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PLATOON DELIVERY SYSTEM

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CAMBRIDGE INSTITUTE OF TECHNOLOGY

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Abstract

This project presents an overview of an automated vehicle platoon. Platooning is the linking of two or more vehicles in the convoy. The prototype is built on the Raspberry pi and Arduino complimented with basic Adaptive Cruise Control technology (ACC). Allowing the platoon member prototype to follow the platoon leader. The same ACC system allow the prototype to perform obstacle avoidance in its designated path. Platoon leader has the capability to connect to the local server using Internet, hence can provide web update. Thus, platooning reduces energy consumption, risk of accidents, manpower, whereas improving delivery time, traffic efficiency, and safety, when implemented.

Keywords: *Platoon*

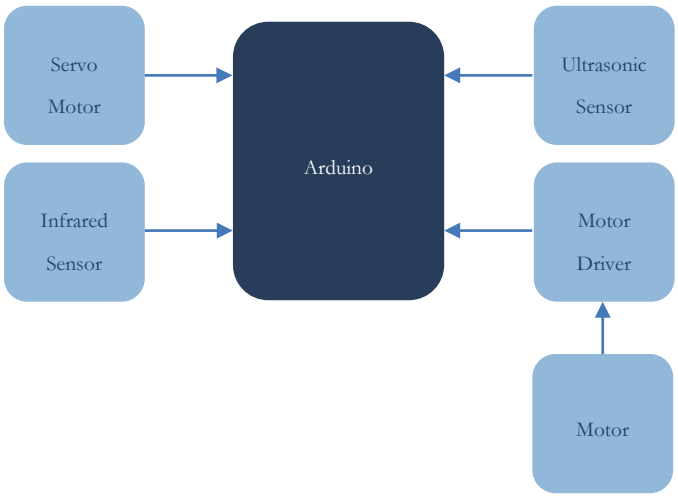
Introduction

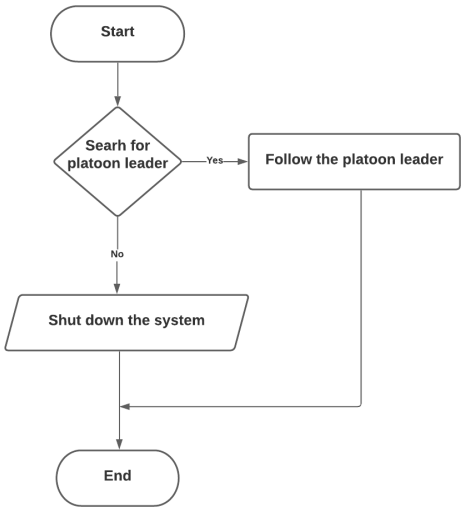
Platooning is the linking of two or more vehicles in the convoy. Platooning has been proposed with the primary objectives of cutting down fuel consumption and increasing road capacity and throughput. A platoon consists of one platoon leader and one or multiple platoon members, a platoon leader is the leading vehicle of the platoon, which is responsible for the direction and velocity, as well as updating the driving instructions to platoon members. The platoon leader can be a human-driven, semi-autonomous or completely autonomous. The platoon member follows the autonomous driving system and follows the driving instructions given by the platoon leader. Like, when a heavy-duty vehicle (HDV) in the motor joins the existing platoon, it becomes a platoon member, each platoon member relies on the driving instructions and information transferred by the preceding and succeeding vehicle.

Objective

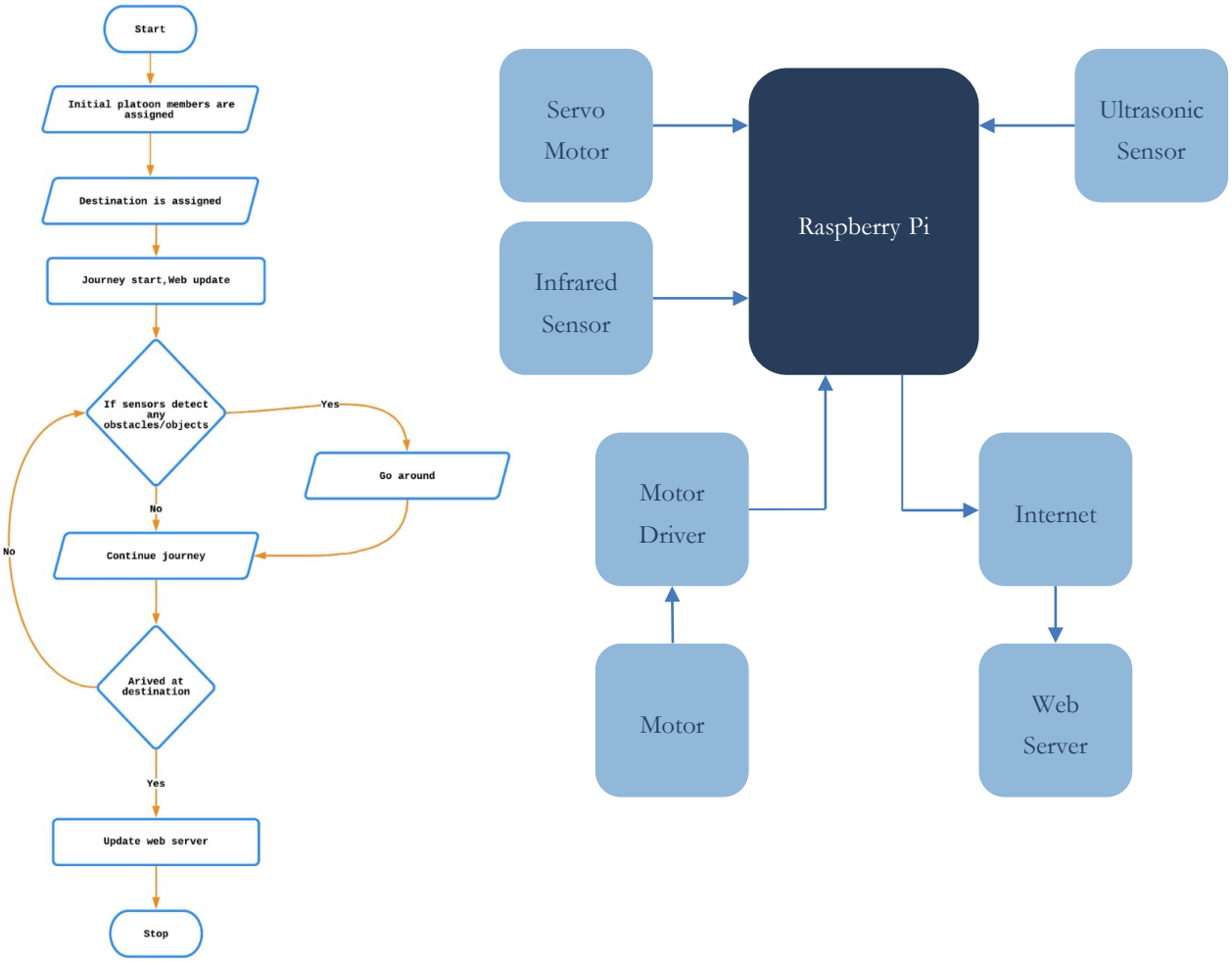
1. Fast and safe delivery of goods and commodity
2. Save fuel or energy used for transportation
3. Efficient traffic control
4. Cost of running is low

Methodology





The above-shown flowchart and block diagram are of platoon members. Its main function is to follow the platoon leader, which leads the path to the destination. The platoon member is mounted with an ultrasonic sensor, servo motor, IR sensor, and basic motor which are controlled by an Arduino microcontroller.



On the other hand, we have the Platoon leader, unlike the platoon member, it is controlled by a raspberry pi micro-computer with the same sensors as the platoon members, which are ultrasonic sensor, servo motor, IR sensor, and motor. As it is the first vehicle of the platoon it has obstacle detection and avoidance ability using the above-mentioned sensors. The Micro-computer has the ability to connect to the internet, allowing the platoon leader to update the local server with basic status of the platoon it is leading. The block diagram and the flowchart of the platoon leader is shown above.

Result

We've considered a rectangular track of dimension 60 cm and 25cm in length and width respectively. The starting position is designated by the letter A. To reach destination B, the prototype must travel 60 cm forward, then turn right and travel 25 cm forward, finally turn right again and travel 60 cm forward. During our study, we discovered that the prototype successfully arrived at its destination 7 out of 10 times, with minor variations in the path to be followed. The first three cases where the left-hand side motor was faster than the right-hand side motor, changed the entire course of the prototype, hence failed to reach its destination. The prototype was successful in updating the local webserver about the beginning and end of the journey to the local server every time. Thus, requires constant internet connection for this service.

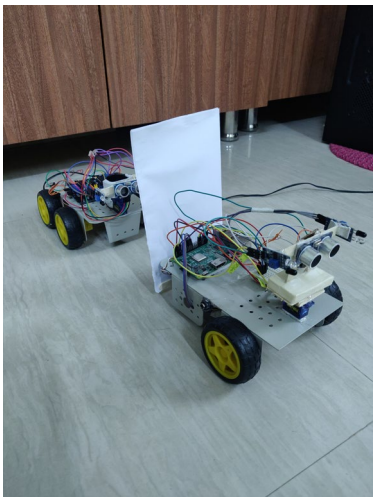
To gain a better understanding of the platoon prototype a layout of obstacles were laid to reduce the performance error rate close to zero to avoid collision of the prototype vehicle to achieve safety (i.e., collision avoidance). A number of tests were taken with different cases and the following results were concluded:

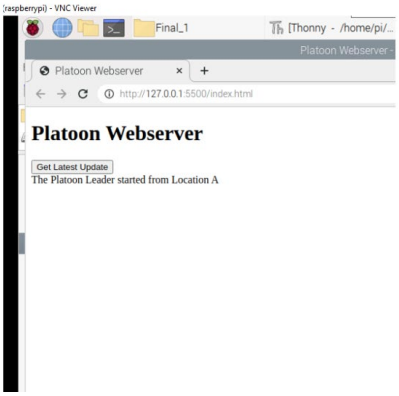
Case A: During the experiment, the vehicle and the obstacles were 20cm to 30 cm apart, it was observed that the vehicle stopped its journey or it collided with the obstacle as it couldn't deviate itself from the obstacle. It was also observed that there was an 80% chance of collision.

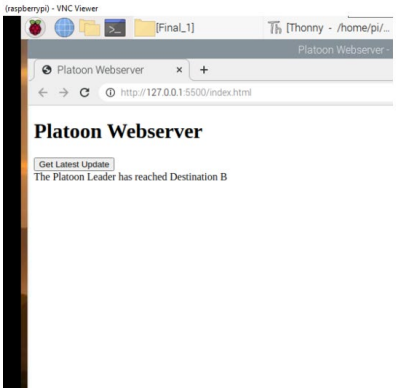
Case B: In the second case the vehicle and the obstacles were 40 cm to 45cm apart, it was observed that the collision of the vehicle with the obstacle was low compared to "Case A". The collision of vehicle error rate was reduced from 80% to 60%.

Case C: In this case vehicle and the obstacle were 50cm to 60 cm apart and observed that the collision of the vehicle was very low compared to "Case A" & "Case B" and got a positive response from the experiment. The collision of the vehicle was reduced from 60% to 5% and the error rate was almost reduced to zero compared to other cases.

As observed from experimenting on different cases we concluded that case 3 was more reliable than other cases.







Conclusion and Future Scope

This project presents the basic working of a platoon prototype system that implements adaptive cruise control technology. For this, a prototype vehicle was constructed especially for this research. The basic control algorithm was written to incorporate further navigation systems for path control. The model is equipped with a pair of infrared sensors and an ultrasonic sensor to keep the platooning vehicle in close proximity.

The two vehicles are built using different boards and similar components and were individually programmed for their functionality. The follower vehicle combining the various sensor can follow the leading vehicle close enough without colliding. Whereas the leader can update the webserver about the journey and will be the first vehicle of the platoon. The leader can also detect the obstacle in the path and can judge the safety of the platoon.

Besides the study of the control of the platoon vehicle future work includes the V2V communication protocol, IoT control. Moreover, navigation algorithm for lateral control of the merging and splitting of the platoon.