Zig-Bee Based Vehicle Entraining System for Purblind People in Unknown Outdoor Environments

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Abstract

Zig-Bee based wireless body area networks have enabled its way when it gets embedded with Integrated Engineering which proves an aid for the human assistance as well. Navigation in case of unknown outdoor environments for visionary impaired people becomes tedious. Different solutions such as white cane, walking stick, guide dogs and GPS guidelines are there which proves its ability to act as the second eye. Evolutions have been made through rapid change & development with the advent of the electronic devices where in real-time scenarios; road crossing has become a prominent issue which is quite not natural for visually impaired. The system provides flexibility in using Zig-Bee wearable modems which will be used as wearable devices for blind people and also in all the vehicles where visually impaired can have safe navigation along with a voice over interface provides a direct communication facility & directional path at road & street crossings with GPS facility. The system contains Zig-Bee wearable modems technology with voice over interface to communicate with the unknown outdoor environments.

Keywords: Visually Impaired People, Navigation System, Ultrasonic Sensor, PIC16F877A, Zig-Bee Wearable Modems, Speech Recognition, Voice Circuit.

I. INTRODUCTION

Road safety is an emerging concern in the developing countries especially in countries like India it poses a major threat it's been increasing dayby-day. According to Open Government Data Platform (OGD), an estimate says that nearly 5 deaths on every 4 minutes every day. It is nearly 15 to 16 deaths per hour which means for every hour nearly 15 to 16 deaths occur on an average in case of Indian roads [1]. Designing & developing a vehicle entraining system by provides a human assistance for the navigation of the visually impaired people has become before 10 years. After the advent of the integrated engineering has taken its arena in the electronics & hardware industry, much concentration has made in its advancements on meeting the societal needs. In such a way a designing hardware prototype for the visually impaired people has become easier than before. Numerous solutions like walking stick, white cane, guide-dogs though exist; assisting in providing navigation in unknown environments has become a threat for the visually impaired. Guidance in unknown outdoor environments for the visually impaired still poses a threat in proving a human assistance system.

Vehicles play an important role for traveling from ancient times. Social connection has been possible while traveling by two-wheelers, fourwheelers, etc., which is not feasible for the majority of blind and visually impaired people. In case of known environments, navigation has become successful since visually impaired has the potential & the ability to sense the route and to have a directional path during road crossings, intersections, lane crossings, etc., Majority of visually impaired finds it difficult while traveling by bus, pedestrian crossings, road intersections, etc. The proposed system uses Zig-bee protocol based wearable modems provides human assistance by communicating the directions, traffic conditions enabled by GPS facility and make them to feel like an ordinary people while transportation. To provide a human assistance, a vehicular entraining system by using Voice over interface has been proposed which informs both the vehicle and the blind to information about path crossings, street crossings, road intersections, etc which provides flexible navigation for the visually impaired. The proposed system consists of a adorable transceiver zig-bee modem one with the blind and other on the vehicle namely two-wheelers, fourwheelers, etc.

II. WEARABLE WIRELESS BODY AREA NETWORKS

Wireless body area network field is an interdisciplinary area where monitoring a real-time

scenario with the help of the internet is made possible by the use of sensors, low power-wireless integrated circuits that offers wireless communications as a feature. A number of intelligent object detection sensors can be integrated into a wearable wireless body area network, which provides monitoring of surrounding outdoor environments as possible. The information will be transmitted wirelessly to an external processing unit. This device will instantly transmit all information on real-time to the voice over interface where the user can get the necessary input for further processing. With the help of integrated engineering, zig-bee based wearable devices have made its way in case of constant real-time monitoring scenarios.

III.ZIG-BEE TECHNOLOGY

Zig-Bee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless M2M networks. Zig-Bee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz. Zig-Bee supports outdoor location systems by establishing communication with web-based tracking systems or location platforms.

Zig-Bee technology provides advanced encryption security standard (128-bit) that offers multi-hop communication encompassing a large number of nodes which contains long battery life with low-cost battery as wearable devices. Wireless communication ranges from 70m indoors and 400m outdoors. The system results show that its performance is effectively safe and reduces the manufacturing cost to a lower extent.

A. Zig-Bee Stack Architecture

Zig-Bee stack architecture offers a higher application protocol which operates on physical layer, data link layer, network layer. Each layer has its own capability and own set of services. The Zig-Bee application layer consists of the application support sublayer (APS) sublayer, the Zig-Bee device objects (ZDO) and the user-defined application objects. Application layers are mainly responsible for profiles, messages, message formats, and processing actions which enables distribution & inter-operability that reside on separate devices. The Zig-Bee device objects (ZDO), represent a base class of functionality that provides an interface between the application objects, the device profile, and the APS. The Zig-Bee device objects (ZDO) is located between the application framework and the application support sub-layer. It satisfies common requirements of all applications operating in a Zig-Bee protocol stack.



Fig 1: Zig-Bee Protocol Stack



Fig 2: Zig-Bee Module

IV.DESIGN METHODOLOGY

The design consists of a micro-controller with an embedded C programming capability which will detect objects using the object sensor that senses using zig-bee protocol. Zig-bee protocol offers wide range outdoor communication that varies from 30 m to 100m. Wireless Design methodology consists of a PIC16F877A micro-controller, object detection sensors, zig-bee modem, ultrasonic sensor detection, buzzer ring and voice module.





A. Pic Series Microcontroller

PIC16F887 series micro-controller is a Microchip which features all the components which modern microcontrollers with a wide range of application, high quality and easy availability. FLASH is the most recently emerging technology used in PIC 16F877A microcontroller which retains the data even when the power is switched off [10]. Easy Programming and Erasing are also the other features of PIC 16F877A. PIC 16F877A CMOS Flash unit contains 8 bit microcontroller and the 200 instruction executed in nano seconds per cycle. PIC 16F877A has high performance RISC CPU and its operating voltage range is 2 to 5.5V where the temperature ranges from -40 to +125. PIC microcontroller architecture consists of RAM, ROM, CPU, timers, counters and supports the protocols such as SPI, CAN, and UART for interfacing with other peripherals. PIC microcontrollers are very much consistent and it has lesser faulty nature. The performance of the PIC microcontroller is very fast because of RISC architecture which reduces the power consumption and makes programming easier. Interfacing of an analog device is easy without any extra circuitry.

B. Ultrasonic Sensor Detection

Ultrasonic sensors emit short, highfrequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor. Ultrasonic waves are sounds which cannot be heard by humans in the normal condition, with frequencies of above 20 kHz. In order to detect the presence of an object, ultrasonic waves are reflected on objects. It is used to detect the obstacles in front of the blind to navigate. The given below diagram represents the HC-SR04 sensor.



Fig 4:HC-SR04 Sensor

C. Buzzer Ring And Voice Module

A buzzer is an audio signalling device which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input. A piezoelectric buzzer can be driven by an oscillating electronic circuit or other audio signal source. A click, beep or ring can indicate that a button has been pressed. The given below diagram represents the buzzer,



V. ZIG-BEE BASED VEHICLE ENTRAINING HARDWARE PROTOTYPE

The proposed system consists of the system where the zig-bee modems are enabled as wearable devices for the purblind and for the vehicles too. Visually challenged has this transceiver unit which is used to read the information's about the bus then convert into voice which can be heard through the voice board module. Also the obstacle sensor is used to sense the objects in between the path. Any obstacle in the path will be sensed and sound gets produced through buzzer which makes the visually challenged to be safe to clearly identify the path to reach the destination. The diagram represents the working principle about the connection with the blind unit.

- Zig-Bee modem has both the transceiver unit which receives and transmits the signals.
- The obstacle sensor is used to sense the object.
- The information is then shared with the system through the PIC series micro-controller using the voice-over module interface.
- Buzzer is to indicate the blind people to reach the destination safe and clear navigation about road crossings, intersections, etc.

A. Implementation

Integrated Engineering has been under its progress marching towards the solution oriented hardware prototype which paved a wide way to develop the artifacts based upon the requirements and needs of the society. The hardware requirement for the simulation consists of PIC Micro-Controller, Zig-Bee Modems, Object Sensors, Buzzer, and LCD & GSM. The software's are used to interact with the hardware interface where the programming can be done by using Embedded C, PCW IDE Compiler.

B. Hardware Prototype

To navigate the blind people without any assistance has been successfully implemented by using Integrated Engineering Technology. The results has distributed into three units such as i) Zig-Bee Modem Unit ii) Micro-Controller Unit iii) Buzzer Unit iv) Object Sensors. The Fig 6 shows the hardware prototype of the vehicle entraining system. The hardware unit consist of the zig-bee modem, ultrasonic sensor, buzzer, voice module are used to navigate the blind people without any assistance.



Fig 6: Working Principle of a Zig-Bee Based Vehicle Entraining System



Fig 7: Hardware-Blind Unit

VI.CONCLUSION

Visually impaired people need some aid to interact with their environment which enhances their security during mobility. Vehicle entraining system using Integrated Engineering Technology makes secure communication for the visually challenged. The purpose is to have an interactive human- aid system for the visually impaired so they can travel like a normal people in buses, cross-roads comfortably like others.

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