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Indoor positioning using beacons

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ABSTRACT

Nowadays every smartphone is Bluetooth enabled, making the use of this technology more flexible. Satellite-based positioning doesn't work indoors, but other technological standards have emerged that make indoor positioning possible. Since Satellite-based positioning GPS does not work, Bluetooth is a good alternative for indoor positioning and indoor navigation. From the RSSI, we can obtain the distances from the individual beacons, we describe and analyze a system for indoor positioning, which enables a person with a smartphone to find his or her location within an enclosed space, with an accuracy of up to 2 meters.

Keywords: *Beacons, RSSI, Database, App.*

1. INTRODUCTION

Indoor positioning systems have played a vital role in people's lives with the fast improvement of indoor position estimation and with the spread of smartphones since the GPS satellite technology became publicly available in the late 90's. Positioning indoor is more complicated than outdoor positioning using GPS because a certain infrastructure needs to be in place indoors. GPS signals do not work indoors or in narrow streets as they tend to attenuate and scatter by roofs and walls. We describe and analyze a system for indoor positioning, which enables a person with a smartphone to find his or her location within an enclosed space, with an accuracy of up to 1-2 meters. Accuracy does vary depending on circumstances but can be as good as within 1-3meters. Customers and visitors use this technology for navigation and for the location-based content reception. For that, they use their smartphone, tablet with an app they install. The app provides indoor maps and location specific content automatically. The idea is to place 2 or more Bluetooth beacons at known positions in a room, and have a smartphone to record the signals strength emitted from them.

2. INDOOR POSITIONING SYSTEM

Indoor Positioning System (IPS) is a system knowing for the tracking of people or objects in a specific area by using radio waves, magnetic fields, or other sensors obtained by mobile devices. Indoor Positioning System by using radio waves have advantages over other sensors because of the technology on mobile devices capable of processing radio waves that exist around the user. Technology that can emit radio waves and commonly used for data communications on IPS is Wireless Local Area Network (WLAN) and Bluetooth. This Technology is newly emerging in a Shopping mall, airport, and other indoor locations. Methods for determining applicable positions include triangulation, fingerprinting.

3. RECIEVED SIGNALSTRENGTH INDICATOR

RSSI (Received Signal Strength Indicator) is a measurement of a device can be received a signal from an access point or router. It is used for determining enough signal to get a good wireless connection. It is a Radio-Frequency (RF) term. Beacons can be used to approximate distance to the receiver using the RSSI. It is the signal strength (in decibels) measured by the Smartphone when receiving packets from the beacon. RSSI reduces as the distance increases so that we can estimate the distance using the reading. Factors that affect RSSI measured for a beacon includes:

- Distance – The larger the distance between Beacon and Smartphone.
- Environment – Due to Line of Sight (LoS) reception objects can cause signal attenuation,
- Transmitter antenna power – The higher the power, the higher the RSSI value, but lower the battery life.
- Receiver antenna sensitivity and gain setting – more the sensitive devices higher the RSSI values.
- Transmitter and Receiver orientations.
- Air density affects the path loss.

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4. BEACON SETTINGS

It's good to take a look at beacons settings. Mostly Beacon manufacturers send out their devices with default settings so if you get, you don't even need to do settings at all. Beacons usually come with an application and web portal that we can use to manage them. The transmission power is usually set by default somewhat around 1-4db and the maximum transmission interval up to 350 milliseconds. These are good for accurate indoor positioning. If the speed and accuracy of the positioning are weakened then the transmission interval value has been set higher than that. If we are lacking accurate location of our smart device then beacons have been placed correctly, these settings are something to look at.

5. HARDWARE

Beacons are small computers as part of indoor positioning systems beacons use proximity technology to detect human presence nearby. A beacon is used to send out a signal. It does not steal mobile data. Beacons are not necessarily Internet connected. Beacons are mostly used in big buildings retail to museums, airlines and airports, and even sometimes indoor navigation. A smartphone can get data from the beacon without a physical connection. This means that a smartphone can connect to multiple beacons at the same time, getting all the nearby data quickly and easily. This connection-less data transfer is the biggest positives of the beacons.

Points to Remember:

- The beacons are placed regularly and evenly in the environment.
- Depending upon the environment we place a number of beacons.
- Place them in the corner of the wall around 2m height.
- Pay attention you have set the preferred settings of beacons before using. Please check the interval and transmission power.
- Manage the environment according to the dimension of beacons range.

6. TRACKING WITH BLE BEACONS

System components include iBeacons, cloud-based server and BLE nodes for communication.BLE nodes collect the clients' advertisements and upload that data to the server. Beacons spread around advertising their identifiers and The server estimates the client's locations relative to the BLE nodes known locations.

7. LONG BATTERY LIFE

BLE beacons provide extended battery life. This is because of their very low energy demand for simply advertising their presence, and the ability to configure the frequency of their advertisement, which is the major culprit in draining the battery. There are several BLE beacons providers. All of them highlight battery life.

8. APPLICATION AREAS OF BEACON INDOOR NAVIGATION

Bluetooth beacons are mostly applied in stationary trading. They connect the online and offline world and are supposed to increase sales at the point of sale (POS). The technical possibilities offer a lot of opportunities to provide the customer, visitor, patient, employee or traveller relevant information at the right time and at the right place.It is also possible to analyze visitor flows. Based on that information, products in shops can be arranged perfectly or walking routes can be optimized.Indoor navigation and indoor positioning in complex buildings, for example, fairgrounds We can use it for Asset and staff tracking in offices and industrial sites.

9. COMPONENT REQUIRED TO PROVIDE BLE INDOOR POSITIONING

Ble Beacons

BLE Beacons are small devices which can be easily mounted on walls.BLE beacons use a battery power supply and Good beacons can run for years on a single battery charge.

Application

An app for Smartphone is required to provide visitors navigation and location-triggered content.

10. CONTENT MANAGEMENT SYSTEM (CMS)

CMS is where you prepare floor plan, place beacons, trigger points and control the content. CMS is usually hosted online and maintained by chosen indoor positioning system provider.

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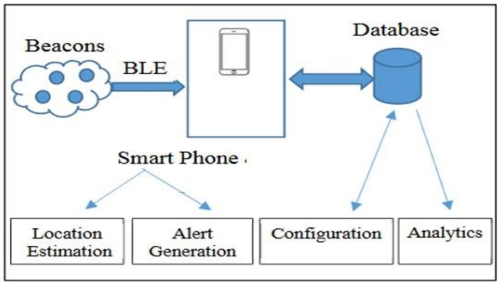
11. HOW IT WORK



The system contains beacons that are small and cheap devices emitting signals according to the BLE (Bluetooth low energy). Beacons repeatedly send their Universally Unique Identifier (UUID), which will be received by BLE receivers including all sorts of smart devices. Those signals can be used to identify subgroups and individual ones in subgroups. In this work, iBeacon type beacons are used as they can easily be identified by both Android and iOS devices. The receivers used in systems are an Android smartphone equipped with a BLE receiver. It is programmed to scan the available BLE signals "on the air" and the received signals contain the following pieces of information in a package size of 60 bits, 10 bits specify major and minor values, following 24 bits for the iBeacon UUID2 bits for TX power, 8 bits for the factory ID12 bits specify MAC address and the last 4 bits specify RSSI value. The RSSI values can be used to determine the distance of the receiver to each of the beacons. As those location data are stored in the database, navigation of the receiver can also be tracked and alerts can be generated if certain rules are violated. Action and location information accuracy is only required within meters.

12. COMPARISON

BLUETOOTH LOW ENERGY(BEACON)

- Every battery-operated Bluetooth emits signals that use the app to calculate a position that is accurate up to 3 meters
- Works with all operating systems
- Bluetooth low energy beacons send a signal;
- device detects signal and acts based on data service rules
- 5.best for-Indoor tracking; passive notification of contextual information; peer-to-peer messaging
- High Accuracy Compared To Wifi (Up To 1m)

WIFI

- The signal strengths of available Wi-Fi networks are analyzed and provide positioning that is accurate to 5-15 meters
- Apple devices are excluded in this case.
- Wireless access points detect devices
- Triangulate distance based on a received signal strength
- Best for-Existing infrastructure and/ or a strong need for WiFi connection and location information accuracy is only required within meters
- Relatively Inaccurate (5-15m) Compared To BLE

13. CONCLUSION

From the data, it is evident that a better accuracy would be achieved if we increased the beacon advertising frequency.it is cost-effective, unremarkable hardware and it consumes low energy. Flexible integration into the existing infrastructure (battery-powered or power supply via lamps and the domestic electrical system).

14. FUTURE SCOPE

The future of indoor positioning is very bright with new applications utilizing the technology. BLE beacons are inexpensive, easy to install and easy to maintain thus making this technology available to almost every organization. Indoor positioning technologies are helping a variety of organizations to improve their customer's experience. There is big potential for this technology within museums, shopping centers, airports, theme parks, conferences and event's organizers, basically everywhere, where indoor navigation and location-based content is important. At Locatify we can try for CMS(Content management system) and test your results in a testing app (both free of charge). All you need are BLE beacons and Smartphone running Android or iOS. CMS is currently set up for Museum installations, conferences, and events and retail shopping centers.

15. REFERENCES

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