Machine Learning for optimization and Information Security of ATMs Machine

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***Abstract*— In our paper, we delve into the critical aspects of Automated Teller Machine (ATM) management, including cash forecasting, security measures, user-friendliness, and more. We explore various challenges such as predicting cash demand, detecting fraud, addressing ATM failures, optimizing user interfaces, determining replenishment strategies, selecting optimal ATM locations, and understanding customer behavior. We specifically focus on leveraging Artificial Intelligence (AI) techniques for tasks like fraud detection, failure prediction, and replenishment planning. Additionally, we discuss several statistical methods utilized for evaluating these forecasts. Throughout the paper, we examine AI methodologies such as neural networks, regressions, and support vector machines, illustrating their outcomes through graphical representations across different sections. We review relevant literature spanning the past decade (2006–2016) and compare the effectiveness of various approaches based on factors like dataset characteristics and prediction accuracy. Furthermore, we compile a list of datasets accessible to researchers in this domain to facilitate further investigation. Lastly, we highlight unresolved issues and outline potential avenues for future research in each of the discussed areas.**

Keywords— Automated Teller Machine, Artificial Intelligence techniques, forecasting performance and accuracy.

1. INTRODUCTION

Automatic Teller Machines (ATMs) are computerized devices facilitating financial transactions without human assistance in public spaces. As reported by ATMIA, there were approximately 1.6 million ATMs worldwide in 2007, primarily financed and managed by financial institutions. These machines offer customers convenient access to financial services with minimal human involvement [1].

ATM management involves various predictive tasks such as cash management, fraud detection, and understanding customer behavior, enabling organizations to enhance planning and service delivery. This is particularly crucial in the competitive landscape of financial institutions striving to attract investments and offer cost-effective services.

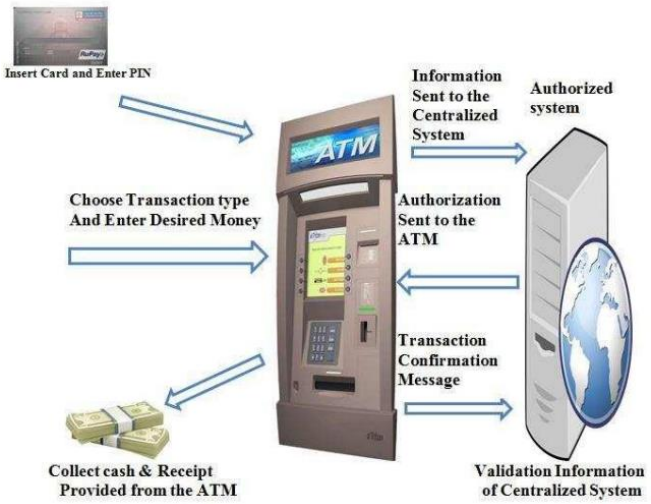
In Section 2 of our discussion, we categorize the paper into seven main areas: forecasting cash demand, fraud detection, ATM failure, user interface, replenishment strategy, ATM location, and customer behavior. We delve into data sets in Section 3, where we introduce and analyze several data sets, examining their specifications and features [2]

The paper introduces AI techniques utilized in ATM management prediction. The literature is organized based on these techniques, and we aim to comprehensively review these studies, analyzing various aspects to offer valuable insights for researchers interested in this domain.

In this paper proposed an idea using the Encrypted Li-Fi Communication. In this technique we transmit data through Li-fi [11]

and data is in the encrypted form then no one can't easily predict it. Encryption techniques used to convert the simple text in the unreadable code by using a suitable algorithm. Different type Encryption algorithm provides the different level security. Li-Fi used as a bidirectional, high-speed network for wireless communication, using visible light communication (VLC). And VLC used for indoor communication by switching LED ON/OFF.

Where LED light used for the transmitter and photodiodes and image sensor used as a receiver. Li-Fi is transmission by taking the fiber out of fiber optics by sending data through an LED bulb that varies in intensity faster than the human eye can't follow:-[3]



2. LITERATURE REVIEW

(Moutinho & Meidan, 1989) states that technological development leads to the usage of a new product like

ATM. It helps in reducing the usage of the bank and interaction between the banker and the customer [4].

(Choodambigai, 2011) This study aims to find the usage of ATM among the customers. The result is that most of the customers use ATM for withdrawal of their money and very few of them use to verify the account details. This study only concentrates on public sector banks. The paper also aims to study credit card and ATM services based on customers' perception [5].

(Jetley, 2004) The technological development in various sectors illustrates the need for new innovative concepts like ATM in the banking sector as well. The advancement in ATMs in the recent times is shown through the environment friendly approaches adopt by the banks such as solar power ATM centers[6].

Solar power ATM centers will become a necessity in the near future as India is suffering from the lack of adequate supply of electricity in most of its areas. Power is the biggest barrier for the development of ATMs in India [7].

Source: (RBI DATABASE):-

YEAR	ON-SITE	OFF-SITE
2011	41,268	34,377
2012	47,545	48,141
2013	55,760	58,254
2014	83,379	76,676
2015	89,061	92,337
2016	1,01,950	97,149
2017	1,09,809	98,545

(Davies, Moutinho & Curry, 1996) states that ATMs act as a mediator between the banker and the customer. It also acts as a connecting device between persons and artificial intelligence

(Kumar, 2011) This study expresses the reason for increasing usage of ATM in India. The ability to provide major facilities like bill payment, money transfer and other financial services helps to customers to save their time. The trust prevalent over the ATMs is high that the customers do not even count after withdrawing their cash from the machine.

(Tuli, Khatri & Yadav, 2012) This study aims to compare public sector and private sector bank ATMs, usage and other facilities. Only two banks- SBI and ICICI were taken for the study. The result reveals that the public-sector bank dispenses old currencies and private sector bank run out of cash most of the times. Thus, both the banks have their limitations. The paper does not consider the bank employee perspectives and concentrate only on the customers who are using the ATM [8].

(Premalatha & Sundaram, 2012) The primary concern of this paper is about customer satisfaction while using ATM, and it has been found there is a significant effect on age factor and safety, gender and tangibility. But there is no significant relation between occupation and satisfaction level. So, it is concluded that the customers expect safety, assurance and convenience while using ATM and suggests to the banker to provide safety and accurate information to the ATM users to increase reliability.

(Bishnoi, 2013) The paper shows the increase in the usage of ATM customers but lacks to find out the reasons and factors for the same.

(Renuka & Paulraj, 2014) This study concentrates on customers satisfaction at the point of withdrawal, 24 hours and on the deposit system. But there is lack of awareness among the customers while using ATM. It is suggested to the bankers that ratifying customers' comments, doubts and suggestions will increase the reputation of the bank among the customers [9].

(Sisat & Barbuddhe, 2014) This paper explains the various threats to ATM and Cash Deposit machine. There are three types of risks involved while using the ATM, which are currency fraud, logical attacks and physical damages. This paper explains the security system of ATM and CDM.

The above table gives details about the number of ATMs available in India. As per the table during 2011 (March) only 41,268 onsite ATM and 34,377 offsite ATM were present. But according to the latest report of March 2017, there are nearly 1.1 lakhs onsite ATM and 1 lakh offsite ATM in India depicting the high increase in the number of ATMs within a short span of 6 years. The graph for the above data is as follows [10].

ATMs have been analyzed in the literature for some thirty years. The earliest studies concentrate on explaining the adoption of this new technology. Mandell (1977) discusses ATM adoption in the USA. The first ATM was installed in the USA in 1969 and, according to Mandell, only 10% of all national banks had adopted even one ATM after eight years. Mandell states that a bank's adoption of innovation depends eg on its size, branching status and competitive position [10].

Explain in this research paper that LiFi is providing us bidirectional high-speed network and wireless mobile communication using the LED light. And remind that

this technique replaces radio frequency waves with visible light, infrared or ultraviolet. Explain that it is much faster than the Wi-Fi and provide best solution compare to Wi-Fi with respect security, human health and bandwidth. In which concept VLC used for data transmission And VLC works on by switching ON/OFF which is too faster than human eye can't noticed transmission of data [3].

TABLE 1. Comparison between the current concepts of ATM transaction

Sr. No.	Author with Publication Year	Technique Adopted	Significance	Limitations
1.	Jane Ngozi Oruh (2014)	Three-factor Authentication for Automated teller Machine	In this paper author used smart card, user PIN and fingerprint authentication as a three factor Authentication	Some kind of attack like skimming attack, phishing attack, card stolen issue and No backup method in fingerprint failure situation and OTP Method
2.	Milind Nemade[1], Laukik Karnavat[2], Prachi Dharu[3], Ruchika Desure[4], Sejal Gandhi[5]	A Review Paper on Improving Security of the ATM System	The purposed system used in this paper consist three security levels which are card with PIN, fingerprint as a biometric identification and last one is the OTP.	Purposed system used the RFID reader which contains the radio frequency spectrum, which is harmful for health or intruder easily read data from the RFID spectrum. Issue on card and PIN are attacks. skin diseases are the bad influence using fingerprint identification.
3.	V. Meena Mphil (2015)	Facial Recognition Technology for use in the ATM transactions	User facial image verified during ATM transaction which is stored in the banking database.	Sometime system didn't recognized facial image in different situation like camera distance in facial image clarity, different face angles and lighting condition.
4.	Joyce Soares[1] Dr. A. N. Gaikwad[2] (2016)	A Survey on the Security of an ATM transaction	In this paper techniques used biometrics (fingerprint and Iris Recognition), GSM and image quality.	Iris recognition have high installation or maintenance cost, GSM techniques not feasible for everyone

3. THE OBJECTIVE OF THE STUDY

To remove the vulnerability in the current model by using facial recognition during the complete process, which will detect if the person who is making the transaction is the owner of the card

The main work of the facial recognition is to check if the person making the transaction is the owner under all conditions like every lighting condition, every angle etc.

The main objective of this study is to analyze the satisfaction of ATM users. The specific objective of this study is to understand how people perceive the ATM facility.

There has been extensive research on the ATM in the world. Many regional and nationwide similar studies can be found. Even few papers explored the ATM on Nepalese case. However, the issue of ATM service is new one and very less explored.

Therefore, this study contributes how people perceive ATM in terms of usefulness. The main aim of this study is to analyze the satisfaction of ATM users. Once the study will be completed, it would be highly useful to the related institutions and individuals.

Implementing data encryption between the ATM and the processing center, preventing arbitrary code execution, and safeguarding against network attacks targeting ATM transactions. Additionally, securing communication with the card reader, encrypting card data, and adhering to best practices outlined in the report are essential to mitigate card data theft.

4. RESEARCH METHODOLOGY

Research methodology is the science of finding out and it is a subfield of epistemology, which is the science of knowledge. Indeed, utilizing an appropriate methodology is not only the right path to the truth, but also the duty of every researcher. The methodology covers issues that relate to the type of data collected, the way it was collected and analyzed [10].

A. Study Area and Sources of Data

• Within the study area, the study is based on primary data. We use primary data since our study is related to ATM which isn't available from secondary sources.

• Our study area is Jawalakhelof Lalitpur. The study area is presented on the figure given below

This study is wholly based on secondary data. All the data were sourced from Reserve Bank of India database. The time period of the ATM statistical report taken ranges from 2011 to 2017 and only the report for March month was taken for the study. Other sources include articles from various recognized journals, periodical articles, monthly magazines, and web. This paper employed percentage analysis to find out the growth of ATM sectors in India.

Historical ATM Data:
Gather historical data from ATMs, including transaction logs, cash withdrawal patterns, and replenishment schedules. This data will serve as the foundation for training and evaluating machine learning models. Include information such as date, time, location, transaction type (withdrawal, deposit, balance inquiry), and cash amount.

Cash Demand Patterns:

Analyze cash demand patterns over time. Consider daily, weekly, and seasonal variations. For instance, weekends and holidays may exhibit different withdrawal behaviors. Explore factors that influence cash demand, such as location (urban vs. rural), time of day, and nearby events (festivals, paydays).

Here are some essential techniques to consider:

Data Cleaning:
Remove or impute missing values in your dataset. Common methods include mean imputation, median imputation, or using predictive models to fill missing values1.Detect and handle outliers that might affect model performance.

Feature Engineering:
Create new features from existing ones. For ATM optimization, consider features like: Day of the week: Encode weekdays and weekends separately, as cash demand patterns may differ.

Feature Scaling:
Normalize or standardize numerical features to ensure they have similar scales. Common methods include min-max scaling or z-score normalization.
Scaling helps prevent certain features from dominating the model due to their larger magnitude.

5. RECENT DEVELOPMENNT OF ATMs IN INDIA

The growth of Indian economic systemin the past decade is found to grow at a rapid rate. Banking industries in the financial sector are introducing a new conception a regular basis to attract the customers. The first ATM in India was presented by HSBC bank in 1987 at Mumbai branch for withdrawal. The ATM was introduced with an objective to serve the customers during emergency situations where cash deposits and withdrawals after regular banking hours are required [13].

The next development in the ATM field is the introduction of an enquiry system to know the account balance and statement so that the customers do not waste time waiting inside the bank premises. Many significant changes like account transfer from one-person account to another account holders, requisition claims like chequebook need, message alert etc.were noted after 2000. After 2010, technological developments increased in ATM non-bankingservices.

Such services include bill payments, ticket bookings, mobile recharges, etc. Even though many developments have been introduced in the sector, much more should be brought in to increase the quality of ATM services in India.

Types of ATMs Few such changes are as follows:[12]

1.White Label ATM

White Label ATMs can be set up and operated by private, non-banking entities. As per RBI guidelines, the bank which operates ATMs must have minimum net worth amount of 1 Crore. This type of ATM operatoris permitted to use all kind of bank ATM cards, and are also allowed to display their advertisement on the ATM counter. The operator must have a sponsor bank who will provide money for their ATMs. As per RBI rules, the company is not permitted to use any logo or name of the sponsor bank in the ATM centre. They can also provide a lot of value-added services like bill payment, recharge, etc. with a maximum withdrawn limit Rs. 10,000. These ATMs function 24/7. As per RBI guidelines, minimum two ATM centres are mandatory in 3 to 6 tiers and if the bank desires, one ATM can be installed in the 1 & 2 tier cities. Following table shows the details of the tier cities.

Table 1 Details of Population Categories

CATEGORIES TYPE	TIER	POPULATION
Metropolitan	1	**10 Lakhs and above**
Urban	1	**1 Lakh and above**
Semi-Urban	2	**50,000 to 99,999**
Semi-Urban	3	**20,000 to 49,999**
Semi-Urban	4	**10,000 to 19,999**
Rural	5	**5,000 to 9,999**
Rural	6	**Less than 5,000**

2. Brown Label ATM

Brown label ATMs can be taken onlease under the ownership of the service provider. They are responsible for seeking a place for ATM centre and negotiating with the landlord.They must also arrange for the electrical

power supply, network system, interior decoration and ATM centre maintenance worker. They can use the logo and name of the sponsor bank who maintains the cash management and connectivity. This ATM follows the outsourcing concept where all the activities are done by the third person.

The service providers collect their charges form the bank. The main advantage of this ATM is that the bankers need not worry about external factors and huge investment in the ATM centre.

3. Smart ATMs:

Smart ATMs incorporate advanced technologies such as touchscreen interfaces, biometric authentication, and contactless card readers to offer enhanced user experiences and security features. They may also provide additional services like bill payments, fund transfers, and account management.

Online ATM relates to a bank database where all the details like amount withdrawal limit, balances, etc. are monitored by the bank.

a. ATM service:

The ATM services are Purchasing travel tickets, pay bills, purchasing phone talk time, check account balance, withdrawal and others to specify. It is presented in the bar diagram [12].

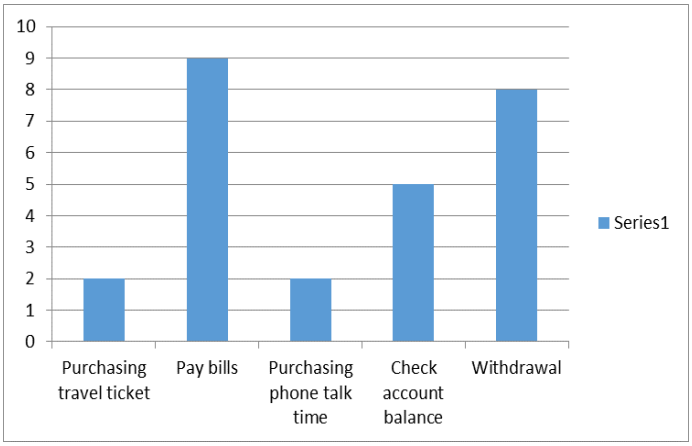


Fig: Types of ATM service willing to use

b. Level of satisfaction from current ATM services providers

As per the research findings, out of 26 respondents, 16 of them are strongly satisfied with the ATM service provided by their bank. Whereas 7 of the respondents are satisfied. Similarly 3 of them are neutral about ATM service provided by their bank.

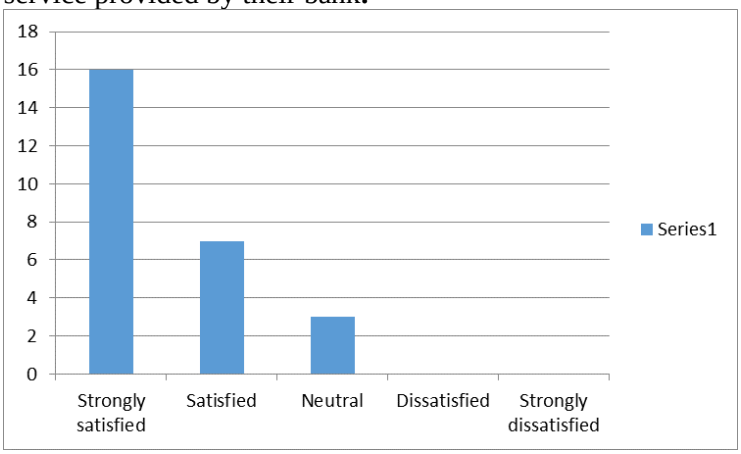


Fig: Level of Satisfaction from ATM service

6. Growth Of ATMs In India

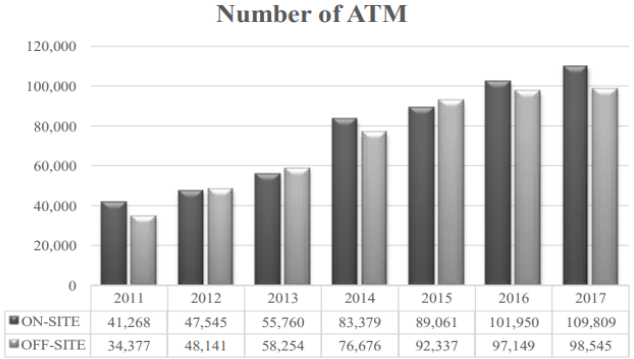
Automated teller machines or ATMs is one of the most popular and notable banking products resulting from innovation in information and communication technology. Automated Banking Machine (ABM) or Cash Machine are other synonyms for ATM. Use of ATMs not only assisted banks in extending their banking services, it also provided convenience and ease to customers [18].

The RBI database regarding ATM installation for the past eight years for the month of March is given below in Table

Table: Number of ATM

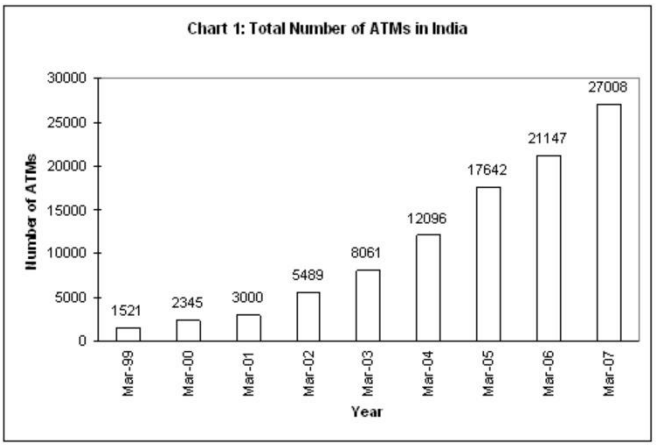
YEAR	ON-SITE	OFF-SITE
2011	41,268	34,377
2012	47,545	48,141
2013	55,760	58,254
2014	83,379	76,676
2015	89,061	92,337
2016	1,01,950	97,149
2017	1,09,809	98,545

The above table gives details about the number of ATMs available in India. As per the table during 2011 (March) only 41,268 onsite ATM and 34,377 offsite ATM were present. But according to the latest report of March 2017, there are nearly 1.1 lakhs onsite ATM and 1 lakh offsite ATM in India depicting the high increase in the number of ATMs within a short span of 6 years. The graph for the above data is as follows [13].



Initially the ATMs were introduced to provide cash to the customers but subsequently with technological developments its services have been extended to include cash withdrawals, funds transfers from one account to the other and make payments (Abor ,2004). In the early 1990s, ATMs initiated by foreign banks were introduced to the Indian banking industry. At that time, most international banks and some private sector players were suffering from a severe challenge of absence of a strong network of branches [15].

As per the Global ATM Market and Forecasts to 2016, the maximum growth of ATMs is happening in Asia pacifi c region. India and Indonesia are having one fouth of the number of ATMs, and china is accounted for half of the New ATMs. Worldwide growth of ATMs is steadily increasing in the given below figure [14]:



ATMs were introduced to the Indian banking industry during 1987 by HSBC Bank in Mumbai. Mr Jasvinder Gill, MD of NCR India has stated, "As banks continue to open new branches, attract new customers, and encourage existing and new account holders to use cards, the Indian ATM industry is set to grow. Since many banks still operate proprietary networks, the increasing number of banking customers is likely to spur ATM growth." ATM technology was used to reach the customers at a lower initial and transaction cost with hassle free services [19].

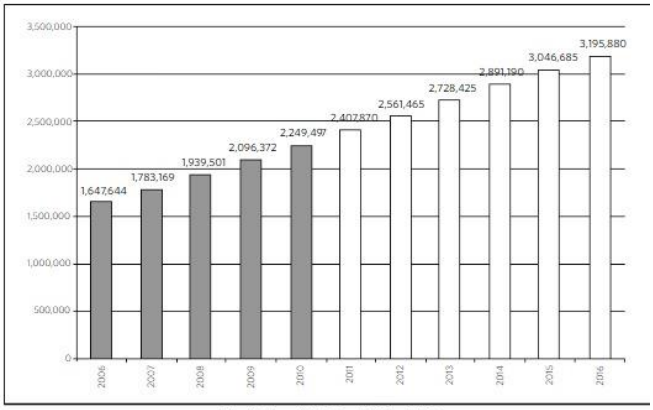


Fig. 1: No. of ATMs, 2006 to 2016
(*Source*: Global ATM Market and Forecasts to 2016 (Retail Banking Research))

As per an interaction with senior general managers (South Asia channel partners and strategic alliance), ATM segment witnessed a growth rate of 30% since last 5 years in India. ATM terminals in India will be expected to grow at a compounded average growth rate of 25% between 2006 and 2016 [16] &[20].

1. People using ATM Card

Among 30 respondents, 26 respondents use ATM services and 4 of them don't use ATM service. It is presented in the bar diagram.

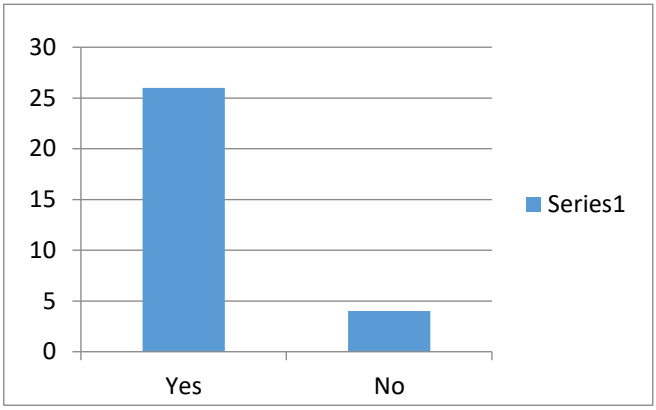


Fig: Person using ATM Card

2. Number of ATM hold

Most of the respondents are comfortable carrying a single ATM. It is presented in bar diagram.

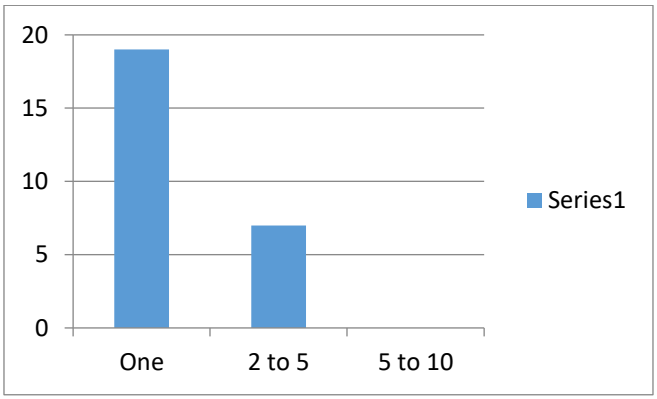


Figure 1: Number of ATM hold

ATM transactions involve withdrawing cash directly from the ATM machine, whereas POS transactions involve swiping the card at the point of sale. POS transactions offer customers the advantage of carrying less cash with enhanced security. In 2017, there was a significant rise in POS transactions compared to 2011, with a 15-fold increase, whereas ATM transactions only doubled during this period.

7.CONCLUSION

This research employs descriptive analysis to examine the patterns, frequency, and expansion of ATM usage among Indian bank customers. The findings indicate a notable surge in ATM usage in India, particularly following the implementation of the demonetization initiative. Moreover, there is a noteworthy increase in awareness regarding cashless transactions among the populace over recent years.

It is imperative for the government to take proactive measures to mitigate existing levels of unawareness among users, thus fostering greater awareness and receptivity towards technological advancements in the Indian banking sector. The transition towards a cashless economy necessitates collaborative efforts between the government and the public to steer the country in that direction. type of data collected, the way it was collected and analyzed.

This study reveals that widespread awareness exists regarding ATM services, with the majority of individuals utilizing ATM facilities offered by their respective banks. Interestingly, all participants in the research possess their own bank accounts. While occasional challenges are encountered during ATM withdrawals, overall satisfaction with the ATM service remains high. ATM services have evolved into a convenient means of accessing cash at any time and location.

The ATM machine plays a crucial role in facilitating banking transactions at any time and from any location. Numerous monetary transactions are conducted daily through ATM machines. However, there is a significant risk of fraud due to inadequate ATM security measures. Encrypted Li-Fi communication offers enhanced security and faster transaction processing. Implementing ATM transactions via encrypted Li-Fi communication can elevate the security standards of the transactions. If Li-Fi technology is effectively utilized, every light bulb could potentially serve as a medium for wireless data transmission. In case of device malfunction during data transmission, users can simply install an app on another device and connect it to the Encrypted Li-Fi transfer pin to resume the process. The adoption of unique authentication methods reduces costs, time, and efforts for both financial institutions and users.

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