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Use of Smart Wireless Node in Vehicle Networking

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Abstract— The paper proposed the use of smart wireless node in vehicle network for communication between different Electronic Control Units (ECU) in the vehicle more specifically for Body Control Module (BCM) in bus platform. In typical bus platform the main constrain is wiring harness as it involves many critical issues as weight, complex design and many more. To overcome this issue the smart wireless nodes in vehicle can play important role as it significantly reduced wiring harness. We use PIC 18FXX microcontroller, Zigbee Device with IEEE 801.15.4 standard for communication between different wireless network modules in vehicle.

Keywords— Wireless Node, In vehicle Networking (IVN), Electronic Control Unit (ECU), Body Control Module (BCM), PIC Microcontroller, Zigbee

INTRODUCTION

The electrical circuits and their electronic control units are essential for good performance of vehicle and communication between them. At the beginnings of the 1980s, the engineers of the automobile manufacturers assessed the existing field bus systems for their use in vehicles as requirements are continuously changing so lots of research activities and innovation gets involved in automotive segment. Intra vehicle to vehicle communication, Vehicle to road infrastructure communication, Communication between different parts within vehicle such as trailer and dispatchers are getting connected and able to gather and distribute data, which could be used to enable better operations. If we broadly consider any communication possible by physical hard wired point to point connection, second is use of inter ECU communication protocol and third one is wireless communication medium. Till date above both physical point to point hard wired connections for communication and proprietary hard wired serial communication protocol is used but even though wireless sensor networks are having potential to be used in many vehicle applications it is not being actively used or not on focus for further research. They came to the conclusion that none of protocols fulfilled completely their requirements. It supposes the beginning of the development for new field bus protocols use of same in vehicle. With the increased number of electronic control unit system and its complexity it is impossible to implement this exchange of information through point to point links because it would suppose a disproportionate length of cable, an increase of cost and production time, reliability problems, and other drawbacks. To overcome this scenario using more than one protocol in vehicle, to reduce wiring harness reduction and better scalability wireless sensor network (WSN) can play important role. In this IEEE 802.15.4 protocol based Zigbee transceivers module are used to make the wireless sensor network. The node will acquire and internally store data periodically. Starting times as well as the time intervals for can be freely programmed over the network system. As soon as a proper network is detected in its proximity the node will automatically transfer data. Optionally sensor data can be delivered on demand. When in its idle state the node remains in power-down mode in order to minimize power consumption. These multiplexed network modules installed in the vehicle to provide an important reduction of the wiring that involves a reduction in costs, less breakdown risks, and easier scalability. Also, the maintenance tasks can be enhanced.In this paper non safety critical functions are consider for implementation as a first step toward use of smart wireless node in-vehicle networking. As in-vehicle network architecture can be partitioned into different domains mainly safety critical or non-safety critical function. Safety critical functions are the functions which are introduced in the system to prevent or stop accident or critical situation occurrence. If this critical safety function is malfunction then there may be chance of accident. Non-safety critical functions are the function those does not affect main system if it gets failed due to some reason but if these functions are present in the system then it

enhanced overall system. From bus platform view it includes user oriented features in vehicle like park light, buzzer, Internal Lights, front and rear side of lamp etc. after successful proto building later on can able to move towards complete wireless in-vehicle networking architecture.

OBJECTIVE AND SCOPE

The scope and objective of this paper is to integrate wireless sensor node in the vehicle also to get different solution for existing wiring harness design. The technology chosen for the wireless network is Zigbee, after successful implementation of concept on prototype communication protocol can be easily upgrade. Another important point is weight reduction. In vehicle there are different parts of wiring harness such as front panel, dashboard, Engine, Body control, Chassis, Tail wiring harness and total weight is more than 130kg in trucks and buses. If total length we consider then it is more than 8km of copper wire and cost is huge so even if consider and manage 10 to 30 % reduction in wiring harness it will create significant difference in terms of both cost and weight.

Main Objectives is

- To provide alternate solution for current system
- Overview of future technological requirement

Other Expected Key Outcomes

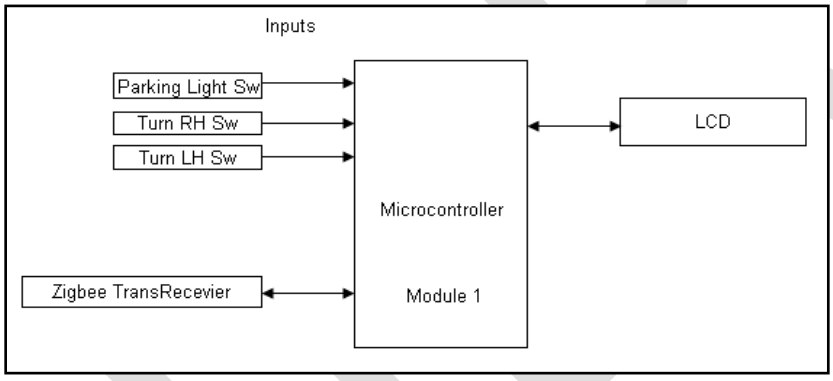
- Reduction in wiring harness complexity
- Reduction in total weight
- Cost Reduction
- Easy Diagnosis , Monitoring
- Higher Scalability

PROJECTDESCRIPTION

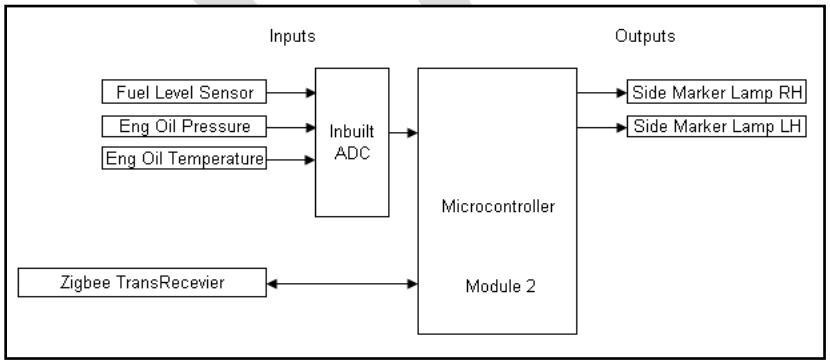
The number of sensors in the vehicle has increased significantly over the past few years, mainly due to various safety and convenience applications. Currently, the sensors and the microprocessor in a car communicate over a serial data bus and are connected with physical wires. The most significant problem of the current wired architecture is scalability, resulting in the emerging need to develop an in vehicle wireless sensor network to provide a flexible open architecture to incorporate hundreds of sensors which will be installed in future vehicles. Wireless sensor Networks recently have come into importance due to the fact that they have the prospective to revolutionize many segments like environmental monitoring, transportation, healthcare industries. Because of the advantages of the wireless sensor network such as low power consumption, wireless distribution, and flexibility without cable restrictions the usage of WSN in automobile filed is expected to grow in coming years and it will drastically reduce overall wiring harness cost as well as weight.

As shown above figure3 in prototype there are three modules which is called as nodes, this nodes will be placed in vehicle at appropriate location such that source of signal or output that need to be derived from node is very nearby place that will help to reduce wiring harness. First node will be near to front side that in driver cabin, as all front combi switch inputs will be easily accessible. Input from combi switch such as turning light input, parking light input is given to node one, it will transmit wireless data to both second node and third node. Second node will be placed in middle of vehicle as side blinker lamps will cover in this module and engine related sensor input given to second module. When data received from first node it will turn on side blinker lights. Third module will be at rear side of vehicle and rear loads of vehicle will be connected to this module. The sensor input such as air pressure, Engine oil pressure will be given to node and it will transmit data to first node, it will receive data from respective node and display on LCD module. Each sensor node contains a computational module (a programmable unit) which provides computation ability, storage, and bidirectional communication with other nodes in the system.

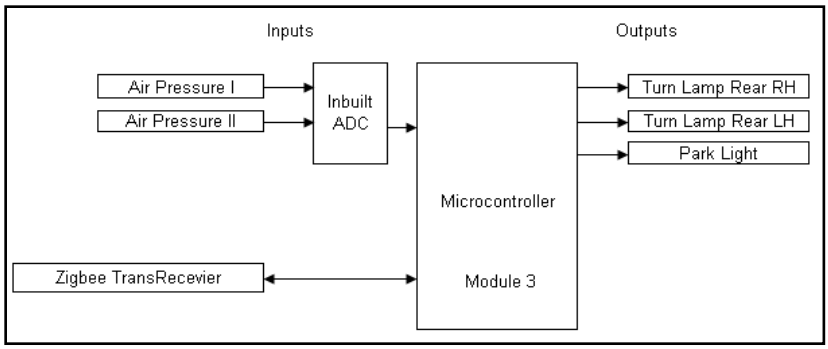
The main two advantages are they can be re-task in the field and easily communicate with the rest of the network. Nowadays the need to collect and act on real-time data increased drastically. However, to collect data using typical wired sensor networks has always been expensive, considering to installation and maintenance costs. Although past wireless measurement solutions have been elusive, the spreading of the use of wireless sensor networks (WSNs) is in fast development. WSN is a term used to describe an emerging class of embedded communication products that provide redundant, fault-tolerant wireless connections between sensors, actuators and controllers. WSNs are typically formed by groups of several sensor nodes, so called as nodes, whose individual constitution is based on actually combining sensor radios and CPUs into an effective robust, secure and flexible network, with low power consumption and advanced communication and computation capabilities. Its applications include industry, atmosphere monitoring, and defense, among others. Besides instrumentation concepts, WSNs involve aspects of wireless communications, networks architectures, and protocols. A wireless sensor network is composed of autonomous distributed sensors that cooperate to monitor physical conditions. In a vehicle these conditions can be tire pressure, cargo temperature, trailer door status, presence detection and others. Furthermore, with this technology available in vehicles, many other applications can be implemented for the truck. Device is installed in the trucks, trailers, tippers to collect information from the vehicle. One of the main advantages of using Zigbee for this application is that it supports mesh topologies. By using that it is possible to have a very flexible network. The main advantages of this topology are that it is possible to reconfigure the network to skip broken nodes and it is possible to choose the shortest path to a certain destination. Volvo group presents concept use of WSN on trailer in which wireless nodes consist of side-marker lights and sensors that create an electronic "fence" around the trailer and can detect if an unauthorized person is trying to access the truck's cargo, steal its fuel or anything else from the vehicle. The network is composed by the lamps and sensors, which is the Zigbee coordinator and has the intelligence to process the messages from the lamps and identify and alarm situation.



Module 1



Module 2



Module 3

The major blocks of the proposed system are given below, the block describes about the components and modules used in the systems. The major blocks are,

- ZigBee Trans receiver (2.4 GHz)
- Microcontroller
- Software

ZIGBEE TRANS RECEIVER

ZigBee is a wireless communication protocol standard based on the IEEE 802.15.4. Zigbee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power usage allows longer life with smaller batteries. Different networking topology provides high reliability and more extensive range and also very flexible network. ZigBee nodes can go from sleep to active mode in 30 ms or less, the latency can be low and devices can be responsive, particularly compared to Bluetooth wake-up delays, which are typically around three seconds. Because ZigBee nodes can sleep most of the time, average power consumption can be low, resulting in long battery life.

MICROCONTROLLER

The Microcontroller used in the proposed system is general purpose PIC18F46K22 controller with serial UART (Universal Asynchronous Receiver and Transmitter).The UARTisconnected to ZigBee transceiver module for serial communication. The vehicle chassis unique number and module node ID is saved in the NVM (Non Volatile Memory) of controller while final programming this is required to identify and to authenticate appropriate node and vehicle platform.

SOFTWARE

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC8bit, 16bit and 32bit microcontrollers. MPLAB IDE tool is easy to use and includes software components for fast application development and debugging. PICPgm is a PC-Software to program PIC microcontrollers using external programmer hardware connected to the PC. It allows

- flashing program a HEX file into a PIC microcontroller
- Read the content of a PIC microcontroller and save it to a HEX file
- Erase a PIC microcontroller
- Check if a PIC microcontroller is empty, i.e. not programmed (Blank Check)

CONCLUSION

Based on study and document experience with prototype model it is observed that today introduction of new functionality in vehicle is limited by expensive installation and harnessing and communication protocol which could be enhance by the introduction of wireless sensor networks in current system. The ultimate goal of in vehicle Networking research is to enable novel applications that change the

way of interact or communication in vehicle. The challenge is at the same time to transform the capabilities of sensor networks to be useful services for the vehicle application.The architecture is able to support flexible, application-specific communications protocols without sacrificing efficiency. This architecture has been validated through the development of three hardware node and a software system. For these networks, lifetime is the main evaluation criterion. A second class of applications is that of highly dynamic sense- and control networks with higher data rates, and highly mobile nodes. Instead of passively monitoring a relatively static environment, these networks attempt to control the environment in real time. We have evaluated or architecture with respect to both application classes.

FUTURE SCOPE

The proposed work is mainly focused on receiving the data from the remote wireless nodes and finding alternative solution to conventional wiring harness. There are different possibilities for extension of the research work and they listed as under:

- In our work only three control nodes are provided we can deploy several control nodes with mesh networking to cover maximum functionality.
- We have used 8 MHz Microcontrollers. In future we can construct low power microcontrollers for wireless sensors.
- GUI for Data log facility on PC can serve purpose of Diagnostic and ease for the fault finding.
- More expertise require for packaging and installation of wireless modules.

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