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Zigbee Based Vehicle Navigation

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Abstract- This paper elucidates the concept and development of Zigbee aided real-time navigation system without the use of Global Positioning System systems. The system has the ability to assist in navigation, bypassing traffic congested roadways, and in parking the vehicle. With the real time data that it facilitates to the navigator and it can also work in addition to the GPS. The basic features and functioning of the system have been illustrated in this paper.

Index Terms- Navigation, Zigbee, Infrared Sensor, Node

I. INTRODUCTION

This era has seen radical changes in the way humans travel, be it technological advancement in the form of GPS, or the more efficient automobiles on the roads. This gave us an opportunity to design a navigation system that would empower the navigator to bypass the roads that are congested and reach the destination at a much faster pace.

The Zigbee Based Vehicle Navigation System is one time investment system. Once the nodes are set up and the car units are purchased no further investment either to the node or to the car unit would prevail. The reason for feasibility of this system is mainly because of the real time information it provides without having any dependency on the GPS signals.

The designed system uses zigbee wireless transceivers for wireless communication. Transceivers are devices capable of both transmitting and receiving radio signals. These transceivers can be detected at a distance of 100m to several kilometers depending upon its output power and receiver sensitivity.[2]

II. PRINCIPLE AND WORKING

This system makes use of PIC microcontrollers for decision making processes and zigbee technology which is IEEE standard 802.15.4, for interaction between the car unit and node unit. We have used wireless locomotive robotic units as a representative of a car, and node units represent the zigbee transceiver devices that are installed along the road. The nodes could also be attached to the streetlights. Wherever it is installed, the path length between any two node terminals remains the same.

The path lengths between any two node devices were made equal. The car transmits the information to the node about its current location and its destination. The node unit runs an algorithm taking into account all the information from car unit and IR sensors. It then selects the best possible path routes the car onto that path. It also sends the instructions for maneuvering the car along the corresponding path. The car then executes these instructions to reach the destination. These instructions inform the car whether to take a turn or drive straight, and also how many degrees to turn. The node unit can be re-programmed for envisaging all new records time to time.

The working model was programmed for three different cases:

1) Hospital
2) School
3) Parking

When Hospital button is pressed, the car unit sends coded information to the nearest node unit. The node decides to which path the car should be routed and communicates this information back to the car via zigbee transreceiver. However, if the road was found to be congested with traffic, the node would reroute the car based on the information in its database. Similar operations would perform when the School button is pressed. When the Parking button is pressed, the Parking Node controller reads the status of the parking sensors i.e., the IR sensors. Based on this information it would display on an LED on the car unit as 'Parking Available' or 'Parking Not Available'.

III. HARDWARE ARCHITECTURE

The following components form the main part of the finalized design:

A. Microcontroller

A microcontroller is a small computer on a single integrated circuit containing a processor core, memory and programmable input/output peripherals. There are many types of microcontrollers. Microchip Technology provides with the PIC series of microcontrollers. The PIC architecture was among the first scalar CPU designs, and is still among the simplest and cheapest. We have used PIC16F876 for our system.

B. Zigbee

Zigbee devices, based on the protocols of the IEEE standard 802.15.4, are low to medium powered devices and suitable for providing wireless capability to any product with serial data interface. This technology requires minimal power and provides reliable delivery of data between the concerned devices. The specifications of it are as follows:[1]

Table 1 : Zigbee Specifications

Maximum Transmit Power	1mW (+0 dBm)
RF Data Rate	250 kbps
Receiver Sensitivity	-92 dBm
Serial Interface Data Rate	Maximum 115200 baud
Operating Temperature	-40 to 85 °C
Antenna Options	Chip & Wire Antenna,

C. Infrared Sensor

Infrared Sensors or the IR sensors are detectors that pick up radiations in the infrared spectrum of light. Any hot body, including vehicles, gives off heat, which in turn emits radiation in the IR spectrum. Based on these radiations, the sensors report a status to the controllers about the traffic and parking information.

D. Motor

An electric motor is an electromechanical device that converts electrical energy into mechanical energy. There are two basic types of motors viz, DC motors and AC motors, depending upon what type of electrical input they work on. We have used stepper motor for the design purpose. Stepper motor is a brushless DC electrical motor that divides a full rotation into a number of equal steps. This gives the freedom to give command to the vehicle in terms of degree to turn. These motors are controlled by L293DD IC. The L293DD IC is a monolithic high voltage, high current four channel driver designed to accept standard DTL or TTL logic levels and drive inductive loads and switching power transistors.

E. Power Supply

The car unit is powered by 12V replaceable batteries. The power supply to the node unit receives through the mains i.e., 240V AC which is stepped down by a step down transformer. Also, LM7805 IC used for voltage regulation purposes.

F. Liquid Crystal Display

Liquid Crystal Display or LCD displays are used in the car unit for taking the readings of the commands sent by the node unit. Also, LCD is used to display the parking information when a parking related query is sent to the Parking node unit.

G. Input Buttons

The system was designed to respond for three different cases. These cases related queries are triggered by the case related buttons, which are as follows:

1) Hospital
2) School
3) Parking

The block diagrams are shown below.

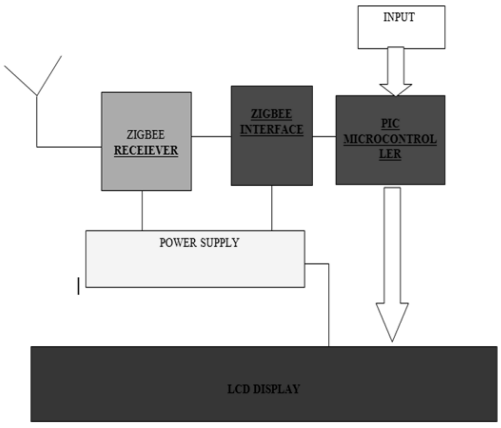

Figure1: Car Unit

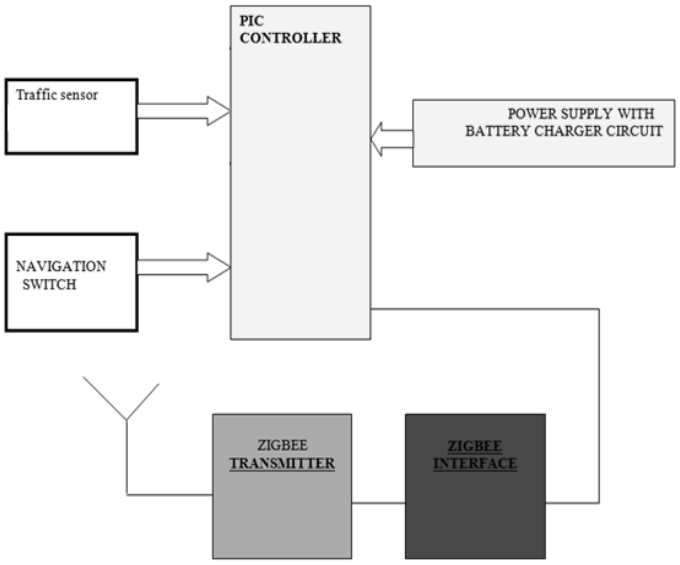

Figure 2: Node Unit

IV. SOFTWARE

A. PICBASIC Pro

PICBASIC pro converts the BASIC programs into files that can be programmed directly into a PIC microcontroller MCU. This software was used for programming both the car and node units.

B. EAGLE v6.2

This software was used for designing of the Printed Circuit Board or the PCB layout. The layouts are as follows:

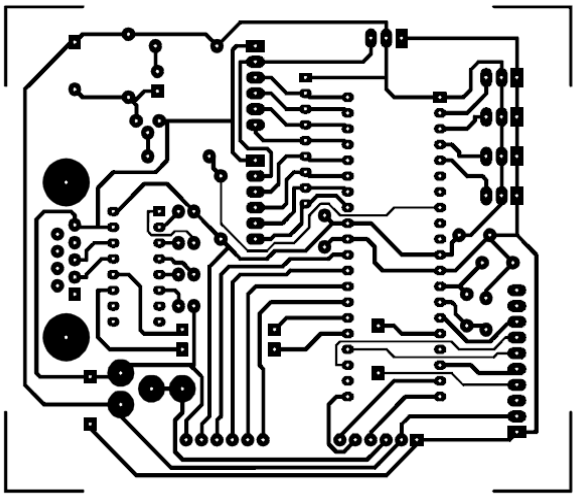

Figure3: PIC Layout

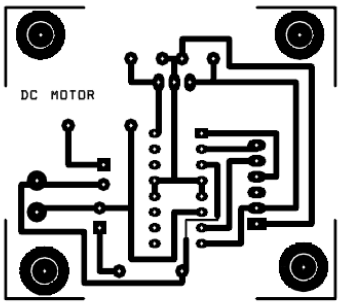

Figure 4: Motor Driver Layout

V. ADVANTAGES

As the node units can be re-programmed, they keep all the updated information. When a new road is constructed it can be fed into the node unit's database and would be considered during routing the car unit. Also, the IR sensor signals fed to the system controllers keeps the system updated about any traffic congestions on the pathway, and re-route the car unit if such circumstances arise. This would save much time of the user if the car bypasses the congested road by another free road that leads towards the same destination. Also, the node units which can be installed in parking spaces can remotely tell the user about parking availability at that location. In this way, the system contributes towards improving the overall navigation experience.

VI. CONCLUSION

The final model of the Zigbee Based Vehicle Navigation system was developed completely according the plan we had. The system was tested in real time scenario and was found to be functioning properly and yielding excellent results. Also, the decisions given by the node unit to the car unit were found to be legitimate. Thus the system presented its ability to manipulate on the real time information and guide the navigators according to them.

ACKNOWLEDGMENT

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