Beacon Technology the Future of Retail: A Review of the Literature and SWOT Analysis

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Abstract

Beacon technology is in the nascent stage and is expected to grow unexceptionally. Despite the enormous scope in this field, limited work is available on this technology. Previous literature on Beacons is scattered and mostly focuses on experimental work and its architecture. This article works on this gap and tries to present a systematic review of the literature and does a SWOT analysis on Beacons. The current study presents the results of 80 academic papers. For the SWOT analysis, a two-phase interview was conducted to collect information. This article is going to enhance the existing literature on Beacons and will help future researchers to understand the concept clearly and concisely.

Introduction

There is an undying fact that smartphones are changing working models and plan of actions of businesses as well as commercial centres at an amazing rate. App development revenue will reach $693 billion in the next two years (CDN, 2020).

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Today's technological innovation era has made Beacon-based technology solutions a hot topic in the tech industry. Although many people are unaware of this technology, it is been discovered that it has become an important part of many people's lives, as well as businesses. This new technology has had a colossal impact on the retail industry.

In the year 2013, Apple coined the term 'Beacon'. Beacon is now referred to as 'iBeacon' by industry experts. Beacon is small pieces of hardware used to send radio signals to nearby devices. The broadcasted radio signals sent by Beacon can be received by smart devices like mobile phones (Triantafyllou et al., 2017; Yao et al., 2019). Beacon has compatibility with mobile devices; they can be used to improve user experience and connectivity. They are one of the key conceptual components of the internet of things (Danova, 2015; Zhuang et al., 2022). The global Beacon technology market is expected to grow at 45.5 per cent during 2019–2024 to reach $10.2 billion by 2024 (ReportLinker, 2019).

The discussion on Beacon is in the nascent stage. Limited work has been done on its implementation in the retail sector. The available literature on this technology is scattered. This article presents a detailed literature review on Beacon technology and exhibits a SWOT analysis of this technology. This article will add value to the available literature on Beacon technology and may help the present and future applications of Beacon's in various sectors. This article will be useful for researchers, scholars and strategy makers by educating them and presenting the modern ways of customer engagement through automation.

Methodology

The current study presents the results of 80 academic papers selected from various databases on Beacon technology. The peer-reviewed literature; dissertation and conference proceedings were the main sources of information. Literature search was conducted using databases such as ProQuest, Google Scholar, Research Gate, Elsevier, Emerald, ScienceDirect, IEEE Xplore, SpringerLink and JSTOR. The search was performed with the keywords, namely Beacon, technology in retail, Bluetooth technology, Bluetooth Low Energy (BEL) and near field communication. The results were screened based on the relevance of their title first, followed by reading the abstract and keywords. The detailed process of selecting literature is presented in Figure 1.

Data for SWOT analysis was gathered through two-phase interviews. In the first phase, telephonic interview was conducted with six experts in the area of digital technology and retail to explore information on Beacons devices. These questions were designed by the author based on the literature reviewed. Seven open-ended questions were used to get the views of experts (Table 1). Views of experts were noted down. A manual content analysis was performed and four themes were identified.

Based on these four themes (strength, weakness, opportunity and threats), an open-ended questionnaire was framed with 15 questions on it (Table 2). This questionnaire was sent to two experts for face validity.
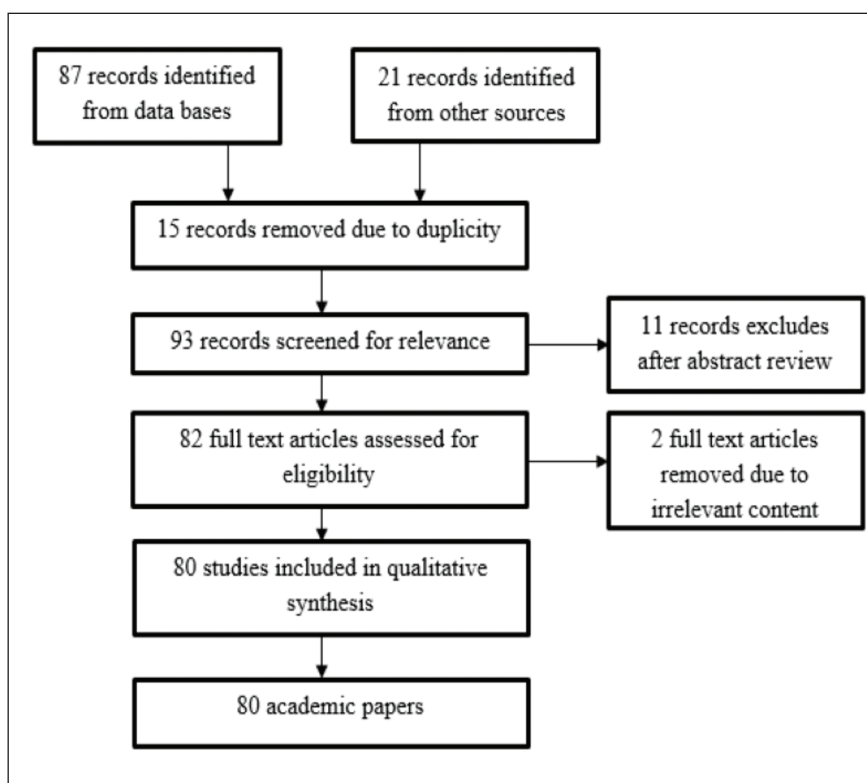
Figure 1. Literature Selection Process.

Table 1. First Phase Telephonic Interview Questions.

Sr. No.	Questions
1	Are Beacons really helpful in proximity marketing?
2	How is the performance of these devices?
3	How Beacons technology is used in retail sector?
4	How Beacons are changing the shopping experience?
5	Are customers really finding them useful?
6	How to motivate users to use Beacon technology?
7	What could be the future of this technology?

Source: Secondary data.

The second phase questionnaire was sent to 46 customers who had experienced this technology. Out of these, 15 fully filled responses were received. A content analysis was performed for this data too. Based on the results of the second phase data, a SWOT analysis was performed.

Table 2. Questions from Previous Literature to Conduct a SWOT Analysis.

Sr. No.	Questions
1	Are there any elements of Beacon technology that make it especially valuable to users?
2	Do Beacons have any special abilities?
3	What Beacons could do better than other location-based technologies?
4	Are there features of Beacons that give it a unique advantage?
5	Do Beacons lack certain abilities within location-based technology that other technologies have?
6	Are you asking for something which Beacons cannot provide?
7	What prevents Beacons from getting users?
8	Are other location-based technologies better than Beacons?
9	Are Beacons able to do something that other location-based technologies cannot?
10	Are there new trends that Beacons are in a position to jump on?
11	Do Beacons' strengths offer it the option of doing something else?
12	What feature of Beacons has not been shared with users?
13	Is the technology changing to make Beacons ability obsolete?
14	Is Beacon technology still relevant?
15	Are Beacons' weaknesses life-threatening?

Source: Primary data.

Literature Review

The buzz on Beacon technology started in September 2013 when the first Beacon product was announced by a company called Estimote (Newman, 2014a). Academic work on Beacon can be divided into three areas. The first category of research work on Beacon technology was exploratory and focused on introduction and importance of this technology. In second category, more experimental research was conducted, which was focused more on working on this technology and architecture development in various places. The third category of work on Beacon was empirical, which discussed the implementation for various areas.

Exploratory Research on Beacon Technology

Beacons or BEL Beacons are typically super-small computers with Bluetooth radios which can emit a signal. These signals can be picked by any Bluetooth-enabled device within a close range (Dudhane & Pitambare, 2015; Newman, 2014b; Lin et al., 2022; Park & Choi, 2021). When a Beacon identifies a Bluetooth-enabled mobile device, it transmits location-aware signals to phone applications. The application then works on the data delivered. Programmed measures could range from offers and coupons to specific in-app experiences (Moody, 2015).

Beacon technology addressed various challenges that marketers were trying to solve for many years. It allows secure and proximity-based communication with customers, also a helpful and cost-effective solution for in-store location services (Daudov et al., 2020; Divya Lakshmi et al., 2022; Newman, 2014b).

Beacons could be used in stadiums, hotels and resorts, museums, airports, retail stores, healthcare, fitness, and security and home entertainment industries (Abhishek & Hemchand, 2016). This technology could provide product information, personal local positioning, activate recommendations, navigate customers inside the store and start a conversation with customers at the point of purchase (Daudov et al., 2020; Dudhane & Pitambare, 2015; Lin et al., 2022; Moody, 2015; Park & Choi, 2021). The increasing number of Smartphone users and BEL-supportive mobile technology shows a brighter future for Beacons.

Some researchers tried to explain the challenges associated with Beacons. The biggest challenge discussed was the readiness of various stakeholders in the adoption of the technology at a large stage. The infrastructure behind the technology, consumer behaviour and consumer's habit to switch off mobile apps for saving battery power were some other challenges discussed in previous researches (Abhishek & Hemchand, 2016; Yao et al., 2019). Apart from this, the privacy of a customer, balance between personalisation and privacy, and regulations on direct marketing were some other challenges (Sanden et al., 2019).

Experimental Research on Beacon Technology

Beacons have resolved a long-persisting problem with indoor retail. As they are affordable, it is feasible to deploy Beacons in large numbers. Each Beacon consists of three parts, CPU, battery and radio. The radio consistently transmits signals which are received by gadgets generally mobile devices. The broadcast signals can be detected by a mobile application in nearby location. Each signal has a unique ID and through this Beacons identify the location of each mobile device (Haines, 2020; Zhuang et al., 2022). When a Beacon sends a unique advertisement signal, it is received by the mobile app and this app automatically connects with the server. The server then shows the information and displays that product through the app. It is interesting to know that Beacons themself does not collect any data (Parekh et al., 2019). Beacons could determine the approximate distance with the mobile device based on received signal strength (RSSI) (Triantafyllou et al., 2017).

Some researchers discussed the network specification for Beacons. Bluetooth networks could be arranged through three topologies named point-to-point, broadcast and mesh. Point-to-point topology is used for the audio exchange between phones and smartwatches or headphones. Broadcast topology is suitable for Beacon's solutions as it offers one-to-many device communication. Mesh topologies are best for sensor network applications, as it allows many-to-many device communication (Ng, 2015). Broadcast technology and mesh topology was combined and tested to extend the applicability of Beacons.

Placement and distance estimation for Beacons was also discussed in previous studies (Liu et al., 2021; Paek et al., 2016; Triantafyllou et al., 2017). For different vendors of Beacons and for different mobile device types, the signal propagation varies significantly. The installation height from the ground, physical obstacle types and indoor and outdoor environments vary among different vendors (Liu et al., 2021; Paek et al., 2016).

Empirical Research on Beacon Technology

Limited empirical work is available on Beacon technology. Moody (2015) conducted a survey to check customers' perceptions of location-based apps. Customers were asked questions based on age, the motivation behind access to location apps and feeling towards location-based apps. The findings revealed that customers were not aware of this technology. Customers were in favour of location-based apps if they were developed to help them in shopping (Moody, 2015). Different age groups and education levels have different statuses towards usages of such technology. The older population, that is, those above 67 does not have concerns about Bluetooth-enabled technology. Tech-savvy, educated and young customers were more likely for such technologies. Customers with different professions show similar interest in Bluetooth technology (Phua et al., 2015). A study on users' behaviour analysis of Beacons was conducted and found users' performance could be improved with micro-positioning services. Users found the use of Beacon technology easy to use and it saves their time and effort. If users' attitude is positive towards Beacon then the possibility of using this technology will be higher and it will positively influence their behaviour intention (Liu & Hsu, 2018).

In recent years, few studies came out focused on the adoption of Beacon and its effect on customer satisfaction, loyalty and risk associated with Beacon (Alzoubi et al., 2022; Divya Lakshmi et al., 2022). Risk was a serious factor, studied in few other studies and found to have a negative impact on attitude, adoption intention and intention to use. Apart from risk, technology anxiety and social presence were also discussed and found to have an important role in customers' willingness to participate in relationship programmes given through the proximity BBT-based platform (Lin et al., 2022).

Schrage et al. (2022) applied technology acceptance (TAM) model for location-based retail apps. Results revealed that perceived usefulness and perceived enjoyment had a positive impact on customers' attitudes towards location-based retail apps while privacy concerns and fear of spam had a negative impact on attitudes. Customers' attitudes towards location-based retail apps and subjective norms had a positive effect on intention to use location-based retail apps. Similar kind of results came out from the study of for use of Beacon for library Information Services (Liu & Hsu, 2018).

Research Gap

The literature that is now accessible examines the usefulness of location-based technologies in various industries or concentrates on the technical elements of Beacon technology. There have been a few articles that have attempted to address the implementation side of location-based technologies, but they did not isolate any particular technology. We are unaware of any study that examines Indian consumers and provides a thorough grasp of the advantages and disadvantages of Beacon usage. It is also critical to comprehend what opportunities this technology will present in the future for retailers adopting Beacons.

SWOT Analysis of Beacon Technology

SWOT analysis is utilised across enterprises to quantify the Strengths, Weaknesses, Opportunities and Threats of a venture. SWOT analysis can be applied at various levels such as individual level, hierarchical level, public level and international level. It is well utilised by educational establishments, non-profit associations, nations, ventures on multiculturalism, governments and so on (Gurel & Tat, 2017).

Strength

Beacon technology turned the way brick-and-mortar stores work. With the help of Beacons, it is possible to integrate online and offline retail to enhance customer experience and provide personalisation. The biggest advantage of Beacon is its short distance range of operation. They can sense users' spots accurately down to few centimetres while other location-based devices can detect device locations up to 5 meters. Beacons can work well indoors unlike GPS. They are cost-effective in comparison to GPS, Wi-Fi, Geofencing and RFID. Utilising Beacons businesses can communicate with customers by sending them highly personalised promotional notifications in-store or in proximity based on their previous purchase history, could navigate them inside the store and could generate huge data about consumers' behaviour. Businesses could identify the areas of stores that receive the highest or lowest traffic, employees' movements and levels of customer engagement with various categories, resource utilisation through the supply chain and information on new and repeat customers. This data help businesses to learn more about their customers, give them a whole different level of customer engagement and could help them to improve the layout and other touch points.

Weakness

Although Beacons are in the market since 2014, their popularity is still very limited. In the introduction phase, this technology was adopted by many stores; however, this hype soon subsided due to several problems. Before implementation, it must be understood to intend to resolve it. Retailers used Beacons in past, but they did not realise how to use them efficiently and they were not able to tell customers how this technology will help them.

The corrections were made in the technology and operations rebuild. Still few points of corrections are there like the signals of Beacons can be easily absorbed by other proximity Beacons. The timing of notifications due to flotation in Bluetooth signal strength is also a concern. Whenever any signal is sent by Beacon, retailers need to make sure the customers have your app and Bluetooth of the device must on. Another concern is meeting the need for safety and security. All customers are not comfortable with accessing their preferences and information. Bluetooth-connected devices are not battery friendly, and very few customers keep their Bluetooth activated all the time.

Opportunity

The world is shifting towards mobile-first and Beacons will play a significant role for bricks and mortar retailers. Beacons could be extremely useful as they can collect users' data. Beacons could be integrated with the CRM systems and can track footfalls, a past purchase, customer loyalty, revisit, queuing behaviour and results of marketing efforts. All this data could be used for improving marketing efforts and improving customer experience. Beacons could be used for directing customers inside the store to help them find products.

Beacons could be used in other industries apart from retail. It could be used in the airline industry, hotel industry, sports stadiums, amusement parks, libraries and museums. In future, we could see the use of Beacons in home automation such as users could operate lights, operate appliances and open doors or window shades with the tap of the mobile screen.

Threats

Although the marketers are very hopeful for IoT and its future implications like Beacon, some manufacturers are still having no security of any kind. Spoofing and sniffing a Beacon allows you to clown it and employ your Beacon profile and apply it in their app. Apart from security, there are very few service providers offering services like set up Beacons, consistent monitoring, measurement and managing them. The placement of Beacons is also a concern as they are inaccurate at close distances and cancel signals from each other.

Every technology has its limited time and could be absolute with the emergence of advanced and modified technology. More and more businesses are turning to Wi-Fi-based technology solutions as they need a Wi-Fi network and customers need permission to log in through their web page. No additional apps, complicated methods and costly hardware are required for it.

Managerial Implications

Beacon innovation is ready to change how customers communicate with brands, making devices more adaptable and reforming the way retail advertisers measure the effectiveness of online promotions during offline trade. The SWOT analysis of Beacons indicates that practitioners must clearly and concisely explain the value offered to customers (Gazley et al., 2015; Sanden et al., 2019). They should inform people that a Beacon may assist with their everyday shopping, that it is simple to use, and that it has no technological issues. Also, retailers must encourage customers to download technology-supporting apps and have their mobile Bluetooth and location settings active while shopping (Parikh et al., 2015). Data loss and misuse are issues that practitioners need to address. Additionally, consumers need to be reassured about financial hazards and privacy risks (Lin et al., 2022). Customers have excellent reason to be worried since they might value their mobile device more than the advantages of a retail app.

Conclusion

Beacons have the potential to revive brick and mortar retail model, as it is capable to integrate your offline operations into the online world (Foroudi et al., 2018). It allows understanding users via their data and allows retailers to serve them better with superior personalised experiences, customised notifications and loyalty benefits (Lin et al., 2022). Simultaneously, Beacons give an understanding of the relationship between advertising endeavours and customer conversions.

Surely, Beacon technology is not the magic bullet and there are some security concerns with it (Lin et al., 2022; Schrage et al., 2022). To overcome them, retailers should try to adopt a personalisation strategy that shows they are not pushy and disturbing. Customers were not very well informed about Beacons (Yao et al., 2019), so retailers need to educate them and tell them about the benefit of using Beacon apps. As the adoption rate will increase, users' security concerns automatically will come down. Manufacturers and retailers need to be confident about their Beacon strategies to develop strong customer relationships both online and offline world.

Scope of Future Research

The work in the future might be expanded in a way that integrates offline data gathered by Beacons with online shopping behaviour, or the other way around. Some models for measuring the relationship between variables such as risk, engagement, acceptance and awareness could be introduced. With these models, it is also possible to examine the impact of demographic variables. In addition, future research could examine the direct relationship between the variables discussed.

Declaration of Conflicting Interests

Funding

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