

Improving ATM User Interface (UI) of Pakistani Banks Using Keystroke Level Modelling (KLM)

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Abstract— The ATM connotes as Automated Teller Machine or Cash Machine. This machine has earned its currency on a larger scale in our modern society. However, unfortunately, most users have met bad experiences. For instance, reinserting the ATM card to continue to other transaction, slow transactions and navigation menu options are not allied that create complexity for users and this is because of its outdated design and user interface. In this paper, we investigate some existing Pakistani bank ATM navigation menus and propose the 'Pak ATM' as a new approach.

Keywords—Keystroke Level Model, Human Computer Interaction, Velocity, GOMS

I. INTRODUCTION

Information and communication technology (ICT) is renowned for its dynamic perspectives (i.e. tele-communication, internet services, financial industry etc.) and automated services are part of ICT. In financial industry, automated teller machines (ATM) are widespread and well known to all.

In this era of advancements, various terms and titles are specified for ATM machines including ATM, and cash dispenser. The Automated teller machine is the mixture of electronic computer and telecom device that are used in banks, financial insurance and other type of financial industries. Now, the customer priority is security. It is an efficient and error free communicative method to access customer's account. The ATM is an automatic service workstation. It accepts fixed instructions and repossesses them in cash form. Most of ATM's have additional banking facilities and features for users like balance inquiry, bill paying etc. Beside these features, ATM can work by putting the ATM bank card and machine will only accept the cash cards/credit cards into its card reader slot.

ATM card contains the customer's account information in a PIN (Personal identification number) which is illuminated on the magnetic stripe card. When user inserts his/her card

and withdraws cash, the machine will directly contact to the bank computer and validate customer account, dispense the money and will notify the complete transaction notice at the end.

A) HCI Technology Application in ATM:

The term HCI (Human Computer Interactions) means to describe the communication between human users and electronic computer. HCI is technique through which we can make an effective coordination. For instance, if we want to act or perform an action, the computer will response accordingly. HCI includes some common devices such as touch-sensitive devices, voice input devices and graphics devices. If ATM is secure, user friendly and based on country cultural requirements then it will be more popular and considered professional. In this way, users can easily use these machines and will be facilitated to use these machines by their own native or mother tongues. The basic advantage of using the native languages on ATM's is it will take less time to perform a task and carry out other transactions efficiently. Therefore, in order to create a high-quality ATM machines with high quality performance, HCI experts work hard to recognize the basic factors, which decides how people can operate ATM systems and start proper utilization of the ATM successfully. They build tools and procedures to help creative designers to make sure that ATM machines display the correct output to accomplish proficient, powerful and safe interface for both individual and group cooperation's [1].

B) Objective of the Study

The main purpose of this research is to improve the ATM Navigation menu systems. This can be accomplished through the Keystroke level modelling (KLM). Besides, the researcher will investigate various other existing Pakistani ATM systems and associated problems such as users have to reinsert their ATM cards to continue other transactions etc. Issues like slow transactions and ATM interfaces problems will be considered and their sound solutions will be suggest-

ed. The ATM menu design is most imperative and more complicated task. The researcher will attempt to improve the menu design and add some new features to make ATMs more users friendly.

II. LITERATURE REVIEW

The chapter reviews previously published work that deals with the websites, web applications and their lacking in experimental studies including usability of ATM Machines. In 2005, Wells Fargo, one of the leading Bank in U.S.A decided to redesign the ATMs user interfaces and resolve the issues and bugs that helps improve customer satisfaction and user experiences [2]. One of the famous study regarding the ATMs [3] says that mostly the middle age people face difficulties in using ATMs. For instance, they do not recognize which side of their ATM card should be inserted in the ATM machine slot. It is due lack of inexperience or they feel it inconvenience and uncomfortable at the time of using the card.

Researchers Roger et al. [3] have found the actual difficulties while using the ATMs. According to their survey research, most of the users including adult and aged users have to stay long for their turn to use the machine. It is because many people use a single ATM at the same time. They also recorded the rate their actual difficulties while facing the ATMs. Resultantly all age groups, marked on, take it a bit difficult task to make their payment from ATM. For example, the withdrawals and balance check would be easy for all adult groups whereas the cash deposits, fund transfer and advance cash is much harder then withdrawals.

A) General ATM

Now a day, ATM is a useful service to bank consumers but there are a lot of issues in the design interface. ATM interface helps the consumer and machine to communication between them. Therefore, ATM Designer try to improve their interface for high usability levels. When consumer use the ATM, there are some other problems, which are highlighted below and illustrated in figure 1.

- Users have to face the problems to reinsert their ATM card to continue other transactions.
- Sometime users have to face longer waiting time to use the ATM means waiting in the queue.
- Lower visibility of ATM screens due to high sun light.
- Sometime a novice users insert wrong side of ATM Card which is the common problem. Some ATM machine enu selections are not set correctly with their corresponding buttons.
- Some ATM users find it difficult to understand the ATM instructions and how to execute them.

- ATM user are facing difficulties to understand the ATM machine because they do not know how to operate it.
- Some ATM machine did not offer the users favourite amount in cash withdrawal transaction. Then user go to the other option menu to find their required amount option and it will takes little bit more seconds.

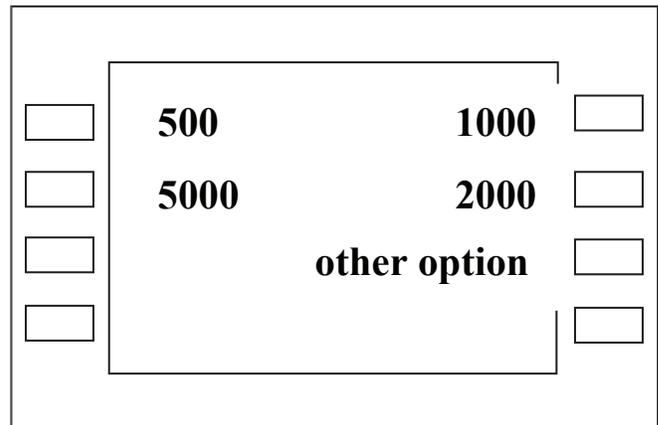


Fig. (1). Typical ATM Menu Screen

At this time, most of the users are confused and are not able to determine which key is right to select the required amount of money and what if the user select the 'other Amount' option then which button is to be pressed.

Now if that type of situation occurs, it will be confusing and puzzling. Some of the problems are inescapable like for example, ATM is out of Cash, Host not responding, etc.

The researches will focus on the ATM user interface design problems and try to resolve the said problems.

With increasing technology, the ATM interface will also grow and improve with the new technological steps and most modern ATMs will be more flexible, expressive and convenient. In the late of 70's, ATMs were introduced only in UK but now ATM machines are available in every Malls, hospital, airports and other public places [4].

The ATM Problems are already mentioned in above paragraph and one of the problem is when an ATM card is return to the user, the user still may have some other transactions to make [5-6].

Human Computer Interaction (HCI) will help us to design an efficient computer system through which the users can perform their tasks efficiently and securely.

Now the visible and decent location is major factor. If users can find the ATM location easily, it will save a lot of time and will gain good feedback from customers. Most of the

users have facility to use other bank ATM's as well and out of their own decision, they would utilize their favoured ATM constantly. The more prominent utilization a bank's ATM gets, the more potential there is for the bank to make benefit [4]. This is the reason a bank or building society ought not under-evaluation the significance of good ATM interface plan.

Automatic teller machine (ATM) would prevail method of access to trade for those living out industrialized social orders [7]. To make a portion of the governmental issues of the ATM more obvious, some sufficient number of ATMs, secure location, speed, cash backup, convenient and cost are crucial fundamental quality feature of ATM service [8].

II. METHEDOLOGY

In this section, the researcher discuss the proposed ATM interface approach namely "Pak ATM" menu system and target to the active users who can use modern ATM machine.

The "PAK ATM" system have not concern about ATM common factors for example, invalid card and insufficient cash because it work on ATM simulating navigation menu system. In Figure – 2, the sequence diagram of ATM working functionality is shown.

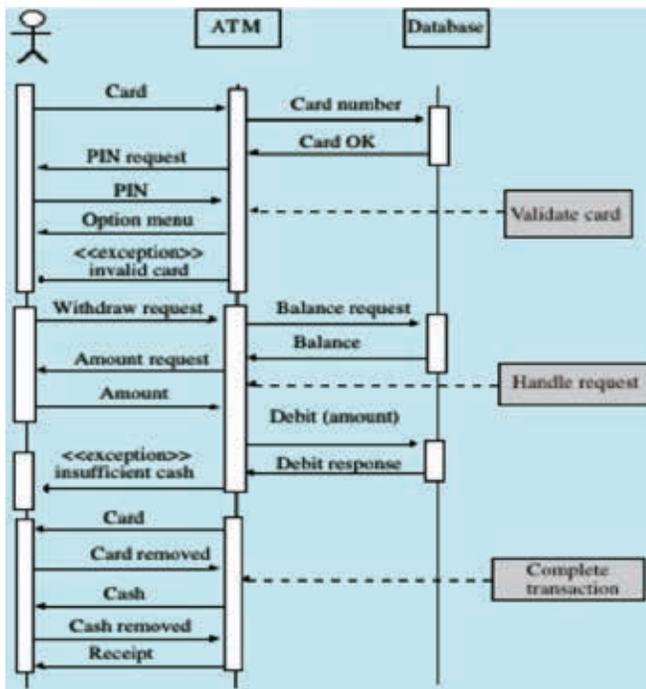


Fig. (2). ATM sequence diagram.

On initial level, we need the existing ATM system so we visited ATM, elaborate its design interface, and capture its menu systems. For this research, we target some selected Bank ATMs, which are "Habib Bank of Pakistan, National Bank of Pakistan and Meezan Bank. To accelerate the procedure of catching the ATM menus, a format was utilized as given in Figure 03.

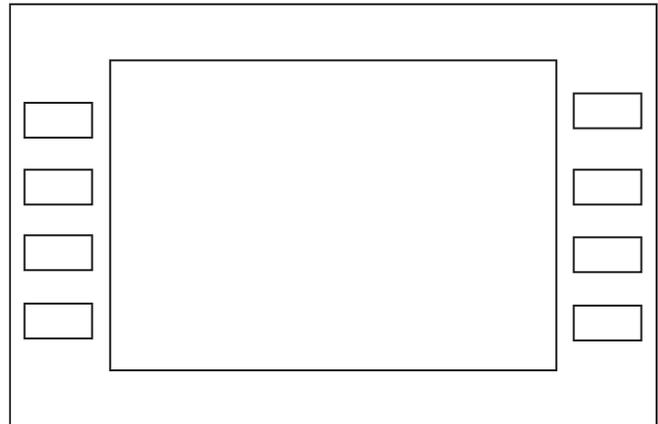


Fig. (3). General ATM Interface Screen

Figure 3 shows the General ATM screen and its keys used in menus. It is essential to every ATM menu that framework is mapped out precisely.

The objective of transmitting the ATM menu system onto a C# project is an important task to recreate ATM just like a genuine ATM system. Therefore, in that way, we can calculate the execution time of ATM.

Figure 3 show the real world template of ATM menu system which is most important factor of HCI (Human Computer Interaction). On initial level, ATM menu template were designed and implemented in C# Code.

To measure various ATM Transaction performance such as "Cash withdrawal, Fast Cash, Mini Statement and Check balance", a C# program and KLM (Keystroke Level Modeling) were created to simulate and calculate the time of each ATMs Transactions in the lab. The mock-up program is used to analyse and examine the ATM transaction performance. The simulation program is fully touch based and have some necessary button. When user clicks or touches the required option, the particular screen will appear.

The proposed simulation ATM user interface 'Shell' remain same for the said transactions i.e. PIN Screen, main screen and keypad that is show in Figure 4.

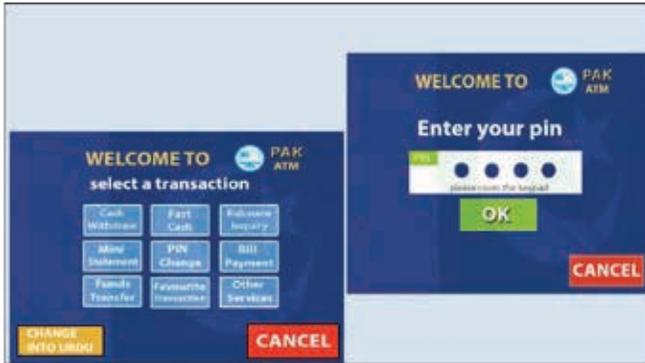


Fig. (4). ATM Simulator Interface Design

A) PIN Box

Fundamental to the design viewpoint of this model was the desire for vivid colours. The big difference between the deep purple background and large buttons attracts the user's account with respect to key inputs. Now at this stage Fitts's Law test the hypothesis that procedural speed (velocity) required to control/click a push button is a method of its size and distance from the user. As a result, the OK button was developed for PIN password and button was large and in middle in screen [9-10].

PIN Box would be taken care of by a pop up on-screen menu before the user touches the suitable button.

B) Main Screen

The main screen page show the new menu style of proposed ATMs with a 3 x 3-grid layout and this layout will attract the user and consume less time.

The proposed approach has introduced the new ATM interface as shown in figure 4, and this will test the different transactions performance on existing ATMs as well as "PAK ATM". At the point, when we use the ATM the ATM machine frequently requires some time to process the users information, for example 'handling/processing card' and 'connecting to the back/building society'. Now at this stage, the simulator ATM will not execute this performance time periods and this will not terminate the transaction process test output. Another essential point is to note is as per the following; numerous inconvenience can happen when utilizing an ATM, for example, –users enters PIN inaccurately, mistake in perusing card, ATM is out of cash per say. The proposed approach will not cover all these situations. At the point, when utilizing the ATM test system, "ideal" task will be mimicked i.e. the ATM checks the user card without any mistake, the users has inserted the correct PIN or not and the balance in account.

To enter a PIN password, the user just click/touch four digit pop-up keypad appeared on screen which is already shown in figure 4. Every ATM design interface have four-digit PIN password number and every bank ATM have their own mechanism for PIN Password. When the PIN password will be inserted, a click event is triggered which switch the user to the next screen as shown in figure 4.

To choose a selection from the menu screen, the user just touches/click on any of the given option and go to next screen. The is a same process as conventional ATM, the only difference is user Interface.

We will study three different Pakistani banks as mention earlier as example of user transaction and selection process. Here in Figure 5, the user interface of "Meezan Bank ATM" and its transaction options is shown. For example, the user may want to perform a cash withdrawal transaction. In this case, the user first insert their card, select their native language, read the safety guidelines, and then enter their PIN Password. The user just simply click on the selection button adjacent to the option 'cash withdrawal'. Then this will shows the cash withdrawal screen.



Fig. (5). Meezan Bank ATM Screen

Each accessible ATM has been mentioned in this research. Using the 'Habib Bank ATM', when user insert the ATM card, the selection of language screen will appear and user just select their language then PIN screen will appear, when user enter their PIN Password, system will automatically jump to the main screen and user just click the cash withdrawal options. This is shows in figure 06



Fig. (6). HBL ATM Screen

The initial steps are same as mentioned in above paragraph, User insert their ATM card' and 'selection of Language', now the next step is user have to select their default account and after that the screen will jump to the main menu and user just click the cash withdrawal options as shown in figure 07.



Fig. (7). NBP ATM Screen

It was important that collated ATM interface design simulations are the real life ATM menu design and its layout that produce the accurate and reliable transaction performance test results.

IV. RESULTS

For the accurate results, a questionnaire was created to study the quality of customer towards ATM. After calculating the different transaction times through the Keystroke level modelling method, the data collection was conducted among 100 persons who have account in Meezan Bank, Habib Bank and National Bank of Pakistan and analysed the some common issues that users faces. For example, some users have to reinsert their ATM cards and etc. So this way, the data was recorded and analysed with the percentage method.

Table 1. ATM reinserting card

ATM	Total ATM observed	Total Number of reinserting ATM Card	% (For reinserting card)
NBP Bank	62	2	3.23
HBL Bank	54	6	11.11
Meezan Bank	33	3	9.09

The data in Table 01 shows the percentage of inserting ATM cards and its graphical representation will be in figure 8. The above table 01 indicate that National Bank of Pakistan has bigger usability problems whereas the Meezan Bank has the least.

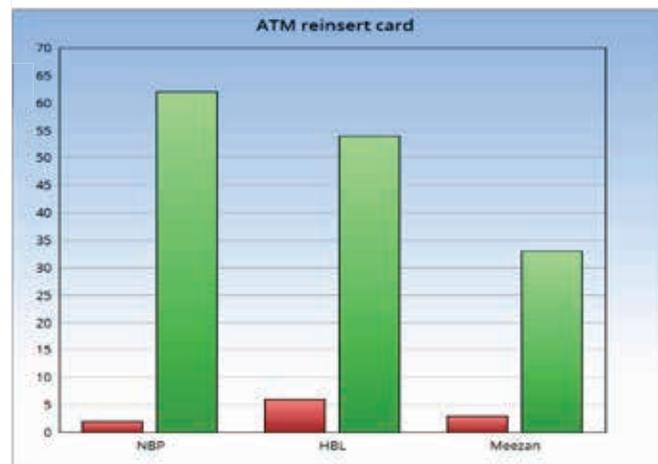


Fig. (8). ATM reinserting card

- No of users used ATM
- Reinserting ATM card

The calculated data in Table 01 and its graphical view in figure 8 shows the data was irrelevant for systematic purpose, According to the researcher and survey, 100 users were observed for all 3 banks out of which 73.7% users answered that they use the ATM to withdraw the cash. Whereas the remaining 29.5% users answered that, they only check their account balance. Figure 9 show the graphical view diagram.

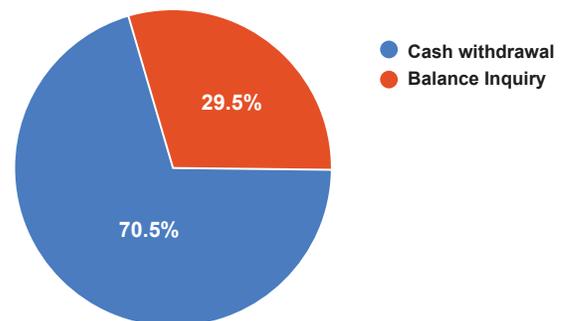


Fig. (9). ATM Main purpose

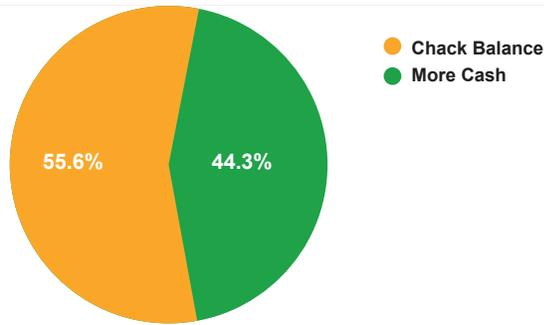


Fig. (10). ATM reinserting reasons

The above graphical diagram and data will be useful for designing the ATM menu system in proposed approach 'PAK ATM'. It will be better to use, design the ATM for the most frequently used transaction, and it is mentioned that a reoccurring issue in ATM machine was the users need to reinsert their ATM card to complete the further transaction. Customer reasons for reinserting the Card in given figure 10.

Examining the existing ATM and taking online surveys from ATM users did not give enough data to make the proposed approach 'PAK ATM'. As specified in previous section that every ATMs (National Bank of Pakistan, Habib Bank and Meezan Bank) menu system was captured and design interface is mentioned in methodology sanction. Here in table 2, each ATM different transaction performance was tested and calculated the time of each transaction by KLM (Keystroke level modelling).

Table 2. KLM Operator with default time

KLM Operators	Description	Time in Seconds
P	Hit the objective with key or mouse	1.10
K	Press any key or button	0.20
H	its homing operator	0.40

The different ATM transaction performance tests were (1) Cash Withdraw 500 PKR, (2) Fast Cash 500PKR, (3) Check Balance on Screen & Print receipt, (4) Mini Statement. These transactions will cover every standard bank ATM and give a good sign of every ATMs general execution. Due to the lack of space, we not do cover all the above mention transactions; we just focus on the most frequent transaction such as cash withdraw. Table 03 Show the average number of click required to execute the ATM transaction.

Table 03. Average Number of Clicks For ATM Transaction

Task	Number of clicks required
Cash Withdrawal	10
Fast Cash	10
Balance Inquiry	7
Mini Statement	7

The table 04 shows the ATM Cash withdrawal Transactions steps of NBP, HBL and Meezan Banks, in KLM (Keystroke level modelling) we cover every the transaction steps and its calculated time for all three banks.

Table 04. ATM Task performed on KLM

Transaction	NBP	HBL	Meezan Bank
Cash Withdrawal	Insert an ATM Card	Insert an ATM Card	Insert an ATM Card
	Select your Language (Eng, Urdu)	Select your Language (Eng, Urdu)	Select your Language (Eng, Urdu)
	Safety Guidelines	Safety Guidelines	Safety Guidelines
	Enter correct PIN	Enter correct PIN	Enter correct PIN
	Select Your Transaction (Cash withdrawal)	Select Your Transaction (Cash withdrawal)	Select Your Transaction (Cash withdrawal)
	Enter Amount or Other Amount Option	Enter Amount or Other Amount Option	Enter Amount or Other Amount Option
	Receipt (Yes or No)	Receipt (Yes or No)	Receipt (Yes or No)
	Take Cash and Take Card	Take Cash and Take Card	Take Cash and Take Card

A) *KML Calculation Method:*

Keystroke level modelling can be calculated in the following way:

$$T_{\text{task}} = T_{\text{acquire}} + T_{\text{execute}}$$

where

- T_{task} = show the complete the assigned task
- T_{acquire} = selected the particular transaction task
- T_{execute} = time of that particular task

Table 05. Times and Number of Keystroke for the selected Every ATM Transactions

Tasks	NBP	HBL	Meezan Bank	PAK ATM
Cash withdrawal	20.92 sec Keystroke	19.29 sec Keystroke	19.57 sec Keystroke	17.66 sec Keystroke
Fast Cash	No facility available	19.29 sec Keystroke	19.57 sec Keystroke	17.66 sec Keystroke
Balance Inquiry	19.54 sec Keystroke	17.92 sec Keystroke	18.19 sec Keystroke	16.56 sec Keystroke
Mini Statement	19.54 sec Keystroke	17.92 sec Keystroke	18.19 sec Keystroke	16.56 sec Keystroke

Table 05 shows the different ATM transaction times For NBP of Pakistan, HBL Bank, Meezan Bank and PAK ATM Bank. The transaction time was calculated through Keystroke Level Modelling methods and each transaction shows the time in seconds.

The four different transactions were selected which are mentioned in above table 01 and apply the KLM (Keystroke level modeling) technique on each ATM transaction. The most time was taken to complete the transaction was National Bank of Pakistan and this is because of keystroke steps or number of clicks required to perform the task are more than other banks Meezan bank, it is also takes little bit more time consume to complete a task/transaction then other banks.

The HBL time was and this because of its service and number of feedback from the users.

'PAK ATM' out performed all three banks and this is because of its efficient and simple interface designed. The number of clicks required to perform the transaction time was reduced as compared to other three banks.

Here we analysed each of the ATMs in a sequence of transaction execution tests. As result shows, the "PAK ATM" have all the maximum features. Figure 11 demonstrates the normal time of every ATM perform the cash withdraw over 1000 PKR. The reason behind to choose the cash withdrawal of 1000 PKR because it is a standard amount which is offered by every ATMs and it is a regular transaction for ATM users.

"PAK ATM" takes the shortest time to complete a cash withdrawal transaction over the amount 1000 PRK. When user enter PIN Password, the screen will automatically jump to the Main Transaction menu screen and then user select the cash withdrawal option and perform the task.. Whereas the other ATM takes little bit extra time then PAK ATM.



Fig. (11). Cash Withdraw Time over 1000PRK

For verifying the test result, the 'PAK ATM' have contains the all-necessary transactions from ATMs which yield the quickest and most helpful for every transaction. So in this research the 'PAK ATM' have all the same type of features just like other banks for every specific type of transaction; but it is not possible and workable for all diverse transactions. The ATM menus are as if a system means they are interrelated and associated. This means we cannot say that 'PAK ATM' is not ready to include the paramount features of one specific ATM without keeping some of its less proficient features. Negotiation is always essential part when developing any type of system like 'PAK ATM'.

The 'PAK ATM' is well performed then other existing ATMs, but it is very difficult to resolve the user problem which is user again insert their ATM cash card after successfully perform the cash withdrawal transaction. This is because ATM clients have no any other choice to continue for further another transaction after performing the cash withdrawal. The motivation behind for this type of case is why bank ATMs do not suggest the bank customers the alternative of further transaction after the cash withdrawal. User just collect their money, disregard the ATM cash card, and walk away from ATM machine. This type of case occurs security risk for people who did not remember their card. To reduce the problem, therefore the 'PAK ATM' introduce the option 'Do you need further transaction?' when pulling back money, ATM machine will responsible that user cannot go away without their ATM cash card from machine.

Compact ATM machine or Independent Convenience Cash Dispensers work in an alternate way in that (1) User have to insert their cash card; (2) Cash card is perused and user is told to take out the cash card and (3) User enter the correct PIN and perform the required transaction. This make

sense those users to be offered for 'further transaction' subsequent to pulling back money [11]. This type strategy for operation, users could pull back money and after that, a light box message will appear 'Would you like for further transaction?' This way, once the user takes their money, it is impossible to overlook their cash card – as user fetch it before they started their transaction procedure. However, this makes a security issue all alone. Consider the possibility that the user just takes their money and leave without considering to the message 'Would you need another transaction?' Could the next user use the earlier users account and pull back money. Now point is here a safeguard would be installed in every ATMs, which means after the said time like after 5 seconds the session will automatically expire and user account will close. This is the only possibility to overcome the problem.



Fig. (12). PAK ATM Transaction Options

The Pak ATM design interface is simple, efficient and easier to use than other ATM systems explored. The above Figure 12 shows the actual designed output of proposed 'PAK ATM' menu system, which displays the user PIN screen, main transaction menu screen, cash withdrawal menu screen and check balance screen. The proposed approach tries to reduce the transaction time and keystroke steps, so this way our focus is to create the efficient and simple designed interface. To check the 'PAK ATM' was performed well and reduces the time and keystroke, we test the all-remaining transaction steps in given below sections.



Fig. (13). Fast Cash Transaction

Figure 13 shows the Fast Cash transaction graph over 1000 PKR and 'PAK ATM' takes the lowest time to complete the transaction than other bank ATMs. National Bank of Pakistan have no any facility for Fast Cash whereas the Meezan and HBL are almost same to perform the Fast Cash transaction.



Fig. (14). Balance Inquiry Transaction

Figure 14 shows that the 'PAK ATM' is performed well in balance inquiry transaction, this is because due to the ATM design interface and use the minimum keystroke steps to complete the whole transaction, whereas the other ATMs bank takes little bit more time to complete the balance inquiry transaction



Fig. (15). Mini Statement Transaction

Figure 15 shows the mini statement transaction just like figure 14 mention the balance inquiry transaction .These two transactions are almost same but the only difference is mini statement print last fifteen days transaction and remaining steps are same. Again, 'PAK ATM' is out performed then other ATM banks.

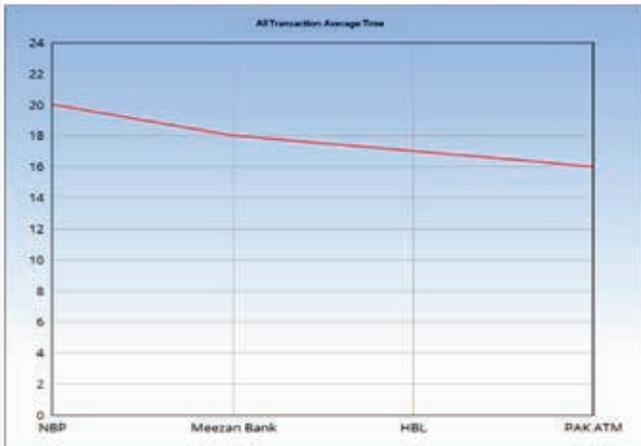


Fig. (16). All Transaction Times Average

Figure 16 shows the average performance time for all bank ATMs in all said transactions. The result shows 'PAK ATM' design interface was out performed in all transaction of ATM then other existing bank ATMs.

V. CONCLUSION

The main purpose of this research was to develop and design 'PAK ATM' menus. The designed 'PAK ATM' menu system was well performed and it is simple and efficient design system then other investigated ATMs. The 'PAK ATM' menu system was try to resolve the common issues which users facing now a days. Like users having to reinsert their ATM card to perform another transaction and reduce the steps of different transaction which directly reduce the transaction time. The 'PAK ATM' focus on users every day's transactions and 'PAK ATM' is out performed in that type of service. There are so many advance ATM system, which are using now a days and they facilitate the users in many other different truncations such as ability to pay bill at terminal, top-up pay like mobile phone bill, train ticket purchasing, some famous concert tickets and cash and cheque deposits. We can say ATM plays a vital role in our daily life and we hope that ATMs is more convenience as much as we expect in other type of services. However, one thing is more important here to define is when we increase or added the functionality in ATMs then the design interface menu become more complicated. This can lead to systems become even more confusing for users and more difficult to choose. It is recommended that designers ATM out extensive consultations with users of ATMs to help them design and create ATM-systems easy to use and efficient.

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