Vehicle Platooning

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Abstract- *Platooning, the idea of vehicles autonomously communicating with surrounding vehicles is a hot topic in research. It has huge potentials to improve traffic flow efficiency and most importantly, road traffic safety. Platooning is a way to increase the traffic flow and capacity on roads to handle the upcoming problems of traffic congestion and exhaust emissions. Wireless IR communication is a fundamental building block – it is needed to manage and to maintain the platoons. To keep the system stable, strict constraints in terms of update frequency and reliability must be met. We developed communication strategies by explicitly taking into account the requirements of the controller, exploiting synchronized communication slots as well as transmit power adaptation. Wireless networking is fundamental for this application, as it is needed to manage and maintain the platoons and, clearly, has strict requirements in terms of frequency update and delay constraints. This paper surveys the literature about platooning systems and related research, identifies some open challenges, presents a simulation framework which can be used to tackle them, and outline promising approaches.*

Keywords-Accidents, Highway-traffic, Inter-vehicle Communication, Platoon, Traffic Congestion.

I. INTRODUCTION

Vehicle platooning is an important innovation in the automotive industry that aims at Improving the safety, efficiency and the time needed to travel. Autonomous Capable vehicles in tightly spaced, computer controlled platoons will lead to increased highway capacity and increased driver comfort. The introduction of Automation into road traffic can provide essential solutions to the mainstream issues of Accidents, traffic congestion, pollution. Under cooperative Driving, automated vehicles drive like the migration of birds or a group of dolphins; the formation of birds in the migration is aerodynamically efficient, and Dolphins swim without collision while communicating with each other. The cooperative driving, simulating the formation of birds or dolphins, will contribute to the increase in the road capacity as well as in the road traffic safety.

This platoon demonstrated the ability to start, stop, accelerate and decelerate as a unit. Also demonstrated was the ability to split the platoon to allow for the entry of vehicles and then to rejoin as one platoon. A Heads-Up-Display unit was used to communicate to the driver information such a speed, overtake request and whatever maneuver the vehicle is currently executing. Following the concept presented earlier, we can say that Vehicle Platooning is an approach to improve the current transportation system both economically and technologically. In this approach, different layers of control hierarchy are responsible for performing different tasks needed to implement an AHS. Since each vehicle knows the dynamics of its leading car and might also know the platoon's leading car. In many recent approaches, inter-vehicle communication is also employed to transmit the required messages, i.e. the speed and position of the platoon's leading vehicle". Platooning can enhance the travel experience covering consumption issues, safety, and comfort: First, it has the potential to improve the traffic flow and decreasing pollution. Second, platooning can improve drivers' safety if a system fault is less likely than a human error, which is the main cause of accidents.

II. LITERATURE SURVEY

Fault Tolerant Control (Reference 1, Year: 2000)**:** In this paper they developed an AHS design that will perform well under most conditions. A common practice when designing such *fault tolerant* control schemes is to make use of two modules a fault detection module, to determine whether a certain fault has occurred and a fault handling module, where special controllers are implemented to minimize the impact of the fault on the system performance. Because the system performance is likely to degrade anyway, we will use the term degraded modes of operation to describe operation under these special controllers. The extended control scheme should guarantee graceful and gradual degradation in performance. Detection of failures in an AHS is a very challenging problem. Fault detection filters can be designed to identify faults in the on-board sensors and actuators. Due to the distributed, multiagent character of the AHS problem, communication with neighboring vehicles may also be required (in addition to the fault detection filters) for complete diagnosis and isolation of faults.

Identified Three Levels (Reference 2, Year: 2014): In this paper F. Michaud identified three levels in a driving task: strategic (highest level, for route planning and goal selection);

tactical (intermediate level, selecting maneuvers to achieve short-term objectives such as passing cars, making an exit, merging); and operational (lowest level, for control operations). Mobile robot research successfully addresses all three levels to different degrees. Platooning is considered a special case of a formation control problem in mobile robotics. Formations are defined as groups of mobile robots establishing and maintaining some used radar sensors to measure distance between vehicles, and magnetometers for lateral position control (providing vehicles with relative positioning information). Vehicles were controlled using a three-layer hierarchical distributed approach. Only one maneuver at a time was allowed in the platoon, and the leading vehicle was responsible for coordinating the actions required. For instance, a vehicle wanting to exit the platoon would first request permission to the leading vehicle; if granted the vehicle would change lane and the leading vehicle would allow the following one to close the gap. This is usually known as a centralized coordination approach.

Disengages The Platoon Formation (Reference 3, year 2014): The system used for this testing disengages the platoon formation if a gear shift, transmission neutral, or brake pedal activation is detected. This necessitated a speed trace that the vehicles could accomplish while staying in top gear and using only engine braking to vary the speed. The "Cruise Mode" section of the California Air Resources Board (CARB) Heavy Heavy-Duty Diesel Truck (HHDDT) schedule was used as a starting point, but the speed range was too low for top gear for a standard line haul tractor; therefore, 10 mph was added to all speed points of the HHDDT to bring the trace into the range of highway driving accomplished in top gear for these tractors. This modified HHDDT schedule was repeated roughly 2.5 times to approach 56 miles, intentionally short of the test distance of 59.5 miles. The variable-speed distance was set shorter than the normal test distance both to allow for error in meeting the trace and to allow the vehicles to enter and exit the test under 60 mph in the cruise control condition using normal test procedures.

Dedicated Short-range Communication (DSRC) (Reference 4, Year: 2012) : In this paper each vehicle is equipped with an IEEE 802.11p (DSRC) transceiver and sends out a message containing its position, speed, and acceleration (often known as the "Here I am" message). The following further assumptions were made for the communication system:

1. For each vehicle, messages are sent every *Ks* time steps from time 0.
2. After each message is sent, it takes $\tau 0$ seconds for encoding and decoding the message.
3. When one message is sent, it is received by each vehicle independently with probability $1 - \rho$, where ρ is the message loss rate. This rate ρ was assumed to be a constant for all sender–receiver pairs and for all time.

III. PROPOSED SYSTEM

The Block Diagram consist of 5 separate sections i.e. Centre Vehicle, Front Vehicle, Following Vehicle and Left-right side Vehicles. These consist of PIC, Stepper Motor Drive, Stepper Motor, IR Trans-receiver, LCD Display, Keys. TSOP Receiver mounted on car with stepper motor will rotates and detects surrounded vehicles.

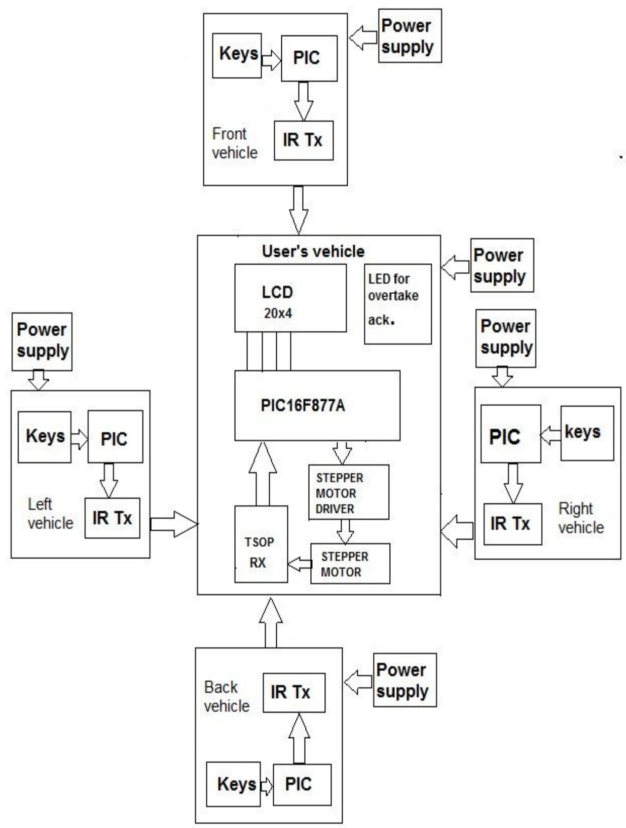

Figure 1: Block Diagram of group of vehicles containing transmitter and receiver.

A Position where vehicle is detected, IR transreceiver mounted on stepper motor stops at that position and communicates with surrounded vehicle to transfer data. For every transfer of data between single vehicle needs upto 300msec maximum. In our system, rotating receiver stops at every direction for 3 sec to communicate with transmitter. That is, few seconds are enough to communicate and collect data from surrounded vehicles. According to data, parameters such as speed, break information and any vehicle wants to overtake or not will be displayed on LCD.

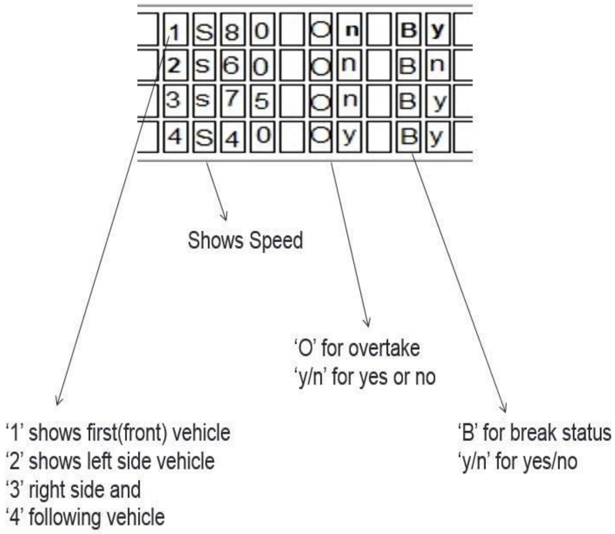

Figure 2. Display scheme at receiving vehicle

IV. SOFTWARE DEVELOPMENT

The mikroC PRO for PIC is a powerful, feature-rich development tool for PIC microcontrollers. It is designed to provide the programmer with the easiest possible solution to developing applications for embedded systems, without compromising performance or control.PIC and C fit together well: PIC is the most popular 8-bit chip in the world, used in a wide variety of applications, and C, prized for its efficiency, is the natural choice for developing embedded systems. MikroC PRO for PIC provides a successful match featuring highly advanced IDE, ANSI compliant compiler, broad set of hardware libraries, comprehensive documentation, and plenty of ready-to-run examples.

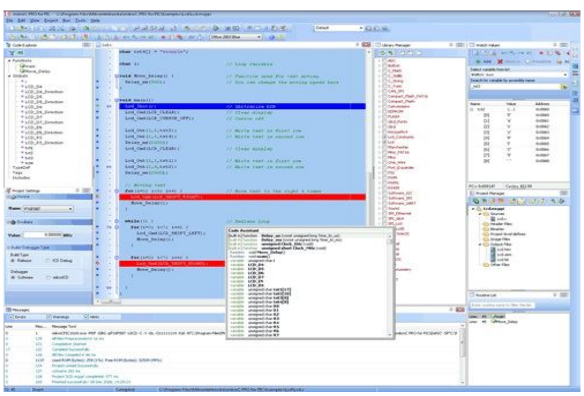

Figure 3: Simulation

V. RESULTS

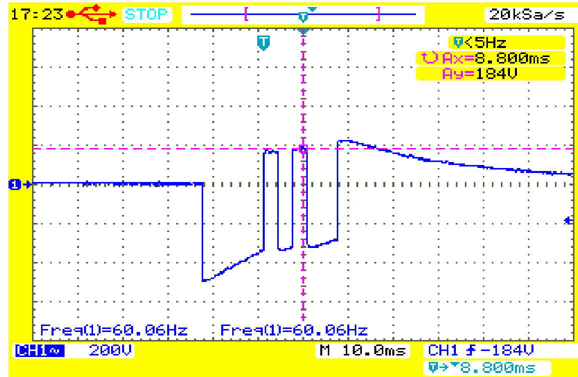

Figure 4: waveform of 8-bit frame transmitted by IR.

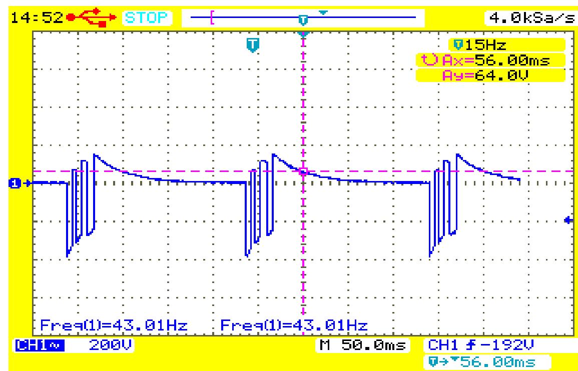

Figure 5: waveform of continuous reception of frames by TSOP receiver.

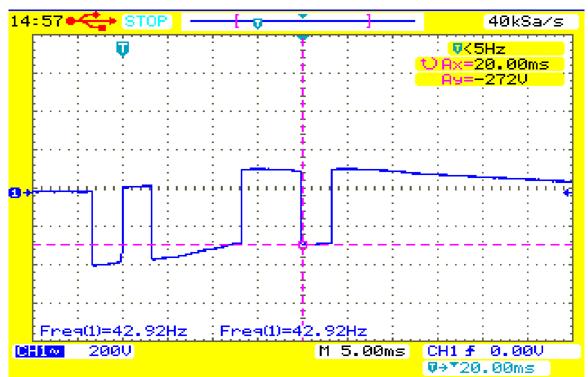

Figure 6

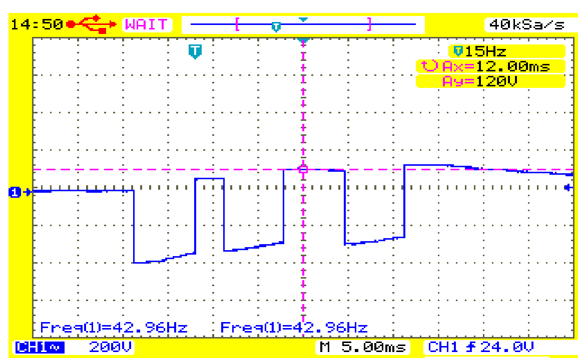

Figure 7

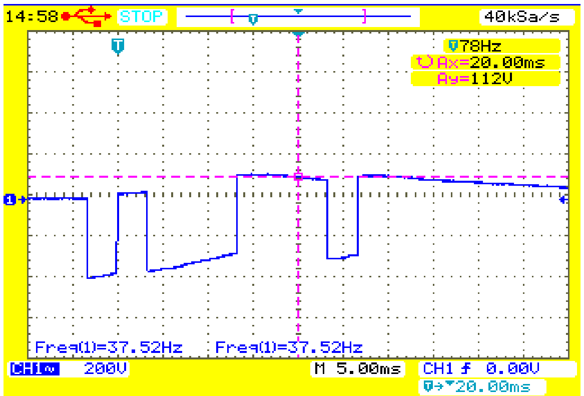

Figure 8

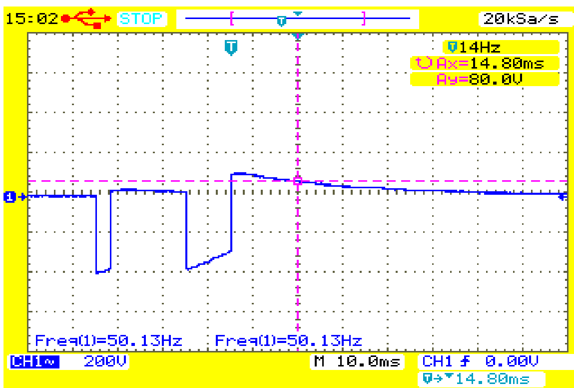

Figure 9

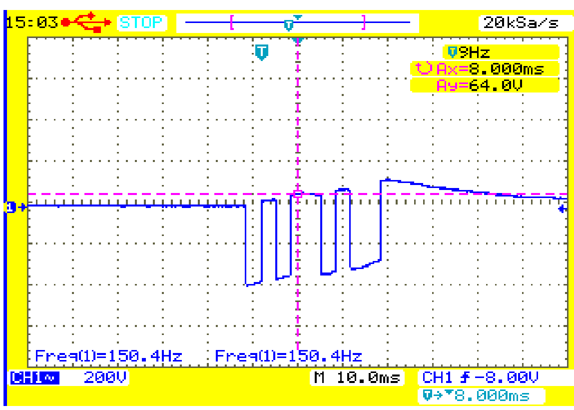

Figure 10

Figures 6, 7, 8, 9, 10. shows the waveforms when change in speed (increase and decrease), braking status and when overtake request key is pressed.

VI. ADVANTAGES

- Traffic efficiency.
- Driver comfort.
- Safety.
- Avoid Road Accidents.

VI. CONCLUSION

It is important to demonstrate that vehicle platooning brings major transportation benefits in terms of safety, efficiency, affordability & usability, & environment in order to achieve its de-velopment goals. Yet, as we can see in the case of vehicle platooning, program acceptance is not just based solely on technological capabilities but also on people's social, economic, & environ-mental concerns.

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