DE-40 (DC&SE)

NUST COLLEGE OF

ELECTRICAL AND MECHANICAL ENGINEERING

Smart Superstore Guide

A PROJECT REPORT

DE-40 (DC&SE)

Submitted by

ASC AMNA BATOOL

NS IQRA NADEEM

NS USMAN HABIB

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BACHELORS

IN

COMPUTER ENGINEERING

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PROJECT SUPERVISOR

DR. AHSAN SHAHZAD

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DECLARATION

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ACKNOWLEDGEMENTS

Firstly, all thanks to ALLAH Almighty, that our Final Year Project is finally complete and all Thanks to Allah for giving us the strength and courage to keep moving forward and helping us on each and every step on the way.

Secondly, we would like to thank our supervisors, Dr. Ahsan Shahzad and Dr. Urooj Fatima, who helped us a lot, on each and every single issue. Due to their guidance and support at all stages, we were able to complete this project.

And lastly, we would like to thank our parents, without their support and prayers, we might not have been able to complete our FYP. They played great role throughout our journey and we are very thankful to them.

ABSTRACT

The efficacy of Google Ads and other digital media ads is very low. So here the need arises for some technology that would be cost-effective and provide best results for real time or on spot advertisements. There should be some technology for large supermarkets to market the products in best possible way with less resources. Our project focuses on using BLE Beacon technology for providing an effective solution for smart marketing and convenient shopping. This system is deployable to many places but our interest is to go for large grocery stores.

The idea aims to provide real time advertisements on Android App along with the query based product search feature which will help customers to find the location of the desired product on map. The system will also have a Web App for retailers to manage the product advertisements and other specs of products from back end. This technology is being used in some countries for such purposes but there is no such system over here in Pakistan. Using this cost effective solution we hope to provide best solution for sharing real time advertisements with customers directly on their smart phones. The customer can get authentic information directly on their devices by just having our application installed and Bluetooth turned on. We will deploy this system at our case study CSD Supermall, Lalkurti, Rawalpindi.

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Chapter 1: Introduction

1.1 Introduction

Internet of Things (IoT) is network of physical objects that are embedded with sensors and other technologies in order to connect and exchange data with other devices and systems. Some real life applications include smart appliances, wearable devices and smart cars etc[1].

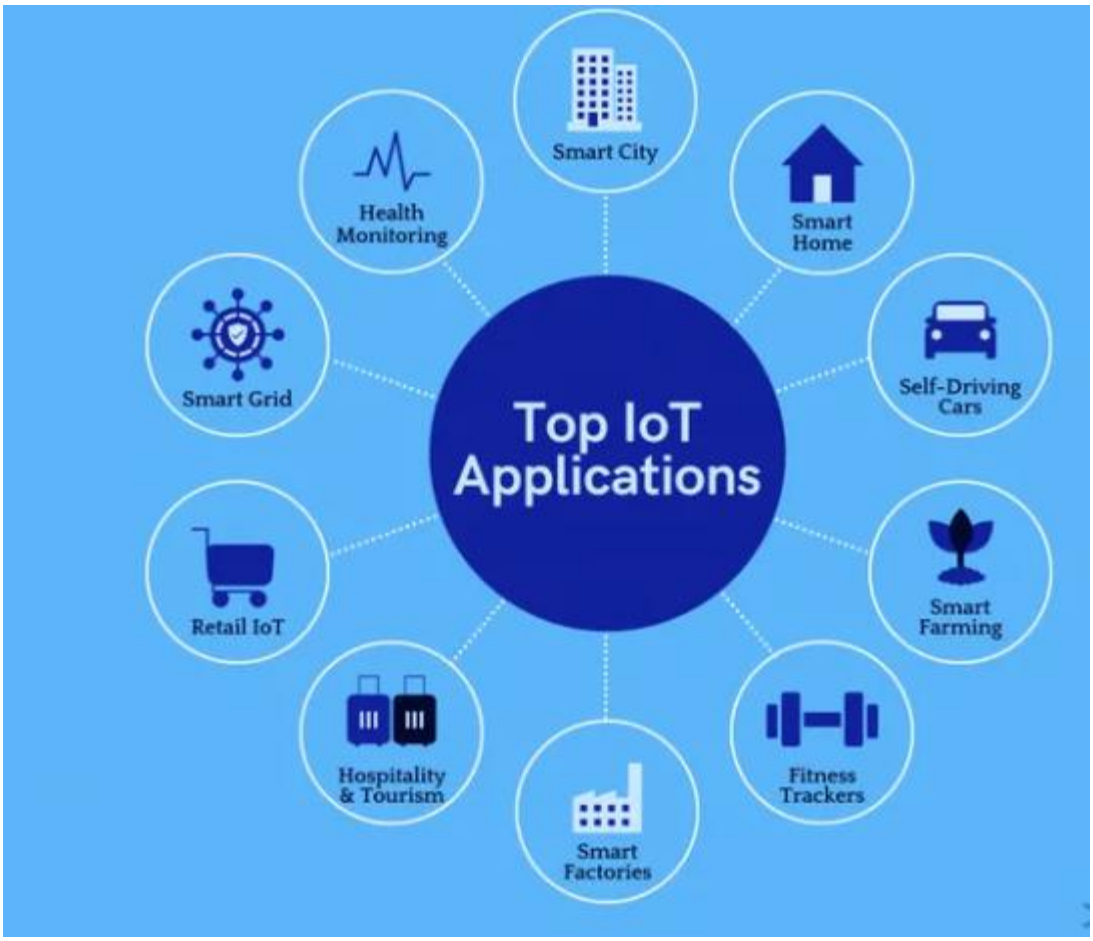

Figure 1: IoT Applications

As Internet of Things (IoT) is transforming current society towards a smarter one, many challenges and opportunities have arisen to accommodate the demands and resources used for IoT development. Low Energy wireless devices are, without any doubt, the most feasible solution for variety of applications in the field of IoT. Among such devices BLE beacons have emerged as one of the most feasible solution due to the easy availability of Bluetooth-compatible smart devices including Android phones, iPhones, Tablets and Smart Watches.

BLE Beacons find one of its applications in proximity-based information system which is not only restricted to information but can also be taken to the level where we can also get indoor navigation and positioning.

IoT in retail sector can be a massive success by improving customer experience, accurate real time product-tracking, improved staff strategy and overall efficient inventory management. Similarly, our project focuses on using BLE Beacon technology for retail sector to market the products in large supermarkets efficiently and guide customers to their desired products. In this way, retailers can share reliable information with customers directly through advertisements on their smart devices and improve their shopping experience while driving the product sales for manufacturers. This idea can be deployed everywhere where user requires some system for guidance and help of someone while being confused or not sure about information related to something.

1.2 Motivation

Google Ads were introduced in 2003. The efficacy of Google Ads and other digital media Ads including facebook and Instagram Ads is very low[2]. These Ads require internet access as well for marketing and promotion of products and also get ignored easily by audience as you may forget about details being shared about product as being at some other place at the time of display of Ads user might not order that thing immediately. The other problems of these marketing ways may include malicious Ad making, expensive keywords due to high competition and bot clicks. The best solution is one where you get notified about right product at right time and in a right way using less resources.

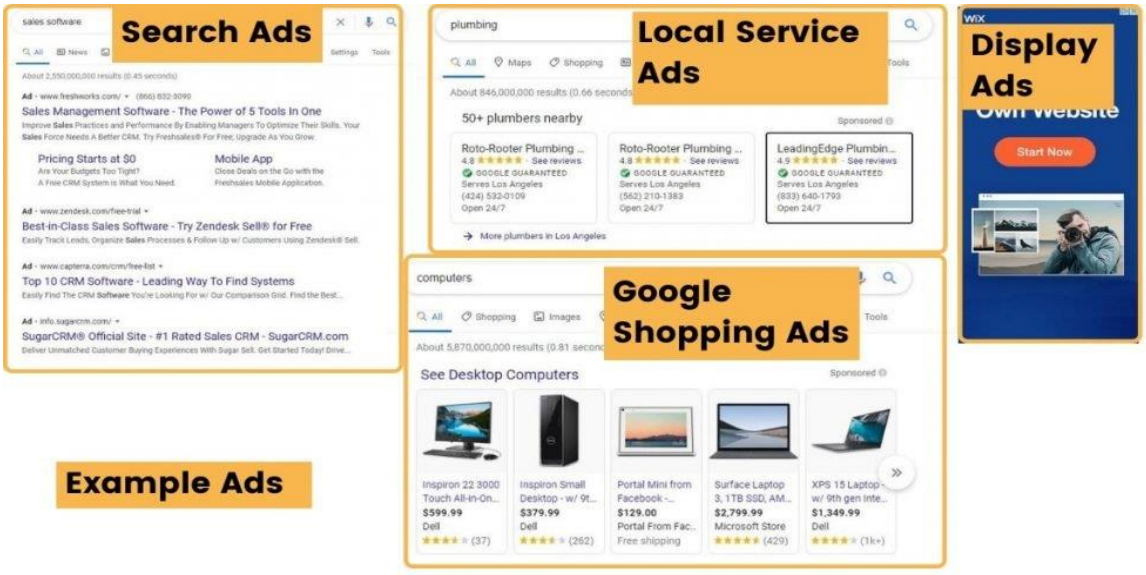

Figure 2: Google Ads

The other very important need for this project was to help customers in providing the best solution for convenient shopping and smart marketing of products. The customer might feel lost while in some big grocery store and when thinking of whom he/she should consult for help in case of busy hours of store, there is a need of such solution at such moments. Some people also don't want to consult staff of the stores for inquiry of information, which may be due to their shyness or their poor past experiences like staff may forget about exact details and will also definitely market their own product rather than what customer wants.

One of the motivation for us to move with this idea was to provide our society with some innovative solution to their everyday life problem of doing grocery in effective way. The solution will not only help customers but will be excellent way of marketing as well. The manufacturers of products will love the idea of marketing directly to customers without third person that is sales man being involved in process. As they can share authentic and reliable specifications of products to their target audience directly.

The retailers can also get efficient management system for the products and they don't need to hire as much staff as they used to before this system. We aim to provide cheap yet efficient marketing solution to provide real time or on spot advertisements to customers.

1.3 Scope

The scope of this project is very vast. It covers IoT field, retailing sector and all people who will be using this system for everyday shopping purposes. The BLE Beacon based proximity information system along with feature of guidance to respective products being searched can be deployed everywhere especially in large grocery stores, some huge shopping malls, cricket and football grounds and other such places where guidance is required by staff.

The project is basically having 2 main parts technically. One is web application for retailers to manage the notification of products from backend. The other is Android application for customers for getting real time on spot advertisements and path to desired products being searched.

The other very important part of our project is our selected Case Study place i.e CSD Lalkurti , Rawalpindi. We have deployed our system over there and have tested it's feasibility and have analyzed what is their need as per customers feedback.

The scope of the project can be defined in terms of the following objectives:

- Development and testing of Web App
- Development and testing of Android App
- Map Digitization and Integration with Android App
- Deployment at Case Study

1.4 Structure

Following is the structure of the report ahead:

- Chapter 2 covers explanation of technology used for developing solution.
- Chapter 3 deals with the innovative side of the project, exploring related solutions and products and establishing how the project is different from existing products.
- Chapter 4 deals with design and development of Web app, Android app and Map Digitization.
- Chapter 5 covers Case Study analysis for deploying system and it's effectiveness through customer's feedback.
- Chapter 6 consists of concluding the report and exploring future possibilities and directions in which the project can be taken.

Chapter 2: BLE Beacons

2.1 BLE Beacon Introduction

The beacon technology was first introduced by Apple in 2013, these are small bluetooth devices that can send alert to smart devices based on location proximity.

The Bluetooth Low Energy Beacons is basically an Information broadcasting system like Google, Facebook ads but instead it uses Bluetooth low Energy Beacons for broadcasting Information to nearby devices mainly aimed to provide not just proximity-based information in vast area of practical implementation like in Airports, Hospitals, Malls etc. but also indoor navigation and positioning. But this is not the end of its application users can experience this technology in other fields health care, asset tracking and proximity marketing, consumer electronics, industrial automation, wearable electronics.

According to report written by World's Largest Customer and Supplier Intelligence Company IndustryARC it is stated that "**Bluetooth low energy market was valued $4,774.6 million in the year 2017 and anticipated to grow at a CAGR of 19.7% during 2018-2024**".

Bluetooth Low Energy is a kind of wireless communication which covers short-range communication issues. BLE is like Wi-Fi in the nature that it allows communication between devices. However, it is for situations where battery life is a priority over high data transfer speeds. In short BLE provides effective communication at a much cheaper cost.

Figure 3: BLE Beacons

2.2 BLE Beacons Types

There are 3 main types of BLE Beacons [3]:

1. URI Beacon/ Eddystone
2. Alt Beacon
3. iBeacon

Figure 4: Types of Beacons

URI Beacons:

They are also known as Eddystone Beacons. They are like iBeacons with URL, which makes them very similar to QR codes. URI Beacons are different from iBeacons and AltBeacons as they have a configuration service i.e there is a need to update them with new information over time. For them, there is no need of other additional databases as whole internet is a database for them. There will also be no need of special smartphone for each application, just have URI Beacon pointing to a website that controls it. The URI Beacon spec uses 28B of 31B available in advertising packet. Examples include Coupon code , Interactivity and Games.

Alt Beacons:

They are open-spec, free beacon design is provided by Radius Network. They provide same functionality as iBeacons but they aren't company specific. Using Alt Beacons more data per message can be delivered as compared to iBeacons. The Alt Beacon spec is 28B and 26B are user modifiable. Examples can be same as iBeacons with some modifications like they can have different manufacturer ids.

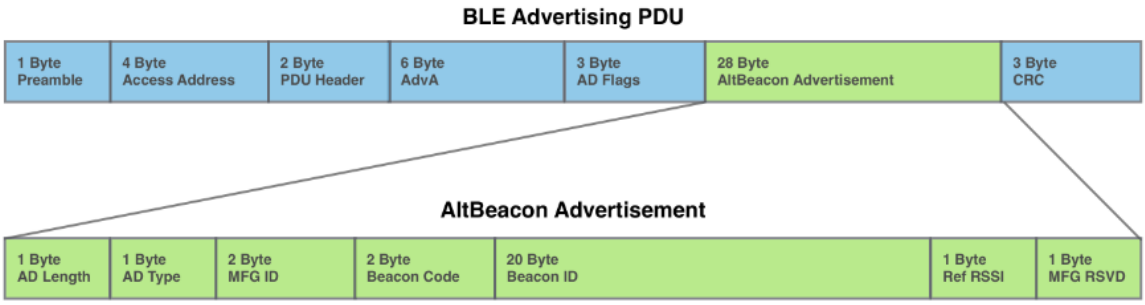

Figure 5:Alt Beacons specs

iBeacon:

Apple's iBeacon were first BLE Beacon technology devices, then other Beacons took inspiration from data format of iBeacon. The iBeacons is closed standard. iBeacon are enabled in several of Apple SDKs and can be read and broadcast from any of BLE enabled iDevice. Examples include iBeacons on coffee shop at coffee racks and some iDevices to automate check-ins at events. They are widely supported as they are Apple product but the only limitation is database requirement to give meaning to iBeacon data. UUIDs are meaningless, if there is no database.

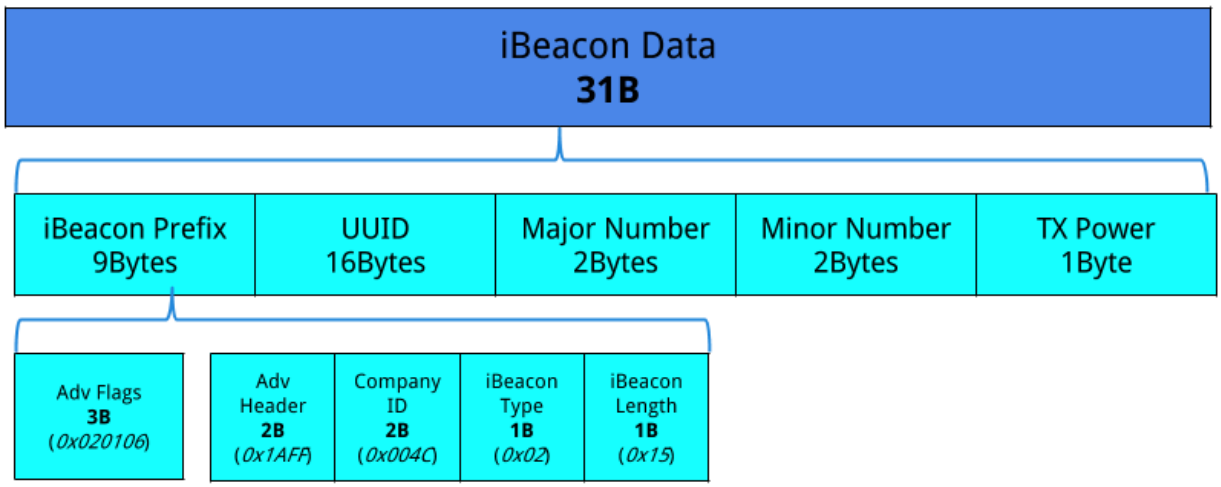

Figure 6: iBeacons specs

2.3 Some commonly used BLE Beacons with their Specifications

There is large variety of Beacons, so customer might get confused while purchasing them, if he/she doesn't know about all the specs and his/her requirements. So following are some Beacons based on user needs[4].

An expensive Beacon : TON9108 or PC037
Waterproof, larger battery, longer range beacon: iB003N or i7 or i3
Longest range: iB003N-PA or if USB powered then BPC-FSC-BP109
Maximum battery life: SmartBeacon-AA
Maximum battery life and waterproof: SmartBeacon-AA Pro

AKMW-iB003N

Figure 7: AKMW-iB003N

Transmission	Eddystone, iBeacon
Battery size	CR2477
No of batteries	1
Battery life	58 months
Weight	30g
Android SDK	YES

iOS SDK	YES
Transmission distance	100m

Table 1:Specifications of AKMW-iB003N

PC037:

Figure 8: PC037

Transmission	Eddystone, iBeacon
Battery size	CR2032
No of batteries	1
Battery life	300 days
Weight	10g
Android SDK	NO
iOS SDK	NO
Transmission distance	30m

Table 2: Specifications of PC037

E7:

Figure 9: E7

Transmission	Eddystone, iBeacon
Battery size	CR2477
No of batteries	1
Battery life	3 years
Weight	26g
Android SDK	YES
iOS SDK	YES
Transmission distance	100m

Table 3: Specifications of E7

2.4 BLE Beacons Pricing

Different kinds of BLE Beacons can be purchased at different rates from different online sites and different countries[5].

Company	origin	Price/unit	Type/Support
Instock PK	Pakistan	2650	Supported iOS 7.0+, android 4.3+, apple iBeacon™ standard, Bluetooth 4.0 (BLE)
Ali Express	International	$6 +$5 (shipping charges)	Eddy stone iBeacon
Ali baba	international	US$3.50 - US$6.50	Eddy stone
Ali baba	international	US$8.00	Eddy stone
Alibaba	International	$10.5 +$8(shipping)	Bluetooth 5.0 Low Energy iBeacon & Eddystone Beacon (minimum order of 2)
Shopus	Pakistan	RS. 4988	Bluetooth BLE iBeacon
Shopus	Pakistan	Rs. 4556	Mini Bluetooth 5.0 Proximity Low Energy Beacon with Eddystone, iBeacon and Alt Beacon, Android & iOS programmable
Ali express	international	Rs. 3118	UUID switchable Smart BLE iBeacon & amp; Eddystone beacon ABSensorN01

Table 4:Table showing BLE Beacons with pricing details

2.5 BLE Beacons Working

Bluetooth Low Energy (BLE) is a type of wireless communication, the purpose of which is to provide short range communication systems[6]. BLE is similar to Wi-Fi as they both are used for communication purposes. BLE is effective where high battery life is more essential requirement then higher data transfer speed. In short, BLE provides effective communication at a much cheaper cost as compared to Wi-Fi.

For example, if someone wants to do marketing campaigns in the proximity of newly launched devices. The amount of data which needs to be transferred to a visitor's smartphone is very small, hence BLE compatible beacons can do this task without fast battery drainage.

Most of the smart devices including smartphones, tablets and smartwatches etc. today are BLE compatible, thus it means they can easily communicate with Bluetooth enabled wireless headphones, car stereos, fitness trackers, smartwatches, and hardware devices like beacons.

BLE data transfer is basically type of one-way communication. If a BLE beacon wants to communicate with any smartphone in proximity, a BLE beacon device sends data packets at regular time intervals means continuously after some fixed time interval. The data packets are then detected by applications installed on your smart devices.. This BLE communication triggers actions such as, push notifications or promoting of an application.

In order to save energy and provide higher data transfer speed, all Bluetooth BLE communication framework consists of 40 frequency channels, separated by 2MHz frequency. There are 3 primary advertisement channels and 37 secondary or data channels. The Bluetooth communication starts with the 3 primary advertisement channels and then transfers to the secondary channels.

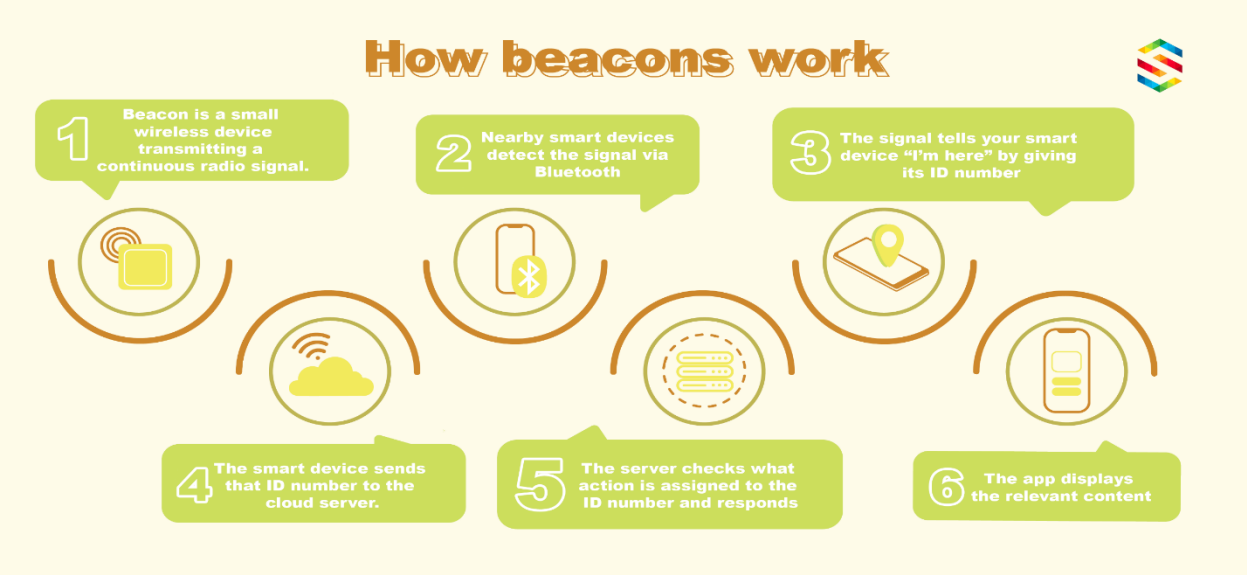

Figure 10: Working of BLE Beacons

2.6 BLE Beacons vs WiFi

There are many other solutions which can be used in place of BLE Beacons like WiFi , RFID, QR etc. But these are all expensive solutions having some limitations in terms of range, feasibility and expenses. So BLE Beacons are best from all these. Following comparison proves why we are using BLE Beacon technology.

#	Beacons	WiFi
Battery	Low consumption	AC (does not work on battery)
Range	up to 70 meters (230 feet)	up to 100 meters (330 feet)
Accuracy	up to a meter	1-5 meters
Cost	Low	High
Best For	Indoor Campaigns, Loyalty, Customer Analytics, Indoor Location	Indoor Campaigns, Loyalty, Basic Customer Analytics

Figure 11: Comparison of Beacons with WiFi

2.7 BLE Use Cases

BLE Beacons can be used for many different purposes in everyday life for better experience. The most important use cases are discussed here:

- **Proximity based information system**

The best use case in almost all sectors including retailing sector majorly is giving proximity based information to customers. For this purpose Beacons provide efficient way of marketing at real time. The customer can get on spot advertisements based on nearby Beacons deployed from proximity based information system.

- **Asset tracking**

Instead of transmitting id's to mobile devices, the BLE beacons listen unique IDs of BLE tags that are attached to our assets. This can be very helpful for asset management.

- **Indoor navigation**

As we all know that GPS is for outdoor navigation. For indoor, its performance is poor but BLE is the solution especially in case of multi-story stores, shopping malls and museums. The beacon based indoor navigation system is of great importance to users as they can get directions to their desired location in indoor places where searching something is difficult like big grocery stores, big shopping malls etc[7].

- **BLE Beacons at events and stadiums**

Proximity-based event applications are found to be 235% more engaging than standard mobile applications at events. The success of such systems at stadiums is a proof that it's best solution for customer engagement in better way at busy and massively populated places or huge indoor places.

2.8 BLE Applications

Some of the best applications where such systems have been deployed and are working at their best are discussed below[8].

- **Eldheimar Museum, Iceland**

Eldheimar museum was equipped with BLE indoor positioning technology in 2014. It is the first museum with this technology to guide visitors. The content based on location is provided to visitors.

- **American Airlines, United States**

American Airlines use BLE beacons to send notifications using location through American Airlines app to their users. The users of application can get information like distance to gate, boarding time and closest security check line.

- **Walmart, United States**

Walmart is a huge shopping place at US. They are using BLE beacons to send push notifications of special offers and discount coupons along with marketing of products to customers in their stores. This is the best application of BLE Beacons for marketing purposes.

Figure 12: Walmart, US

- **Macy's Store**

Macy's is using BLE Beacons based system to push offers to customers regarding sales and discounts etc on their products.

Figure 13: Macy's Store

- **Kew Gardens**

Kew Gardens is a garden which is using Beacons based proximity information system for guiding it's visitors to respective places over there.

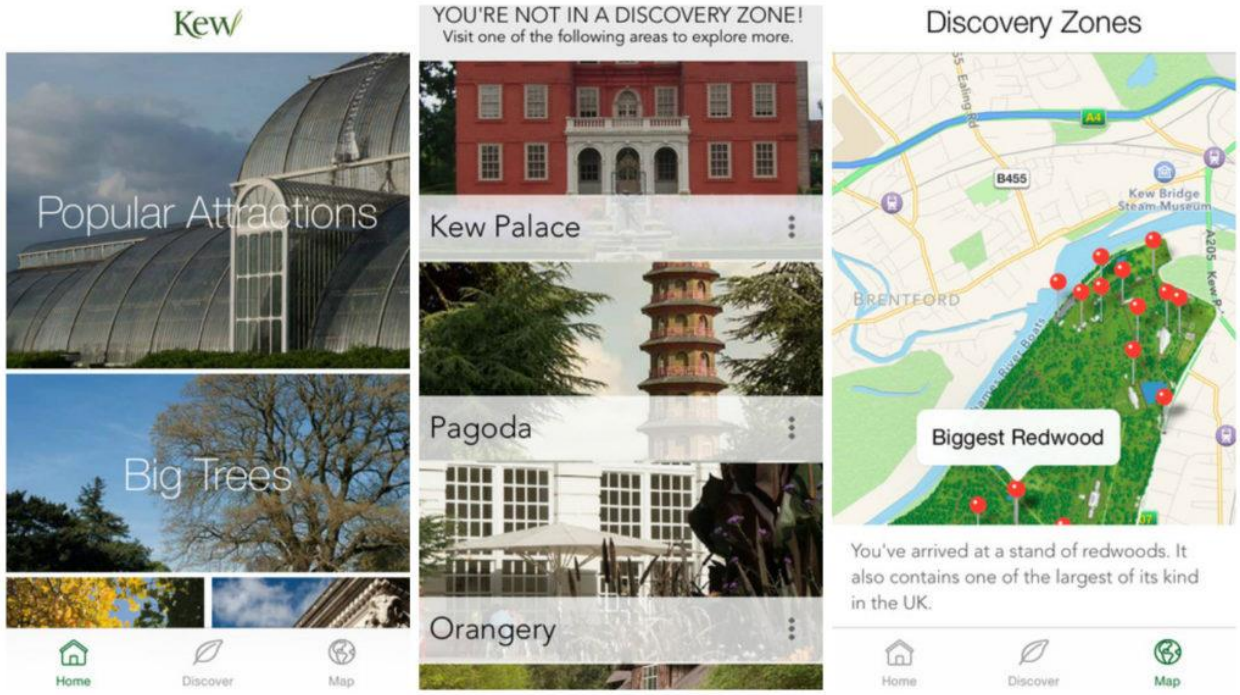

Figure 14: Kew Gardens

- **MLB Stadium**

MLB Stadium is Major League Baseball stadium which uses BLE Beacons based system for improving stadium experience by guiding audience to their seats and about offers and discounts at tickets etc.

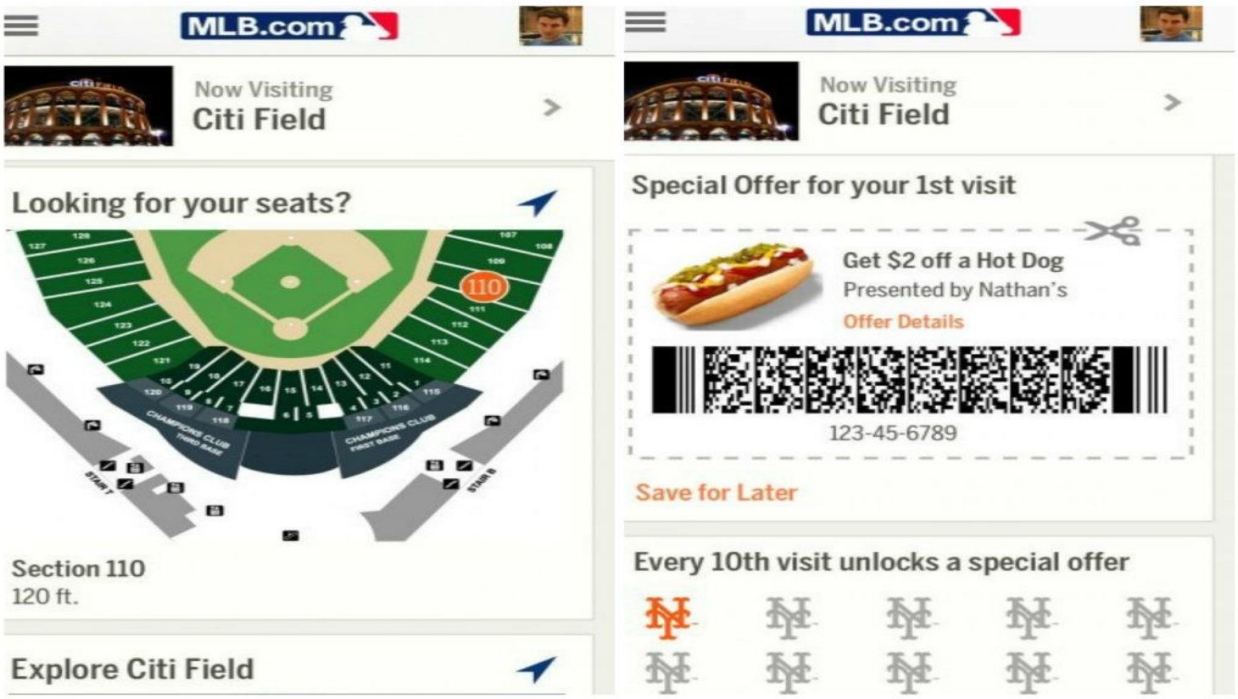

Figure 15: MLB Stadium

2.9 Our BLE Beacons

We are using E7 Beacons imported from China for our project. They are having Minew G1 gateway with them , if they are to be used over ethernet or WiFi. E7 Beacon plus are widely used and small in size, cheap BLE Beacons having excellent battery life.

Figure 16: E7 BLE Beacons

2.10 BeaconSet+ App /Beacon Configuration

The very important thing after having BLE Beacons is their configuration or checking whether they transmit signals continuously as they should. For this purpose, there is an application available called BeaconSet+ which shows BLE devices being scanned continuously with their names and other specs.

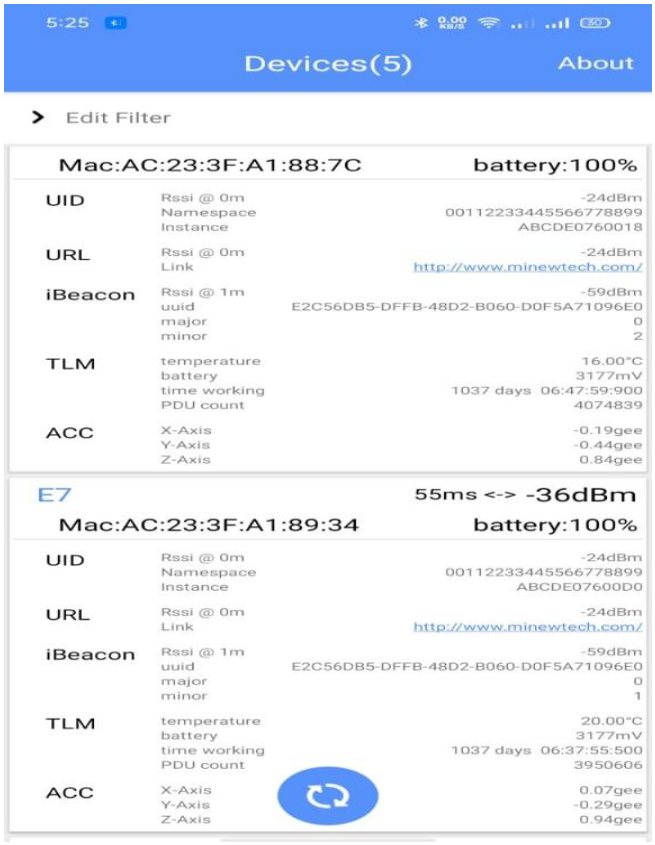

Figure 17: BeaconSet+ App showing Beacons scanned

Chapter 3: Related Products/Literature Review

3.1 Related Products and Solutions

International Level:

Large supermarkets and stores are often overwhelming for users. Beacons are best solution for guiding customers around shopping premises[9]. Customer just needs to have the store app and can view location of products and information about nearby products.

Amazon's Cashier less Go store is a solution to provide ease to customers without standing in queues. The customers can get what they want and bill will be charged once they leave. There is no such system for customer ease at our grocery stores and marts.

Figure 18: Amazon's Cashier Less Go store

National level:

Pakistan Army Museum Lahore has used Beacons based proximity information system for guiding visitors and improving interactivity[10]. The system triggers hyper targeted contextual information to visitors through mobile content delivery network. Instant of using 'human guide' people can instantly watch what happened decades ago on their cell phones. Pakistan based software solution company (Alchemative) for the first time introduced the beacon technology based system for interactive and improved visitor experience. Pakistan Army

Museum has successfully deployed this system in 2017 and it has engaged audience in an effective way for information delivery.

Figure 19:Pakistan Army Museum, Lahore

3.2 How is our idea different?

Our idea is different from only existing solution at Pakistan which is just for guiding visitors about museum as our system will not only market the nearby products continuously using BLE Beacon based proximity information system while sharing reliable specs of different products but will also guide customers to respective or desired product on map integrated with application. Thus, along with the marketing of nearby products at big stores, our application will provide an efficient solution for convenient shopping and smart marketing directly on their smart devices. We can extend this project by adding some additional features like billing etc to make it even more smart solution.

3.3 Literature Review

IoT is continuously evolving field in which there is connection between some devices for developing smart solutions and automation of things. IoT is having vast number of applications in all sectors including health, agriculture, retailing sector and industries as well. IoT not only gives you control of things in surroundings but also informs you about state of things around you.

IoT and continuous development and innovation of IT industry leads to some of the best solutions to everyday problems. There are many solutions for wireless communication like Radio Frequency Identification (RFID), ZigBee and BLE etc. BLE Beacons have emerged as most useful solution for various IoT use cases.

BLE Beacons based systems are in demand as they provide best solutions for indoor navigations and proximity based information system. BLE technology has been successfully used in various IoT innovations, for example in improving shoppers experience, museum guiding, indoor localization and tracking, helping disabled people, energy saving smart offices, managing smart homes and warehouses and so on. There are many solutions using beacon technology deployed internationally and one is also in Pakistan.

One of the issue which may arise due to dense Beacon environment is it's inability to be scanned properly which may be due to overlapping of signals transmitted by BLE devices. Here comes the concept of RSS (Received Signal Strength). It is used to check strength of signals being transmitted. The relationship between RSS and distance is given by following formula:

$$\mathrm{RSS} = -\alpha \log(d) + K$$

Here α is loss exponent, K is offset constant, d is distance measured in meters[11].

All of the solutions are discussed in detail in this document. There should be some smart solution for improving customer experience at our places as well. So we are trying to use cheap devices to provide right solution to right people at right time.

Chapter 4: Design and Development of Web and Android Applications

4.1 System Level Diagram

First step in implementation of this idea was to have some system level diagram, in order to know about work flow of the system. The system level diagram shows how information flows though our proposed system from BLE Beacons to the end user's device.

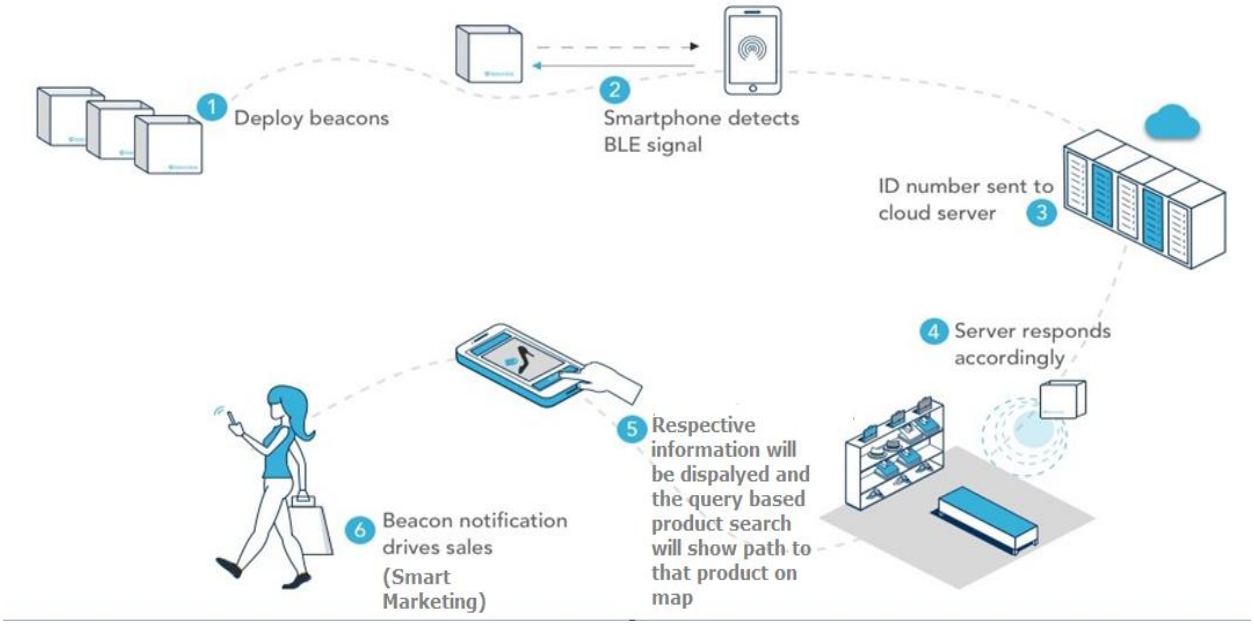

Figure 20: System Level Diagram

4.2 Real time deployed system look alike

Following diagram shows how our real time system will look alike when beacons will be deployed and how will it engage customers.

Figure 21: Deployed system look alike

4.3 Web Application

The very first step of our system development was to create web application for retailers to manage the notifications from back end. Our web application allows retailers to login and then add data corresponding to beacon id's in databases. The retailer can add, update and delete information corresponding to some beacon id as per requirement. The database we used was MySQL.

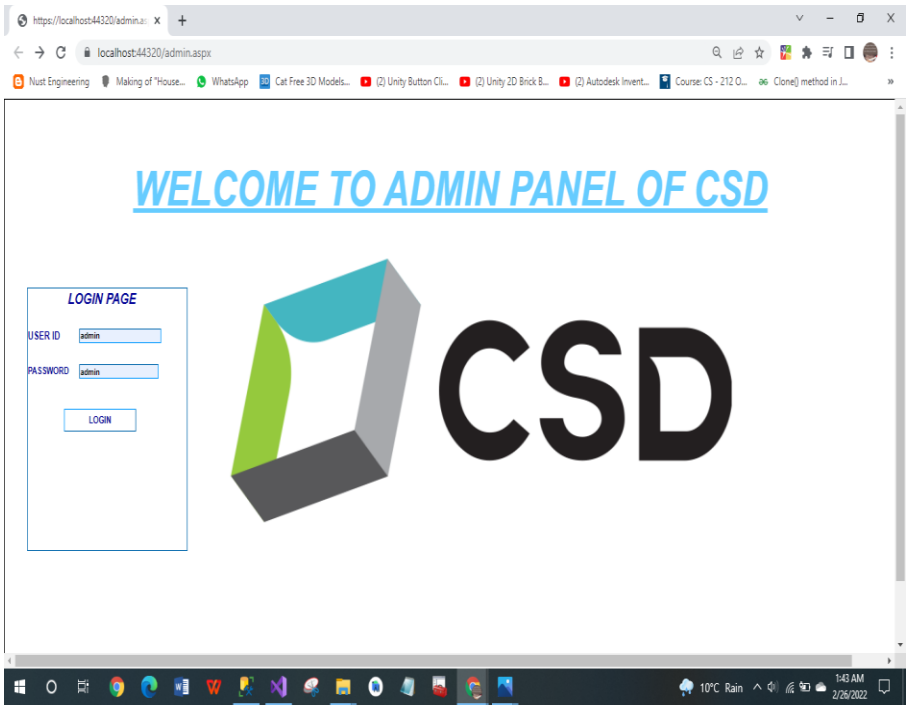

Figure 22: Login page of Web App

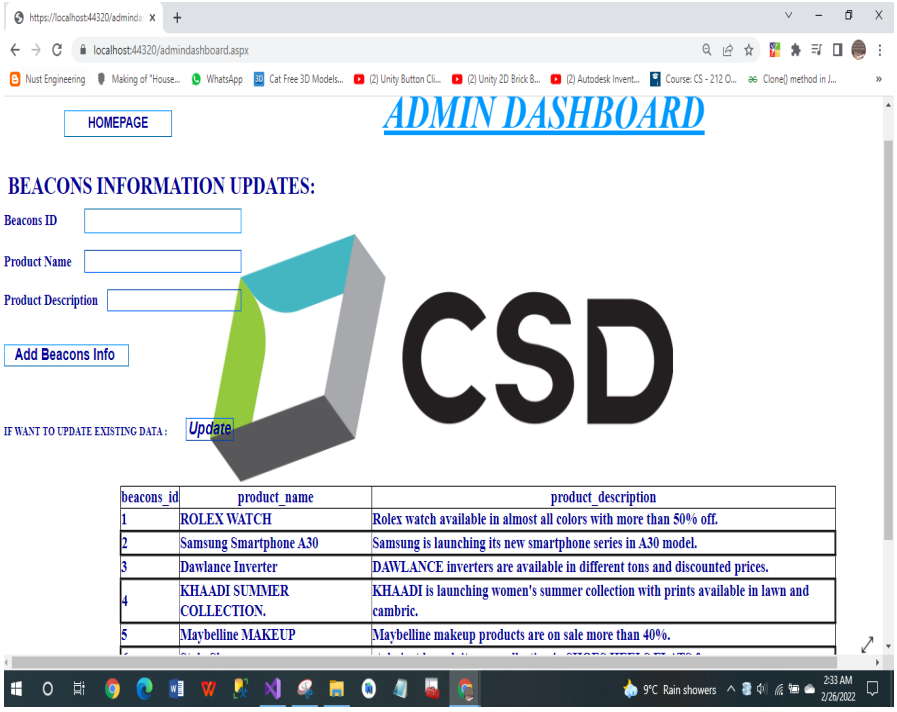

Figure 23: Dashboard of Web app

4.4 Android Application

The android application for our project is the basic end user product which will be used by customers for getting real time on spot advertisements and path to desired product.

Figure 24: Android app for customers

User Interface Designing

The User Interface designing for android application was a difficult task as it should be appealing to customers and user friendly as well. The android application developed by us is having a page with search bar at top to search some product and the nearby products as per beacons proximity are marketed by sending on spot advertisements below search bar.

Setting up Database

The database being used earlier was MySQL but late we switched to Firebase as it was easy to use and is best for advertisement purposes. The important reason for shifting database was the connectivity issue with the MySQL database for android application with Azure Cloud.

4.5 Map Digitization

The other very important feature of our application is map which will show path to desired product to customers on Android application. The map digitization is done by taking real map of our case study CSD Lalkurti and then digitization on software with beacons as points.

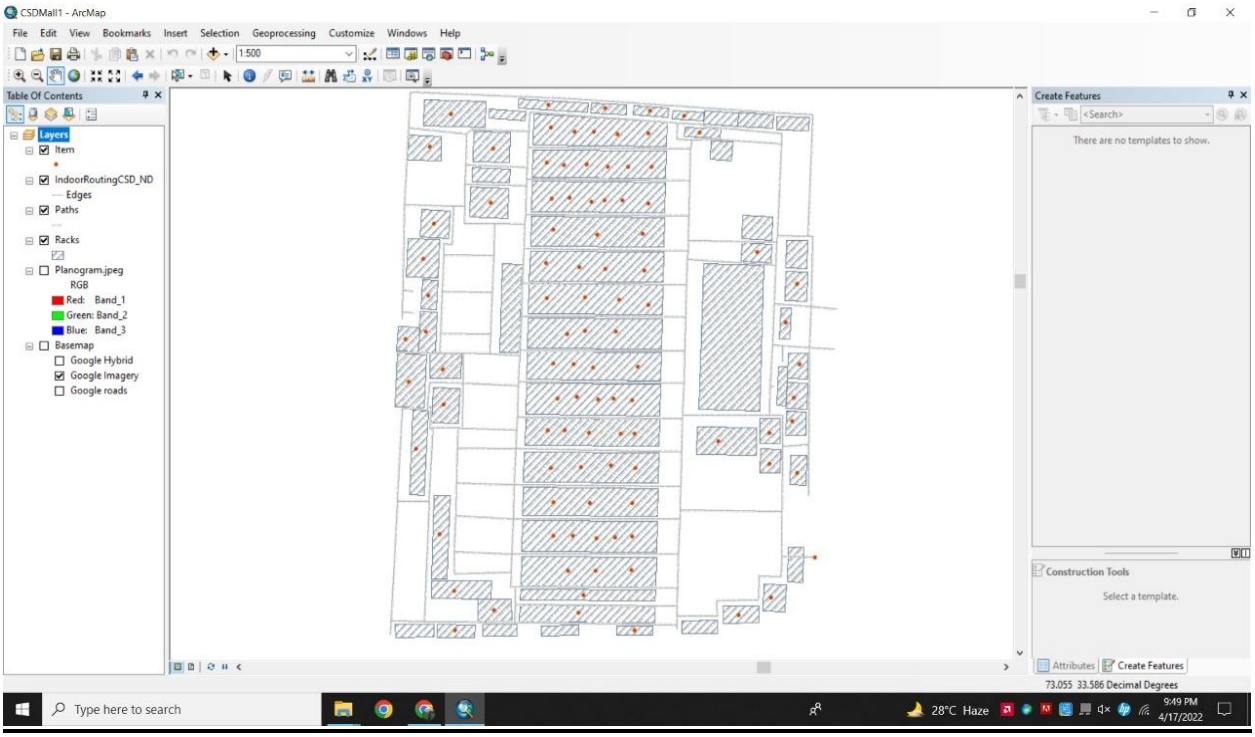

Figure 25: Digitized Map of CSD Supermall

4.6 Case Study (CSD Supermall)

We selected CSD supermall, Lalkurti as case study for deploying our developed system and testing it's effectiveness against customer's feedback. The CSD Lalkurti is one of the massive grocery stores in Rawalpindi, Pakistan which definitely needs some sort of solution for customer engagement in effective way and their better shopping experience.

It is located at Tamiz-ud-din road, Lalkurti , Rawalpindi. The CSD Supermall is having lot of customer engagement and many varieties of almost all kinds of products. The project Smart Superstore guide aims to help CSD visitors by improving their shopping experience through smart marketing using BLE Beacons, a very feasible and reasonable solution.

We deployed beacons on shelves and the corresponding relevant information was saved in database. The testing of our system was done by moving through the CSD and getting on spot notifications on our created application, installed in our smartphones. The system was working as expected.

Figure 26: Case Study (CSD Supermall, Lalkurti)

4.7 Tools and Components Used

Following are the tools and components used for developing this project.

Hardware Components

There is only one hardware component used in this project.

E7 BLE Beacons

We have used E7 BLE Beacons for our project. Their detailed specs have been shared already in this document. E7 Beacon plus beacons with white color and beacon id on them are imported from China.

Figure 27: Hardware for our project (E7 Beacons)

Software Tools Used

The following software tools are used for developing web and android applications and map digitization.

Visual Studio

Microsoft visual studio is used for web development. The C# language is used for coding. ASP.NET is a free web framework for building great websites and web applications using HTML, CSS, and JavaScript.

Figure 28: MS Visual Studio logo

Microsoft SQL Server Management Studio

It is a relational database management system that uses Structured Query Language (SQL).

- SQL is most popular language for adding, accessing and managing content in a database.
- It is noted for its quick processing, proven reliability, ease and flexibility of use.

It is database software which uses SQL language. We used SQL for database of our system but due to error in connectivity issues with Azure Cloud, we changed the database software.

Figure 29: Microsoft SQL Server Management Studio logo

Firebase

We used Firebase as database. Firebase is a cloud based NoSQL database that serves as a backend for mobile applications. The service provides a real time database with the help of its API that is open to all developers. A NoSQL database was chosen as the data handled was not contained in a single data structure i.e. the data structures varied and it helps in data visualization and analysis.

Figure 30: Firebase logo

Android Studio

We have created android application on android studio with Native Java language. Android studio is free software for creating android applications.

Figure 31:Android studio logo

ArcGIS

ArcGIS is a software used for map digitization. We have used ArcGIS for digitizing map of our case study and then built in Dijkstra Algorithm for finding path to product being searched.

Figure 32: ArcGIS logo

Chapter 5: Market Analysis

As we all know that commercialization of any project requires a complete market analysis on the basis of which a business plan is created. The market analysis helps in figuring out not only the need but also the demand of the device. The key objective should always be figuring out alternative solutions and feasibility of your proposed solution along with competitor analysis.

5.1 Market Size

The IT sector is continuously evolving especially IoT industry. The retailing sector always needs some technological solutions for efficient marketing strategies. The demand for Beacon industry is rising continuously, primarily in retail, transportation and logistics[12].

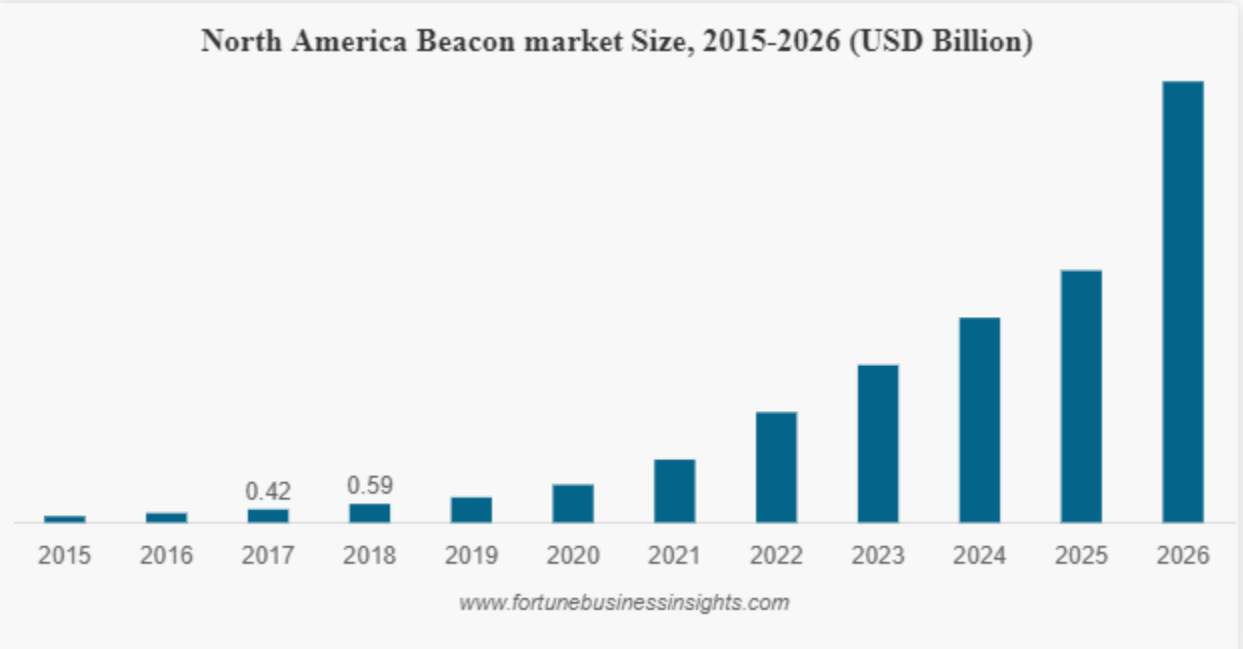

Figure 33:Beacon market size of North America

Here you can clearly have a look at how size of Beacon market is growing at North America with respect to time.

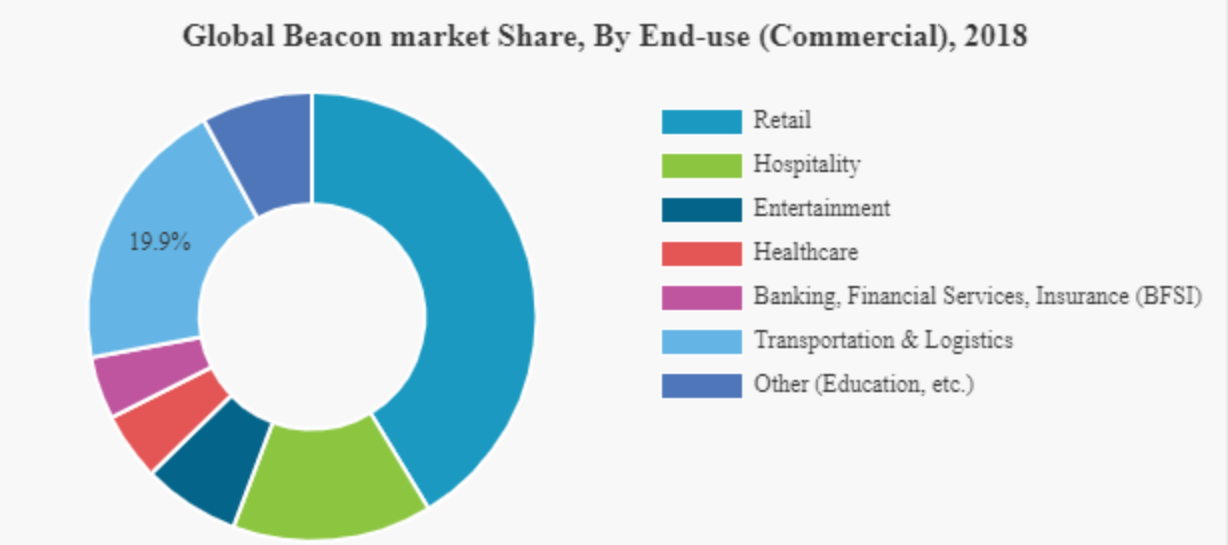

Figure 34: Beacon market share

The above image shows Beacon market share in different sectors as per 2018's analysis.

5.2 Business Model

A business model is the backbone of a company that is starting. It is a model for the successful operation of a business, identifying sources of revenue, the customer base, products, and details of finances. It is the document which drives the first two years of operation and strategic decisions of a business.

A business plan is a long document and cannot be accommodated within the scope of this report but a lean canvas model can be shown which represents the plan in more concise way that is summarized and highlights the most important points.

This BLE Beacon technology can be successfully be taken to large scale with proper business plan. There is lot of growth as well as innovation in Beacon technology in different sectors including retailing, industrial and health care as well.

5.3 SWOT Analysis

A SWOT analysis helps a business analyze its strengths, weaknesses, opportunities and threats. Having an oversight of such things enables a business to succeed in the market and be a better competitor. The SWOT analysis shows that although we have existing threats and weaknesses but the opportunity at hand is too good to be thrown away.

Strengths +	**Weaknesses –**
Real time advertisements Reliable information sharing Efficient marketing Feasible solution for convenient shopping	No human resource will be required for marketing
Opportunities +	**Threats –**
System can be extended with billing feature Can be deployed in big malls as well Complete store automation can be done	Technical issues Database issues Cyber security hacking

Table 5: Table showing SWOT analysis

5.4 Innovative Comparison

There are many different technologies providing such functionalities which BLE Beacons provide but innovation and development in IoT demands best and reasonable solutions.

As BLE Beacons are best for indoor navigation and proximity -based information systems so there is no other technology which can compete them at such reasonable rates.

Figure 35:Different solutions available

Technology	Pros	Cons
Wifi	• Technology available today with Wifi and can be used across all smartphones • Relatively in-expensive	• Requires an installed app by user to engage • Investments in Wifi SW/HW to achieve accuracy*
NFC/RFID	• Great accuracy for use with payments and product information • Very low cost of RFID sensors/stickers (0.01 USD)	• Not supported by Apple • 20 cm (7.9 Inch) range
iBeacon/ BLE	• Based on Bluetooth 4.0 and available on most new smartphones	• Requires an app to be installed and Bluetooth to be running • Requires new technology/ investments and becomes complex to maintain when you scale up

* Cisco, Navizon, Meridian, KAIST, WirelessWerx, GISi Indoors, Euclid, etc

Figure 36: Comparison with pros and cons of Wifi, RFID and BLE

Chapter 6: Conclusion and Future Prospects

6.1 Conclusion

The project successfully developed an android application and a web application and case study where system was deployed. The web application is for retailers, an android application is for customers of CSD Supermall. The web app is used to manage all the data and notifications from back end. The android application is for customers, where they can get real time or on spot advertisements and perform query-based searches to search desired product.

6.2 Future Prospects

The project has great prospects in the future. As a complete product there are multiple new ways to make it even better and provide more development work. Many of the planned improvements could not be implemented due to time constraints. We hope that these recommendations will be taken with a positive outlook and will be worked on with great zeal.

Such proximity-based information systems and indoor positioning systems can be taken to large scale and deployed everywhere, where audience engagement is a problem due to massive crowding and lots of products available. Some additional features can also be included in order to make it better. Like billing feature can make it even more interesting and practical when there will be no need of staff for managing grocery stores.

Figure 37: How the idea can be evolved in future?

Appendix A

Software Evolution

Figure 38: Prototype of Web app earlier

Figure 39: Final Web app Dashboard layout

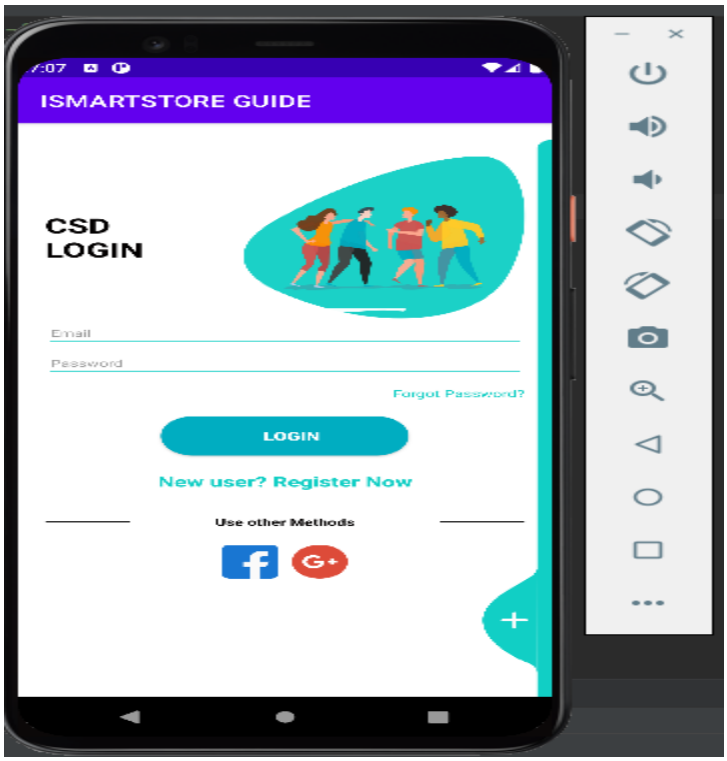

Figure 40: Login page for Android app

Figure 41: BLE Beacons being scanned in Android app

Figure 42: Android app with relevant advertisement

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