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Automatic Teller Machine for disable users and its security issues

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Abstract

Automatic Teller Machine is highly beneficial in banking industry. The banking industry forcefully promotes the use of ATM cards. In spite of the success and extensive use of Automatic Teller Machine, a large percentage of bank clients can not use them and it has been noted that no importance has been given to the feature of the accessibility at all. The significant number of disable users in bank industry had experience many difficulties in their interaction with these ATM's. Speech technology has been recommended by which a blind person might be encouraged to use ATMs in banking industry. This paper investigated users approach to the use of ATMs and its security issues in banking industry and illustrates how ATMs can be improved with a focus on universal design.

1. Introduction

Automatic Teller Machine (ATM) is a computerized telecommunication device and was first developed by Luther George Simjian and was first installed in the city of New York, USA by the City Bank of New York in 1939 and was removed after six months due to the lack of acceptance. After 25 years the first electronic machine was developed by De La Rue and was installed in Enfield Town in North London on 27th June 1967 by Barclays Bank. The idea of using Personal Identification Number (PIN) was first introduced by James Goodfellow, a British engineer in 1965 (Wikipedia, 2007).

ATM provides a secured financial transaction self supported system to bank customers. Using ATM helps bank customers to withdrawal their cash or to enquire their balance. The developed services of ATMs are now offers bank customers to deposit their cash or cheques, paying their utility bills or even to transfer money between their bank accounts.

The traditional operating hours of banking industry do not suit today's customer needs. Due to the high volume of transaction the banks staff also feel pressure in banking industry. It is also difficult for bank industry to put such large number of staff to cope with this high volume of transactions. Alternatively today's banking industry moved to ATM technology which helps customers to perform a transaction in flexible hours where ATM facility is available but not necessarily for everyone. Therefore, Automatic Teller Machine should integrate universal design, accessible by everyone and operate by everyone regardless any disability and physical limitations. The design of using speech recognition devices for transactions of ATM machines directs to a number of issues and concerns. The two important issues are here to be considered are the privacy and security. In addition to the cash withdrawal function the banking industry should provide all customers with a wide variety of services and help them to automate bank counter work. In fact the demand for making accessible Automatic

Teller Machine in society is growing due to the multiplicity and complication of services offered. The ATMs in banking industry required a lot of improvements in terms of barrier free and universal design. The ATMs installed in public places are supposed to be operated much more frequently than ever before but accessibility to ATM is also an issue for disable user that depends on the nature of disability. In general the conclusion is the need of secure and effective use of ATM facilities. There is a general concept in the society that people do not want to take long to use an ATM especially when they are queuing behind them. Therefore it is very difficult to say that how many people usually leave the ATM without completing their transaction. Also there is a possibility for a disable people to give up using such a facility on ATM which takes too long for them.

A typical Automatic Teller Machine contains two input devices and four output devices. The input devices are usually a card reader and keyboard while the output devices contains a screen to display information, cash dispenser to withdrawal cash from ATM, receipt printer to print account information usually balance and speaker that links the ATM to the ATM host network. ATM is similar to a personal computer in operation and usually comes with the Operating System/2 and some precise application software that helps the user interface to communicate with the system. ATM usually uses magnetic strip cards and personal identification numbers (PIN) to identify information of account holders and to perform transaction. ATM transfers customer's request and information to the financial institution by using customer strip card.

If a customer requests for withdrawal the host processor of the ATM signals for an Electronic Funds Transfer (EFT) from the customer's bank account to the host processor account. After transferring the funds the ATM receives an approval code authorizing it to give out the cash. All this communication, verification and authorization can be delivered in several ways. To connect the host system dial-up or wireless data links can be used but it depends on the cost and reliability of the whole infrastructure. The EFT network may support debit card transactions using PINs, or credit card transactions using a signature. Point-of-sale services that use PINs are also possible (Whelan, 2003).

2. Problems with the use of ATMs

There are some general problems with the use of ATM machines e.g. robbery (Scott, 2002). For a disable person it is likely to be difficult to use a public place ATM for financial transaction if unsafe. Although the risk of robbery is available for all people but is increased when disability is present as these people are less able to protect their self. Other important issues which need to be considered are following.

- Stealing some one's personal identification numbers i.e. pin numbers.
- Theft electronic data interception and fraudulent electronic transaction.
- The use of fraudulent and illegal ATM cards.

Automatic Teller Machine was developed to mechanize and computerize a range of bank counter services. They are developed to enhance the bank services offered to bank customers. ATM is commonly used by different users like elderly people, children, foreigners and people with different permanent or temporarily disabilities.

For instant transactions and other services these ATMs must ensure sufficient usability for all users and bank customers without any discrimination or physical limitations.

To achieve the highest level of accessibility on ATMs, banks should incorporate different accessibility features into ATMs. For example for elderly people, an accessible computer interface with high visibility of producing characters is required. Similarly a special type of handset with a numerical keypad is required for visually impaired people that helps and allows a visually impaired person to communicate with ATM using numeric keys according to speech recognition systems and instruction provided through the handset. To increase visibility for a people with low vision and other wheel chair user's mirrors can be used in the ATM inlet and outlet port.

3. ATMs Accessibility for Visually Impaired People

For a visually impaired person finding an ATM is not an easy task overall. The blind person also may not be sure whether the ATM will accept his card or not. The ATM also can be out of service when visiting by blind user. Other accessibility issues for blind users include the following.

- The screen of ATM can not be read
- There may be uncertainty in the keyboard of ATM keyboard functions or may not be labelled.

During the process of transaction on ATM for a visually impaired person it is not obvious whether the user will complete the financial transaction successfully or not. The user may get lost during this operation if there are worthless key labels on ATM. There are also very high possibilities that the blind person become confused with all the steps involved in financial transaction. He may not get any feedback about the transactional progress during this operation on ATM. Memorizing the complete series to withdraw cash is the common approach used by visually impaired people on ATM but even a blind person with very good memory will be doubtful whether he will be able to obtain the amount without any support.

For a partially sided person and a low vision user also can find difficult to read the signs of ATM. Reading the ATM screen, receipts and key labels is also an issue for them. The poor background screen light of ATM can also create difficulty for a partially sided person to read the screen.

The use of handsets makes it possible for a visually impaired person to communicate with ATM in banking industry. These handsets are highly evaluated because users can confidentially operate the ATM with the hand without using personal identification numbers and operation instruction known by third parties. Even those users who could not read Braille can confirm their balance by speech recognition systems. An essential issue has been raised with the use of handset that whether a visually impaired person can guess how to hold and function on handset by simply touching it. It also required a system necessary additional development in terms of returning the handset device at the end when user finished the transaction and operation. A common shaped designed receiver with the particular location digital keypad can be

used for this purpose. An addition a cable connected to receiver to take up reel on the receiver for effortless replacement is required in operation (Asawa et al, 2004). The same input method used for cellular phones can be used to communicate through these handsets which can characterize the series of key operation for cash transfer.

4. Hearing Impairment

People with hearing impairment do not face as much problem as visually impaired people. But in some cases if the ATM machine uses a sound beep system to point to a mistake which can not possible to hear by deaf person can create a problem. To avoid this visual alert of warning system can be used in ATM. Using ATM for a person with both deaf and blind is more difficult. In that case Braille out is the only option for those people to communicate with ATM.

5. Cognitive and Learning Disabilities

Consistency of steps in transactions is the most important issue. People with learning disabilities can face difficulties on ATM if the transaction's steps are not consistent. The use of simple English is important too.

An audio equivalent device like speaker or headphones can be used to assist people with cognitive and learning disabilities. They can be reinforced and also have room for those who may not read effectively. Additional advertisements and messages should be avoided to display on ATM as it can make the situation more complicated for people with cognitive or learning disabilities during the process of financial transactions.

To choose and locate an ATM for people with disabilities is also a concern in eBanking industry. Finding a nearest ATM is very necessary and a complex issue for people with different types of disabilities. Because of different ATM machines in use banks provide different facilities which make it difficult for people with disabilities. Some banks use touch screen technology while others not. They don't provide any feedback to disable people by using any speech recognition devices for the further steps during the process of transaction.

6. Using ATM Card

Some card issues of ATM are also important to be considered to achieve the highest level of accessibility on ATMs. These issues can create difficulties for disable users while using ATM. One of the issues is to insert the card into ATM properly. For a blind person using ATM card is difficult to know which side he needs to insert in the machine. This can cause another problem and the machine can gobble the card when inserted into card reader of the ATM incorrectly. An ideal ATM should not accept the card if inserted incorrectly. Also a beep or visual notification system can be used to avoid this. Some disable users got severe problem to remember their pin number of the ATM card. People with learning disabilities can have this problem too. To avoid this biometric authentication and verification system can be used to supervise user information to determine the type of required accessibility. The idea of smart card can be very useful and beneficial in terms of accessibility to store a specific user's preference for the required screen layout and voice output for disable peoples.

7. Using ATM Keyboard

A Braille system on the keypad of the ATM can be used to help a visually impaired person but it is not too important nor a beneficial for general public using ATMs. The other problem with the ATM keyboard is that only the numeric keys on the keyboard got the Braille system while the other important function keys for selecting deposit and withdrawal amount or for selecting to display balance on screen etc. are not labelled. This is because their function changes during the process of transaction from screen to screen. A speech recognition device can be used to solve this problem on ATM which can assist a blind person through the whole process of the transaction step by step.

8. Using ATM Screen

Font size and colour contrast on ATM screen are the major concerns for people with low vision. Poor description of labelling on the ATM and using small font size text on ATM receipts is also a barrier in the way of accessibility. Some newly made ATMs are still difficult to read. Some touch screen ATMs are available to use but actually these touch machines are even more difficult to use for person with disability. This is because the functions of screen keys are differ on different phases of the transaction.

9. ATM Security Issues

Banking customer expects a very high reliability from ATM. The security issues of ATM have serveral dimensions. The physical security of ATM is itself an issue. There is evidence available that ATM has been ventalized or steals on different occasions by criminals.

To prevent fraud ATM uses the system of encryption of personal information. ATM encrypts the sensitive data with the help of Data Encryption Standard. There are number of incidents of ATM fraud where criminals have attached fake keypads or any other type of card readers to ATM that records the customer's PINs and other information of the bank card in order to gain unauthorized access to their account. Somr ATMs are now equipped with the camera system or CCTV for their security purpose but still the security of the customer is an issue.

ATM network typically suffers the following threats:

9.1 Eavesdropping

Eavesdropping is one of the most common attacks to the ATM network in which the attacker basically connects in the transmission media and gain unauthorized access to the financial data. Due to the use of optic cable to connect ATM network most people thought that tapping is not an easy task. This impression is wrong because most of the hackers are familiar with communication technology and the relevant protocols operating at the point of tapping. On the other side the information is widely available and can be used by any hacker for unauthorized access to the ATM network.

9.2 Spoofing

In spoofing the hacker basically sends fake or spoofed messages causing network to be confused such as network switches. The hacker basically impersonates another user to the third part and can get access to resources used by the victim of the data. To gain an unauthorized access the hacker can use some special tool to perform spoofing successfully. As we know that our network is always connected to several un-trusted and unknown network via the Internet, therefore it is easy for a hacker to gain access or trace people with the particular access permission. ATM is also being implemented in public domain and is subject to this kind of attack. Authentication plays critical role in Communication Systems. To prevent spoofing every key should be authenticated in public network.

9.3 Service Denial

Due to the connection-oriented technique called Virtual Circuit, established by SETUP signals and can be disconnected by RELEASE or DROP PARTY signals, in ATM and attacker can disconnect the Virtual Circuit. The attacker can send these signals frequently and can distribute the communication between different users and therefore will disable the Quality of Service (QoS) in ATM.

9.4 Stealing of Virtual Circuits

An attacker can steal a Virtual Circuit from another end user if two end switches between a communications of an ATM network compromise. In ATM network cell travels through different ATM networks and it's very easy for two switches to compromise.

For example, VC1 and VC2 are two virtual channels owned by two different users U1 and U2, which is from switch A to switch B. If A and B have compromised, then A can switch VC1's cells going from A to B through VC2 and B will switch back those cells to VC1. Since switches will forward cells based on the VCI (Virtual Channel Identifier) or VPI (Virtual Path Identifier) in the cell header, A and B can just alter these fields back and forth. Switches between A and B won't notice these changes and will switch the assumed VC2's cells just like the authentic VC2's cells. In ATM network, if quality of service is guaranteed, then user 1 can gain a lot by stealing a higher quality channel which user 1 is not entitled to use (Liang, 1997)

9.5 ATM Switch Attack

In order to manipulate a switch an attacker can use the P-NNI (Private Network to Network Interface) protocols which is a dynamic source routing protocol for ATM inter-networks. The P-NNI protocol basically provides routing between ATM switches and group of switches. Incorrect information can be inserted in the peer group database. It is also possible for an attacker to break the communication channel of entire peer group. The attacker can also redirect communication over his own workstation. Based on the P-NNI protocol a 'Hello' message can be used for attacks to insert malicious information. This can be broadcast by the peer group leader to make the wrong routing path (Benecke, 2006).

9.6 ILMI Attack

The Integrated Local Management Interface can be used at the interface between switch and workstation. Based on the SNMP (Simple Network Management Protocol) it does not offer any mechanism for the purpose of authentication. ILMI can be used basically to register an additional ATM address for any workstation. This additional ATM address helps to evade address filters configured at the switch. It is also possible for an attacker to register himself as an offline workstation.

9.7 Traffic Analysis

The hacker can approach to information by collecting and analyzing the information like the volume, timing and the communication parties of virtual circuits. If the data is even encrypted the volume and timing can disclose a lot of information. The source and destinations parties can be obtained by examining the cell header. A covert channel technique can be used to encode the information in the timing and volume of data to distribute information without being monitored (Liang, 1997).

10. Discussion

ATM services are provided almost anywhere which helps to enhance the services offered by banks to their customers. ATM is now commonly used by different users like elderly people, foreigner and people with different disabilities. Unfortunately it has been noted that no importance has been paid to the accessibility of these ATM at all. Although some banks offer the use of Braille system on their ATM machine but it is important to understand that Braille itself is not the final solution. The notion of accessibility has always been considered as secondary in the banking industry. Most of the banks claim that their services are accessible for people with disabilities. Using a bank Website via Internet is now a very common way to communicate with bank likes ATM but the great challenge facing the web is to make sure that all developers and designers follow accessibility guidelines in providing descriptions that optimize access to end users with disabilities. There has been a lot of discussion on different forums regarding eAccessibility on the part of web developers and designers. This causes the development of a plethora of new software utilities and the interesting part of these utilities is that all are claiming to automate the process of evaluating and/or repairing web pages.

The aim of all these utilities and tools are to assist the developer and authors of HTML to pin point the changes needed in the HTML coding to make sure and achieve the high level of eAccessibility.

The available two sets of standards to achieve the goal of eAccessibility used by developers of evaluation and repair products are Web Content Accessibility Guidelines 1.0 from the Web Accessibility Initiative (WAI) of the World Wide Web Consortium (W3C) that provides a priority based (Priority 1, 2 and 3) checklist of guidelines. This document is now used as a reference for evaluation and assessment of the eAccessibility and web-based resources.

In addition, the rehabilitation act amendments of 1988, section 508, covers access to United State Federal Agencies in making their electronic and information technology more accessible to people with special needs. An independent US Federal Agency, The Access Board, whose goal is to achieve the highest level of eAccessibility has established a “Guide to the Section 508 Standards for Electronic and Information Technology.”

The legislative frame work is clearly defined by World Wide Web Consortium (W3C) for developing an accessible Website to people with disabilities. The standards are achieved in the design area of Websites (Jahankhani et al, 2002) but online banking services industry should develop a policy to pay more attention to make their Websites and resources more accessible to people with disabilities. Although most of the banks are aware about the importance of eAccessibility but a very little attention has been paid to incorporating accessibility guidelines in the Websites development of those banking Websites.

In a research conducted to find out the accessibility level of Websites of eBanking Services across United States of America and European Union it has been found that most of the banking websites failed to appreciate the importance of eAccessibility approach.

The research conducted for 1049 Websites of the eBanking services of United States of America by using the Bobby tool proved that only 13% Websites achieved the minimum level of eAccessibility defined by the Web Content Accessibility Guidelines 1.0, a standard developed by World Wide Web Consortium (W3C). Out of 1049 tested websites only 2% Websites achieved the high Level of AA conformance and 1% achieved the AAA conformance.

Similarly in European Union out of 927 Websites of eBanks only 33% Websites achieved the Level A conformance. 5% Websites achieved the Level AA conformance and 6% Websites achieved the highest Level of AAA conformance of WCAG 1.0. This is illustrated in the following diagram.

Achieved Level of Priority of WCAG 1.0	Total Number of Websites Checked for Accessibility Test	
	USA (1049)	EU (927)
Priority 1	13%	33%
Priority 2	02%	05%
Priority 3	01%	06%

11. Conclusion

The growth of the World Wide Web means that people with serious sight problems now have the opportunity to enjoy a wealth of information and services that was previously unavailable to them. The Automated Teller Machine is the well known system that provides opportunity to everybody for easy access to banking activities. ATM technology is one of the most complex networking technologies. To achieve the highest level of accessibility and security on ATM is really difficult than design. eBanking industry is facing the issues of accessibility and security on their Websites

and ATMs. The low level of accessibility of eBanking Websites proved that ATM services are also inaccessible to people with disabilities.

The research has shown that the banks can only achieve a high level of eAccessibility, by taking a forward looking attitude and a carefully considered design. Good practice examples proves that there is no need to sacrificed visual appeal and the impression it is intended to convey to its users to the legal requirement. Instead all criteria can be met as part of a balanced relationship.

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