Wireless Communication using ZigBee

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ABSTRACT
The proposed system provides real time tracking application that provides location of the mobile unit to the fixed control unit as well as display advertisements. The location of the object is seen on the map on the computer interfaced with the central unit. The ZigBee module designed to operate within the ZigBee protocol to support GPS tracking system in terms of latitude and longitude. The module operates in the ISM 2.4 GHz frequency band with minimal power and provides reliable delivery of data between remote devices.

General Terms
Global Positioning System, ZigBee et. al.

Keywords
Global positioning System, ZigBee, ZigBee architecture, system design, navigation.

1. INTRODUCTION

1.1 Global Positioning System
The Global Positioning System (GPS) is used for tracking where it provides navigational information in terms of parameters such as latitude, longitude, altitude and time. One of the applications includes Vehicle Tracking and through which monitors the vehicle as it moves along.

The main principle of the Global Positioning System Network deals with the measurement between the GPS receiver and the actual satellites. The principles behind the operation of Global Positioning Systems can be simply described in few steps.

The first step deals with the positioning and displacement of satellite which is calculated using triangulation method. The second step calculates the actual travel time of the radio signals which is measured using GPS receiver. The third step correcting the signal delays as it travel through atmosphere, which are picked up and corrected by the GPS tracking stations. [1]

The GPS receiver acquires NMEA GGA strings for the smooth data transfer for postprocessing. The strings has the information regarding latitude, longitude, time, distance, velocity etc. These strings keep on repeating continuously after certain strings.[2]

The GPS system is used with Zigbee technology to enhance its application in the network communication.

1.2 ZigBee [3]
ZigBee operates in license free band of 868 MHz, 915 MHz, 2.4Ghz which has the features of low power consumption (long battery life), low data rates, security and reliability. [6] It is an IEEE 802.15.4 standard for wireless personal area network. This has various advantages over the existing Bluetooth technology (Wi-Fi). It has found application in home automation, medical emergency, patient monitoring system, location-positiong and tracking system. Zigbee offers the following characteristics:

- Maximum range of 250 feet
- Maximum data rate of 20 kbps @868 MHz, 40 kbps @915 MHz, 250 kbps @2.4 GHZ
- High throughput and low latency (<0.1%)
- Use Carrier sense multiple access with collision avoidance (CSMA/CA) accessing scheme
- Addressing space is of up to 64 bit
- Fully reliable “hand-shaked” data transfer protocol
- Support various network topologies such as star, mesh, peer to peer.

2. ZIGBEE ARCHITECTURE
Zigbee Stack Architecture is shown in Figure 1.

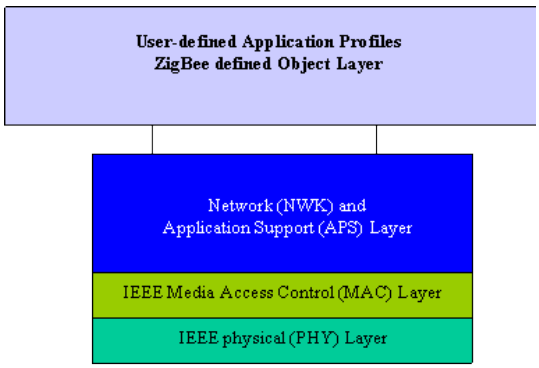

Fig 1 Zigbee architecture

2.1 Physical(PHY)Layer
The IEEE802.15.4 PHY physical layer accommodates high levels of integration by using direct sequence to permit simplicity in the analog circuitry and enable cheaper implementations. This Layer is responsible for: [3] [4]

- Turning the radio receiver on and off
- Detecting the presence of an RF signal in the current channel
- Analyzing and reporting link quality for received packets
- Selecting a frequency channel for operation, transmitting and receiving data

2.2 Media Access Control (MAC) layer

The IEEE802.15.4 MAC media access control layer permits use of several topologies without introducing complexity and is meant to work with large numbers of devices. Access to this medium is performed by CSMA/CS mechanism. This layer is responsible for: [3][4]

- Generating time synchronization frames
- Association and disassociation
- Device security and support of security mechanism implemented by network and application support layer
- Managing channel access
- Handling and maintaining the guaranteed time slot mechanism
- Maintaining reliable link (16 bit CRC- error detection)

2.3 Network and Application Support Layer

The network layer permits growth of network. This layer can handle huge numbers of nodes. This level in the ZigBee architecture includes the ZigBee Define Object (ZDO), user-defined application profile(s) and the Application Support (APS) sub-layer. These layers are responsible for: [3] [4]

- Maintaining tables for binding
- Forwarding messages between two devices
- Initiating and responding to binding request
- Establishing a secure relationship
- Discovering devices on network
- Determining the type of application service

3. SYSTEM DESIGN

The system is designed in two module : hardware module and software module. Hardware module consist of mobile unit (MU) and fixed control unit (FU) where Mobile unit has ZigBee module (end device) and GPS receiver interfaced with microcontroller and the fixed control unit has ZigBee coordinator interfaced with the computer. The communication between the units is a single point to multipoint network communication. [5]

The Global Positioning System (GPS) is used for tracking. It receives data from satellites and send it to microcontroller. The microcontroller is programmed using Embedded Basic language, so that it receives the data (location of the vehicle) from the GPS and transmits it to the control unit using ZigBee module.

3.1 Hardware

To send the GPS information from mobile unit to fixed unit, we are using Xbee modules one as transmitter and the other as receiver. The transmitter is interfaced with GPS hand-held unit and Microcontroller and the receiver is interfaced to the Host computer at the other end. We send signals from MC through the ZigBee transmitter as shown in Figure 2 to the ZigBee receiver as shown in Figure 3 which is host Computer. [6]

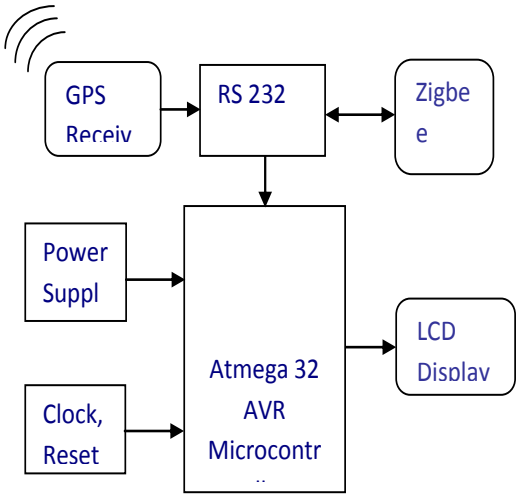

Fig 2 Zigbee Transmitter

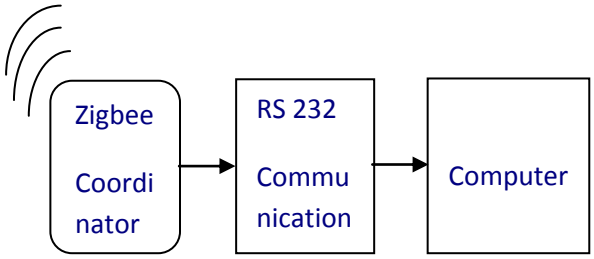

Fig 3 Zigbee Receiver

3.2 Software

The GPS data decoding software program has been developed using Embedded Basic language as discussed using flow chart in Figure 4.[7]

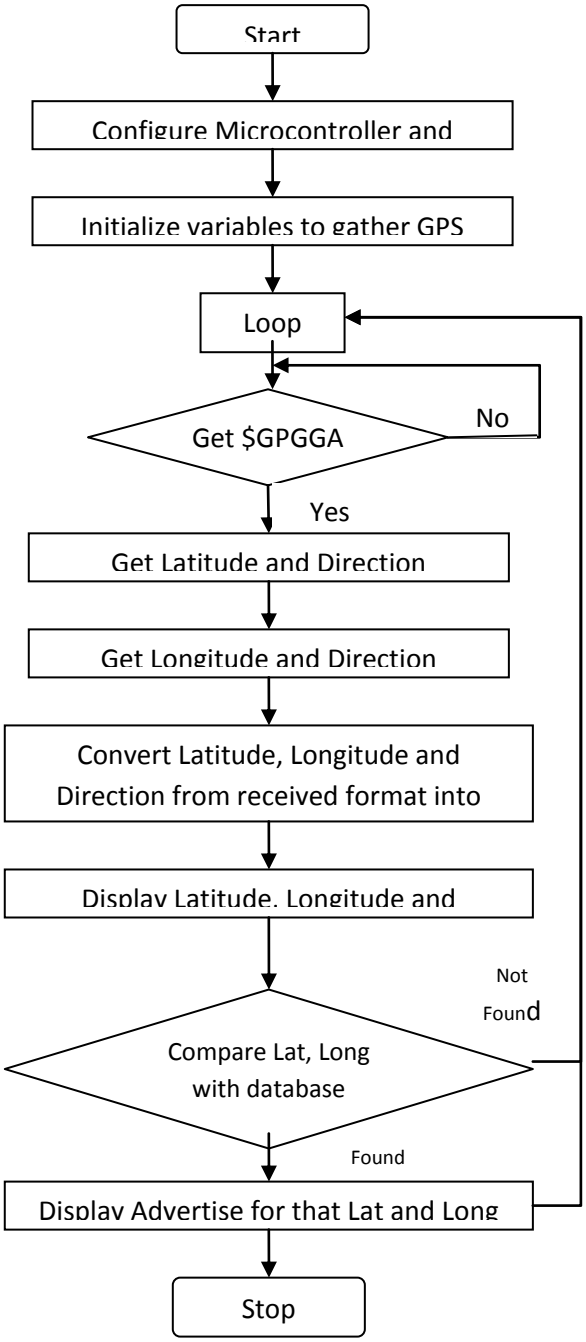

Fig 4 Flow chart

4. RESULT AND CONCLUSION

To evaluate the performance of the GPS system, the real time results were taken by GPS based Navigator System. The tested results are tabulated in Table 1 and Location of the place is seen on the map as shown in Figure 5 and the advertising of the location with latitude and longitude at the receiver unit is shown in Figure 6.

Table 1

Sr.No	Latitude (North)	Longitude (East)	Location
1	19 06 52	72 50 22	A
2	19 06 54	72 50 22	B
3	19 06 56	72 50 23	C
4	19 06 59	72 50 25	D
5	19 11 28	72 58 25	E
6	19 11 24	72 58 71	F
7	19 18 22	72 62 64	G
8	19 09 34	72 56 27	H
9	19 09 37	72 56 25	I
10	19 09 42	72 57 23	J

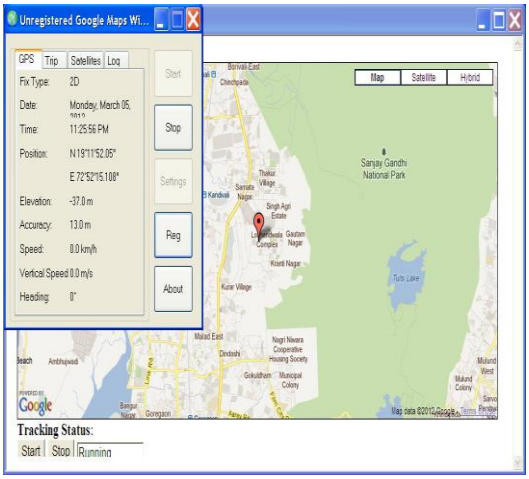

Fig 5 Location of the place

Fig 6 Advertising the location

5. ACKNOWLEDGEMENT

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6. REFERENCES

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