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Research Article

NAVIGATION USING TRIANGULATION METHOD IN WIRELESS SENSOR NETWORK

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ABSTRACT

The aim of our project to develop a system that can be used as tracking device in the satellite signal denied region. This technology allows us to create a new horizon of possibility in many applications like military services, trekking, mining etc. where Global Positioning System (GPS) is unavailable. Very few navigation devices are available for tracking but depends on the GPS values or they are complicated, bulky, difficult to install and requires technical person to operate. The system that is developed here eliminates all the above specified limitations. There are number of motes, one as display mote and rest as reference motes are implemented. The display mote is given to an individual and reference motes are placed on the way to the destination. So person when gets lost from the camping site with the help of this display mote they can reach the destination by tracking their way without any difficulty. The reference motes guide the way to the destination.

Keywords: GPS, Motes, RSSI, WPAN, Signal Triangulation method, Transceiver.

INTRODUCTION

Satellite denied places like reserved forest, sea, caves, coal mines etc., cannot be easy to travel and monitoring. Owing to the restriction of signal, mainly the defence people suffer quite intensely. Normally they are communicating through the low frequency radio signal which is not a reliable one for secured communication.

For the above mentioned problem this project has been formulated by developing the wireless personal area network. By using this project the tracking and communication between people in signal denied area becomes easy and better.

In existing system the cordless module has been used to convey the information among the soldiers. But that works in low frequency range around 400 MHz which transmit data quite slowly. And also by using this they cannot be tracking the correct way without any other assistance.

In this system, the communication takes place by creating a wireless secured area network. There are number of motes can be networked which will leads to a large communication network. Every mote can be placed in our desired place or area which acts as reference mote and the soldiers having the display mote.

These motes are communicating with each other in range of frequency about 2.4 GHz. Mainly in army by using this system the human life's can be saved by missing of soldiers, identification of land mine areas, and so on. This new navigation scheme can provide accurate position estimation and does not require prior knowledge.

In this system we are considering totally 4 motes which have been networked through MiWi protocol communication. Three motes placed in a particular place and one mote carried by the particular person. When the power switch on the four motes will be communicate with each other. If the display mote makes any moves coordinate values will be display in the LCD display which has been connected with display mote[1-5].

RELATED WORKS

The following IEEE papers are studied and reviewed and the limitations are observed and specified in this session and some of the concepts are used in formulating this system.

Timing via the new loran-c system (2003) - Long Range Radio Navigation (LORAN) is a terrestrial radio navigation system which enables ships and aircraft to determine their position and speed from low frequency radio signals transmitted by fixed land based radio beacons, using a receiver unit. The most recent version of LORAN in use is LORAN-C, which operates in the low frequency (LF) portion of the radio spectrum from 90 to 110 kHz. The navigational method provided by LORAN is based on measuring the time difference between the receipts of signals from a pair of radio transmitters.

If the positions of the two synchronized stations are known, then the position of the receiver can be determined where the time difference between the received signals is constant. So a LORAN receiver which only receives two LORAN stations

cannot fully fix its position. As it is described above the method is tedious and complex equations are derived to calculate the time difference and the LORAN stations are bulkier and difficult to install. This method is soon replaced by GPS itself.

Design of an agile radio navigation system using sdr techniques (2005) - This paper describes the design, development, and hardware prototyping of a frequency-agile, programmable-bandwidth radio navigation. In this paper, the authors has developed Theatrical Positioning System used along with the Global Positioning System as a backup. There are several significant features of the theater positioning system (TPS) which differentiate it from GPS, including its operating frequency range (<30 MHz), frequency- and modulation-agile capabilities, propagation modes (principally groundwave), and signal security mechanisms. The only drawback of this system is the usage of low frequency radio waves due to which the signal interference and distortions are possible leading to inappropriate results. TPS should be used along with the GPS and due to this, interference of signals takes place reducing the accuracy.

Navigation in gps-denied environments (2008) - In this paper Navigation methods LORAN and Theatrical Positioning systems are discussed. The predecessor of the TPS navigation is Long Range Radio Navigation LORAN which was the original wide area radio navigation system that preceded GPS. Its relatively long wavelength (3000 meters) provided large geographic coverage without satellite navigation via groundwave propagation[1-5].

The LORAN is limited by lace of resolution and highly susceptible to interference. For TPS method the distance is calculated by deriving an equation that is obtained by comparing the values obtained using GPS and TPS. Hence in GPS denied regions the TPS gives the distance which the author terms it as approximate distance and it has its own limitations. This theoretical calculation is influenced by the height of the users and altitude of the location.

Lightweight location verification algorithms for wireless sensor networks (2013) - This paper gives the theoretical calculation and performance of the sensor nodes in different location. Different errors that occurs due to sensors are studied and solved it by deriving equations. They verify the results using on-spot verification and in-region verification.

On-spot verification is to verify whether the sensors true location is same as the verified location. In-region verification they used a protocol called Echo to verify whether the sensor is inside a physical region such as room, auditorium etc. sensor performances are plotted according to the two verifications and compared.

Face-to-face proximity estimation using bluetooth on smartphones (2013)- This paper discuss about the proximity estimation using Bluetooth. Based on the Received Signal Strength Indication – RSSI of Bluetooth the proximity of the individuals are measured considering different scenarios. The author discuss about the simplicity of the implementation of this technique as Bluetooth is commonly available in all smart

CHOICE OF HARDWARE

The block diagram and working of the system is studied and care is taken while selecting the devices for each block. In this system, a microcontroller, RF transceiver of 2.4 GHZ and LCD display is used.

phones.

Two approaches are done to study the values of RSSI obtained i.e. single threshold and multiple threshold using light sensor to smoothen the obtained values and accuracy is studied. This paper only determines the face to face proximity by connecting the Bluetooth of individual's smart phones to calculate the exact location of the individuals.

The limitations are the coverage of Bluetooth is less and the values studied shows that the persons whose Bluetooth is connected when kept in bag or any holder or pocket the error in determination of the location is quite high.

PROPOSED SYSTEM

In this system, the communication takes place by creating a wireless secured area network. There are number of motes can be networked which will leads to a large communication network. Every mote can be placed in our desired place or area which acts as reference mote and the soldiers having the display mote. These motes are communicating with each other in range of frequency about 2.4 GHz.

When a lost person with the display mote moves towards or away from the display mote, the message and signal strength gets displayed accordingly[6].

The display mote moving towards or away from the reference mote is calculated with respect to Received Signal Strength Indication – RSSI. In this system we implement motes referred as reference motes in different locations while making our way to the destination.

The reference motes consists of IEEE 802.15.4 RF Transceiver termed as MiWi. The change in RSSI is monitored by controller. The RF transceiver is connected to controller via Serial peripheral interface bus – SPI. The display mote consists of a RF transceiver as well which will transmit and receive RF signal from reference motes.

The communication between these motes are monitored by a controller. The value of the RSSI and the display messages are determined by the controller and are displayed in LCD which is connected to the controller via I2C – Inter Integrated Circuit[7].

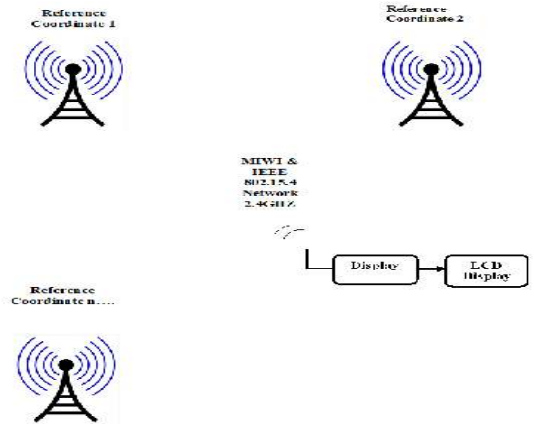

Figure 1: Implementation of the system

According to the proposed system, the best choice of microcontroller is PIC microcontroller due to following reasons

- PIC microcontrollers has reduced instruction set RISC.
- MiWi are compatible only with PIC microcontrollers

- Low cost
- Free development tools available

Hence from PIC microcontroller family PIC18F45J11 is used in this system. PIC18F45J11 has 32k program memory and 3.8k data memory.

RF transceiver IEEE 802.15.4 MiWi of 2.4 GHz is used in the system. There are two models of MiWi of 2.4 GHz of microchip proprietor is available. But the basic model of MiWi transceiver is sufficient for our model. Hence MRF24J40 MiWi transceiver is used. A detailed study of the device is also done and understood in the nest chapter.In recent years Liquid Crystal Display is widespread use replacing LEDs. This is due to

- The declining prices of LCDs.
- The ability to display numbers, characters and graphics.
- In corporation of the refreshing controller in the LCD.
- Ease of programming for characters and graphics.

The above specified devices are bought and tested for operability. Basic circuit connection like power supply, oscillator for operating frequency, ground are given and basic program is run and tested[8].

TEST SETUP

The setup is made as shown in the block diagram with the components and tools specified. The main concept of the project depends on the RSSI of the RF Transceiver i.e., received signal strength indicator. The PIC microcontroller is connected to the IEEE 802.15.4 RF Transceiver MiWi of the display mote via SPI. The result to be displayed is shown in LCD which is connected to the microcontroller via I2C.

Similarly for the reference mote IEEE 802.15.4 RF Transceiver is connected to the microcontroller via SPI – serial peripheral Interface. Once the setup is made, the display mote and reference motes are switched on. The motes starts communicating as soon as the power is on by transmitting and receiving the RF signal.

The motes are placed very close to each other and the RSSI values are studied and noted. Then the display mote is taken slowly away from the reference mote and the change in RSSI values are noted. Now display motes are taken far until there is no RSSI value to display and again bought closer slowly to observe the increase in value and also to study the coverage area of the system.

Thus different values are noted in different position. According to the values noted the controller are programmed to monitor and compare the RSSI value and display the desired result in the LCD via I2C. The values does not depend upon any equation or pre-assumed value or on the values of the GPS tracker. Hence it is independent of GPS and easy to implement and user friendly system.

ALGORITHM

Algorithm for the above system is designed as given below. Consider Mote 1 is placed in the X- Coordinate and mote 2 is placed in the Y- Coordinate.

- Step 1 - Start
- Step 2 - Set RSSI_Low = 50 and RSSI_High = 220.
- Step 3 - If signal detected, synchronize.
- Step 4 - Check for signal.
- Step 5 – Store the signals received from the motes in the registers. Ex - Mote 1 = register A, Mote 2 = Register B.
- Step 6 – Check if received signal is > RSSI_Low.
- Step 7 – if step5 satisfied for mote A then, get five samples of the received signal from register A and find the average value of the signal.
- Step 8 – if the average value of the signal is greater than the RSSI maximum value, then display "Near X-coordinate" and go to stop.
- Step 9 – else display "finding coordinates"
- Step 10 – repeat step 5 for Register B.
- Step 11 – if the average value of the signal is greater than the RSSI maximum value, then display "Near Y-coordinate".
- Step 12 – else display "Navigating XY".
- Step 13 – display received RSSI value.
- Step 14 – Stop

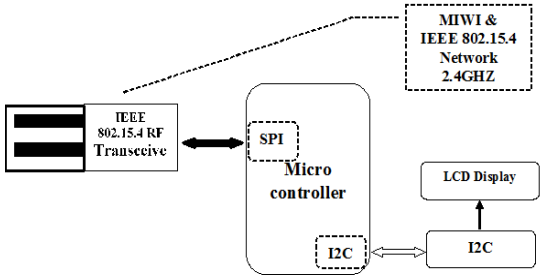

Figure 2: Block Diagram of Display Mote

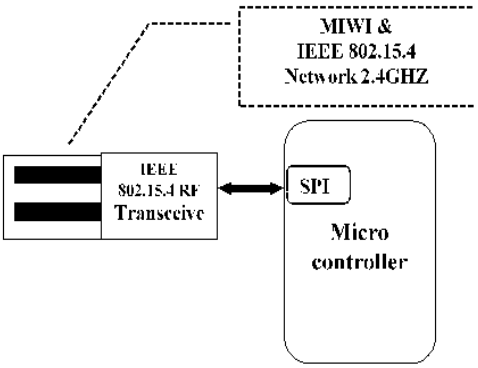

Figure 3: Block Diagram of Reference motes

CONCLUSION

A clear insight about the proposed system was given and block diagram and implementation of the system was designed. Program is developed according to the designed algorithm and flow chart and it is compiled and tested in MPLAB. The program is written in C language for better simplicity and easy implementation. The application of the proposed system is vast and not confined, but it will provide a great contribution to the following fields. In military services where militants are expected to camp in areas where there are

no satellite signal. Militants getting lost or even loss of life can be avoided by using this system. In the mining fields. There are number mining regions for different metals or valuable where people need to camp in a temporary basis. The people employed in this job are mostly illiterate and the system proposed is very easy to implement and use and does not require much knowledge to operate it. Global Positioning System can navigate to a place and the place can be a big mall or a theme park. Navigation inside those places cannot be achieved using GPS but can be done with the help of the proposed system.

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