**A comparative study of of an Automatic Teller Machine (ATM)**

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**Abstract:-** The Automated Teller Machine (ATM) is one type of innovation that can mechanically accept deposits,

issue withdrawals, transfer funds between accounts and collect bills. This study aims at comparing the

attitude of people toward ATM of SBI and ICICI bank. It also aims at find out the factors influencing the

use of ATM. It also outlines the problem usually face by customer while using ATM of their banks.

Target group chosen for this study were the people who have account in different types of bank in

(New Delhi, India) and who are using the facility of ATM. This study reveals that on some point there is a

difference in attitude of customer with ATM services and Without ATM services. It reveals that most

important factor which influence customer to use the ATM services is its convenience in use in case of

bank. Easy availability of machines also affects its use. Customer also uses ATM of

ICICI because they agree that its use is secure. This study find that the main problem face by customer of

SBI is that they get old currency notes from ATM of SBI. The main problem from ICICI ATM is that its

machine goes out of cash. We also find that use of ATM is increasing from last 2 years. People are now

moving towards using the Automated Teller Machine.

**KEY WORDS**: Automated Teller Machine, Attitude, Cash withdrawal, Customer preference,

Services, Out of cash.

## 1 Introduction

The idea of self-service in retail banking developed through independent and simultaneous efforts in Japan, Sweden, the United Kingdom and the United States. In the US patent record, [Luther George Simjian](http://en.wikipedia.org/wiki/Luther_George_Simjian) has been credited with developing a "prior art device".[[5]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-5) Specifically his 132nd patent (US3079603) was first filed on 30 June 1960 (and granted 26 February 1963). The roll-out of this machine, called Bankograph, was delayed by a couple of years, due in part to Simjian's Reflectone Electronics Inc. being acquired by Universal Match Corporation.[[6]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-6) An experimental Bankograph was installed in [New York City](http://en.wikipedia.org/wiki/New_York_City) in 1961 by the [City Bank of New York](http://en.wikipedia.org/wiki/Citibank), but removed after six months due to the lack of customer acceptance. The Bankograph was an automated envelope deposit machine (accepting coins, cash and cheques) and did not have cash dispensing features

[](http://en.wikipedia.org/wiki/File:Fr%C3%BCher_Bankautomat_von_Nixdorf.jpg)

**Figure 1.**

.[[7]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-7)

ATM stands for; Automated Teller Machine. It is also referred to as a cash machine, a cash dispenser and ‘the hole in the wall’ among other names. The ATM is an electronic computerized telecommunications device that allows financial institutions (e.g. bank or building society) customers to directly use a secure method of communication to access their bank accounts. The ATM is a self-service banking terminal that accepts deposits and dispenses cash. Most ATM’s also let users carry out other banking transactions (e.g. check balance). ATM’s are activated by inserting a bank card (cash or credit card) into the card reader slot. The card will contain the customers account number and PIN (Personal Identification Number) on the cards magnetic stripe. When a customer is trying to withdraw cash for example, the ATM calls up the banks computers to verify the balance, dispenses the cash and then transmits a completed transaction notice.

# 2 Interacting with ATMs

Although ATM’s provide an extremely useful service to banks customers, at times they can be very frustrating to use and therefore there is a lot of room for improvement in the interface design. The interface enables communication between the user and the machine. Therefore good user interface design is imperative for high usability levels. Often there are problems or inconveniences experienced when using an ATM. Some of these problems include:

* Waiting in the queue to use the ATM. If users ahead of you in the queue experience difficulties in using the machine, this will increase the time waiting in the queue.
* Inability to see the ATM screen well. This depends on the location of the ATM in relation to the position of the sun. At times it can be difficult to view the contents of the ATM menu.
* Wrongly inserting the ATM card. This problem is more common with new ATM users who are not familiar with their new card and the ATM.
* Getting the required amount of money. Some ATM’s may not offer the user the required amount of money they want on the initial cash withdrawal screen. The user will then have to use a few more key strokes to select the required amount (e.g. to withdraw £50 the user might have to select the ‘other amounts’ option then type in ‘50’ using the keypad and then press ‘enter’).
* Understanding how to perform operations. Some ATM users find the instructions on how to perform operations quite difficult to understand.
* Often the ATM card is returned to the user while further operations are required (e.g. the card is returned once the user requests a sum of cash. However the user may want to do further transactions; such as check balance or top-up a mobile phone). This will lead to the customer having to re-insert their ATM card, further increasing their time spent at the ATM.
* On some ATM machines the menu options are not aligned with their corresponding menu key. An example of this is illustrated in .



Figure 2: Typical ATM Menu

Although the sums of money £10 to £100 are not aligned with the related keys, most users will be able to determine what keys are to be used to select the required sum of money. However, if a user wanted to select the ‘Other Amounts’ option; what button is to be pressed? There is obvious reason for confusion here. It is evident that problems exist with the use of ATM’s. Some of these problems are unavoidable (e.g. an ATM running out of money) but solutions exist for others. This research paper focuses on the user interface design problems. ATM navigation menus could be improved considerably to make ATM’s more usable.



**Figure 3: Typical ATM Menu**

As technology increases the ATM interface should evolve to take advantage of the new technological innovations. This has happened to a certain extent over the years. However, it is clear that most of today’s ATM interfaces do not have the desired high level of usability they should. The modern ATM should be flexible, expressive and easier to use. As mentioned earlier ATM’s were introduced in the UK in the late 60’s and early 70’s. ATM’s can now be found in shops, hotels and airports among other places. There was a major design problem when ATM’s were first introduced (Dix et al., 1998). During a transaction the ATM dispensed cash to the customer before returning the customers card. This resulted in customers not collecting their card from the ATM. This design problem has now been rectified. The customers’ card is returned before cash is dispensed. There have been improvements in the usability of ATM’s over the years but there is still a lot of room for improvement. The modern ATM is much more than a simple cash dispenser. Standard UK ATM’s offer relatively basic services including cash withdrawals; balance checks and the ability to top-up pay-as-you-go mobile phones. ATM’s in different countries (such as USA and Japan) tend to offer advanced services which include cash deposits, cheque deposits, paying bills, purchasing tickets (e.g. train, concert) and purchasing stamps.

[](http://en.wikipedia.org/wiki/File:ATM_pinpad_in_german.jpg)

**Figure 4.Buttons**

The design of an ATM should not only include its inherent usability but also its perceived usability’. This is just one version of possible problems encountered when using (or trying to use an ATM). It reinforces the problems that exist with ATM use. Another typical problem, which was already mentioned earlier, is when an ATM returns the customers card prematurely i.e. the user still has additional transactions to make. This problematic process is as follows (say the customer wants to with draw cash and then check their balance):

* Insert card
* Enter PIN
* Choose transaction option (Withdraw cash)
* Select/Enter amount of cash to be withdrawn
* Receipt? (yes/no)
* Card ejected from ATM
* Take cash
* Re-insert card
* Enter PIN
* Choose transaction option (Balance Enquiry)
* Return card

This shows how using an ATM can be frustrating. Human computer interface is a term used to describe the interaction between a user and a computer; in other words, the method by which a user tells the computer what to do, and the responses which the computer makes (Heathcote, 2000). (Preece, 1994) also states Human-Computer Interaction (HCI) is about designing computer systems that support people so that they can carry out their activities productively and safely. This can be summarised as ‘to develop or improve the safety, utility, effectiveness, efficiency and usability of systems that include computers’. If ATM’s were more usable then they would become more effective and efficient machines as users would find them easier to use. This would cause the users to spend less time using the machines and to carry out more efficient transactions. This would be very desirable as it would lessen waiting times in a queue to use an ATM’s services. This research paper is concerned with the usability of ATM’s; to investigate why existing ATM’s user interfaces (navigation menus in particular) have problems and to design a proposed ‘best of breed’ ATM menu system with excellent usability. Preece (1994) explains usability is concerned with making systems easy to learn and easy to use. Poorly designed computer systems can be extremely annoying to users. This point is particularly relevant. ATM’s, at times, can be extremely annoying to use for many reasons which were mentioned earlier. In order to produce computer systems with good usability HCI specialists strive to understand the factors that determine how people operate and make use of the computer technology effectively; develop tools and techniques to help designers ensure that computers systems are suitable for the activities for which people will use them and achieve efficient, effective and safe interaction both in terms of individual human-computer interaction and group interactions.

The last point is relevant for ATM design as users want their banking interactions to be as quick as possible. However, using an ATM’s services is very personal (especially with the development of ATM crime) so the group interactions can be ignored in this case. A good interface design can help to ensure that users carry out task when the using the system:

* Safely – this is important for safety-critical software systems; such as software for a jumbo jet for example.
* Effectively – the user get what they want from the system e.g. if an ATM user requests £100 cash, the user should get this and not £50.
* Efficiently – this is the main point concerned with this research paper. If the ATM menu’s were improved this would make ATM use more efficient. For example users don’t want to spend 5 minutes trying to find the correct way to insert their cash card and type their PIN and the amount of cash they want and then eventually leave without remembering to extract their cash card.
* Enjoyably – systems should be attractive and inviting. Generally if a system is effective and efficient to use, it should also be enjoyable to use as a consequence. However additional effort could be made in ATM interface design to make ATM’s more enjoyable to use such as making the screens and menus more colourful and have images for example. A lot of ATM’s still just have a black background screen with illuminated text, which is quite dull.

Well designed systems can improve systems significantly. They can improve the output of employees, improve the quality of life and make the world a safer and enjoyable place. An ATM is a service a bank offers to its customers. There are two factors which contribute to the usage of a particular ATM. These are location and the usability of the ATM. Obviously location is the major factor. If an ATM is conveniently located then it will be used a lot. If an ATM is easy to use then this will encourage customers to use the ATM. Many people may have preferences over other ATM’s and if they had the choice would use their preferred ATM all the time. All in all, the greater usage a banks ATM receives, the more potential there is for the bank to make profit. This is why a bank or building society should not under-estimate the importance of good ATM interface design.

Preece (1994) states that ‘the best user interface design guidelines are guidelines in a true sense: high level and widely applicable directly principles’. The following principles can be applied widely:

* Know the user – This can often be difficult to achieve, especially when a diverse population of users has to be accommodated or when the users can only be anticipated in the most general terms. This is particularly true for ATM user interface design as this system has a wide range of users from teenagers to pensioners.
* Reduce Cognitive Load – This concerns designing so that users do not have to remember large amounts of detail. Again this is very relevant for ATM user interface deign. The ATM system should be easy to use and users should remember how to understand how to use the system.

* Engineer for errors – a system should be designed to accommodate inevitable user error. If the user makes an error while using the system the system should be able to recover. Engineering for errors includes taking forcing actions to try and prevent users from making errors initially, providing good error messages, and using reversible actions to apply users to correct their own errors.
* Maintain consistency and clarity – Consistency emerges from standard operations and representations and from using appropriate metaphors that help to build and maintain a user’s mental model of a system. For example the ‘desktop’ in a PC is an appropriate metaphor of a work desktop in an office. ATM user’s interfaces generally use consistent language e.g. withdraw cash, PIN services etc. However, different banks offer different ATM user interfaces. It would be ideal if there was a universal ATM user interface design, or at least a standard design in each country.

A number of studies have already been carried out regarding ATM’s. Most of these studies however have focused on ATM use in relation to the age of users and user disabilities (such as blindness). Adams and Thieben (1991), Mead et al. (1996), Rogers et al. (1997) and Rogers and Fisk (1997) concentrate on ATM use in relation to the age group of the users. Mankze et al. (1998) focuses on ATM usability by the blind while Hone et al. (1998) focuses on modes of control for ATM’s including voice control. Rogers et al. (1994) say that they have been informed by banking staff that training is not necessary for ATM’s because they are inherently user friendly. This statement however is often not true as many people find ATM’s difficult to use, never mind the elderly users and users who are disabled in some way (for example blind). There has also being significant research done on ATM usability and user behaviour. (Hatta and Liyama (1991), El Haddad and Almahmeed (1992), Burford and Baber (1993), Rugimbana and Iversen (1994), Mead *et al*. (1996), Pepermans *et al*. (1996), Rogers *et al*. (1996, 1997), Rogers and Fisk (1997) but none propose a best of breed system. This research is concerned with usability of ATM’s. Each ATM investigated (one from each bank e.g. Bank of Ireland, First Trust etc) is evaluated and measured by efficiency (transaction times). This is done using ‘mock-up’ ATM prototypes which are direct replicas of the Bank’s ATM menu design**s.**

There is a lack of systematical and detailed documentation of design knowledge and modeling

prototypes of ATM systems and a formal model of them in denotational mathematics and

formal notation systems (Wang, 2008a, 2008b). This paper presents the formal design, specification,

and modeling of the ATM system using a denotational mathematics known as Real-Time

Process Algebra (RTPA) (Wang, 2002, 2003, 2007, 2008a, 2008c, 2008d). RTPA introduces

only 17 meta-processes and 17 process relations to describe software system architectures and

behaviors with a stepwise refinement methodology (Wang, 2007, 2008c). According to the RTPA

methodology for system modeling and refinement, a software system can be specified as a set of

architectural and operational components as well as their interactions. The former is modeled

by Unified Data Models (UDMs, also known as the component logical model (CLM)) (Wang,

2008c), which is an abstract model of system hardware interfaces, an internal logic model of

hardware, and/or an internal control structure of the system. The latter is modeled by static and

dynamic processes using the Unified Process Models (UPMs) (Hoare, 1978, 1985; Bjorner &

Jones, 1982; Wang, 2007, 2008c; Wang & King, 2000).

This paper develops a formal design model of the ATM system in a top-down approach on

the basis of the RTPA methodology. This work demonstrates that the ATM system can be formally

modeled and described by a set of real-time processes in RTPA. In the remainder of this

paper, the conceptual model of the ATM system is described as the initial requirements for the

system. The architectural model of the ATM system is created based on the conceptual model

using the RTPA architectural modeling methodologies and refined by a set of UDMs. Then, the

static behaviors of the ATM system are specified and refined by a set of processes (UPMs). The

dynamic behaviors of the ATM system are specified and refined by process priority allocation,

process deployment, and process dispatching models. With the formal and rigorous models of

the ATM system, code can be automatically generated by the RTPA Code Generator (RTPA-CG)

(Wang, 2007), or be seamlessly transferred into program code manually. The formal models of

ATM may not only serve as a formal design paradigm of real-time software systems, but also

a test bench for the expressive power and modeling capability of existing formal methods in

software engineering.

THE CONCEPTUAL MODEL OF THE ATM SySTEM

An ATM system is a real-time front terminal of automatic teller services with the support of a

central bank server and a centralized account database. This paper models an ATM that provides

money withdraw and account balance management services. The architecture of the ATM system,

as shown in Figure 1, encompasses an ATM processor, a system clock, a remote account

database, and a set of peripheral devices such as the card reader, monitor, keypad, bills storage,

and bills disburser.

The conceptual model of an ATM system is usually described by a Finite State Machine

(FSM), which adopts a set of states and a set of state transition functions modeled by a transition

diagram or a transition table to describe the basic behaviors of the ATM system. On the basis of

the conceptual model of the ATM system as given in Figure 1, the top level behaviors of ATM

can be modeled in a transition diagram as shown in Figure 2.

**3.Global use:-**

[](http://en.wikipedia.org/wiki/File:Bankomaty_na_dworcu_Pozna%C5%84_G%C5%82%C3%B3wny_01.JPG)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Bankomaty_na_dworcu_Pozna%C5%84_G%C5%82%C3%B3wny_01.JPG)

ATMs at the [railway station](http://en.wikipedia.org/wiki/Pozna%C5%84_G%C5%82%C3%B3wny_railway_station) in [Poznań](http://en.wikipedia.org/wiki/Pozna%C5%84)

There are no hard international or government-compiled numbers totaling the complete number of ATMs in use worldwide. Estimates developed by [ATMIA](http://en.wikipedia.org/w/index.php?title=ATMIA&action=edit&redlink=1) place the number of ATMs in use currently at over 2.2 million, or approximately 1 ATM per 3000 people in the world.

To simplify the analysis of ATM usage around the world, financial institutions generally divide the world into seven regions, due to the penetration rates, usage statistics, and features deployed. Four regions (USA, Canada, Europe, and Japan) have high numbers of ATMs per million people. Despite the large number of ATMs, there is additional demand for machines in the Asia/Pacific area as well as in Latin America. ATMs have yet to reach high numbers in the Near East and Africa

One of [the world's most northerly](http://en.wikipedia.org/wiki/The_world%27s_most_northern) installed ATMs is located at [Longyearbyen](http://en.wikipedia.org/wiki/Longyearbyen), [Svalbard](http://en.wikipedia.org/wiki/Svalbard), [Norway](http://en.wikipedia.org/wiki/Norway).

[The world's most southerly](http://en.wikipedia.org/wiki/The_world%27s_most_southern) installed ATM is located at [McMurdo Station](http://en.wikipedia.org/wiki/McMurdo_Station), located in [New Zealand](http://en.wikipedia.org/wiki/Realm_of_New_Zealand)'s [Ross Dependency](http://en.wikipedia.org/wiki/Ross_Dependency), in [Antarctica](http://en.wikipedia.org/wiki/Antarctica).

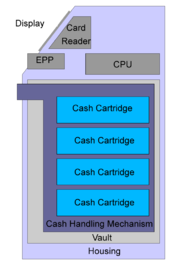
According to international statistics, the [highest](http://en.wikipedia.org/wiki/Highest) installed ATM in the world is located at [Nathu La Pass](http://en.wikipedia.org/wiki/Nathu_La_Pass), in [India](http://en.wikipedia.org/wiki/India), installed by the Indian [Axis Bank](http://en.wikipedia.org/wiki/Axis_Bank) at 4023 metres (13200 ft). According to the Mainland Chinese media and [CPC](http://en.wikipedia.org/wiki/Communist_party_of_China) statistics, the highest installed ATM in the world is located in [Nagchu County](http://en.wikipedia.org/wiki/Nagchu_County), [Tibet](http://en.wikipedia.org/wiki/Tibet), [China](http://en.wikipedia.org/wiki/China), at 4500 metres, allegedly installed by the [Agricultural Bank of China](http://en.wikipedia.org/wiki/Agricultural_Bank_of_China). Israel has the world's lowest installed ATM at [Ein Bokek](http://en.wikipedia.org/wiki/Ein_Bokek) at the Dead Sea, installed independently by a grocery store at 421 metres below sea level.While ATMs are ubiquitous on modern [cruise ships](http://en.wikipedia.org/wiki/Cruise_ship), ATMs can also be found on some [US Navy](http://en.wikipedia.org/wiki/US_Navy) ships.

[](http://en.wikipedia.org/wiki/File:World's_most_northerly_ATM.JPG)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:World's_most_northerly_ATM.JPG) **Figure 3.1 Screen look**

Welcome message displayed on the world's most northerly ATM located in the post office at [Longyearbyen](http://en.wikipedia.org/wiki/Longyearbyen)

**4.Hardware**

[](http://en.wikipedia.org/wiki/File:Atm_blockdiagram.png)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Atm_blockdiagram.png) **Figure 4.1.** **A block diagram of an ATM**

An ATM is typically made up of the following devices:

* [CPU](http://en.wikipedia.org/wiki/CPU) (to control the user interface and transaction devices)
* [Magnetic](http://en.wikipedia.org/wiki/Magnetic_stripe_card) or [chip card](http://en.wikipedia.org/wiki/Chip_card) reader (to identify the customer)
* [PIN](http://en.wikipedia.org/wiki/Personal_identification_number) pad EEP4 (similar in layout to a [touch tone](http://en.wikipedia.org/wiki/Touch_tone) or [calculator](http://en.wikipedia.org/wiki/Calculator) keypad), manufactured as part of a secure enclosure
* [Secure cryptoprocessor](http://en.wikipedia.org/wiki/Secure_cryptoprocessor), generally within a secure enclosure
* Display (used by the customer for performing the transaction)
* [Function key](http://en.wikipedia.org/wiki/Function_key) buttons (usually close to the display) or a [touchscreen](http://en.wikipedia.org/wiki/Touchscreen) (used to select the various aspects of the transaction)
* Record printer (to provide the customer with a record of the transaction)
* [Vault](http://en.wikipedia.org/wiki/Bank_vault) (to store the parts of the machinery requiring restricted access)
* Housing (for aesthetics and to attach signage to)
* Sensors and indicators

Due to heavier computing demands and the falling price of [personal computer](http://en.wikipedia.org/wiki/Personal_computer)-like architectures, ATMs have moved away from custom hardware architectures using [microcontrollers](http://en.wikipedia.org/wiki/Microcontroller) or [application-specific integrated circuits](http://en.wikipedia.org/wiki/Application-specific_integrated_circuit) and have adopted the hardware architecture of a personal computer, such as USB connections for peripherals, Ethernet and IP communications, and use personal computer operating systems.

Business owners often lease ATM terminals from ATM service providers, however based on the economies of scale, the price of equipment has dropped to the point where many business owners are simply paying for ATMs using a credit card.

New ADA voice and text-to-speech guidelines imposed in 2010, but required by March 2012[[37]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-37) have forced many ATM owners to either upgrade non-compliant machines or dispose them if they are not up-gradable, and purchase new compliant equipment. This has created an avenue for hackers and thieves to obtain ATM hardware at junkyards from improperly disposed decommissioned ATMs.[[38]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-38)

[](http://en.wikipedia.org/wiki/File:Two_Loomis_Employees_Refilling_an_ATM_at_the_Downtown_Seattle_REI.jpg)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Two_Loomis_Employees_Refilling_an_ATM_at_the_Downtown_Seattle_REI.jpg) **Figure 4.2:** **Two** [**Loomis**](http://en.wikipedia.org/wiki/Loomis_%28company%29) **employees refilling an ATM**

The vault of an ATM is within the footprint of the device itself and is where items of value are kept. [Scrip cash dispensers](http://en.wikipedia.org/wiki/Scrip_cash_dispenser) do not incorporate a vault.

Mechanisms found inside the vault may include:

* Dispensing mechanism (to provide [cash](http://en.wikipedia.org/wiki/Cash) or other items of value)
* Deposit mechanism including a check processing module and bulk note acceptor (to allow the customer to make deposits)
* Security sensors (magnetic, thermal, seismic, gas)
* Locks (to ensure controlled access to the contents of the vault)
* Journaling systems; many are electronic (a sealed flash memory device based on in-house standards) or a solid-state device (an actual printer) which accrues all records of activity including access timestamps, number of notes dispensed, etc. This is considered sensitive data and is secured in similar fashion to the cash as it is a similar liability.

ATM vaults are supplied by manufacturers in several grades. Factors influencing vault grade selection include cost, weight, regulatory requirements, ATM type, operator risk avoidance practices and internal volume requirements.[[39]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-39) Industry standard vault configurations include [Underwriters Laboratories](http://en.wikipedia.org/wiki/Underwriters_Laboratories) [UL-291](http://en.wikipedia.org/w/index.php?title=UL-291&action=edit&redlink=1) "Business Hours" and Level 1 Safes,[[40]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-40) [RAL](http://en.wikipedia.org/w/index.php?title=RAL_%28standards_institute%29&action=edit&redlink=1) TL-30 derivatives,[[41]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-41) and CEN EN 1143-1 - CEN III and CEN IV.[[42]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-42)[[43]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-43)

ATM manufacturers recommend that an ATM vault be attached to the floor to prevent theft,[[44]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-44) though there is a record of a theft conducted by tunnelling into an ATM floor.[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)]

**5.Software:-**

With the migration to commodity Personal Computer hardware, standard commercial "off-the-shelf" operating systems, and programming environments can be used inside of ATMs. Typical platforms previously used in ATM development include [RMX](http://en.wikipedia.org/wiki/RMX_%28operating_system%29) or [OS/2](http://en.wikipedia.org/wiki/OS/2).

[](http://en.wikipedia.org/wiki/File:Postomat-Windows-p1020441.jpg)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Postomat-Windows-p1020441.jpg) **Figure 5.1:ATM**

.Today the vast majority of ATMs worldwide use a [Microsoft Windows](http://en.wikipedia.org/wiki/Microsoft_Windows) operating system, primarily [Windows XP Professional](http://en.wikipedia.org/wiki/Windows_XP_Professional) or [Windows XP Embedded](http://en.wikipedia.org/wiki/Windows_XP_Embedded).[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)] A small number of deployments may still be running older versions of Windows OS such as [Windows NT](http://en.wikipedia.org/wiki/Windows_NT), [Windows CE](http://en.wikipedia.org/wiki/Windows_CE), or [Windows 2000](http://en.wikipedia.org/wiki/Windows_2000).

There is a computer industry security view that general public desktop operating systems have greater risks as operating systems for cash dispensing machines than other types of operating systems like (secure) [real-time operating systems](http://en.wikipedia.org/wiki/Real-time_operating_system) (RTOS). [RISKS Digest](http://en.wikipedia.org/wiki/RISKS_Digest) has many articles about cash machine operating system vulnerabilities.[[45]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-45)

[Linux](http://en.wikipedia.org/wiki/Linux) is also finding some reception in the ATM marketplace. An example of this is [Banrisul](http://en.wikipedia.org/wiki/Banrisul), the largest bank in the south of [Brazil](http://en.wikipedia.org/wiki/Brazil), which has replaced the [MS-DOS](http://en.wikipedia.org/wiki/MS-DOS) operating systems in its ATMs with Linux. [Banco do Brasil](http://en.wikipedia.org/wiki/Banco_do_Brasil) is also migrating ATMs to Linux. Indian-based [Vortex Engineering](http://en.wikipedia.org/wiki/Vortex_Engineering) is Manufacturing ATM's which operates only with Linux. Common application layer transaction protocols, such as [Diebold](http://en.wikipedia.org/wiki/Diebold) 91x (911 or 912) and [NCR](http://en.wikipedia.org/wiki/NCR_Corporation) [NDC or NDC+](http://en.wikipedia.org/wiki/NCR_Corporation) provide [emulation](http://en.wikipedia.org/wiki/Hardware_emulation) of older generations of hardware on newer platforms with incremental extensions made over time to address new capabilities, although companies like NCR continuously improve these protocols issuing newer versions (e.g. NCR's AANDC v3.x.y, where x.y are subversions). Most major ATM manufacturers provide software packages that implement these protocols. Newer protocols such as [IFX](http://en.wikipedia.org/wiki/Interactive_Financial_Exchange) have yet to find wide acceptance by transaction processors.

With the move to a more standardised software base, financial institutions have been increasingly interested in the ability to pick and choose the application programs that drive their equipment. [WOSA/XFS](http://en.wikipedia.org/wiki/WOSA/XFS), now known as [CEN XFS (or simply XFS)](http://en.wikipedia.org/wiki/CEN/XFS), provides a common [API](http://en.wikipedia.org/wiki/API) for accessing and manipulating the various devices of an ATM. [J/XFS](http://en.wikipedia.org/wiki/J/XFS) is a Java implementation of the CEN XFS API.

While the perceived benefit of XFS is similar to the Java's ["Write once, run anywhere"](http://en.wikipedia.org/wiki/Write_once_run_anywhere) mantra, often different ATM hardware vendors have different interpretations of the XFS standard. The result of these differences in interpretation means that ATM applications typically use a [middleware](http://en.wikipedia.org/wiki/Middleware) to even out the differences between various platforms.

With the onset of Windows operating systems and XFS on ATM's, the software applications have the ability to become more intelligent. This has created a new breed of ATM applications commonly referred to as programmable applications. These types of applications allows for an entirely new host of applications in which the ATM terminal can do more than only communicate with the ATM switch. It is now empowered to connected to other content servers and [video banking](http://en.wikipedia.org/wiki/Video_banking) systems.

Notable ATM software that operates on XFS platforms include Triton PRISM, [Diebold](http://en.wikipedia.org/wiki/Diebold) Agilis EmPower, [NCR](http://en.wikipedia.org/wiki/NCR_Corporation) [APTRA Edge](http://en.wikipedia.org/wiki/NCR_Corporation), [Absolute Systems](http://en.wikipedia.org/w/index.php?title=Absolute_Systems&action=edit&redlink=1) AbsoluteINTERACT, [KAL](http://en.wikipedia.org/wiki/KAL_%28Korala_Associates_Limited%29) [Kalignite Software Platform](http://en.wikipedia.org/wiki/KAL_%28Korala_Associates_Limited%29), Phoenix Interactive VISTAatm, [Wincor Nixdorf](http://en.wikipedia.org/wiki/Wincor_Nixdorf) [ProTopas](http://en.wikipedia.org/wiki/Wincor_Nixdorf) and [Euronet](http://en.wikipedia.org/wiki/Euronet_Worldwide) EFTS.

With the move of ATMs to industry-standard computing environments, concern has risen about the integrity of the ATM's software stack.[[47]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-47)

**6.Security:-**

Now a days, there is no proper security for ATM machines. Robbery of the ATM machines has been increased widely. By using the existed technology ATM machines are not safe in order to provide proper security for money. So it is proposed a new technology which can overcome this problem. Vibration detection sensors, microcontroller and GSM modem are used here to make up the problem.

**II. EXISTING SYSTEM**

Presently the ATM machines have only one security system. It only provides security to the entrance door itself, by placing ATM card detectors near the door. This technology exists in Few ATM centers only. It Provides security for the ATM machine itself. When the attacker try to damage the ATM machine vibration detection sensors gets activated. A message is passed to the nearby police stations with the help of GSM modem.

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. While these GSM modems are most frequently used for sending and receiving SMS and MMS messages (shown in Figure 2).



**Figure 6.1:Structure of an ATM**

**Microcontroller:-** The AT89C51 is a low-power; high-performance CMOS 8-bit microcontroller with 4K bytes of Flash Programmable and erasable read only memory (PEROM).It is heart of our project. Fully Static Operation: 0 Hz to 24 MHz it has 32 Programmable I/O Lines it has two 16-bit Timer/Counter. **Vibration Sensor** In engineering, the applications of vibration sensor are widely used, so it caused by a high degree of importance about its research and development in the world. At present, with the development of science and technology, the shortcomings of vibration sensors continue to be overcome; measurement accuracy and increasing the sensitivity range of applications are increasingly being used. **Proposed Features:** 1) It provides security for the ATM machine itself. When the attacker try to damage the ATM machine vibration detection sensors gets activated. A message is passed to the nearby police stations with the help of GSM modem. By using this technology attacks over the ATM machines can be overcome. The attackers can be caught easily. 2) ADC means Analog to Digital Converter. Here we have an analog input at pin6.And we have to convert it to digital output by giving certain set of commands to microcontroller to control ADC. By following steps one can convert analog data to digital data. Make CS (Chip Select) pin of ADC Low. Make a Low to High Transition on WR (Write) pin of ADC. Wait for 110 micro sec for Analog to Digital Conversion. Make RD (Read) pin Low. Copy the 8 bit Digital data. Make RD pin High for next reading. Vibration detector-vibration analysis [2] Holroyd manufacture a range sensors and accessories which are compatible with our vibration detector measurement and analysis equipment. This includes structural monitoring and remote monitoring accessories for vibration sensors (shown in figure 3).

**7.Physical:-**

[](http://en.wikipedia.org/wiki/File:Procash_stolen_1.jpg)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Procash_stolen_1.jpg) **Figure 7.1:Physical envolvement**

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Automated_teller_machine.JPG)

Automated Teller Machine In Dezfull in southwest of Iran

Early ATM security focused on making the ATMs invulnerable to physical attack; they were effectively safes with dispenser mechanisms. A number of attacks on ATMs resulted, with thieves attempting to steal entire ATMs by [ram-raiding](http://en.wikipedia.org/wiki/Ram-raiding).Late 1990s, criminal groups operating in Japan improved ram-raiding by stealing and using a truck loaded with a heavy construction machinery to effectively demolish or uproot an entire ATM and any housing to steal its cash.

Another attack method, *plofkraak*, is to seal all openings of the ATM with [silicone](http://en.wikipedia.org/wiki/Silicone) and fill the vault with a combustible gas or to place an explosive inside, attached, or near the ATM. This gas or explosive is ignited and the vault is opened or distorted by the force of the resulting explosion and the criminals can break in. This type of theft has occurred in the [Netherlands](http://en.wikipedia.org/wiki/Netherlands), [Belgium](http://en.wikipedia.org/wiki/Belgium), [France](http://en.wikipedia.org/wiki/France), [Denmark](http://en.wikipedia.org/wiki/Denmark), [Germany](http://en.wikipedia.org/wiki/Germany) and [Australia](http://en.wikipedia.org/wiki/Australia).This type of attacks can be prevented by a number of gas explosion prevention devices also known as gas suppression system. These systems use explosive gas detection sensor to detect explosive gas and to neutralise it by releasing a special explosion suppression chemical which changes the composition of the explosive gas and renders it ineffective.

Several attacks in the UK (at least one of which was successful) have emulated the traditional WW2 escape from POW camps by digging a concealed tunnel under the ATM and cutting through the reinforced base to remove the money.

Modern ATM physical security, per other modern money-handling security, concentrates on denying the use of the money inside the machine to a thief, by using different types of [Intelligent Banknote Neutralisation Systems](http://en.wikipedia.org/wiki/Intelligent_banknote_neutralisation_system).

A common method is to simply rob the staff filling the machine with money. To avoid this, the schedule for filling them is kept secret, varying and random. The money is often kept in cassettes, which will dye the money if incorrectly opened.

**8.Transactional secrecy and integrity:-**

[](http://en.wikipedia.org/wiki/File:49024-SOS-ATM.JPG)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:49024-SOS-ATM.JPG) **Figure 8.1 An ATM**

A [Triton](http://en.wikipedia.org/wiki/Triton_Systems) brand ATM with a dip style card reader and a triple DES keypad

The security of ATM transactions relies mostly on the integrity of the secure [cryptoprocessor](http://en.wikipedia.org/wiki/Cryptoprocessor): the ATM often uses general commodity components that sometimes are not considered to be "[trusted systems](http://en.wikipedia.org/wiki/Trusted_system)".

Encryption of personal information, required by law in many jurisdictions, is used to prevent fraud. Sensitive data in ATM transactions are usually [encrypted](http://en.wikipedia.org/wiki/Encryption) with [DES](http://en.wikipedia.org/wiki/Data_Encryption_Standard), but transaction processors now usually require the use of [Triple DES](http://en.wikipedia.org/wiki/Triple_DES).[[54]](http://en.wikipedia.org/wiki/Automated_teller_machine#cite_note-54) Remote Key Loading techniques may be used to ensure the secrecy of the initialisation of the encryption keys in the ATM. [Message Authentication Code](http://en.wikipedia.org/wiki/Message_Authentication_Code) (MAC) or [Partial MAC](http://en.wikipedia.org/wiki/Partial_MAC) may also be used to ensure messages have not been tampered with while in transit between the ATM and the financial network. In some countries a system has been developed that if the ATM card holder is told to withdraw the cash forcefully by the thief then if he entered his card password starting from the last digit to the first digit then the alarm will sound in the nearest police station[[*citation needed*](http://en.wikipedia.org/wiki/Wikipedia:Citation_needed)].

**II.Customer identity integrity**

[](http://en.wikipedia.org/wiki/File:Japanese_ATM_Palm_Scanner.jpg)

**Figure 8.2**

There have also been a number of incidents of fraud by [Man-in-the-middle attacks](http://en.wikipedia.org/wiki/Man-in-the-middle_attack), where criminals have attached fake keypads or card readers to existing machines. These have then been used to record customers' PINs and bank card information in order to gain unauthorised access to their accounts. Various ATM manufacturers have put in place countermeasures to protect the equipment they manufacture from these threats.

Alternative methods to verify cardholder identities have been tested and deployed in some countries, such as finger and palm vein patterns, [iris](http://en.wikipedia.org/wiki/Iris_recognition), and [facial recognition](http://en.wikipedia.org/wiki/Facial_recognition_system) technologies. Cheaper mass-produced equipment has been developed and is being installed in machines globally that detect the presence of foreign objects on the front of ATMs, current tests have shown 99% detection success for all types of [skimming](http://en.wikipedia.org/wiki/Skimming_%28credit_card_fraud%29) devices.

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:Worn_ATM.jpg)

ATMs that are exposed to the outside must be vandal and weather resistant

Openings on the customer-side of ATMs are often covered by mechanical shutters to prevent tampering with the mechanisms when they are not in use. Alarm sensors are placed inside the ATM and in ATM servicing areas to alert their operators when doors have been opened by unauthorised personnel.

Rules are usually set by the government or ATM operating body that dictate what happens when integrity systems fail. Depending on the jurisdiction, a bank may or may not be liable when an attempt is made to dispense a customer's money from an ATM and the money either gets outside of the ATM's vault, or was exposed in a non-secure fashion, or they are unable to determine the state of the money after a failed transaction.Customers often commented that it is difficult to recover money lost in this way, but this is often complicated by the policies regarding suspicious activities typical of the criminal element.

**9.Customer security:-**

[](http://en.wikipedia.org/wiki/File:ATMs_In_A_Van.jpg)

[http://bits.wikimedia.org/static-1.24wmf15/skins/common/images/magnify-clip.png](http://en.wikipedia.org/wiki/File:ATMs_In_A_Van.jpg)

Dunbar Armored ATM Techs watching over ATMs that have been installed in a [van](http://en.wikipedia.org/wiki/Van)

In some countries, multiple [security cameras](http://en.wikipedia.org/wiki/Security_camera) and [security guards](http://en.wikipedia.org/wiki/Security_guard) are a common feature.In the [United States](http://en.wikipedia.org/wiki/United_States), The [New York](http://en.wikipedia.org/wiki/New_York) State Comptroller's Office has advised the New York State Department of Banking to have more thorough safety inspections of ATMs in high crime areas.

Consultants of ATM operators assert that the issue of customer security should have more focus by the banking industry; it has been suggested that efforts are now more concentrated on the preventive measure of deterrent legislation than on the problem of ongoing forced withdrawals.

At least as far back as July 30, 1986, consultants of the industry have advised for the adoption of an emergency PIN system for ATMs, where the user is able to send a [silent alarm](http://en.wikipedia.org/wiki/Panic_alarm) in response to a threat. Legislative efforts to require an emergency PIN system have appeared in [Illinois](http://en.wikipedia.org/wiki/Illinois), [Kansas](http://en.wikipedia.org/wiki/Kansas) and [Georgia](http://en.wikipedia.org/wiki/Georgia_%28U.S._state%29),but none have succeeded yet. In January 2009, Senate Bill 1355 was proposed in the Illinois Senate that revisits the issue of the reverse emergency PIN system.The bill is again supported by the police and denied by the banking lobby.

In 1998 three towns outside the Cleveland, Ohio, in response to an ATM crime wave, adopted ATM Consumer Security Legislation requiring that an [emergency telephone number](http://en.wikipedia.org/wiki/Emergency_telephone_number) switch be installed at all outside ATMs within their jurisdiction. In the wake of an ATM Murder in Sharon Hill, Pennsylvania, The City Council of Sharon Hill passed an ATM Consumer Security Bill as well. As of July 2009, ATM Consumer Security Legislation is currently pending in New York, New Jersey, and Washington D.C.

In China and elsewhere, many efforts to promote security have been made. On-premises ATMs are often located inside the bank's lobby which may be accessible 24 hours a day. These lobbies have extensive security camera coverage, a courtesy telephone for consulting with the bank staff, and a security guard on the premises. Bank lobbies that are not guarded 24 hours a day may also have secure doors that can only be opened from outside by swiping the bank card against a wall-mounted scanner, allowing the bank to identify which card enters the building. Most ATMs will also display on-screen safety warnings and may also be fitted with convex mirrors above the display allowing the user to see what is happening behind them.

As of 2013, the only claim available about the extent of ATM connected homicides is that they range from 500 to 1000 nationwide, covering only cases where the victim had an ATM card and the card was used by the killer after the known time of death.

# 10.Conclusion :-

The main objective was to design a ‘best-of-breed’ ATM menu system. This was achieved in the form of the OptiATM. As demonstrated, the OptiATM menu design, out performs and is a more usable and efficient system than the existing ATMs investigated. The OptiATM system was designed to resolve the problem of users having to reinsert their ATM cards to carry out another transaction and to speed up transaction times. The system could help improve user’s basic everyday ATM transactions however the OptiATM system is basic in that the functions and services they offer. Many advanced ATM machines offer an abundance of additional services including cash and cheque deposits, ability to pay bills at terminal, top-up pay as you go mobile phone and purchasing tickets such as train or concert tickets. ATMs have become part of the modern world’s infrastructure. We expect ATMs for convenience as much as we expect a good transport service. However, as the services offered grow, the ATM menu designs will become more complicated. This may lead to the systems becoming even more confusing for users and harder to choose. It is recommended that ATM designers consult extensively with ATM users to help them design and create easy-to-use and efficient ATM systems.

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