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Vehicle to Vehicle Communication for a Platooning System Using CAN Bus

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Abstract: This work describes about the communication between vehicles. The aim of this paper is to create a project which is helpful to drive vehicles in platoon. Platoon is known as road train. In Platoon system a manually driven Master vehicle is followed by many slave vehicles. The platoon forms a cooperative system where the each vehicle is sub-system. Zigbee wireless module is used to establish connection between vehicles. Zigbee is used to communicate data wirelessly such as speed, direction, braking and destination place of vehicle. Controller area network (CAN Bus) is fastest wired communication standard designed protocol used to communicate microcontroller and devices in vehicles with each other within a vehicle. Result show that when slave vehicle is entered into platoon system it will start following master vehicle and after exit it will not follow the instructions from master vehicle.
Keywords: CAN Bus, Master, Platoon, etc

I. INTRODUCTION

This work describes a vehicle to vehicle communication system that is developed for platoon system. The project aim is to develop and integrate solution that allows vehicles to drive in platoon. Platoon is known as road train. Now days, number of accidents are increased on highways. These accidents are caused because of the high speed of vehicles, carelessness of driver and many more. Road safety is an issue of national concern, considering the number of accidents it's a negative impact on the economics of country, general welfare of the people and health of public.

Now a day, highway injuries are one of the major cause of deaths, hospitalization and human disabilities etc which affects on social and economics of country. Therefore safety measures are important to prevent the road users from being killed and injured in highway accidents. Vehicle drivers, passengers are called as road users. Because of the road accidents several unwanted consequences happens every day on highways such as death of road user, permanent injuries, loss of earning etc. [1]

Safety, efficiency and traffic control are currently a major concern in transportation. Research and projects have been done on Intelligent Transportation systems with the aim of improving the current state of road safety and transportation. [3]

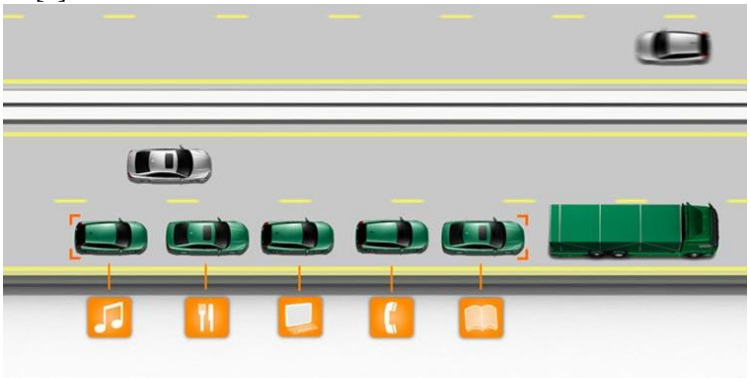

Figure 1 General Concept of Platooning System [11]

Chain collisions can be potentially avoided; one way to provide more time to drivers to react in emergency situations is to develop Intelligent Transportation System applications using emerging wireless

communication technology. The primary benefit of such communication will be to allow the emergency information to be propagated among vehicles much quicker than a traditional chain of drivers reacting to the brake lights of vehicles immediately ahead [9]. So to avoid these accidents platoon system is one of the best methods. In this paper we are describing about the communication of vehicles. The aim of this project is to build an answer which allows vehicles to run in platoon system. Platoon is known as road train [7] i.e. numbers of vehicles are following to each other on strait road. Platoon system is consisting of one master vehicle and number of slave vehicles following to master vehicle. Master vehicle is manually driven. The instructions are given to master vehicle is by laptop. Laptop and master vehicle is wirelessly communicating to each other. Slave vehicle is following instructions given by master vehicle wirelessly. Zigbee modem is used for wireless communication purpose. Slave vehicle can join or leave platoon system on the arrival of desired destination. For this purpose simple switch is given on slave vehicle.

The platoon is a cooperative system and every vehicle is a sub-system. In platoon sensing the data, control algorithm distributed throughout the system and data is communicated between vehicles to vehicles. Every vehicle is having local sensors which plays important role to avoid instability in the platoon system. [2] Here IR distance sensor is used to keep safe distance between two adjacent vehicles. Therefore platoon system is incomplete without vehicle to vehicle communication. For the safety of the platoon system, vehicle to vehicle communication should be error free and accurate. So make sure that all slave vehicles are receiving the same commends from master vehicle. Many technical challenges are involved this project such as establish vehicle to vehicle communication, deign of vehicle hardware, control algorithm, selection of components, development of programming etc. This paper gives an overview of platoon system and describes the working of project.

Controller area network is a common wired communication protocol. Controller Area Network (CAN), as its name implies, is the network established among microcontrollers. It is design to allow fastest communication between microcontroller and distance sensor in slave vehicle. CAN Bus is used to share distance between two adjacent slave vehicle signals to main microcontroller for further decision purpose.

The aim of this work is to establish the vehicle to vehicle communication. Master vehicle is manually driven i. e. instructions are given by laptop wirelessly. When slave vehicle sends a joining request to the master vehicle it will accept that request and allows to join the platoon system. Then slave vehicle will start following master vehicle commands. When slave vehicle is entered into platoon system the diver can do his own work like eating, reading relaxing etc. as shown in fig 1. On desired destination slave vehicle can send a leaving request to the master vehicle after accepting that request by master vehicle, slave vehicle can follow their own path. To join and leave platoon slave vehicle is having simple switch. During this operation it's very important to keep constant and safe distance between every two successive vehicles.

II. HARDWARE

Here two vehicles are considered for demo. As shown in figure 2, 1st vehicle is known as master vehicle and 2nd vehicle is known as slave vehicle shown in figure 3. Master vehicle is manually driven i.e. instructions are given by laptop. Laptop and 1st vehicle is having Zigbee wireless communication modem. Master vehicle hardware is simple as compared to slave vehicle. Slave vehicle hardware is divided into two PCBs. PCB1 is main microcontroller of which control the working of slave vehicle and PCB2 is having IR distance sensor. PCB 1 and 2 are connected to each other via CAN trance receiver wired communication.

PIC microcontroller 18F2480 is a brain of both the vehicles. PIC18F2480 is 28 pin microcontroller having enhanced flash memory, 10 bit A/D, less power consumption and in-built CAN controller. Hardware become simple because of in- built CAN controller.

The aim of this project is to establish vehicle to vehicle wireless communication. For this purpose we are using Zigbee wireless communication modem which is simple and reliable module. 12V, 1A transformer is used to supply the power for both the vehicles.

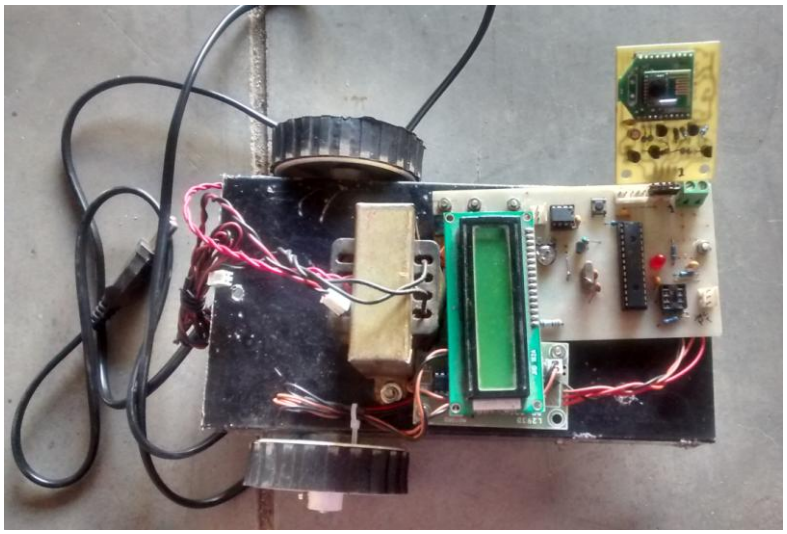

Figure 2 Hardware of Master Vehicle

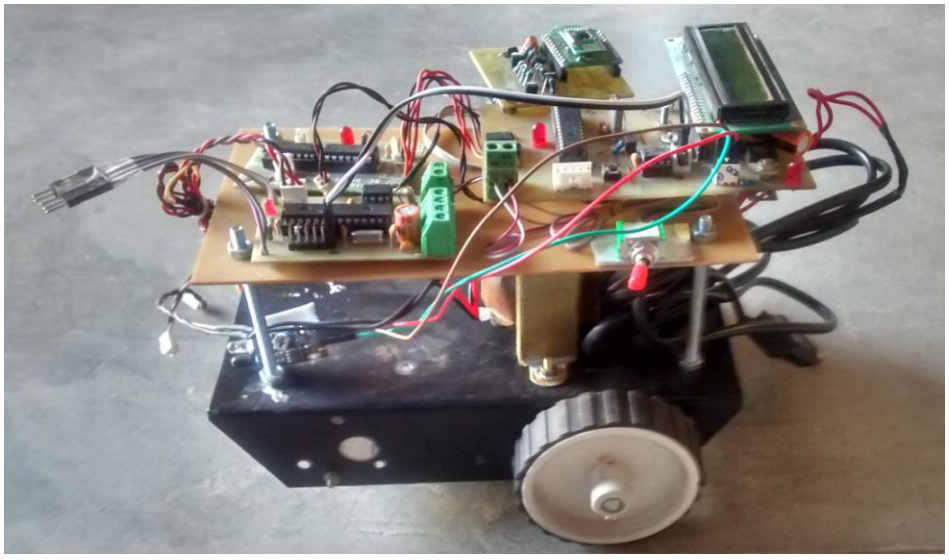

Figure 3 Hardware of Slave Vehicle (side view)

Slave vehicle is having switch button which will decide the states of vehicle i.e. leave or join the platoon system. PCB1 is having Zigbee trance receiver model which will receive and transmit data signal to the master vehicle wirelessly. PCB1 is having LCD display. On this screen we can display data example project name, states of vehicle in platoon system i.e. join or exit, distance between vehicle and received command etc.

MCP2551 is CAN trance receiver. CAN bus is a wired protocol. It is fastest wired communication. The purpose of using CAN Bus in this project is to convey the distance between two vehicles rapidly to PIC2, so microcontroller can take decision and avoid collision of two vehicles. PCB 1 is consists of PIC 18F 2480 microcontroller, infra-red (IR) distance sensor GP2Y0A21YK0F is continuously measuring the distance between two vehicles and measured distance is given to controller 2 (PCB2) for further decision process.

III. WORKING

Vehicle to vehicle communication is important part of project. Zigbee modem is used to establish the network between master and slave vehicle. Master vehicle is manually driven vehicle. So instructions are given by laptop to master vehicle. Laptop and master vehicle are accepting instructions by Zigbee wireless modem. Initially slave is self driven. When slave vehicle wants to join the platoon system it will send the joining request to

master vehicle. After accepting that slave vehicle will start follow the master vehicle. Slave vehicle is having IR distance sensor at front side. IR sensor helps to keep constant distance between two vehicles. Measured distance is given to PCB1 of slave vehicle via CAN bus. CAN bus is wired protocol used as fastest communication. If measured distance is less than set point, then microcontroller 1 will stop the vehicle to maintain the distance between two vehicles. When obstacle is removed, again slave vehicle will start the following instructions from master vehicle. If slave vehicle wants to leave the platoon system again we have to press the switch then it will stop receiving commands from master vehicle and follow its own path.

IV. SOFTWARE

The mikroC Pro for PIC is used to develop the software of this project. The microC for Pro is a powerful development tool for PIC microcontroller. It is easiest solution to develop program for embedded system. Programming C language and PIC complement each other. PIC is very popular 8 bit microcontroller used in a wide range of application. C language is known for efficiency.

In the new project we should define the device name and required device clock. Edit your C language source code in new project. After that it will debug the code.

Algorithm

Master Vehicle:

- Start
- Hardware initialization
- Receive wireless commands from laptop (F, B, R, L, X)
- If receive 'J' send the commands (f, b, r, l, x) to microcontroller 2 of slave vehicle.
- Stop

Slave Vehicle: - 1st microcontroller:

- Start
- Hardware initialization
- CAN initialization
- Continuously read distance using LM 393 s IR distance sensor.
- Send distance to microcontroller 2 through CAN bus.
- Stop

2nd Microcontroller:

- Start
- Hardware initialization
- CAN initialization
- Read distance through CAN frame
- Send 'J' to vehicle 1 when vehicle 2 wants to join platoon.
- If distance is less than set point then display obstacle and stop vehicle or follow the instructions from master vehicle.
- If switch is press, stop following instructions from master it is leave the platoon system or follow the instructions from master vehicle.
- Stop

V. CONCLUSION

V. 1 Advantages:

1) Reduces number of accidents on highway.
2) Increased road safety.
3) Increased driver convenience.
4) Platoon system can be implemented on highways without changing infrastructure.
5) Possible to allow mixing of platoon system with other road users.

6) Reduced fuel consumption.[11]

V.2 Limitations:

1) This work is for demo so only two vehicles are considered.
2) Zigbee range is up to 100 m only.

V.3 Conclusion:

This project describes the Platooning system which helps to improve the present traffic conditions and helps to reduce the accidents on the highways. Without change in the infrastructure it improves the safety of road users. Master vehicle is manually driven and slave vehicles are following the master vehicle. So it increases the driver convenience.

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