

A Unique Methodology Enabling Lost Object Tracking Using iBeacon

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Abstract : Indoor and outdoor tracking is a variant of wireless tracking. It is an excellent way to monitor and track the location of people or valuable objects within a specific area such as building, hospital etc. Bluetooth Low Energy (BLE) is the newly emerged technology in the context of indoor tracking. It is known that the technological advancements are increasing at a faster pace. But the utilization of these technologies are very less in various sectors. It is a common fact that we tend to lose various items inside or outside our room. But because of these facts we may experience various stress and problems related to the loss of those objects. So we propose a system where we can identify the lost objects with the help of iBeacon.

IndexTerms - Outdoor mapping, iBeacons, RF modules.

I. INTRODUCTION

Nowadays, positioning technologies are used in a wide variety of areas such as location finding and tracking valuable objects. In June 2010, the specification for the Bluetooth 4.0 technology was released. The specification which is introduced named as “Bluetooth Low Energy” (BLE) or “Bluetooth Smart”. The technology operates between 2400MHz to 2485MHz divided into different channels. The BLE technology introduces 40 channels with 2MHz Spacing, Out of which 3 channels are dedicated for advertisement purpose. It is low-cost, low power consumption, low complexity and low bandwidth technology. A major advantage of using BLE technology is that it is a technology with high penetration in society.

An iBeacon is a small Bluetooth Low Energy (BLE, Bluetooth 4.0) device that can be powered by a coin cell, batteries or through an external power supply. An iBeacon is a device that only sends a packet in specific data format. To take an advantage of iBeacon, Apple provided iBeacon supports in iOS version 7.0 and Google added it in Android version 4.3. Windows phone does not support iBeacon, which means currently there is no anyway to create an application for iBeacon support for this operating system.

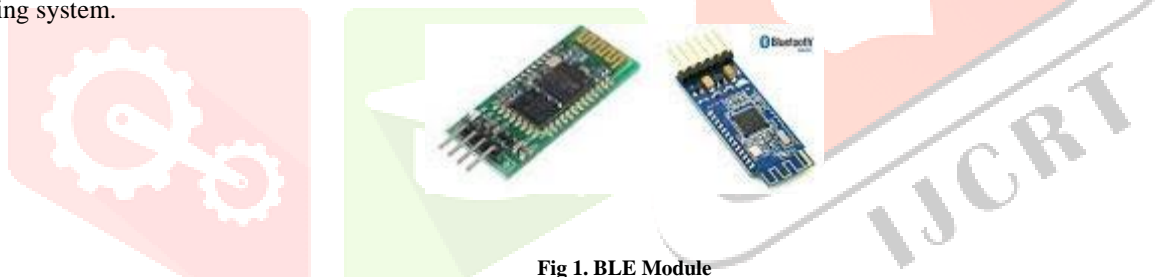


Fig 1. BLE Module

iBeacon is a protocol developed by Apple and introduced at the Apple worldwide developers conferences in 2013. The technology enables smartphones, tablets and other devices to perform actions when in close proximity to an iBeacon. iBeacon is based on Bluetooth Low Energy proximity sensing by transmitting a universally unique identifier picked up by a compatible app or operating system. It can also be used with an application as the indoor positioning system which helps smartphone determine their approximate location or context. It differs from some other location based technologies as the broadcasting device is only a 1-way transmitter to the receiving smartphone or receiving device.

iBeacon refers to tiny battery powered devices which emit Bluetooth low energy signals. The iBeacon, or just beacons, transmit a unique signal multiple times every second which can be received by phones within a few meter radius. Phones can accurately position themselves by receiving signals from all nearby beacons. The mechanism is very similar to how ships used to use lighthouses – the lighthouse would emit light which was picked up by passing by ships.

In this paper, here we using two set of RF modules where one of them acts as an alarm section and the other will act as a switch to intimate the location of the object with the help of the buzzer. The advantage of using these iBeacon is it can be more precise and accurate in locating objects than GPS. It uses 9 satellite co-ordinates such as latitude, longitude, elevation, RSSI, accuracy, major, minor, azimuth angle and UUID wherein GPS it is limited to only 3 co-ordinates(latitude, longitude, elevation).

II. BLOCK DIAGRAM

User section:

The user section consists of the mobile with which the user makes use of the beacon application that communicates with the iBeacon module at the object section. The application indicates the detection of beacon present nearby and tracks its location.



Fig 2. User section

Object section:

The object section is where the iBeacon module is placed that indicates the location of the object when its lost with the help of beacon application with the user. The block diagram of object section as shown below.

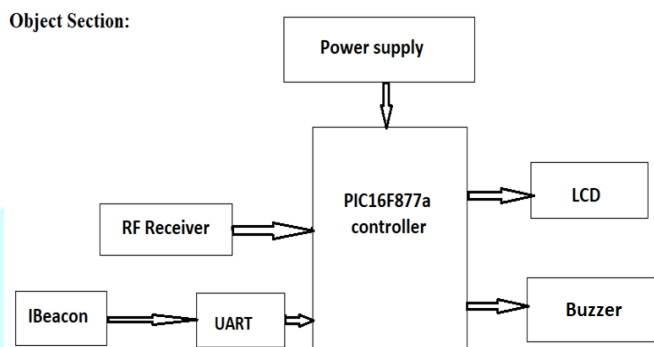


Fig 3. Object section

Object intimation section:

The object intimation section helps the user to get alert the very instant the object is lost. The block diagram of object intimation section as shown below.

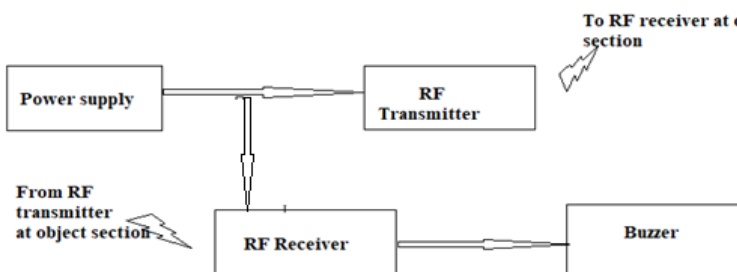


Fig 4. Object intimation alarm section

II. DESCRIPTION OF THE SYSTEM

In this section we provide the details of our system including a *user section*, *object section*, *object intimation alarm section*.

1. IBEACON MODULE

The primary concept of our approach is based on the use of BLE beacons that are installed in objects. The beacons communicate with the back-end server via mobile application running on smart phone which allows the user to identify the location of the object.



Fig 5. Beacon communication

The basic process that is responsible for the functioning of beacons is known as ‘advertising’. In this process, the devices emit packets of data using Bluetooth low energy and other scanning devices nearby such as smartphones that are in the vicinity

detect this data. The smart phone collects the signals of data for the system and then uploads to cloud server to positioning and navigation.

Ibeacon is Apple's version of the Bluetooth –based beacon concept, which allows the Bluetooth devices to broadcast or receive tiny and static pieces of data within short distances. The ibeacon is one of classes of BLE that can produce small signal indicating its location. Bluetooth Low Energy (BLE) is the global wireless standard that enables wireless communication among devices within a short range. It ensures subversive low power consumption and it is designed for transmitting small amount of data. Using Bluetooth low energy (BLE) proximity sensing beacons transmit a universally unique identifier in the form of signals which are picked up by a compatible application or operating system. These details helps in locating the smart device. BLE provides optimal balance between infrastructure reliability robustness and accuracy.

2. RF MODULES

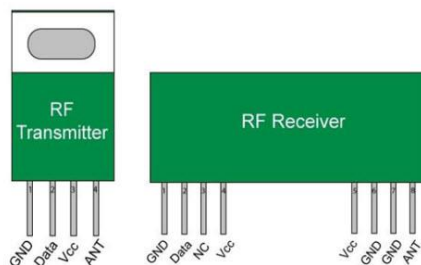


Fig 6. RF Transceiver

An RF module (Radio Frequency) is a small electronic device used to transmit and receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This communication may be accomplished through radio frequency communication. The application of RF modules mainly involve in low volume and medium volume products for consumer applications like wireless alarm section, garage door openers, smart sensor applications, wireless home automation system and industrial remote controls.

The **RF Transmitter** is small sized PCB capable of transferring a radio wave and modulating radio wave to carry data. RF transmitter modules are usually applied along with a microcontroller which will offer data to the module which can be transmitted. These transmitters are usually subject to controlling to requirements which command the maximum acceptable transmitter power output.

The **RF Receiver** module takes the modulated signal to demodulate it. There are two kinds of receiver modules, namely the super-regenerative receivers and super-heterodyne receivers. Usually super-regenerative modules are low power designs and low cost using a series of amplifiers to remove the modulated data from a carrier wave. These modules vary, generally inaccurate as their operation as frequency significantly with power supply voltage and temperature.

3. PIC16F877A MICROCONTROLLER



Fig 7. PIC16F877a

This powerful (200 nanosecond instruction execution) yet easy-to-program (only 35 single word instructions) CMOS FLASH-based 8-bit microcontroller packs Microchip's powerful PIC® architecture into an 40- or 44-pin package and is upwards compatible with the PIC16C5X, PIC12CXXX and PIC16C7X devices. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital (A/D) converter, 2 capture/compare/PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). All of these features make it ideal for more advanced level A/D applications in automotive, industrial, appliances and consumer applications.

II. RESEARCH METHODOLOGY

The user section consists of the beacon application that indicates the signal strength of the beacon module transmitting small signals. The application indicates the detection of beacon present nearby and tracks its location.

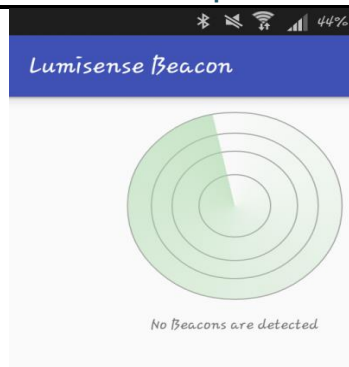


Fig 8. User section

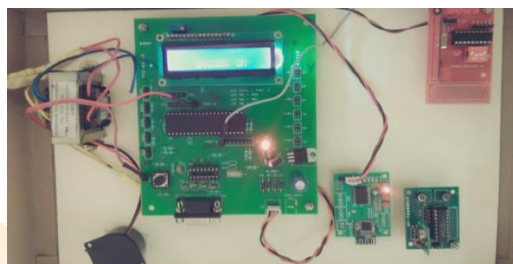


Fig 9. Object section

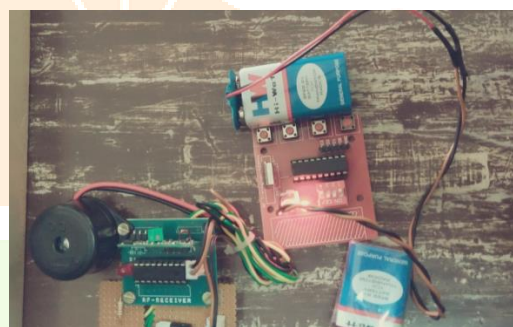


Fig 10. User intimation section

In the object section consists of the ibeacon that is interfaced with the PIC microcontroller with the help of UART cable. The RF receiver is fixed with the PIC microcontrollers in the C port at the pin number RC0. The buzzer is interfaced with the microcontroller at the pin number RB0 at the port B. The RF receiver receives the signals from the RF transmitter at the user section which is also provided with a buzzer that aids to provide the alerting sound caused due to the parting of the RF transmitter and RF receiver over a certain range. And the beacon present in the object section will help in locating the location of the object. RF transmitter is connected with the buzzer where the positive end is connected with one end of the 10K resistor and the negative end is connected to ground. The other end of the resistor is connected to ICB544G1106G2. A 9V battery with its positive end connected to the 5V of the transmitter and the negative is grounded. At the object section the beacon module is connected to RB2 at the port B. and the LCD is interfaced with microcontroller from D0-D7 to the RD0-RD7. RS/RW/E are connected to the microcontroller's RE0, RE1, RE2 respectively.

II. RESULTS AND DISCUSSION

Here the object location could be found at anywhere at any time in a vast environment irrespective of distance. This ibeacon module being more accurate and precise in positioning a particular object it moreover replaces GPS and also works more effectively and is also highly secure. Here there are some of the places where the ibeacon module has exactly identified the locations. Here the sample image as shown.

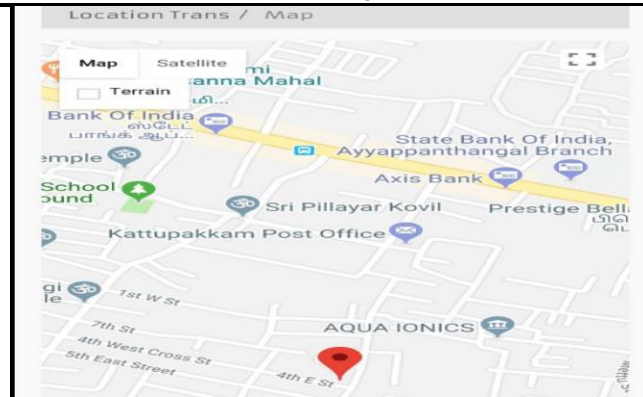


Fig 11. Object location at kattupakkam 4th E street

Here the object location is indicated in satellite mode where the object location exactly shows at the SMMCHRI playground. This indicates the object has been lost over this place and is identified by the ibeacon module placed in it



Fig.12. Object location at SMMCHRI Playground

III. CONCLUSION

The object location using ibeacon is more efficient as it's a modern technology. The advantage of using the beacon for locating objects is that it has low power consumption. And are more accurate and reliable. It is a simple application interface that makes the system user friendly. These beacons used here is a replacement to any other object locating devices such as GPS, NFC. It is a true fact that beacons can accurately detect the location of the object with relevant beacon application. This accomplishes the fact of finding objects easily.

III.FUTURE ENHANCEMENT

This project can be implemented in compact form and can be used in various miniature assets. So that we can get hold to things easily and avoiding the missing of objects even if they are small. The project may be used for military applications as well, as they have the concept of locating objects.

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