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Impact of Internet of Things (IOT) in the Retail Sector: Opportunities, Challenges and Future Trends.

**Dr. G. China Babu
Adjunct Professor & Lead Consultant - SAP

**M. Sumathi Rani
Assistant Professor, Department of CSE
Keshav Memorial Institute of Technology (KMIT), Hyderabad.

Abstract:
The Internet of Things (IoT) has hit a variation point in the minds of business executives across the globe. Facilitated by real-world examples of what it can achieve, IoT is showing strong gains across a range of markets. The theme from here is clear that IoT is moving from good to great. Today, over half of companies have already adopted IoT technology, and in the future the number is expected to reach very huge percentage. Retail industry is also adopted IoT technology. The retail industry has been developing over time due to the impact of the Information Technology and this has led to adoption of various new business value intentions in terms of processes involved. The technology impact in Retail industry started with the introduction of E-Business proposition and this moved the overall model to look beyond adoption. In this paper, the study investigates the impact that the concept of IoT will bring in Retail Industry in coming years with the point of view of new business outlook based upon parameters of reliability, integration, security, discoverability, and interoperability. It also analyses and evaluates how IoT can contribute towards providing a superior shopping experience to the customers. IoT is rapidly advancing into the retail industry, although its adoption is progressing erratically across the subsectors. Many of the IoT devices in use today are inadequately secured, leaving organizations vulnerable to attacks. This is an immediate issue impacting organizations today. The study is focus on the Challenges of IoT predominantly in Retail sector.

Key Words: Internet of Things (IoT), Information Technology, Retail Industry, Business Profitability, Customer Shopping Experience.

1.0.Introduction:

The "Industrial Internet" has emerged as a term to describe how companies are leveraging cloud, mobile, big data and other technologies to improve operational efficiencies and foster innovation by tightly integrating the digital and physical worlds. The technologyInternet of Things (IoT) combines connectivity with sensors, devices and people, enabling a form of free-flowing conversation between man and machine, software and hardware. With the advances in artificial intelligence (AI) and machine learning (ML), these conversations can enable devices to anticipate, react, respond and enhance the physical world in much the same way that the internet currently uses networks and computer screens to enhance the information world.

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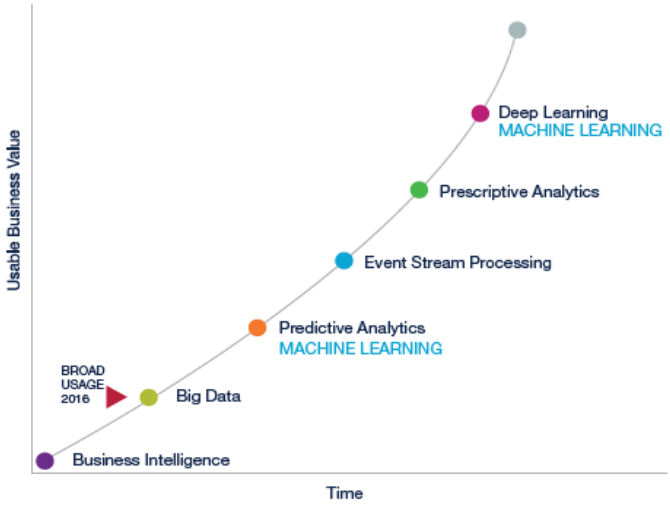


Source: Figure-1. Insights Through Advanced Analytics

Definition of IoT - The Internet of Things (IoT) describes the connection of devices, any devices to the internet using embedded software and sensors to communicate, collect and exchange data with one another. With IoT, the world is wide open, offering a virtually endless array of opportunities and connections at home, at work or at play.There is more confusion and uncertainty about the IoT than about most other technologies. This is, in part, because IoT is not just a single technology, but a catch-all umbrella phrase used to describe what is really a broad set of technologies. Business leaders said that IoT was 'just beginning' and would transform business as we know it.

According to Wortmann and Flüchter (2015), the term Internet of Things (IoT) has recently gained significant popularity. However, there is no classic definition or comprehension of what the IoT includes. The term was originated 20 years ago by the Auto-ID Labs at the Massachusetts Institute of Technology (MIT) while they were working on networked "radiofrequency identification (RFID)" infrastructures. Ever since the scope of IoT has expanded beyond the extent of RFID technologies.

Kevin Ashton definedIoT means sensors connected to the Internet and behaving in an Internetlike way by making open, ad hoc connections, sharing data freely and allowing unexpected applications, so computers can understand the world around them and become humanity's nervous system."

The International Telecommunication Union (ITU) describes Internet of Things as "a global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies."

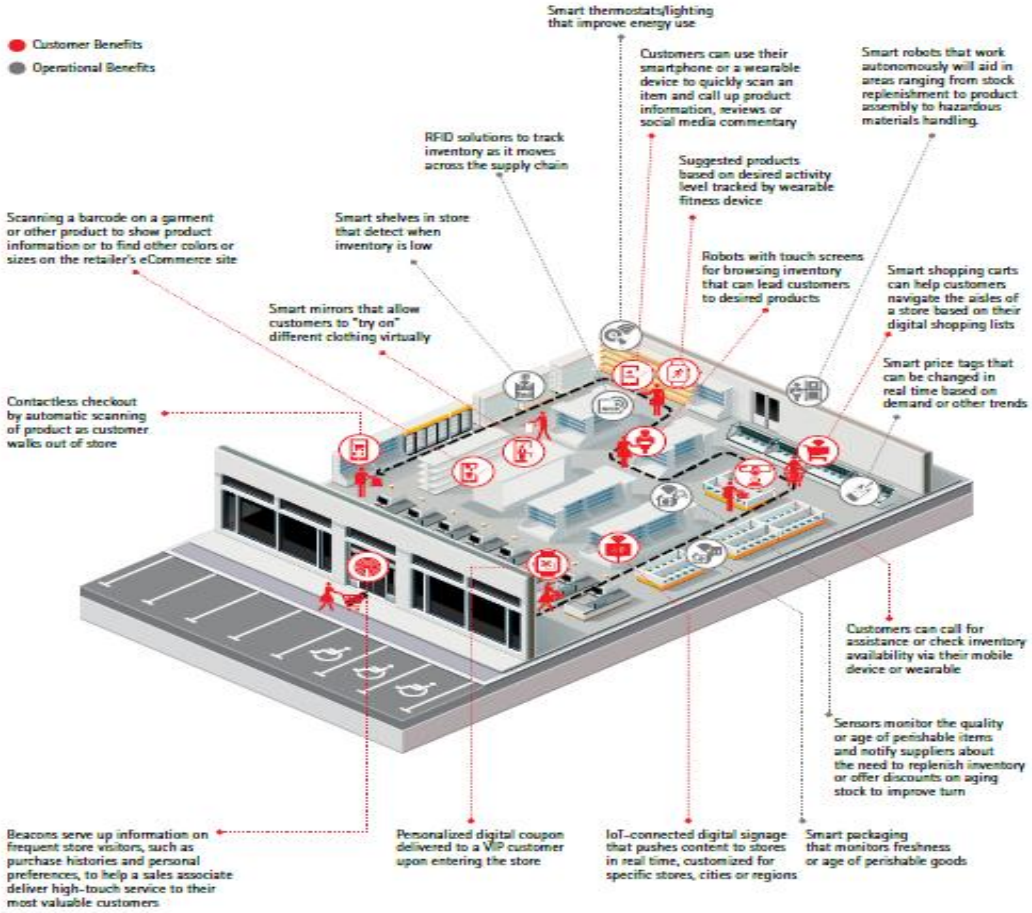
IDC defines the Internet of Things as a network that aggregates and connects uniquely identifiable endpoints, device, wired or wireless, that communicate autonomously using IP connectivity. According to the IDC Asia Pacific Retail Trend Analysis 2017, about half of the retail organizations across APAC are aware of the benefits of IoT. Out of these retail organizations, only about half are currently using IoT in their businesses, while the other half are still investigating applicability and evaluating technology vendors.

1.1. Review of Literature:

(Miorandi, et al., 2012) explains that the Internet infrastructure will be an even dynamic mainstay to everyday life. Content and services will be all around us, allowing new ways of interacting, information-sharing, working and living. It will enable physical objects to interconnect with computing abilities across a wide range of services and technologies, creating so-called 'smart' objects. This interconnection between the physical and visual dominion will cover the way for new technologies and services. This relationship between physical and digital entities is known as the Internet of Things. IoT builds around three pillars i.e. 1) anything identifies itself 2) anything interacts and 3) anything communicates. (Haller et al., 2008, p.3) defines the IoT as a world where physical objects are clearly integrated into the information network, and where the physical objects can become active participants in business processes. Services are available to interact with these 'smart' objects over the Internet, query their state and any information associated with them, taking into account security and privacy issues. (Reynolds, et al., 2007) emphasis is often put on supply chain logistics and other back-end aspects. Retailers are looking at what could save them costs, instead of looking at what could make them more money. (Vermesan et al.2011) explains IoT has already transformed traditional business models in areas such as manufacturing, health care, building automation, transportation, and environmental monitoring. One industry with vast potential for IoT is retailing. (Gregory, 2015) identifies that IoT will particularly be troublemaking to the retail industry. He expects that it will offer opportunities in three critical areas i.e. customer experience, supply chain and new channel and revenue streams. Retailers are mainly adaptors of innovation rather than developers of innovation themselves. They are attentive on creating new products and selling them, rather than improving the technologies that enable their services.

(Pantano, 2014) identifies three main key drivers of innovation within the retail industry. First, the (customers) demand for innovating. Earlier studies exposed that customers expect more entertainment and supporting tools while shopping. There is a growing need for technologies that increase interactivity (for instance by using sensors), support the purchasing decision, reduce waiting times etc. Second, the availability of new advanced technology-based tools for investigating market. Critical for retailers is to understand and predict market trends, furthermore they need the capability to quickly react to the external environment when needed. Therefore, retailers need systems that can match customer behavior, trends and analyze information to set up future strategies. This all will benefit the competitive advantage. Third, the ambiguity in adapting innovations. The attitude from consumers but also employees against certain technologies plays an important role when it comes to innovative success. Although there is some research on whether the consumer would accept a certain technology, research from the employee's perspective is still very limited. (Parris et al., 2015) explains the retail industry is highly competitive, so efficiency and growth require not only solid business operations but also innovation. Moreover, online competitors are changing the cost structure and profitability of the business model for in-store operations. Considering these circumstances, retailers are revolving to information technology and new business models to devise omnichannel strategies to provide to their customers for online, in-store and mobile shopping. (Verhoef et al., 2015) defines the rise of omnichannel retailing has introduced a refined but crucial change in the industry. (Eliasson, 2017) explains that the many players do not know what to do with all the new information that the IoT systems have given them and they have

therefore chosen to focus on smaller implementations and installations, such as optimization of light and cooling. Technology will in its early stages always be implemented in small proportions.



Source: Figure 2. Representation of the instore experience of tomorrow (By Gregory, J. (2015). The Internet of Things: Revolutionizing the Retail Industry.

1.2. Research Methodology:

A case study method has been adopted for this study in which various use cases in the retail sector have been analyzed with respect to the implementation of IOT for retailing sector and the benefits accumulated of the same and discussed the Challenges and Future trends. The data for this study has been collected through various articles, reports, online databases, whitepapers etc. Collected literature was then analyzed for relevance to the topic.

The following were the research questions discussed through thus study:

What is the Internet of Things?
What is the IoT ecosystem, and what are the business opportunities?
How is IoT used in action devices, applications, and real-world examples?
What are the IoT challenges, trends, growth forecasts, and other predictions?

1.3. Fundamental Elements of the Internet of Things

- **Secure Network**: One of the most important demands created by the ITOT convergence is the need to have a secure network. OT traditionally needs a username and password system for security, but convergence will need more erudite security controls. IoT poses the threat of introducing new attack surfaces, including external and connected devices using the network. This creates an omnidirectional threat matrix, rather than traditional linear attack methods, that requires a layered approach to security. Role-based and device-based access controls, with strict policies, will be primary factors. Interference prevention systems, which typically check for irregularities using IT-based signatures, will have to include industrial-control signatures as well.

- **Convergence:** With IT-OT convergence, facilities such as lighting, card readers, and heating and cooling systems use the data network for controls. These operations integrate nontraditional sensors onto the IP network. The operations also extend beyond the traditional methods of communication to include Wi-Fi for wireless communications, Long Term Evolution (LTE) for cellular communications, LoRa for low-power wide area networking for IoT edge devices, and more.

- **Resilient**: OT convergence requires network dismissal and resiliency. The network plays a fundamental role in business and mission operations. Despite security threats or network outages, operational technologies must remain functional. The network must, therefore, continue providing such services while mitigating challenges. Security controls must quarantine attacks while allowing operations to continue, therefore adding to the resiliency of the network.

- **Analytical:** An IoT-ready network should be able to handle multiple edge devices that feed data back to the network. However, an information-rich network can also face bandwidth challenges. For this reason, analytics at the edge will be critical. When more analysis can be done at the edge of the network, less information traverses the central network. Instead of becoming content-rich but ineffective, the IoT network can be used for faster decision making without requiring immense bandwidth. Intelligence built into the sensors, as well as edge routing devices, can provide these benefits. The IoT-ready network can be used to automatically trigger machines as well.

- **Automated:** Given the large number of operations that can be held through the network, service offerings should be automated for improved scalability. Processes can be adaptable, easier to change, and replicated easily in an automated environment, which is critical for rapidly changing mission needs. In terms of incorporating sensors into the edge of the network, device provisioning can become an automated process. An IoT network can incorporate self-learning properties to automatically provision approved devices in mass quantities.

1.4. Technologies of Internet of things (IoT):

a) **Radio Frequency Identification (RFID)**- Radio Frequency Identification (RFID) is a system that transmits the identity of an object wirelessly using radio waves. RFID comprises of a tag,

an antenna, a reader, software and a server. It is low-priced, effective and secured thus making it reliable.

b) **Electronic Product Code (EPC)-** An Electronic Product Code (EPC) is a universal identifier that gives a unique identity to a specific physical object. EPC is a 64 bit or 98-bit code electronically recorded on an RFID tag. EPC code can store information about the type of EPC, unique serial number of products, its specifications, manufacturer information etc. technology, which is used for sharing RFID information.

c) **Internet Protocol (IP) -** Internet Protocol (IP) is a set of rules governing the format of data sent over the Internet. The two versions of Internet Protocol (IP) in use are: IPv4 and IPv6 as stated in Bicknell, IPv6 Internet Broken, and Verizon Route Prefix Length Policy 2009. The protocol provides for 4.3 billion IPv4 addresses while the IPv6 will significantly augment the availability to 85,000 trillion addresses. This supports around for 2128 addresses.

d) **Barcode** -Barcode is a method of representing data in a visual, machine-readable form. Initially, barcodes represented data by varying the widths and spacings of parallel lines. Barcode is just a different way of encoding numbers and letters by using combination of bars and spaces of varying width. Bar codes are optical machine-readable labels attached to items that record information related to the item. Barcodes are designed to be machine-readable. Usually laser scanners and cameras are used to read them.

e) **Wi-Fi** -Wi-Fi is a wireless networking technology that allows devices such as computers (laptops and desktops), mobile devices (smart phones and wearables), and other equipment (printers and video cameras) to interface with the Internet. It allows these devices--and many more--to exchange information with one another, creating a network.

f) **ZigBee** -It a kind of technology is designed to carry small amounts of data over a short distance while consuming very little power. It is a low power wireless network protocol based on the IEEE 802.15.4 standard. ZigBee has range of around 10-100 meters and a bandwidth of 2.4 GHz. As opposed to WiFi, it's a mesh networking standard, meaning each node in the network is connected to each other.

g) **Bluetooth** -Bluetooth is a wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves in the industrial, scientific and medical radio bands, from 2.402 GHz to 2.480 GHz, and building personal area networks (PANs). Bluetooth is an inexpensive wireless technology, short-range radio technology.

h) **Artificial Intelligence** -AI refers to any device that perceives its environment and takes actions that maximize its chance of success at some goal. It is characterized by an embedded, Context Aware, personalized and adaptive system.

i) **Actuators -** An actuator is something that converts energy into motion, which means actuators drive motions into mechanical systems. Actuators can create a linear motion, rotary motion or

oscillatory motion. Cover short distances, typically up to 30 feet and generally communicate at less than 1 Mbps.

j) **Wireless Sensor Networks (WSN) -** It is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants, at different locations.

k) **Near Field Communication** - NFC is a set of short-range wireless technology at 13.56 MHz, typically requiring a distance of 10 cm or less. NFC is complementary to Bluetooth and 802.11 at a distance of up to 20 cm but much slower than that of Bluetooth. Since, NFC has a shorter range it reduces the likelihood of unwanted interception.

1.5. Applications of Internet of things (IoT):

a) **Smart gadgets -** It is basically making the users smarter in terms of action, learning, thinking, as well as enhanced user's experiences. Wearables remain are smart electronic devices that can be worn on the body as implant or accessories.

b) **Smart City -** Smart City solutions promise to improve real problems of people living in cities these days. IoT solutions in the area of Smart City solve traffic congestion problems, reduce noise and pollution and help make cities cleaner and safer.

c) **Smart Grid** -It refers to the electric grid, which is a network of transmission lines, substations, transformers that deliver electricity from the power plant to your home or business.This automates the distribution system and reduces power pilferage. It uses information about the behaviors of electricity suppliers and consumers in an automated fashion to improve the efficiency, reliability, and economics of electricity.

d) **Home automation**- It is building automation system for homes. It includes the control and automation of lighting, heating, ventilation, air conditioning, and security as well as home appliances. Smart Home ranks one in IoT applications as on all measured channels.

e) **Industrial Internet of Things (IIoT) -**Industrial Internet of Things is the use of Internet of Things technologies in manufacturing.It incorporates machine learning, big data, using sensor data, machine-tomachine (M2M) communication and automation technologies that have existed in industrial settings for years. IoT holds great potential for quality control, sustainable and green practices, supply chain traceability and overall supply chain efficiency.

f) **Smart Car -** Connected cars contains of Navigation systems, which will enable drivers to determine not just the fastest route but also the most fuel-efficient and Vehicle management systems, which will provide detailed information about the car's performance.

g) **Connected Healthcare -** Connected healthcare management and delivery by using technology to provide healthcare services remotely with accurate services.

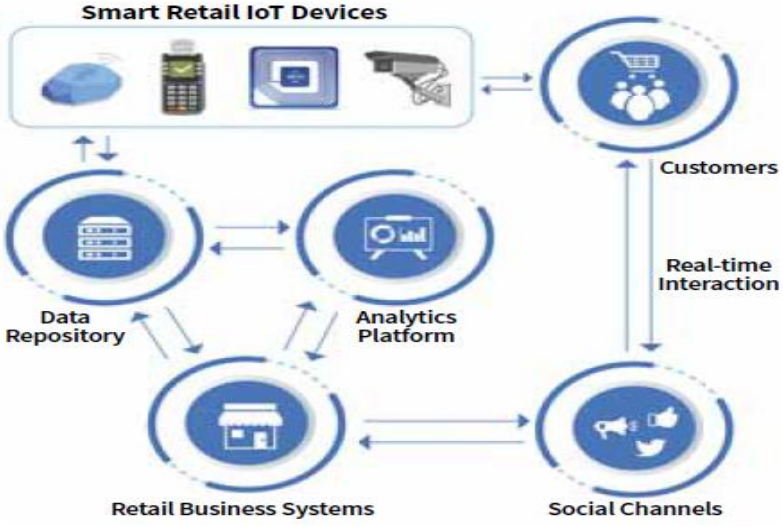
h) **Smart retail** -Smart Retail is an important provider of shopper visions and analytics that empower retailers to improve profitability. Retail industry is slowly transforming from an un-organized sector to an organized one by incorporating technology. Smart retailing is evolving and proving to be a promising

i) **Smart supply chain -** Radio frequency identification (RFID) is the technology that uses an RFID tag on objects or people, so that they can be identified, tracked and managed automatically using IoT technology.Supply chains have already been reaping benefits from IoT.

j) **Smart farming**: Growing concerns about farming like climate change, limited arable land, and costs/availability of fossil fuels is reducing the productivity. The remoteness of farming operations and the large number of livestock that could be monitored the Internet of Things could revolutionize the way farmers work.

1.6. IoT and Retail Industry:

There are several new innovations that were introduced in the area of embedded systems leading to a new paradigm adoption in the vast array of the heterogeneous devices leading to computing and networking optimizations. This led to the formation of the concept of smart grid and the feature of integration became the most important focus in the area of new technology innovation. The innovations has raised web based service economy as the present focus of Internet of Things and platform enabling the service as a part of "Software As A Service" model enabling to bridge the gap between the representation of physical world in information systems and the physical world itself. The overall challenge in any IoT project will be the following: a) Real-time information retrieval, b) Process Optimization, c) Responsiveness, d) Scalability, e) Network dependency.



Source: Figure-3. The Future of Retail & E-Commerce: How IOT shapes shopping, today and tomorrow-By Mike Ghasemi, Research Director, APAC, Retail Insights

For the retailer, the first layer of an ecosystem is comprised of smart retail IoT devices that include beacons placed strategically throughout the store, POS technology, and RFID technology. All are

connected to the network and send data back and forth between customer devices. The IoT devices transmit date back and forth to the data repository, which in turn interface with analytics platform and retail business systems. The data exchanged between these elements is dynamic and fluid, creating opportunities to gain insight and interact with the customer to improve their shopping experience. Social channels are leveraged to create real-time interaction between enterprises and customers. Of course, for the retail enterprise, there are several IT investment implications when creating a safe, secure and effective IoT ecosystem. Areas like device authentication and authorization, network performance and wireless communications, device and traffic administration, and data analytics and storage are just some of the big ones.

1.7. Opportunities of IoT in Retail Sector:

a) **Improving the customer experience with use of IoT**: A typical, modern mobile user who is connected will have many prospects from a retail store when it comes to customer experience. They will want good service, accurate information, quicker delivery, and so on. On the other hand retail companies also rely on the Internet of Things application development to improve self-checkout, digital signage, and other valuable technologies that help provide users with a better experience. The IoT creates an infrastructure and provides devices that allow data circulation throughout the buyer's cycle more efficient. By implementing IoT solutions, retail organizations can solve a lot of customer experience problems.

b) **Marketing to the Consumer:** Consumer businesses are already using IoT technologies to improve and enhance their connection with their customers and potential market. For example, Leading US department store Macy's uses Shopkick Bluetooth Low Energy (BLE) beacons across many of its stores. Beacon technology, based on an Apple standard, allows the retailer to detect a customer's precise location within a store and sends messages to the customer's smartphone. Customers have to choose into the service and usually download an app. Macy's customers approving to use the service receive discount coupons and rewards within a store based on their locations.

c) **In the Distribution Network:** Radio frequency identification (RFID) technology has been available for more than 30 years. Small RFID tags can send information about the product, pallet of goods, or container of raw materials to nearby scanners or gateways without needing line of site for barcode laser scanners. Although the technology has underwhelmed some industries, more smart features and more sophisticated back-end technologies are improving their return on investment (ROI). The trend is what some call the "digitization" and "smartification" of the supply chain and consumer products.

d) **In the store:** Today, retailers want to track their inventory from the moment it leaves the manufacturing plant till it is finally delivered. It is also no longer enough for a retail business to just track all the inventory, as a lot of retailers also need to know the condition of their goods at any given moment within the supply chain. Some retailers need to make sure that their items are transported only after meeting the prerequisites on the grounds of temperature and other such conditions. The capacity of IoT technologies to improve inventory management extends to the store environment. Several leading retailers already benefit from technologies built around RFID and other short-range transmission technologies.

e) **Better Customer Service**: IoT also helps brick and mortar retailers by generating insights into customer data while opening opportunities for leveraging that data. For example, retailer IoT applications can synthesize data from video surveillance cameras, mobile devices, and social media websites, allowing merchants better to predict customer behavior.8 in 10 retail stores have admitted that IoT has improved overall customer experience. Roughly the same number have claimed that it has increased business efficiency.

f) **Checkout automation**: Check-out is one operation that is the most labor-intensive and often disliked process for customers. When checkout lines are too long, many people leave without purchasing anything, resulting in lost profit. In order to stop customers from leaving without any purchases, retailers can use IoT solutions to automate point of sale (PoS) systems. Automated PoS can read tags on each product when the customer leaves the store and automatically charge them from a mobile payment app.

g) **Foot-Traffic Monitoring:** Determination of retail operations with foot traffic analytics from door, a complete people counting solution for retail and facility management. In a small store, the mall traffic can be inspected across several retailers, so the entire shopping journey is understood. In a smart store, retailer can use video-based foot-traffic monitoring to see whether customers reside in one product area more than others. Then, in real time, you can direct an associate to help out the customer or examine the information later in order to squeeze the store layouts for more effective customer visits. Moreover, by observing the store traffic and customer demand in real-time, we can customize the existing in-store shopping experience.

h) **Smart Fulfillment**: In retail, moving merchandise more professionally is a major goal to achieve. IoT can play a vital part in the maintenance of transport, tracking, and route optimization. Of course, many retailers have been using GPS to track and route goods transportation for years, but with IoT, retailers are able to understand with much greater accuracy how close a pallet of merchandise is given to the store.

1.8. Challenges:

a) **Standards:** Standardsor a lack thereof for IoT to progress, connectivity standards need to evolve. Similar to the communication challenges that people from different parts of the world face, in today's IoT ecosystem, devices, sensors, machines and people are often speaking completely different languages with one another. Without a common language or standard of implementation, IoT will remain limited in its application.

b) **Infrastructure:**Most retailers lack the infrastructure and network components that vast volumes of IoT data require. In order for merchants to digitize their retail stores, they would need to have a robust network, cloud solutions, and end-user solutions such as barcode scanners, tablets, and mPOS. All of those things would require considerable investment. The solution here is that there is no need to overinvest in infrastructure all at once when it comes to implementing a new technology. With small infrastructure changes, *e.g.* using IoT to manage AC or the lighting, which will bring a more immediate ROI.

c) **Big Data:** With the start of the IoT, having a single customer view is more important than ever the intelligent use of cross-channel data will allow for predictive analysis for stock/consumption as well as personalization. Data presents a huge challenge for everyone involved in the IoT users, developers and businesses. It's great to have a single customer view, whether they're in-store, online or elsewhere in the journey to purchase, but working out who's responsible for their details isn't that easy, especially when you're trusting on third parties to deliver at least some of the experience. The management, security and ownership of data is possibly the biggest issue for retailers, because it requires a commitment to co-operation across not only the businesses themselves but anyone involved in the purchase journey who touches on customer data that includes manufacturing, logistics, outdoor advertising, shopping mall management and more.

d) **Beyond the Board:** Being on a retail C-suite in the era of IoT can be a challenge. Board members are listening and responding to what they hear from the industry, but they are finding it hard to make the right decisions quickly and don't want to back the wrong horse. What they need is reassurance that while the IoT is about tech, it's also about value. Enabling the IoT and 'connecting the dots' using development platforms is the only way to deliver superior customer experiences and exciting innovations like chatbots and virtual concierges. And, while this will touch every part of the business from logistics to HR and operations, the most important IoT assets are people, customers, sales colleagues, buyers, designers and anyone involved in the retail chain can be empowered by the right kind of technology.

e) **Security:** Many retailers are suspicious of the security and privacy issues associated with IoT. These concerns have been amplified by the introduction of GDPR (General Data Protection Regulation). Access to the customer's data gives retailers various opportunities but at the same time opens the door to cyber attack threats and legal complications. Retailers should work closely with IoT software developers to make sure that the devices and sensors they use are designed with strong security mechanisms in mind, including basics like secure passwords, as well as more advanced security infrastructure like end-to-end encryption, regular software updates, and an IT infrastructure that actively scans for bugs and vulnerabilities.

f) **Data Management:** IoT data analysis in a timely and relevant manner represents a huge challenge for retail businesses due to a lack of relevant qualifications and expertise. There isn't enough technical and analytical skill at hand to gain valuable insights from the huge amount of data collected from IoT.

g) **Online Retailing challenges**: Retail IoT success depends on delivering a positive, consistent, customer experience. Consumers need to have a unified experience across all online and in-store interactions, whether purchasing at a brick-and-mortar location or through a voice assistant, a wearable device or a smart fridge. If customers should always know the store hours (even on holidays), available inventory (or appointments), and ideally be able to reserve it for pickup in the store or have it delivered. "The IoT shapes the line between in-store and online experiences," which puts more burden on underlying systems and requires additional in-store bandwidth. Brick-and-mortar shoppers now use mobile devices to check reviews or compare prices, and many retailers also use connected devices in store. Any disconnect between in-store

and online systems can become quickly become a customer experience problem and a lack of connectivity can be a turn-off.

1.9. IOT Future Trends:

Most retailers, it's obvious that the retail landscape will continue to progress toward IoT technologies into the next decade and beyond as consumers become more linked to technology. The digital consumer of the future will likely expect, even demand, that their shopping be an engaging and personalized journey enabled through their devices. Consumers will enjoy easy self-service options, and richer, more intelligent, and authentic interactions. Shopping by speaking to a device will be commonplace, and the ability to visualize products in 3D, customize them, or even try a virtual fitting room with social sharing options will likely become a reality in future years. The future of retail shopping will include these and other new scenarios. Consumer engagement as part of digital transformation will continue to drive greater personalization and contextualization of experiences. The retail industry is seeing a speedy transformation, with the Internet of Things (IoT) solutions taking the center stage in the sector. Having plenty of applications, IoT helps increase customer loyalty, boost sales, offer a personalized experience, and improve inventory management.

a) **Smart shelf systems:** It contain three elements: an RFID tag, an RFID reader, and an antenna.Smart shelves are suited to inventory management, that has been an expensive and tedious process for a long time. Now smart shelves can automatically monitor inventory and send managers alerts if a certain item is running low or its date will expire soon.Therefore, connected devices are crucial for avoiding oversupply, shortage of goods, and thefts in stores. By tracking inventory, they enable to reduce stress, remove operating mistakes, and save costs.Smart shelves also take an important part in making intelligent insights into customer behavior.

b) **Beacons:** Beacons are devices that use low-energy Bluetooth connections to automatically send push notifications directly to shoppers' smartphones once they appear in the coverage area.Customers are notified about shares, discounts, and offers in real-time, making them more likely to enter a store and make a purchase. As beacons are small, they can be easily attached to walls, counters, and other places.Retail companies also use beacons for customer in-store navigation, sending push messages, and collecting customer data. Coupled with mobile apps, beacons enable retailers to increase customer loyalty and boost sales. Through beacon technology, retailers can easily reach their audience and provide an engaging experience.

c) **Robots:**Robots have the potential to significantly change the retail sector. Tested robots in one of its San Francisco locations to help stock shelves and take inventory.Restaurants in China have started replacing waiters with robots.

d) **Digital signage:**It helps retail companies provide personalized and interactive shopping experience. Digital signage solutions like Ipad screens, digital-out-of-home applications (DOOH), intuitive touch screens, and in-store digital screens, help retailers impress customers and increase sales.

e) IoT And Machine Learning:Machine learning as a software discipline plays a huge role in how the IoT ecosystem responds to the outside world, and what insights these devices can generate to feed business units.Most of the biggest U.S. retailers like Walmart, Searsetc. use a combination of IoT devices and machine learning.

f) IoT And Supply Chain Management:Replenishing the stock on time, with the exact SKUs and minimal losses, is crucial for a successful retail business. At the same time, if retailer can't deliver goods on time and in the right shape, stellar marketing team won't make a difference. That's why retail businesses are investing heavily in the development of their IoT infrastructures supporting their logistics.

g) **IoT And Inventory Tracking:** Mobile self-checkout is a growing trend among retailers. It comes in various forms, including RFID chips that automatically disconnect after a customer makes a purchase via a specialized app.

h) **IoT And Blockchain:**Blockchain is one of those technologies with a growing number of applications within retail supply chain management. For example, IBM offers blockchain-based solutions that cover the entire supply chain cycle, with a specific focus on logistics. One of their solutions, TradeLens, is a platform where business users have access to a shared ledger that's updated and validated in real time.

2.0.Conclusion:

The Internet of Things (IoT) is making our lives easy, more comfortable and thus giving a better standard of life. It has touched virtually every aspect of the business right from day-to-day task of manufacturing, to complex task like mining and real estate. IoT is still in the very primary phases of implementation. But IoT deployments are likely to reflect the rapid adoption curves of other recent digital technology revolutions, beginning with the birth of the Internet and continuing with the rapid-fire rise of mobile devices, ecommerce and social media. Technology development has given ground for IoT implementation in many areas, including retail sector. Rapidly changing customer expectations and industry competition may require retailers to look at the IoT even more aggressively than they have other technology disturbances. Implementing universally accepted standards, a compliance regulatory body, proposing a generic architecture, emphasizing on standard Internet protocols and opting for vendor specific technology IoT can be made more realistic. The retail industry is looking forward to more unruly innovations from the digital dominion. The competition is high, and customers have curved choosier, only the most inventive can make an impact which also means the earlier adopter of Internet of Things will surpass their challengers easily. Security is another big challenge and having a compliance body could be the solution for most of the privacy and security concerns. With all these IoT is still rising at an exponential pace and promising to deliver better results in days to come.

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