

# Beacon Technology for Library Guidance

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## Abstract

A scenario of a person entering a massive library for the first time. If the person does not know where to search for a book of their interest, they will eventually find themselves stuck at every corner searching for the book of their choice, to add to this, the multitude of books cause an even greater confusion in pinpointing whether the books are even there in the library. The librarian may be able to provide the person with directions but it is still not easy. Unfortunately, most modern libraries have neither the technology to automatically guide the user through the library nor the technology to provide the user with necessary information. This paper is aimed at resolving the aforementioned problem. The concept of Internet of Things brings forward the incorporation of Beacon Technology, which uses Bluetooth Low Energy (BLE), where beacons are used to communicate with user's device to provide a detailed description of the books in the library including the distance from the section where the book is located along with all the books present in a section of the library. This is achieved by the BLE proximity sensing capability of the beacons along with a database linked to the mobile application.

**Keyword-** Internet of Things, Beacon Technology, Bluetooth Low Energy

## I. INTRODUCTION

The Internet of Things (IoT) is a system of computing devices, mechanical and digital machines, objects, animals or people that are interrelated and has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Figure 1 is taken from [iotworm.com](http://iotworm.com) and it represents the architecture of the IoT.

In addition to reduced or no human interference, the direct interaction of the physical world and computer-based systems is achieved by the sensing and controlling of internet enabled objects, remotely, which in turn results in an improved efficiency, accuracy and economic benefit. The augmenting of sensors and actuators enhances the technology in becoming an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, intelligent transportation, smart-homes and smart cities. All devices and objects that are IoT enabled are uniquely identifiable through their embedded computing system and can easily interact within the existing Internet infrastructure. If understood and secured, IoT will enhance communications, lifestyle, and delivery of services. However, if misunderstood and misconfigured, IoT poses risk to our data, privacy, and safety.



Fig. 1: Architecture of the IoT

Figure 2 is taken from [github.com](https://github.com) and it represents a Bluetooth beacon. A beacon's sole purpose is to transmit signal using low energy Bluetooth connections. It is completely unaware of any mobile devices that are around it. It does not connect to them

or steal their data. It just constantly sends out the signals. They do not have any data on them and usually don't connect to the internet.



Fig. 2: Bluetooth beacon

Bluetooth beacons are hardware transmitters - a class of Bluetooth Low Energy (BLE) devices that broadcast their identifier to nearby portable electronic device. Bluetooth Low Energy is a wireless personal area network technology used for transmitting data over short distances. Bluetooth beacons uses BLE proximity sensing to transmit a universally unique identifier picked up by a compatible app or operating system. The identifier and several bytes sent with it can be used to determine the device's physical location. A location-based action on the device can be triggered using the device's location. Beacons are commonly platform-independent.

This paper aims at incorporating of BLE proximity sensing to aid users in easily obtaining complete information of books in a library. The beacons are stationary, and are placed in the various sections of the library. These beacons are used to provide their location for the users. A mobile application that is linked to these beacons linked to a database provides the user with complete information on the various book of each and every section of the library. Both these features enhance the user interaction in a library and helps in providing the user with the distance to all sections throughout the library that are within the range of the user.

This paper is structured as follows. Section II depicts the allied works in library management system. Section III lists the shortcomings of the existing system. Section IV outlines the proposed work. Section IV describes the experimental results followed by the conclusion in Section V.

## II. RELATED WORKS

Yujun Li et al [1] suggest an improvement to traditional library management system that is designed and implemented based on web service. In this system, a three-layer architecture is employed, applying model building language that UML carries on needs analysis and design, using the JSP technique to build the system front interface, and using SQL Server 2005 technology to build the back-end database.

Sree Lakshmi et al [2] proposed a method similar to that of a bar code reader. This method integrates the use of Radio Frequency IDentification (RFID), for Auto Identification and Data collection technology. The use of RFID readers and passive RFID tags, aid in issuing, monitoring, and returning of books without much manual labour, and also help against theft. But it falls short when implemented on a large scale wherein the amount of resources required largely steepens. For an efficient system, the need of good quality RFID tags and RFID readers is required both of which in turn makes it very expensive to create the system. To add to this, the construction of a RFID circuit is a very tedious task.

Manjiri Andhale et al [3] extend the use of RFID readers and using RFID cards. Whenever a student has to borrow any book from the library, the student needs to insert RFID card into the RFID card reader placed in the library. The Field-Programmable Gate Arrays (FPGA) checks whether the student has got membership or not by communicating with RFID card reader, based on which the student can borrow a book and in this way, student can update the information regularly while borrowing and returning of books automatically. Along with this process GSM technology is also used in order to send messages to the respective student regarding the due date of the book issued by the student and the fine applicable if the book is not returned on time.

Keshinro K. K et al [4] suggests another extension of the RFID technology. This is achieved by incorporating microchip technology. The information contained on the microchips in the tags affixed to library materials is read using radio frequency technology. This system aids in the tracking of the books whether they are issued or they are in the library, so that the library user will get instant information.

G. Tiwari et al [5] proposed a system that primarily aims in creating a user-friendly interface. The project is designed in creating a completely automated books catalogue system in library with the help of touch screen sensor and a graphical LCD to control and provide a user-friendly environment, where the user can register, login and select any book. The library catalogue would be displayed automatically on the GLCD display and allows the user to directly select the book via the help of the touch screen.

### III. ISSUES IN EXISTING SYSTEM

- 1) Most of the presently existing systems are based on RFID technology. The use of RFID tags and RFID reader need for more resources.
- 2) To add to this the need of creating and maintaining the RFID circuit is tedious.
- 3) Even if user interface is taken as the primary aspect of the system, it compromises in aiding the user through a large library.
- 4) In addition to creating a sense of ease for users, it is necessary that all systems created are required to be cost efficient, both in terms of manual labour and expense; which is compensated for in most of the systems.

### IV. PROPOSED SYSTEM

This system introduces the use of beacons. Firstly, for all sections of the library, a database would have to be created, that consisted of the respective section, and all the books present in that section. This database would be present on a computer accessible by the librarian. The librarian would have a unique log-in, which would allow them to access the database to add, delete or modify existing data. Next, to each of these sections a beacon would have to be attached, whose details would be incorporate in the database. Each beacon constantly emits its own signals holding the device's unique identifier, which is designated exclusively to its respective section. Then, the mobile application developed is installed in the user's smart phone which would be able to sense these beacons, and display the registered section name in order of range from closest to farthest. The user is to log-in to the system with their unique username-password combination, where all information would be available for authorized users. In the system, the mobile and the computer holding the database are connected to each other via a wireless network. As and when a person walks near a beacon with the application residing on the person's phone, the mobile would sense the beacon; based on sensed beacon's ID the app identifies the section to which the beacon is attached. Finally, based on the section information, the person can identify their proximity from the respective section as well as retrieve relevant information regarding the books available in the section. Once the user takes or returns a book the information is updated on the database. Figure 3 represents the architecture diagram of the system. Here the database communicates with the mobile application and the web application. The mobile app, web app and the computer on which the database reside are connected to a wireless local area network.

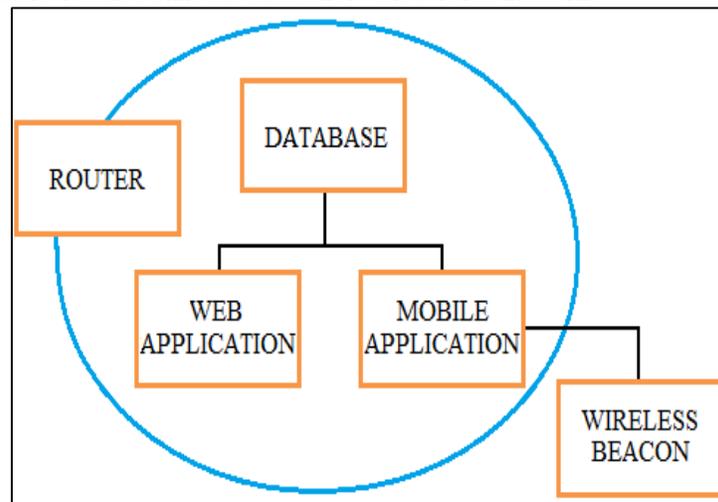


Fig. 3: Architecture diagram of the system

#### – Login Screen

On opening the mobile application, the user is presented with the login screen where they are required to login to the system. New users can register into the system by providing adequate information.

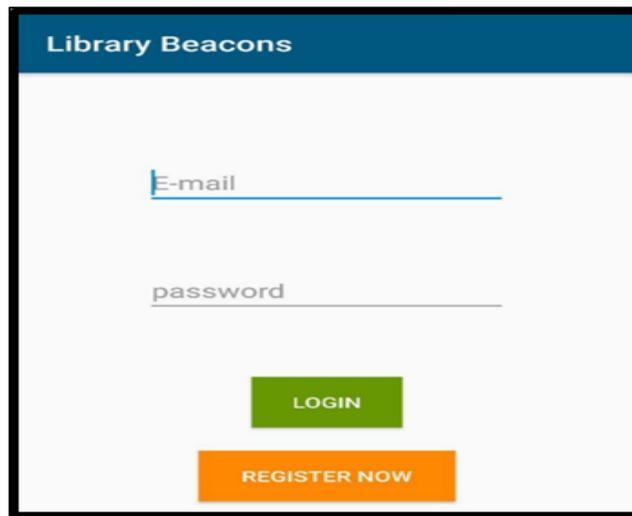


Fig. 4: Login Screen

– Request to Enable Location

A pop up requests the user to activate their location to pinpoint their distance from the beacons. All the android, version 6.0.1, phones or above must enable the location in order to detect the beacons.

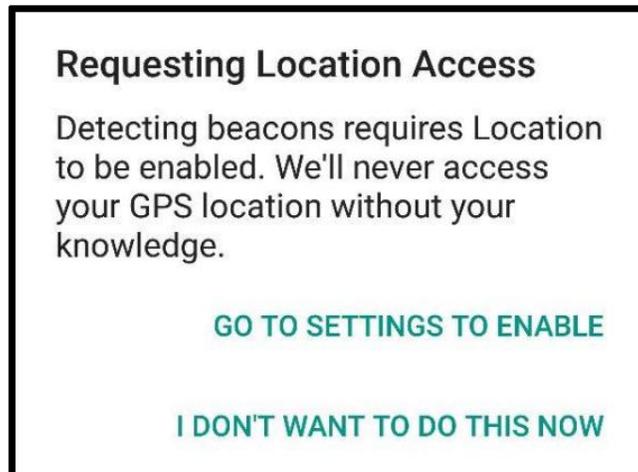


Fig. 5: Request to Enable Location

– Request to Enable Bluetooth

Another request is made to the user to activate their Bluetooth. The Bluetooth is required to enable the mobile device to detect the Bluetooth Low Energy beacons.

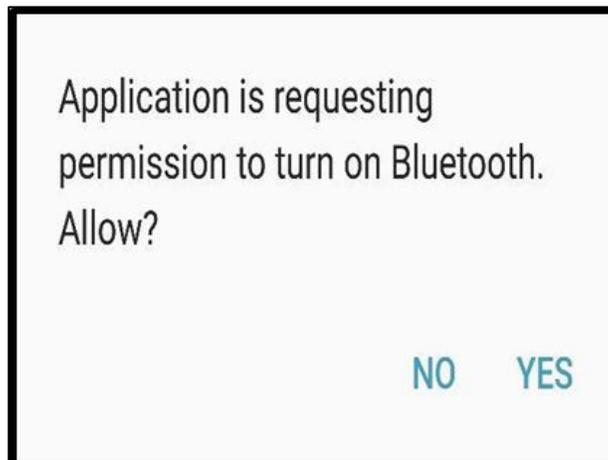


Fig. 6: Request to Enable Bluetooth

– Detecting Beacons

Once both the Bluetooth and the location facilities have been enabled, the mobile screen would display all the beacons in its range. Each beacon is mapped to a department name. This mapping is made by using the mac id of the beacons. Each beacon has a mac id that is universally unique. Here one beacon is mapped to the computer science and another beacon is mapped to a information technology. The ordering of the sections is done based on its proximity to the user to understand how much closer they are to a section of the library.

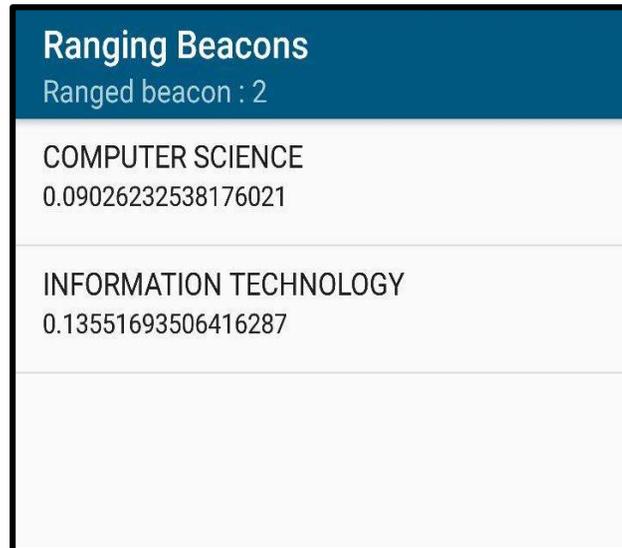


Fig. 7: Detecting Beacons

– Displaying Books

The user is given the privilege of selecting the section of their choice and viewing all books that are available in that particular section.

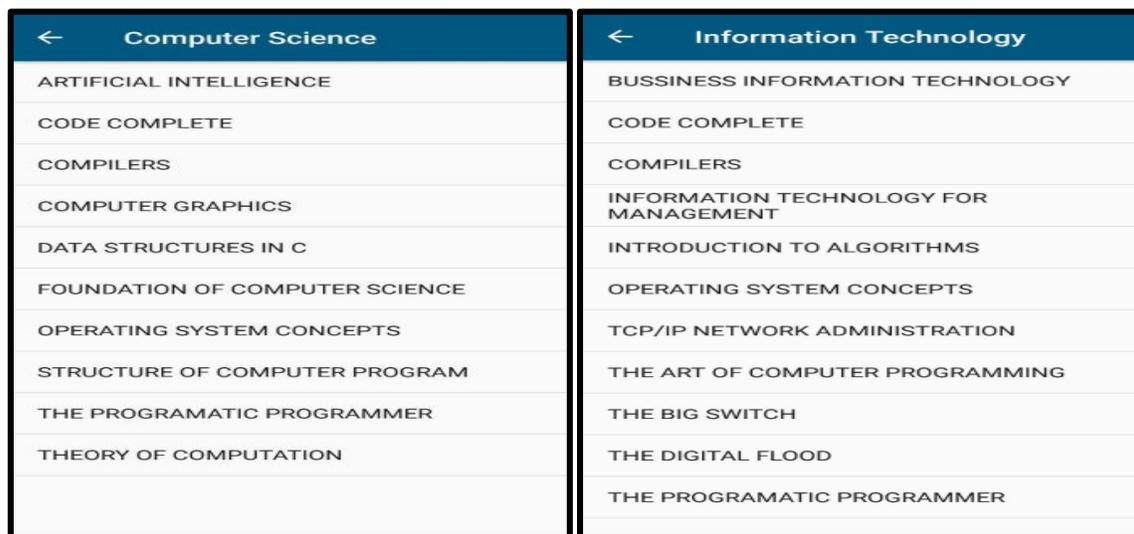


Fig. 8: Displaying Books

## V. CONCLUSION

In this paper, an efficient library management system is proposed via the use of beacon technology. The issues of cutting cost and enhancing user interaction in the library are overcome by incorporating beacons. The utilization of Bluetooth Low Energy Beacons allows in creating a sense of ease in navigating through the library and viewing all the information with much simplicity. Incorporation of long-range beacons along with the use of better suited Database Management software allows for an enhanced system in a large library; this system poses to be more advantageous in such a situation by cutting cost. The system can be extended to accommodate more information on the books to provide users with a better insight of all the books.

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