Internet of Things in Smart Banking: Hopes and Challenges

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Abstract— **Banking services are one of the essential parts of our daily lives. People conduct almost all financial transactions through banks. Now we cannot do without digital activities. Manual banking operations have some unavoidable limitations, such as slow fund transfers, vast documentation, huge manpower, etc. The internet of things (IoT) is a gift of the digital world. It has diverse functions in various fields, including banking operations. This paper sketches a current scenario on the hopes and challenges of the IoT application in digital banking services based on the database reports. We performed an up-to-date (July 2023) literature survey using some nominated keywords in the Google Scholar database. The findings demonstrate that IoT has many important operations in current banking systems worldwide. It opens a new window for rapid and efficient services in the banking system. However, IoT technology also has some shortcomings that should be solved to provide safe, effective, and efficient banking services to consumers. Taken together, the IoT might be an interesting network for digital banking services.**

Keywords— **Smart marketing, Wireless networking, Banking service**

I. INTRODUCTION

We live in the modern era; in this modern era, banking service is undergoing a significant transformation due to technological advancement and changing customer demand and expectations [1]. Most customers are shifting towards digital services. They want to get access to their account through mobile applications to make transactions, get financial information, and also get 24/7 services [2]. Through the use of artificial intelligence (AI), banks can realize customer preferences. There are a lot of scopes remaining for modern banking services, including account opening, loans, mortgages, credit cards, etc. The major functions of banking services include accepting deposits, providing loans, facilitating payments and transfers, managing customer accounts, offering financial advice, and ensuring the security of transactions. Banks play a very

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important role in economic growth, channeling funds for investment, etc. [2, 3].

Manual banking services were an ancient idea and present several difficulties in today's digital age. In this service, customers physically wait in line at bank branches during the brief hours they are open [4]. Manual banking service involves gigantic paper, faces lots of security, changes in error, delays, etc. All activities are done manually, so it is a lengthy process. Customer physical appearance is mandatory, so it takes lots of time [5].

Digital technology has significantly changed the banking sector. With the help of the internet of things (IoT), customers can now easily operate their banking services. Now the customer does not need to go to the bank physically. From starting to opening a bank account to closing, there needs to be a physical appearance of the customer in the bank [6]. With digital banking, users may access their accounts whenever they want to check their balances, make payments, transfer funds, or apply for loans. They can operate their account by using different IoT, like mobile banking, SMS banking, internet banking, automated teller machine (ATM) booths, etc. Through digital banking services, the customer gets 24/7 service, which increases the workforce and also creates a dynamic workplace [7, 8, 9]. Therefore, the hopes and scope of the digital banking system mostly depend on advanced uses of IoT in all kinds of banking services. The main role of the IoT is to interconnect devices through the internet, which helps enable data exchange and communication. IoT devices can provide real-time information, and through the use of AI technology, organizations can measure their customers' needs and wants and offer their products according to those needs. IoT enables cameras, sensors, and monitoring of the whole banking infrastructure, which improves the security of the organization [9, 10, 11].

This paper aims to summarize the applications and challenges of IoT-based technologies in digital banking systems based on up-to-date database reports.

II. METHODOLOGY

A. Search strategy
Data were searched in the Google Scholar database with the main keyword "banking service", which was then paired with the secondary keywords "digital system", "internet of things, or simply IoT", or "modern technologies" until June 2023. No language restrictions were imposed. Following are the inclusion and exclusion criteria for database evidence.

B. Data inclusion criteria
  a) Digitalized banking information;
  b) IoT application in the banking system;

c) All kinds of banking services are governed by IoT or digital technologies.

C. Data exclusion criteria
   a) Data repetition or duplication;
   b) Digital or IoT-based networking implementation other than banking operations;
   c) Titles and contents not meeting inclusion criteria.

III. RESULTS AND DISCUSSION

A. Database findings

A total of 1010 pieces of evidence were seen in the Google Scholar database until July 2023. Among them, 710 articles were discarded due to repetition of information, and 200 were non-relevant to the banking service. Only 10 articles were excluded after reading the title and contents. Therefore, this paper included 90 articles based on the above-mentioned inclusion criteria. Among these 90 articles, 50% were related to fund transfers; 20, 20, and 10% were related to customer service, account opening, and loan sanction, respectively.

B. IoT Networking System in Banking Service

The IoT networking system proves to be a revolution in the banking sector as it helps to enhance the services of the banks. It enhances customer service and also concentrates on security. The application of IoT in the banking sector is given below:

Smarts ATMs: Smart ATMs are automated teller machines that simplify the process of dispensing cash. Smart ATMs are used to ensure better monetary control for customers by reducing the chances of fraud. Using ATMs, the majority of banks disclosed their branches and moved to digital banking services. Through smart ATMs, banks offer services like account opening, cash deposit, and withdrawal or fund transfer. These encourage customers to self-service, reduce hazards for the banks, and make the operation more effective [12, 13, 14].

Branch Operations: IoT makes banking operations easier than ever. By introducing IoT, banks can reduce the cost and time of branch operations. Apart from that, the IoT helps to track and monitor assets and infrastructure most easily. The IoT sensor works to make a pattern for every customer by monitoring their patterns of using different banking services. This helps the banks provide a customized service for every customer [15, 16].

Security and Surveillance: Through IoT, banking security becomes top-notch and reduces the chances of robbery and fraud. The IoT-connected surveillance cameras work continuously to monitor suspicious activities, take control of the access points, and give real-time signals to the security personnel [17, 18].

Asset Tracking: Through IoT devices, the bank authority can track valuable assets like cash shipments, timely delivery of assistance, and proper transactions as well [19].

Smart safes and vaults: Through IoT devices, security becomes stronger as it provides smart safes and vault facilities. The smart safe and vault IoT device provides extra security as it measures the temperature, humidity, and other necessary concerns to ensure better security of the vault [20].

Payment Terminals: IoT devices help ensure a smooth and safe transaction through cards. It also provides remote diagnostic and maintenance services. The payment terminal is triggered by IoT devices with high autonomy [21].

Customer Experience: Through IoT devices, banks can design more personalized services for every customer. Targeting different customers from various locations can start the promotional activities. Through digital signage, banks will get real-time assistance, which makes location-based promotion easier for them [22, 23].

Risk Management: IoT devices are effective in risk management as well. The IoT sensors monitor the condition of the environment in different data centers and storage facilities. It gives a warning about the equipment that may fail in the future [24].

Loan and Mortgage Processing: IoT also has property assessment tools for real-time property evaluation and risk assessment. By using real-time data, the lender has the advantage of assessing the credit risk, and it also offers interest rates in a personalized way [25].

ATM Cash Management: IoT sensors can also monitor the cash levels and condition of currency in the bank's ATMs. This gives the banks an idea for future replenishment of cash in those ATMs through these IoT sensors [26].

Remote Banking: By using IoT devices, banks can offer remote banking facilities to their customers. With this service, customers can conduct transactions, check the balance in their bank account, and manage the financial activities of their account by using their smart devices [27].

Fraudulence Prevention: The IoT sensors and data can help the banks easily detect any kind of fraud activity by monitoring different things such as the pattern of the transaction using real-time data, consumer behavior, etc. This helps to give protection to the physical assets of the bank, such as branches and ATMs [28].

Regulatory Compliance: The IoT data and programming will help the banks follow all the regulatory guidelines through real-time monitoring, reporting, and keeping records of all the transactions [29].

Customer Insights: One of the most influential things that IoT can provide is customer insight by monitoring customer behavior and preferences. IoT devices help banks establish a 360-degree view of their customers, which helps the banks collect data about customers such as their name, age, lifestyle, and social status [30].

Data Security: Privacy and security are big concerns for customers when providing personal information to banks.

IoT devices play a vital role in protecting customer data, such as personal information, income status, etc. [31].

C. Banks and Their Basic Operation Procedures

***Manual Services*:** Manual services refer to traditional banking processes that rely on physical interaction, paperwork, and human intervention. These services typically involve customers visiting a bank branch and engaging with bank personnel to perform transactions or obtain assistance. Some key aspects of manual services include [32, 33, 34, 35]:

i. **In-person Interaction:** Customers have face-to-face interactions with bank staff, allowing for personalized assistance and guidance.

ii. **Paper-based Processes**: Manual services often involve physical documents, such as application forms, checks, and signatures, which need to be processed and verified by bank staff.

iii. **Teller Transactions:** Cash deposits and withdrawals, check encashments, and other transactions are conducted at the teller counter with the assistance of bank employees.

iv. **Document Verification**: Manual services often require the submission of physical documents for verification, such as identity and address proofs.

v. **Relationship Building:** Manual services can facilitate relationship-building between customers and bank personnel as customers interact with familiar faces and receive personalized attention.

***Digital Services*:** Digital services in banking refer to electronic and online platforms that allow customers to perform banking transactions and access services remotely. These services leverage technology, automation, and the internet to provide convenience, speed, and accessibility. Some key aspects of digital services include [36, 37, 38]:

i. **Online Access:** Customers can access their bank accounts and perform transactions anytime, anywhere, using computers, smartphones, or other internet-enabled devices.

ii. **Self-Service Options:** Digital services empower customers to perform various banking tasks independently, such as fund transfers, bill payments, balance inquiries, and account management.

iii. **Automation and Efficiency:** Digital services streamline banking processes, reducing manual intervention, paperwork, and processing time. This can lead to quicker transaction execution and improved operational efficiency [39].

iv. **Electronic Documentation:** Digital services often eliminate the need for physical paperwork, as documents can be submitted and processed electronically [40].

v. **24/7 Availability:** Customers can access digital services around the clock, allowing for flexibility and convenience.

vi. **Enhanced Security:** Digital services incorporate robust security measures, such as encryption and multi-factor authentication, to protect customer data and transactions.

Technological advancements, shifting consumer preferences, and the need for increased efficiency have all contributed to the shift toward digital services in banking. However, it's important to note that manual services still play a significant role, particularly for certain transactions, customers who prefer in-person assistance, or regions with limited digital infrastructure. Banks strive to strike a balance between manual and digital services to cater to the diverse needs and preferences of their customers [37, 41].

D. Current IoT-Based Operations in Banks

Customer Service: A bank handles hundreds of customers every day. Each customer may have a unique or different demand from the bank. Thus, a bank employee may face one or more new challenges to solve issues regarding customer handling. For this reason, banks generally solve their customers' problems through manual and digital strategies [42]. IoT can be applied to understand customers' behavior [43]. One study performed by the Bank of Morocco reports that IoT networking systems can be used to provide satisfactory customer service. It is due to IoT technology that long wait times can be minimized, thereby reducing the number of customers in the bank and maintaining the appropriate distance between bank employees and customers. Thus, IoT is helping to ensure safe, smooth, and effective customer service in banks [44].

i. **Account Opening:** Account opening is the process of creating a new financial account for personal and business use. These typically require personal details, filling out an application form, and providing necessary and supporting documentation. Through verification of all documentation, the office opens an account [40].

ii. **Loan Sanction:** The term "loan sanction" refers to authorization by a bank to execute funds for a borrower. For the sanctioning process, the bank checks or justifies the borrower's assets, income, and financial history, and also evaluates any other factors to determine the loan [45].

iii. **Fund Transfer:** The term fund transfer refers to when money is moved from one bank to another through different channels like online banking, mobile apps, wire transfers, and debit or credit instructions. Both intra-bank and inter-bank transfers are viable options for moving money around [46].

iv. **Money Exchange:** Money exchange is the process of converting or exchanging one currency for another. Money exchange is also known as foreign exchange or currency exchange. The buying and selling of currency at an exchange rate is facilitated by banks and currency exchange businesses. This is the most crucial part, which is used for international trips or engaging in international travel [47].

v. **Money Withdrawn:** In the money withdrawal process, where the account holder takes out cash from a bank. For withdrawn money, the account holder wants to visit the bank branch with the checkbook, or someone provides the bank with a signed checkbook, or use an ATM (Automated Teller Machine) and also mobile apps, where the account holder has a valid form of identification and enters a personal identification number (PIN) [48].

vi. **Documentary:** The term "documentary" refers to forms of paper utilized in banking operations like account statements, loan papers, legal contracts, financial reports, etc. [49].

vii. **Issue and Clearance:** "Issue and clearance" is the term used for checks in the banking industry. Check issue means the check is written and signed by the account holder to authorize payment to a specific individual. Clarence refers to the process of verifying and double-checking the check details and then ensuring that the required fund is available and transferred from the account of the check's issuer to the account of the check's intended recipient [50].

viii. **Deposit Scheme:** Banks and other financial institutes encourage their account holders to deposit in deposit schemes, which is one kind of investment in their account. Through depositing money in their account, customers get interest for a certain period. There have to be different categories of deposit schemes, like fixed deposits, recurring deposits, savings accounts, and other similar products, that provide different interest rates [51].

E. Challenges of IoT-Based Banking Services

Though IoT is helping the banking sector by providing different benefits, there are some challenges as well. It is very important to point out those challenges to make IoT services more effective. The challenges related to IoT-based banking services are given below [52].

***Security and Privacy Concerns*:** The main concern with using IoT in banking services is the possibility of cyber and malware attacks. This increases the chances of customer data being hacked and their unethical access to the financial transaction. To ensure the security of IoT services, regular updates of the different security systems and regular monitoring are necessary [53].

***Data Privacy and Compliance*:** By using IoT devices, banks collect data about customers, and there are privacy concerns as the data is very private. There are regulations set by GDPR, HIPAA, and related financial industries. Those regulations are tough to follow sometimes, which is a big challenge. So, the banks have to take care of their data handling process, consent management process, and data usage techniques [54].

***Interoperability and Standardization*:** Lack of standardization of a wide range of devices used through the IoT creates interoperability issues, which may prove to be a big issue. This may decrease the effectiveness of the devices that are used in the IoT ecosystem. To face this challenge, the banking organization has to check the technical aspects, such as communication and run time, of all the devices that are purchased from different manufacturers [55].

***Scalability and Infrastructure*:** The IoT ecosystem demands a wide range of devices that may add extra load to existing devices and infrastructure, which is also a big challenge in IoT. To face this challenge, a handsome amount of investment is required to make the infrastructure better than before, and a foolproof plan is also required to control the overall ecosystem of devices [56].

***Complexity of Integration*:** The integration of different IoT devices is not that easy, and it is time-consuming as well. If the devices are not well integrated, the purpose of using IoT devices will remain incomplete. Banks have to find out the issue while integrating different devices and focus on system disruptions that may occur during the process [57].

***Data Management and Analysis*:** IoT devices are used for information from different criteria and by a vast number of people as well. It is very challenging to manage that amount of data all at once. But data management and analysis are a must to make any kind of decision, so banks need to introduce data management techniques for better data management and analysis [58].

***Reliability and Downtime*:** The devices that are used in the IoT need to be top-notch in terms of reliability, as they are responsible for many sensitive tasks. The transaction process and ATM operation have to be reliable because these are two of the most crucial and critical banking operations. Instant response is required when any device fails to convey the desired output [59].

***Energy Efficiency*:** Many IoT devices are powered by batteries, so after a certain time, the batteries need to be charged to provide the necessary power. Those battery-powered devices must maintain energy efficiency for a long period of time to help the operation [60].

***Cost and Return on Investment (ROI)*:** The devices and infrastructure used in ROI are very costly, and their maintenance costs are higher as well. Maintaining a good return on investment is not always possible. So, banks need to evaluate the return on investment against the cost [61].

Regulatory Reporting and Compliance: The banks must report all the IoT service information and compliance reports to the top authority daily. Regular reporting to demonstrate compliance is also a big challenge [62].

Skill Shortage: If the person who is related to maintaining IoT devices doesn't have the required skills, the effectiveness of the task will automatically decrease. So, banks must give proper training to those personnel who are related to controlling and monitoring IoT devices [63].

Data Overload and Relevance: As IoT devices collect a lot of data, this may result in data overload. The devices may not always maintain data relevancy, which is also a reason for data overload. That's why banks have to collect relevant information to solve this data overload problem [64, 65].

Cultural Change: By using IoT services, the traditional culture of operating banking tasks shifted to the modern culture of completing tasks. The working personnel may not adopt this thing that easily, so banks need to focus on these issues to increase their effectiveness [66].

Customer Acceptance: Building customer acceptance and belief in IoT services is also a big challenge for banks, as there are security concerns. Banks need to educate their customers as well through different workshops to accept the overall IoT process [67, 68].

IV. CONCLUSION AND FUTURE PERSPECTIVES

IoT integration into the world of digital banking services promises a dynamic and exciting path for the future of financial transactions and customer experiences. Combining terms like "Smart marketing," "Wireless networking," and "Banking service" captures the IoT's promise to revolutionize the banking industry. IoT enables smart marketing opportunities for the banking sector that make the overall customer attention process very easy. By using IoT, banks are now able to collect real-time data related to customer preference, customer behavior, customer requirements in different locations, and their transaction habits as well. After collecting this information, smart marketing comes in to tailor the promotional activities and design personalized promotions for individual customers. By doing this, the bank can engage their customers more with the operation. By establishing a good understanding of the behavior of the customers, banks can easily enhance the satisfaction level of the customers and allocate resources more appropriately.

Wireless Networking is another important part of establishing IoT in the banking sector. By using wireless networking technology banks can provide remote service to customers through their smart devices. Through wireless service technology, banks can establish a unique ecosystem by introducing ATMs, payment terminals, mobile apps, and wireless devices. This will ensure secure access for customers to their financial resources. Apart from that, the IoT ecosystem helps to improve banking services by enhancing the efficiency of the overall banking operation. Through IoT devices, banks are easily able to detect fraud based on real-time information that is given by the devices. It also helps to reduce human errors and provides security

for the assets of both customers and financial institutions.

It is obvious that IoT makes the operation of the banking sector more difficult, but it is also true that there are some challenges as well. There are big possibilities of cyberattacks, and there are privacy concerns for customers as they provide their personal information. If IoT devices are operated by skilled personnel, these challenges or issues may not affect any banking operation. In essence, IoT can be very impactful if it is used technically. IoT helps to understand the customer better, which leads to strong customer relationships, optimized operations, and an enhanced overall banking experience. Lastly, if the financial institution is successfully able to face all the challenges, the IoT will create an ecosystem where banking operations will be more secure and the customer experience will be more optimized and satisfactory.

CONFLIST OF INTEREST
The authors have no conflicts of interest.

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