OTP Based Cardless Transction using ATM

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Abstract— **Banks provide ATM cards to customer to avail the services like cash withdrawal, PIN change, balance inquiry etc. But physical cards have some problems. It can be stolen, skimmed, cloned, hijacked, damaged or expired. Due to this problem, we need to think an alternate way to provide better security. Many researchers are thinking about cardless transaction through ATM. Iyabode et. al. [1] proposed a conceptual model for cardless Electronic ATM through which customer can do cash withdrawal, balance inquiry, fund transfer etc. We have analyzed their protocol and found some flaws on this. This protocol doesn't specify what if it is off us transaction. Besides, customers get different categories of services but this protocol cannot determine which customer will get which category of services. That is why, inspired by this protocol we have proposed a modified model for getting same transaction facilities as exists which uses BPIN that will determine the bank identity (B) and a random Personal Identification Number (PIN) and One Time Password for authentication of the customer instead of biometric fingerprint because of major disadvantage of biometric authentication. And obviously it will use no card for accomplishing the transaction.**

Keywords— Automated Teller Machine, One Time Password(OTP), cardless transaction

I. INTRODUCTION

Luther Simijan, an American inventor and businessman first invented the automated banking machine called Bankograph in 1960 which could deposit check or cash at any time of a day [2]. In 1967, an idea of more comfortable and self-servicing technology came from the mind of Scottish inventor John Shepherd-Barron when he was in the bathtub thinking that if vending machines could dispense chocolate bars why couldn't they dispense cash? [2]. This idea was implemented by Barclays London Bank. It used printed paper voucher with radioactive ink [2]. Later Donald Wetzel, a Dallas engineer and former professional baseball player used plastic card instead printed paper. A branch of Chemical Bank implemented this machine in 1969 [2]. After that the usage and familiarity of ATM is growing. In today's world there are around 2 million ATMs across the globe.

Now, banks are providing debit/credit/prepaid cards to customers to avail banking services through ATM. Every card consists of 16 digit numbers in which first six digits unique number is Bank Identification Number (BIN) by which acquirer bank (the bank who accepts the card) recognizes the customer belongs to which bank. The next 9 digit is card number and last 1 digit is the check digit. BIN is fixed for each bank, 9 digits are generated randomly or in sequence based on the bank's policy. A payment network such as VISA, Master Card (MC), American Express (Amex) etc has been introduced to connect different banks in different countries. Now customer of one bank can withdraw cash from ATM of other bank using this network.

Each network has different types of cards like VISA Gold debit/credit, Platinum debit/credit, MC Platinum debit/credit etc. Each of the cards has different facilities which are provided by banks based on their policy. These cards use a magnetic strip or chip which is more secure than magnetic stripe card. Magnetic stripe contains sensitive customer information which is called track data. The chip also stores customer information along with authentication information. A Personal Identification Number is used to authenticate a customer. This PIN is mandatory for ATM transaction and in some cases in PoS also. The transaction cannot occur without card and PIN.

Manual banking is based on paper and time-consuming. A customer has to go to branch physically, do cash withdrawal using a check or ask the teller to inform him about his balance which is very much annoying sometimes. ATM is invented to remove this hassle as it is self-servicing, no teller is needed. Customers can use this machine 24/7 basis. They can access it whenever they want whatever the time of day is. Life becomes very easy with the advent of ATM. People can access their bank account through balance inquiry, withdraw cash, transfer fund etc using ATM. It makes all these transactions paperless. To avail these facilities, the bank provides a plastic card to customers. But the plastic card has some disadvantages. It can be lost, damaged, expired or skimmed. To overcome these disadvantages, we have proposed a new model for the cardless transaction which uses BPIN and OTP for secure authentication. The BPIN is used to identify issuer institution; customer type and category of facilities are enrolled for that customer.

The rest of the paper is organized as follows. Section II discusses related works. Model of Cardless ATM [1] is discussed in section III. In section IV major disadvantages of this model are explained and improved model is proposed in section V. Advantages of the proposed methodology are depicted in section VI. Finally, we conclude this paper in section VII.

II. RELATED WORKS

With the growing usages of ATM, researchers are doing research about the development, security and enhanced facilities of ATM. In 2012, the ATM manufacturing brand NCR Corporation introduced a new way to withdraw cash from ATM using smartphone [3]. The process needs a smartphone with a built-in camera and NCR application installed in it. At first, the customer needs to log in to the application, then the customer is authenticated by the PIN, the application shows options of all bank accounts of the customer. He can choose an account from which he wants to withdraw cash, enter the amount. After accomplishing these activities, a QR code is displayed on the ATM screen; he uses his smart phone's camera within the application to scan

the code. If it is successful, ATM dispenses cash to the customer [3]. But this method reduces the security of the customer because only one factor PIN is used for authentication instead both card and PIN. Besides the application is not tied with a specific smartphone so that application can be run in any smartphone that means there is no ownership of device [4]. Another vulnerability is QR code can be faked or manipulated by a hacker. FIS and Wintrust Financial Corporation introduced an almost similar approach in 2013 [5]. Another ATM manufacturing firm Diebold introduced almost similar but bit different approach to address the 'millennium generation' [6]. Diebold added One Time PIN for verification to protect the vulnerability of fake QR code. The one time PIN is sent to the user's smartphone application and the user has to enter this PIN to ATM [6]. A survey had been done about the usage of ATM and customers' satisfaction in Nigeria [7]. They included three banks in Ogun State, Metropolis of Nigeria viz-a-viz First Bank, Guaranty Trust Bank, and Skye Bank. Their research found that customers' satisfaction was not up to the mark though ATM was increasing day by day in Nigeria because of poor service delivery. They used questionnaires and sample of 200 respondents to collect data. To analyze the data chi-statistical tool was used. Mosabber Hossain had studied the status of ATM in Bangladesh and discovered two different processes of ATM in Bangladesh [8]. One is Core Banking and another is Consortium of Banks. The major problem he found that users don't know the exact location of every ATM and the status of ATM whether it is in service or out-of-service without going to booth location physically. To overcome this situation, he developed software which will be helpful in this situation. A. B. Garko proposed a framework to deposit money in ATM and later transfer the fund which can be inter-bank or intrabank [9]. An approach was proposed based on Neural networks for optimization of cash management at ATM in [10]. It can forecast daily cash demand for every ATM. His simulation provided a good result but further experimental investigations are necessary. Another research [11] had been done on the use of ATM card. He collected data from interviews of ATM users, analyzed those data and result showed that ATM smart card had a lot of problems including card lost, duplication, stolen or impersonation etc. To protect the problems he proposed the use of biometric voice-based access control system in ATM. But voice can be recorded by a hacker and presented at ATM without the presence of the authentic user. Besides voice may be changed due to the physical problem. So biometric voice recognition is also vulnerable.

III. REVIEW OF A.M. IYABODE MODEL

A cardless ATM [1] was proposed which has no card reader. Instead, it is replaced by the biometric device to authenticate the user while trying to do a transaction. The proposed ATM used the alphanumeric PIN and biometric information to authenticate the user. They have divided the ATM activities into two groups; Activities A and Activities B and authentication will be done based on the degree of transactions. Activities A includes a high degree of the transaction such as cash withdrawal, fund transfer, payment of bills etc. Activities B includes the low degree of transactions such as balance inquiry. Activities A need both PIN and biometric authentication but Activities B need only PIN to fulfill the transaction. When the user goes to the ATM booth, it prompts the user to press any key from screen to

activate the ATM and prompt to enter alphanumeric PIN instead of a plastic card. The PIN consists of seven characters. First three characters are alphabets which are unique to a particular bank e.g. Firstbank (FBN) and the last four characters are numeric numbers e.g. 0137 unique to the customer. With the alphanumeric PIN e.g. FBN0137, the users can perform any of the transactions in category B. If users want to access category A transaction, ATM will prompt to enroll biometric identity. then if verified, the transaction will be completed. For biometric identity enrollment, each bank has all customers biometric fingerprint through BVN registration, this biometric will be enrolled at ATM. Whenever the user inputs biometric information, ATM will verify it and if it has at least a 60% match then the transaction will have happened.

IV. WEAKNESS OF A.M. IYABODE MODEL

We have analyzed this model and found some flaws on it. This model does not answer the following question:

- How the off us transaction will be happened? If a customer of Bank A wants to do transaction using the ATM of Bank B then how this cardless ATM will satisfy the transaction.

- Banks provide debit/credit/prepaid card of different payment brands like VISA, Master Card, American Express etc to customer. There are different categories of card like Silver, Gold, Platinum and their facilities are also different. So how will this method determine this?

- Biometric authentication is more vulnerable than password. Imagine that your biometric information (finger print) is stolen by hackers. You can never use your finger print for authentication until death or remove all copies. Passwords can be changed but you cannot change your biometric information.

- Scanner or camera cannot determine whether the person is live or not because someone can take the picture of facial or bring the copy of fingerprint and show it to camera or scanner.

- Besides there involves an additional infrastructural cost for integrating biometric scanner in the ATM machine.

To address these vulnerabilities, we have proposed a new model which mitigates these vulnerabilities. Our proposed model is discussed below at section V.

V. PROPOSED MODEL

In our model, we have used a unique number named BPIN and One Time Password (OTP) instead of biometric information. BPIN consists of six digit Bank Identification Number (BIN) and four-digit Personal Identification Number (PIN). BIN is fixed and unique for every bank and PIN is also unique for every customer of a particular bank. Banks use different Payment Network (PN) such as VISA, Master Card (MC), American Express (Amex) etc. When banks become the member of PN, each PN provides a unique BIN to each member bank. Using this BIN, PN recognizes which bank is this and routes the transaction to that bank. Banks issue debit, credit or prepaid cards. There are categories among these cards such as VISA Gold Credit card, MC

Platinum Credit card etc. The services of these cards are different based on the card type. This also can be determined by the BIN. Our proposed BPIN is able to satisfy this criterion. The PIN is provided by Issuing Bank (IB) to its customers. It is generated very securely by IB. we have used a randomly generated unique one-time number called OTP for providing second-factor authentication service which reduces the vulnerabilities of biometric information. Because OTP is randomly generated and cannot be used more than one time. Its validity period is also very less. After the specific time period, it becomes invalid whether we use it or not. So it is used for strong authentication purpose. In this model, the BIN is used for bank identification and to determine the card category e.g. platinum or gold or silver etc. PIN and OTP both are used for authentication of the customer which makes our OCT model strong and secure.

To understand our model let assume a scenario where two banks are involved Bank A and Bank B. There is two payment network (PN) named VISA and Master Card (MC). Both banks are the member of PN (VISA and MC). Bank A issues VISA Gold Credit BPIN to a customer AC1 where BIN is provided by VISA which is 500001. And his PIN is 0129. So BPIN of AC1 is 5000010129. Another customer AC2 of Bank A has MC Platinum Credit BPIN which BIN is provided by MC that is 600002 and PIN is 9876. So BPIN of AC2 is 6000029876. Bank B issues MC Platinum Credit BPIN to his customer BC1 where BIN is provided by MC which is 600002 and PIN is 5432. So BPIN of the customer BC1 is 6000025432. Another customer of Bank B BC2 uses VISA Silver Credit BPIN which BIN is 500003 and PIN is 6543. So BPIN of BC2 is 5000036543.

Here three types of transactions can be happened which is described below (from the perspective of bank A)

*a)   On Us (OU) transaction:*Customer of Bank A uses the ATM of that Bank A that is own BPIN, own ATM.

b)   Remote (ROU) On Us transaction: Customer of Bank A uses the ATM of another bank suppose Bank B. That is own BPIN, other ATM.

*c)   Off Us (OffU) transaction:*ATM of Bank A is used by customer of Bank B which is actually opposite of ROU transaction if we think from the perspective of bank B.

We will discuss those transactions based on our model which is given below:

A.   On Us (OU) transaction based on our OCT model

Steps of this transaction are listed below:

1)   A customer of Bank A comes to the ATM of this bank, presses "Cardless Transaction" button of ATM to enable the cardless transaction feature.

2)   ATM will prompt to enter BPIN of that customer.

3)   Customer will enter his BPIN (e.g. 5000010129).

4)   The ATM will display the menu option in the ATM screen.

5)   Customer will choose an option suppose Cash Withdrawal (CW), enter amount and confirm it.

6)   Then ATM will forward this message to its Host.

7)   Host will recognize that the customer is its own customer based on the BIN that means the bank is issuer for
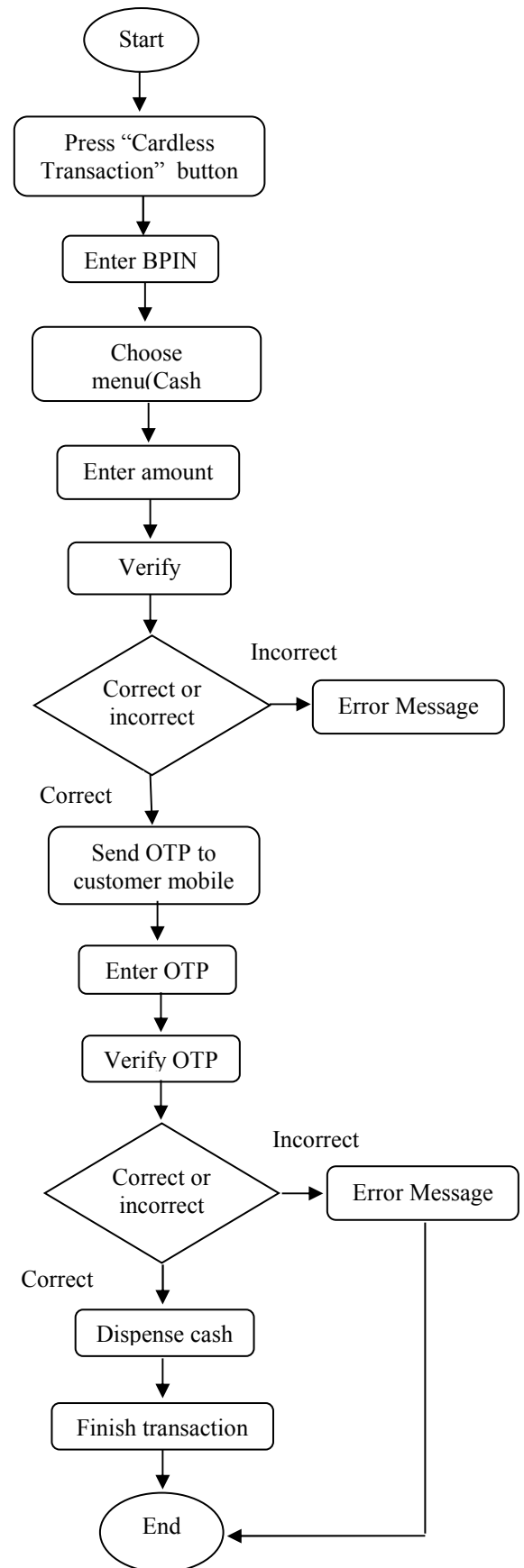

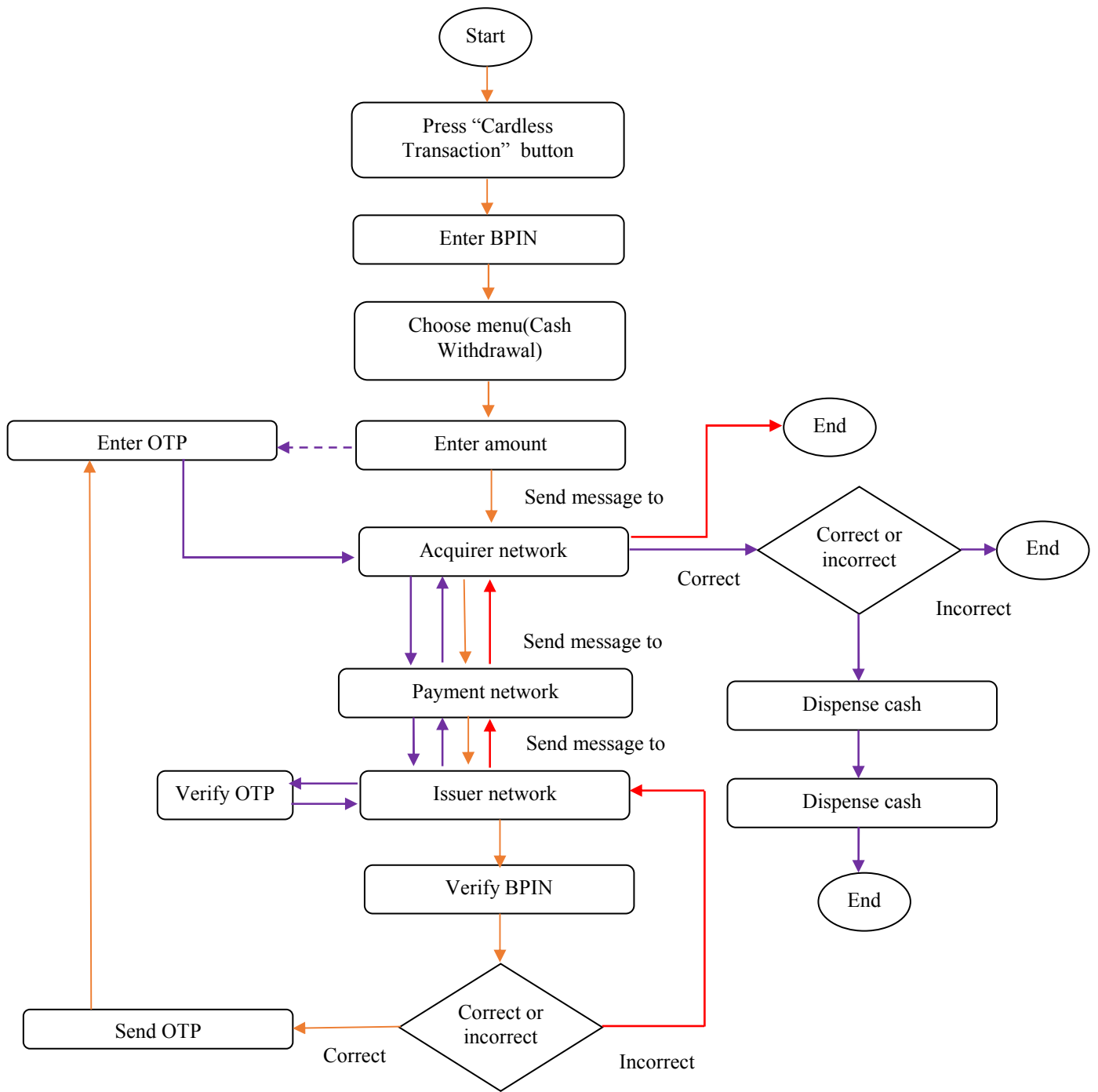Fig 1. UML diagram of OU transaction based on OCT model

Fig 2. UML diagram of ROU transaction

this customer. So it will not route this transaction to any payment network. The Host will determine that the customer is VISA Gold Credit or MC Platinum Credit BPIN holder based on BIN. The services like cash limit, purchase limit will be different based on the BPIN type.

8) It will verify the PIN (0129).

9) After successful verification, issuer will send an OTP to customer mobile number. The ATM will prompt for entering OTP.

10) Customer will enter OTP.

11) ATM will send this OTP to issuer network for verification.

12) Issuer will verify it and if it is successful then

13) Issuer will debit his account and tell the ATM machine to dispense money to the customer.

14) ATM will dispense money and customer will collect it.

B. *Remote On Us (ROU) transaction based on our OCT model:*

Suppose customer of Bank A who is VISA BPIN holder goes to the ATM of Bank B for Cash Withdrawal (CW). Bank B is a member of VISA payment network. Steps of this transaction are listed below:

1) A customer of Bank A comes to the ATM of Bank B, presses "Cardless Transaction" button of ATM to enable the cardless transaction feature.
2) ATM will prompt to enter BPIN of that customer.
3) Customer will enter his BPIN (e.g. 5000010129).
4) The ATM will display the menu option in the ATM screen.
5) Customer will choose an option suppose Cash Withdrawal (CW), enter amount and confirm it.
6) Then ATM will forward this message to Acquirer Network (AN).
7) AN will recognize that the BIN 500001 is not its own BIN. It is under VISA payment network.
8) So It will route the transaction to VISA because its BIN is 500001.
9) VISA will determine which bank belongs to this BIN and forward the transaction to Issuer Network (IN) or bank.
10) IN will verify the PIN (0129) of its customer.
11) After successful verification, issuer will send an OTP to the mobile number of that customer. The ATM will prompt for entering OTP.
12) Customer will enter OTP.
13) ATM will send this OTP to acquirer network.
14) Then the model repeats the step 8 and 9.
15) IN will verify the OTP and verification message (correct or incorrect) is sent to payment network (VISA)
16) VISA will send this message to acquirer network.
17) If OTP is correct, acquirer network will instruct the machine to dispense money.
18) ATM will dispense money and customer will collect it.

VI. ADVANTAGES OF THE PROPOSED OCT MODEL

There are some advantages of our proposed OCT model as compared to the model of A.M. Iyabode et. al. Some of them are stated below:

- Our OCT model can determine the payment network and service facilities (gold, silver or platinum) of customer.
- Remote On Us (ROU) transaction is possible using this model.
- We have eliminated the vulnerabilities of biometric authentication replacing OTP.
- Biometric authentication needs large storage to store the images of biometric. In this model we don't need any large storage because OTP is generated run time and only small time it is stored on the server. After specific time period it is flashed.
- Biometric information (finger print, voice, facial) can be changed due to physical problem or sickness. This inconvenience is mitigated by using OTP.
- Customers can enjoy same transaction facility without card as previously enjoyed with plastic card.

- We don't need to install any extra hardware into ATM so there is no extra infrastructure cost.
- Very easy and convenient process.
- Multifactor (BPIN and OTP) authentication process is used for ensuring strong security.

VII. CONCLUSION

In the proposed model BPIN and OTP have been used to complete a transaction without the hassle of carrying physical cards. OTP is used to facilitate a second layer of security for customer. It removes the disadvantages of biometric authentication because if biometric information is stolen then it cannot be used anymore for authentication and biometric information cannot be changed until death. This model can provide separate facilities to customer based on their category. With this model there is no problem for banks to be acted as member of payment network like VISA, MasterCard etc. It is also shown by analyzing the model that banks can be benefitted in business because extra infrastructure cost is not needed.

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