Platoon System for Vehicles using ZigBee Module and CAN Bus

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Abstract: Based on Intelligent Transport System (ITS), establish vehicle to vehicle communication for platoon system is aim of this work. Platoon is known for road train where lead vehicle (LV) is human driven and many following vehicles (FV) follow the lead vehicle automatically. Platoon system does not require any changes in existing road infrastructure. Controller area network (CAN Bus) standard protocol is used to communicate within the vehicle environment. PIC 18F2480 microcontroller with in-built CAN trance receiver is used. Zigbee module is used for wireless communication in overall platoon system. CAN Bus provide high speed wired communication, increased in flexibility and error free communication. The software design considers hardware initialization, CAN initialization, message sending and receiving unit etc.

Index Terms **–** CAN Bus, vehicle automation, platoon,

I. INTRODUCTION

An economy of country is strongly connected to performance of transportation. Highways are major part of transportation. Intelligent transportation system (ITS) is developed to improve the safety measures, efficiency, comfort level, and string stability of road users. ITS involves vehicle to vehicle wireless communication network. If vehicles are exchanging the set of information such as speed and position to other vehicles wirelessly, then it helps to detect the unwanted events such as traffic jam, surrounding vehicles, obstacles, weather conditions etc. Due to previous warning driver can be aware of harmful traffic situation, accidents and collision etc. Driver will get more time to react on unwanted things. Traffic accidents become a major reason to take thousands of lives of road users and temporary or permanent disabilities every year. Studies show that 60 % road collisions could be avoided if the operator of the vehicle will provided warning at least one half second prior to a collision []. Driver behavior is considered as leading reason for accidents. The inability of drivers to react in time to emergency situation often creates a chain collision, in which an initial collision between two vehicles is followed by a series of collisions involving the following vehicles. [13] Chain collision can be avoided by reducing the time between emergency situation and time taken by vehicles behind are informed about it. To avoid chain collision vehicle to vehicle communication is important.

As shown in figure 1, the platoon is a cooperative system and vehicles are considering as a sub systems. A platoon is a collection of vehicles where heavy lead vehicle (LV) is followed by many vehicles automatically. Following vehicles (FV) are fully or partially auto moving. Following vehicles (FV) may join or leave the platoon on arrival of destination. Signals such as speed, direction is communicated throughout the platoon via wireless network. Vehicles driving in a platoon consume less fuel compare to driving vehicles separately.

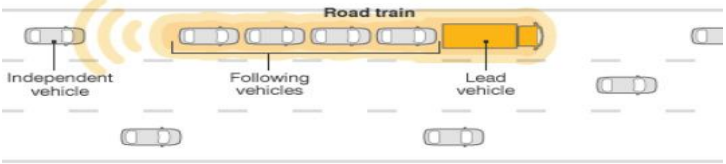


Figure 1 General Concept of Platoon System [ ]

II. Hardware

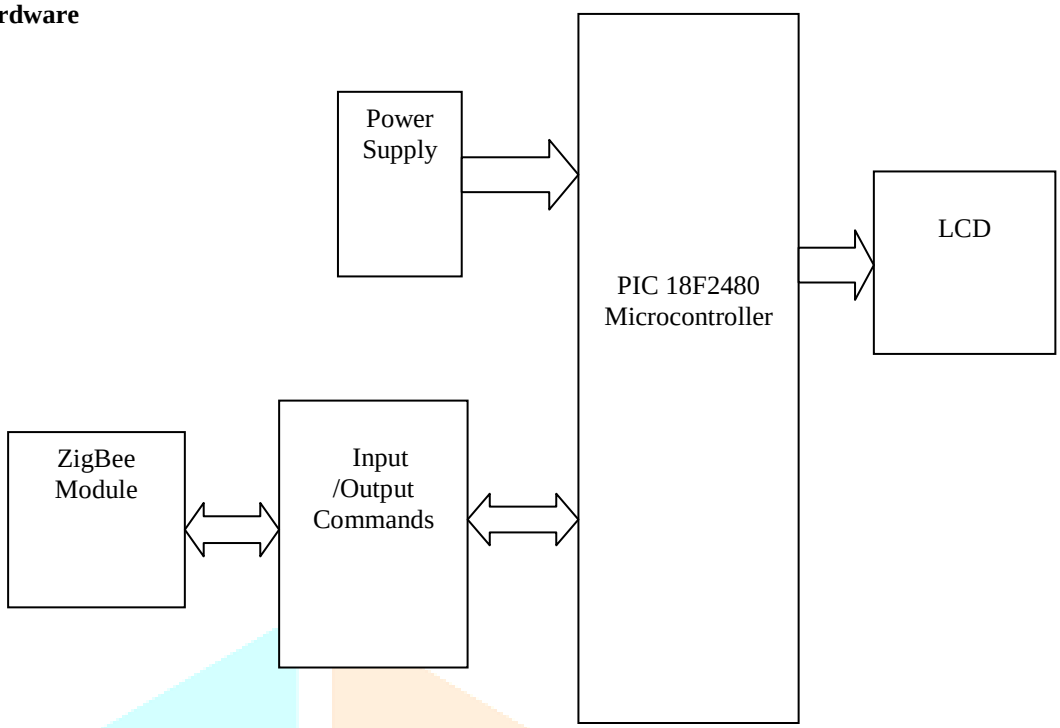


Figure 2 Block Diagram of Lead Vehicle (LV)

The block diagram of Lead vehicle (LV) is as shown in figure 2. Lead vehicle is mainly consisting of PIC 18F2480 microcontroller, LCD, ZigBee wireless module. Lead vehicle (LV) is manually driven. Therefore commands are sending via laptop wirelessly. LCD is used to display the name of project.12 volt transformer is connected to provide supply.

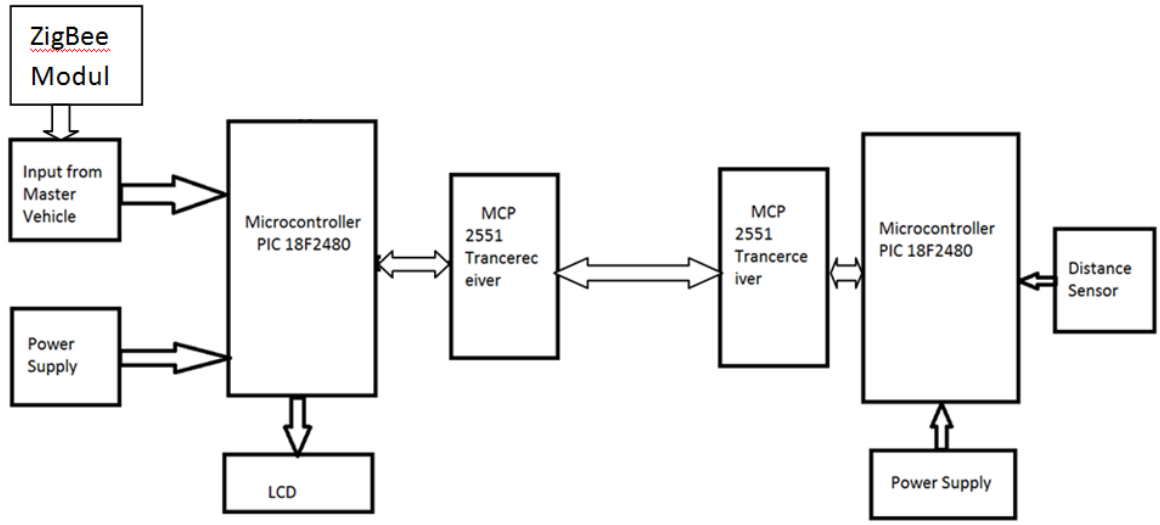


Figure 3 Block Diagram of Following Vehicle (FV)

The block diagram of following vehicle (FV) is shown in figure 3. Following vehicle hardware is sub-divided into two PCB. PCB1 is having Zigbee module connected to the microcontroller for vehicle to vehicle communication. PCB1 is mainly consisting of PIC 18F2480 microcontroller, Zigbee module, LCD, CAN Bus trance receiver MCP 2551. PCB2 is consisting of IR distance sensor, CAN trance receiver MCP 2551. PCB1 and PCB2 is connected via wired CAN Bus protocol. CAN Bus is fasted wired communication. IR distance sensor is used to measure a distance between two vehicles. 12 Volt transformer is connected for power supply.

In Platoon system, Lead vehicle (LV) is manually driven and following vehicles (FV) are only following the instructions given by lead vehicle. When FV wants to enter into platoon it will send a request message to the LV. Simple switch is given to FV to join or leave the platoon. Press the switch then FV will join the platoon and FV will start receiving commands. If again switch is pressed then FV will leave the platoon and then FV will not receive any kind of a command from LV, it will follow its own path. Adriano Infrared Collision avoidance sensor is used to maintain the distance between two vehicles. Microcontroller 2 is given a predefined distance limit which is known as a set point. Microcontroller 2 will continuously check the distance which sensed by sensor. During travelling if distance between vehicles is decreasing i.e. distance is less than set point then following vehicle will automatically stop. Lead vehicle is accepting commands in capital letters and following vehicles are accepting commands in small letters. GP2Y0A21YK0F IR distance sensor is used to maintain the distance between two vehicles. The sensed distance is displaying on LCD.

Example commands are given in following table.

Table 1 Commands and their Meaning

Sr. No.	Commands	Meaning of Commands
1	F	Move in Forward direction
2	R	Take a Right turn
3	L	Take a Left turn
4	B	Move in Backward direction
5	X	Stop
6	J	Join in Platoon
7	E	Exit from Platoon

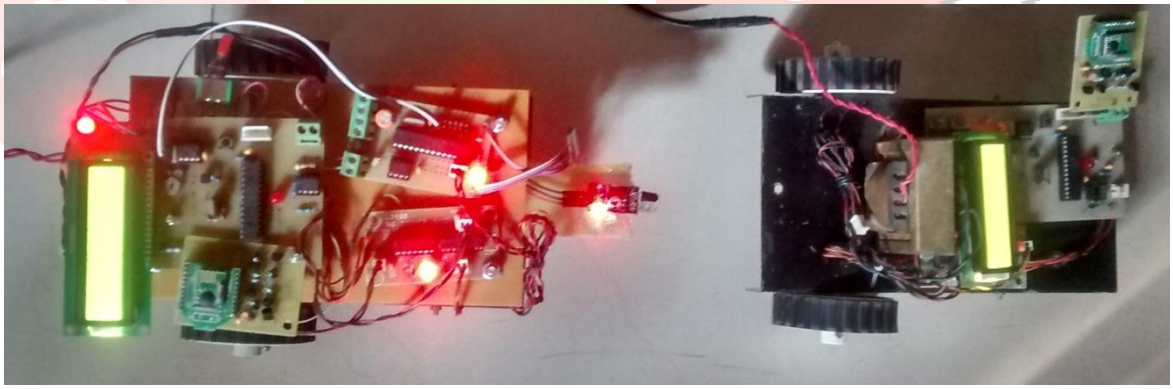


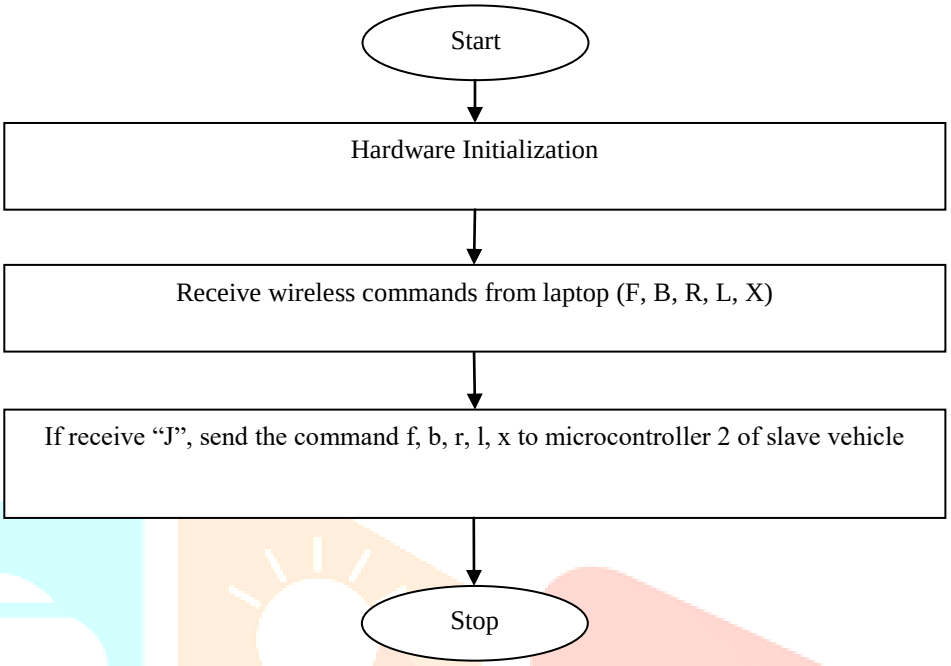
Figure 4 Hardware Implementation

Figure 4 shows the hardware implementation of platoon system. 1st vehicle is leading vehicle (LV) and 2nd vehicle is following vehicle (FV). Red light indicates that power supply is on. Distance sensor is attached at the front side of slave vehicle. When following vehicle is entered into platoon system it will start following the leading vehicle. Commands are given to leading vehicle by the laptop unit. ZigBee module is used to communicate between the vehicles.

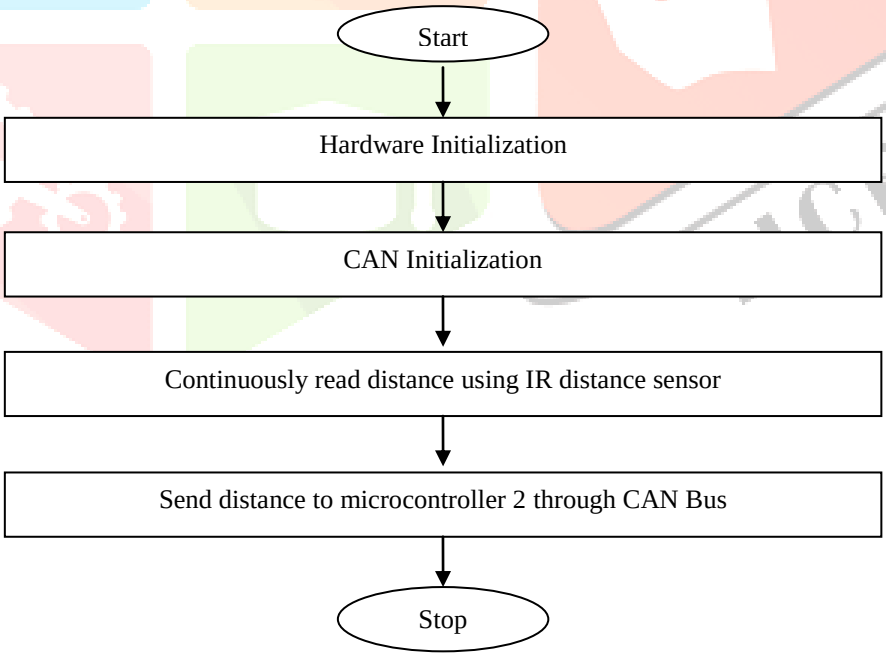
III SOFTWARE

To develop the project software mikroC Pro is used. The mikroC Pro is a powerful tool used to development of embedded system. Programming C soft language is used with mikroC.

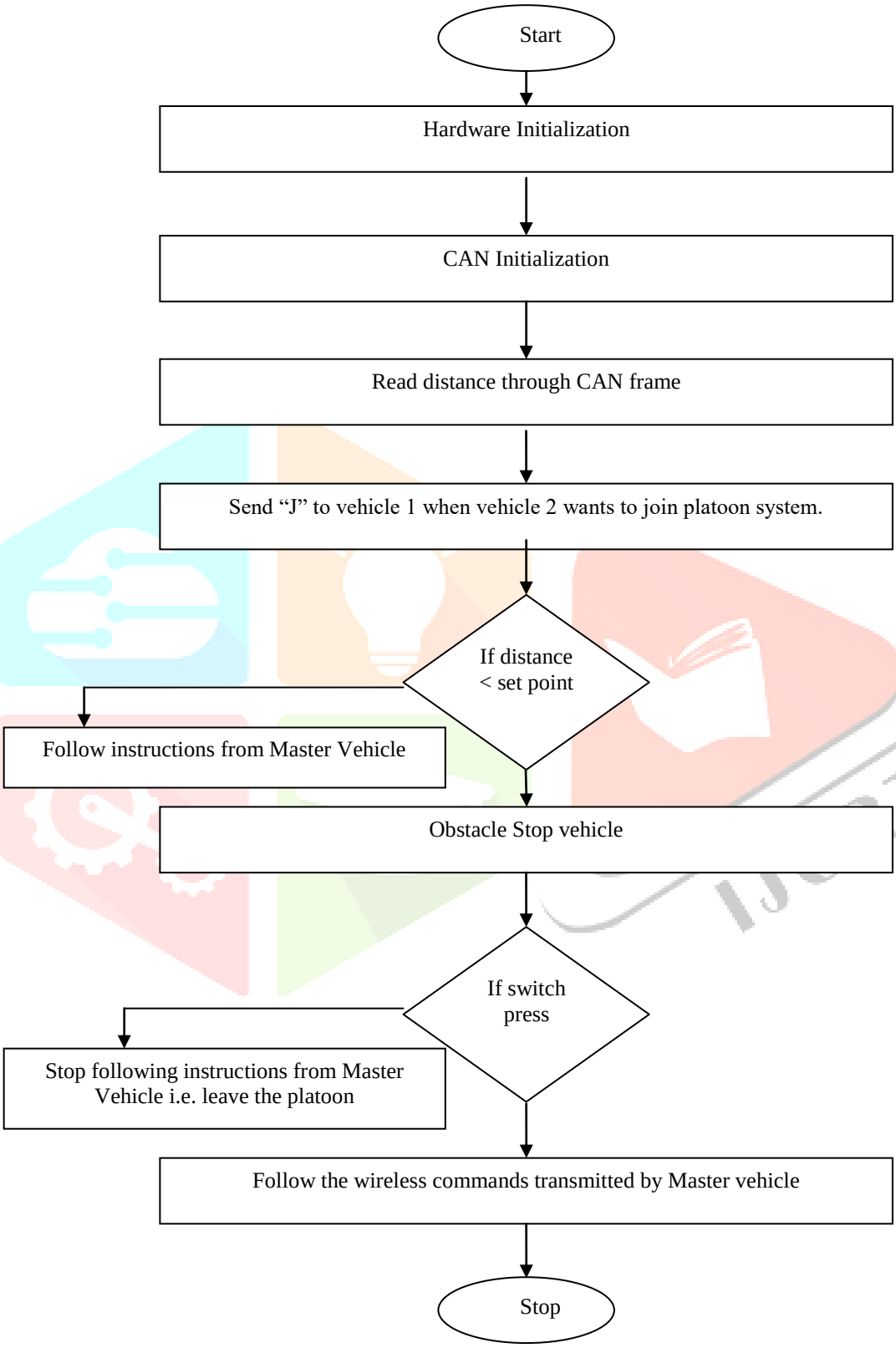
Flow chart for Leading Vehicle (LV):-



Flow chart for Following Vehicle (FV) PCB1:-



Flow chart for Following Vehicle (FV) PCB2:-



Conclusion:-

Figure 5 Platoon System Result on LCD

Figure 5 shows the result of platoon system on LCD of following vehicle. Distance between vehicles is displayed on screen of following vehicle. The status of the following vehicle is displayed on LCD screen. Join or exit the platoon system is given on the screen. "J" indicates the join and "E" indicates the exit the platoon. The command send by the lead vehicle is shown on the screen.

References:-

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