# Role of Internet of Things (IoT) in Retail Business and Enabling Smart Retailing Experiences

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## ABSTRACT

Internet of Things (IoT) is anticipated to be one of the primary megatrends up in innovation. Integrated with the current and upcoming mobility of digital gadgets, it offers ground to applications in numerous domains, including retail. The capability of sensors for setting applicable, customized, real-time, and intuitive communication with buyers and customers is considered to be a driving force of traffic and exchange, a facilitator of development along the way to elevate their purchasing experience. Simultaneously, IoT can serve to further develop relationships and foundations for more viable retail business and digital store management. Currently, digitally savvy customers expect an Omnichannel experience at each touchpoint. They need to track down the ideal data at the perfect time at the right location. Location-based innovation in a retail setting identifies the way that users take to arrive at specific areas of a retail store and helps upgrade the shopping experience. This is the reason the Internet of Things (IoT) is beginning to take the online business to a higher level, and will probably disrupt the conventional retail processes on a significant scale in the coming time. This paper surveys and arranges the most common applications of IoT and solutions for successful marketing at retail from the point of retailers and customers as well as from the point of manufacturers confronting framework or communication-related issues. We propose a model that demonstrates the potential that IoT has as compared to standard industry practices of retail to drive business results and gain an upper hand. In this paper, we've likewise talked about the new developments and new techniques for the organizations to accomplish competitive advantage brought about by the uses cases of IoT, particularly in the field of mobile sensors. Such developments are likely the most prominent factor in the coming years to make progress in the advanced economy.

**Key words:** IoT, Retail business, Smart retailing, Artificial intelligence

## INTRODUCTION

The worldwide retail industry has extended amazingly in spite of the financial disruption last year in 2020 and fluctuating retailing patterns across the world. Retail industry is anticipated to develop at CAGR 5.3% by 2023 (Donepudi et al., 2020a). The emerging countries of America, China, and India and their economies are turning out to be major players in the development size of retail industry all over the world. It is suggested that China has the potential to outperform the United States as the world's leading customer by the end of 2025 (Donepudi et al., 2020).

The present status of issues lies in the change in outlook of this industry from the standard perspective of retail store to the online business channels. This transformation has provided the opportunity of purchasing in any time, any place and at whatever point the consumer requests which the standard physical retails stores couldn't give. Today's digital world is the market of massive competition where retailers need to compete with the internet-based vendors (Ahmed et al., 2021; Begum et al., 2012; Bynagari, 2015; Bynagari, 2019; Khan et al., 2021; Manavalan, 2016; Paruchuri et al., 2021; Neogy & Bynagari, 2018; Manavalan & Ganapathy, 2014). Conventional methods of retailing are in a dire need of groundbreaking innovation to elevate purchasing experience and provide more creative solutions for managing labor, resources, financial aspects and space efficiency (Bynagari & Amin, 2019).

With the new development of the retail business commercial center, speculation is presently centered on IoT in retail landscape. The retail industry is immensely developing because of the upgrade in technologies specially Internet of Things (IoT). This innovation is an important piece of the development of retail domain. What we mean by the development here is that retailers are consistently upgrading themselves, in a quick span of time while making the required progress. New methods are coming forth with digital advancement step-by-step to address customer issues and needs, barcode scanners, and RFID technology accessible today. The actual challenge here for retailers is to integrate and track these smart objects for further develop proficiency and decrease costs; to upgrade functional performance with real-time data analytics; and at last to adapt change by communicating with users in new ways powered by the innovation of IoT (Manavalan & Bynagari, 2021). In this paper, we attempt to provide a clear understanding in the conceivable role that IoT frameworks could play as a service tool for the retail industry, by basically taking a look at the critical drivers of development inside this industry.

## LITERATURE REVIEW

The Internet of Things (IoT) is a powerful data network comprising of Internet-based devices, like radiofrequency IDs, sensors, and actuators, as well as different tools and smart tools that are turning into an integral part of the Internet. The IoT is a clever set of network that connects everything to the Internet to exchange data and conveying the data through digital gadgets as per protocols. It accomplishes the objective of smart identification, research, tracking, monitoring, and managing objects (Chen et al., 2014).

Kolaric, et al. (2011) in a survey, conducted a research´ to look at the effectiveness of e-business application in the organizations within Serbia. The motivation behind the paper comprised of the proof of knowledge of the meaning of e-business, as well as the level of productive applications of Internet innovation in current states of Serbian public endeavors'. Research and examination of the outcomes have shown that other than strong commonality of workers with the meaning of e-business, the current state of electronic communication doesn't offer full support to the activity of public ventures in Serbia.

Li et al. (2011) talked about that the IoT is a digital framework, where retail stores are multifunction sensors constantly checking the store environment from different viewpoints and programmed virtual feedback is contribution to further develop security, safety, service quality, and crisis response abilities. This review is to comprehend the course of adoption of the innovation and to recognize the basic achievement factors for the effective execution of the IoT applications in the retail industry.

Nam and Pardo (2011) explored IoT solutions used by retailers. The analyst discovered the retailers equipped with smart innovation i.e., Cloud Base Inventory control through RFID tag, GPS, Barcode Scanner, PoS sensors, and so forth, and furthermore equipped with a large number of "objects", mobile terminals and installed gadgets as well as connected sensors and actuators and application of smart IoT devices.

Duke Hyun talked about the Internet Retail Stores (IRS) is expanding violently with the developing fame of the internet-based businesses. Authors developed an analytics model for a more profound comprehension of the connection among predecessors and behavioral results of consumer loyalty on internet retail stores. Experts also found that four internet retailing execution factors were created according to the outlooks of data technology, customer support, and smart retailing impact on consumer loyalty. It additionally analyzes that customer satisfaction emphasizes the connection between internet retailing stores performance and customer goals.

## IOT ECOSYSTEM AND POTENTIAL BUSINESS OPPORTUNITIES FOR RETAIL INDUSTRY

### The IoT Ecosystem

For retailers, making an IoT ecosystem inside their organization can be a complex and overwhelming operation. IoT is a market with numerous innovation layers and players – device merchants, communication services, different IoT platforms, software vendors, and IT service providers. Luckily, there are some basic solutions out there, yet for the time being, we should check out precisely what is involved, at the minimum level, in a common IoT ecosystem. The IoT system begins, obviously, with the users. Customers will stroll into stores with a smartphone, tablet, or other gadgets connected via Internet. This is a part of the IoT environment that is controlled and claimed by the customer. They might be accessing their smart devices to look into the performance, search for anything within the store, access customer support, search for favorable deals, or some other activities.

For the retailer, the main layer of this ecosystem lies in the smart retail IoT gadgets that incorporate beacons placed all over the store, POS innovation, and RFID technology. All are associated with your organization, and send important data to and fro between customer gadgets. The IoT gadgets communicate this data to and fro your retail store, which thus link towards your analytics system and your retail business frameworks. The information exchanged between these components is dynamic and real-time, presenting opportunities to acquire understanding and collaborate with the customers to further develop their shopping experience. Social channels are utilized to develop instant connection between your store and your customers.

Obviously, for the retail stores, there are a few IT implications while creating a protected, secure and powerful IoT ecosystem. Domains like device identification and approval, network performance and wireless communication, device and traffic organization, and information analysis and storage are only a part of the huge challenges.

**Business Opportunities for Retail Industry**

Area based advertising empowers retailers to all the more likely influence their wireless networks to connected with digitally-active clients. It additionally offers huge development potential as it meets the following three goals:

At the core of IoT is Location-based Services (LBS) that use different remote availability options to pinpoint the location of customer, gather relevant information, and connect with them through direct communication mediums that further develop their shopping experience, alongside standards for reliability (Manavalan & Chisty, 2019). This approach has shown elusive results, for example, having the option to measure the quantity of visits of a customer to a particular department or area of the store.

Another case is those customers that invest a great deal of energy in a specific area, so they can get a promotional notification on their cell phone, empowered by LBS. Or then again LBS can offer walkway directions in a bigger shopping area, or execute other location-based operations and offers. The advantages are twofold. To begin with, customer notifications provide momentary freedoms to improve the client experience. Second, the data can be utilized by the retailers for executing a well-researched promotional strategy or further help in developing a CRM (Customer Relationship Management) system.

Retailers can utilize this innovation to pinpoint specific locations, promote offers, in-store solutions, and product announcements that can be shipped off customers' smart phones as they enter a particular zone. Also, as customers wander through the store, retailers can track their movement and acquire important insights from their journey. This offers retailers the chance to acquire some entirely important bits of knowledge into their customers' shopping behavior and can even assist make some groundbreaking decisions regarding how customers are welcomed at the store front, as well as various different elements that can influence their purchasing decisions. The best part is that retail advertisers can use real-time information to more readily target buyers based on the extensive data. Advertisers can also measure how digital promotions drive traffic into stores and even draw an obvious conclusion from advertisements to customers to buy.

From a business usefulness and effectiveness viewpoint, IoT has many advantages for retailers as well. A significant piece of a digital change is the ability to use information from various networks to make decisions more autonomic, empowering more astute and quicker business transformation with a flow of more relevant products.

Autonomic processes will empower employees to execute at a more significant level across the organizations, present new product ideas quicker, respond instantly to changing economic situations, and convey a more extravagant, more customized user experience. This is something more than data, however an application of noteworthy information that retailers can use to drive significant business decisions across their enterprise.


Figure 1: Anticipated Number of People Using Mobile Applications for Retail Shopping

## Role of IoT in Enabling Smart Retailing Experiences

IoT innovations have discovered numerous applications in retailing. The industry review shows that 37% of food and grocery organizations as of now explore different avenues regarding IoT innovation or have effectively started IoT services or products and further 58% are intending to grow their use of the innovation (Irish, 2017). IoT assists with working on both internal tasks and customer-centric issues. IoT presents various functional advantages including personalization, dynamic pricing, inventory tracking, monitoring, and personalized recommendations. Energy-savvy indoor regulators and lighting are likewise used in various retail frameworks. Sensors give real-time inventory information which is then utilized to cater to customer demands and upgrade inventories.

IoT further improves tracking and control by coding and tracking inventory. That enables organizations to turn out to be more productive, speed up work processes, decline blunders and avoid threats. The real-time information given by sensors allows retailers to make better functional as well as financial decisions. IoT-enabled smart labels presents opportunities to support product identification as well as provide critical data. This data can be integrated with personalization and recommendation frameworks to enhance shopping experience with unavoidable immersive displays and smart objects. IoT also provides ways to engage customers throughout the product life-cycle. For instance, smart objects can communicate with smart phones to interpret biometric data. The life-cycle support requires a satisfactory IoT design guaranteeing productive and secure information handling.

To sum up, retailers use IoT for inventory management, tracking of various products and services, hardware management and customer engagement. According to the customer point of view, the current research focused on customer support, client experience and purchase satisfaction. Be that as it may, there is little work on utilizing IoT according to the effect of natural conditions on customer behavior in retailing. That is theoretically addressed as an IDEF0 model in Figure 2.

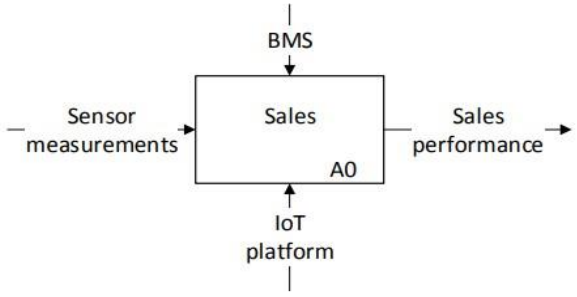


Figure 2: The Representation of IDEF0 Model of Sales Activity in Smart Retailing

Table 1: Demand-side and supply-side of Iot smart objects

| Demand | | Supply | |
|---|---|---|---|
| High Throughput | Camera Networks | High Density | Passive RFID Tags |
| Medium Throughput | Smartphones | Medium Density | Bluetooth, Wi-Fi |
| Low Throughput | Smartcard Chips | Low Density | GPS Services |

An IoT platform is utilized to tackle sensory measurements of the natural conditions. These are utilized by a Building Management Systems (BMS) to change natural controls and to work on the biological conditions at a retail store. That should bring about further improved sales performance. To accomplish that, relations among the business performance and the sensor estimates should be appropriately understood to manage a building management system.

## Real World use Cases of IoT in Retail Landscape

### Amazon Go

Presented in the year 2016 and based in the US, this offering of smart stores is a chain of retail shops powered by online business great, Amazon. It runs total seven Go stores all over the US – 4 in Seattle, 4 in Chicago, and 3 in San Francisco. All of these smart stores are equipped with automated check-out points where the customers are tracked and charged without any human intervention.

The infrastructure of Amazon Go is significantly based on machine learning, deep learning, IoT sensors, and computer vision methodologies. It utilizes innovations such as neural networks, artificial intelligence, and internet of things, integrated payment systems, QR code identification, image cognition, and an incredible application which utilizes GPS. There are more than 100 cameras and Amazon Go is well-versed to track and recognize each thing without allotting a particular chip to each product.

### Zippin

What began as a tracking organization in 2014 is now a budding start-up based out of San Francisco. In the present time, Zippin is a convenience store with automated check-out points. The objective of this startup is to disrupt the standard practices of retailing to minimize effort, save time, and add comfort. Zippin utilizes a mix of smart cameras and IoT sensors, alongside its intelligent programming powered by AI to follow each customer's move in their store. Installed cameras leverage DL to identify and process this information and keeps shifting from one camera to another one as the customers stroll through the retail store. They use a wide range of smart objects that incorporate a mix of cameras, devices, acoustic, and so forth. The intelligent framework runs on PCs that are designed to run DL models with exceptionally low transfer speed. Finally, the pictures are processed over the cloud.

### Watasale

Watasale is first completely computerized retail store in India, established in 2018. Watasale is the idea of 5 individuals coming from two different backgrounds – technology and retail. It required 3 years of extensive conceptualizing and hard work to make this idea a reality it is today. Important difficulties confronted by the leaders were to track down capable HR for this state of the art innovation. The creators made a solid group of experts who were well-versed in deep learning and AI.

The main objective of Watasale is to enable a problem-free purchasing experience for the target audience. The formation of Watasale was conceivable with the integration of technologies such as IoT sensors, artificial intelligence, deep learning, and computer vision. The smart retail store intends to change the whole user experience of going for shopping and buying things without having to get in the line for bill.

The whole experience of buying anything with Watasale is extremely speedy and convenient. It includes the customers downloading mobile application and filtering the QR code. Afterwards, they are just supposed to go around and buy things they need and once done with the shopping, they can essentially leave the store. Finally, they will get the payment bill on their smartphone. That bill can be paid off through any debit card or mobile wallet.

## Major Applications of Internet of Things in Retail Industry

### In-store Technologies

There exists an industry norm that retail stores are still a very critical part of retail landscape. Their primary focus lies in

enabling a high quality purchasing experience within a retail store. Presently, various innovations are being leveraged to support the in-store technologies such as: automated displays, 3D virtual mirrors, VR tables, 3D life-sized models, AR (Augmented Reality) and tablet functionality to support mobile applications. Be that as it may, shops are not only about experience. They must have the option to catch the key decision moment of purchasing or not purchasing a product. Stores must have the option to exchange information real-time about these objects through RFID tags, barcodes, and NFC readers. That's why stores are now allowing customers to purchase via mobile commerce applications or via mPOS-enabled associates to perform transactional activities.

**Devices for Business Agility**

The technologies applied in this innovation might not be something you see or touch on a regular basis but they form the necessary foundation and shape the brain behind all the activities that empower retailers to strengthen business agility. Generally, there are 2 major types of developments inside this technology. The main one identifies with the technologies that empower availability inside retail shops. These include indoor availability solutions – majorly Wi-Fi and mobile networks. The next one represents the innovations that empower the ability and control of information. Such devices are usually cloud-based.

**Buyer and Market Data Analytics**

Information is at the center of all retailing exercises. It is the blood of present day retailers. Buyer and market information are then fundamental for understanding buyer behavior and examples over the various channels. Business knowledge and information analysis are basic to draw value from raw data. Retailers can profile shoppers, fragment and group buyers, anticipate purchasing patterns, break down channel traffic, think about other mediums to reach out, improve their advertising effort and identify new opportunities.

**Online and Social Media Technologies**

The retail presence on the Internet through online business has been the primary move towards multi-channel platforms. With the introduction of informal communities, these online business platforms are connected to the brand's essence on social media networks like Facebook and LinkedIn. There are user-friendly internet business platforms, for example, Magento and Shopify. In any case, online media assumes a vital part as far as user engagement is talked about and hence the product advertising. Facebook, LinkedIn, Google+ are the key platforms to run digital marketing campaigns. Yet, in the retail industry, Instagram and Pinterest are acquiring solid pace.

**iBeacon Devices and QSense**

The IoT iBeacon innovation is one well-known locationbased development that is as of now getting a charge out of far and wide use across industry verticals, including retail. Among perhaps the most fascinating solutions for retailers intending to integrate IoT in their organization is the Quinnox iBeacon platform, known as "QSense." This creative innovation offers location-based information, empowering retailers to gain insights about a customer's shopping conduct. QSense empowers retailers to communicate and engage purchasers continuously, in their physical and digital spaces. The iBeacon innovation of QSense can be accessed directly from any standard tablet or smartphone, eliminating the requirement for handheld readers.

## Limitations and Implementation Challenges of IoT in Retail Industry

**Millennials**

As the biggest generation, recent millennials will have a spending power of 1.4 trillion US dollars (Manavalan, 2020). They're likewise a difficult age segment that requests a customized insight with insubordinate shopping patterns, exclusive requirements and little persistence. Numerous retailers are having difficulties to carry out the data-driven, consistent and customized experience that recent millennials request, and the retailers who neglect to address these demands will be left far behind.

**Omnichannel Reach**

In our current reality where shoppers continually need to purchase, get and return things from any place quickly and proficiently, retailers can't keep up. Over 70% (Manavalan, 2018) of retail and consumer goods CEOs said that omnichannel satisfaction was a first concern and revealed they were under danger from other online and social retailers offering same-day delivery services. Retailers are confronted with coordinating their supply chains with fast visibility and proficiency from the warehouse straight to the client, and everything in the middle. It particularly impacts retailers who should rapidly turn over occasional inventory, present new fashions without any past experiences of sales and convey consistently developing designs, colors and sizes. Retailers that lack visibility and capacity to immediately deliver products to their customers will not endure.

**Rising Wages**

As retailers create omnichannel techniques that balance the requirements of physical and digital channels, they're additionally confronting rising work costs and a demand for more prominent customer support. Basically cutting hours or labor force can have drastic impacts by reducing the customer experience. With no reasonable, assigned solutions, many are exploring different challenges regarding automation, improving work processes and further developing work plan. Innovation like tablets, sensors and automated signage can enhance and better empower human partners to serve clients all the more adequately (Donepudi et al., 2020a). Self-serve stands, mobile payments and applications can also play a vital role in emphasizing more responsibility on staff.

## CONCLUSION

For most retailers, clearly the retail scene will keep on advancing toward IoT technologies into the following decade and past as customers become more associated with innovation. This makes having a drawn out IoT technique a need. The digital buyer of things to come will probably expect, even demand that their shopping be an engaging and customized process empowered through their gadgets.

One might say, the IoT-empowered store is wherever the client is or needs to be. It incorporates instinctive and consistent connection with products and interconnected innovations, happening wherever at without fail. Purchasers will appreciate simple self-sufficient choices, and more extravagant, more smart, and credible shopping experience. Shopping by addressing a gadget will be typical, and the capacity to witness products in 3D, modify them or even try a virtual fitting room with social sharing choices will probably turn into a reality in only a couple of years.

The eventual future of shopping will incorporate these and other new ideas. Customer engagement as a component of advanced change will keep on driving more important personalization and simplification of retail endeavors. However, for this load of expectations, in actuality, this future is as of now here. Customers are all around associated and turning out to be tech-savvy. Hence, the challenge for retailers to overcome is making a powerful IoT ecosystem that adjusts and stays aware of the buyers' demands and preferences. For retailers that embrace IoT by utilizing advanced, mobile, sensor-empowered, and social media platforms powered by an IoT environment, what's to come is today.

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