Sfwr Eng 4HC3

Assignment 2: Design Document

Zichen Jiang   jiangz26   001320889
Kelvin Lin   linkk4   001401464

Table of Contents

Introduction

This document details a touchscreen ATM interface created by Zichen Jiang and Kelvin Lin for Sfwr Eng 4HC3.

Functionality

The ATM can validate a user through three different input methods: inserting their bank card, swiping their bank card, or entering an account number. Afterwards, the ATM will ask the user to enter a passcode associated with their account. As a security feature, users will be given three attempts to enter this passcode. If they enter it incorrectly three times the account will be locked out of the system, and a message will be displayed to the user telling them to go to the bank to unlock their account.

Once the user validates their account, they will be directed to a menu where they can select their desired tasks: withdraw, deposit, transfer, check balance, change passcode, and sign out. The withdraw feature lets users withdraw money from the ATM, provided they already have money in their account. Users can also deposit money using the deposit feature, which will add money to their account. Users can transfer money to other users, provided that they have their bank number. Users can check their current balance, as well as their transaction history, using the check balance feature. Users can change the passcode associated with their account using the change passcode feature. Finally, users can sign out of the system using the sign out feature.

Context

While the functionality of the system is universally accepted, the design of systems is constrained by cultural and societal beliefs and values. Different societies develop different conceptual models and have different expectations of how a system should work. In order to design a good interface – one that can be used by 95% of the population – a target population of users must first be described.

The target audience for the ATM machine will be the working population. This includes everyone 15 years of age and up. About 85.6% of Canadians have working knowledge of English, while 30.1% have working knowledge of French [1]. Aside from Canada's official languages, the next most commonly used languages in Canada are Chinese, Punjabi, Spanish, and Tagalog. It will be assumed that most Canadians have prior experience with touch screens and ATMs, even if they are not contained within one system.

The Application Layout

The application is divided into two components: the ATM system, and simulated physical controls. The main ATM system is located at the top of the screen, and it is enclosed in a black border. The black border is not intended to be part of the system: it is there to separate the ATM system from the simulated physical controls.

Figure 1: The Application Layout

There are 6 buttons below the application. The five buttons act as physical controls to the system. They simulate actions that the user can perform on the ATM without accessing the touchscreen interface. Such actions are inserting their card, removing their card, swiping their card, taking money from the machine, inserting money into the machine, and speaking to the bank clerk.

The console is also used to denote simulated physical interactions that the user can have with the ATM. Such actions include the card reader being blocked, no money is dispensed from the machine, or the deposit box is closed.

Selecting a Language

Since Canada is a multicultural society, multiple languages will be supported. The ATM supports English, French, Spanish, Chinese, Punjabi, and Tagalog. English and French are supported because they are the official languages in Canada, and most Canadians have a working knowledge of either English or French. The other 4 supported languages are the four most commonly used unofficial languages in Canada. Supporting these languages ensures that 95% of the Canadian population can use the ATM.

The actual localization functionality was not implemented. This is because the localization feature does not add to the overall design of the application. The application would still look the same. One interesting consideration for the future might be to mirror the ATM application for languages that read right to left, since people who read in those languages are more likely to scan the right hand side of the screen first. Therefore, for languages that read right to left, important information should be placed on the right instead of the left.

Users can select a language by typing one of the six buttons on the start screen.

Figure 2: Language Selection Menu

Providing a Bank Account Number

The first operation users make when using the ATM is providing their bank account. They can do this in three different ways: inserting their card, swiping their card, or entering their bank account number. Since inserting or swiping their card is a physical interaction, the system allows the user to preform those at any time before the user is logged in.

To enter their account number, users will need to tap on the initial screen to access the input selection menu. Afterwards, users will need to tap on the account number button to reach the interface for entering their account number. Users can use either the number pad on the touch screen or the physical number pad to enter their passcode. In the application, this is simulated as users can either press on the on screen buttons to enter their passcode, or enter their passcode on the keyboard. It will be assumed that the physical number pad has the same keys as the onscreen number pad. Two options are given because some users may be uncomfortable typing their bank account number using a touch screen fearing that the fingerprints they leave behind may allow the next person to access their bank account. A text label below the text field will inform users they can use the physical keys.
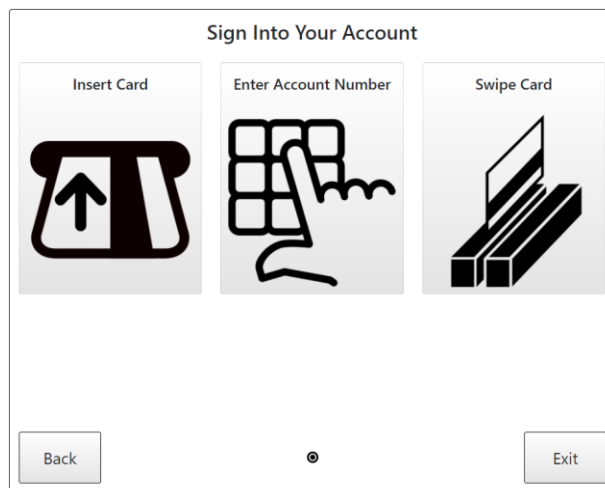
Figure 3: Input Selection Screen   **Figure 4: Account Number Entry Screen**

The account number entry method is less assessable to the user because it is expected that option will be the least frequently used. Bank account numbers are commonly 16 digits long; however, a person's short term memory can only hold about 7 items. Hence, it is expected that most people will not remember their bank account number, so instead of typing their bank account number from the card, they will rather insert or swipe.

In this application, bank account numbers are 10 digits long because the purpose of this application is to model strong applications of design principles rather than to create a hyper-realistic functioning system. To prevent slips such as tapping the same number twice or entering more digits than necessary, the text field is constrained to 10 digits. Users are also able to see the numbers they type in, as a bank account number is not private, and it is guarded by a personalized passcode.

If the account number is not valid, then the user is shown a red 'X' and text saying that the account number is not valid. Red is used to emphasize the significance of the event.
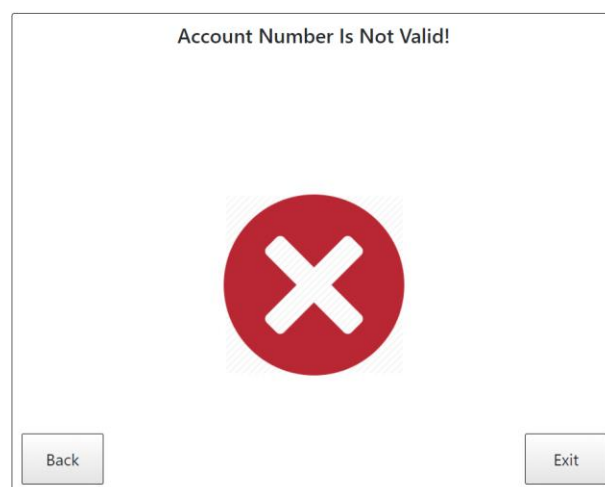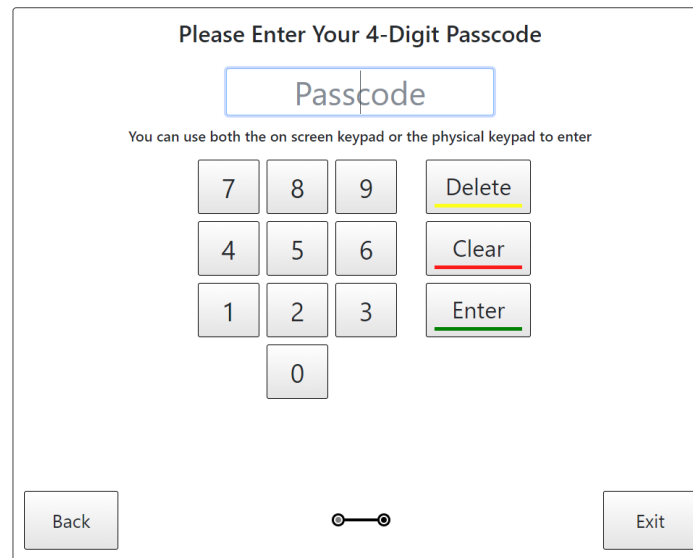

Figure 5: Account Number is Not Valid Screen

Entering a Passcode

As a security feature, once the user inputs their bank account number, the user is also required to provide a passcode. This is intended to prevent unauthorized access to a person's bank account. Like the bank account number, users may use either the onscreen number pad, or they may use the physical number pad attached to the ATM machine. However, unlike their bank account number, their passcode will be blocked, so users will see black circles instead of the actual numbers they typed. This is intended to give users feedback so that they know that their input was registered, while protecting their privacy against people watching behind them.

Figure 6: Passcode Entry Screen

Each passcode is 4 characters long, as most people can remember 4 digits in their short term memory. Users are constrained to only entering 4 characters as any additional characters entered after the fourth character will not be registered.

Success

If the user successfully enters their passcode, one of two actions will occur. If the user swiped their card or entered a bank account number, then they will be directed to the main menu. Otherwise, if the user inserted their card, then they will be prompted to remove their card before they are directed to the main menu. The user is asked to remove their card first so they will not forget about their card after their transactions.

Once the user removes their card, then a mechanical guard on the ATM machine prevents the user from inserting their card again until the user is signed out. Likewise, swiping a card while the user is signed in will not have any effect on the system. In this application, this is represented by messages outputted to the console.

Failure

Users are given three attempts to enter the passcode correctly. This was done to account for slips and mistakes that users might make while entering their passcode.

If the user incorrectly enters a passcode once or twice, then they will be directed to a page with a large 'X' icon. The 'X' icon signifies to the Canadian audience that they have made a mistake. The icon uses the conceptual model of a barrier lets the user know that the previous input they provided cannot overcome the barrier. The icon is red, in contrast to the rest of the monotone interface, to emphasize the significance of the event to the user. It is assumed that most Canadian users will know that an 'X' is a negative signal because 'X's are commonly used to denote mistakes, errors, or prohibitions in signs and schools in Canada. Moreover, textual labels signal to the user the number of attempts they have remaining before the user gets locked out of the system.

Figure 7: Passcode Incorrect Screen

If the user incorrectly enters their passcode 3 times, then they will be locked out of the system. A label as well as an icon of a lock signals to the user that they have been locked out of their account. The conceptual model of a lock is used to let users know that they will need to obtain a key or special permission to access their account again. The lock is black instead of red because the event is no longer in the control of the user, and hence, the user does not need to be warned of the catastrophic consequences. Text at the top of the screen will let users know that they need to talk to a clerk at the bank to get their account unlocked.
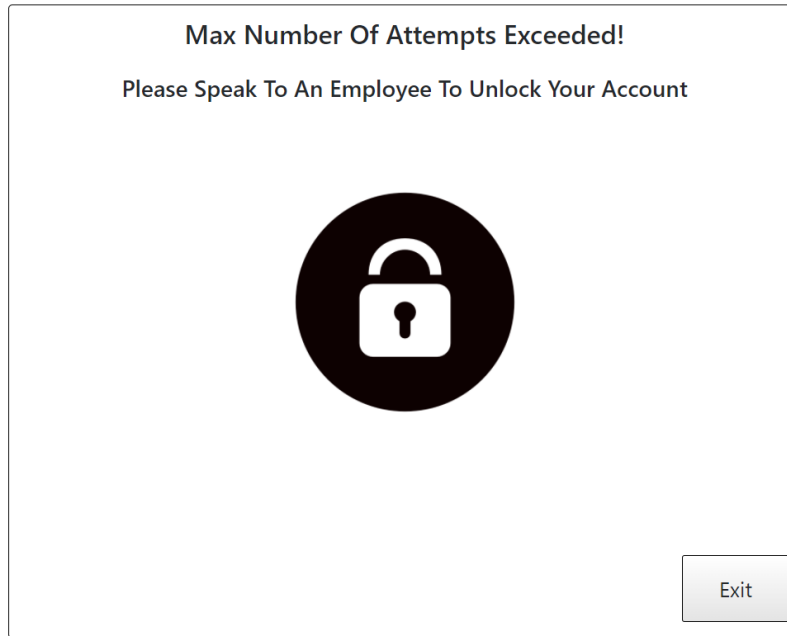
Figure 8: Locked Out Screen

Speaking to a clerk is simulated by an action button in the software; however, when the button is pressed, and the user is locked out, then the interface reverts back to the initial interface. This is to simulate the fact that the ATM interface will reset in the time it takes for the user to go to the bank and to come back.

The Main Menu

Once the user successfully logs into their bank account, they will access the main menu. To maximize discoverability, all of the possible transactions are displayed in the main menu. The user can access any transaction by tapping on the corresponding button.

Figure 9: Main Menu

Showing all available actions to the user may lead to information overload if there are too many on screen elements: users may be overwhelmed by the amount of elements on the screen and decide to ignore important information. To avoid information overload, labels and pictures were used in tandem to convey the maximum amount of information with the least amount of onscreen elements.

Every button on the main menu labels the corresponding action they lead to using text and images. The actions are withdraw, deposit, change passcode, check balance, transfer money, and sign out. Users who are in a hurry can look at the pictures and infer what the buttons do. Users who are confused can use the text to clarify the image.

Withdraw Money

To withdraw money, users must first enter an amount they would like to withdraw. The interface is similar to the bank account number interface and the enter passcode interface. Using a similar looking interface for multiple functions reduces the learning curve associated with using the system. To prevent confusion among similar interfaces with different purposes, light grey text is placed in the text box before the user starts typing to tell the user what number they need to type in. Moreover, the title text also serves as a signifier for the user once the user begins typing.

Figure 10: Withdraw Amount Screen

When the user types the amount they would like to withdraw, the amount is displayed on the screen giving the user feedback as to the key they pressed. The user is free to enter as large of a number as they like. They can navigate long digits by scrolling left and right on the touch screen. An icon will appear once the number exceeds 14 digits to indicate to the user that they can scroll left and right.

The amount of money the user has in the bank is displayed in a label so users know how much money they have. However, the amount of money they can withdraw is constrained by their account balance. The number pad also constrains the user into withdrawing an integer amount of money. This is to

reduce the number of small denomination coins located in the machine. It is assumed that most people will not go to the ATM to withdraw a small amount of money.

The consequences of withdrawing money (whether the withdrawal is successful or not) is described below.

Success

A withdrawal is defined to be successful if the user enters an amount less than their balance. In such an event, money is dispensed from the ATM. The ATM has a sensor to detect whether or not the money has been removed. Until the money is removed, the user will be directed to a screen to tell them to take their money. This is so that users do not forget to take their money. The slot that money is dispensed from is also small (and separate from the slot used to deposit money) so that users cannot insert any foreign objects into it. This is so that people do not try to steal money from the ATM, and it prevents users from trying to make a deposit when they press the withdraw money button. Money is deducted from the account balance, and recorded in the transaction history.
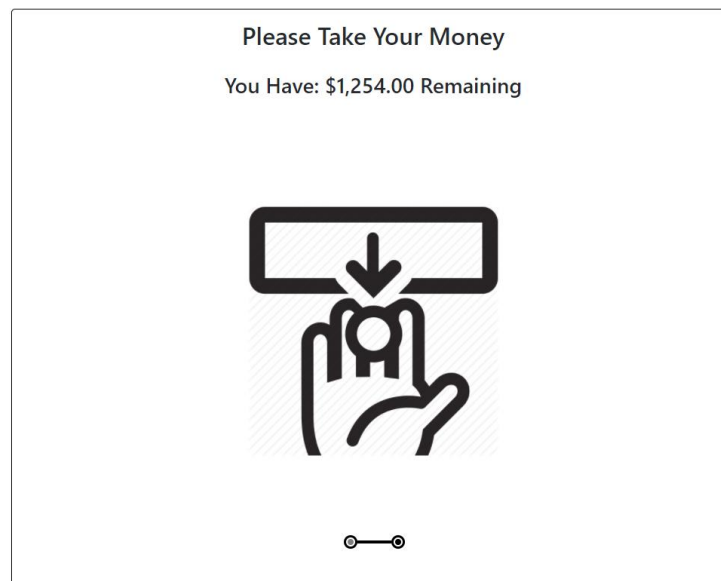

Figure 11: Success Screen

Again, text and a picture signal to the user to take their money. Once the user takes their money, they are redirected to the main menu where they can choose to preform another transaction or sign out.

Failure

If the user enters an amount larger than their current account balance, they will be directed to a screen that will tell them that they have insufficient funds. This screen will allow users to go back to enter a new value, or to go back to the main menu.
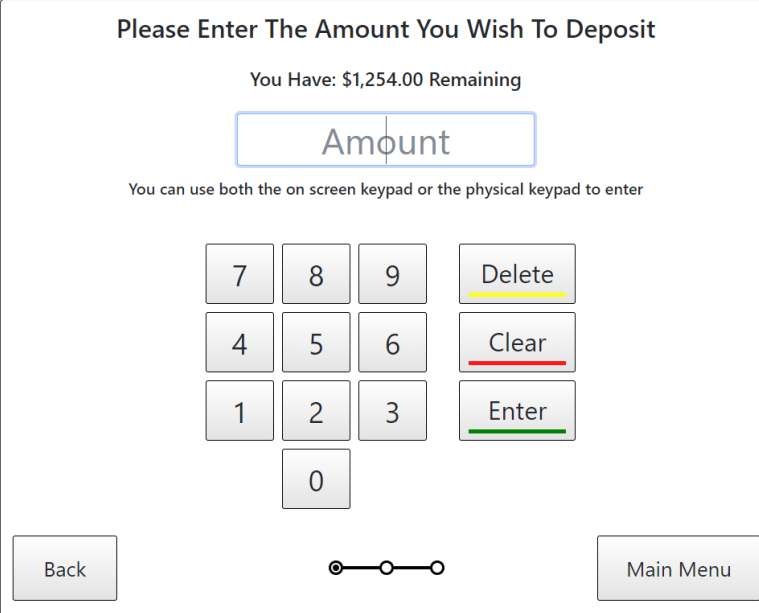
Figure 12: Insufficient Funds Screen

No money will be deducted from the account balance.

Deposit Money

The deposit button uses an image of a "piggy bank" to denote saving. This provides the conceptual model that when the user deposits money, they are also saving money. It is important to note that this conceptual is constrained by culture: the image might only be usable in Canada, because the notion of saving money in "piggy banks" is widely known. The image of the "piggy bank" may need to be changed if the ATM was used elsewhere.

To deposit money, users must first enter an amount they would like to deposit. The interface is similar to the withdrawal interface. When the user types the amount they would like to deposit, the amount is displayed on the screen giving the user feedback as to the key they pressed. The user is free to enter as large of a number as they like. They can navigate long digits by scrolling left and right on the touch screen. An icon will appear once the number exceeds 14 digits to indicate to the user that they can scroll left and right.
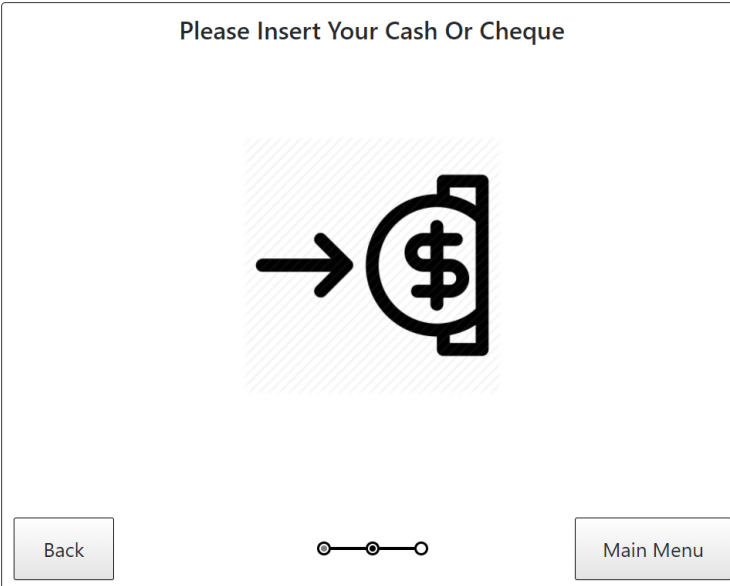
Figure 13: Deposit Amount Screen

Unlike the withdraw function, the only constraint placed on the number is that it has to be an integer. This is because the number pad does not have a decimal place. This was a reasonable assumption because most people also deposit money in whole dollars instead of fractions of dollars.

Deposits are always successful. When the user presses deposit, they are brought to a screen that asks them to deposit money. On the physical machine, a slot, separate from the withdrawal slot, will open up to accept money from the user. This is simulated with a physical interaction button in the application.

Figure 14: Insert Money Screen

As in reality, it is up to the user to place money in the machine. If the user places money in the machine, then they will be directed to a deposit successful screen where they can see their updated balance. Otherwise, users can exit by pressing back to select a new amount to deposit, or main menu.
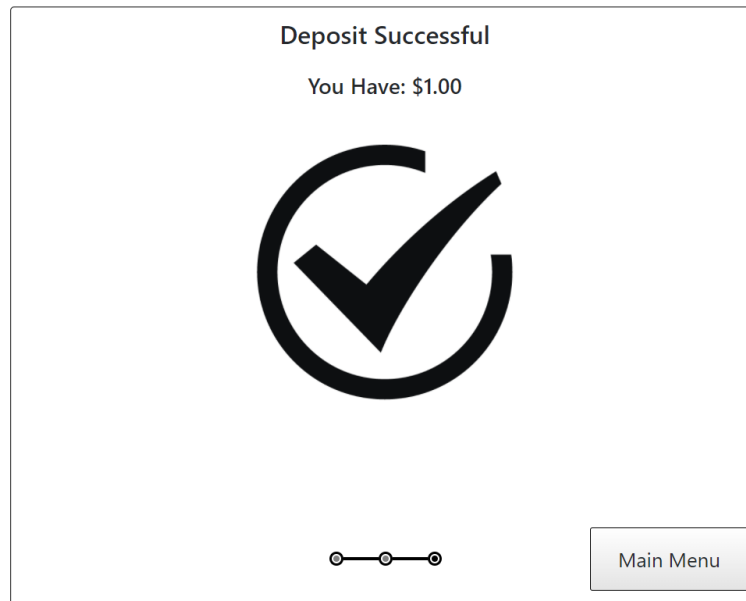

Figure 15: Deposit Successful Screen

Transfer Money

The process of transferring money is similar to withdrawing money, except the balance gets added onto another account. The metaphor of money changing hands is used to show to the user that a transfer is like giving money to someone else.

There are two steps to transferring money: selecting an amount to transfer, and selecting an account.

To select an amount to transfer, users must first enter an amount they would like to transfer. The interface is similar to the withdrawal and deposit interface. When the user types the amount they would like to transfer, the amount is displayed on the screen giving the user feedback as to the key they pressed. The user is free to enter as large of a number as they like. They can navigate long digits by scrolling left and right on the touch screen. An icon will appear once the number exceeds 14 digits to indicate to the user that they can scroll left and right.

Figure 16: Transfer Amount Screen

The amount of money the user has in the bank is displayed in a label so users know how much money they have. However, the amount of money they can transfer is constrained by their account balance. The number pad also constrains the user into transferring an integer amount of money. It is assumed that most people will not go to the ATM to transfer a small amount of money.

The consequences of selecting an amount of money to transfer are described below.

Success

An amount is defined to be valid if the user enters an amount less than their balance. In this case, the user will be directed to another screen that looks like the bank account number interface, which will ask them for an account they would like to transfer the money to. Like the bank account number interface, the user is constrained to entering 10 digits.

Figure 17: Account Number Screen

Transfers are an irreversible transaction, so a mechanism must be put in place to ensure users know the significance and nature of their transaction. Several alternatives were considered, including having a confirmation box, or having users type their passcode. However, it was ultimately decided that these additional interfaces will only slow the user down, and users may decide to ignore them all together if they become too cumbersome. Accordingly, it was decided that a message in red (emphasizing the importance of the message) will be placed under the amount text box to let the user know that they cannot get the money they transfer to another person back, so they should double check to ensure that the account number is correct.

If the user enters a valid account number that is different than the one they are currently using, then the money will be deducted from the user's account and transferred into the other account. The user will receive a message saying the transfer has been successful. The screen will also show the user's remaining balance. The screen will give the user the option to enter another amount they would like to transfer, go back to the main menu, or sign out.
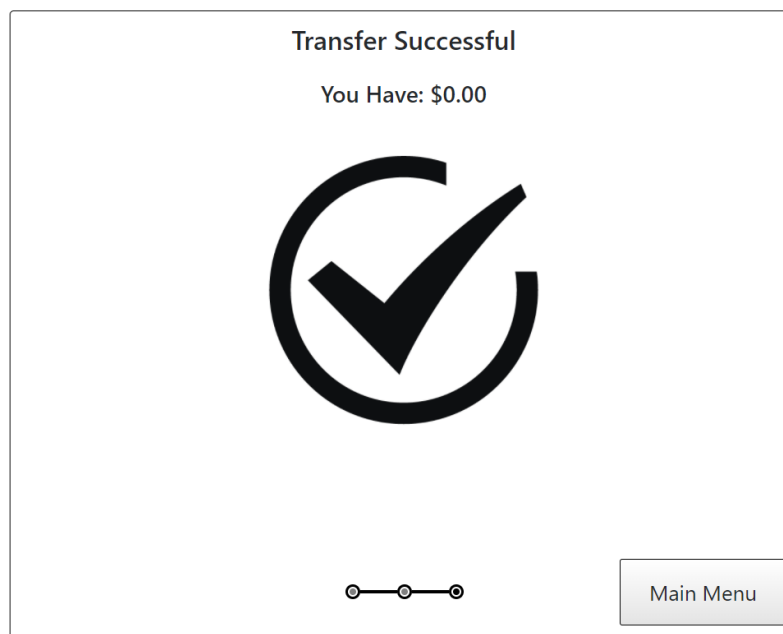

Figure 18: Transfer Successful Screen

If the user enters an invalid account number, then they will be directed to an error screen with a red 'X' (figure 7). The screen will tell the user that the account number is not valid. The 'X' is red because it is important to emphasize to the user the catastrophic effects of their actions. If they transfer money to an incorrect account, then they cannot get their money back.

Failure

An amount is defined to be invalid if the user enters an amount greater than their balance. Users will be directed to a screen that will tell them that they have insufficient funds (figure 12). This screen will allow users to go back to enter a new value, or to go back to the main menu.

No money will be deducted from the account balance.

Check Balance

Users can check their account balance by pressing the check balance button. The check balance button has an icon of a receipt being printed. This conceptual model of a receipt being printed is understood by people ages 15 and up because the target population grew up with paper-based banking. This icon and conceptual model may become obsolete in a decade when people grow more accustomed to paperless banking.

Clicking on the check balance button directs users to a screen where they can see their account number and their account balance. Unlike the other screens, this screen does not contain any images. The lack of images draws the user's attention to their balance and account number.
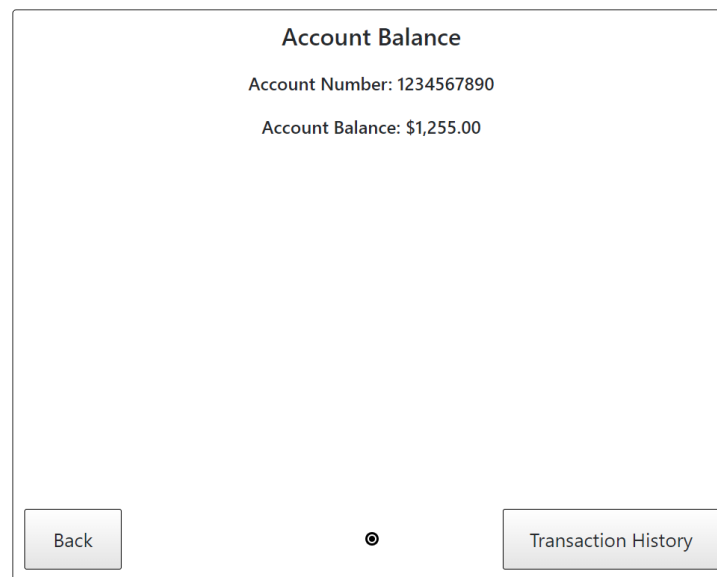
<div align="center">

Account Balance

Account Number: 1234567890

Account Balance: $1,255.00

[Back]   ◉   [Transaction History]

</div>

Figure 19: Account Balance Screen

If the user wants to see all of their transactions, they can click on the transaction history button. This will direct them to another screen with their transaction history. The transaction history is shown in reverse chronological order. This is because it is assumed that users are more likely to be interested in recent transactions rather than later ones.
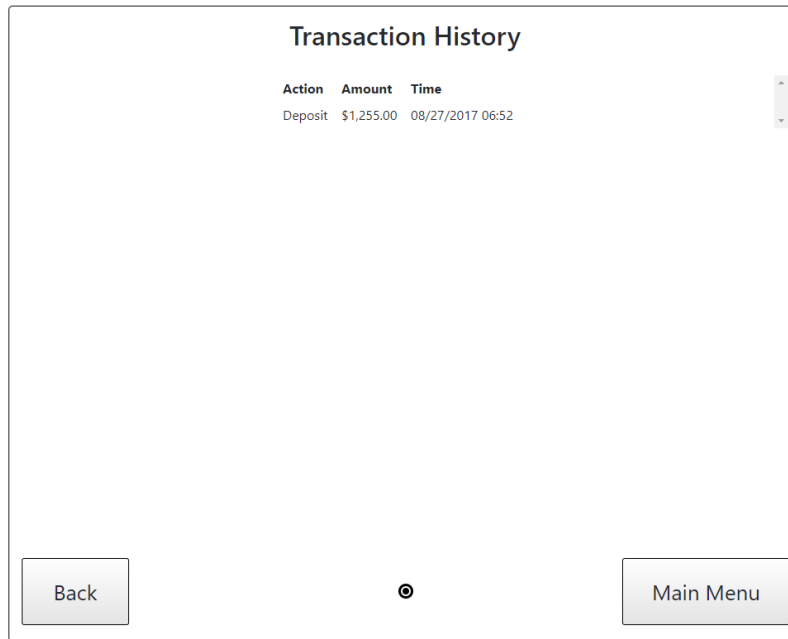
Figure 20: Transaction History Screen

Users are able to see all withdrawals, deposits and transfers that they made, the amount that was involved in each transaction, as well as the time the transaction occurred. If the user has a long history of transactions, then a scroll bar will appear on the right to let the user know that they can scroll up and down. Scrolling down will reveal older transactions, while scrolling up will reveal more recent transactions.

The scroll bar can also be used to signify the length of the transaction history as well as the current position within the transaction history. A longer transaction history will have a smaller dark grey bar. The higher up the dark grey bar is placed, the more recent is the transaction history shown. This is consistent with the most users' conceptual model of scroll bars on computers.

Change Passcode

Since user accounts have passcodes, a feature was implemented to allow users to change their passcode. The passcode change feature was implemented as some users might share their passcodes with someone else (e.g. a business partner), and then situations might arise that require the passcode to be changed to restrict access from people accessing the account.

To change their passcode, users will need to tap on the Change Passcode button. Once the press the button, they are prompted for their existing passcode. This is a layer of security designed to prevent to unauthorized changing of passcodes.

Figure 21: Enter Old Passcode Screen

Figure 22: Enter New Passcode Screen

Figure 23: New Passcode Same As Old Message

Figure 24: Passcode Confirmation Screen

Figure 25: Passcodes Do Not Match Message

Figure 26: Passcode Change Success

If the user enters the correct passcode, they will be prompted to enter a new passcode. They will be constrained to entering a new passcode and not the existing passcode. If the user enters an existing passcode, the user will see a red message below the text field telling the user to enter a new passcode. Red is used as it is important to emphasize that changing the passcode may have a significant effect on the user's future experience. The passcode must be 4 digits long, to ensure that the user can remember it in the future.

To ensure that the user did not make any mistakes, they will be asked to enter the passcode again. If the passcodes match, then the passcode will be changed. Otherwise, the user will be prompted to enter the passcode again.

The user can decide to cancel the operation at any time by pressing the back button or by pressing the main menu button.

Sign Out

Finally, the user can sign out by pressing the sign out button. The sign out button uses the metaphor of exiting a door. This conceptual model helps users realize that after pushing the button, they are supposed to leave the ATM.

This will redirect them to a sign out confirmation which will sign them out of the system.

Figure 27: Sign Out Screen

Moreover, to account for people who forget to sign out of their account, the ATM will automatically sign a user out after 5 minutes of inactivity.

Pressing the home button once signed out redirects the user to the language selection page. If the user does not press the Home button after signing out, the ATM will automatically go back to the language selection page.

The Use of Colour

The ATM interface consists primarily of black and white, except for the occasional spot of red, yellow, and green. This was intentional as it was decided that adding colour would not enhance the usability of the software; rather, in general, it would only serve a stylistic effect. Instead of adding visual flare, colour was used in this interface to emphasize potentially catastrophic events, such as being locked out of an account, irreversible transferring money to another account, or changing an account's passcode. The lack of colour makes these events appear to be more important to the user, drawing their attention from distractions that may surround them. Moreover, the lack of colour makes it clear that most tasks preformed at an ATM are neutral tasks, with little to no emotion attached.

Conclusion

This document describes the ATM bank interface submitted by Zichen Jiang and Kelvin Lin for Sfwr Eng 4HC3. The overall functionality and context was provided to establish a mutual understanding about the task at hand: to design a touchscreen based ATM user interface usable to 95% of the working Canadian population while following good design principles. Then, each feature of the application, and design decisions made in the interface was examined. Finally, the use of colour in the interface was discussed.

Appendix 1: Works Cited

1. Anon. 2017. Languages of Canada. (November 2017). Retrieved November 23, 2017 from
https://en.wikipedia.org/wiki/Languages_of_Canada