

Card-Less Electronic Automated Teller Machine (EATM) With Biometric Authentication

Alebiosu M. Iyabode^{*1}, Yekini N. Nureni^{#2}, Adebari F. Adebayo^{#3}, Oloyede A. Olamide^{#4}

[#]Lecturer Computer Engineering Department

^{*}Lecturer Electrical Engineering Department

Yaba College of Technology, Lagos Nigeria

Abstract: EATM is an electronic banking outlet that allows banks customers to complete one or more banking transactions without the aid of any bank official or teller. It is a self-service technology in financial service delivery usually adopted by financial institutions to reach their customers outside the banking hall. The user of existing EATM machine uses card to access their account to perform one or more financial transactions. Several problem are associated with the use of card such card cloning, card damaging, card expiring, card skimming, cost of issuance and maintenance, accessing customer account by third parties, waiting time before issuance expiring or new card. This paper presents the conceptual framework of design, specification, and model of the EATM system that uses no card. The proposed system will use alphanumeric PIN, and biometric fingerprint to control access to the ATM.

Keywords: ATM, banking hall, alpha numerical PIN, biometric finger print, electronic banking outlet, self-service technology, ATM card, card skimming, card cloning.

I. INTRODUCTION

A. Background to the Study

The Automated Teller Machine (ATM) is a self-service machine that dispenses cash and performs some human teller functions like balance enquiry, bills payments, mini statements, Fund Transfer, Cash Deposit and so on. ATM transactions are carried out through the use of a debit/credit card which enables the card holder(s) to access and carry out banking transactions without a teller [1]. With ATM, customers can access their bank deposit or credit accounts in order to make a variety of transactions mentioned earlier. If the currency being withdrawn from the ATM is different from that in which the bank account is denominated the money will be converted at an official exchange rate. Thus, ATMs often provide the best possible exchange rates for foreign travelers, and ATM is widely used for this purpose [2].

The ATM users access their account through special type of plastic card e.g. master, visa, verve card etc. The card is encoded with user information on a magnetic strip. The magnetic strip contains an identification code that is transmitted to the bank's central computer by modem. It was developed as a

result of need for self-service technology (SST) in financial service delivery by financial institutions [3].

The ATM is designed to replace the manual banking transactions in which customers walk into the bank to fill tellers, withdrawal booklets or cheque. The manual banking system are based on paper, it is time consuming and lacks efficiency in record keeping then giving room for manipulations. In recent time ATM has served as a device that enhances the cashless policy due to its functionality in fund transfer between one account and other.

Apart from using ATMs other computer-based/IT based banking technologies are available for examples internet banking and mobile banking, but the demand for cash still remains high and bank branches are rising continually worldwide as customers demand cash to be accessible at different locations.

The mentioned banking system/technologies such as internet, mobile and traditional banking cannot allow customers to have access to their cash at convenient, and level of internet access and the cost of procuring the facilities to use both the internet and mobile banking such as computer or sophisticated mobile phone are also barrier in using such technologies [4].

ATM creates a paperless office, ensures security of customers' accounts and privacy, it grants customers 24hours access to their accounts, eliminates cash induced robbery, it reduces cost of operation and enhances proper and effective record keeping. ATM allows you to do a number of banking operations such as withdrawing cash from one's account, making balance inquiries and transferring money from one account to another using a plastic, magnetic-strip card and personal identification number issued by the financial institution [5].

Currently one and major way to get access to your account in other to perform some of the transaction mentioned earlier is through the use of ATM card. There are lot of problem associated with the uses of ATM card, these include: Lost or Stolen Card, use of ATM card by third party to perform transaction, ATM Card Skimming & PIN Capturing, damaging of ATM, card expiring, charges on issuance of the ATM card and maintenances by financial institutions etc. with all the problem mentioned, the use of ATM card has become a treat to safety of customer funds, even though the

stakeholders in financial transaction are making great efforts to reduce ATM frauds.

The entire problem associated with the use of ATM card can be eliminated if we can have cardless ATM. The objective of this study is to design a cardless ATM machine that uses alphanumerical PIN, and biometric access control system. This machine will group the activities to be performed on ATM into two, a group of function can be performed by the uses of alphanumerical PIN only, while other can be performed through the use of biometric access control system.

The research documentation is organized as follows: chapter two is literature review where I studied a related work by accredited scholars and researcher, and give summary of their work; chapter three is research methodology and design, in this case I collected data as in component required, discussed the interconnectivity of the components to form the required system, the model of the proposed system and subsystem. Also in the chapter the model of operation of the complete system was given using UML; chapter four is conclusion and recommendations where I present a direction for further research and give summary of research work.

B. Statement of Problem

The needs for virtual card or cardless ATM came to our mind after one of the authors left with disappointment at the ATM spot located at the zenith bank branch at Yaba College of technology, Lagos Nigeria. He was unable to locate his ATM card from his purse. Hence access to his bank account for bank transaction was denied. When narrated his experience. One major conclusion came to our mind after hours of thought and reasoning as regards the need for ATM card before one can access his bank account through ATM, and major information that ATM card contain. Consequently, as a lecturer, researcher, computer/electronic engineer and computer scientist with keen interest in emerging new technology in electronic business, that EATM with virtual or no card can be design to enhance the efficiency of ATM usage. Also, In recent time many lapses (ranging from fraud, stealing, etc.) of ATM usage has been attributed to use of ATM such as card cloning, card damaging, card expiring, cost of issuance and maintenance, accessing customer account by third parties, waiting time before issuance card etc. all these can be a bygone issues if cardless EATM can be design and implement in future.

C. Aims and Objectives

The basic aim of this research work is to design a cardless ATM. If that can be achieved and implemented, it could leads to the following objectives.

- i. ATM fraud and criminal activities can be reduced or eliminate completely.

- ii. Enhance the use of ATM by banking customers.
- iii. It will eliminate financial burden placed on customers for issuance and maintenances of ATM card.
- iv. It will also reduce stress emanated from complaint related to ATM cards at the customers care of bank on bank staff, and customers that uses ATM.

D. Scope and Limitation

The scope of this research work is mainly on design of prototype model of cardless ATM. How the design will be implemented is a further research to this resent work.

II. LITERATURE REVIEW

[6], in their work, the authors are of the opinion that Automated Teller Machine (ATM) packages of banks in Ghana have operated for a very long time without full exploration of all essential functions of the facility and this has been a surprised to the public and other decision makers about the effect of ATM operations on customer demand for it. That leads to author's research interests to assess the operational features of the ATM and the factors that account for customers' willingness to use ATM. The study modelled the operational features of

ATM using queuing modelling and a probity model was estimated to determine the factors affecting customer usage of ATM. They use data that was collected from 160 customers of banks with ATM facilities. It was confirmed that there was a high traffic intensity for ATMs use for most banks in the sampled area. Also, higher educational attainment, number of ATMs per bank, convenience, and security features, efficiency and low transaction charges have significant effect on influencing the usage of ATM services. They recommended that management of the banks should upsurge the number and quality of ATM services in order to increase access and usage of ATM.

[7], these authors investigate ATM Usage and Customers' Satisfaction in Nigeria. He discovered that despite the increasing number of ATM installations in Nigeria. Customers' needs are not satisfactorily met as customers are always seen on queue in large numbers at various ATM designated centers as well as poor service delivery of some of this machine. He uses research engages comparative analysis of three banks in Ogun State, Metropolis of Nigeria viz-a-viz FirstBank, Guaranty Trust Bank and Skye Bank. Data was collected with the aid of questionnaires to sampled population of 200 respondents and chi-square statistical tool was used to analyze the data and the results showed a positive and significant relationship between ATM Usage and Customers' Satisfaction.

[8] The study discusses the effects of the Automated Teller Machine (ATM) network market

structure on the availability of cash withdrawal ATM services and cash usage. The aim of the study was to construct the ATM equation. The study contributes to the earlier discussion on the effects of ATMs on cash usage. The monopolization of ATM network market structure and its effects on the number of ATMs and on cash in circulation are analyzed in theoretically and empirical manner. The unique annual data set on 20 countries was used in the estimations and combined from various data sources. The observation period is 1988–2003, but the data on some countries are available only for a shorter period. Based on our theoretical discussion, as well as the estimation results, monopolization of the ATM network market structure is associated with a smaller number of ATMs. It was revealed that the influence of the number of ATMs on cash in circulation is ambiguous.

[9], this study was focused on a clear view of two different working procedure of ATM (Automated Teller Machine) in Bangladesh. Two processes are Core Banking and Consortium of Banks and author reached a conclusion after few surveys to the bank. The author is of the opinion that the Major problem of using ATM is that the user do not have the information when the ATM machine is off or on. Consequent, if users find it closed after traveling a long distance then it is very much annoying. To support his suggestion, he built software which can be really helpful to the situation. The author also identifies few problems like booths limitations, using limitations and transaction limitations and suggestions was made to arrest the situation.

[10] The author appreciate the introduction of ATM in banking sector, but identify the major setback in that innovation as customer(s) in-ability to deposit money and send it to someone at different location. The author then came up with a framework that allows customer(s) to deposit some amount of money into his account and later transfer the amount to another account(s) or deposit the money directly into another person's account over the ATM network, this can be within a particular bank (intra bank) or involving different banks (inter-bank) in addition to the current transactions customers make using the ATM. He proposed modification of the ATMs by creating another input device that collects the money into the ATM system, reads its denomination and either saves it or transfers to the required customer account. He was limited to the software component of the ATM system. He was of opinion that the enhanced ATM will will further decongest the banking halls thereby enhancing efficiency in the day-today running of the banking system.

[11] Discussed recent development in ATM industry especially the improvement from the OS/2 operating systems to window based operating systems which have considerably enhanced ATM functionality and user interfaces.

[12] studied the formal design model of the ATM system, the study included ATM design specification

using denotation mathematics known as Real Time Process Algebra (RTPA), RTPA architectural modeling methodology, he proposed the architecture of the ATM system to be built and refined by some set of unified data models (UDMs) which share a generic mathematical models of tuples, he specified the static behavior of the ATM and refined it by a set of Unified Process Models (UPMs) for the system transition processing and some supporting processes. Based on his design model: formal design model, codes can be generated automatically using Real Time Process Algebra Code Generator (RTPACG) or be seamlessly transformed into programs by the programmer.

[13], studied present approach to the optimization of cash management for Automated Teller Machine network, his approach was based on artificial neural network to forecast a daily cash demand for every ATM in the network and on the optimization procedure to estimate the optimal cash load for every ATM. The optimization procedure considered important factors for ATM maintenance; cost of cash, cost of cash uploading and cost of daily services. He then present the simulation of the ATM network's cash management optimization system which shows a good results, but for practical implementation of the proposed system further experimental investigations are necessary.

[14], researched into the appraisal of the use of ATM in the banking industry in Nigeria. The research work involves the use of diffusion innovation model, and questionnaires to collect data in order to get the required information from the respondents. The result of the hypothesis was stated at the end of the analysis. The results shows that there is relative advantage of using ATMs; how hard it was to use ATMs, how compatible ATMs were with the lifestyle of the users; how much has been registered (observed) about ATMs by the users and whether ATMs could be tested before consistent use, were issues that influence users' attitude towards intention to use ATMs.

[15], conducted an investigative research on the use of ATM card. The authors made effort to conduct an interview with structured questions among the ATM users, data obtained was analyzed, the result proofed that a lot of problems was associated with the use of ATM smartcard. Some of the problems identified are: difficult to prevent another person from attaining and using a legitimate person's card, conventional smartcard can be lost, duplicated, stolen or impersonated with accuracy. To address the problems, the author proposed the use of biometric voice-based access control system in automatic teller machine. In the proposed system, access will be authorized simply by means of an enroll user speaking into a microphone attached to the automatic teller machine.

III. METHODOLOGY AND DESIGN

In this section we collected data as in components required, discussed the interconnectivity of the components to form the required system, the model of the proposed system and subsystem. Also in the chapter the model of operation of the complete system was given using UML. The section is organized as follows:

A. Analysis of Existing ATM Machine

Existing ATM component parts

Modern ATM machines has the following components part/sub system, has the following components parts which can be divided into input system, and output system.

Input system

- Card reader - The card reader captures the account information stored on the magnetic stripe on the back of an ATM/debit or credit card. The host processor uses this information to route the transaction to the cardholder's bank.
- Keypad - The keypad lets the cardholder tell the bank what kind of transaction is required (cash withdrawal, balance inquiry, etc.) and for what amount. Also, the bank requires the cardholder's personal identification number (PIN) for verification.

Output system

- Speaker - The speaker provides the cardholder with auditory feedback when a key is pressed.
- Display screen - The display screen prompts the cardholder through each step of the transaction process. Leased-line machines commonly use a monochrome or color CRT (cathode ray tube)

display. Dial-up machines commonly use a monochrome or color LCD.

- Receipt printer - The receipt printer provides the cardholder with a paper receipt of the transaction.
- Cash dispenser - The heart of an ATM is the safe and cash-dispensing mechanism.

The diagram fig 1, shows the components parts a typical modern ATM.

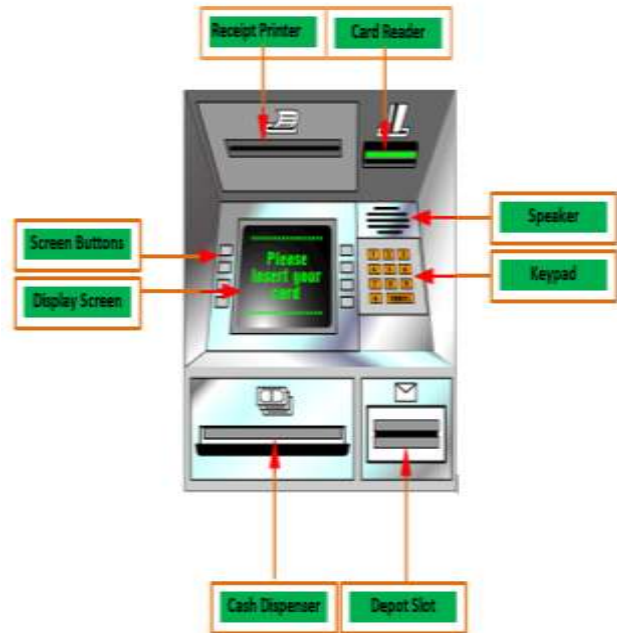


Fig. 1 Modern ATM Machine [16]

B. Algorithm of existing ATM working Principle

Current ATMs can perform one or more of the action shown in the diagram in figure 2.

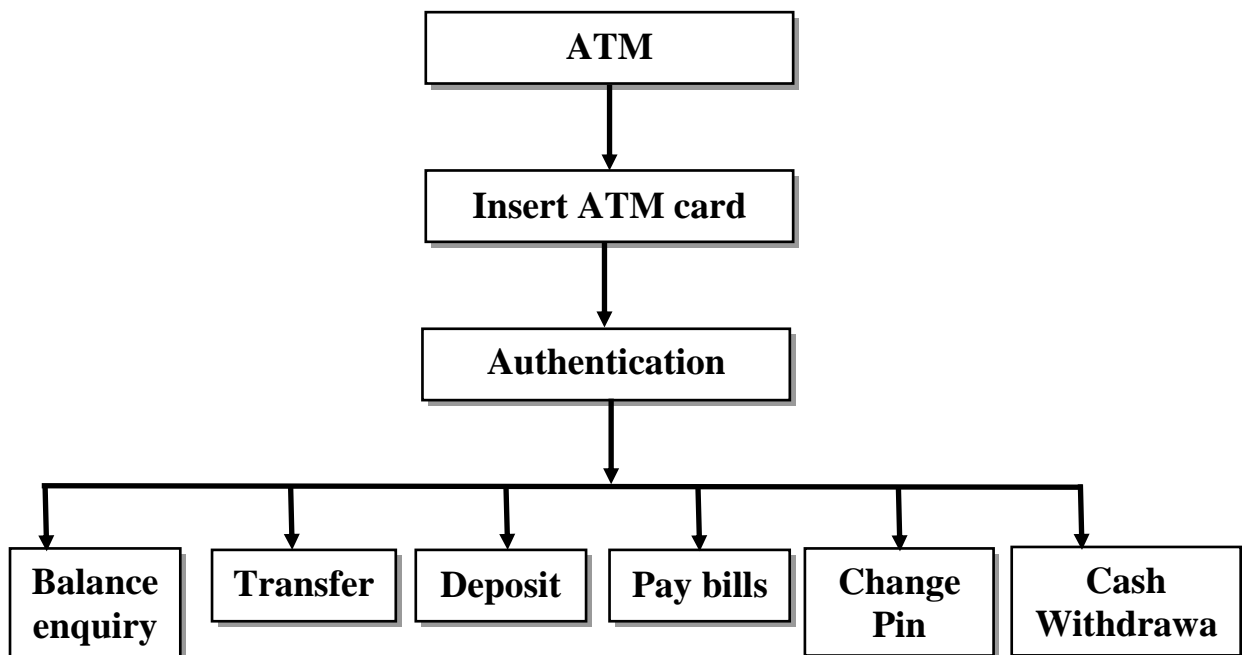


Fig. 2. Some Activities that can be performed on ATM

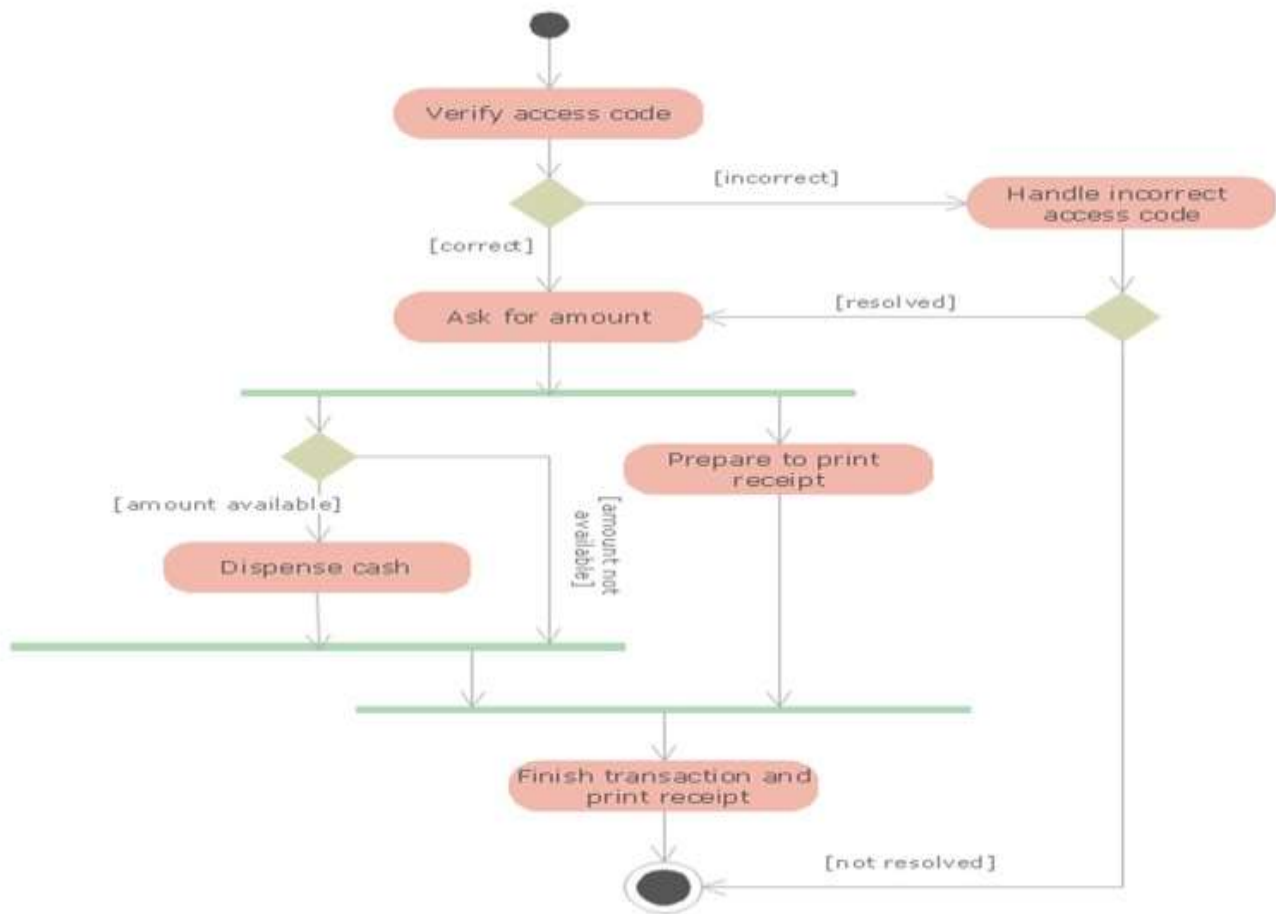


Fig. 3. UML activity diagram for existing ATMs using cash withdrawal a case activity

The algorithm or flow of operation is as listed in 1-10. Figure 3, shows the UML activity diagram for ATMs for cash withdrawal a case activity.

1. Insert your ATM card
2. The system asks your PIN number
3. The system authenticates your PIN number
4. The system displays the type of transactions on the screen
5. Choose the transaction to be performed
6. System ask if you wish to print the receipt of your transaction
7. Click Yes (if you want receipt), and No (if you don't want receipt)
8. After completion of transaction, system ask whether you want to perform another transaction
9. If YES step 1-7 will be repeated, if NO, the machine will eject your card, and then prompt the user to remove his/her card.
10. After completion of every transaction the machine print the receipt of transaction if YES to question 6, otherwise no receipt.

C. Proposed Cardless ATM

Components of Proposed ATM Component Parts

The proposed ATM system will make use of the components in the existing ATM except the card reader, which will be replaced by biometric device that will authenticate the user when trying to make transaction. The proposed ATM will use alphanumerical PIN, and biometric technology especially to authenticate user. As it mentioned in introduction chapters that ATMs activities would be divided into two groups, and the authentication of the user will be done based on degree of the transactions. The transaction is divided as follows:

Activities **A** that required high degree of authentication includes, physical cash withdrawal, fund transfer to another account not linked to the account, payment of bills etc. Activities **B** that required does not required high degree of authentication includes, balance enquiry, fund transfer to account not linked to the account on ATM, fund transfer to another that can be verified by bank if problem aroused. The two access control mentioned shall be used for authentication depends on nature of transactions. When users get to the ATM location that is already on standby, instead of the ATMs to prompt the user to insert card, it will prompt the users to press any key from screen buttons to activate the machine and prompt the users to enter it alphanumerical PIN.

The user account out to have been pre-enrolled on ATMs network.

The PIN shall make up of three alphabets that is unique to a particular bank e.g. Firstbank (FBN), by entering this alphabetical PIN, that will the user to the to the users bank, four digit numeral unique to the users, this will connect the it bank account so that he can access his/her account. With the alphanumerical PIN e.g. **FBN0137**, the ATM users can then perform any of the transaction in categories B. If any of the activities in category A has to be performed by the user it will then prompt the ATM user to enroll it biometric identity, if verified, any of the transactions in that categories can be carried out. Fig 4 is the diagrammatical representation of the proposed, unlike the existing system, the card reader section has been replaced with biometric finger sensors for user to do authentication.

The biometric section of the new proposed system is as described below, the banks already have the biometric finger print of all their customer, through the BVN registration, this biometric will be enroll in the ATM. Whenever the ATM users decide

to run any of the transactions in category A, the machine will required he/she to enroll his finger print and if it has at least 60%, match which equivalent to match of three fingers out of five register fingers.



Fig. 4. Proposed Cardless ATM

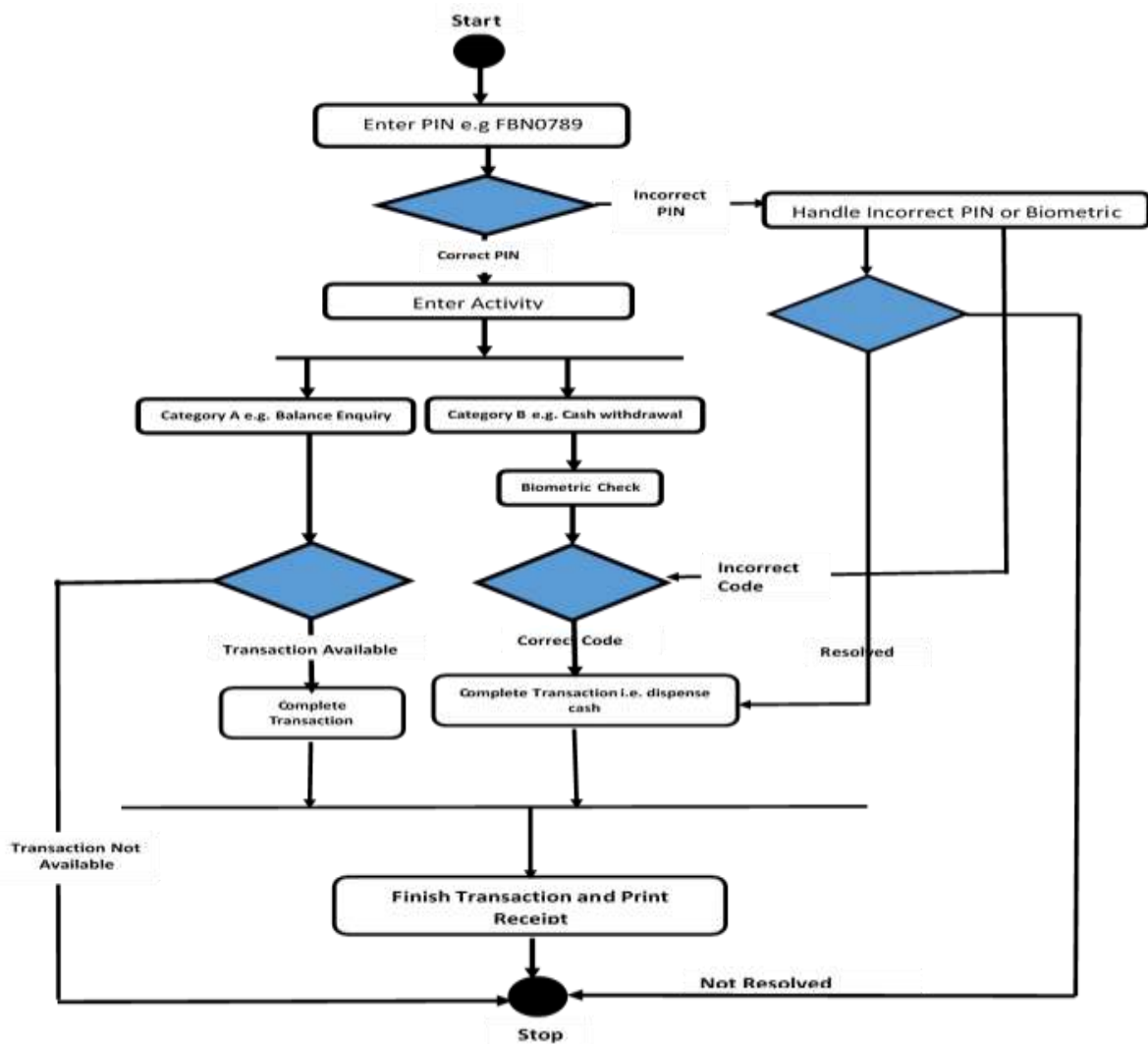


Fig. 5: UML activity diagram for proposed cardless ATM

IV. RECOMMENDATION

This study revealed that card-based ATM faces a lot of security threats such as card cloning, card damaging, card expiring, card skimming, cost of issuance and maintenance, accessing customer account by third parties, waiting time before issuance expiring or damaged card. All this could be eliminated through the use of cardless ATM proposed by the author of this research work. The author has given a conceptual framework for cardless ATM that uses alphanumeric PIN, and biometric finger print for access control. We are of the opinion that this research focus will interest stake holders in banking sector, researchers, professional body like IEEE, and academia. Hence we recommended that young professionals and expert to venture into research towards implementing the proposed system, research into modification of available ATM machines to use virtual card in which user can apply the methodology of accessing proposed ATM on current ATM with card reader without their card. Also more research should be carried out on how the system could be implemented with other biometric technology, like face recognition, voice recognition etc. design the system with focus on some other biometric technologies such voice recognition, facial recognition etc., and bring out prototype of design for possible presentation some IEEE conference.

V. CONCLUSION

The importance of ATM can never be overemphasize, no bank service is convenient, effective and efficient as ATM. ATMs provide security to customers account since each customer has a personal identification number (PIN) that gives he/she access to his account, it also provide a faster and accurate means of maintaining records to banks. The use of PIN in ATM could not guarantee the security of the customer account, since the PIN can be stolen, or forcefully collected from the owner by men of darkness. This cardless ATM if implemented will help to eliminate completely the problems associated with use of ATM card, then enhances efficiency in ATM usage, also reduces congestion in banking hall especially at the customer care section where complaints relating to ATM card and issuance and collection is always tendered. The system will uses both PIN and biometric technology as access control. Hence guarantee maximum security of customer account access and transaction from such account.

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