IoT Enabled Intra-Vehicular Communication for Designing A Smart Car

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Abstract: Nowadays, the number of sensor nodes in the vehicle has expanded altogether because of the expanding of various vehicular applications. Moreover, the wired connection is not adaptable and flexible due to the internal structure of the vehicle, thus, there is an expanding level of appeal to design a system in which the wired connections with the sensor node are supplanted with wireless connections. Design a wireless sensor system inside the vehicle is quite challenging than other systems, e.g., wireless, sensor and computer network, due to the unpredictable environment inside the vehicle. In this project, we discuss about Internet of Things (IoT) enabled Intra-Vehicular Communication for Designing a Smart Car. IoT enabled Intra-Vehicular Communication (IoT-IVC) refers to the system where huge number of sensors are associated with each other for sharing the car components' information to build up a smart vehicular system. The marvel of congestion represents an issue in the IoT-IVC while the traffic load and number of sensors are expanded. A new scheduling algorithm is proposed for minimizing the congestion. A Test-Bed is designed in order to validate the proposed algorithm. The experimental results justify the effectiveness of the proposal.

Key words: *IoT-IVC, ZigBee, MAC, Wireless Sensor Networks.*

Introduction

Day by day, the exponential increase in the number of electronic system in a car arises the needs of sensors and upgraded microprocessor to handle the communication between them in order to develop a smart system that can help driver or passengers feel safer and more comfort. So, the data communication between them must be precise with minimization the percentage of data loss that could interrupt the system. On top of that, the architecture and design of recent network must be scalable and flexible to make an expansion of network

Intra-Vehicular Communication (IVC) refers to the communication inside a car where many sensors are connected and communicated each other in order to develop a smart car system. Generally, sensors and microprocessors in a vehicle connected and communicated through a serial data bus using a physical wires or known as Controlled Area Network (CAN). A CAN network used classic linear bus topology with a twisted pair cable where nodes are connected each other via its transmission medium.

The usage of wireless communication has been widely implemented in data communication between devices and nodes. There were many gadgets change the wired connection to wireless links because of its many benefits instead of can save cost effectively. This type of communication is trending and most used in small scope of network. So, equipping automobiles with wireless communication capabilities is expected to be next frontier in automotive revolution.

IoT enabled Intra-Vehicular Communication (IoT-IVC) refers to the wireless system where huge number of sensors are associated with each other for sharing the car components' information to build up a smart vehicular system

Background

IoT enabled Intra-Vehicular Communication (IoT-IVC) refers to the system where huge number of sensors are associated with each other for sharing the car components' information to build up a smart vehicular system. The marvel of congestion represents an issue in the IoT-IVC while the traffic load and number of sensors are expanded (Rahman, Kabir, Azad, & Ali, 2015). A new scheduling algorithm is proposed for minimizing the congestion. The experimental results justify the effectiveness of the proposal. In choosing what wireless protocol to be used, firstly, we do the comparative study between all listed shorted-range wireless protocol which is Bluetooth/ IEEE 802.15.1, and UWB/802.15.3, ZigBee/802.15.4, and Wi-Fi/802.11a/b/g standards (Lee, Su, & Shen, 2007). At the end of comparative study, we decided to choose ZigBee protocol over Bluetooth, UWB, and Wi-Fi. A Test-Bed is designed in order to validate the proposed algorithm.

Problem Statement

Network congestion is the main problem in any network. So do the IVN, network congestion must be avoid in order to prevent misinterpretation of information among sensors and controller. Wired design and architecture in recent IVN is not scalable anymore due to exponential increase in traffic loads and sensors. Besides that, wired connection maintenance need to be performed continuously and high in cost. It is also affect the vehicle performance of fuel efficiency due to weight over a wire used in a wired connection

Objective

The goal of this project are to design a test-bed for Intra-Vehicular Communication (IVC), the following objectives are set:

- To minimize the congestion problem in IVN.
- To minimize the used of wired connection by deploying a wireless connection.
- To achieve a robust system design by analyzing the project outcomes

Scope

In system functionality, system allows sensors and controller communicate each other in Intra-Vehicular Communication (IVC) in a car to perform a smart system. Driver or passengers will get more confident to drive the car with smart system that can help them to perform specific task while the car is active or inactive. System users are driver and passengers. They will be helped by the smart system in IVC to perform specific task. While in technology ZigBee protocol used to makes sensors and controller communicate each other. Related MAC strategy also used to prevent any congestion in IVC.

Flowchart and Design

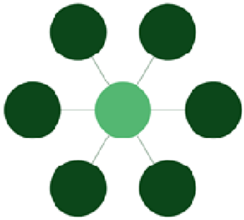

Figure 1: Classic Star-network

Figure 1 depicts the network design of inter-vehicular network that we used to test our algorithm where six nodes are connected to central nodes or controller. In ZigBee, there have been congestion when the central node controller receive multiple data at a time. So by applying some delay and priority to the nodes based on our proposed algorithm, the percentage of congestion will be prevented.

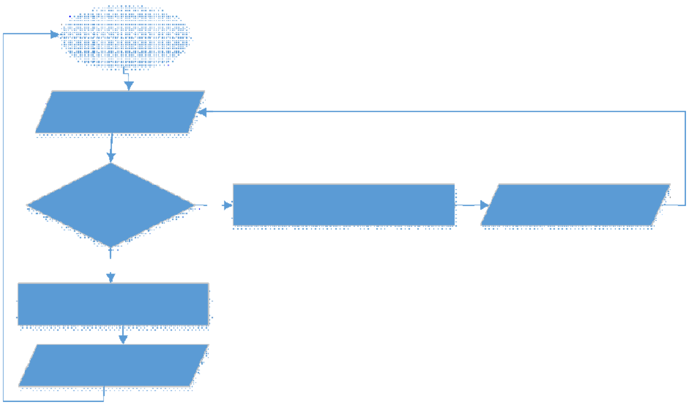

Figure 2: Flowchart of node sending the notification

Figure 2 depicts the flowchart on how the nodes will send and update the sensor data to the controller based on the node's priority and sensor's reading.

Why are they important to community?

In the past decades, the development of vehicle electronics has led to a significant increase in the number of connecting cables within a vehicle (Jawhar, Mohamed, & Zhang, 2010). The connecting cables can contribute up to 50kg to the vehicle mass (Lu, Cheng, & Zhang, 2014). Cables and their accessory components embedded and distributed throughout the vehicle body can be costly and difficult to install and maintain (Lu et al., 2014). A present day wiring harness may have up to 4,000 parts, weigh as much as 40 kg, and contain more than 1900 wires for up to 4 kilometers of wiring (G & D, 2002) . Eliminating, or greatly reducing, the number of wires in the harness can potentially provide part cost savings, assembly savings, mass savings and warranty savings (Ahmed et al., 2007).

In addition to these savings, wireless sensing would enable new sensor technologies to be integrated into vehicles (e.g. tire pressure monitoring systems) which would otherwise be impossible using wired means (Bas & Ergen, 2012). Another major benefit of wireless networks is the flexibility to accommodate the growing demand for on-board sensors without adding physical capacity.

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