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CRASH ESTIMATION AND REPORTING SYSTEM USING GPS AND ZIGBEE TECHNOLOGY

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Abstract— This paper focuses on the use of magnetoresistive and sonar sensors for imminent collision detection in cars. The magnetoresistive sensors are used to measure the magnetic field from another vehicle in close proximity, to estimate relative position, velocity, and orientation of the vehicle from the measurements. First, an analytical formulation is developed for the planar variation of the magnetic field from a car as a function of 2-D position and orientation. While this relationship can be used to estimate position and orientation, a challenge is posed by the fact that the parameters in the analytical function vary with the type and model of the encountered car. Since the type of vehicle encountered is not known *a priori*, the parameters in the magnetic field function are unknown. The use of both sonar and magnetoresistive sensors and an adaptive estimator is shown to address this problem. While the sonar sensors do not work at very small inter vehicle distance and have low refresh rates, their use during a short initial time duration leads to a reliable estimator. Experimental results are presented for both a laboratory wheeled car door and for a full-scale passenger sedan. The results show that planar position and orientation can be accurately estimated for a range of relative motions at different oblique angles.

Key Words: *Microcontroller, GPS, Ultrasonic Sensor, Zigbee, Motor Driver.*

I. Introduction

Adverse set of applications for sensor networks has already emerged for use in a number of fields, including energy, machine malfunctions, medicine, agriculture, the environment, motion tracking, and many others. The delivery of the IEEE 802.15.4 standard for physical and medium-access control (MAC) layers and the development of a ZigBee standard for network and application layers have paved the way for the broad acceptance of sensor devices in a wide variety of applications. Increasing the efficiency of energy delivery, enhancing the reliability of the power system, and mitigating the adverse impact of conventional fuel plants on the environment can all be achieved through increases in the intelligence level of power systems. Intelligent power networks are expected to incorporate millions of sensors, all connected through an advanced, two-way communication and data-acquisition system in order to provide real-time monitoring, diagnosis, and control. IEEE 802.11 (Wi-Fi), IEEE 802.15.1 (Bluetooth), IEEE 802.15.3 (UWB), and IEEE 802.15.4 (ZigBee) are possible candidates for integrating sensors with wireless technologies in

order to provide reliable data and to transform existing power systems into smart grids. ZigBee offers a self-forming, self-healing, secure wireless communication protocol enabled by a mesh topology supported by a low data rate, low cost, and low power consumption. These attractive features make ZigBee a good candidate for application in a smart-grid environment. The U.S. Department of Energy (DOE) expects that the widespread deployment of wireless sensor networks (WSNs) in industry could improve overall production efficiency by 11%to 18%

The goal of the research presented in this paper was to investigate the reliability of a ZigBee-based WSN when it is incorporated into a smart grid. In addition to examining the data size and real-time requirements of power systems, the study also explored the effect of HPD on ZigBee networks due to switching transients. The results of this research will set the basis for and define the limits of deploying Zigbee WSNs in power systems.

II. The Hardware System

Micro controller: This section forms the control unit of the whole project. This section basically consists of a Microcontroller with its associated circuitry like Crystal with capacitors, Reset circuitry, Pull up resistors (if needed) and so on. The Microcontroller forms the heart of the project because it controls the devices being interfaced and communicates with the devices according to the program being written.

ARM7TDMI: ARM is the abbreviation of Advanced RISC Machines, it is the name of a class of processors, and is the name of a kind technology too. The RISC instruction set, and related decode mechanism are much simpler than those of Complex Instruction Set Computer (CISC) designs.

Liquid-crystal display (**LCD**) is a flat panel display, electronic visual display that uses the light modulation properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images or fixed images which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock.

III. Design of Proposed Hardware System

Prediction of vehicle's dangerous driving conditions or maneuvers can help preventing accidents from taking place .One of the major causes of traffic accidents is a result of keeping no safe distance from neighboring vehicles while driving. If a system that warns drivers if they are heading too close and dangerously towards other vehicles is available, that would help reducing vehicles' accidents significantly. This system would be particularly useful in low visibility conditions, like fog and rain, which are also a cause of a large number of accidents. In this system, each vehicle can calculate its relative position and velocity to other vehicles when the transmitted position and velocity of nearby vehicles are available. So, even if the driver has low visibility of other vehicles or if he loses concentration, then the system can issue a warning to alert the driver of possible unsafe driving conditions.

In this project a navigation system that calculates the state of each vehicle is proposed. The whole set up is placed in the backside of the vehicle. Using Zigbee transceivers, the state of the vehicle is continuously

transmitted to neighboring vehicles. A low cost GPS is used to calculate the latitude and longitudinal positions of the vehicle. An ultrasonic sensor continuously emits the rays from the vehicle and if any obstacle occurs the rays revert back and this is used to calculate the distance from the neighboring vehicles. The Zigbee transceiver is use to transmit and receive the information about the state of the neighboring vehicle and this information is displayed on the LCD and an alert system is used to alert the driver of the vehicle.

VEHICLE 1 SECTION:

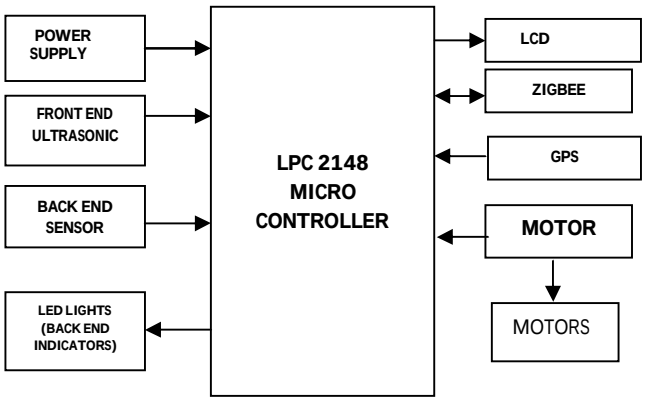

Fig.1. Vehicle Block diagram

IV. Board Hardware Resources Features

Ultrasonic Distance Sensor

Its compact size, higher range and easy usability make it a handy sensor for distance measurement and mapping.

Features

· Minimum range 10 centimeters
· Maximum range 400 centimeters (4 Meters)
· Accuracy of +-1 cm
· Resolution 1 cm
· 5V DC Supply voltage
· Compact sized SMD design
· Modulated at 40 kHz
· Serial data of 9600 bps TTL level output for easy interface with any microcontroller

ZIGBEE Technology

ZIGBEE is a new wireless technology guided by the IEEE 802.15.4 Personal Area Networks standard. It is primarily designed for the wide ranging automation applications and to replace the existing non-standard technologies. It currently operates in the 868MHz band at a data rate of 20Kbps in Europe, 914MHz band at 40Kbps in the USA, and the 2.4GHz ISM bands Worldwide at a maximum data-rate of 250Kbps.The ZIGBEE specification is a combination of Home RF Late and the 802.15.4 specification. The specification operates in the 2.4GHz (ISM) radio band - the same band as 802.11b standard, Bluetooth, microwaves and some other devices. It is capable of connecting 255 devices per network. The specification supports data transmission rates of up to 250 Kbps at a range of up to 30 meters. ZIGBEE's technology is slower than 802.11b (11 Mbps) and Bluetooth (1 Mbps) but it consumes significantly less power. 802.15.4 (ZIGBEE) is a new standard uniquely designed for low rate wireless personal area networks. It targets low data rate, low power consumption and low cost wireless networking, and its goal is to provide a physical-layer and MAC-layer standard for such networks.

Wireless networks provide advantages in deployment, cost, size and distributed intelligence when compared with wired networks. This technology allows users to set up a network quickly,

and allows them to set up networks where it is impossible or inconvenient to wire cables. Wireless networks are more cost-efficient than wired networks in general. Bluetooth (802.15.1) was the first well-known wireless standard facing low data rate applications. The effort of Bluetooth to cover more applications and provide quality of service has led to its deviation from the design goal of simplicity, which makes it expensive and inappropriate for some simple applications requiring low cost and low power consumption. These are the kind of applications this new standard is focused on. It's relevant to compare here Bluetooth and ZIGBEE, as they are sometimes seen as competitors, to show their differences and to clarify for which applications suits each of them. The data transfer capabilities are much higher in Bluetooth, which is capable of transmitting audio, graphics and pictures over small networks, and also appropriate for file transfers. ZIGBEE, on the other hand, is better suited for transmitting smaller packets over large networks; mostly static networks with many, infrequently used devices, like home automation, toys, remote controls, etc. While the performance of a Bluetooth network drops when more than 8 devices are present, ZIGBEE networks can handle 65000+ devices.

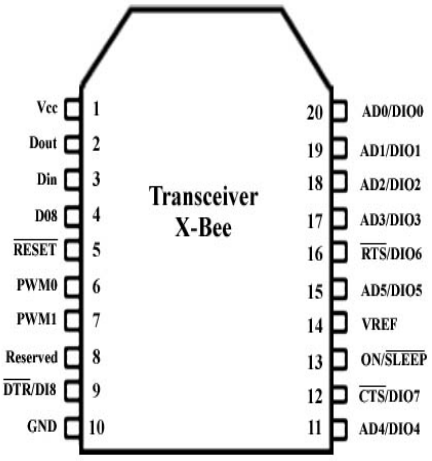

Fig: Pin diagram of X-Bee Transceiver

GPS:

Global Positioning System tracking is a method of working out exactly where something is. A GPS tracking system, for example, may be placed in a vehicle, on a cell phone, or on special GPS devices, which can either be a fixed or portable unit. GPS works by providing information on exact location. It can also track the movement of a vehicle or person. So, for example, a GPS tracking system can be used by a company to monitor the route and progress of a delivery truck, and by parents to check on the location of their child, or even to monitor high-valued assets in transit.

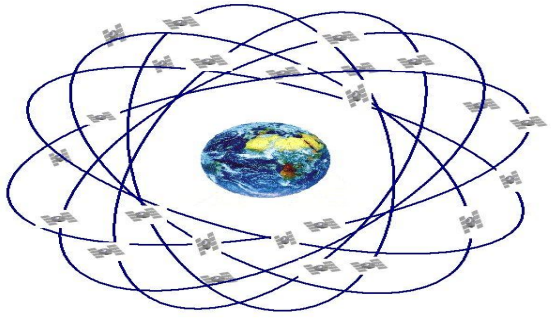

Fig: GPS location tracking

A GPS tracking system can work in various ways. From a commercial perspective, GPS devices are generally used to record the position of vehicles as they make their journeys. Some systems will store the data within the GPS tracking system itself (known as passive tracking) and some send the information to a centralized database or system via a modem within the GPS system unit on a regular basis (known as active tracking) or 2-Way GPS.

V. CONCLUSION

This paper has focused on the development of a novel and unique automotive sensor system for the measurement of relative position and orientation of another vehicle in close proximity. The sensor system is based on the use of AMR sensors, which measure magnetic field. While AMR sensors have previously been used to measure traffic flow rate and to detect vehicles in parking spots, they are used here to measure the relative 2-D position of the vehicle. Analytical formulations were developed to predict the relationships between position and magnetic field for 2-D relative motion. The use of these relationships to estimate vehicle position is complicated by the fact that the parameters in the relationships vary with the type of vehicle under consideration. Since the type of vehicle encountered is not known *a priori*, the parameters for the magnetic field–position relationship have to be adaptively estimated in real time. A system based on the use of multiple AMR sensors and a custom-designed sonar system together with an EKF was developed to estimate vehicle parameters, position, and orientation. The use of the combined sensors results in a reliable system that performs well without the knowledge of vehicle specific magnetic field parameters. Test results with a wheeled laboratory test rig consisting of a door and tests with a full scale passenger sedan were presented. The experimental results in this paper confirm that the developed sensor system is viable and that it is feasible to adaptively estimate vehicle position and orientation even without knowledge of vehicle-dependent parameters.

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