



IoT Solutions for Fintech and Banking Industry ***-Case Study of Visa_Inc's IOT payment innovations-***

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Abstract ;

The purpose of this study is to discuss IoT applications in banking and financial technology, highlighting concepts, challenges, and future directions, as well as presenting VISA's innovations in connected payments. The study concluded that connected payments products through wearables, connected cars and smart home devices are among the most important categories of IoT applications in banking and financial technology. Issues related to digital payments and security are the current area of challenges for the Internet of Things, and Visa contributes a unique ability to lead IoT payment innovations.

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1. Introduction

In the same way that the internet of things is said to be the fourth industrial revolution, which will affect all industries, finTech also represents the new technologies that can revolutionize the finance industry. Banks and fintech companies are now building a reputation for digital leaders and want to stand out from their competitors by leveraging the benefits of the Internet of Things. Although the banking and fintech sectors have yet to adopt the internet of things (IoT) technology as widely as its manufacturing or health, this is rapidly changing. Internet of things will open the door to a range of applications in the banking and financial technology sectors that were previously only imagined in dreams. New applications will also change existing business models, and will create new revenue generation opportunities. Simply put, it appears that the internet of things in finance technology will bring about a change in the way banking is done.

Here, we must be asked the following problematic:

How can IoT technology be used to improve banking and financial technology services?

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

- ✓ An Overview of IoT Technology;
- ✓ Global internet of things (IoT) market growth & forecast;
- ✓ IoT in banks and fintech sector;
- ✓ Visa_Inc's IoT payment innovations;
- ✓ Iot: challenges, threats and future scope in fintech and banking.

1.1 Objectives of The Study

- Understand the concept of the Internet of Things
- There is a clear gap in the literature, the study contributes to increasing literature on IoT applications in fintech and banking industry;
- -To understand how the Internet of Things is helping the fintech industry and banks to improve customer services;
- Introducing Visa's innovations in IoT payment;
- Identify potential threats and challenge;
- Exploring the long-term perspective of the Internet of Things in financial technology and banking.

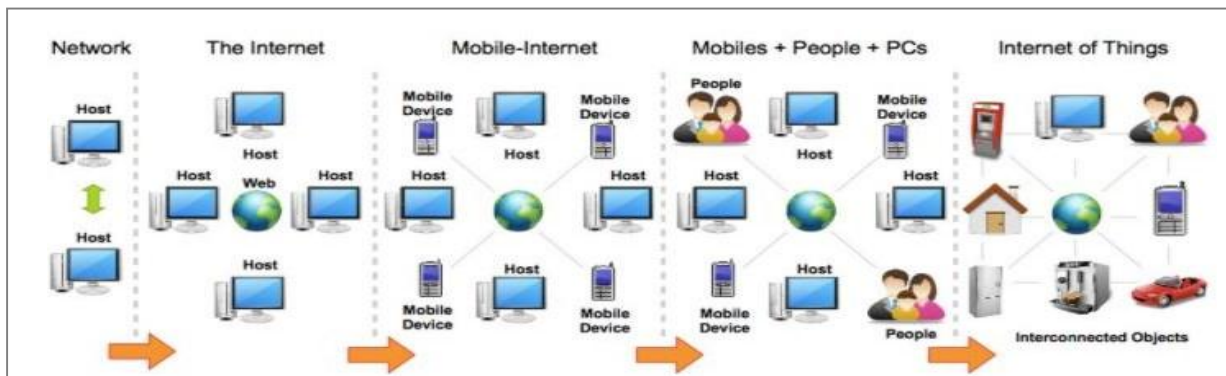
1.2 Search Gap: Since the concept of the Internet of Things is a seemingly new concept, not much research has been done in the field of Fintech and the banking industry, this paper attempts to bridge this gap by highlighting the total possible solutions for IoT technology in this field, while presenting Visa's innovations as a model. Exploring the long-term perspective of the Internet of Things in financial technology and banking.

2. An Overview of IoT Technology

2.1 Birth and Evolution of Internet of Things (IoT): The concept of a network of smart devices appeared as early as 1982 at Carnegie Mellon University, where a modified Coca-Cola machine became the first device connected to the Internet, able to report the stock of drinks and whether they were cold (Gokhale et al., 2018, p. 41). Before the term Internet of Things was first used in 1999, the concept of connected devices was not referred to as IoT, it was often referred to as "embedded Internet" or "pervasive computing" or "ubiquitous computing", etc. Despite the advent of the Internet of Things, it gained its importance from 2010 onwards (Maiti & Ghosh, 2021, p. 1), "IoT (Internet of Things), what we call it today, developed into a compact concept in 2013 with the growth in the usage of multiple systems modern technologies, from micro-electro mechanical systems to embedded systems, Web connection to cordless interaction and more " (Prasanthi & Kumar, 2019, p. 9246).

Today, thanks to the spread of wireless networks, something small or large can be turned into a part of the Internet of Things, by adding sensors to it to become more intelligent and responsive without involving humans. The Internet of Things can develop many fields such as industry, health, commerce, environment, etc.

Fig.1. Evolution of Internet of Things



Source: (Bakar et al., 2021, p. 66).

Figure 1 depicts the evolution of IoT in five phases. In the beginning, the connection was between two computers, then moved towards the creation of the World Wide Web by connecting many computers, until mobile devices were connected to the Internet and the so-called Internet through the mobile phone appeared. Then, through social networks, people's identities joined the Internet. Finally, a trend has emerged towards things connected to the Internet, whether they are individuals, animals, clothes, equipment... and this is what is called the Internet of Things.

2.2 Definition of IoT (Internet of Things): The Internet of Things 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 & Magesh, 2015, p. 71).

The internet of things (IoT) is a network consisting of devices of all types and sizes, vehicles, smartphones, home appliances, games, cameras, medical instruments and industrial systems, animals, people, buildings, and all information related to communication, sharing, positioning, and tracking, security and control, and even personal real-time online monitoring, process control and management (**Patel & Patel, p. 6122**)

According to the Internet Architecture Board, IoT is “a technology with a large number of embedded devices that employ Internet Protocols Communication Services and are not directly controlled by people”. It is a computing concept that depicts a future in which ordinary items, such as wearable gadgets or any other device, are connected to the Internet (**El-Aziz et al., 2020, p. 2**). Rather than addressing only Internet infrastructure, direction has dramatically changed to address our physical world, that including smart home security systems, autonomous farming equipment, wearable health monitors, smart factory equipment, and many more (**Sadiq et al., 2021, p. 1**).

However, I wish to define IoT as one of the greatest technological advances of this era, a network connection of billions of uniquely addressable devices to the Internet that allows data to be exchanged and transmitted through chips and sensors implanted between devices. Thanks to the Internet of Things, most electronic devices will become independent and do not need any human intervention. Internet of things devices may be everything that comes to mind. This technology can be applied in all sectors such as industry, health, transportation, agriculture, finance, etc.

In terms of how the Internet of Things works, it starts with sensors that collect data from their environment, the sensors may be part of a device that does more than just sense things.

An example of this is a phone is a device with more than one sensor (digital camera, accelerometer, GPS, etc.), then this data is sent to the cloud, which is a huge network of servers that provide different services, this data is analyzed and processed, Then the end user benefits from the information in the form of an alert, for example when the car malfunctions, the sensors send the data to the nearest auto repair shop, which in turn sets a date for the car to be repaired.

3. Global Internet of Things (IoT) Market Growth & Forecast

3.1 Total IoT Market: According to GSMA report, the global IoT market is expected to reach a value of USD 1.1 trillion by 2025 from USD 166 billion in 2016 at a CAGR of 23.38% over the forecast period (2016-2025).

Fig.2. Total IoT Market



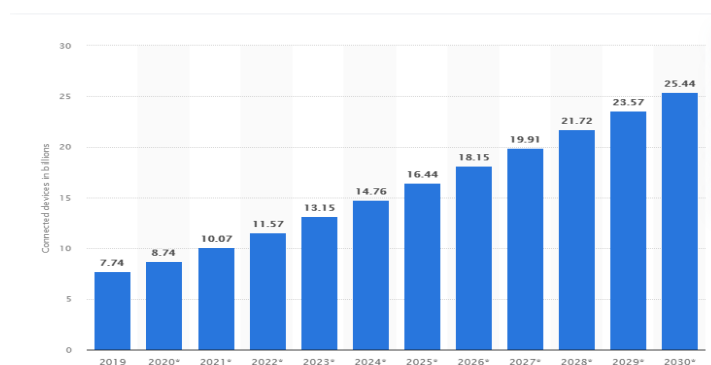
Source: (International Data Corporation (IDC), 2018, p. 5)

The Covid-19 pandemic and the quest of 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 falling cost of connected devices and the massive expansion of the e-commerce industry are Some of the major factors driving the global Internet of Things market to increasing adoption by a wide range of sectors.

3.2 Number of IoT Connected Devices Worldwide: “Things” is an important and essential part of the Internet of Things. They refer to any object on Earth whether it is a smart device, living entity, or even non-connected objects such as food, paper, chai..etc.

Figure 3 shows the evolution of the number of IoT connected devices worldwide from 2019 to 2030. The number of Internet of Things (IoT) devices worldwide is forecast to almost triple from 7.74 billion in 2019 to more than 25.4 billion IoT devices in 2030, By calculating the growth rate of devices during the studied period (2019-2030), we find it 69.57%, which indicates the speed of its development and the bright future that awaits the Internet of Things technology.

Fig.3. Number of IoT connected devices worldwide 2019-2030 (in billions)

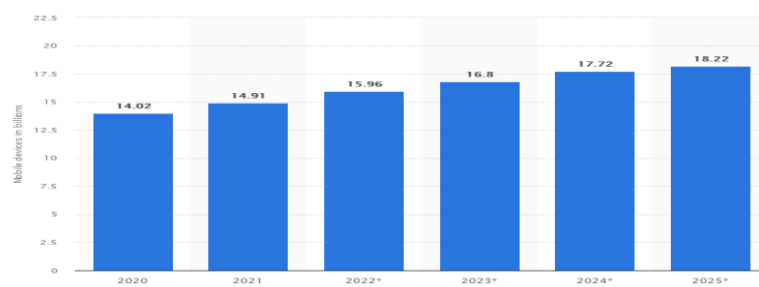


Source: (Statista, 2020)

This tremendous growth is due to the exponential increase in wireless data traffic with the increasing demand for data-oriented applications, the result is also due to the advantages offered by the Internet of Things (reducing time, reducing cost, speed in performing tasks, quality of service). This means that institutions and companies will have to be prepared to be more competitive in the global market.

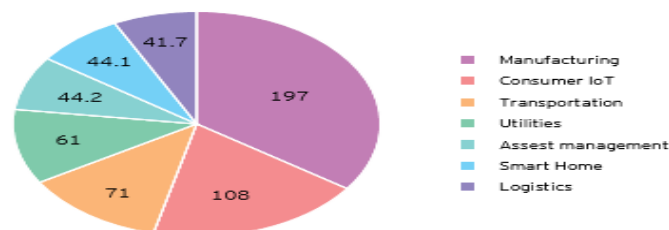
3.3 Forecast Number of Mobile Devices Worldwide: Figure 4 shows Forecast number of mobile devices worldwide from 2020 to 2025, The number of mobile phone users is growing exponentially, and the proof is that the number of smartphones swelled to nearly 15 billion in 2021, compared to just over 14 billion in 2020. The number of mobile devices is expected to reach 18.22 billion devices by 2025, an increase of 4.2 billion devices compared to the levels of 2020.

The importance of smart phones in the Internet of Things is shown in the ability to control many IoT devices through applications on smart phones, and therefore it is the most important market for innovation, it is the easiest and most reliable source of data that banks and fintech companies can leverage to gain market insights, given that every phone contains a number of sensors (digital camera, accelerometer, GPS, etc.) that provide data on location, speed, walking, etc 24 hours a day, 7 days a week.

Fig.4. Forecast number of mobile devices worldwide from 2020 to 2025 (in billions)

Source: (Statista, 2021)

3.4 IoT Spending Worldwide: Figure 5 shows the breadth of uses and applications of the Internet of Things, it will spend more on IoT solutions in the manufacturing sector, then consumer IoT, followed by transportation and utilities, with amounts estimated at \$197 billion, \$108 billion, \$71 billion, and \$61 billion respectively. This widening is due to the fact that IoT is just an umbrella term that refers to any device that can connect and communicate with the Internet, in theory it can cover almost any physical field.

Fig.5. IoT spending worldwide (in billions)

Source : (Rahul & Rajeev, 2019, p. 9)

We also note that the banking and financial technology sectors do not appear in the figure. These sectors are known to be conservative and more vulnerable to risks, and they are relatively slow in implementing technical innovations, due to the difficulty of putting the right regulations in place at the global level, and their reliance on outdated infrastructure that frustrates for innovation, the financial sector still needs to know the appropriate use of such powerful technology.

4. IoT in Banking and Fitnech Sector

4.1 General Framework of IoT in banking: Banks have always had abundant scopes and innovations, IoT has the potential to transform banking services and change the lives of customers, customers can now access their bank accounts from “anything” and “from anywhere”. Figure 6 represents the details of the bank that provides valuable services to the customer using IoT.

Fig.6. General framework of IoT in banking

Source: (Suseendran et al., 2020, p. 199)

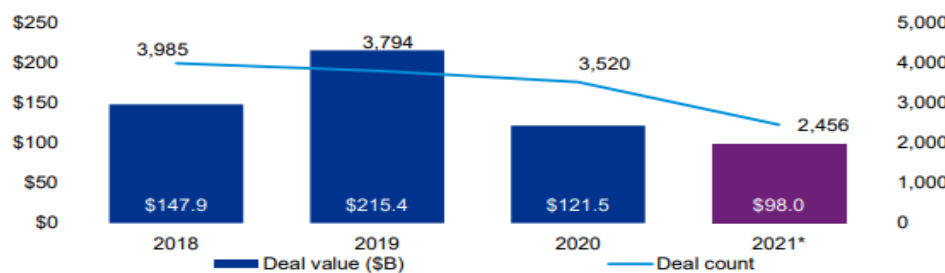
First, bank customers carry out transactions or inquiries using different devices that work with Internet of Things technology. Then the banks collect all the data and information about customers from those devices and analyze them to know customer behavior and preferences.

Based on this, banks introduce new options or services designed to meet the needs of customers, which helps to keep their customers interested in their services.

4.2 Fintech Ecosystem: “FinTech is a word created by combining “finance” and “technology,” and it can be said that it is the technology applying IT to the financial, Examples of FinTech products are new account settlement systems offered by financial institutions by using blockchains, information systems that smooth trading, and so on” (Nakashima, 2018, p. 62).

According to the financial technology report issued by “Wamda Lab” and “Beaufort” Company, financial technology is described as services that rely on technology to improve the quality of traditional financial services in a way that is faster, cheaper and easier to access. By creating new markets or acquiring a significant share in existing markets, by providing value propositions, fintech startups are small, up-to-date companies that promise to improve and improve financial services (Jonas et al., 2017, p.7).

The financial technology ecosystem is a variety of FinTech startups, Technology developers, Government, Financial customers and Traditional financial institutions, where efforts are integrated, providing growth opportunities for many sectors (Mehdiabadi et al., 2020, p. 12).

Fig.7. Total global investment activity (VC, PE and M&A) in Fitnech 2018-2021*

Source : (Ruddenklau, 2021, p. 8).

Investment in financial technology witnessed a rapid development during the period 2018-2021, both in terms of the number of deals and their value, punctuated by periods of decline. Total investment activity reached 147.9 billion US dollars in 2018, and 3,985 deals were concluded.

The rise reached a record \$215.4 billion and 3,794 deals were concluded in 2019, due to the strong activity in almost all regions of the world in the field of financial technology. Global investments in financial technology continued its remarkable recovery during 2020 and the first quarter of 2021 due to Covid-related digital acceleration.

4.3 The Relationship Between IoT and Fintech: The Internet of Things has given the Fintech industry an interesting boost, as FinTech applications are now generating huge volume of financial data from IoT devices (Munusamy et al., 2021, p. 1). Using this data, fintech companies and service providers can improve customer service, better manage risk, make decision, and improve security (Dey et al., 2020, p. 195).

Today in a financial organization the technological presence is not limited to the single but it affects multiple layers of operations such as management, processing and transfer of information to and from different layers of processing or transactions. It will be easy and possible by connecting different devices with the help of IoT (Maiti & Ghosh, 2021, p. 2). Though, there is still a room of challenges need to be carefully addressed before we can fully rely on such highly automated technology, considering the fact that the projection of having \$3.9 trillion to \$11.1 trillion per year in 2025 adding value to the global economy over IoT for FinTech technologies (Sadiq et al., 2021, p. 1-2).

While the Internet of Things is taking over new markets for financial technology companies, the latter is reluctant to start implementing the Internet of things because they are not sure whether the investment will benefit them or not, and they are also afraid about security issues for the industry, so one of the solutions that the Internet of things has taken is Make systems interconnected using artificial intelligence and protect them from data attacks, tampering and fraud.

4.4 Applications of The Internet of Things in Fintech and Banking Industry: Here are the possible applications of IoT in the banking/fintech sector that can make a big difference in the world:

4.4.1 Payments Using Wearable Devices: As the contactless payment infrastructure expands and matures at the point of sale, wearables are a perfect form factor for payment, given their ability to process information with smart sensors and chips while connected to the Internet (Alliance Activities , 2017, p. 7). Bank will give promotional alerts regarding new products and account balances while a customer is approaching a branch / ATM from wearable devices for instant updates. Banks may also incorporate incentives offered by various merchants, based on the quality of the balance of the customer's account and locality (Nordin et al., 2020, p. 12).

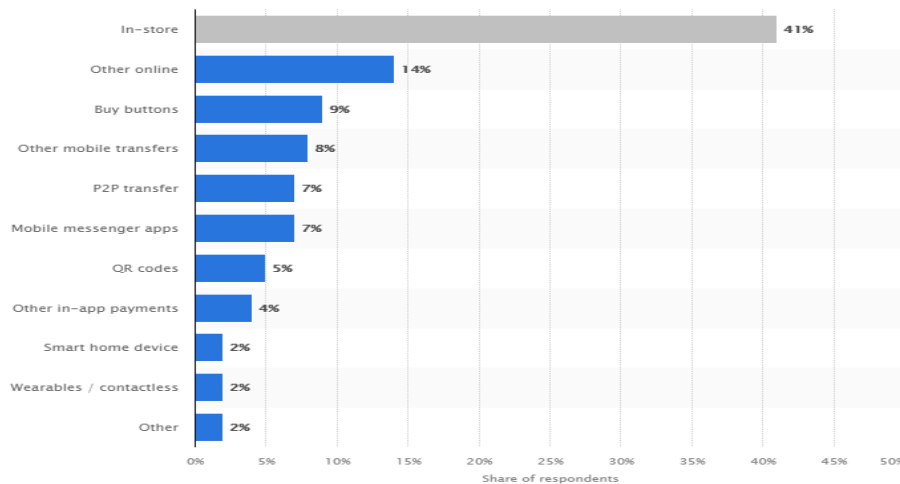
The creation of new devices by companies and the development of wearable options is likely to increase these transactions in the near future.

First we must note that the growth of wearable devices is synonymous with the rise of contactless payments, we note from Figure 8 that according to internet users around the

world the most popular payment methods for daily transactions in 2018 are: In-store buy buttons, (p2p transfer and mobile messenger transfer), QR code, and finally the payment by wearable. These technologies are limited to percentage usage rates of 41%, 9%, 8%, 7%, and 2%, respectively.

There is a significant drop in the adoption of contactless payments because some people see that there is no real advantage to using wearable technology compared to using credit cards, the other reason is the lack of unified points of sale for contactless payment technologies which drives the consumer to buy a smart watch for each store. Despite this, it is expected that payments through wearable devices will make great strides in the market in the coming years especially after the spread of COVID-19 because it will ensure hygiene and protection.

Fig.8. Most popular payment methods for everyday transactions according to internet users worldwide as of June 2018



Source: (Statista, 2019)

4.4.2 Fraud Prevention: IoT-enabled applications can identify transactions made by users with credit and debit cards. The main reason for identifying fake transactions is to create a secure environment and to secure the data resources of customers from black hat hackers. For instance, If the user pays for some products using a debit or credit card, the payment made by user should be verified with the server to determine user authenticity. If the credentials do not match, fake transactions can be blocked (**Bansal, 2020, p. 194**).

It is true that the IoT system detects fraud by tracking accounts and examining applications through data collected by sensors, but on the other hand it leaves the door open to fraud, as cybercriminals can exploit the vulnerabilities and insecurity of devices. Identity theft, customer data theft and privacy violation (this is what we will see in the IOT challenges section).

As a result, the Internet of Things is moving towards adopting other technologies such as artificial intelligence, blockchain, machine learning and deep learning to increase the level of security and privacy.

4.4.3 Capacity Management: The Internet of Things can improve capacity utilization in bank branches. By collecting, storing, processing and sharing customer data in real time, branch managers will be able to monitor the number of customers that enter the bank regularly, the amount of staff required to reach optimal performance, and improve capacity planning at each branch. (Nordin et al., 2020).

4.4.4 Connected Car Payments: A connected car can act as a payment form agent for a variety of goods and services, including ordering spare parts, fuel/ charging station, parking, gas, shopping, toll collection, food and beverage at car restaurants, by utilizing secure vehicle connectivity and technologies. Such as geolocation and voice-activated controls (Alliance Activities, 2017, p. 7). The payments can be remote, card-on-file payments or can leverage other means (e.g., NFC, Bluetooth Low Energy, QR codes) to exchange a secure payment token between the car and the merchant.

Connected cars can also host ATMs as the fleet of cars managed by Idea bank is allocated a safe deposit box and an ATM that can reach customers, the average deposit at a car-based ATM was found to be three times the average deposit at a standalone branch (Ramalingam & Venkatesan, 2019, p. 2036).

Table 1. In-vehicle Payments – Industry Collaborations

Industry Collaboration	Product & Services Description
Honda and Visa (2018)	In-vehicle fuel and parking payment solutions
GM and Shell (2018)	In-vehicle fuel payment
	Pre-purchase drinks
	Pre-book restaurant reservations
Hyundai and Xevo (2018) (Signed on Merchants for this include Chevron, Texaco, ParkWhiz, and Applebee's)	In-vehicle fuel payment
	In-vehicle parking
	In-vehicle purchase of drinks
Mastercard & HERE Technologies (2019)	Develop next generation of connected vehicle services
Honda & Connected Travel (2019)	Integrated services vehicle dashboard – Dream Drive
Visa & SiriusXM Connected Vehicles Service (2019)	In-vehicle payments solutions - allow drivers and their passengers to shop and pay for coffee, find and pre-pay for gas, locate and pay for parking, purchase movie tickets, pay tolls.
Mastercard & Daimler (2020) -Investment in Fintech Thinxnet subsidiary of Ryder	In-vehicle marketplace for fuel, tolling and others.

Source: (Maynard, 2020,p3)

In October 2016, Mastercard announced that it was working with General Motors (GM) to develop the OnStar Go platform, a new cognitive mobility platform that enables drivers to pay for transactions (Alliance Activities, 2017, p. 10).

The development of the Internet of Things will make the connected car an important role in the payments sector in the future, providing multiple opportunities for the driver and passenger. This will be achieved by the joint cooperation of car manufacturers and financial technology companies for payments or financial institutions such as banks, some car manufacturers have already started to provide payment services as shown in table 1.

4.4.5 Virtual Money: Blockchain is a technology that has revolutionized many economic sectors, starting with banking and insurance. The customer can use it securely and without central control to store and communicate information. Blockchain can be used to help

address some of the IoT security challenges, as storing data generated during the IoT in the blockchain is considered a second layer of protection that is difficult for cybercriminals to (Bakar et al., 2021, p. 67).

Blockchain also ensures that data will not be changed due to its high encryption. The decentralization feature of the blockchain ensures that the failure of a particular IoT device does not affect the entire network, while decentralization poses a risk to the distribution of sensitive data.

4.4.6 Smart Branches: Transforming a retail bank branch into a smarter branch could allow, by using video analytics and sensors, to judge the retail banking experience. The same can be used to monitor threats (Ramalingam & Venkatesan, 2019, p. 2036).

Due to the covid-19 epidemic, banking branches have started to build a smart banking infrastructure based on the Internet of Things so as to provide a better customer experience.

4.4.7 Smart Home Assistants: Smart home devices provide various opportunities for payment, for example, capital One in the United States currently makes it possible for customers to pay their bills through Amazon's Alexa, and the UK's challenger Starling Bank is also letting UK try different things with Google Home, orchestrating its API with a smart speaker to empower clients to bring equalisation issues and instalments through voice directions (Bakar et al., 2021, p. 69).

4.4.8 Smart ATMs: Smart ATMs enable the use of sensors and biometrics to improve the customer experience and to combat card or PIN tampering and fraud in general. For example, physical attacks can be prevented by sensing if the user is under threat, and by detecting if a gun or knife is being held (Anjalin Joy, 2021, p. 388).

4.4.9 Insurance Benefiting from The Internet of Things: Insurance is the biggest beneficiary of IoT device data. Half of all sensors that will give important data for risk assessment in new ways will be in the insurance sector (Schulte & Liu, 2017, p. 48). For example, car insurance companies are working in partnership with technology companies and telecom service providers to install sensor-based remote IT solutions in cars, to track driver behaviors in order to increase the accuracy of risk assessment and pricing policies (Rayes & Salam, 2019, p. 245).

The insurance industry has recognized the need to quickly adapt to the digital landscape, as the COVID-19 pandemic poses new challenges to creating more efficient and adapted insurance products. Nevertheless, data privacy remains a major concern for insurance companies.

4.4.10 Leasing Finance Automation: The Internet of Things enables real-time monitoring of assets. Lease finance automation is used to detect asset usage and bill customers based on usage. This enables the leased asset to be remotely disabled in the event of a default. This technology also enables daily leasing of a wide range of digitally enabled assets (Ramalingam & Venkatesan, 2019, p. 2036).

4.4.11 Smart Collaterals: With the digital identity of people and things, IoT technology can enable banks, after a loan is issued, to monitor the quality of collateral in real time by monitoring the state of assets and judging whether they are physically held or not. So that

the bank may deactivate the assets remotely, in the event of non-compliance by the customer (Khanboubi et al., 2019, p. 79).

4.4.12 Wallet of Things: The term wallet of things refers to the concept that smart devices can be embedded with a payment function. Banks have automated payments through the Internet of Things, for example, digital wallets have been added to mobile phones, wearables and smart home assistants (Suseendran et al., 2020, p. 204).

4.4.13 IoT for Smart Contracts in Bank: Smart contracts are simply software stored on the blockchain that run when predefined conditions are met. A smart contract powered by the Internet of Things has a lot of potential in terms of automating processes, mitigating operational risks and improving the consumer experience, for example, a product can be financed by a bank and a party can be linked. Contact the product. The product can remind the customer to pay on time to keep the usage intact (Parida, 2021, p. 2).

4.4.14 Debt Collection: It takes a lot of effort and costs for lenders to collect their debts. Monitoring the operations and supply chain activity of debtor companies using IoT sensors and networks can help determine their willingness to pay. Likewise, the Internet of things (IoT) network associated with ATMs, card readers, and other point of sale devices can be used to assess the borrower's expenditures and income to determine their ability to repay, thus curbing further expenditures for defaulters (Ramalingam & Venkatesan, 2019, p. 952).

4.4.15 Crowd-Based Financing: The crowd-based financing mechanism is based on collecting small amounts from a large number of individuals via the Internet platform to finance a specific project. It takes advantage of the Internet of Things using its new technologies, terminals and platforms. Borrowers' quality and payment habits can also be analyzed by evaluating their data on different IoT devices (Khanboubi et al., 2019, p. 79).

4.4.16 Wealth Management Personalization: Use data mining techniques to produce insights into asset management is a standard procedure. The Internet of Things in banks can only increase the quality and pace of knowledge collection and expand the spectrum of accessible insights (Nordin et al., 2020, p. 13). IoT-enabled wealth management applications can often warn consumers if their financial security is under attack.

4.4.17 Personal Financial Management (PFM): Personal financial management (PFM) refers to programs and methods that help clients manage their money, and get an accurate picture of their accounts, income, and expenses. The data generated by the Internet of Things helps the future generation of PFM tools for banks to provide more personalized services to their customers. For example, by creating alerts or signals to track customer consumption (Khanboubi et al., 2019, p. 80).

4.4.18 Know Your Customer (KYC): Banks implement a 'know your customer' program to verify customer details in order to prevent fraud and money laundering. IoT combined with identity digitization will assess and change the financial behavior of customers to provide appropriate services and products (Bakar et al., 2021, p. 67).

4.4.19 One Touch Multi-Banking: Banks implement a 'know your customer' program to verify customer details in order to prevent fraud and money laundering. IoT combined with

identity digitization will assess and change the financial behavior of customers to provide appropriate services and products (**Gourank et al., 2020, p. 48**).

5. Visa_Inc's IoT Payment Innovation

The Internet of Things (IoT) is changing the way businesses, consumers, and even entire cities interact through connected devices. As these devices expand, almost any of which can include a payment experience, Visa has a unique ability to drive IoT innovation by providing technologies that enable partners to innovate. These new ideas will ultimately shape the future of payments.

5.1 Visa Ready for IoT: Visa has created an initiative called the Visa Ready Program for the Internet of Things. This gives IoT device manufacturers a pathway to embed secure payments into their connected devices that meet Visa and EMVCo security standards and specifications, allowing anything to initiate payments from the watch to the car (**Visa, 2017a**).

Visa Ready's strategic partners (Accenture, Coin, Fit Pay, Giesecke & Devrient (G&D), Samsung) can provide payment expertise and technical integration support for IoT innovators to facilitate payments. They will also be token applicants through the Visa Token service (**Visa**).

Pushing towards connected payments via the Internet of Things is a smart growth method for Visa. It guarantees a clear benefit by making spending simpler, which in turn increases revenue. It's also an opportunity to gain market share, and Visa likely wants to keep pace with MasterCard, its biggest competitor.

While businesses remain skeptical about the IoT hack that has prevented consumers from making widespread payments on wearable devices, visa has created a visa token service to protect its customers from fraud.

5.2 Visa Token for IoT: Visa Token is a new security technology from Visa that replaces sensitive account information on payment cards, such as a 16-digit account number, with a unique digital identifier called a token. The token allows IoT payments to be processed without revealing actual account details that might be compromised.

To drive widespread adoption of this new and exciting payment solution, the Token Service Provider Program was created. Token Service Providers (TSPs) are third-party participating companies that have passed the Visa Ready certification process and are able to securely connect token requests (such as merchants with card credentials) to the token platform (**Visa**).

5.3 Visa Partnerships in IoT Payments: A potential rapid wave of new payment technologies is approaching, so having both the partner network and the right technology is key to making payments on these devices, partnerships for Visa are key to innovation in IoT payments. It is also likely that consumer-facing IoT companies will gain much from enabling payments in their devices, including improving device value, being able to sell products through the device, and laying the groundwork for future opportunities to earn

increased revenue. The first companies to join the Visa Ready program will focus on payments for wearables and cars.

5.3.1 Visa & IBM Collaborate to Bring Payments to The Internet of Things: Visa and IBM have teamed up to allow businesses to offer secure payment experiences across the Internet of Things, making cars, devices, and many other connected devices potential selling points. This collaboration brings together IBM's Watson IoT platform, used by more than 6,000 IBM customers including businesses and governments, with Visa's global payment services, used by more than 3 billion consumers globally (**Visa**).

5.3.2 Visa & Fitbit Ionic: On August 28, 2017, Visa announced that it is making Visa payments available on the first Fitbit smartwatch - the Fitbit Ionic™. Eligible cardholders from participating banks will be able to pay using Fitbit Pay™. Fitbit Pay provides secure payments through the Visa Token service. Active account holders can leave their wallet at home and pay with the touch of their wrist (**Visa, 2017b**).

5.3.3 Visa & Garmin® Vívactive® 3 Smartwatch: In August 31, 2017, Visa announced that it's making payments available on the new Garmin vívactive 3 smartwatch, allowing people who are always on the go to pay with a tap of their wrist instead of hiding their cards or cash in socks while working out (**Visa, 2017b**).

Garmin Pay is easily accessible from a compatible Garmin watch, a special passcode is entered, the appropriate credit card is selected from the virtual wallet, and the wrist is placed near the card reader. Garmin takes the security of payment information very seriously, every time a purchase is made. The purchaser card number is not stored on the device or on Garmin Pay servers. It is also not passed on to merchants upon payment (**Garmin, 2021**).

The Internet of Things is not only creating solutions for payment in cars and watches, but we are likely to see many use cases that integrate with IoT and payments such as refrigerators, machines, smart speakers and even city infrastructure.

Seamless payments have become a basic need in our daily lives, especially in the era of COVID when consumers are spending more time at home, in vehicles and on devices. Moreover, consumers have become more technically efficient, so their expectations for seamless experiences have increased, by making payments possible on any device connected to the internet.

6. IoT: Challenges, Threats and Future Scope in Fintech and Banking:

6.1 Challenges and Threats of IoT for Banking and Fintech: Even though IoT would greatly benefit the fintech and banking industry, there are still significant threats and challenges that need to be considered and resolved before adoption in these environments.

6.1.1 Data Privacy: The EU Commission report on the IoT, CERP-IoT, has identified security and privacy as a major IoT research challenge, including: privacy preserving technology for heterogeneous device sets, models for decentralised authentication, trust, energy-efficient encryption, data protection technologies, security and trust for cloud computing, data ownership, legal and liability issues, repository data management, access and use rights, rules to share added value, responsibilities, liabilities, artificial immune systems solutions for IoT, secure, low cost devices, integration into, or connection to,

privacy preserving, frameworks, and privacy policies management" (Perera et al., 2015, p. 3).

With huge amounts of data being collected by banks and financial technology institutions about customers, ensuring the privacy of this information has become mandatory especially for sensitive data.

6.1.2 Data Security Risk: Banks or fintech companies collect and process a lot of data from customers and use it in their records. A data breach may occur resulting in damage to the customer's relationship with the bank/fintech company (Ramalingam & Venkatesan, 2019, p. 2037).

A data breach may occur due to improper encryption where a hacker uses malware to alter the system and secret code that can compromise data, for example cybercriminals may change low value payments into high value payments. Data processing can also be a means of illegally obtaining data that contributes to a data leak or data breach (Suseendran et al., 2020, p. 201). Weak passwords can also be a reason for hacking.

6.1.3 Data Density: The Internet of Things provides a wealth of data, as processing all the data can give customers more choices. Psychologists theorize and gather evidence that an increased level of choice can contribute to anxiety, confusion, and inability to choose (Ramalingam & Venkatesan, 2019, p. 2037). On the other hand, it seems expensive to store and secure big data. Organizations also do not have the systems available to test for errors, so data quality is not always accurate (Nordin et al., 2020, p. 13).

6.1.4 Complex Infrastructure: The Internet of Things is a complex infrastructure consisting of four parts (objects, transmission, storage, interfaces) and it needs protection and supervision (Dorsemaine et al., 2016, p. 1), any failure or omission in a particular software or hardware will have serious consequences for the network as a whole and there may be a loss of the most important data.

6.1.5 Lack of Unified Standards: There is serious lack of unified standard for IoT & achieving an industry wide acceptance of one unified standard is a huge challenge (Singh & Singh, 2015, p. 1579), this lack can lead to a flaw in the functionality of IoT.

6.1.6 Market Readiness: The Internet of Things market is still undeveloped and not ready on a large scale. The uncertain business environment and the lack of government regulations, policies or other indicators are the most likely reason for this, leaving entrepreneurs and companies unsure of how potential future business will be affected by subsequent government actions (World Bank Group, 2017, p. 27).

6.2 Future Scope of IoT: The Internet of Things provides more search opportunities, here are the most important opportunities related to fintech and banking industry (Ramalingam & Venkatesan, 2019, p. 2038):

6.2.1 Intelligent Banking: The interplay between the Internet of Things, big data analytics, deep learning and artificial intelligence is a research topic based on different banking requirements.

6.2.2 Security and Compliance: Today's hackers are much equipped with smart tools and algorithms to hack complex IT systems and data centers. Security and compliance is an area of research that needs more research, especially in the financial field in general, to bridge the vulnerabilities gap.

6.2.3 Sustainable Energy: Today, solar energy is one of the cheapest avenues of energy available and fintech initiatives like SolarCoin are driving the global transformation by rewarding solar energy producers with an energy reference digital currency. Developing countries also contribute equally to the development of green finance initiatives based on IoT technologies such as M-Pesa, M-KOPA, BanQu and others. IoT-based Fintech solutions will be able to reduce the trade-off between energy demand and BFSI's green goals in the future (Maiti & Ghosh, 2021, p. 3).

6.2.4 Many of the “everything connected” devices still popping up in society today will become commonplace by 2030, and the real factor of all that connectivity will be a trusted digital identity provider with digital currency and advanced/customized algorithms that will make the underlying technology behind them entirely the viewer. Banks and fintech companies will naturally be suited to this role (Bekker, 2019, p. 16)

6.2.5 Payment technologies will be available in a range of clothing and accessories that enable you to communicate, plan and pay without having to reach for your wallet or phone. Built-in batteries will be thin, flexible and efficient, reducing or possibly eliminating the need for recharging. Clothing will be packed with technology, making what you wear functional and comfortable, all while reducing the burden of multiple screens (Visa).

7. Results

- There are still very few studies exploring the adoption of the Internet of Things in the Fintech and banking sectors in general;
- The Internet of Things is still in its infancy, but it promises a brighter future;
- The security threats of the use of the Internet of Things in banking services are on the increase, as data breach and security threat are among the most prevalent problems in the era of the Internet of Things;
- Banks will be able to track and analyze consumer behavior and will be able to deliver a personalized experience to their customers;
- The data source brought by IoT processing will make banking products more adapted to customers' personality and choices, and will provide more applications in FinTech;
- Great strides have been made regarding wearable payment technologies in recent years;
- Wearable devices and connected cars are among the most important categories of connected payments products;
- IoT payment innovation requires the integration of a large number of technologies to thrive, for example, artificial intelligence, blockchain, biometrics and digital identification;
- Visa has the unique ability to lead IoT payment innovation;
- Visa secures payment functionality for the Internet of Things with Visa Token;

- Today, Visa payments can be made with smartwatches such as the Fitbit Ionic™ and Garmin® vívoactive® 3.

8. Recommendations

- Conventional banks have to rethink how they operate and their services to respond to digital transformations;
- More studies and research should be done on this subject as IoT devices are on the way to spread;
- Banks and fintechs must integrate IoT into their systems to increase market share by providing services that meet customer needs based on real-time processed data;
- Strong authentication and data encryption mechanisms must be implemented to protect and secure Internet objects;
- IoT device manufacturers and IoT applications must be ready for security suggestions with an appropriate exit plan to secure the maximum data in a security attack or data breach;
- The government must search for legislation to organize and manage the activity of Internet devices;

9. CONCLUSION

Fintech and banking industry are supported by the addition of sense points such as IoT-based devices that provide better quality data in real time for processing and decision making for scale. The Internet of Things offers new opportunities to solve problems. The Internet of Things is changing the face of finance and banking. End users will be able to do almost everything easily, from anywhere and anytime online.

Internet of things successfully injected new concepts and breathed new life into banking and fintech. FinTechs / Banks do all that is possible to take advantage of Internet of things trends accelerated, they must be in a position to exploit this technology to seize the opportunity to provide personalized and specific services to their client. finally, we can say that the power of the IoT is a double-edged sword, the proliferation and interdependence that makes it strong and effective are the same characteristics that make it vulnerable.

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