Zigbee Based Speed Monitoring and Controlling for Transport Navigation System

T. SRIVANI¹, K. SOMASEKHAR RAO²

¹PG Scholar, Dept of ECE, Geethanjali College of Engineering & Technology, Hyderabad, India, Email: srivanithangelapalli@gmail.com.
²Professor, Dept of ECE, Geethanjali College of Engineering & Technology, Hyderabad, India, Email: gcetmcesd@gmail.com

Abstract: Transportation or transport sector is a legal source to take or carry things from one place to another. With the passage of time, transportation faces many issues like high accidents rate, traffic congestion, traffic & carbon emissions air pollution, etc. In some cases, transportation sector faced alleviating the brutality of crash related injuries in accident. Due to such complexity, researchers integrate virtual technologies with transportation which known as Intelligent Transport System. The idea of virtual technologies integration is a novel in transportation field and it plays a vital part to overcome the issues in global world. This paper tackles the great variety of Intelligent Transport System applications, technologies and its different areas. The objective of this literature review is to integrate and synthesize some areas and applications, technologies discuss with all prospects. However, this paper focuses on the application of the technology in the transportation industry. The application of RFID [3] and Zigbee in Intelligent Transport Systems (ITS) is gaining popularity with its widespread use in the field of the management of the overall transport sector. Speed control unit can give alert message like please slow down the vehicle to control the speed of the vehicles.

Keywords: RFID, Intelligent Transportation Systems, Public Transport, Tag Reader, Zigbee, R F434Mhz, Speed Controlling Unit.

I. INTRODUCTION

Intelligent Transportation system (ITS) takes a vital part in global world. Intelligent Transportation System (ITS) is the conventional of the development of next-generation technologies. It is a novel field that interoperates in different fields of transportation system, such as transportation management, control, infrastructure, operations, policies and control methods, etc. There is a wide range of reimbursement that obtained from ITS deployments. Intelligent Transportation System (ITS) can play a major role in reducing risks, high accidents rate, traffic congestion, carbon emissions, air pollution and on the other hand increasing safety and reliability, travel speeds, traffic flow and satisfied travelers for all modes. Recent governmental activity in the area of ITS specifically in the United States – is further motivated by an increasing focus on homeland security. Many of the proposed ITS systems also involve surveillance of the roadways, which is a priority of homeland security [2]. Funding of many systems comes either directly through homeland security organizations or with their approval.

Further, ITS can play a role in the rapid mass evacuation of people in urban centres after large casualty events such as a result of a natural disaster or threat. Much of the infrastructure and planning involved with ITS parallels the need for homeland security systems. In the developing world, the migration from rural to urbanized habitats has progressed differently. Many areas of the developing world have urbanised without significant motorisation and the formation of suburbs. A small portion of the population can afford automobiles, but the automobiles greatly increase congestion in these multimodal transportation systems. They also produce considerable of air pollution, cause a significant safety risk, and exacerbate feelings of inequities in the society[5]. High-population density could be supported by a multimodal system of walking, bicycle transportation, motorcycles, buses, and trains. Other parts of the developing world, such as China, remain largely rural but are rapidly urbanising and industrialising. In these areas a motorised infrastructure is being developed alongside motorisation of the population. Great disparity of wealth means that only a fraction of the population can motorize, and therefore the highly dense multimodal transportation system for the poor is cross-cut by the highly motorized transportation system for the rich.

An automated Vehicle monitoring system is developed by using an Active Tag RFID system. The requirement for an active tag arose from the fact that vehicle applications requires a long range as well as sufficient power for the tag to ensure reliable data transfer between the modules. Radio Frequency Identification (RFID) technology is an important technology that has found its application in many places. However, its application in the transportation is one of the best system applications. The technology is applied in the
transport sector to perform various tasks such as vehicle or product Identification during transportation, security, safety and operations. The system works using a tag that is placed on the vehicle or product to be tracked. The tag carries vital information concerning the vehicle or product identity and location that is transferred to the wireless reader. In spite of their wide potential applications in the sector, the applications of the system are still limited. This paper conducts an extensive survey in the application of RFID technology in the transport sector (Fig.1) with the major areas of application being intelligent transportation systems (ITS) and vehicle infrastructure integration [6]. Further, this paper surveys a set of successful implementations aiming the paper to detect the vehicle, find out the present end next locations of the vehicle and easily we can control the speed of the vehicle using Zigbee.

The main components which we are using to implement our system are explained in below.

**A. RFID**

Short for Radio Frequency Identification, RFID technology is an IT system that transmits signals without the presence of physical gadgets, but wirelessly. It is categorized under automatic identification technologies that have well established protocols. The working of an RFID system (Fig.2) is very simple. The system utilizes tags that are attached to various components to be tracked. The tags store data and information concerning the details of the product of things to be traced. The reader read the radio frequency and identifies tags. The antenna provides the means for the integrated circuit to transmit its information to the reader. Two categories, active and passive tags exist. The tags that do not utilize power are referred to as passive and they are driven by an antennae that enables the tag receive electromagnetic waves from a reader. On the contrary, active tags rely on power and they have inbuilt power sources that enable it to send and receive signals from an RFID reader. This is the distinction between these two types of RFID tags [8]. There are also semi-active or battery-assisted passive tags which use thin batteries and provide greater range (less than active) and require less power from reader. Memory re writable tags formed the first patent of RFID technology in the U.S that was used for active and intelligent door system with passive tags.

![RFID System Data Flow Diagram](image)

**B. ZIGBEE**

Zigbee is an IEEE 802.15.4 standard for data communications with business and consumer devices. It is designed around low-power consumption allowing batteries to essentially last forever. The Zigbee standard provides network, security and application support services operating on top of the IEEE 802.15.4 Medium Access Control (MAC) and Physical Layer (PHY) wireless standard. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. Zigbee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries and the mesh networking provides high reliability and larger range.

Zigbee is an established set of specifications for wireless personal area networking (WPAN), i.e.digital radio connections between computers and related devices. WPAN Low Rate or Zigbee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Zigbee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit. The Zigbee Alliance, the standards body which defines Zigbee, also publishes application profiles that allow multiple OEM vendors to create interoperable products. The current list of application profiles either published or in the works are:

- Home Automation
- Zigbee Smart Energy
- Telecommunication Applications
- Personal Home

Zigbee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/Zigbee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life.

1. **Zigbee System Data Flow Diagram**

The X-Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to
any serial device. Data is presented to the X-Bee module (Fig.3) through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the Zigbee module, no bit inversions are necessary within the asynchronous serial data stream.

Fig3. Zigbee system Data Flow Diagram.

All of the required timing and parity checking is automatically taken care of by the X-Bee’s UART. Just in case you are producing data faster than the X-Bee can process and transmit it, both X-Bee modules incorporate a clear-to-send (CTS) function to throttle the data being presented to the X-Bee module’s DIN pin. You can eliminate the need for the CTS signal by sending small data packets at slower data rates. If the microcontroller wants to send data to transceiver, it will send RTS (Request to Send) signal. If the transceiver is idle it sends CTS (Clear to Send) signal. The RTS and CTS signals are active low. When microcontroller receives CTS command it will send data to the transceiver through DIN pin. The transceiver will send the data to microcontroller through DOUT pin. The communication between transceiver and the microcontroller at the transmitter and receiver is similar. The communication between transmitter and receiver is through RF communication.

C. RF434 MHz wireless module

Radio frequency (RF) is a frequency or rate of oscillation within the range of about 3 Hz to 300 GHz. This range corresponds to frequency of alternating current electrical signals used to produce and detect radio waves. Since most of this range is beyond the vibration rate that most mechanical systems can respond to, RF usually refers to oscillations in electrical circuits or electromagnetic radiation.

1. Properties of RF

Electrical currents that oscillate at RF have special properties not shared by direct current signals. One such property is the ease with which it can ionize air to create a conductive path through air. This property is exploited by ‘high frequency’ units used in electric arc welding. Another special property is an electromagnetic force that drives the RF current to the surface of conductors, known as the skin effect [1]. Another property is the ability to appear to flow through paths that contain insulating material, like the dielectric insulator of a capacitor. The degree of effect of these properties depends on the frequency of the signals.

Why do we go for RF Communication?

RF Advantages:
1. No line of sight is needed.
2. Not blocked by common materials: It can penetrate most solids and pass through walls.
3. Longer range.
4. It is not sensitive to the light;
5. It is not much sensitive to the environmental changes and weather conditions.

2. Module application

Module has two modes: communication mode and configure mode (Table.1), it is determined by the status of CONFIG pin when power on: CONFIG=LOWL: It enters communication mode for data transmission [2]. CONFIG= HIGH: It enters configure mode to setup work parameters.

Table.1: Pin definition of RF Module

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vdd</td>
<td>Power supply</td>
</tr>
<tr>
<td>2</td>
<td>Dtx</td>
<td>Data Output From Module</td>
</tr>
<tr>
<td>3</td>
<td>Gnd</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>Drx</td>
<td>Data input to module</td>
</tr>
<tr>
<td>5</td>
<td>Config</td>
<td>If this pin is high at power on, mobile will enter configure mode while it communicates if set low.</td>
</tr>
<tr>
<td>6</td>
<td>Enable</td>
<td>If this pin is normal mode, the module will enter sleep mode immediately. Assert high will awaken.</td>
</tr>
</tbody>
</table>

HM-TR series transparent wireless data link module is developed by Hope microelectronics Co. Ltd, dedicated for Applications that needs wireless data transmission. It features high data rate, longer transmission distance. The Communication protocol is self controlled and completely transparent to user interface. The module can be embedded to your Current design so that wireless communication can be set up easily. Pin definition is shown in (Fig.4).

Fig.4: Pin diagram of RF Module.
3. Communication mode
If CONFIG pin is low when powering on, the module will enter into communication mode. The module provides RS232 connector to connect with PC or TLL level with MCU directly.

4. Configuration mode
If the CONFIG pin is in high level when powering on, the module will enter into configuration mode automatically. In this mode the module communicates with the host in fixed serial format (9600, 8, N, 1).

III. PROPOSED SYSTEM
The proposed system contains mainly four nodes Vehicle unit, two reader Units, one central unit. Vehicle unit (Fig.5) is implemented on ARM7, interfaced with Vehicle speed controlling unit. Zigbee wireless monitor and RFID tag. The central Unit (Fig.6) is implemented on ARM7 and is interfaced with Zigbee, RF434 wireless module and database related to each located points of reader Units so as to locate vehicle location. The reader units are interfaced with RFID readers and RF 434 Wireless module. In this system, the readers Units are placed in a distance of 50-100 mts to each. When a vehicle crosses first reader unit-1 (Fig.7) the tag attached to vehicle read by the reader unit and send intimation to central station starts timer, when the vehicle reaches the second Reader unit-2 (Fig.8) there also the Tag is read by reader unit and it also send the intimation to central station.

By taking these details the central stations calculates the Speed of the vehicle and also detects the location of vehicle based on reader’s position and send this information to Vehicle. So the vehicle in this system is going to know the location and the speed that it is going, if the vehicle is going with high speed than predefined then the speed control unit slowly reduce the vehicle speed. The central unit also provides the next location information to vehicle so that he can decide the route that he wants to go. The communication between Vehicle unit and Central unit is using zigbee where as the communication between reader units and Central unit is using RF434 wireless module.

Fig5. Vehicle Unit

Fig6. Central Unit.

A. Overall System Diagram
The figure below shown is overall project diagram of Intelligent vehicle transportation navigation system with speed monitoring and controlling system using RFID and ZigBee (Fig.9)

B. Speed Control Unit
The paper suggests when the vehicle is going with high speed than predefined then the speed control unit slowly reduce the vehicle speed by PWM (Pulse Width Modulation). PWM is a signal (Fig.10) that stays not at a constant level but is rapidly being turned on and off. The ratio of the on time to the off time determines how much power you are driving into the load and hence how fast it goes, like this.

Waveform A is off most of the time and so will result in a slow speed, where as waveform B is on most of the time and so the motor will run faster. If this causes the motor to buzz then place a capacitor across the motor to smooth it out. In these project two PWM’s are used one PWM for reducing the speed manually and other PWM for reducing the speed Automatically. The proposed vehicle speed monitoring and controlling system is shown in flowchart (Fig.11).
Zigbee Based Speed Monitoring and Controlling for Transport Navigation System

IV. RESULTS

The intelligent transportation system was proposed in this paper was fully developed and tested to demonstrate its feasibility and effectiveness. The implementation of realization of “Zigbee based speed monitoring and controlling for transport navigation system” is done successfully. The communication is properly done without any interference between different modules in the design. Design is done to meet all the specifications and requirements. Software tools like keil uvision simulator, proload to dump the source code into the microcontroller, orcad lite for the schematic diagram have been used to develop the software code before realizing the hardware. Circuit is implemented in orcad and implemented on the microcontroller board. The performance has been verified both in software simulator and hardware design. The total circuit is completely verified functionally and is following the application software. It can be concluded that the design implemented in the present work provide portability, flexibility and the data transmission is also done with low power consumption. The below fig 12 shows vehicle Navigation on LCD.

V. CONCLUSION

The results of this literature review have shown that Intelligent Transportation System is a broad field which covers many technologies and they plays a significant role in the technology era. ITS deployments have the possible to offer the following benefits: improved safety, efficiency, mobility, accessibility, intermodal connections. The advantages of Zigbee and RFID solutions have been recognized by traffic sector & transportation industry in developing countries. It is believed that RFID and Zigbee - based technologies can be extensively exploited to improve transportation safety and security, increase the efficiency of the transportation system, ultimately save costs, and improve people lives. Also, Smartcard-based fare payment provides convenience for passengers and efficiency gains for transport service providers. International experience suggests that successful implementation may take many years, and difficulties are common place.

VI. REFERENCES

2nd Int. Conf. information Technology Interfaces, Croatia, 2004, pp. 7-10.


