Truck Platooning System

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***Abstract* - Truck platooning is an innovative type of transportation, where trucks move in close proximity to one another, thanks to advances in autonomous driving technology. Transportation businesses benefit from decreased fuel use and improved driving efficiency, while society benefits from fewer accidents, safer activity, and reduced carbon emissions. This paper will focus on a certain scenario explained by diagrams – Truck platooning behavior regarding road properties.**

Keywords – Truck platooning, Carbon reduced, Road properties, Effective drive.

I. Introduction

Since 2014, when commercial development truck platooning research started gaining pace, the commercial vehicle sector has appeared to be waiting with bated breath for this technology to become a reality on the highways.

The advantages of a system that allows vehicles to travel on highways with defined distances between them using autonomous technology are clear. Trucks may form organized, equally spaced convoys utilizing advanced technology, allowing them to drive closer together over longer distances, reducing air drag friction, fuel consumption, and expenses.

According to the European Automobile Manufacturers, platooning could lower CO_2 emissions by up to 16 percent for trailing cars and up to 8% for lead convoy vehicles. There are also safety advantages, as a group of drivers paying attention to the road is safer than a single driver.[1]

In its white paper Truck Platooning – Driving the Future of Transportation, published in 2015, TNO Voorwaarden which is a respected Dutch research organization, proposed a scenario that would be music to the ears of logistics firms: "Imagine a self-driving truck as part of a road train." One that can only drive by communicating with the truck ahead of it, establishing a truck platoon.

“The driver of the leading truck takes the first shift, driving from Rotterdam to Paris. The driver of the following truck is asleep, as their truck automatically follows the platoon leader. Near Paris, the drivers switch their roles and reverse the order of the trucks. The driver of the now following truck can take a nap or perform administrative work. There is no need to stop for a rest; resting can be done while driving.” [2]

To date, both the vehicle industry and start-ups have been engaged in platooning, with companies such as Daimler, Volvo, MAN, and Scania deploying on-road prototypes. Following successful real-world testing with MAN Truck and Bus in collaboration with DB Schenker and Fresnius University of Applied Sciences in Germany, the appetite for platooning seemed high till 2019. Platooning is not only conceivable, but also "safe, technically, and simply adaptable in the routine of a logistics organization," according to the results of this research.

It's doubtful that you'll notice if you're approaching a platoon. Platooning vehicles resemble conventional trucks in appearance. A truck platoon, on the other hand, may be designated with signage to show that they are moving together.

While platooning, each vehicle in the vehicle platoon has a platooning system installed and operational. This system will allow that vehicle to combine, and adaptive cruise control, which allows for automatic braking, will adjust the gap between the leading and trailing vehicles to a safe distance. A steady platoon's activity will be disrupted by other vehicles cutting in or out. The platooning system, on the other hand, will remain active. In other words, if another vehicle cuts in between vehicles in a platoon, the computer system will modify the spacing and/or temporarily halt platooning.

In the event of a system failure, the licensed driver in each vehicle will assume control of the truck and drive and react as they would normally without the system.

II. Automated driving systems

Reliable automated driving systems that do not require human intervention or relieve drivers of some obligations have the potential to cut traffic accidents considerably. Such systems will never become fatigued, distracted, or influenced by emotions, all of which are characteristics that regularly play a part in human error-related accidents.

Automated driving technologies provide more than just a potential boost in traffic safety. The system can also assist reduce emissions by enabling efficient, resource-saving traffic.

Because most incidents in the road freight transport sector are caused by human error, automated driving systems have a lot of potential in terms of safety. Automated driving systems, for example, can assist truck drivers in difficult driving situations and on long, boring routes.

Despite the advantages, caution must be exercised, as ethical concerns and data-protection hazards must be considered when autonomous driving systems are further developed. The proper usage of artificial intelligence is a significant consideration here (AI). AI is very crucial in self-driving vehicles when it comes to machine learning because it helps the system swiftly and consistently identify objects and situations in or near the roadway, among other things.[3]

It is accepted that in addition to safety, social, ethical, and data-protection considerations will be critical in garnering approval for autonomous driving systems.

III. SYSML MODEL DESIGN

The behavior of the truck platooning system regarding the road properties like pedestrians, road signs and traffic light has been investigated in order to provide safe driving experience.

A. Use Case Diagram

Generally, a use case diagram is a visual representation of how a user might interact with a technology. A use case diagram depicts the system's numerous use cases and different sorts of users and is frequently supplemented by other diagrams. Circles or ellipses are used to depict the use cases. The actors are frequently depicted as stick figures.

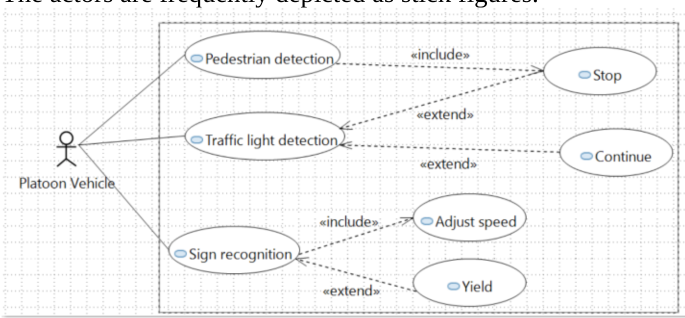

Figure 1: Use Case Diagram

B. Activity Diagram

An activity diagram is another essential behavioral approach, which is used to depict dynamic characteristics of the system. An activity diagram is a more complex version of a flow chart that depicts the flow of information from one activity to the next.

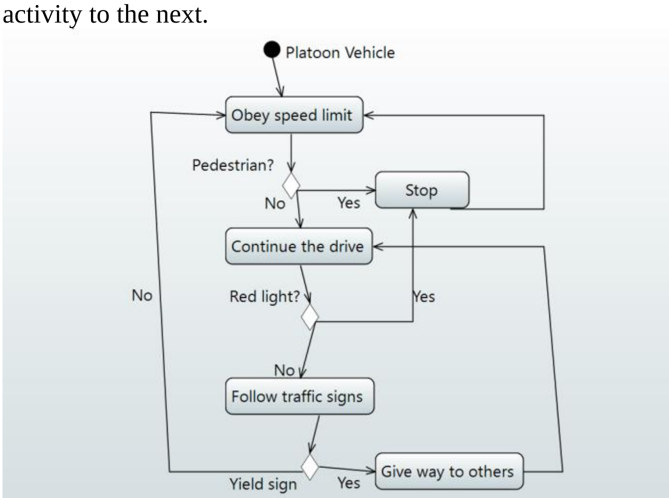

Figure 2: Activity Diagram

C. Block Diagram

A block diagram is a representation of a system in which the major components or functions are represented by blocks that are connected by lines that show the relationships between the blocks. Block diagrams are commonly used for higher-level, less-detailed descriptions that are meant to clarify overall concepts without regard for implementation details.

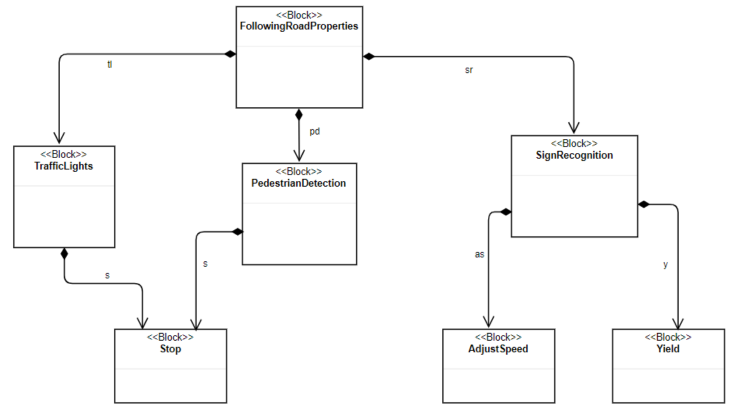

Figure 3: Block Diagram

D. Sequence Diagram

In the discipline of software engineering, a sequence diagram depicts object interactions in time order. It represents the scenario's objects as well as the sequence of messages exchanged between them in order to carry out the scenario's functionality. In the logical view of the system under development, sequence diagrams are usually coupled with use case realizations.

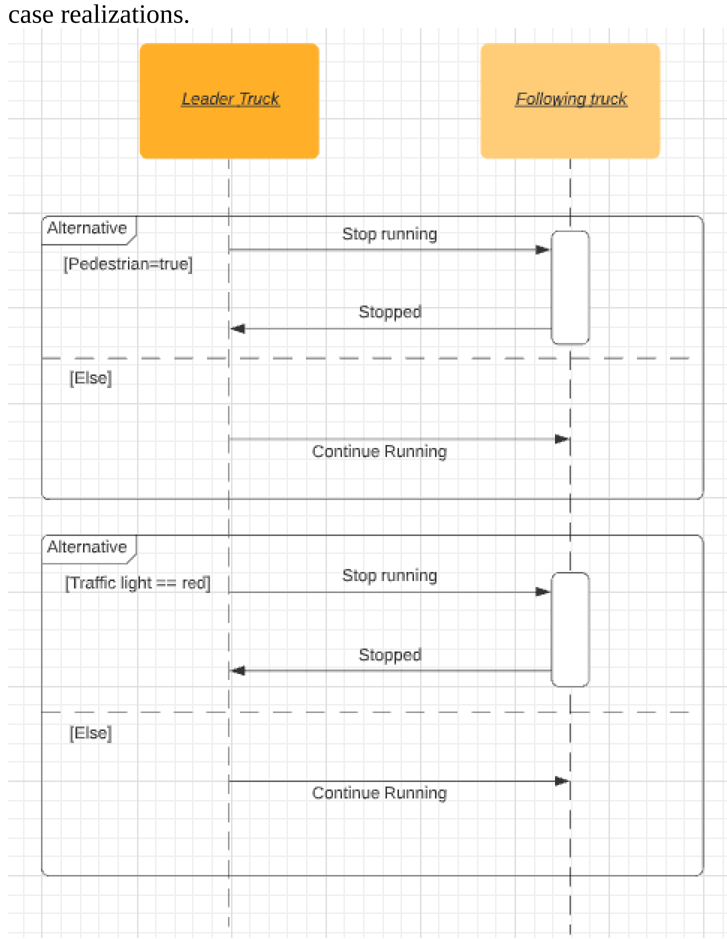

Figure 4: Sequence Diagram

E. Allocation Diagram

Active classes, instances of active classes, and their dependence on a set of hardware cores are depicted in allocation diagrams. The allocation diagram should be used associated with the multicore profile when modeling a multicore application. A conventional object model diagram does not include the multicore allocation components.

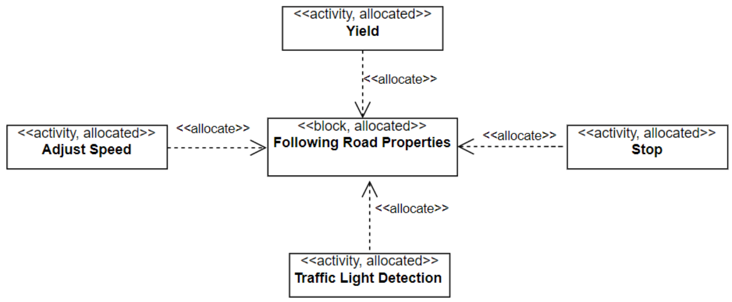

Figure 5: Allocation Diagram

F. State Machine Diagram

A state machine diagram is a behavior diagram depicting discrete behavior of a designed system's part via finite state transitions. Additionally, state machine diagrams may be used to express a system's usage protocol.

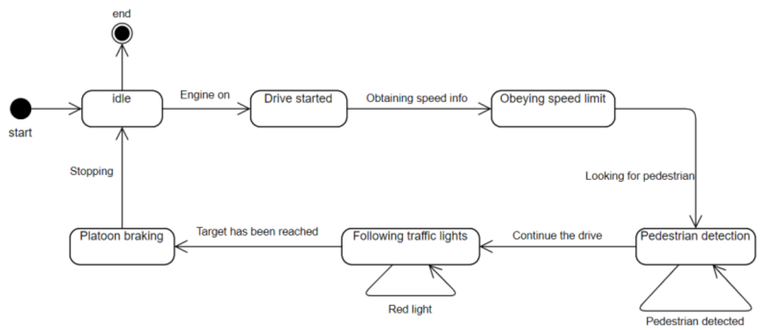

Figure 6: State Machine Diagram

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