Designing and Implementing of ATM System Using Object Oriented Approach

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ABSTRACT- ATM come in a variety of form and sizes all to serve on goal; bring the bank closer to the user. ATMs have certain characteristics that need to be fulfilled at all times one of them is security. ATMs now are so advanced they can communicate with each other even if different Banks. In this research, designing and the implementation of ATM system has been conducted using an Object Oriented Approach along with the necessary tools such as UML and Microsoft Office Visio 2007. The use case took place; and the requirements were analyzed and based on the analysis the design took place; and basing on it the implementation is done based on object oriented concepts under Java NetBeans IDE 8.0.2, whereas the designs of diagrams are designed UML with Microsoft Office Visio 2007.

Keywords: *ATM machine, Use Case Diagrams, Sequence Diagrams, Activity Diagrams, Object Oriented Concepts.*

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1. INTRODUCTION

ATM is a part of our life activity, which helps us in day transactions and business. An automated teller machine (ATM) is a computerized telecommunications instrument that provides the clients of a financial institution with access to financial transactions in a public space without the need for a cashier, human clerk or bank teller. At this time, the ATM provides the people good services especially the people can get money at any time. We need the ATM system because not all the bank branches are open all days of the week, and some of the customers may not in a situation, they can visit the bank every time, and they want to withdraw money or deposit money for emergency cases. The main objective of this research is to implement and design the ATM system through identify the requirements of the ATM system.

The ATM will act as a second person that a customer can talk to; the customer makes choices that ATM replies back accordingly [1].

2. ATM SPECIFICATIONS

The main components of the ATM that will affect the interaction between ATM and its users are:

1. Key-Switch: to startup (ON) or shutdown (OFF) of the ATM machine.
2. Card-Reader: to read the users ATM-cards (magnetic stripe reader).
3. Screen: to display the messages to the users.
4. Key-Pad: to enter the information to the ATM e.g. PIN.
5. Cash-Dispenser: for dispensing cash.
6. Deposit-Slot: to deposit cash or checks from the users.
7. Printer: for printing the receipts.

8. Communication/Network Infrastructure: it is assumed that the ATM has a communication infrastructure to communicate with the bank upon any transaction or activity.

3. ATM BUSINESS RULES WITH ASSUMPTIONS

The ATM would managed physically by an operator, who operates the ATM machine, refill it with cash and receipts, etc. The ATM should not shut down while serving a user, and it serves one user at a time. To start of any transaction in ATM; The user should insert the ATM card which contains user's account information after that the user should enter the Personal Identification Number (PIN) in order to utilize the ATM-services. Then, the ATM will send the user information to the bank to gain the authentication from the bank; without authentication, the user cannot perform any transaction/service. The user's ATM-card will be kept in the ATM until the user requisites against that e.g. the user can press the cancel button at any time, and the ATM Card will be ejected. The ATM System will maintain an internal log of transactions that contains information about hardware failures that posed upon any process; it is assumed that log will be used by ATM operator in order to fix/solve any issues that will be written upon starting and shutting down the ATM.

The authors' assumption as shown below:

1. Identify the system user through the PIN number if the value of the pin number between 1 and 1000 this is a manager, if between 2000 and 5000 this is an officer and between 5001 and 20000, this is a customer.
2. In case of depositing checks the amount of this check will not be added instantly to the user account, it's subject to manual verification of taking

it out by the operator and to obtain the bank approval.

3. It is assumed that the Bank manager and other bank executives, i.e. bank officers will access to ATM system information that stored in the Bank Database, and this information is updated automatically and every day but for the 'check remains cash' service the update will be instantly upon any changing in the cash within the ATM.

4. It is assumed that the user deposits will not be added to his/her account immediately because it will be subject to verification by the bank.

5. It assumed the ATM card is the main player when it comes to security; the account number is a supplement to the credit card and the same time the account number is a user pin and without a card cannot access to the ATM s the user has to have a user pin.

4. ATM INTERACTIONS

ATM interacts with the different real world/external object like Bank, user, operator, etc., and each interaction will be different, based on the type, rank, and behavior of each interacting object. The author will try to categorize and summarize but in the sophisticated manner, the interactions of the ATM system with external objects.

ATM-Human Interactions

ATM system will interact with different human objects as shown below:

4.1. ATM-Operator interaction: operator will be responsible of:
- Turning the ATM in ON/OFF status using the designated Key-Switch.
- Refilling the ATM with cash.
- Refill ATM's printer with receipts.
- Assumed to refill ATM's printer with INK.
- Takeout deposited envelopes.

4.2. ATM-User interactions
The ATM will provide for its users the functions as shown below:
- Cash withdraw: the user can withdraw certain amount of cash.
- Deposit funds: the user can deposit cash or checks in envelops to his/her account.
- Transfer funds: the user can transfer funds to the other accounts.
- Balance inquiry: the user can view his/her account balance.

4.3. ATM-Bank Officers interactions
- To check the total deposits.
- To check the total withdrawals.

- To keep track number of transactions.

4.4. Bank Manager:
- Check the total deposits
- Check the total withdrawals
- Check the number of transactions per day.
- Print total deposits/withdrawals.
- Checks remaining cash.

The main point that has to be noted is that the interaction between the manager/officers with ATM would be conducted through the bank Database.

4.5. ATM-Bank Interaction
- The ATM communicates with the bank's database because the ATM does not contain a database to authenticate any process to the customer without the bank's database.
- The ATM sends the user's information to the bank regarding to the function that selected by the user in the ATM.
- The ATM sends the user's PIN to the bank for authentication; otherwise the ATM will perform nothing until the Bank authentication.

5. ATM SYSTEM REQUIREMENTS

For careful understanding hence plotting of requirements be done. Generally the interaction type is conversing [2]. Therefore, it is very necessary to know the requirements of ATM before design and implement the ATM system like any system. System users and the role of each user is the main concerns have to be considered; to start design and implement the ATM system.ATM system has many users; the first is the operator, who should be able to do turning the ATM in ON/OFF status using the designated Key-Switch, refilling the ATM with cash. Refill ATM's printer with receipts and takeout deposited envelopes? The second user of ATM is the customer who should be able to make cash withdrawal from any suitable account linked to the card, in multiples of $20.00. So to do this step the customer should have an account and this account approved from the bank. To make a system is more interest for the customer; the ATM system provides the customer to print a receipt after each successful withdrawal transaction. A customer must be able to make a deposit to any account linked to the card, consisting of cash and/or checks in an envelope. In addition to that, the customer must be able to make a transfer of money between any two accounts linked to the card. We should take in consideration the customer has more than on account; if he wants to transfer money from his/her account; the ATM system will ask the customer from which account. He wants the transfer to identify the users account. Moreover, the customer must be able to make a balance inquiry of any account linked to the card; from the ATM system, the customer has to amount of his account. With this ATM system, the customer can enter

the amount from money to add it in his/her account with two ways such as cash money or insert an envelope into the ATM with the value of the amount and after manual verification from the operator; the Approval must be obtained from the bank before physically accepting the envelope. ATM system should provide a good service so the system needs security, especially some of the users do mistakes when the insert the pin number; to solve this state the ATM system will allow the system user to insert the pin wrongly for three times only. If the system user inserts the pin wrongly for three times; the ATM system will keep the user card, and he should go to the bank to take it. ATM system should provide the customer for all functions that I mentioned above.[6]

The manager is also a user of the ATM system; which has several functions to do it in the ATM system such as the check the total deposits, total withdrawals and print them. The officer is another user who has some functions in ATM system to do it, such as check total deposits, total withdrawals and keep track number of transactions that were execute every day. Bank validation for each user is the main consideration; it should be ensued to perform all ATM users' functions .So each system user needs the bank validation to perform any transaction.

6. USE CASE OF ATM SYSTEM

A use case is a methodology used in the system analysis to identify, and organize the system requirements [7]. The use case contains all system activities that have significance to the users. The use case is made up of a set of possible sequences of interactions between systems and users in a particular compound and related to a particular goal. The use case used to identify the system users and the activities of each user in the system; clearly as long identify the relationship between the functions of each user, for example, which function as it is should and, which is optional. The use case supplements the requirements of the ATM system throughout represent the systems user and functions with drawings. The use case diagram shown in fig(1) identifies the ATM systems' users, and all the functions which they do in the ATM system.
Why use case One might argue? Simply put "A picture paints thousands of words", it can be used as documentation for future work, to validate and clarify and verify requirements with stakeholders (including development team). [3].

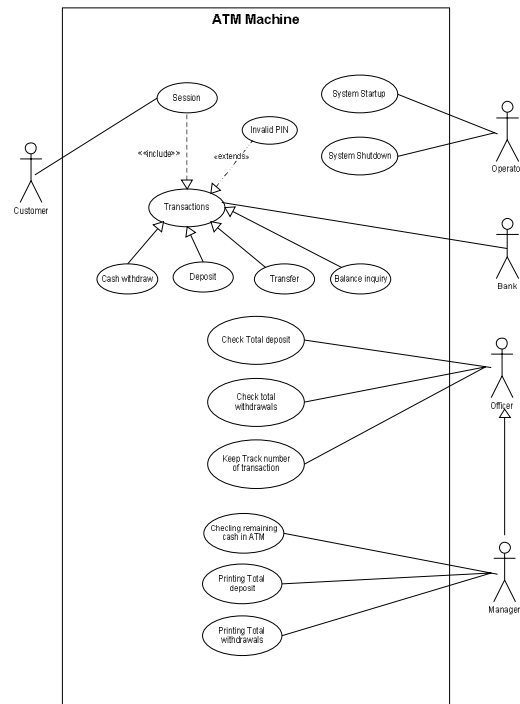**6.1.** USE CASE IDENTIFICATION

Figure 1: Use Case Identification of ATM system

The Transaction Process, Main Success Scenario and Extensions are the factors discussed in each process.

6.2. Use Case of Withdraw Transaction

6.2.1. Withdraw Transaction
The Customer would access to the ATM system through enter the PIN properly; after the PIN validation from the bank the customer chooses the withdraw button from the appeared menu for the customer.

6.2.2 Main Success Scenario
The cash withdrawal started throughout performs a session. The customer chooses the withdraw button from the menu through enter the PIN properly. Then, the customer chooses the amount needs; through selecting the value from the withdraws' options; or enter the amount which wants. The ATM connects to the bank to check the customers' balance; if the amount that chooses less than the balance, the transaction performed and the customer will take the money from the dispenser. After performing the withdraw transaction the balance is reduced.

6.2.3. Extensions

- No enough balance is available for the customer
.
ATM System displays error message saying no balance are available because the amount which the customer choose or enter greater than his balance.

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.3. Use Case of Deposit Transaction

The Customer would access to the ATM system through enter the PIN properly; after the PIN validation from the bank the customer chooses the deposit button from the menu that appears to the customer.

6.3.1. Main Success Scenario

The deposit transaction is started throughout perform a session. The customer chooses the deposit button from the menu. The ATM system requests from the customer to enter the amount of money, or insert the envelope inside the deposit dispenser. The ATM displays a message to the customer, for example "Thank you Dear Customer"

6.3.2. Extensions

- ATM System displays error message saying "please insert the envelop again" when the customer insert the money or the envelope with wrong way.
- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.4. Use Case of Transfer Money Transaction

The Customer would access to the ATM system through enter the PIN properly; after the PIN validation from the bank; the customer chooses the transfer button from the menu that appears to the customer.

6.4.1. Main Success Scenario

The transfer transaction is started throughout perform a session, the customer should choose the transfer button from the menu. The ATM requests from the customer enter the amount of money and the account number of the other person. The ATM checks the balance of customer, if the amount which customer enters it less than balance. The process performs successfully. Otherwise the transaction does not perform, and the ATM displays a message to the customer.

6.4.2. Extensions

ATM System displays error message saying "Your Balance is not enough to perform this transaction"

- Enter the PIN for three times wrongly.

- The card reader cannot read the card and the ATM system displays error message for the customer.
- The amount of money that he enters is greater than the customer balance

6.5. Use Case of Balance inquiry Transaction

The Customer would access to the ATM system through enter the PIN properly; after the PIN validation from the bank the customer chooses the Balance inquiry button from the menu.

6.5.1. Main Success Scenario

The balance inquiry transaction is started throughout perform a session. The customer should choose the balance inquiry button from the menu. The ATM sends the card information to the bank; after that the ATM system displays the amount of money in the account.

6.5.2. Extensions

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.6. Use Case of the Operator
6.6.1 .Use Case Template for System Startup

The Operator would access to the ATM system through enter the PIN properly; after the PIN validation from the bank; the operator can do "ON" and all functions of his will activate.

6.6.2. Main Success Scenario

The ATM system is started up when the ATM operator makes it on the "ON" status. The ATM operator asked to enter the amount of money inside the ATM machine; then the connection to the bank established. after this process, the servicing of customer can begin. In addition to that; the ATM operator may remove the deposit envelopes and reload the machine with cash, blank receipts, etc.

6.6.3. Extensions

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.7. Use Case of System Shutdown

The Operator would access to the ATM system through enter the PIN properly; after the PIN validation from the bank; the operator can do "OFF" status, refilling the ATM with cash, refill ATM's printer with receipts and takeout deposited envelopes.

6.7.1. Main Success Scenario

When the ATM operator makes sure that no customer is using the machine; the ATM operator switches the ATM system to the "OF" status. Furthermore; the connection to the bank shut down too. After the connections' shutdown, the ATM operator is free to remove the deposit envelopes and replenish cash and paper.

6.7.2. Extensions

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.8. Use Case of the Manager

6.8.1. Use Case for Checking the Total Withdrawals and Total Deposits and Print them

The Manger would access to the ATM system through enter the PIN properly; after the PIN validation; Manger can access to the bank data base and check the total withdrawals and even he can check the total deposits and print them.

6.8.2. Main Success Scenario

The manager connects to the bank database through enter the PIN and checking the total deposits or total withdrawals and even print the result on the receipt.

6.8.3. Extensions

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

6.9. Use Case of the Officer

6.9.1. Use Case Template of Checking the Total Withdrawals and Total Deposits.

The Officer would access to the ATM system through enter the PIN properly; after the PIN validation; Officer can access to the bank data base and check the total withdrawals and even he can check the total deposits.

6.9.2. Main Success Scenario

The officer connects to the bank database through enter the PIN and checking the total deposits or total withdrawals.

6.9.3. Extensions

- Enter the PIN for three times wrongly.
- The card reader cannot read the card and the ATM system displays error message for the customer.

7. ATM ACTIVITY DIAGRAMS

Activity diagrams have been used to describe the workflow behavior of ATM system. The Activity diagrams are similar to state diagrams because activities are the state of doing something in the system. It also used to model the workflow behind the ATM system and useful for; analyzing use cases by describing what actions need to take place.

7.1. Activity diagram of ATM System

The requirements of ATM system and its users were identified in the previous sections. Activity diagrams utilized to analyze the use case of ATM through of each function in the system. So the general activity of the ATM system shown in figure is started with the insert the card into the ATM; the ATM requests from the customer to insert the personal identification pin (PIN); after enter the PIN the ATM sends the customer information to the bank for validation. When the PIN validates from the bank; the options of the customer activated, and the customer could choose anyone but, if the PIN do not validates from the bank, the ATM notifies the customer through a message on the ATM screen.
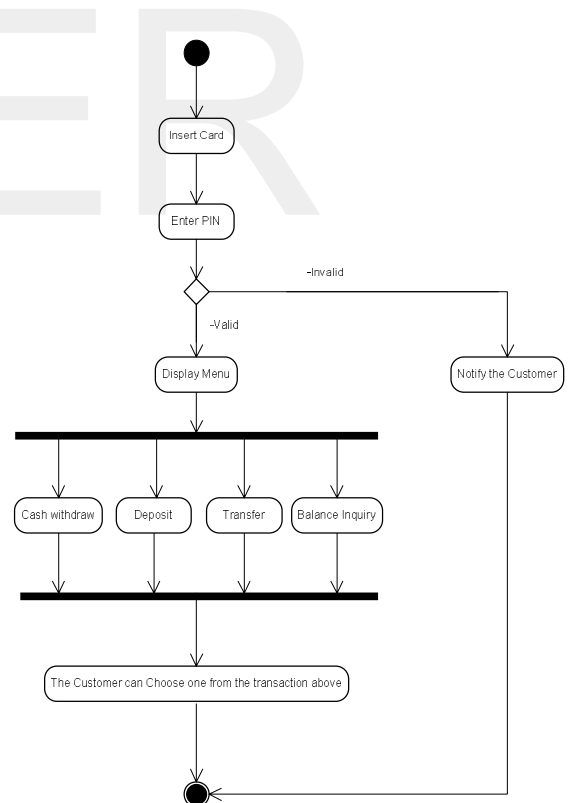

Figure 2: Activity diagram of ATM system

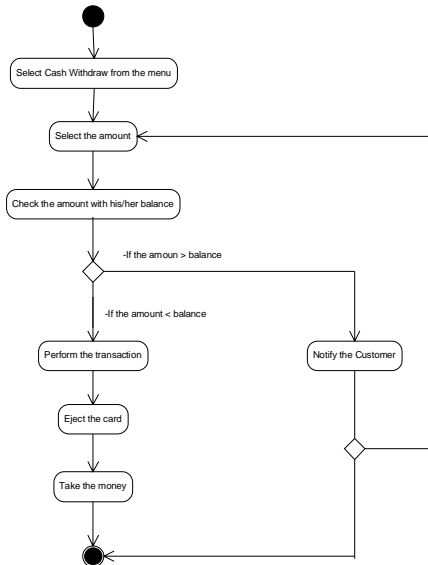## 7.2. Activity Diagram of Cash Withdraw

Figure 3: Activity diagram of Cash Withdraw

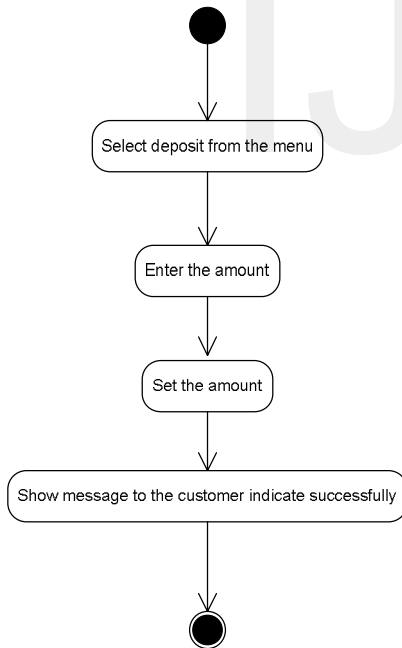## 7.3. Activity Diagram of Deposit

Figure 4: Activity diagram of Deposit

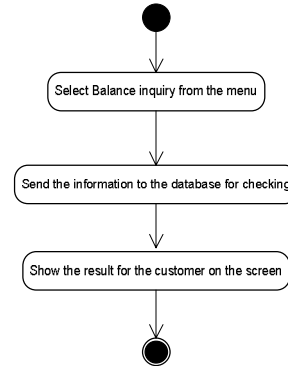## 7.4. Activity diagram of Balance Inquiry

Figure 5: Activity diagram of Balance Inquiry
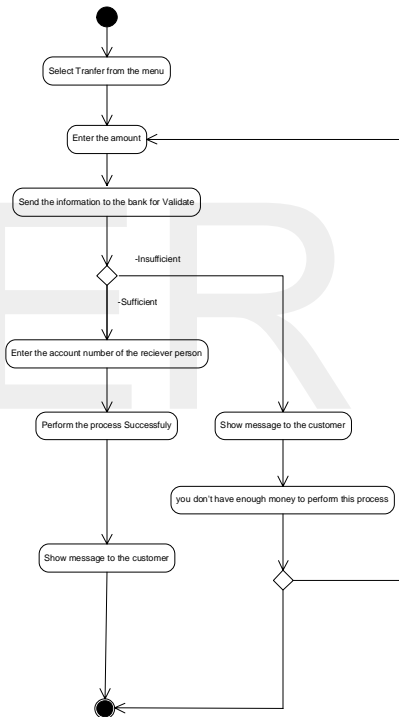
7.5. Activity Diagram of Transfer Money

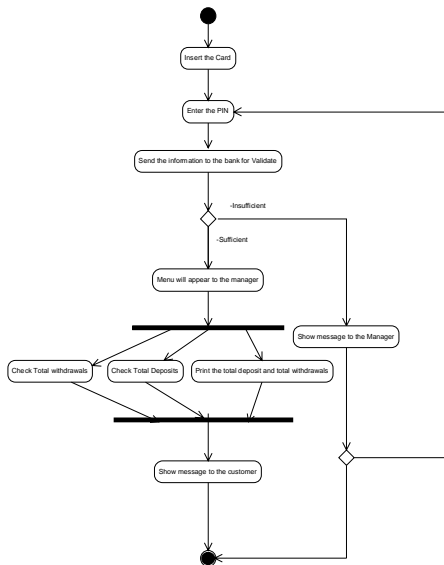Figure 6: Activity diagram of Transfer Money

7.6. Activity diagram of the Manager

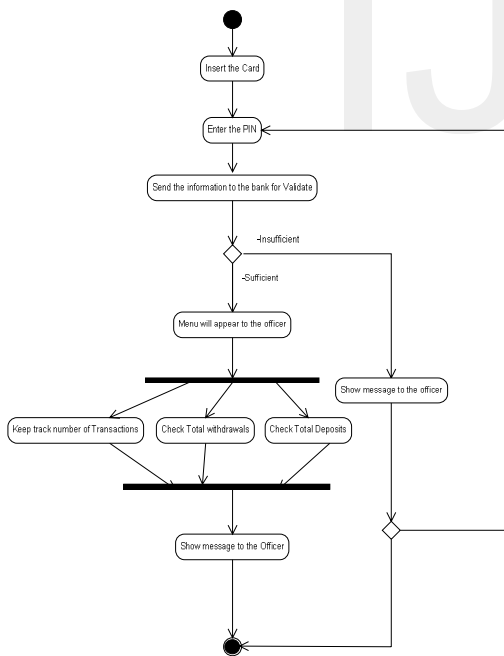*Figure 7: Activity diagram of Manager*

7.7. Activity diagram of the Officer

Figure 8: Activity diagram of officer

8. ATM SEQUENCE DIAGRAMS

Sequence Diagram is an interaction diagram (Grady, B et al 2007) that will reflect the interaction between object, in other terms the behavior for a use case can be reflected here in the sequence diagram.. The developers typically think the sequence diagrams were meant exclusively for them. However, some of the organization's business staff finds the sequence diagrams are useful to communicate; how the business currently works by showing how various business objects interact. During the requirements' phase of ATM system, analysts take use cases to the next level by providing a more formal level of refinement. When that occurs, use cases are often refined into one or more sequence diagrams.

8.1. ATM Startup Sequence diagram
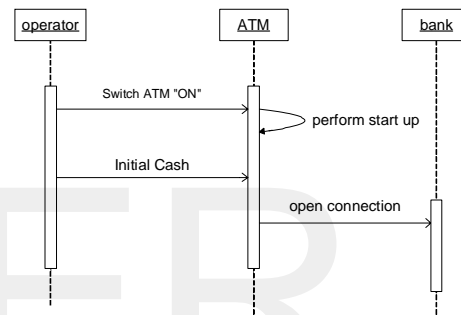
Figure 9: Sequence diagram of ATM Startup

8.2. ATM Shutdown Sequence diagram
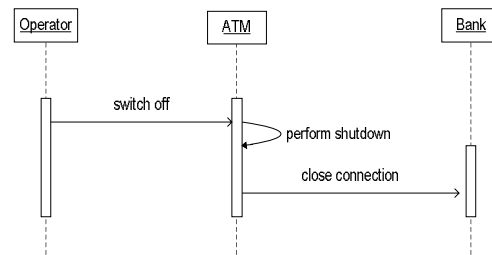
Figure 10: Sequence diagram of ATM Shutdown
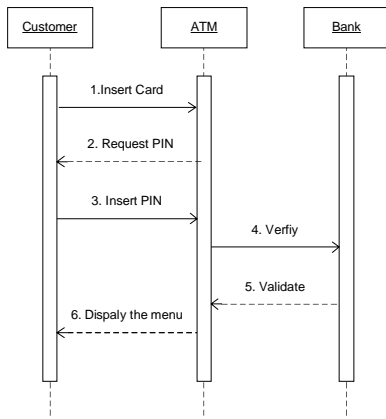
8.3. ATM Sequence Diagram

Figure 11: Sequence diagram of ATM
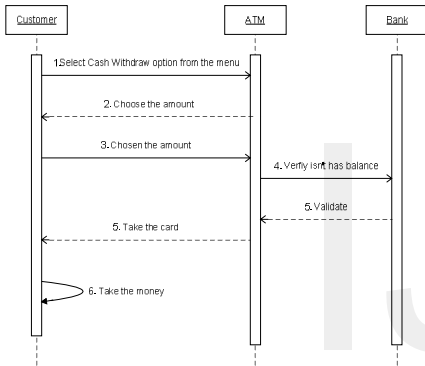
8.4. Withdraw Sequence Diagram

Figure 12: Sequence diagram of Withdraw
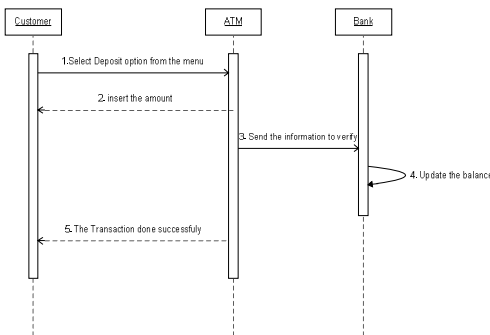
8.5. Deposit Sequence Diagram

Figure 13: Sequence diagram of Deposit
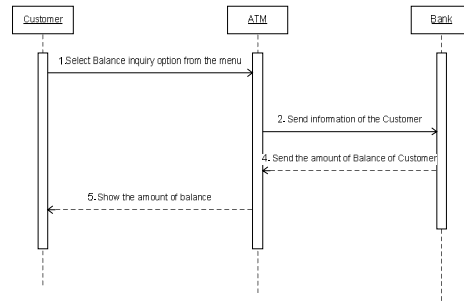
8.6. Check Balance Sequence Diagram

Figure 14: Sequence diagram of Check Balance
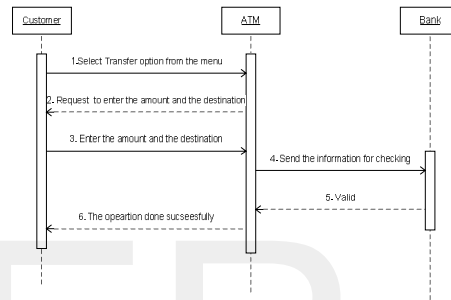
8.7. Transfer Money Sequence Diagram

Figure 15: Sequence diagram of Transfer Money

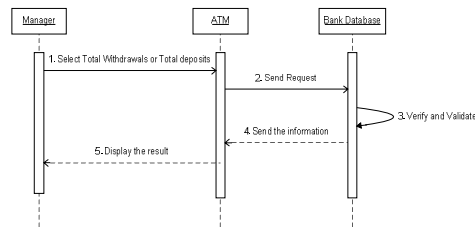## 8.8. Sequence diagram of the Manager

Figure 16: Sequence diagram of Manager

9. ATM Class Diagrams

The class diagram is most widely used diagram in modeling object-oriented system. It shows a set of classes, interfaces, associations and generalizations. Package is usually used model part for organizing elements in class diagram. Class diagrams are not just for visualizing and documenting structure models but also for constructing executable system with forward, reverse and round-trip engineering. There is also a synchronization engine for generating and updating entity relationship diagram from class diagram.
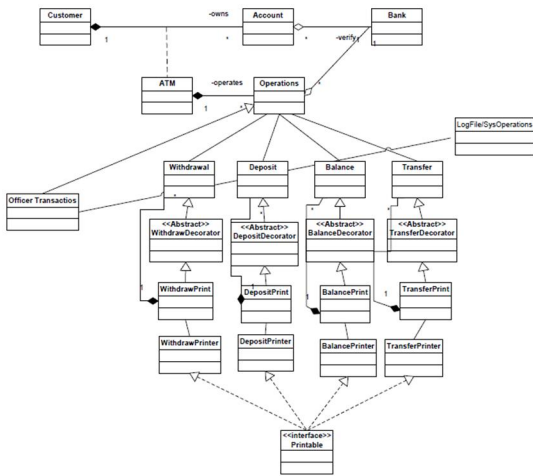
Figure 17: Class diagram of ATM System

10. ATM SYSTEM IMPLEMENTATION

The ATM machines as mentioned earlier come in variety of shapes and design; the GUI design chosen and implemented was based on the analysis and design phases. And to better support it, the prototype was given to several ATM user for a test drive to get the accessibility testing feedback. The login screen as shown in figure (18) appears to the system users.
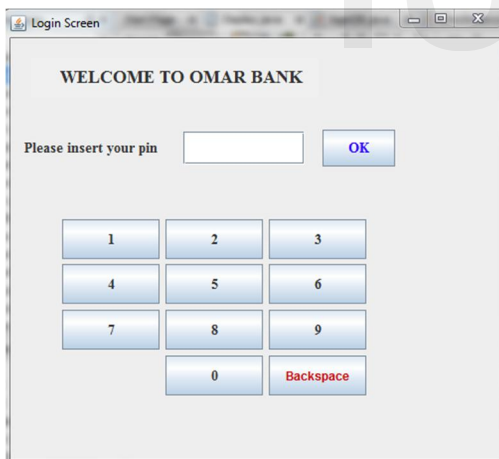

Figure 18: Login Screen of ATM

The login screen requires from the system user to enter the PIN number; from this PIN, we can recognize the system user (Manager, Officer and Customer). The process starts with enter the pin then send the information to the database to identify the system user. If the system user enters the pin wrongly for three times, the ATM displays a message for the system user, and the ATM will keep the card of the system user.

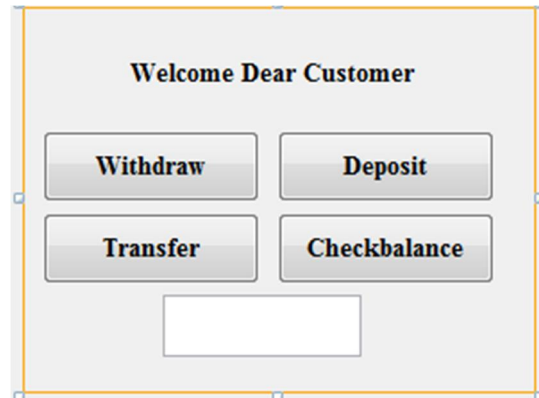Figure (19) shows the screen of the customer

Figure 19: Menu Screen of ATM

ATM functions designed as buttons to make it usable for all kinds of users.

The screen of manger as shown in figure (20)

Figure 20: Manager Screen of ATM

From the manager's screen, the manager would collect the total of withdrawals and deposits and even print the result and make daily report. Officers' screen as shown below:
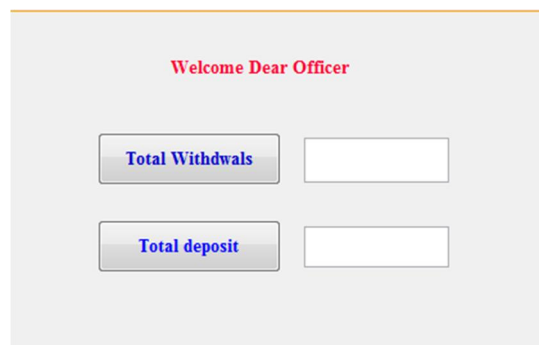

Figure 21: Officer Screen of ATM

11. Design Pattern

The decorator design pattern was implemented to add some functions without changing the original function [4] as shown in the code below:

```java
package atm12;

/**
 *
 * @author OMAR
 */
public abstract class WithdrawDecorator extends Withdraw {

    public abstract void withdraw();


}
```

```java
package atm12;

import java.lang.*;

public class Withdraw {

    private double amount = 0;
    private int pin;
    private double balance;
    UpdateDB updatedb = new UpdateDB();
    private Display display = null;

    public Withdraw(Display parent) {
        display = parent;
        pin = display.getUSER_PIN();
        balance = display.getBALANCE();
    }

    public Withdraw(double amt, int pin, double balance) {
        amount = amt;
        this.pin=pin;
        this.balance= balance;

    }

}
```

```java
package atm12;
import javax.swing.JOptionPane;
/**
 *
 * @author OMAR
 */
public class WithdrawPrint extends WithdrawDecorator {
Withdraw withdraw;
    public WithdrawPrint(Withdraw withd)
    {
    withdraw = withd;
    }
    public  void withdraw(){
    withdraw.withdraw();
    JOptionPane.showMessageDialog(null, "Do you want to print");


    }
}
```

According to the sample of code above and the class diagram mentioned previously the decorator design pattern such as shown below.
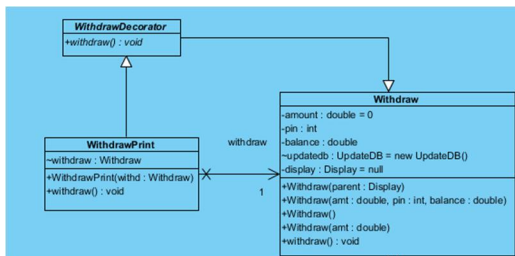
The sample code below explain the one concept of the object oriented, which is override and the rest the author applied them in whole code of ATM system.[5].

```java
package atm12;

public class Checkbalance {
    private int pin;
    private String name;
    private double balance;

private loginDB login=null;
public Checkbalance(loginDB parent){
    login=parent;
}

//override the constructor
public Checkbalance(int pn, String nme, double blance){
    pin = pn;
    name = nme;
    balance= blance;
}

    public void checkbalance(){
        balance=login.getbalance();
}
```

At this stage the complete testing and implementation would be conducted and the ATM set and ready to be deployed. With the implementation of the object oriented concept in developing the ATM machine the requirements came to clarity especially when the use case took place; the requirements were analyzed and based on the analysis the design took place; and basing on it the implementation.

CONCLUSION

ATM come in a variety of form and sizes all to serve on goal; bring the bank closer to the user. ATMs have certain characteristics that need to be fulfilled at all times one of them is security.

ATMs now are so advanced they can communicate with each other even if different Banks. When one looks at the different ATM they all share several operations such that withdrawal and View Balance. The requirements of ATM machine came to clarity especially when the use case took place; and the requirements were analyzed and based on the analysis the design took place; and basing on it the implementation done based on object oriented concepts.

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