# Internet of Things (IoT) technology and the future of payments (Case of Amazon-Go)

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**Abstract:**

        This paper aims to identify the current payment methods that are implemented through internet of things technology. After outlining the main ideas of the IoT concept and its payments, analyze its evolution and investment, focusing on the invisible Amazon Go payment method. The study found that there is a growing trend of IoT-based applications, and it will grow rapidly in the field of payment services. Moreover, Amazon Go is leading the way in IoT payments that are changing retail outlets.

**Keywords:** Internet of things; Payments; Amazon go; Retail.

**JEL Classification: O390; O310; G210.**

**Introduction**

The Internet of Things (IoT) is one of the cornerstones of the Fourth Industrial Revolution, as it represents the highest level of integration of people with the devices and machines in their environment.

The IoT is changing the way businesses, consumers, and even entire cities interact through connected devices. One of the main use cases that are expanding into the IoT is payment. Payment is now possible with a phone, wearable device or home assistant and is spreading to connected retail and car experiences. Consumers demand the ability to make payment wherever they are and with whatever device they use, they also want the transaction to be safe and seamless.With current developments in technology as well as global pandemics, it is now time for the payment market to rapidly develop its products, solutions and business models to reduce social interactions between people for the sake of their health. It is time to advance the payments sector through IoT network. Here, we must be asked the following problematic:

**How does this network of interconnected objects is changing the payment industry?**

In order to respond to the previous question, we have divided this paper into the following parts:

- A brief introduction to Internet of Things (IoT);
- IoT Global Market Growth & Forecast;
- Payments and IoT;
- A case of Amazon-Go.

**1- A brief introduction to IoT**

The Internet of Things is one of the biggest technological transformations in recent times, and it symbolizes the next stage of technological transformation that will change the lives of consumers, and change the way business is done.

**1-1 The concept of the internet of things**

Many definitions of internet of things (IoT) exist, since a universal definition has not been created yet:

The IoT enables intelligent operations and advanced communications for devices, smart things, systems and services. It is a new revolution in communication technology which means that everything will be assigned a unique identifier, so that it can be processed, linked to other things and information exchange **(Abdul-Qawy, Pramod P, Magesh, & Srinivasulu, 2015, p. 71)**.

"IoT means the ability to make everything around us starting from (i.e.Machine, Devices, Mobile phone and Cars) even (Cities and Roads) are expected to be connected to the Internet with an intelligent behavior and taking into account the existence of the kind of autonomy and privacy. The

principal idea of IoT is promoting the communication between anything from anywhere at anytime **(Ali, Ali, & Badawy, 2015, p. 37)**. This capability is enabled by several communication networks such as the internet, Near-Field-Communication (NFC) and Radio-Frequency Identification (RFID), microprocessors, or sensors **(Fiandrino, 2021, p. 30)**.

In simpler terms, the IoT describes billions of physical devices around the world that are connected to the Internet thanks to the ubiquitous spread of wireless networks. Adding sensors and processors to these devices adds a level of digital intelligence, enabling them to communicate and share data with other devices and systems over the Internet without the need for human-computer interaction.

## 1-2 Data Sources in IoT

There is Tow key data sources can be used to power the IoT innovations, namely Mobile Apps and Digital Sensors.

### 1-2-1 Mobile Apps

Due to the large number of mobile users, the mobile application is the primary IoT application and therefore the easiest and most reliable source of data that banks can utilize to generate market insights through mobile banking applications **(kumar, 2019, p. 951).**

The number of smartphones swelled to 1.4 billion in 2015, and each of these phones contains up to 20 sensors that provide data on location, speed, proximity, exercise, walking, real ownership, and physical acceleration 24/7 with more than one device **(Schulte & Liu, 2017, p. 42)**.

### 1-2-2 Digital Sensors

Digital sensors can be placed in physical units such as bank branches, ATMs and stores to analyze consumer behaviour. These digital sensors can report unexpected customer problems, service issues, and the ease of operation of ATMs and other automated devices **(kumar, 2019, p. 951).**

Because the vast amount of data is collected from many devices and may come in different formats, it must be converted into a standard format through big data platforms, and then processed before it can be used. This data helps consumers and organizations make better decisions about their future, saving time and energy. The challenge for organizations is no longer the technology, but the ability to derive value from the data they collect.

### 1-3 IoT communication models

There are four classical communication types for IoT environment that can be connected to anything at any time with any network topology and any service as follows:

### 1-3-1 Device-to-Device (D2D) communication

In this model, two or more devices communicate directly with each other, without an intermediary application server **(Kulkarni & Kulkarni , 2017, p. 89)**.The model is often used in applications that use small data packets of information for communications such as home automation systems **(Ali, Abu, & Harum, 2017, p. 13445)**.

### 1-3-2 Device-to-Application (D2A) communication

It presents a safe user-centric connection between IoT applications and smart devices that have been embedded to the human life using content-centric, messaging technology, cloud technology and sensor technology **(Souri, Hussien, Hoseyninezhad, & Norouzi, 2019, p. 5)**.

### 1-3-3 Device-to-Gateway (D2G) communication

This model often involves application software operating on a local gateway device that acts as an intermediary between an IoT device and a cloud service and other functionality such as data or protocol translation **(Lande, Meshram, & Deshmukh, 2018, p. 2)** .

### 1-3-4 Device-to-Cloud (D2C) communication

In this model the device itself connects directly to an Internet cloud service, using Wi-Fi connections and the IP network, This cloud server facilitates the exchange of data and control of communicationS **(Souri, Hussien, Hoseyninezhad, & Norouzi, 2019, p. 5)**.

It is important to know how to connect different IoT devices with each other and to research effective IOT communication models, to foster innovation and add value to the end user by enabling better access to the IoT device and its data.

### 2- Global development of IoT market

Products and services that use technology have been in demand over the years. Recently, IoT technology has attracted great interest due to the wide scope of businesses and industries to which this technology is associated, as it has exerted its influence on almost all industries across countries, under the idea that everything is connected to the Internet.

### 2-1 Global IoT revenue

The worldwide IoT market totaled around $389 billion in 2020, and is expected to rise to more than $1 trillion in 2030, more than double its revenue in ten years as represented in Figure 1.

The market growth is attributable to the increased adoption of cloud platforms and the lower cost of sensors. Furthermore, there are some unknown opportunities that have yet to be discovered and exploited, such as geographic expansion into emerging markets and the widespread implementation of IoT technology that is currently being replicated on a smaller scale. For a payment

system, this means greater access to diverse markets through more than one payment method in an instant.

**Figure number 1: IoT total annual revenue worldwide from 2019 to 2030 (in billion U.S. dollars)**
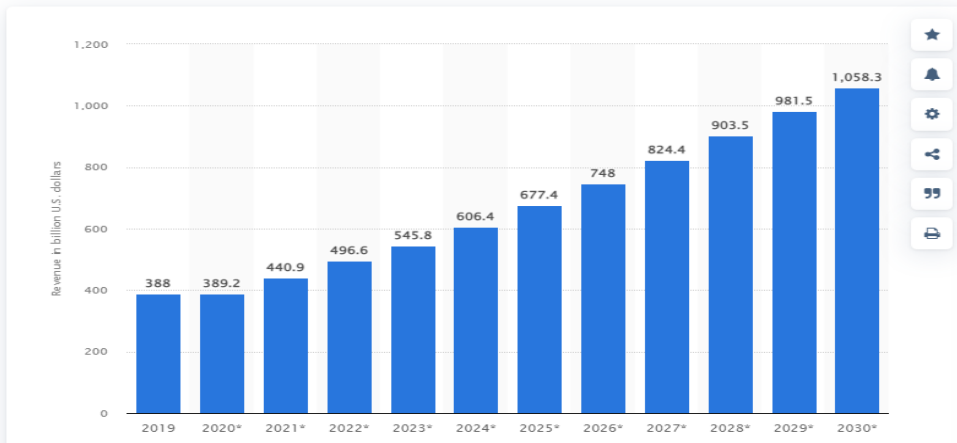


**Source: (statista, 2021)**.

## 2-2 Global IoT device adoption

Figure 2 shows a strong growth has been observed in devices connected to the IoT. It is estimated that the number of connected devices is growing much faster than the growth of the global human population, and is expected to reach 75 billion devices for 8.08 billion people by 2025. Compared to 20 billion devices for 7.48 billion people in 2017.

The COVID-19 pandemic and the quest by many organizations to provide IoT-based solutions to effectively overcome the crisis, the development of wireless networking technologies, the emergence of advanced data analytics, the availability of low-power technology, cheaper sensors and the massive expansion of e-commerce are some of the major factors driving the Increased adoption of the IoT by a wide range of sectors compared to the situation a decade ago.

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**Figure number 2: IoT device adoption**
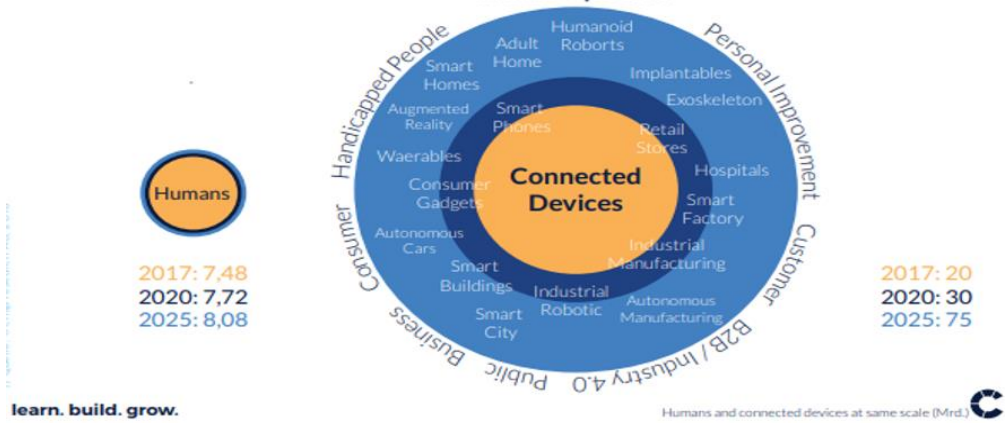


**Source: (Ried & Lemmermann, 2018, p. 5)**

**2-3 Iot entreprise spending**

Organizations spending on IoT is expected to reach $159.8 billion by 2021 from $128.9 billion in 2020 at a CAGR of 24% over the forecast period (2020-2021). and at a CAGR of 27% during the period (2021-2025), spending is expected to reach $411.9 billion in 2025 as represented in Figure 3.

The rise is mainly due to COVID-19, the new coronavirus, which has prompted organizations to rethink how they operate. Many employees have been asked to work from home. The effects of the pandemic have caused priority to be given to spending on technology that constitutes industrial revolution 4.0, and investing in connected technologies is no longer a luxury, but has become a necessity for survival and business continuity, and the Internet of things is no longer seen as an exploratory technology only.

**Figure number 3: IOT enterprise spending**
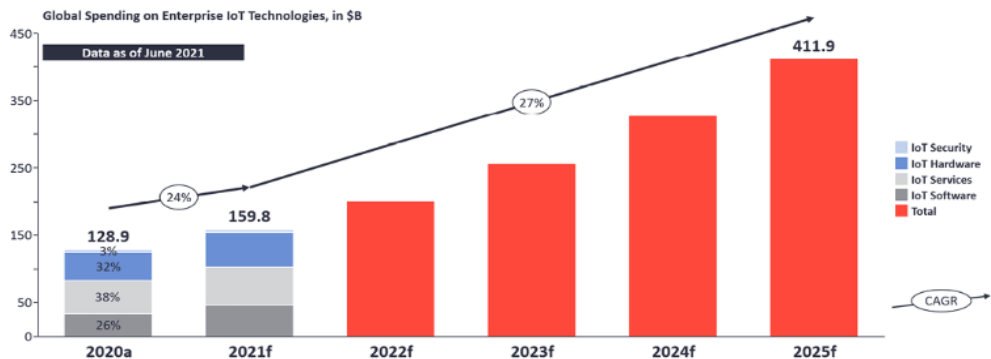


**Source: (IOT ANALYTICS, 2021)**

### 3- Payments and IoT

IoT opened the door to a range of applications and cooperation between industries that were not imagined in the past. This new technology has changed current business models, and has changed the way to innovation and created new opportunities to generate revenue. The revolution of Internet payments is the current field of applications and challenges facing IoT, this would pave the way for an emergence of a new "smart payment service" more attractive, change in consumer behavior and enabling it to make the payment process easily.

### 3-1 Definition and benefits of IoT payment

IoT payments are defined as payment transactions operated by IoT devices (including connected cars, home appliances, and wearables)," In parallel, the IoT is also changing the retail point of sale to include a number of new touch points, including parking meters, fitting room mirrors, and vending machines**" (Secure Technology Alliance, 2017, p. 6)**.

Three trends are coming together to drive the payment revolution across the Internet of Things (Acceleration of digital payments, massive growth in connected devices, The increased use of Artificial Intelligence). IoT payment revolution also brings a host of great benefits to it:

- For consumers, a truly frictionless experience for frequent or low-value purchases, saving them time and effort and reducing stress.
- For merchants, a seamless experience for their customers leads to higher conversion rates, increased revenue and more custom repeat.
- For all companies innovating new offerings based on IoT and AI, the ability to include automated payments in their value propositions to create innovative and comprehensive solutions for their customers **(Worldline, 2021, p. 4)**.

In this sense, the revolution of the Internet of Things along with other technologies such as artificial intelligence will inevitably lead to changes not only in the way society works, but also in the way payments are made, we will become more connected to our things and intertwined with markets, it is very difficult the users embedded in these systems must then separate themselves from this financial system.

### 3-2 Major IoT environments implementing payments

IoT payments can be implemented in a variety of environments, taking into account that some of the innovative solutions that currently exist and are not widely spread, and some are being developed, and more are expected to be integrated in the future, each environment will be explained in the following:

### 3-2-1 smart cars

Here are the types of financial transactions that can take place through a financially enabled car service

- **Buy-In Vehicle :**The connected car can act as a payment form agent for a variety of goods while the driver is in the car eg: gas/fuel; food (pre-order for drive cars); parking; fees.

- **Car Wallet** :The car has its own digital wallet, which allows it to make purchases or collect points through affiliation with reward programs. The smart car requires a digital ID and access to a digital card that allows it to make payments without any help from users inside or outside the car **(Fiandrino, 2021, p. 52)**.

### 3-2-2 smart retail

The retail industry uses IoT technologies to make invisible payments as there is no need for any physical interaction between buyer and seller. Connectivity between the merchant and customer devices allows the point of sale to be extended to include in-store surfaces such as mirrors, storefront windows and smart carts. Payment is made either in an app or through the devices' built-in contactless payment capabilities:

- **Smart Mirrors:** Through the application of augmented reality (AR) (enhancing the shopping experience for the consumer in the store), cameras and IoT devices, customers can use the smart mirror to compare different products, or to assist in purchasing decisions, allowing the customer to complete the payment process **(Secure Technology Alliance, 2017, p. 8).**

- **Smart Carts:** It uses RFID technology to scan the products and calculate the total payment price once the customer has finished shopping, this allows to avoid long queues **(Fiandrino, 2021, pp. 52-53)**.

### 3-2-3 Wearables payments

Wearables are a perfect form factor for payment, given their ability to process information with smart sensors and chips while connected to the Internet.Wearables include a trendy wristband, a fancy pair of headphones. Smartwatches and wristbands..etc **(Secure Technology Alliance, 2017, p. 7)**.

### 3-2-4 Smart Homes

Three enabled subcategories of payment are defined:

- **Smart Speakers:** Use hands-free, among its functions, to transfer money, shop online, access banking services, make person-to-person payments or even make donations.

- **Smart Refrigerator**: Allows identification of all products stored inside, and items that are about to expire. With this information, the user is able to place an order directly to an associated grocery store inside the refrigerator.

- **Other Smart Devices:** This category is integrated with things that are able to order their own supplies (batteries, coffee, ink, etc.). One of the services featured in this category is Amazon Dash. The Amazon Dash button allows customers to request renewals of the specific product associated with it **(Fiandrino, 2021, p. 54)**.

The payment scene is shifting towards a new world by integrating IoT technology, although it is sufficient to provide four types of environments that include different payment innovations, the need to reduce human interaction, especially after the crisis of the spread of the Corona epidemic, may push this type of technology to more Development is faster than ever. Payment networks (eg, Mastercard and Visa) and technological enablers (eg Samsung and IBM) help facilitate many IoT payment use cases.

### 3-3 Tokenization for IoT payments

Payment tokenization, which is the process of replacing sensitive data with a unique identifier that indicates but does not reveal confidential data. The token replaces the Primary Account Number (PAN) As an additional security measure, this card code can also be used to convert IoT devices into payment-enabled devices. For example, a connected car can host a token payment card, which allows payment from the car **(Worldline, 2021, p. 9)**.

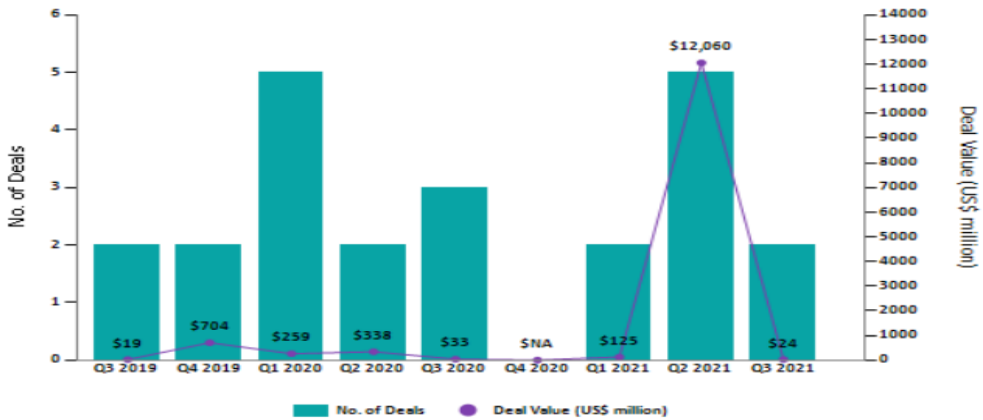### 3-4 IoT Market Growth & Forecast in Banking & Payments

The Internet of Things is one of the emerging trends that have contributed to significant changes in the banking and payments industries, it will be an important factor in completing the future payment process. The main objective of this technology is to customize the customer experience which means delivering products and services at the right time, in the right package and in the right channel, based on data processed in real time.

### 3-4-1 IoT deals in Banking & Payments

It is clear that the Internet of Things is on the cusp of tremendous growth in the world of financial services and payments, as it represents a new market for payment networks and financial institutions, especially after the global health crisis and its demand for a comprehensive reform of traditional banking and payments systems.

Given this background, it is perhaps not surprising that the largest number of IoT transactions related to the Internet of Things in the banking and payments sector reached during the first quarter of 2020, and the largest value of transactions during the second quarter of 2021 as shown in Figure 4 during a study GlobalData which analyzes the evolution and The value of the number of transactions related to the Internet of things in the banking and payments sector between Q3 2019 to Q3 2021.

**Figure number 4: Value and number of IoT-related deals in the Banking & Payments sector between Q3 2019 and Q3 2021**

IoT-related deal activity in the sector saw two deals in Q3 2021, marking a decrease of 60% over Q2 2021. Overall, IoT-related deal value in the sector totaled $24m in Q3 2021, when compared with $12,060m in Q2 2021.

**3-4-2 IoT venture financing deals in Banking & Payments**

Figure 5 shows that IoT-related venture financing deal activity in Banking & Payments stood at two in Q3 2021, indicating a decline of 33.3% over the previous quarter. By means of value, IoT-related venture financing deals in Banking & Payments totaled $24m in Q3 2021, a decrease of 60% when compared with Q2 2021.

Considering the financial advantages (reduced cost, increased customer loyalty..) as well as health related benefits (reduced interaction between people, reduced queues..) that IoT payment technologies bring, it is expected that it will not stop there, but rather the impressive growth will continue in Connecting more devices and developing new digital experiences for both consumers and businesses In the field of payment transactions, IoT will provide consumers with new and easier ways to pay, and provide merchants with better ways to authenticate payments.

**Figure number 5: Value and number of IoT-related venture financing deals in the Banking & Payments sector between Q3 2019 and Q3 2021**
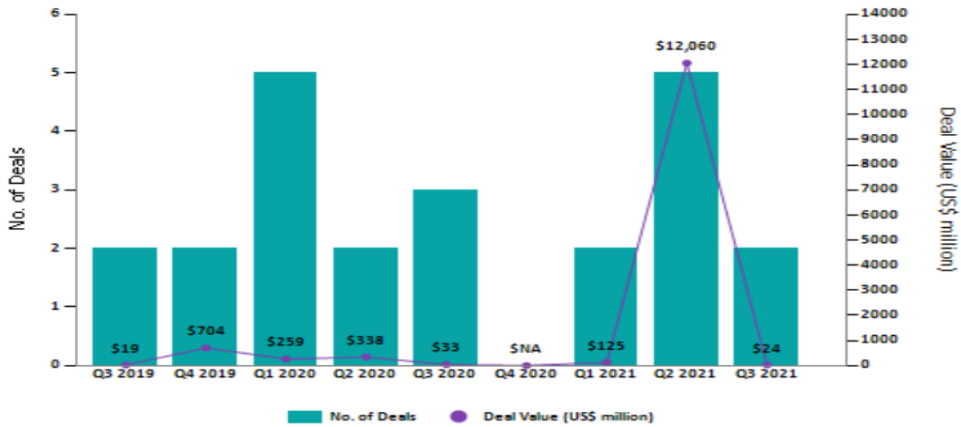


**Source: (GlobalData, 2021).**

### 3-4-4 Contactless Payment Market

Contactless payments refer to the ability to pay for goods and services without physical contact with customers. According to a study conducted by verified market research on the size of the contactless payment market during the period 2020-2028 shown in the figure 6, the global contactless payment market is expected to reach a value of USD 25.34 billion by 2028 from USD 10.3 billion in 2020 at a CAGR of 12.1% during the forecast period (2020-2028).

**Figure number 6 : Global contactless payment market**



**Source: (Verified Market Research, 2021).**

The development of innovations through the Internet of Things and other technologies has made it possible to make payments without physically contacting the parties involved. Mainly to help fight the virus during the global health epidemic, the World Health Organization has announced the use of cash as a possible means of spreading the virus.

## 4- A case of Amazon Go

Everyone is familiar with the queuing lines in retail, where shoppers struggle with standing longer than they would like to make a purchase of groceries or clothes.

### 4-1 The smarter future of autonomous retail

Autonomous retailing is a retail process where a physical store is aware of all elements involved—products, people, and activities—without explicit help from human workers. Autonomous stores allow shoppers to pick up products and walk out of the store, without going through a checkout lane. For example, Metro AG tested a RFID-enabled autonomous checkout store in 2003. IBM illustrated a similar experience in a RFID commercial in 2006. However, Amazon Go is the first known attempt to bring the concept to reality at scale. Since then, several retailers and technology providers, such as Bingo Box, Alibaba Tao Cafe, and Standard Cognition, have demonstrated similar proofs of concept (**Liu, 2018, pp. 336-337**).

As we explained in the section "IoT Payment Environments", retail includes Invisible Payments, which is an automated payment system that belongs to the concept of contactless payments. Amazon has become one of the leaders in the Internet of Things, and the innovation of Amazon Go shows how an IoT device combined with artificial intelligence and some other technologies can solve the creation of a contactless, independent, invisible, independent and instantaneous payment method.

### 4-2 Amazon Go, cashierless store of the future

In 2018, Amazon opened its Amazon Go store in Seattle Washington, a store where all deals are almost automatic, where customers can buy products without using a cashier or payment terminal, a result of the continuous advancement in information and communication technology that includes IoT (**Hamidi, Muhamad Yusof, & Shuhidan, 2020, p. 1541**).

The store works in conjunction with the Amazon Go app, creating a virtual cart with your products. The technology, powered by computer vision, Internet of things and deep learning, can easily identify products you have chosen or returned. So, after you leave the store, your Amazon account is automatically debited and you can get the receipt from the app in no time, including your payment details (**Bielskyi, 2020**).

Customers can also press "refund" on their app and receive money back for an incorrect or faulty item. Amazon said the store partly operates under an honour system, and it anticipates thieves will be in the minority (**Dougall, 2018**).

In terms of data extraction, it symbolized a great evolution for brick-and-mortar stores as retailers became able to monitor which items were placed

back on shelves and by which customers, therefore, taking a step further on understanding customer behaviour inside stores **(Soares, 2021, p. 12)**.

In response to the view that this is a lot like shoplifting, Amazon's system, powered by the Internet of Things and artificial intelligence, has led to severe restrictions on security. If you roll an item on the shelf with your shopping bag, and then take it off the shelf, you'll still be charged for that item when you check out, even if the cameras don't see you're taking the item off the shelf **(Benjamin, 2018).**

Speaking of Amazon Go flaws, IoT devices can cause privacy issues for consumers that are difficult to secure. In cases like Amazon's Payment-Free Store, massive amounts of customer data and payment information, product preferences, and even what they look like will have to be collected and stored by IoT sensors. A breach of this data could be disastrous for both Amazon and its customers **(Matthews, 2019).**

Another disadvantage of Amazon Go is the high cost of deploying hundreds of cameras and sensors with huge computing power for image processing **(Sarwar, et al., 2020, p. 2).**

On the other hand, the new Amazon experience has left many wondering what the future will be for those working in the retail industry. Amazon believes that no jobs will be lost, rather, The roles of those jobs are shifting **(Benjamin, 2018).**

From the above, the integration between IoT and artificial intelligence in the Amazon Go system is evident in that IoT devices collect large amounts of data that can feed machine learning algorithms to artificial intelligence to predict consumer behavior and the ability to effectively implement independent payments.

## Results

- The Internet of Things will be one of the most technological innovations in the coming years;
- Payments are the next big wave of innovation in the Internet of Things and their widespread deployment will soon be possible;
- The Internet of Things will provide consumers with new and easier ways to pay, and provide merchants with better ways to authenticate payments;
- Tokenization appears to be the currently preferred method for securing payment account information in IoT payment transactions;
- For companies around the world, the Internet of Things has passed the stage of being seen as only an exploratory technology;
- Attitudes toward cash have changed during the pandemic, as it has accelerated payments innovation and worked to develop low-touch transaction systems;

- IoT is already entering retail with the purpose of simplifying the customer path within a store;
- Amazon Go is driving the Internet of Things payments that are changing retail outlets.

**Recommendations**

- It is very important to further research the field of IoT payments, taking into account the possible forms and uses in the future;
- The traditional banking and payments systems must be overhauled;
- It has become imperative for people to adopt advanced payment technology during the recent global pandemic as it promotes social distancing;
- Organizations need to understand the capabilities needed to take advantage of the potential created by IoT payments and how they can transform their industry;
- Relationships between IoT device and network vendors and specialized payment service providers should be developed.

**Conclusion**

This article focused on IoT payments. Many of the IoT commerce use categories that have emerged so far are: connected cars, smart home devices, wearables, and retail. Judging by the growth of the IoT market and the increase in enterprise investment in it, the growth in the number of connected devices, the advances in artificial intelligence, the rise in the IoT payments market and the emergence of many applications, the IoT payments revolution is now a certainty rather than a possibility.

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