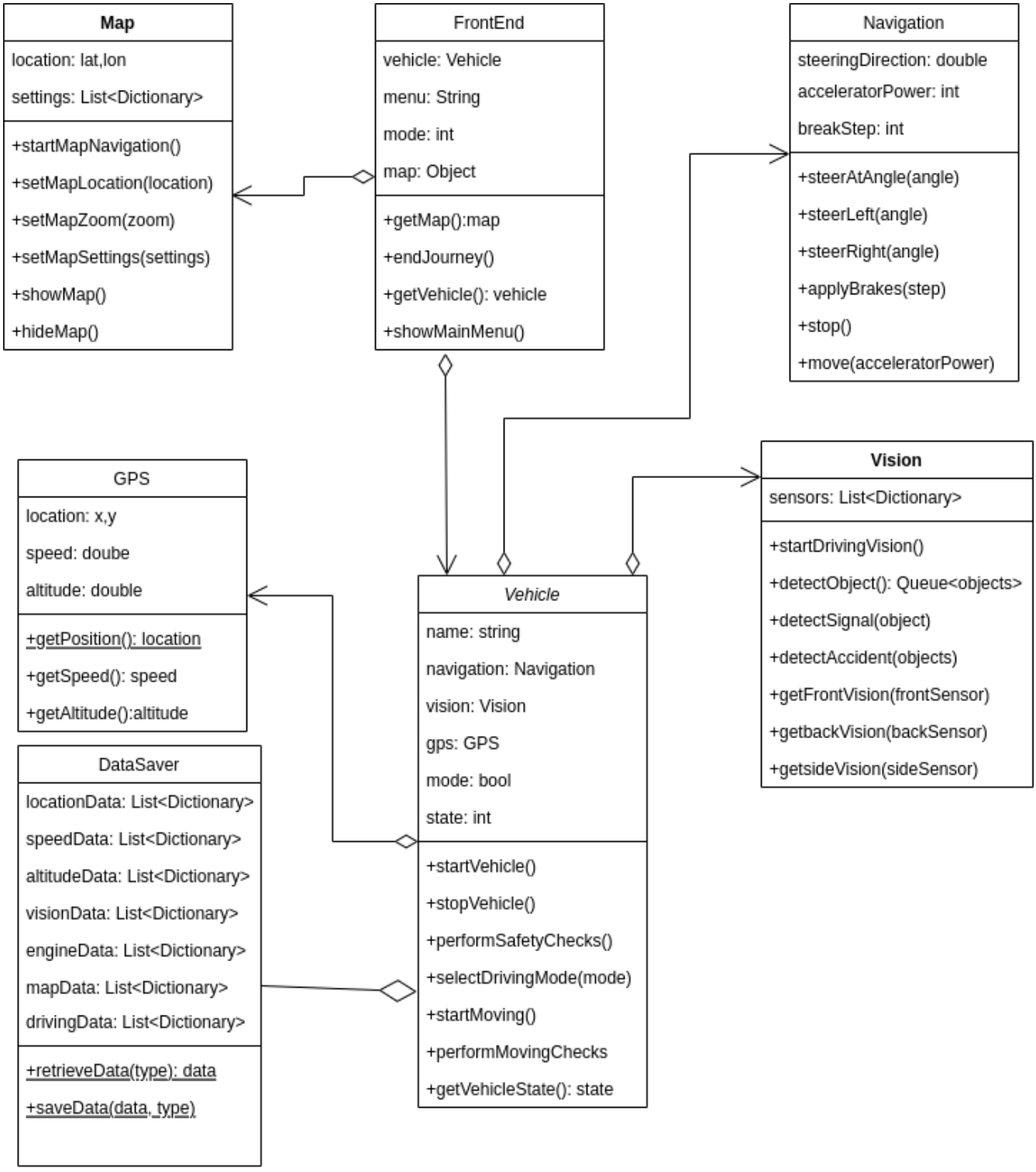

Fig 2: Autonomous Vehicle UML Class Diagram with Data structures

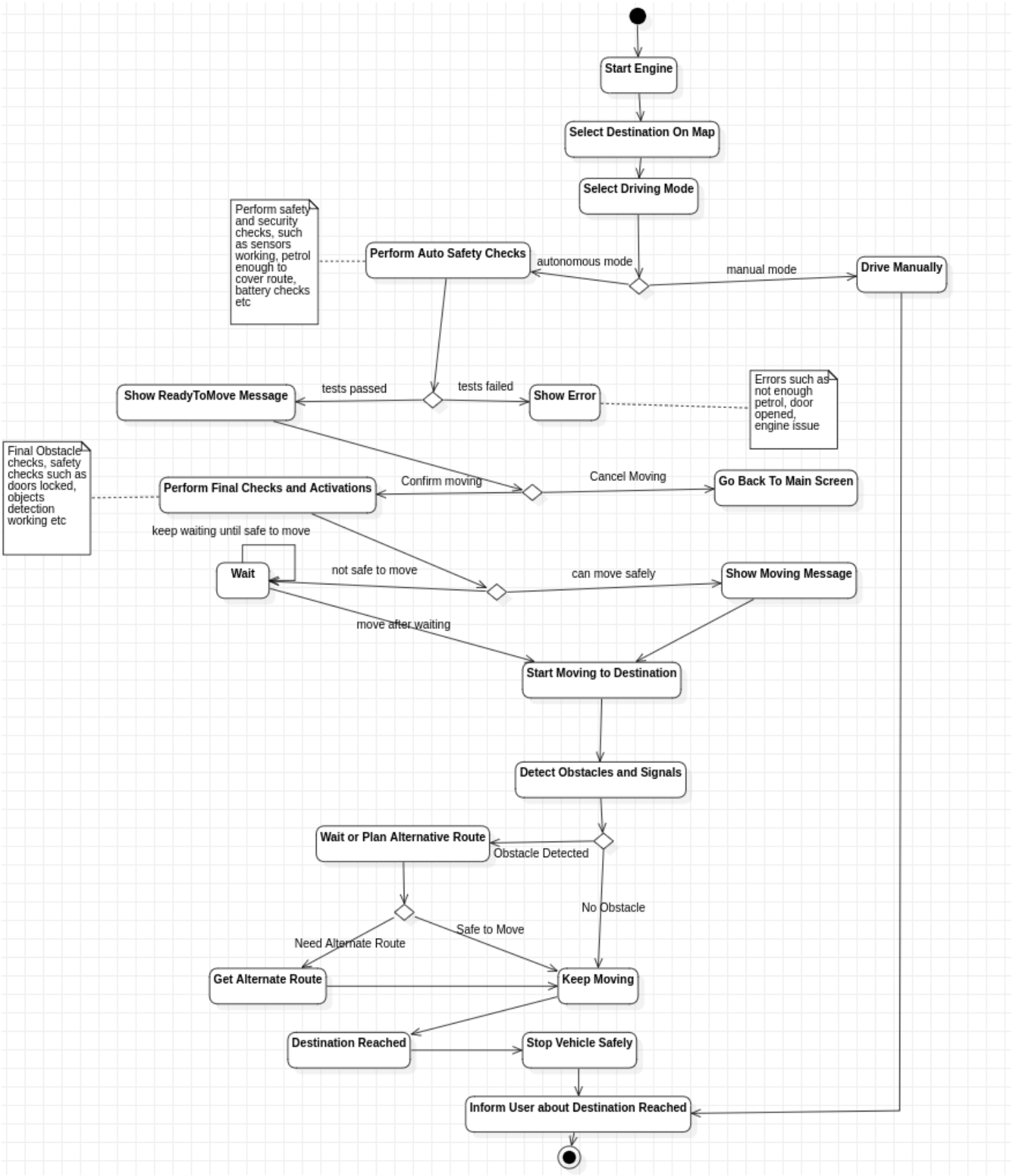

Fig 3: UML Activity Diagram for Driving an Autonomous Vehicle

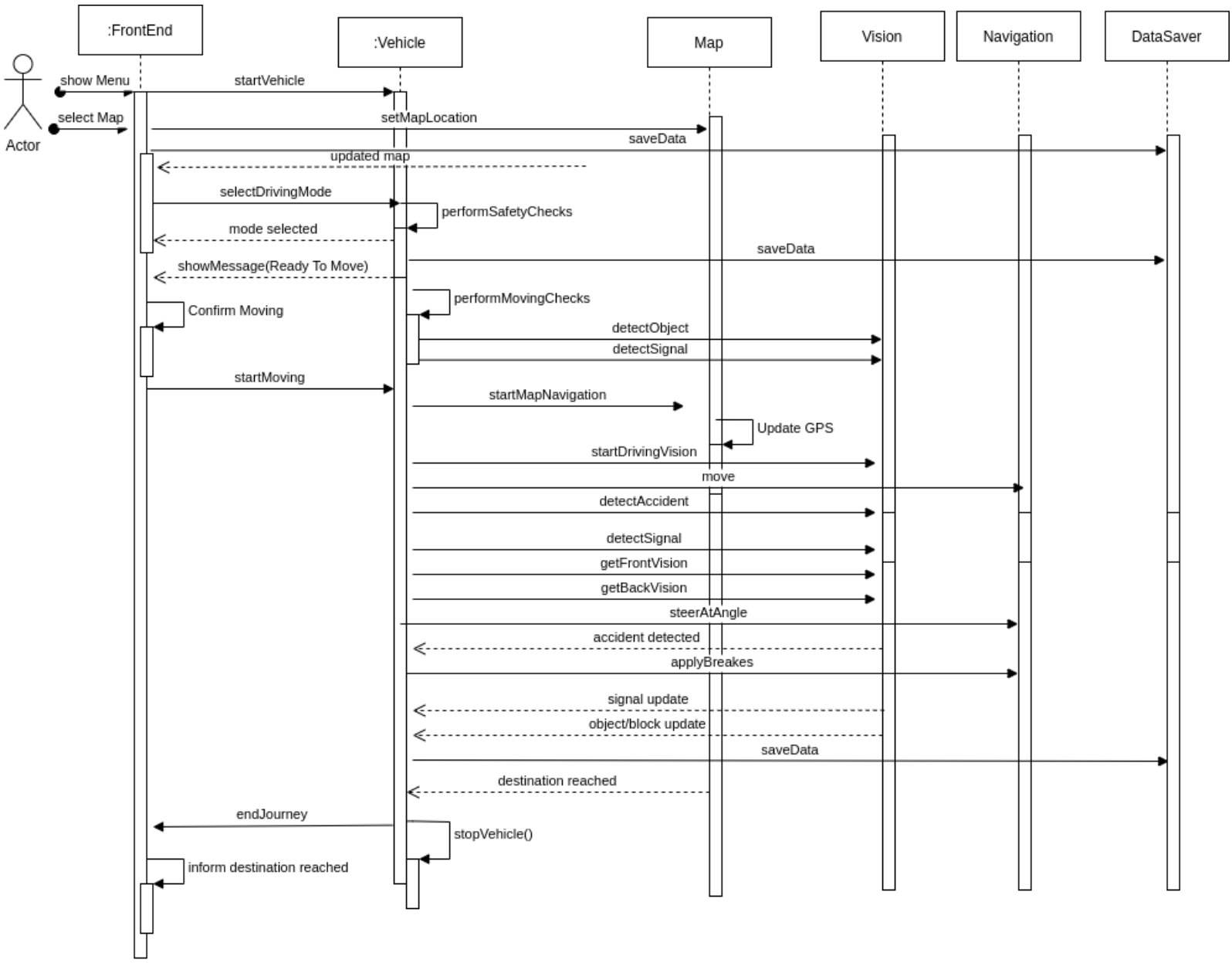

Fig 4: UML Sequence Diagram for driving Autonomous Vehicle

Vehicle State Transition Diagram

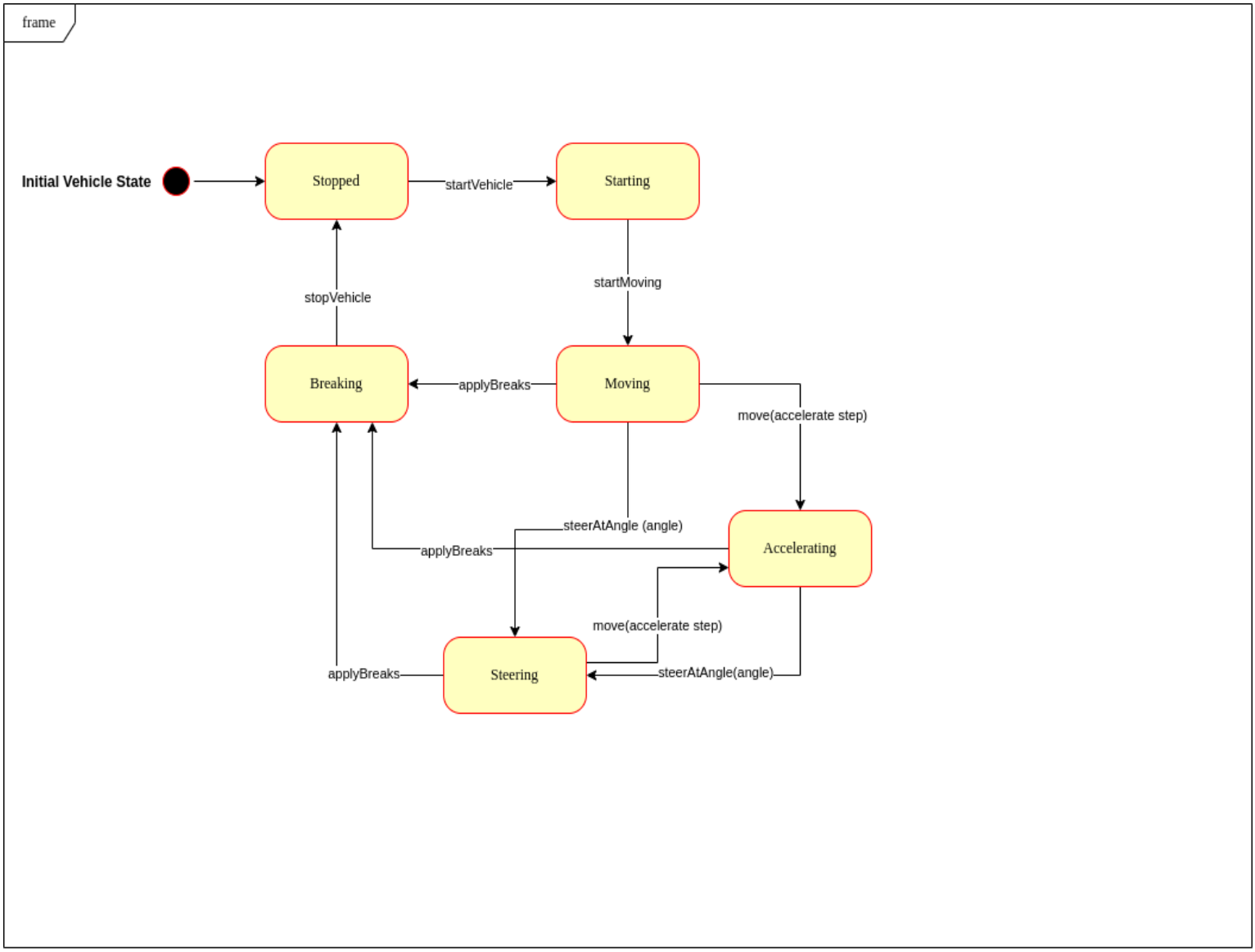

Fig 5: Showing Vehicle States in UML State Transition Diagram with events/actions

References:

- Faisal, A., Kamruzzaman, M., Yigitcanlar, T. and Currie, G., 2019. Understanding autonomous vehicles. *Journal of transport and land use*, *12*(1), pp.45-72.

- Jameel, F., Chang, Z., Huang, J. and Ristaniemi, T., 2019. Internet of autonomous vehicles: architecture, features, and socio-technological challenges. *IEEE Wireless Communications*, *26*(4), pp.21-29.

- Herchi, H. and Abdessalem, W.B., 2012. From user requirements to UML class diagram. *arXiv preprint arXiv:1211.0713*.

- Li, X., Liu, Z. and Jifeng, H., 2004, April. A formal semantics of UML sequence diagram. In *2004 Australian Software Engineering Conference. Proceedings.* (pp. 168-177). IEEE.

- Vidgen, R., 2003. Requirements analysis and UML-Interaction diagrams and state transition diagrams. *Computing and Control Engineering*, *14*(3), pp.7-11.

- Reddy, P. P. (2019) Driverless Car: Software Modelling and Design using Python and Tensorflow.

- Zhou, Z. Q. & Sun, L. (2019) Metamorphic testing of driverless cars.Commun.ACM 62(3): 61–67. DOI: https://doi.org/10.1145/3241979