Human Computer Interaction – Group 4

A project to create a new generation of ATM

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Overview

The ubiquity achieved by Automatic Teller Machines (ATMs) has led to almost complete homogeneity in their design and conservatism amongst their creators. The fear banks have of moving away from a close to universally adopted standard has stifled innovation for much of the past three decades. The regularity with which ATMs are used by much of the population often hides their limitations. Indeed, Hatta and Iiyama (1991) found that 42% of infrequent users fail in making a withdrawal on their first attempt. This section will critique modern ATM interface design, drawing upon both the literature and our own observations.

Literature review

Usability is one of the most important qualities of any system; indeed, it constitutes a *conditio sine qua non* for the survival of most products. The International Organisation for Standardization (ISO) defines it as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction". However, so integral are ATMs to the functioning of modern life that the commercial ramifications for banks of bad design are less than would otherwise be the case. Yet, this does not mean there are no competitive advantages to be gained through their improvement. Better usability has the potential, inter alia, to improve confidence and trust in the bank, encourage the usage of high margin secondary functions, such as mobile top-ups and reduce support costs.

 An ATM's user interface is the "window to the bank's services" Coventy (2005); it should thus be visually appealing, clear and have a consistent layout. However, Curran and King (2008), who investigated the ways in which ATMs are used, argue current menus fail to account for the frequency with which different transactions are used. For instance, even small cash withdrawals often required ten buttons to be pressed, a clear failing when 202 of the 217 people sampled said withdrawing was the principal reason for their use of ATMs. Table 1 shows the average number of clicks required to perform common tasks on an ATM, even simply checking one's balance took 7 clicks.

Table 1 – Average number of clicks required for common ATM transactions – Cooharojananone et al (2010)

Task	Number of clicks required
Withdrawal	13
Balance inquiry	7
Transfer	25
Mobile Top-up	23
Credit card payment	25

ATMs are an important connection to the modern world. Therefore, banks have a moral duty to ensure that the most vulnerable in society, such as the elderly and illiterate, are able to operate them. However, there has been a tendency to assume all such groups have the same requirements, yet Rogers et al (1996) argue that "'older adults' are not a homogenous population; instead there is a range of individual differences that might influence ATM usage'". Their telephone survey of elderly users of ATMs found the lack of communication from machines to be particularly troublesome. For example, there would seldom be sufficient information on a transaction's receipt; the time would run out with no warning and feedback as to why a transaction failed would neither be clear nor detailed enough. Furthermore, Cooharojanone et al (2010) found the "design of the hierarchical menu structure is difficult to access", especially for those who find it challenging to rapidly assimilate a great deal of information. Unfortunately, there must be willingness from the banks themselves to improve accessibility, as in the case of ATMs "standards do not guarantee accessibility and accessibility does not guarantee usability" Coventry (2005).

In rapidly developing countries, where significant numbers of illiterate people are engaging in the banking system for the first time, there are even greater challenges. Thatcher et al (2007) point to "empirical evidence that certain groups of banking customers are resistant to this technology". Therefore, it may well be necessary to either offer a significantly altered user experience, or provide special training, if large numbers are not to be excluded.

Curran and King (2008) discovered that, along with designs that are not user friendly, the main drawback of ATMs was the time required to complete a transaction. Rogers et al (1996) agree, finding that if users wish to perform a second task, they are forced to re-enter their card. Their sample of 217 people, using five different types of ATM, found that 8% of customers were forced to re-insert their card more than once, the reason for 60% of which was to check their balance following a withdrawal.

Hendy et al (2007) identified the factors that contribute to a successful ATM experience. Other than accessibility for a wide range of users, they concluded that security is of paramount importance. The predominance of the PIN as the mechanism for interactions with an account proves it delivers an acceptable level of security. Yet they posit that in the future, additional security features, such as biometrics, may be required in order to mitigate the ever increasing sophistication of fraud. However, the tension between the desire for superior security and the need to maintain speed and ease of use will likely prove difficult to solve. Rogers et al (1996) suggest the sense of vulnerability the elderly often feel when using an ATM means it can be a stressful experience. The lack of any form of 'panic button' or discernible protection system of any kind must be addressed.

Observations from existing systems

The following evaluation of existing systems will draw upon task analysis, so as a better understanding of user requirements can be made. Task analysis is a framework that "provides a means of analysing the

describing the jobs and tasks people do" Atakan (2006). In addition, it will draw upon the five key components of usability put forward by Neilsen (2003), who defined it as "a quality attribute that assesses how easy user interfaces are to use". The components are as follows:

- ■ Learnability - the ease with which users are able to learn to complete basic tasks successfully
- ■ Efficiency - how quickly and accurately users can perform tasks
- ■ Memorability - whether users can remember how to operate it after their first encounter
- ■ Errors - the number of errors a user makes while performing tasks, how serious these errors are and how quickly the user can recover after an error.

Table 2 – Tasks involved when using an ATM

Task	Description
0	Withdraw
1	Check machine works
1.1	Look at status indicator
1.2	Look for card logo
2	Insert card
3	Enter pin number
4	Initiate withdrawal transaction
4.1	Select 'withdraw cash'
4.2	Enter amount
5	Select 'Check balance'
5.1	Observe amount
6	Complete the transaction
6.1	Take card
6.2	Take cash

 In order to actually understand all the user has to do when completing a certain operation, the task must be 'decomposed', that is, broken into its constituent operations. The resulting list is known as a plan. Below are the plans for withdrawing money and checking the balance.

Plan 1 (withdrawing cash): do 1; if possible do 2; repeat 3 until PIN correctly entered; do 4; do 6

Plan 2 (checking balance): do 1; if possible do 2; repeat 3 until PIN correctly entered; do 5; do 6

Plan	Machine	Time (seconds required)	Notes
1	1	28.1	When clicking on 'Cash', users are asked on a new page whether they would like a receipt, whereas machine 2 has a separate homepage button for each.
1	2	19.5	
2	1	25	Machine 2 required the user to press the 'enter' button, whereas machine 1 did not. This inconsistency is likely to confuse users and increase time required.
2	2	11	

Machine 1
Bank: HSBC

Clear flashing indicator of where to put the card

The exterior

Small keypad, despite ample room for a larger one

Dull, small and highly reflective screen

The 'home page'

Reflections make the screen difficult to read

Cash in big letters, but other options are hierarchical and have a lot of text

Buttons are large and clearly match an option

The cash withdrawal page

Logical denominations of cash.

Machine 2
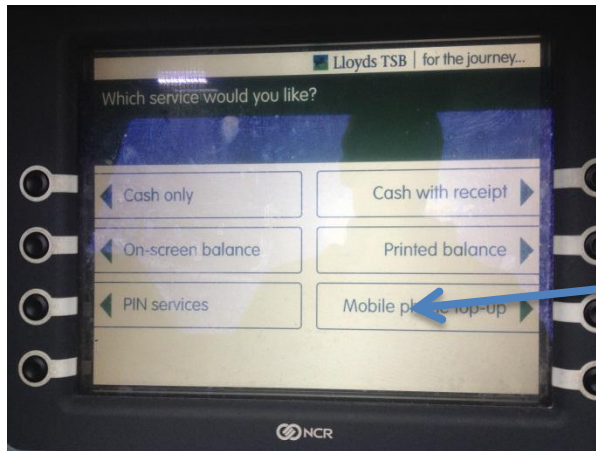**Bank: Lloyd's TSB**

The exterior

Small buttons

Large screen, with friendly imagery

Security message to reassure users

The keypad

Keys are compressed, but easy to read

A simple menu, but all options are the same size

Analysis of machines 1 and 2 using Nielson (2003)

- ■ Learnability – Both machines have crammed hierarchical menus, which is contrary to the assertion by Preece (1994) that a reduction in the 'cognitive load' of a system is essential – but the large 'Cash' button on the homepage of machine 1 is more effective than the more reserved withdrawal options of machine 2.
- ■ Efficiency – The larger, brighter screen of machine 2 is makes it easier to read the options. However, the need to press the 'enter' button after typing one's pin is likely to cause confusion.
- ■ Memorability – For withdrawing, because the option is on the top line, users will likely be able to remember it easily. However, for more complicated actions, unless repeated often, the user will likely have to relearn each time. Preece (1994) argues that, "it would be ideal if there was a universal ATM user interface design, or at least a standard design in each country".
- ■ Errors – The default response of machines to errors is to return the user's card. Should the user forget to take their cash, the machine will swallow the card, which requires the user to either go into the bank or make a phone call.

Summary

Results from previous empirical analyses, as well as our own observations, lead to the unequivocal conclusion that current ATM design is not fit for purpose. Systems fail to take the ways in which they are used into account, requiring an excessive number of clicks to perform even the simplest of tasks. Moreover, little discernible regard has been made for those users with an impairment of any description. For instance, their hierarchical and wordy menus mean a high proficiency in reading is a prerequisite for their effective use. In addition, failure to consider even basic aspects of usability, such as prevention of screen flare by reducing the tilt of screens, has resulted in poor user experiences.

Personas

In order to ensure the system we construct is suitable for those it is intended for, three distinct personas have been developed. Each of these represents a user with different requirements.

 Scenarios have been developed to identify the particular situations for which they will actually need the system. This will help determine where emphasis should be placed when creating the relevant user interfaces. Following the presentation of each prototype, an analysis and evaluation will be made in relation to how well they solve those needs peculiar to each of the user groups, both in general terms and for the requirements detailed in the scenarios.

 The rationale as to why each type of user was chosen is as follows:

 International student: As people living abroad are more likely to have greater need to manage their finances, they are thus generally heavier users of ATMs than domestic customers. Furthermore, the added need for clearer communication as a result of a potentially lower proficiency in English means extra focus must be placed on this vital area of design, something that will ultimately benefit all customers.

 Elderly – Rogers et al (1996) discussed the fact that the elderly are a heterogeneous group, with a wide range of physical and memory related impairments. As such, by solving their needs, the system will also be make suitable accommodations for a large number of disabilities.

 Busy working man – Whilst most 'average' people are not as speed focused as those with exceptionally busy schedules, by working hard to ensure the system does allow for efficient use, the experience for more standard users will be greatly improved.

The spider diagram below demonstrates a number of factors for each persona that affect how they use ATMs
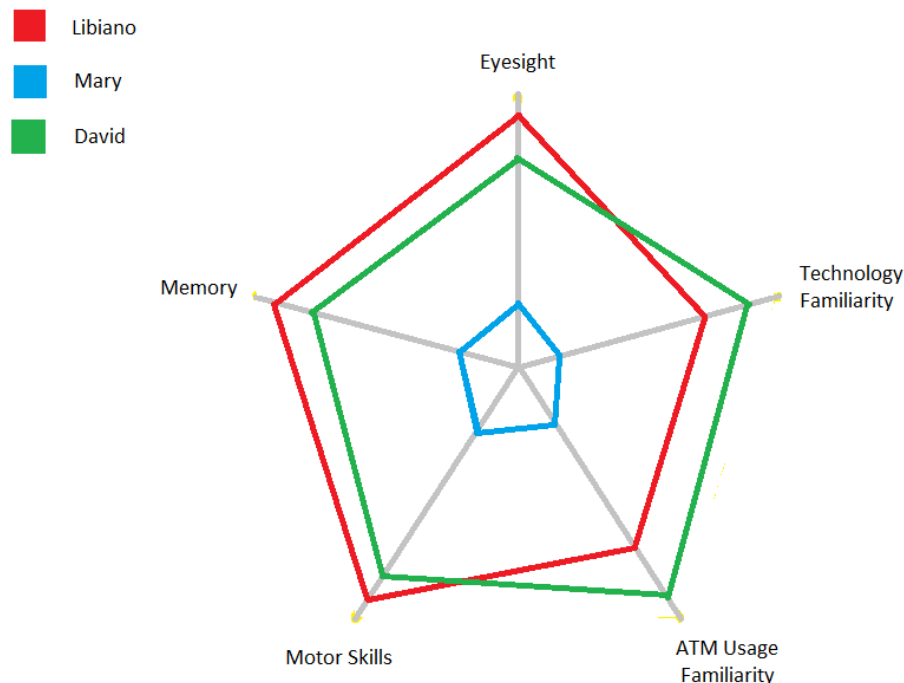
International Student

Libiano Forte

Background

Age: 23
Occupation: Student
Universiity: Birmingham

Main Points

- Lives on student loan, so tight budget
- Wants easy way to manage house bills
- Has difficulty with technical English

Goals

- Manage his finances easily
- Find the latest exchange rate
- Minimise ATM charges

Technology familiarity

ATM usage intensity

"I just want an ATM that doesn't punish me for not having a British bank account"

Description

Libanio is a 20-year old undergraduate student from Portugal. He came to the United Kingdom two years ago to attend the University of Birmingham. His parents believe that the opportunity to improve his English, whilst also studying at a prestigious university, will improve his prospects greatly.

He is currently in the second year of his studies and plans to apply for a scholarship in order to pursue postgraduate studies in History.

Libanio's parents live on a limited budget and have decided to send him only small amounts of money every week, so that he can cover his basic living expenses. When he arrived, Libanio decided to open an account in an English bank, however, the lengthy process, stringent document requirements and minimum deposit requirements led him to abandon the idea. As a result, he continues to use his Portugese account.

ATMs are the only way Libiano can receive the money his parents send him, as he does not trust wire transfers. As he gets charged whenever for each transaction, he prefers to withdraw enough to last him a whole week. He will normally do this on Fridays, after his lectures finish.

Scenarios

Libanio needs to pay for the internet in his student house. He is unfamiliar with the UK direct debit system, so wants to arrange recurring payments through the ATM.

Libanio's reads in the newspaper that Sterling has slid against the Euro. As he must constantly be careful with his money, any small change in the exchange rate can have a big impact upon his budget. He therefore wants to see the rate he will actually now receive from the bank.

Libiano has just arrived in Manchester train station on his way to visiting a friend. He needs to travel from the station to his friend's house, but can't afford a taxi. He has never caught a bus in the UK before, so would like a ticket before he gets on the bus.

Pain points

- Waiting long ATM queues.
- Often misreads menu options, so presses the wrong button.
- Every time he withdraws money he has to calculate the Euro equivalent.
- He cannot see his balance, as the ATM does not support online connection with Portuguese banks.
- Whenever he withdraws money from the ATM he is charged with a fee, about which the ATM does not provide detailed information.

Elderly

Mary Mason

Background

Age: 84
Occupation: Retired

Main Points

- Suspects she has early stage dimentia
- Poor manual dexterity and pain in fingers caused by arthritis
- Does not like paying by card, so carries cash whenever possible
- Feels exposed when using an ATM alone
- Inexperienced with graphical interfaces and so is unfamiliar with traditional menus

Goals

- Maintaince independence
- Easily withdraw cash for grandchildren
- To not have to go into the branch for basic transactions

Technology familiarity

ATM usage intensity

"I want the ATM to support me to be able to live on my own for as long as possible"

Description

Mary is 84 years old and lives alone since the death of her husband three years ago. She has two children and several grand children to whom she occasionally provides financial support. During her working life she accumulated a reasonably large amount of money which she now keeps in a high-interest savings account, separate from her money for day-to-day spending.

Mary goes to the supermarket once a week in a taxi to buy her groceries, she goes alone in order to maintain her independence. She also walks to a smaller local shop when she finds she has forgotten to get something. Before going in to the supermarket she usually withdraws £100 because she finds the screen and keypad of the ATM somewhat easier to use than those of the card machines at the tills.

Mary also uses the ATM to check her balance once a month, around the time that she is supposed to receive her pension money, in order to check that she has received the money. She occasionally combines this transaction with withdrawal of cash and is frustrated when she is forced to re-insert her card in order to accomplish both aims.

Scenarios

It is Mary's grandson's birthday tomorrow. She wants to withdraw thirty pounds to give him as a present.

Mary's memory has worsened recently. She has just selected to withdraw fifty pounds, but before the cash is dispensed, she forgets the amount. She wants to know if the money she has received the correct.

Mary is home alone and her family have gone on holiday. It is ten PM and she realises she has forgotten to buy anything for dinner. The only ATM she can reach on foot is down a secluded road, so she worries might be mugged when withdrawing cash.

Pain points

- Awkward typing her PIN and pressing options
- Menu options are too small for her to read easily
- She gets confused when she uses more involved functions on the ATM
- Feels intimidated when withdrawing cash

Busy working man (General user)

David Thomas

Background

Age: 27

Occupation: Management Consultant

Main points

- Is very career focused, often working from seven in the morning until eleven at night
- Has very little spare time, so wants his ATM visits to take as little time as possible
- Pays by card wherever possible, he usually only carries cash in case he needs to buy a coffee for a client
- Very experienced user of technology, so is well accustomed to learning new systems

Goals

- Minimise the interruption ATMs cause upon his busy lifestyle
- Spend as little time as possible queuing in ATMs
Be able to complete a wide range of transactions quickly

"I want the ATM to be invisible and have little impact upon my lifestyle"

Description

David graduated six years ago, since when he has being working for a prestigious boutique management consultancy in central London. His life revolves around work, which consumes the overwhelming majority of his waking hours.

David lives alone in a studio apartment, for which he must pay the bills. He currently manages his finances online, but would be happy to use the ATM to do more if it allowed for efficient payment.

David often has informal meetings with clients over coffee, for which he is required to pay. As his favourite independent coffee house does not accept card payments, he must always have enough cash to pay for up to five people. He currently commutes on the Underground, and so likes to use the ATMs near stations, so as to minimise the distance he must travel. However, he gets frustrated because currently, ATMs take so long to use that there are frequently long queues.

Scenarios

David is travelling to a business meeting in Manchester. He arrives at the train station with only a few minutes to spare, but the queue to buy tickets is very long. He remembers that the new style of ATMs from Global Bank allow for the purchasing of train tickets. So he rushes to the ATM to buy one.

It is 8:20am and David is running late. He has a client meeting a 9, but he still needs to catch the train. He has no cash on him, so needs to make a withdrawal very quickly.

David was forced to use his personal account to make an impromptu purchase for a client yesterday. He can't remember the exact amount he spent and so wants to see, without the need to print out his entire statement.

Technology
familiarity

ATM usage
intensity

Pain Points
-Long ATM queues
- Inefficient systems, that take a long time to use
- The sense that ATMs have been usurped by online banking, of which David is not an admirer, for all but cash withdrawing
- ATMs placed out of the way, so he needs to travel to them

First Prototypes

Overview

First prototypes are an essential means of identifying and evaluating potential designs in an efficient and affordable way. Their fidelity should be sufficiently high to convey the spirit of the mechanisms through which features will be operated, without requiring the development of time consuming minutiae.

Three prototypes are presented in this section, each of which has been described and analyzed. Through our personas, we have three clearly developed use cases, with different requirements. Therefore, the approach taken was to develop prototypes that were especially suited to solving the needs of a particular user group. However, those features that prove especially apt or unsuitable for the other personas will also be identified. Where appropriate, if the same feature appears across multiple prototypes, numerous potential designs will be created, so as to maximize the range of options to integrate into future iterations.

Nielson's ten usability heuristics will be used to determine the efficacy of the prototypes in relation to commonly accepted evaluation criteria. Mankoff et al (2002) argue heuristics are effective because of their "potential to provide quick, inexpensive feedback about the possible issues". However, they caution that, without further empirical analysis, heuristics analysis "does not help to identify which of these issues are real problems and will have a measurable impact upon usability". Yet, of the seven inspection methods identified by Nielson (1994), heuristics are the most suitable for first generation prototypes due to their ease.

In addition to evaluating the prototypes according to Nielsen's heuristics, any usability issues identified will be assigned a severity rating in order to give an idea of which are the most pressing problems at this stage. Nielsen (1995) writes that severity ratings are crucial in solving usability problems as they give a definite value which can be used to prioritise problems and thus simplify decisions about where to allocate resources. They will be used here; both to identify the features that should be removed and those that should be carried forward. Nielsen's severity ratings, along with their respective meanings, are as follows:

Severity Rating	Meaning
0	I don't agree that this is a usability problem at all
1	Cosmetic problem only: need not be fixed unless extra time is available on project
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority
4	Usability catastrophe: imperative to fix this before product can be released

Prototype 1

Tool used: Adobe Photoshop
Primary target group: International students

Rationale

As exemplified by Libanio Forte, international students require much the same banking service as their domestic counterparts, albeit with the additional need for the easy facilitation of currency conversions. Those international students who have studied in the UK for a prolonged period, in particular, will likely need a similar range of transactions as home customers. As such, key decisions as to the layout and flow of transactions will be transferable to more general versions.

Page 1 – pin entry

Central to the design philosophy of this prototype was the desire for crisp, vivid colours. The high contrast between the deep purple background and large, bright buttons draws the user's attention to the key inputs. Fitts's Law confirms the intuitive assumption that the speed required to click a button is a function of its size and distance from the user. Therefore, the OK button has been made large and is as central as possible.

PIN entry is handled by a pop up on-screen menu, before the user touches the appropriate button.

The Process:

Upon pressing the OK button, the user is either:

1. Taken to the 'hub' page, if the PIN was correctly entered
2. Allowed to reenter their pin up to two more times, after which the system will place a block on subsequent transactions. All the contact details to reinstate their card will be displayed on the screen.

The layout is minimalistic and spacious, with no superfluous information. All text is clear and easy to read.
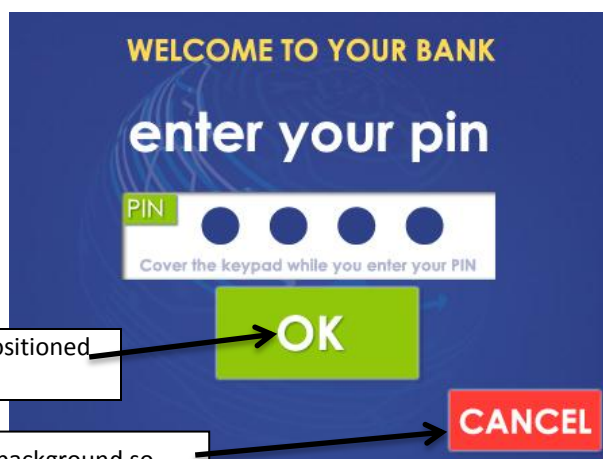
The OK button is large and centrally positioned

The CANCEL button contrasts with the background so that it is easily identifiable by the user.

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Page 2 – the 'hub' page

This page has replaced the ineffective hierarchal menu style of current ATMs with a 3 x 3 grid layout. As Libiano confirmed, many international students wish to use a wide range of services through their ATM. Therefore, the design below contains a wide array of novel features, including:
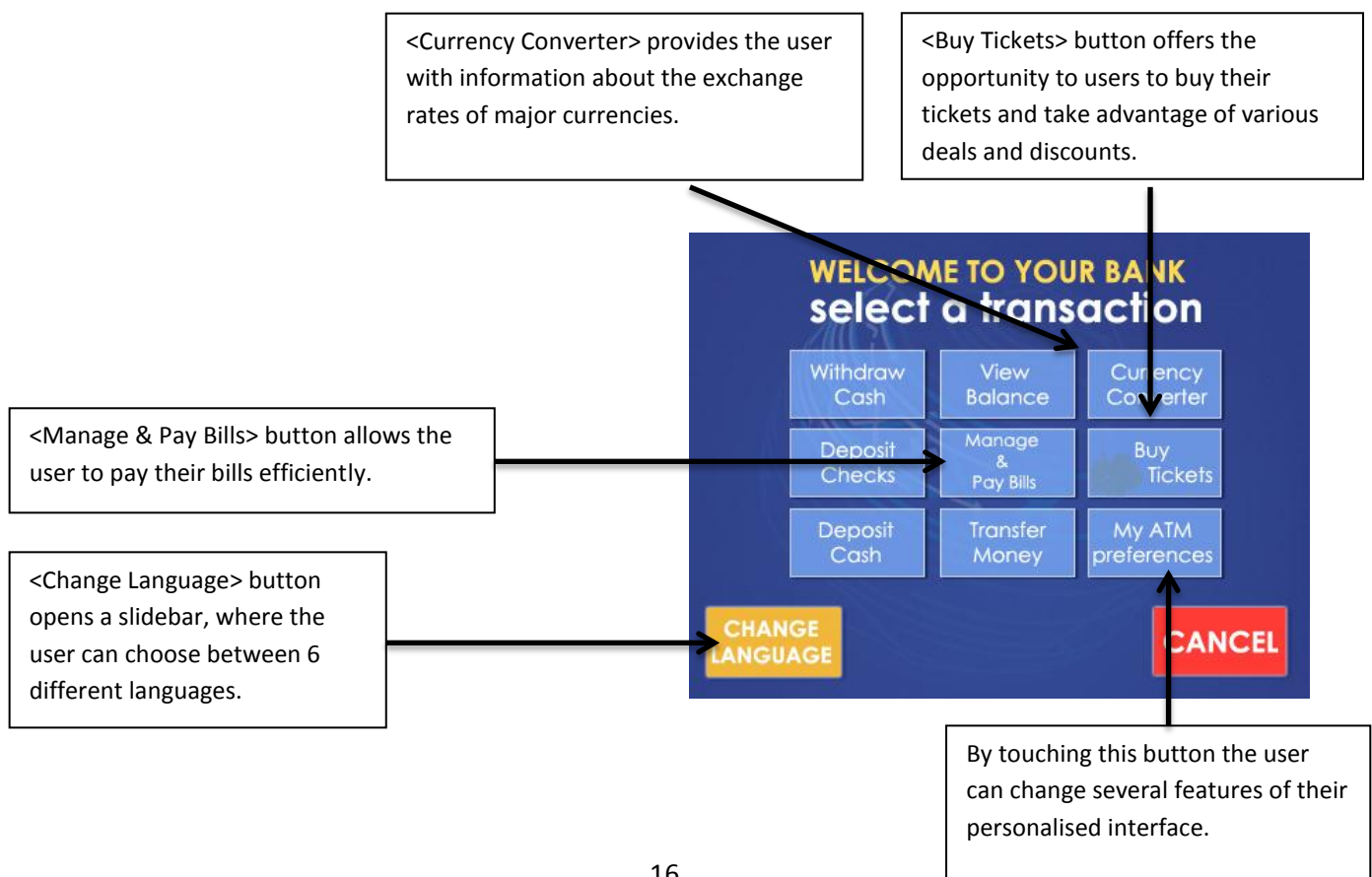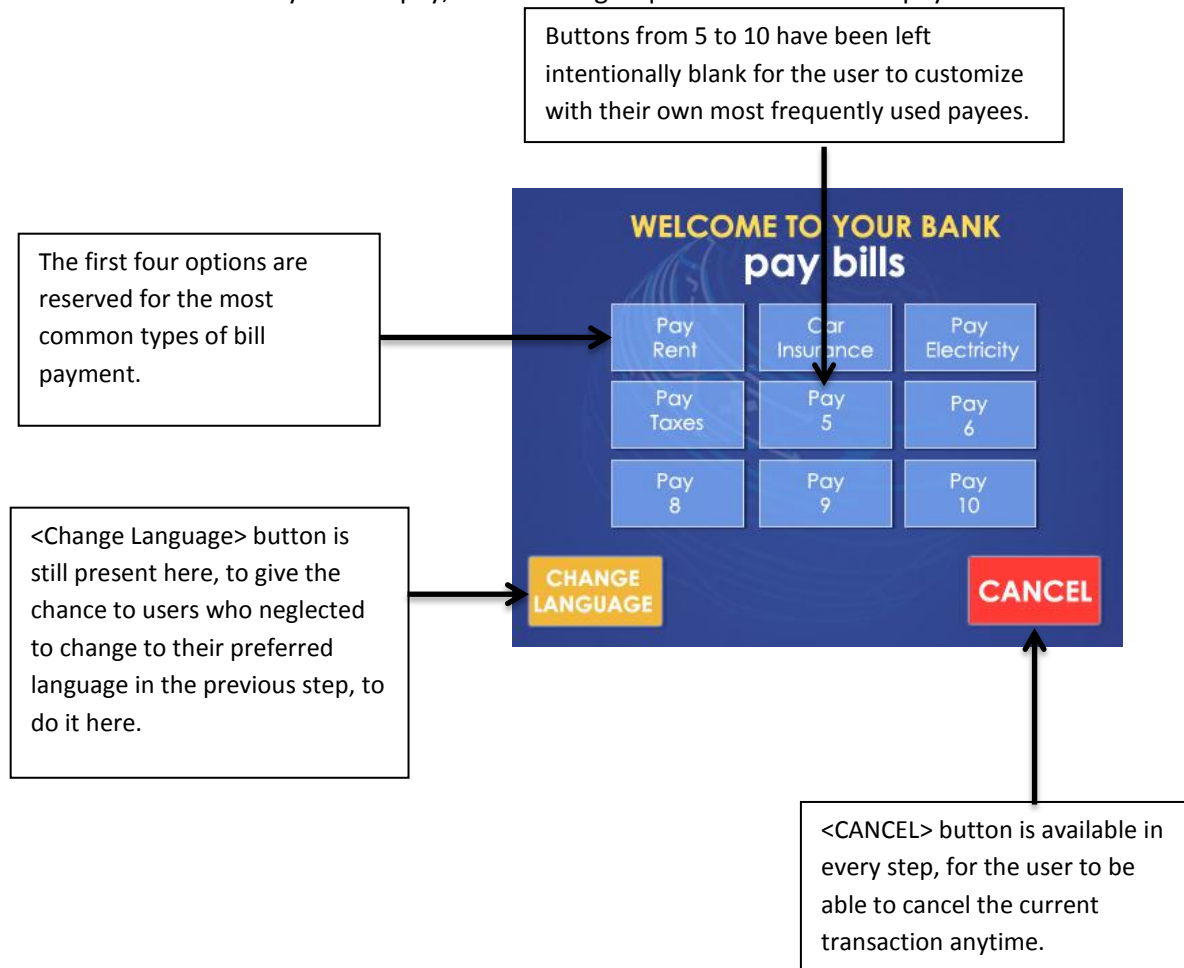
- Exchange rate checking – the user is able to confirm how much a given amount will be worth in another currency. Key global currencies are covered and when the system loads new data, the user is updated as to its progress.

- Manage and pay bills – users are able to save frequently used payees on the 'ATM preferences' page. These then simply need to be clicked to send a payment. Both transfers to individual bank accounts, such as that of a landlord, and direct debit payments can be managed.

- Buy tickets – this attempts to improve the relevancy ATM machines have to users' lives, by allowing them to save time and money. A significant proportion of ATM visits occur immediately prior to using public transport, meaning there is great potential to reduce the time required to purchase tickets in a station. Finally, this feature will be enhanced by offering deals and discounts from the ticket issuing organizations.

<Currency Converter> provides the user with information about the exchange rates of major currencies.

<Buy Tickets> button offers the opportunity to users to buy their tickets and take advantage of various deals and discounts.

<Manage & Pay Bills> button allows the user to pay their bills efficiently.

<Change Language> button opens a slidebar, where the user can choose between 6 different languages.

WELCOME TO YOUR BANK
select a transaction

Withdraw Cash	View Balance	Currency Converter
Deposit Checks	Manage & Pay Bills	Buy Tickets
Deposit Cash	Transfer Money	My ATM preferences

CHANGE LANGUAGE

CANCEL

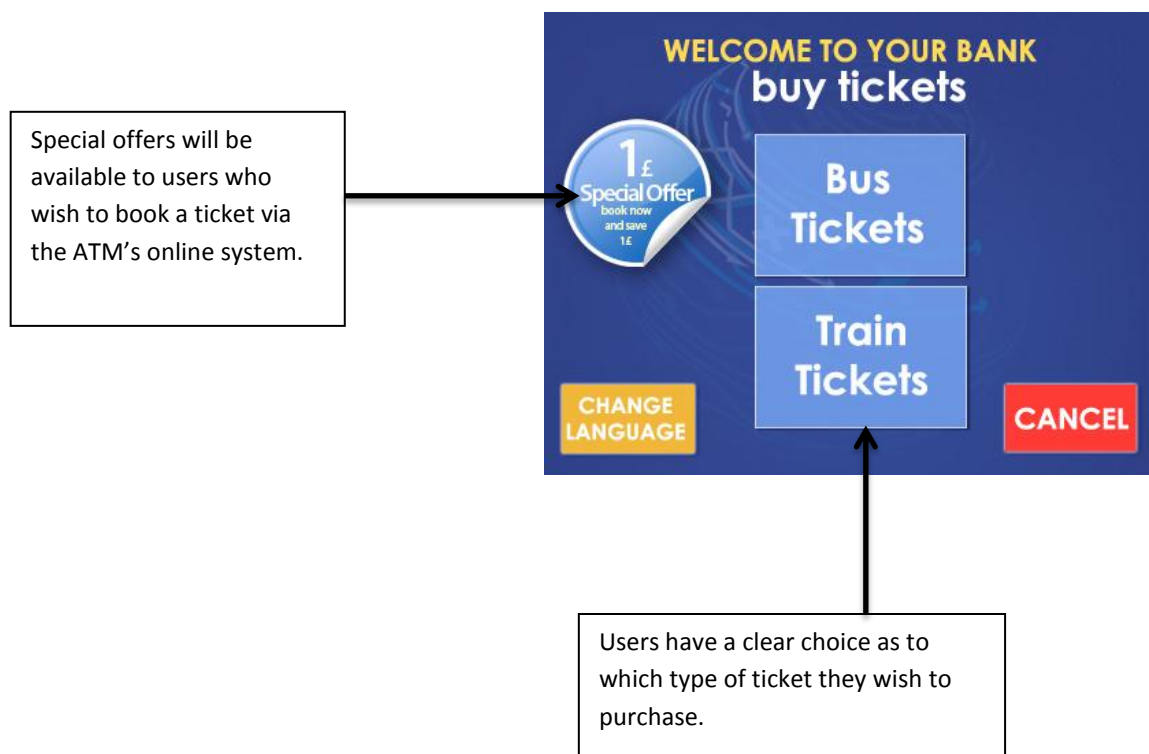By touching this button the user can change several features of their personalised interface.

Page 3 – the 'Manage & Pay Bills' page

The following interface is designed to allow for the efficient payment of bills. The four most common payment types have reserved buttons, whilst the remaining five slots can be personalised through the 'ATM preferences' option. Upon touching a recipient, the user will enter the amount they wish to pay, before being required to confirm the payee and amount.

Buttons from 5 to 10 have been left intentionally blank for the user to customize with their own most frequently used payees.

The first four options are reserved for the most common types of bill payment.

WELCOME TO YOUR BANK
pay bills

Pay Rent	Car Insurance	Pay Electricity
Pay Taxes	Pay 5	Pay 6
Pay 8	Pay 9	Pay 10

CHANGE LANGUAGE

CANCEL

<Change Language> button is still present here, to give the chance to users who neglected to change to their preferred language in the previous step, to do it here.

<CANCEL> button is available in every step, for the user to be able to cancel the current transaction anytime.

Page 4 – the 'buy tickets' page

In this step, it is assumed that the user has pressed the <Buy Tickets> button on page 2. The ATM provides for the purchasing of bus and train tickets within a pre-designated locality. Upon choosing the type of ticket, the user will be taken to a standardized purchase page that can amalgamate data streams from multiple sources.

Special offers will be available to users who wish to book a ticket via the ATM's online system.

Users have a clear choice as to which type of ticket they wish to purchase.

Evaluation of prototype 1

Many of the concepts detailed have great potential, yet much refinement will be necessary to ensure they are sufficiently simple to use. Indeed, the depth of features offered is both its greatest strength and weakness. For instance, innovative functionality, such as the ability to purchase tickets for local transport, has the potential to make the ATM once again relevant to modern life. However, it is clear greater consideration must be paid to the feasibility of such designs as, for example, without a cheap and reliable way to print tickets, it is of little use.

What follows is an evaluation of the key elements of the prototype, guided by Nielson's ten usability heuristics. Whenever possible, analysis has been made in relation to a particular persona. Following this, an evaluation as to how the prototype solves the scenarios for each persona will be made, before an identification of key recommendations for future iterations.

Heuristic	Severity	Discussion / ways to solve
#1 – Visibility of system status		
No provision for dealing with Internet reliant features when the connection is disrupted	**4**	Requiring a constant Internet connection offers numerous benefits, but it also increases the need for the system to degrade gracefully when problems arise. Two techniques could be deployed to ensure this: 1. The removal of menu options requiring the Internet when the connection is lost 2. Retaining the options, but upon being clicked, provide clear feedback as to why the feature is unavailable and, where possible, suggest appropriate alternatives For future versions, the former would be inappropriate, as it may cause confusion, particularly for technologically inexperienced users, if menus change between sessions without explanation. In addition, the second option enhances communication between the system and the user.
Clear status updates of the time required for loading online services such as real time currency conversion are displayed	___	To be useful in practice, predictions as to the time required must be accurate. Furthermore, as the majority of loadings are likely to require less than two seconds, a small symbol should be created, since a message will not be required.
#2 – Match between the system and the real world		
'Change language' button in English	**3**	Whilst international students are likely to be sufficiently proficient in English to understand, many tourists will not. Furthermore, the button is large and vivid, but is not visually stimulating enough to draw attention without requiring cognitive processing.
Overly long descriptions of options, with ineffective division of services	**1**	It is superfluous to have both 'deposit cash' and 'deposit cheques' options; rather they should be merged, with automatic detection of the type. Moreover, words with multiple accepted spellings, such as cheque, should be spelt in the local way. This is especially important for international users who are more likely to be unaware that they mean the same. Most of the home screen options contain unnecessarily long descriptions, a single word

		would suffice. Examples include writing 'cash' instead of 'withdraw cash' and 'balance' instead of 'view balance'.
Incorrect use of '£' sign for special offer on buy tickets page	2	Users are offered a '1£' special offer. This ignores the accepted standard of writing prices in the UK and is likely to grate, even for those international customers whose countries display their currency in such a way.
Excessive repetition of words	1	The 'Buy Tickets' page, for instance, contains the word 'ticket' in the title, and on every option button. It is sufficiently clear from the context to be able to drop the repetition of the word 'tickets' on the buttons, even for those with only basic proficiency in English.
#3 – User control and freedom		
No way to return to the homepage from subsequent pages	3	This flaw is worsened by the customisation available through the 'ATM preferences' page, as users will undoubtedly wish to return to view the impact of their changes upon completion. In addition, the large number of steps required for transactions such as the purchasing of tickets increases the likelihood of mistakes being made.
A clear 'cancel' button available on every page	___	However, whilst clear, it may be unnecessary and ignores the familiarity most users have with a keypad-based cancel button.
#4 – Consistency and standards		
Interface will be familiar to those accustomed to existing ATM's	___	Wherever possible successful mechanisms of existing ATM's were kept, although built upon. For example the PIN entry system maintains the style of current machines, albeit in a more user friendly way.
Inconsistency of text on buttons – of capitalisation and repetition	1	- On the 'Pay bills' page, most options include the word 'pay', but the car insurance does not. - Throughout, whenever an option has multiple words, each has its first letter capitalised. However, this is not the case on the 'My ATM preference' option.
#5 – Error prevention		
Users are given lots of wordy options, with no clear explanations	3	Features such as the 'Pay bills' page provide advanced functionality, yet there is no clear on-screen explanation as to how they work.

#6 – Recognition rather than recall

Too many options on many pages	**2**	This undermines learnability, as it is likely users will need to spend a great deal of time finding the option they require.
Font is relatively small and low contrast	**2**	As well as being unsuitable for those with poor eyesight, it will worsen the difficulty international students face if their language is not provided as an option.

#7 – Flexibility and efficiency of use

'Pay bills' page already has the four most common payment options predefined, with more able to be added	**___**	This improves the speed with which users, novice and advanced alike, can complete involved transactions. Those comfortable with the system can also assign their most frequently used payees to further options, allowing experienced users to use the system more efficiently.
Counterintuitive mechanism to add frequent payments	**3**	Too cumbersome to have to do this on a separate 'My ATM preferences' page. It is vital that greater emphasis be placed on usability rather than functionality. If no better means of customisation can be found, the functionality ought to be dropped.

#8 – Aesthetic and minimalistic design

Strong background colour	**___**	Allows buttons and titles to clearly stand out, especially important for those with poor eyesight.
Low contrast between the colour of the option buttons and their text	**2**	Increases the likelihood of text being missed

#9 – Help users recognise, diagnose and recover from errors

As yet, not clear means of informing the user of specific issues	**2**	Display clear descriptions on-screen of errors encountered and concise steps of possible ways to remedy or work around the problem.

#10 – Help and documentation

Not applicable for ATM

	Mary Mason - retired	Libiano Forte – International student	David Thomas – Working man
Scenario 1	Withdrawing cash	Arrange recurring payment for house bills	Seeing previous transactions on screen
Score	3	6	N/A
Reason	Apart from the login screen, the design makes no attempt to assist those with sight issues. She struggles with the low contrast and small buttons on the home page. However, although she can't properly read the 'withdraw cash' button, she is able to find it because of its position in the top left corner.	Although the provision does exist – the clumsy way in which they need to be assigned confused Libiano as he must go to a separate preferences page, which is not explained. Furthermore, as his English is not fantastic, he lacks the capacity to freely explore to discover the functionality	This prototype fails to provide this functionality
Scenario 2	Checking amount received is correct	Checking the exchange rate of euros/pounds	Quickly buying train tickets
Score	N/A	7	7
Reason	No system for displaying the amount after selection was designed – although it would likely provide a message saying to take your cash.	The wording of the 'currency converter' option means he is not sure if this lets him actually receive Euros or, as he requires, just find the exchange rate. However, upon clicking it, it is straightforward for him to use.	He is able to quickly locate the page required to book train tickets. However, the lack of integration with the nearest train station means the system fails to suggest the most likely destination.
Scenario 3	Feeling secure	Buying train tickets	Making a fast withdrawal
Score	1	8	6
Reason	Apart from the standard secure PIN, no	He is able to easily find how to buy the tickets,	Whilst he is able to make a withdrawal quickly, it is not

	mechanisms were implemented to allow her to feel safer when using the machine	as once on the correct page, the buttons are large and clear	faster than he would be able to on his existing ATM
Overall			
Score	2	7.5	6
Reason	The difficulty Mary has with reading the main options menu means it is almost unusable for her	Whilst it fulfills the requirements of Libiano's scenarios effectively, the large amount of text on the option buttons make it difficult for him to read.	This prototype was not built for speed and it is therefore not particularly suited to David. It seems unlikely he would choose it if given a number of alternatives

From this design, the following features will be considered for taking forward in to the next generation prototype:

Feature	Reason
Prominent cancel button displayed throughout transaction	Makes it clear to the user that they are able to change their mind about a transaction at any time – useful for all kinds of user
Prominent change language button	Reassure international users, who may be intimidated by a dense English display, that they are able to switch at any time to their preferred language
Simple PIN entry screen	Displays no more information than is necessary and provides clear indication of what is expected of the user
Rich features, such as purchasing of tickets, currency conversion	
The general aesthetic	The look and feel of the background was effective

Prototype 2

Tool used: Balsamiq Mockups
Primary target group: The elderly / illiterate

Rationale

Although they constitute a very small proportion of total users, those with difficulty reading, memory or mobility require specific features in order to effectively use any system. Therefore, the aim of this prototype was to develop ideas to make the system as accessible as possible. An emphasis was placed upon making the interface both as simple and as visual as possible.

Page 1 – Home page

An assumption was made that for more complex banking transactions, such as fund transfers, so-called 'vulnerable' users would require the assistance of a human teller. Therefore, only those options deemed to be essential are available. However, as these are the only features such users are likely to wish to use for the overwhelming majority of time anyway, the system would still satisfy their requirements. Both the 'withdraw' and 'balance' buttons are large and have images showing what they do, for the semi-literate. Furthermore, a large 'eject' button, with a picture of a card being ejected is displayed at all times in the top right hand corner. Whilst on a standard ATM keypad the red button 'cancel' is easily visible, its precise function may be confusing.

In order assist those with memory, but not reading issues, a 'breadcrumb' trail, reminding the user of both which steps they have completed and where they are currently is displayed at the top of the screen. If they wish to return to a previous stage, they need only click on the appropriate label.

A clear finding of the Rogers et al (1996) report was that elderly people in particular often feel threatened whilst using an ATM. In order to mitigate this, there is an ever-present and clear panic button. This will automatically swallow the user's card, so preventing a forced cash withdrawal. In addition, the relevant authority, either the bank's own security, or the police would automatically be informed.

Should the user wish to turn off accessibility mode they can do so. This option is clearly displayed in the bottom left corner and the fact it is in no way visual does not matter since only those able to read fully would require it anyway.

A 'breadcrumbs' trail makes it clear precisely how far through the process the user is, so those with rapid memory loss will be able to always know what they have to do, and where they have come from.

This 'eject' button allows the user's card to be returned at any time, in a large, visual way

Step: Choose transaction

Eject

Withdraw Balance

You have:
£xx

Options are big and have images, so even those unable to read can use the ATM. Functionality is cut down to the minimum

Accessibility mode: ON
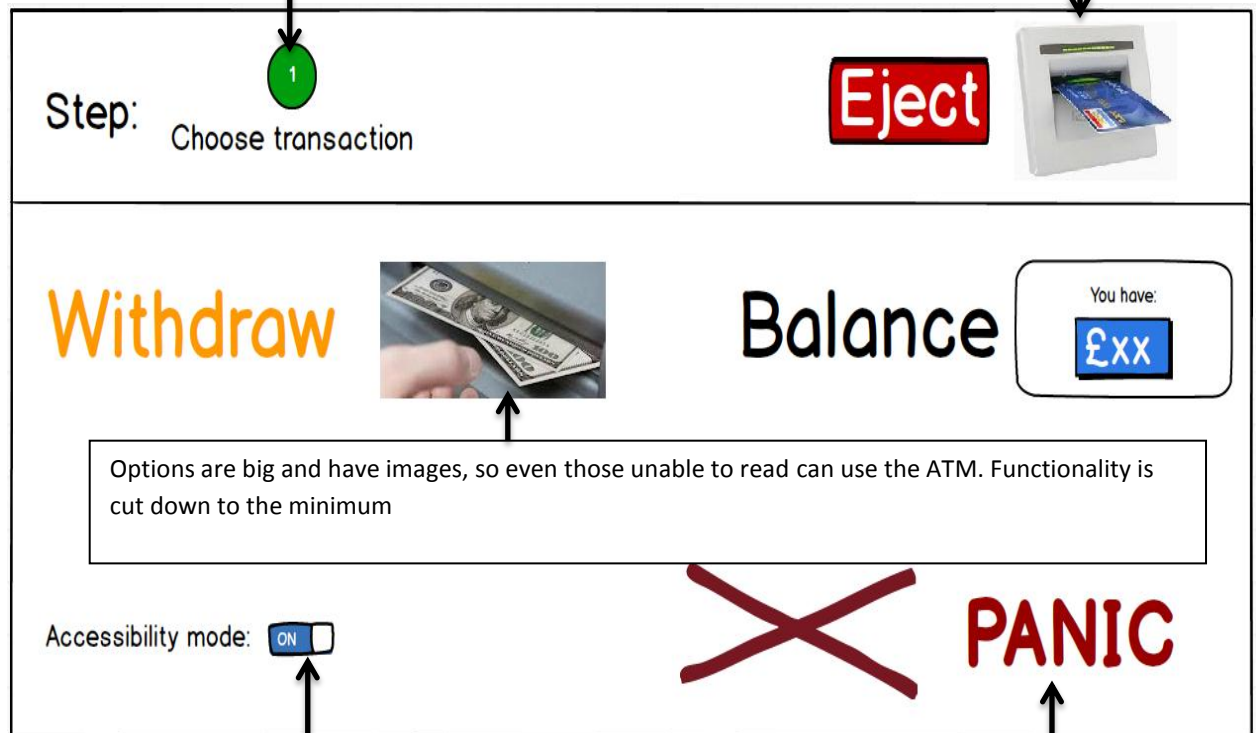
PANIC

'Accessibility mode' can be switched on or off, this reverts back to a more fully featured version, with more options.

A big issue for elderly ATM users is feeling scared whilst using ATMs. This panic button will close the transaction, swallow the card and call either the police or the bank's security

Page 2 - Withdrawal

Numerals alone, which although understandable by all but a tiny fraction of even the most vulnerable of users, may not be sufficient for those who can no longer associate a particular note with a value. Therefore all denominations are shown in terms of the notes they are comprised of.

The user can just touch this button to return to the previous page

Amounts are shown using actual notes, so as to make it clearer for illiterate people
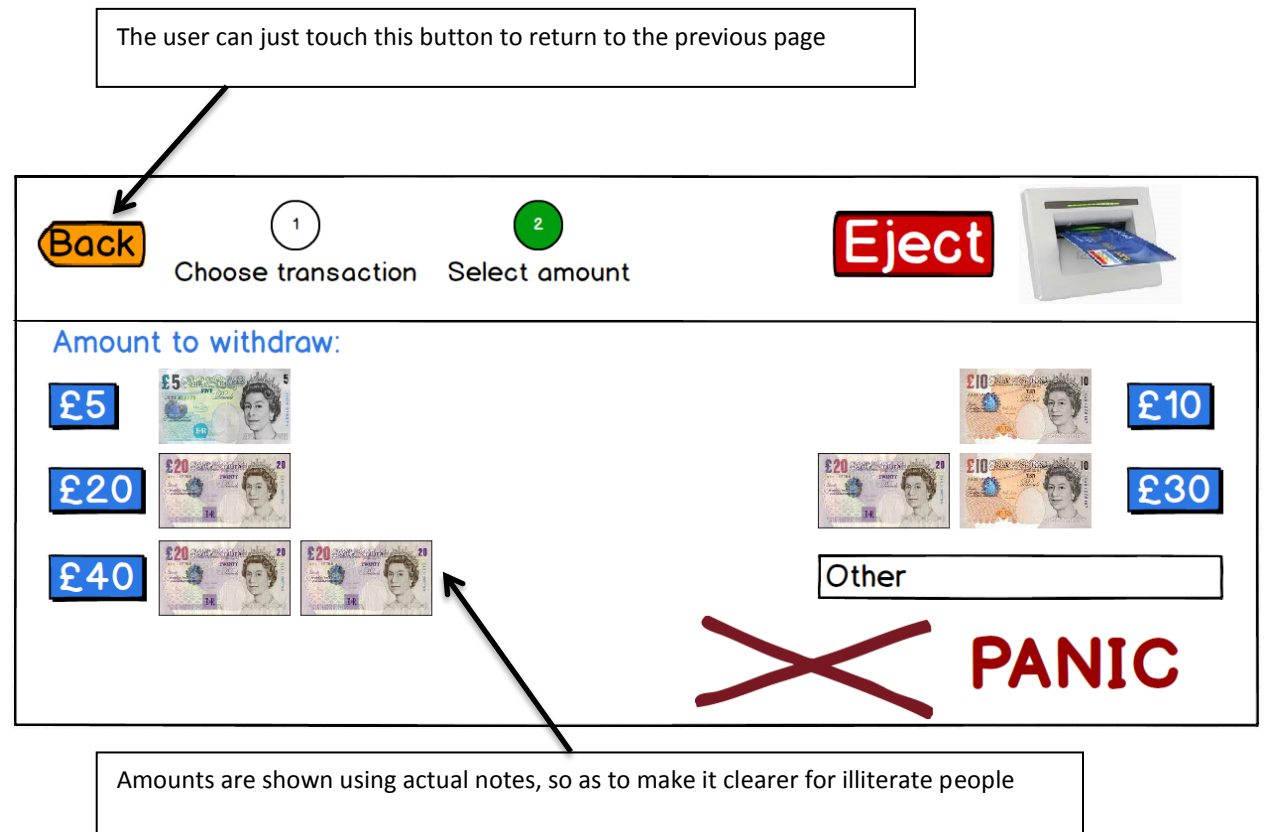
Page 3 – Take cash page

The exact notes the user should expect are displayed, so that those with memory issues do not forget how much they selected to withdraw and so are not able to confirm they received the correct amount.

When the user is given their cash, they are shown pictures of what notes to expect, so users with a poor memory or poor mathematical skills can be sure they receive the correct amount of money
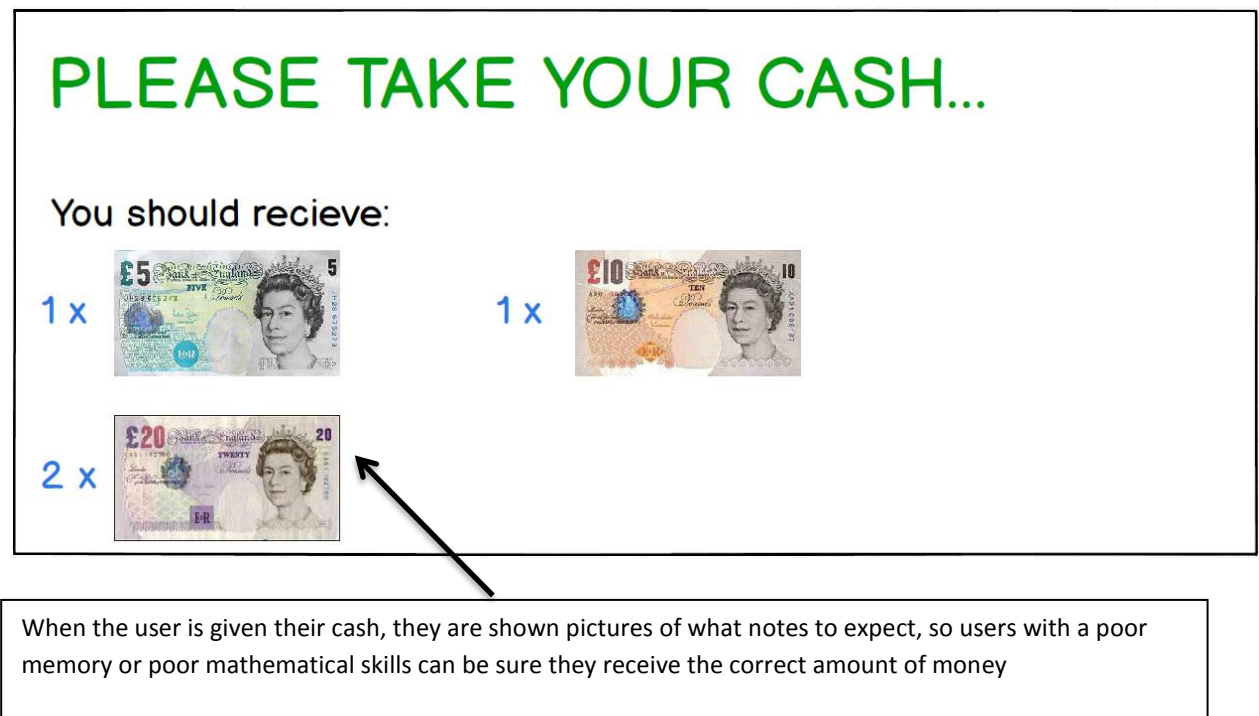
Evaluation of prototype 2

This prototype was effective in the sense that it met the requirements for its target group of users. However, due to the limitations imposed by the constrained scope of this project, the best features of the prototype will have to be assimilated into a final, 'standard' interface, as opposed to a dedicated accessibility mode.

The clear pictures and breadcrumbs trail aid both the learnability and memorability of the system. Furthermore, the reduced functionality means even those users with the least comfort using technology would be able to interact with it.

The biggest weaknesses of this system are in the form of security. The panic button, on the face of it, would seem to reduce the risk of theft. However, the user's card being swallowed may well anger the assailant, increasing the potential risk of violence. In addition, a message being sent to the police could panic them, potentially leading to more volatile behaviour. A better solution to the problem of feeling threatened would simply be the placing of ATMs in more open and busy areas, where the thief is likely to be put off by the passing footfall. Finally, the 'take the cash' page, whilst innovative and effective could prove to be a security

risk. For future generations of design, it may be wise to have a button users can press to see the cash they should receive only if they are sufficiently comfortable with their surroundings.

Heuristic	Severity	Discussion / ways to solve
#1 – Visibility of system status		
How users are informed the system is down has not been designed	**4**	- Elderly users might become distressed if the ATM is out of order - Semi-illiterate people will need to be told in a visual way Considering both of these requirements, an effective solution would be to include an interactive map, with clear instructions about how to travel to the nearest available ATM (such as a photo trail).
#2 – Match between the system and the real world		
As few words as possible, each of which has a clear function	___	Whenever possible, actions are described using just a single word such as 'withdraw', 'panic' or 'eject', alongside an image that represents it. This will be most helpful to users who have trouble reading complex words.
#3 – User control and freedom		
A breadcrumbs trail that makes it clear precisely the steps the user has taken to reach this point	___	However, because it involves a lot of relatively small text, it will be ineffective for users with, for example, poor eyesight.
#4 – Consistency and standards		
Interfaces and input mechanisms will be familiar to those who have used ATM's before, but in a more accessible way	___	The cash withdrawal page conforms to the norms of ATM design, in that it has clear choices laid out in a logical way. However, it also shows the user a representation of the amount in cash. Whilst this is helpful in aiding vulnerable users, without synchronization between the interface and the actual notes the machine will provide it could lead to confusion if the user is not given what they expect.
#5 – Error prevention		
Before dispensing cash there is a page to confirm the user is sure they have selected the correct amount	___	This prevents a mistake that could distress elderly users, in particular
#6 – Recognition rather than recall		
Reduced number of pages, with few options and lots	___	Ensures learnability as users need not think about what they are going to click

of images		
#7 – Flexibility and efficiency of use		
'Accessibility mode' can be turned off	**2**	The current 'on/off' slider does not sufficiently protect against accessibility mode being accidentally turned off
#8 – Aesthetic and minimalistic design		
Whilst each option is large and clear, some pages are too busy	**2**	By making each button stand out, by using different colours and large font, the user is drawn to too many features at once. This may be somewhat overwhelming for some users and may point to a need for the inclusion of fewer options
#9 – Help users recognise, diagnose and recover from problems		
Much communication between the machine and the user	___	Upon making an error, a clear description is displayed. Furthermore, the receipt for each transaction documents everything in a simple to understand way
#10 – Help and documentation		
Additional training	___	Other than clear instructions when using the ATM, such a system should be deployed in conjunction with a proactive training programme, so as to ensure adopters can maximise the benefits it offers

	 Mary Mason - retired	 **Libiano Forte – International student**	 **David Thomas – Working man**
Scenario 1	Withdrawing cash	Arrange recurring payment for house bills	Seeing previous transactions on screen
Score	10	N/A	N/A
Reason	The large text of the 'withdraw' button, along with the image of cash being taken out means she can easily move to the correct page. The pictures of the cash amounts mean she can visualize what she needs	see reason for overall	see reason for overall
Scenario 2	Checking amount received is correct	Checking the exchange rate of euros/pounds	Quickly buying train tickets
Score	9	N/A	N/A
Reason	When she receives her cash, she can simply check that it matches the combination on screen. Therefore, the consistency between what is stated and what is delivered is essential. The details remain onscreen sufficiently long for her to be able to check.		
Scenario 3	Feeling secure	Buying train tickets	Making a fast withdrawal
Score	6	N/A	N/A
Reason	Although the PANIC button means she does know she can take a proactive action in the event of an emergency, she		

	does worry it could lead to a greater threat of violence against her.		
Overall			
Score	8	N/A	N/A
Reason	The visual elements, easy navigation and simple interface serve to reduce the stress Mary experiences when using ATMs. She feels it matches her banking requirements, in that she wishes to be able to use the ATM for quick transactions, but will still use a teller for other services.	Although this is an accessibility version, Libiano would never actually use it, there are design principles that could assist him if implemented. The reduction of text to a minimum, along with the images, would speed up his use of a system as his reading speed in English is low	Same as with Libiano. However, in addition, the clear buttons will speed up the speed of navigation.

From this prototype the features that will be taken forward to the next generation prototype are as follows:

Feature	Reason
Clear indication of what the 'eject' button will do	Some users may not expect a 'cancel' button to eject the card, an 'eject' button will avoid this potential problem
Visual representation of the amount of cash that the user should receive	Allows the user to visualise the money they will receive and makes it easier to check that the machine has dispensed the correct amount.
Images attached to menu options	Minimize the need for users to spend time thinking about what a button will do
Most common transactions given more screen real-estate	Minimize the time that a user spends looking for their required function

Prototype 3

Tool used: Pencil Project
Primary target group: General, making the most of new technology

Rationale

As technologies such as touch screens and biometrics have become cheaper; it has become more feasible to incorporate them into ATMs. However, as with all hardware, there is little point in spending money to include them without first developing software that capitalizes upon the advantages they afford. Therefore, this prototype will demonstrate some of the potential interface layouts that could be used to improve the user experience by employing such technology. The prototype will be aimed at general ATM users.

Page 1 – identification confirmation

Biometric technology has long held a niche position in consumer technology, being used to secure laptops and PDAs. It is now gaining traction in such places as member's clubs, for instance EasyGym uses a palm scan as opposed to a card to let members in. The system will have a palm reader, rather than a keypad. Upon inserting their card, the user will be prompted to scan their palm.

Page 2 – withdrawal page

As Curran and King (2008) found, the vast majority of ATM users wish only to withdraw cash. Therefore, rather than having a distinct home page, this prototype takes the user directly to the cash withdrawal page. However, there is an ever-present side bar, with the

most common functions – withdrawal and checking balance, along with an eject button. If the user does wish to use a more advanced feature, they click the options button, which will take them to a page with more functions.

Rather than the standard predefined amounts, the user simply taps the bank notes that they wish to withdraw. This makes use of the touchscreen to deliver an innovative interface.

The current page is coloured green, with a star next to it.

The user taps the notes they wish to withdraw, they are then added to the total so far section below

These are the notes the user has already selected to withdraw. The red 'X' indicates that if the user clicks on one of the notes, they will be removed from the total
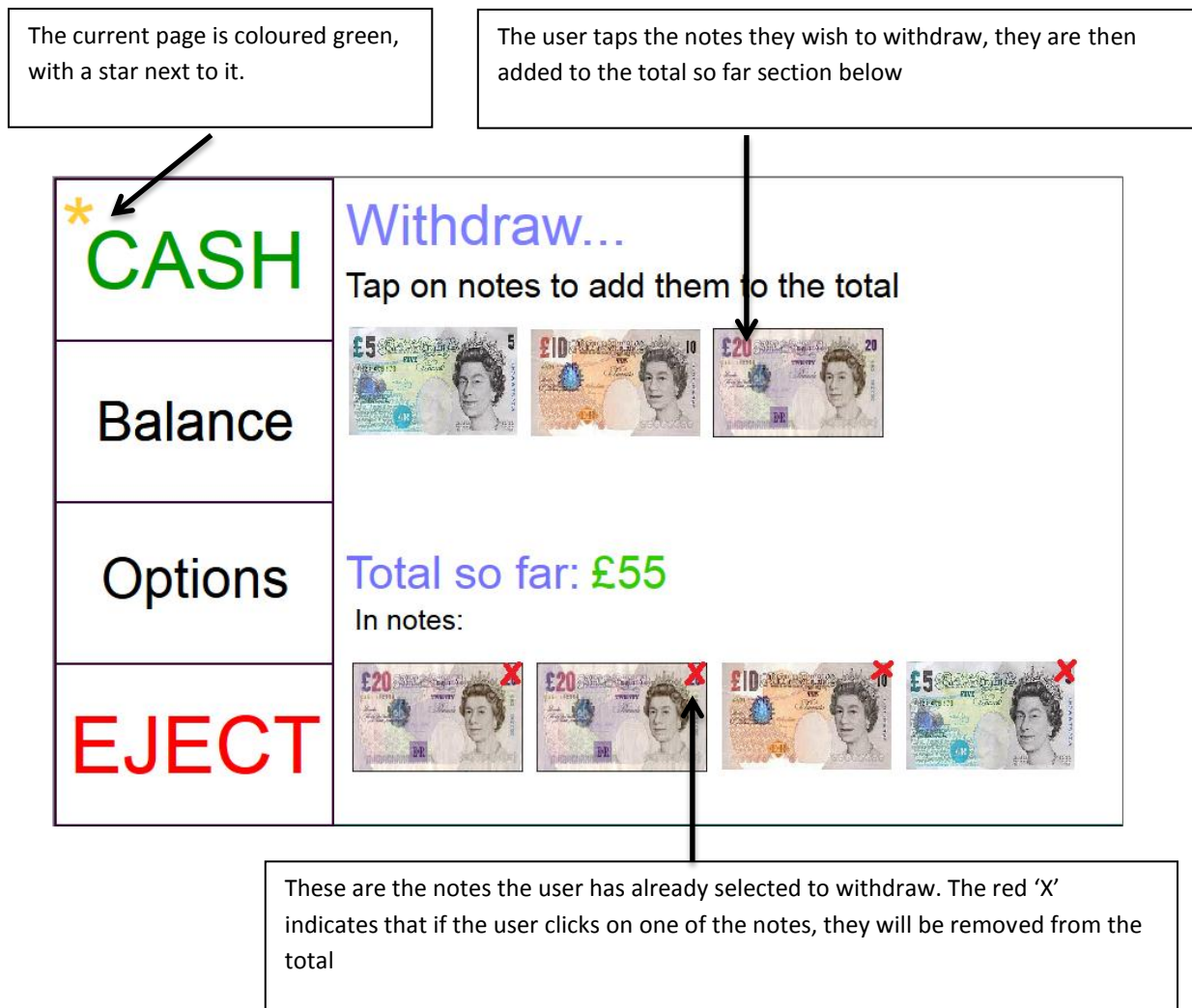
Page 3 – Check balance page

It is common for bank customers to wish to inspect previous transactions, so as to be able to confirm there has not been any fraud, as well as to track their spending.

Bright, clear balance shown

CASH

* Balance

Options

EJECT

You have:

£250.34

Your last 5 transactions

1 £10 @ 17:51 on 20/01/2013- Sainsbury's

2 £22 @ 10:27 on 19/01/2013- McDonald's

3 £97 @ 13:22 on 18/01/2013- Amazon

4 £5 @ 11:14 on 18/01/2013- Travel West Midlands

5 £7 @ 10:47 on 14/01/2013- Waitrose

The user is shown their last 5 transactions – displaying amount, time, date and recipient / sender
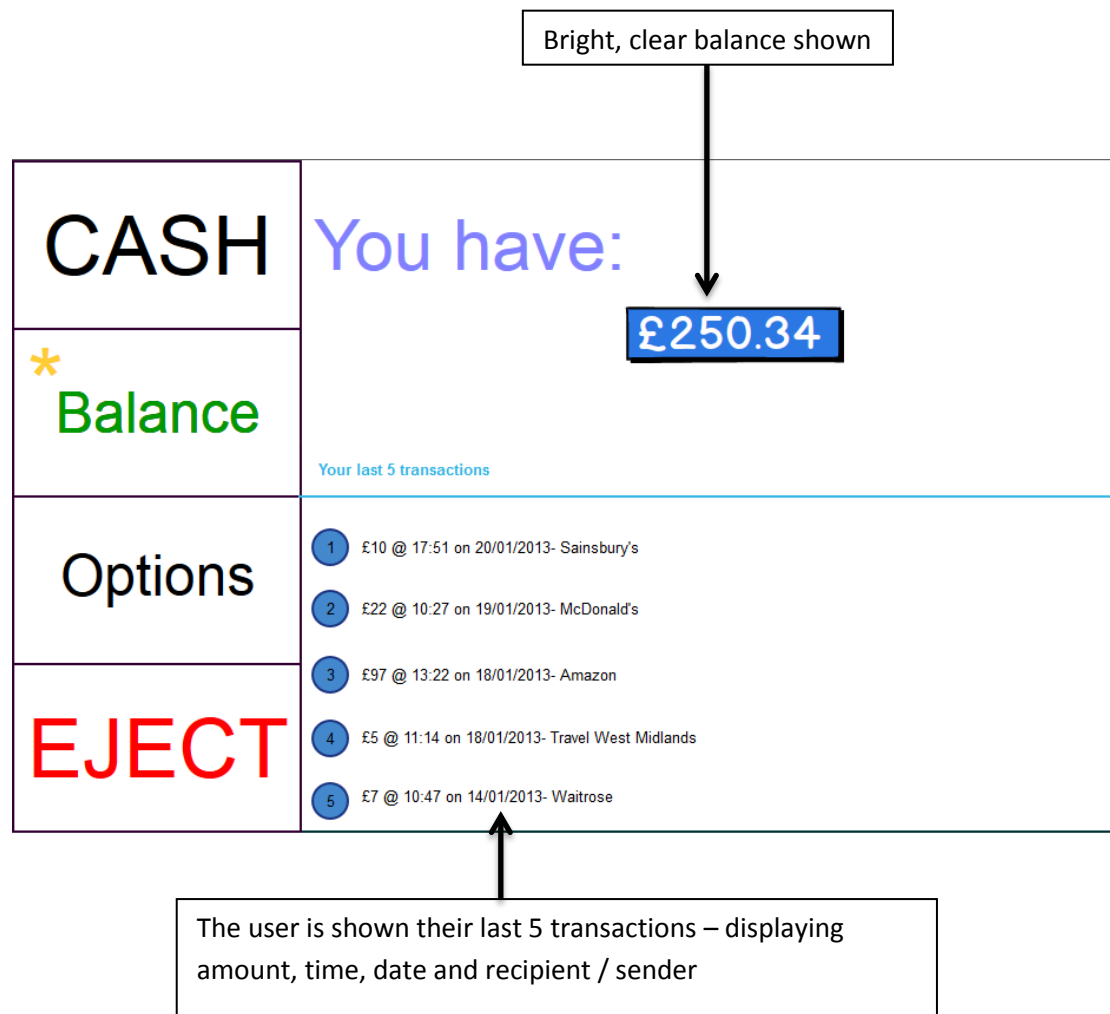
Evaluation of prototype 3

Although many of the ways to interact with the interface in this prototype are innovative, they are not necessarily preferable to variants of existing mechanisms for input. For instance, whilst biometric scanners mitigate the risk of a PIN being seen, they increase the chance that the ATM user will be overpowered and forced to scan their hand. Furthermore, the conservatism that results from the sensitive nature of banking means that customers are likely to be resistant to change in something so fundamental to security as the PIN.

Whilst the withdraw system might be just as fast for amounts up to £20, it requires too much thinking for larger quantities. This would be particularly unsuitable for users who have difficulties with arithmetic. Even if this input mechanism were to be combined with preset amounts, it seems it could cause annoyance.

The side menu is very effective. By allowing the user to always move to the most commonly used pages in just one touch, the time required for each transaction will be minimized. (Heuristic Evaluation of Ambient Displays – Mankoff et al, 2002)

Heuristic	Severity	Discussion / ways to solve
#1 – Visibility of system status		
Currently selected screen highlighted in the sidebar	___	This will aid users in keeping track of their transactions, particularly those who have trouble with short term memory such as Mary, the elderly lady in our persona.
#2 – Match between the system and the real world		
Withdrawals are represented as images of the notes that the user will actually receive.	___	Should aid the user in deciding how much cash they require if there is any doubt.
#3 – User control and freedom		
Users can choose the notes that will be included in their withdrawal e.g. when withdrawing £20, the use can select whether they would like one £20 note or two £10 notes. A nice feature, but should be optional if included.	3	There are situations in which this feature would be useful such as times when the user wants to pay for something with an exact amount of cash. However, it is not appropriate as the primary means of cash withdrawal as large amounts of cash will require a huge number of button presses, which is something our system tries to avoid.
#4 – Consistency and standards		
Notes are represented in two different orders on the withdrawal screen, ascending value at the top and descending value at the bottom.	2	This may cause confusion for certain users. The latter order is probably preferable as when adding up cash people tend to count in descending order of denomination.
Unclear how the transition to purely biometric verification will be made.	0	If the system does not include a PIN system the changeover from PIN to biometric verification will likely require users to visit a branch of their bank. This is an inconvenience to the user and something the system should aim to avoid.
#5 – Error prevention		
It may not be clear that crosses on the notes on the withdraw screen will remove the notes from the transaction	2	This mechanism is likely to be fine for users who are used to the 'close' button in the top right corner of the windows of common computer systems. For less tech savvy users, such as the elderly, however it may require some form of documentation to be displayed on-screen.
#6 – Recognition rather than recall		

Currently selected screen highlighted in the sidebar	___	Removes the need for the user to remember which screen they have selected. Particularly of use to users with poor memory.
#7 – Flexibility and efficiency of use		
No option for users to use PIN, as opposed to biometric, verification.	**3**	Whilst biometric verification is undoubtedly more efficient and secure, users who are unaccustomed to technology, who may have taken time to get used to chip and PIN verification, are likely to be uncomfortable with it.
#8 – Aesthetic and minimalistic design		
#9 – Help users recognise, diagnose and recover from problems		
No mechanism specified for informing the user of specific problems.	**2**	In the event that something goes wrong, it is probable that users will want to know exactly what it is, particularly users uncomfortable with technology such as elderly users.
#10 – Help and documentation		

	Mary Mason - retired	**Libiano Forte – International student**	**David Thomas – Working man**

Scenario 1	Withdrawing cash	Arrange recurring payment for house bills	Seeing previous transactions on screen
Score	6.5	N/A	9
Reason	She has no problems in navigating to the correct page. She likes the visual elements of the input mechanisms. However, firstly she doesn't like having to make more on screen clicks than necessary to choose the amount and finds it hard to think the exact amount she needs to withdraw.	Although the intention would be to have this feature available, it was not designed for this early prototype	David is able to easily see the most recent of his transactions. If it does not compromise security, this feature could be extended to allow more previous history, rather than just five. However, because it does not have a dedicated page, it is on the check balance screen, there is a risk some people may not be able to find it.
Scenario 2	Checking amount received is correct	Checking the exchange rate of euros/pounds	Quickly buying train tickets
Score	N/A	N/A	N/A
Reason		As above	See Libiano
Scenario 3	Feeling secure	Buying train tickets	Making a fast withdrawal
Score	3	N/A	8
Reason	She finds the biometric scanner preferable to a PIN as she need not worry about someone watching over her shoulder. However, as with prototype 1, there are no other discernible attempts to help her feel safer	As above	Cash withdrawal being the homepage means David need not waste time navigating. However, the limitations of the touch interface mean it is not ideal for this scenario.
Overall			
Score	4	6	N/A
Reason	Although navigation is effective for Mary, the large number of features requiring multiple on screen touches are unsuitable given her lack of manual dexterity.	Whilst it currently does not support any of the requirements detailed in Libiano's key scenarios, its general layout and input mechanisms are effective for him.	This prototype is the most effective at facilitating at efficient usage.

The following features will be taken forward in to the next generation prototype from this design:

Feature	Reason
Visual representation of amount that should be received	Allows the user to visualise the money they will receive and makes it easier to check that the machine has dispensed the correct amount.
Sidebar displaying possible options	Allows the user to navigate to any page from any other, eliminating the need for a back button
Highlight currently selected menu item	Useful for users with memory problems and helps all users to keep track of their transaction

Second Prototype

Evaluation of Tools

Process

In building the second prototype, we first returned to our recommendations based upon the first generation prototypes. Balsamiq Mockups was used to produce a low fidelity version containing as many of the positive points as possible. We proceeded to produce high fidelity screens for the system in Adobe Photoshop, before importing them in to Microsoft Powerpoint, so as to be able to implement the interactivity we required.

Balsamiq Mockups

Evaluation

We chose Mockups to create our initial prototype primarily because we felt it provided the ideal combination of ease of use, speed and quality. A program that was quick and easy to use was essential to avoid wasting time in this early stage of the development process. The quality of prototype that one is able to create with Mockups is also not far from that of other, more complicated programs. Another big point in favour of Mockups was its relatively full-featured free version, that does not require the user to sign up[1].

Possible Alternatives

There are a huge variety of tools available on-line for creating low fidelity prototypes. Some of the options considered for this project include InvisionApp, MockupBuilder and HotGloo. Although InvisionApp is capable producing of a very high quality of prototype, we felt it had a more complicated interface than Mockups, so would have taken up an unjustifiably large amount of time to learn at this stage[2]. MockupBuilder, on the other hand, has an interface very similar to that of Mockups, but the prototypes are of lower quality and we judged the trade-off in this respect to be too great[3]. HotGloo seemed to offer a good mix of all of the qualities that we wanted, but its lack of a feature-rich free version caused us to decide against it[4].

Adobe Photoshop

Evaluation

We chose Adobe Photoshop to create the screens for our system largely because it allowed us to effectively implement all of the features we identified as necessary for our second prototype. In contrast to many modern ATM systems, which have two colour text only displays, we were able to include such things as colouring and texturing of buttons, images to prompt the user and pop-up messages[5].

Possible Alternatives

There myriad image editing suites with comparable functionality to Photoshop that would have suited our purposes. Some of the examples we considered are Corel PaintShop Pro and the GNU Image Manipulation Program. Both of these programs offer more than enough functionality for our purposes, but in the end it was decided that Photoshop was the preferable alternative due to it being more widely used in professional image editing than the alternatives and it was the program we had most experience of using[6].

Microsoft PowerPoint

Evaluation

PowerPoint was chosen to add functionality to our system mainly due to our existing familiarity it and the limited requirements in terms of interactivity. We required only the capability to link screens together when buttons are clicked[7].

Possible Alternatives

There are a number of programs which could have been used to add functionality in a similar way to PowerPoint. Some of the prototyping tools described in the section on possible alternatives to Balsamiq Mockups provide this functionality, as do a number of other on-line prototyping applications such as AnteType[8] and PopApp[9]. All of these programs provide a great deal of functionality beyond simply linking between screens of a system and so have more complex interfaces that would have taken unnecessary extra time to learn and use.

[1] http://www.balsamiq.com/products/mockups/manifesto

[2] http://www.invisionapp.com/tour

[3] http://mockupbuilder.com/About

[4] https://www.hotgloo.com/signup

[5] http://www.adobe.com/products/photoshop.html

[6] http://web.uvic.ca/ail/techniques/photoshop.html

[7] http://office.microsoft.com/en-gb/home-premium/

[8] http://www.antetype.com

[9] http://popapp.in/#simulate

Presentation of the prototype

Pages 1 and 2 – Biometric finger scan

Biometrics will initially be used alongside PIN on this ATM. Eventually, the aim would be to remove PIN entirely, however, an anecdotal survey of ten people revealed that none would yet feel sufficiently comfortable with the technology to want that. Furthermore, there would be a danger that, if ATMs stopped requesting PINs, more bank customers would forget them, which would cause problems whilst shopping. Given that it would be necessary to have one's finger print saved before being able to use it, the system will automatically degrade to just PIN entry if it detects this has not yet been done.

The user is prompted to scan their finger. However, the central box suggests that the scanner is on the screen, when it is actually on the machine itself, next to the keypad. This was a source of much confusion for our evaluators.

The red light notifies the user that the initial state of the ATM is locked.

An image of a fingerprint is placed in the background.

This area will be used by the user to place his/her finger.

This message notifies the user about the action he/she is required to perform
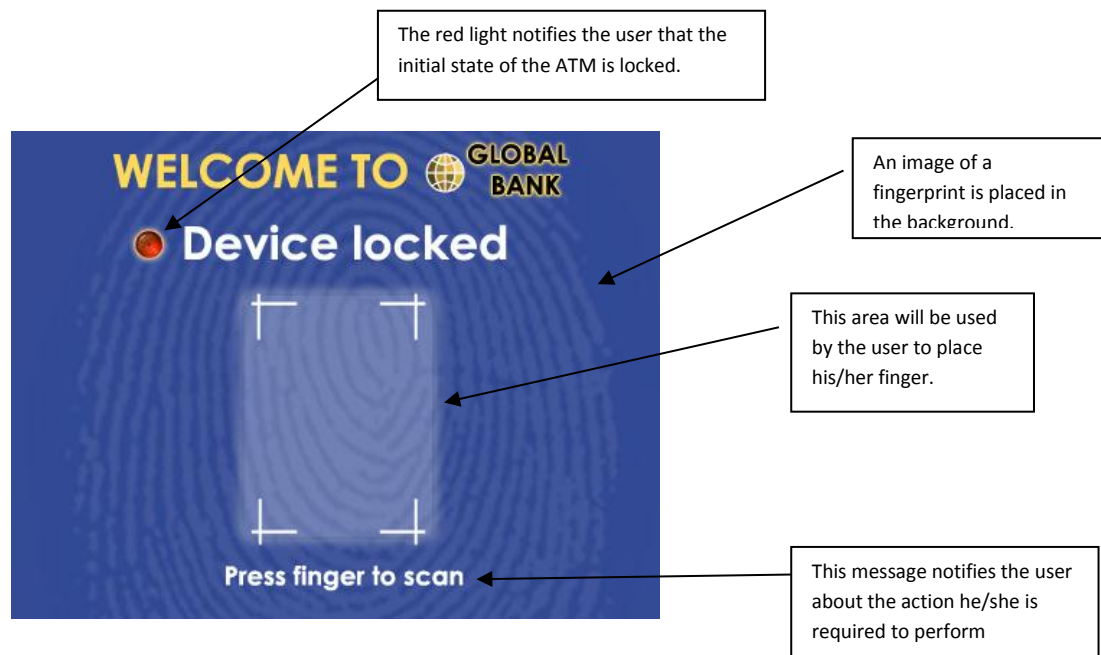
After swiping their finger, a clear loading message is displayed. In addition, the red light shown on the screenshot above has turned green, demonstrating visually that the scan was successful.

The red light has turned green, an indication of a successful scan.

Initializing message will be prompted to the user, as long as the scan takes place.

An image of a fingerprint is placed in the background.

The ATM has successfully captured the user's fingerprint.

This message notifies the user about the action he/she is required to perform.
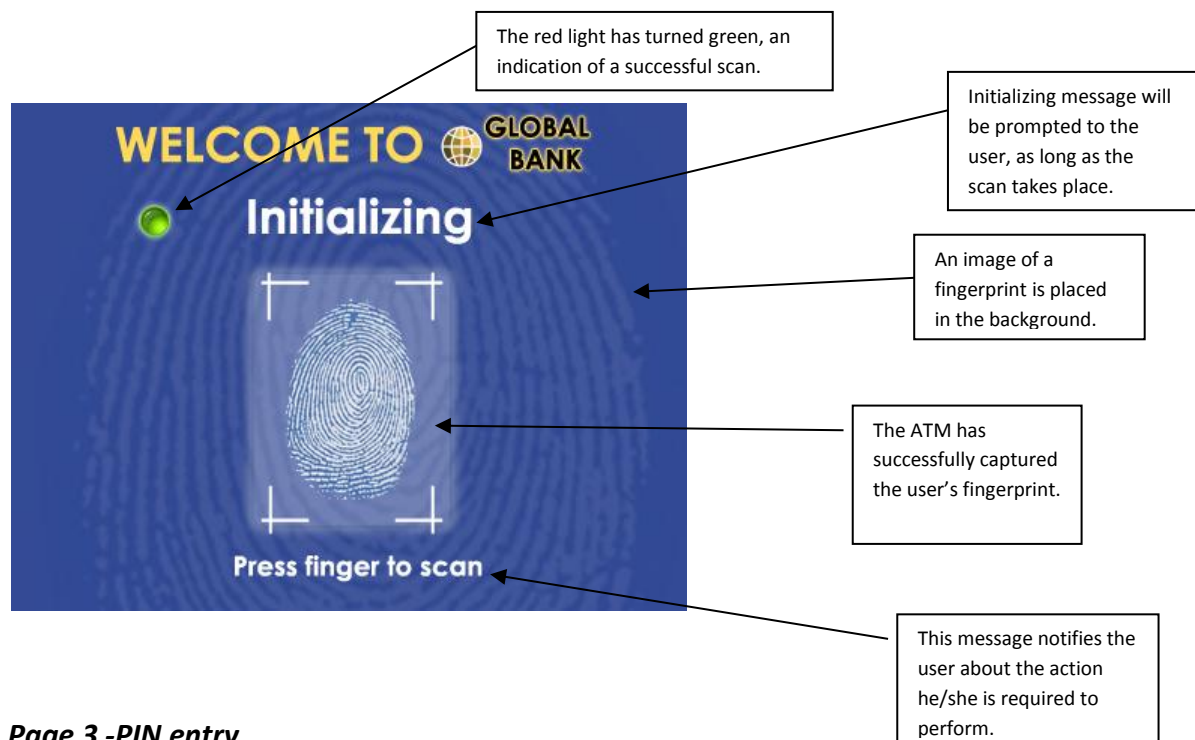
Page 3 -PIN entry

The enter PIN page from the first of the first prototypes has remained in its entirety. The large, vivid buttons provide a clear sense of direction.

Instructions to the user, while entering his/her PIN.

Large font size was chosen for the "Enter your pin" message in order to be clear to the user.

Spacious area, for the user to enter his/her PIN.

The color for the <<OK>> button is light green in order to avoid eye strain and to be more easily readable by the user.

The color of the <<CANCEL>> button is light red to avoid eye strain and to be more easily readable by the user.

Page 3 - The cash withdrawal/home screen

In response to Curran and King (2008) finding that the most efficient ATMs are those that immediately present the user with the cash withdrawal screen, the user is no longer taken first to just a menu screen. Rather, universal navigability is achieved through the use of an ever present side bar menu, containing the key functions, along with the option to see more. In order to allow each option to stand out, a range of formatting styles 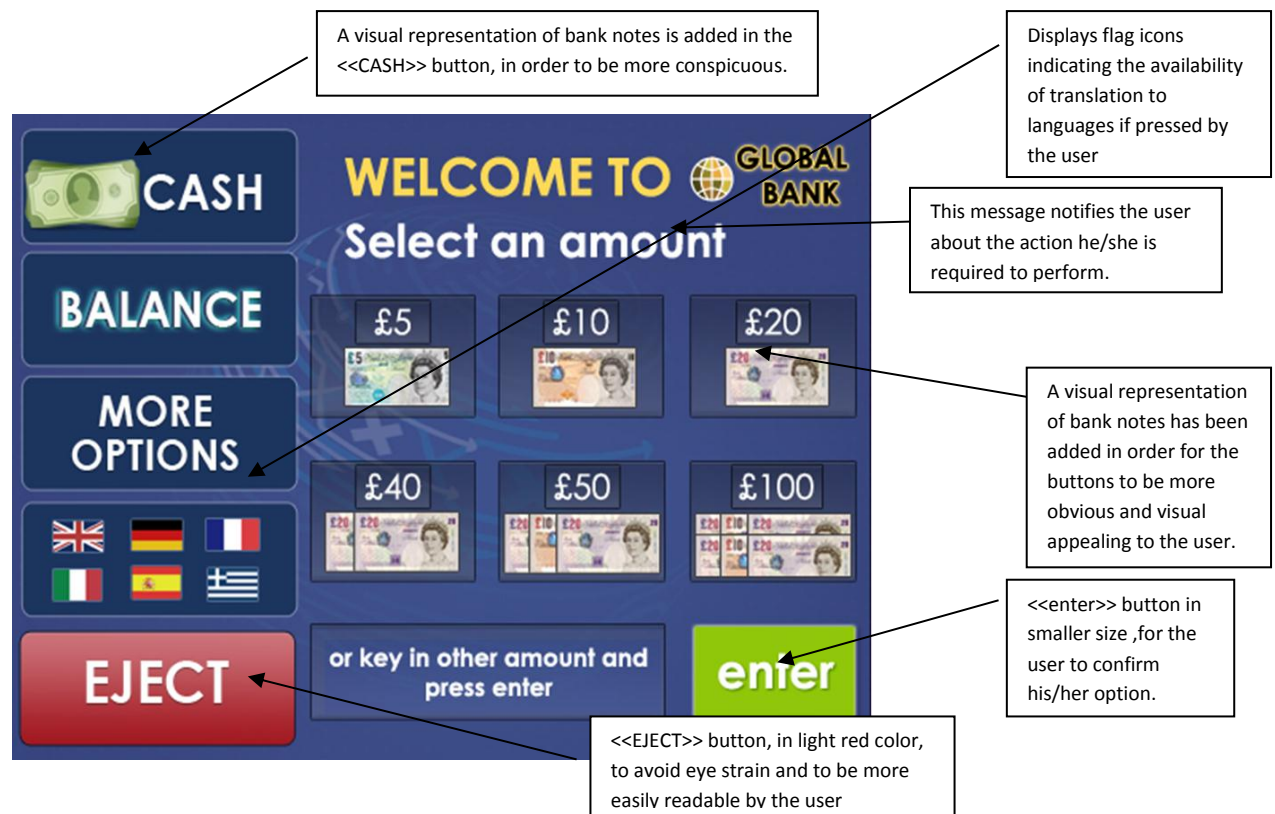has been used. In addition, wherever possible, they have been made as visual as possible, through the use of images for the cash and languages buttons and a bright red background for eject.

The most common withdrawal amounts are presented, along with a graphical representation of what they look like in bank notes. The user must touch their chosen amount and then confirm it using the enter button. This mitigates the risk of vulnerable users making a mistake.

A visual representation of bank notes is added in the <<CASH>> button, in order to be more conspicuous.

Displays flag icons indicating the availability of translation to languages if pressed by the user

This message notifies the user about the action he/she is required to perform.

A visual representation of bank notes has been added in order for the buttons to be more obvious and visual appealing to the user.

<<enter>> button in smaller size ,for the user to confirm his/her option.

<<EJECT>> button, in light red color, to avoid eye strain and to be more easily readable by the user

Page 4 - Check balance:

The 'your balance is' label is highlighted, so as to draw maximum attention to it. This, along with the large and clear amount pane ensures it will be suitable for visually impaired users. Rather than having to choose separate options for just viewing onscreen or printing out, the user has the option of printing if they so wish.

This message notifies the user about his/her current transaction.

The notification regarding the balance is highlighted to be conspicuous and clearly visible to user.

Spacious area, so the user can easily see his/ her remaining balance.

<<print>> button to be pressed if the user wishes to acquire a printed copy of his/her remaining balance.
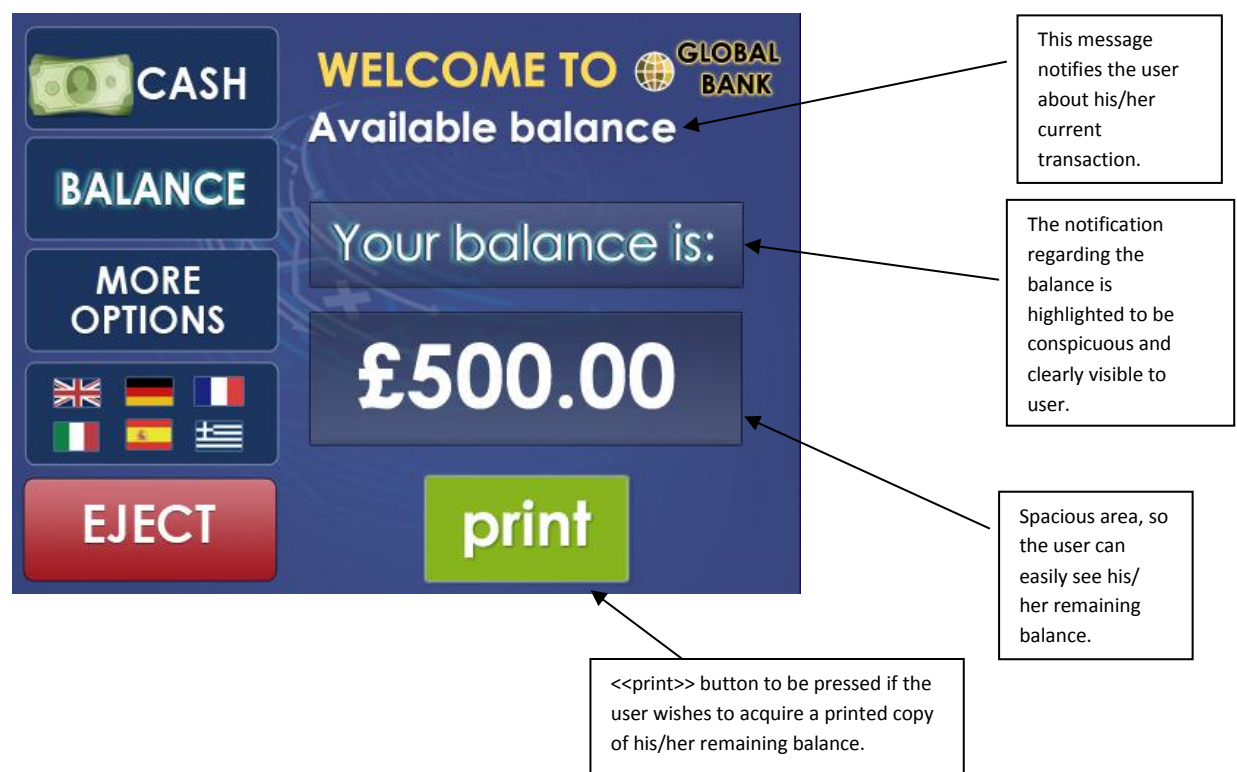
Page 5 - More options page

The key transaction types are presented in large buttons, with high contrast. Where appropriate, the options have visual elements, including transport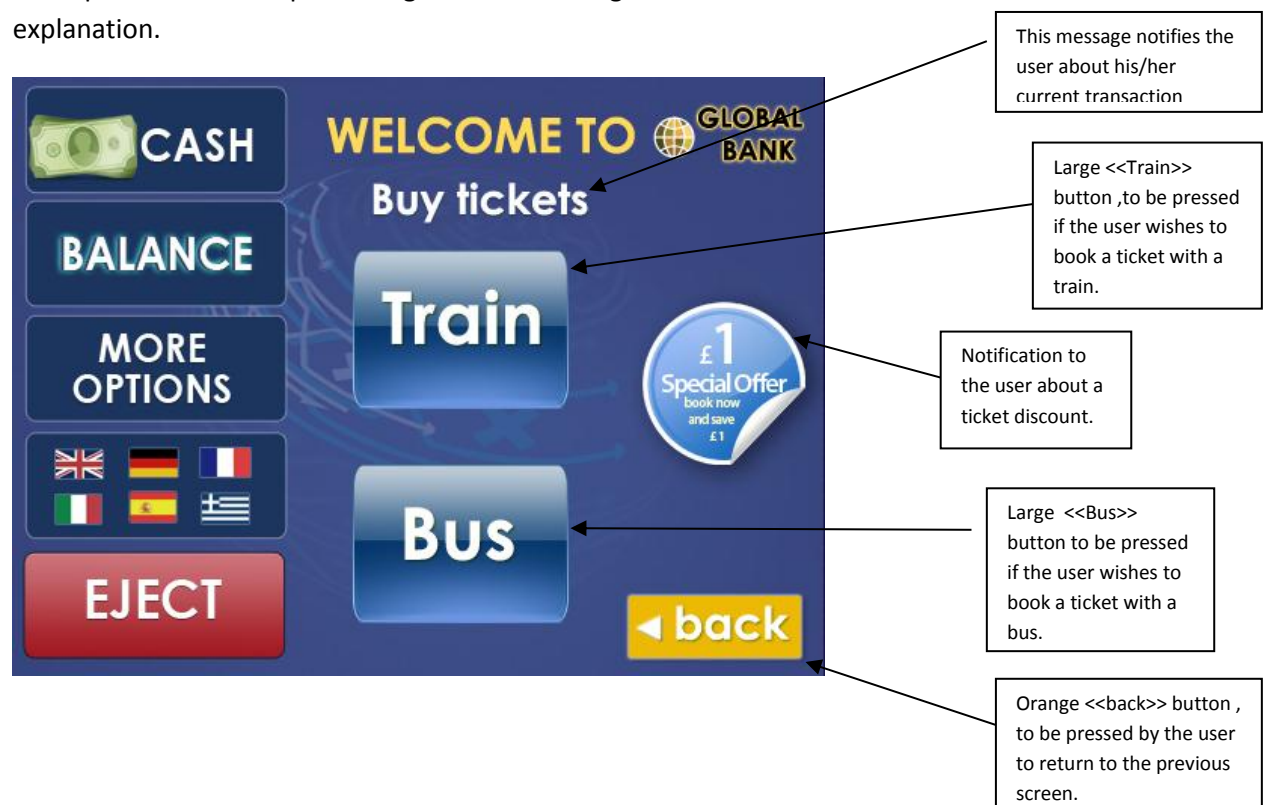 tickets being shown on the 'tickets' option and various currencies in the background of the exchange rate option. The side bar means the menu is no longer too cramped, with too many wordy options.

This message notifies the user about his/her available options.

<<Tickets>> button to be pressed if the user wishes to purchase bus or train tickets.

<<Exchange rates>> button to be pressed if the user wishes to perform currency conversions.
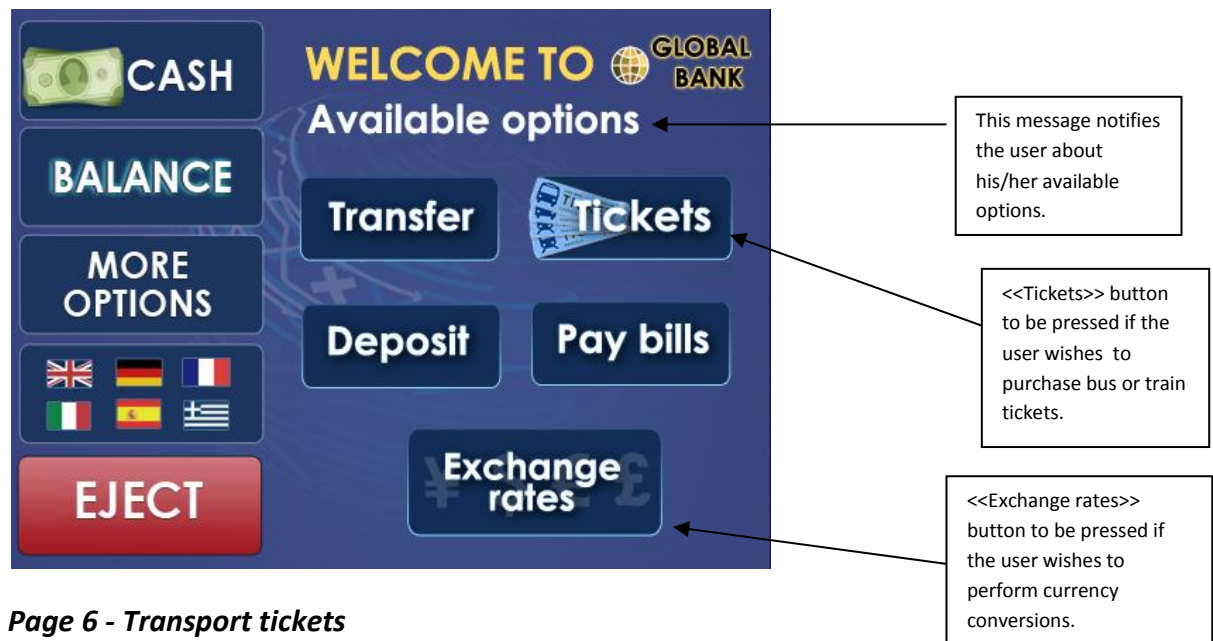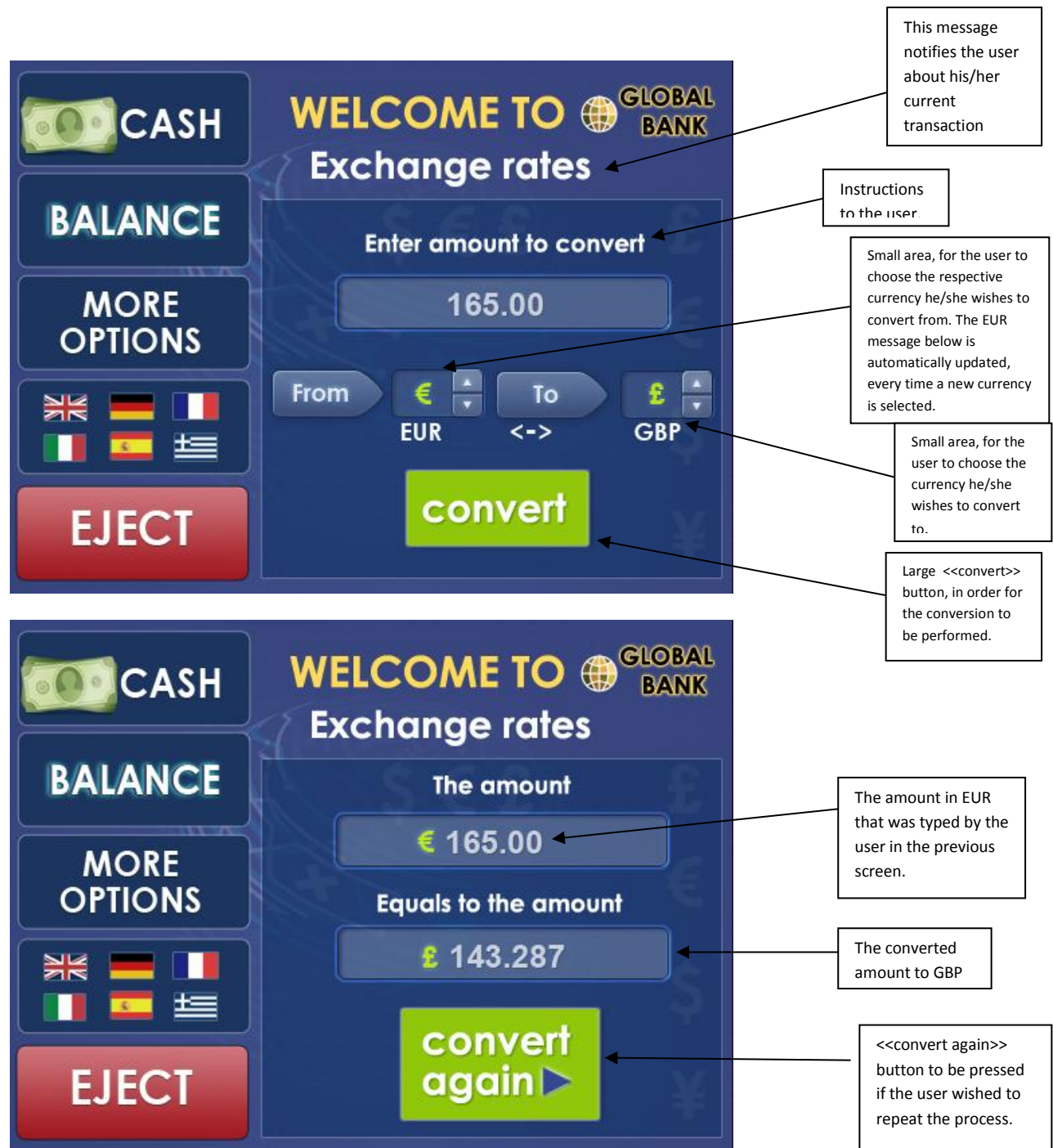
Page 6 - Transport tickets

The two main types of ticket can be purchased. When the option is not available, the user is presented with a clear message detailing how best to buy tickets in an alternative way. In addition, if a particular transport time is inappropriate in the context of a particular locality, that option has a cross put through it and a message box underneath with a clear explanation.

This message notifies the user about his/her current transaction

Large <<Train>> button ,to be pressed if the user wishes to book a ticket with a train.

Notification to the user about a ticket discount.

Large <<Bus>> button to be pressed if the user wishes to book a ticket with a bus.

Orange <<back>> button , to be pressed by the user to return to the previous screen.

Pages 7 & 8 -Exchange rate

The requested currencies can be changed through the use of arrow selection boxes. Upon pressing convert, the user is presented with the amount, along with the option to convert another amount.

This message notifies the user about his/her current transaction

Instructions to the user.

Small area, for the user to choose the respective currency he/she wishes to convert from. The EUR message below is automatically updated, every time a new currency is selected.

Small area, for the user to choose the currency he/she wishes to convert to.

Large <<convert>> button, in order for the conversion to be performed.

The amount in EUR that was typed by the user in the previous screen.

The converted amount to GBP

<<convert again>> button to be pressed if the user wished to repeat the process.
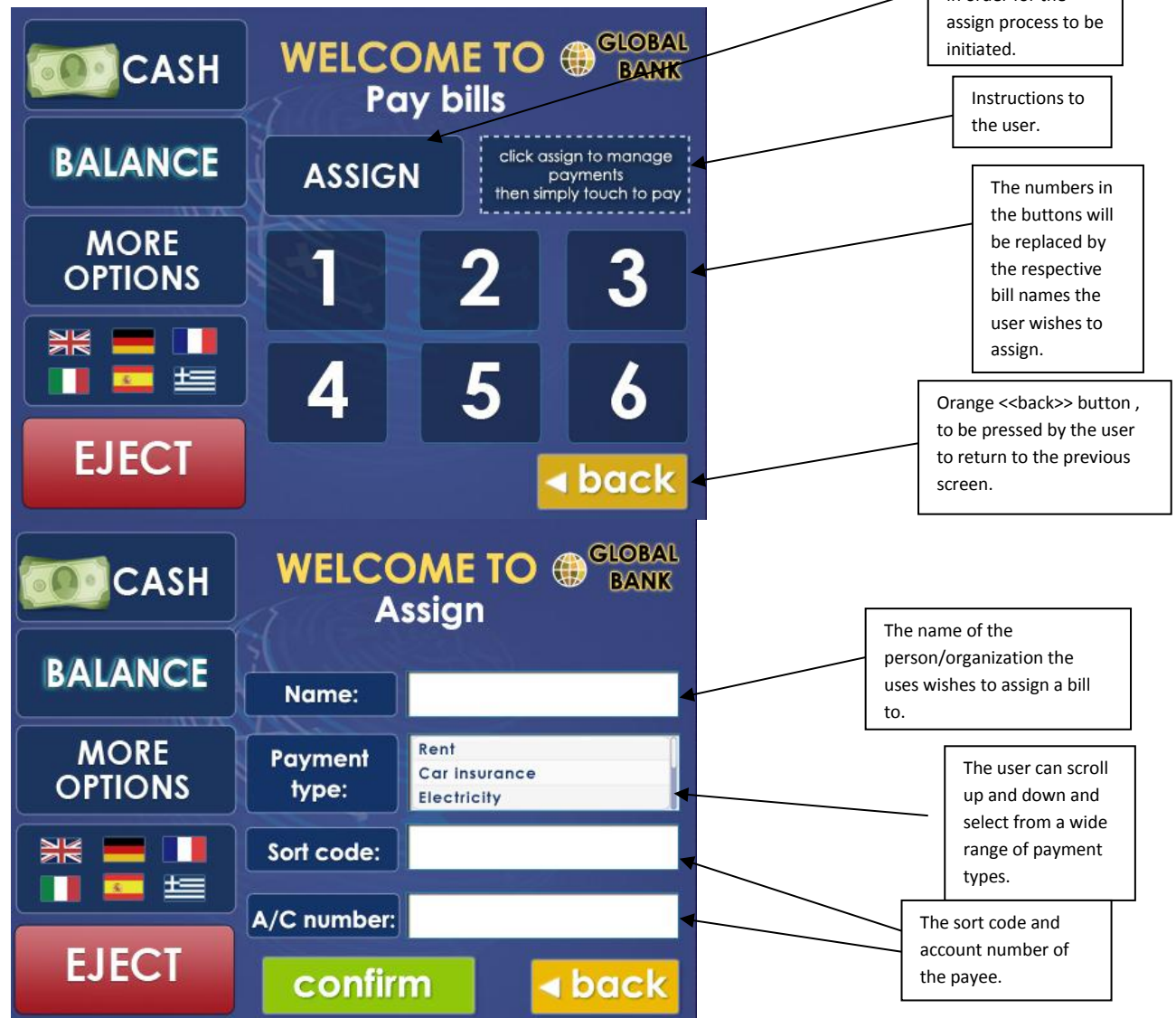
Pages 9 and 10 – Pay bills

There are six slots available for storing one's commonly used payments. Initially they are numbered, but upon filling in the assign form, the number is replaced with the
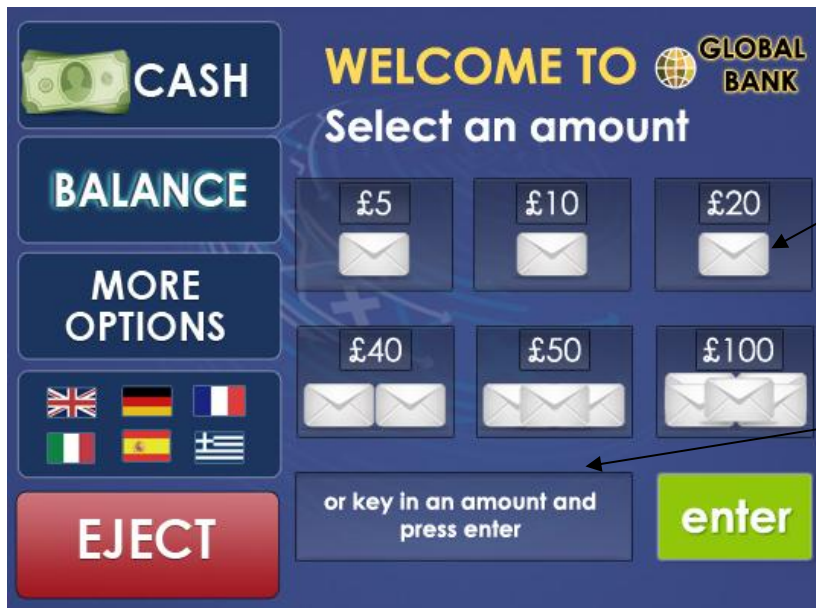
name and description of payment. A message informing the user how to use the function is displayed next to the assign button.

When completing the details of the payment, standard text boxes are used for name, sort code and account number. These will be used in conjunction with the keypad on the machine itself. The payment type is chosen through the use of a sliding menu that contains the most common types of payment.

<ASSIGN>> button, in order for the assign process to be initiated.

Instructions to the user.

The numbers in the buttons will be replaced by the respective bill names the user wishes to assign.

Orange <<back>> button , to be pressed by the user to return to the previous screen.

The name of the person/organization the uses wishes to assign a bill to.

The user can scroll up and down and select from a wide range of payment types.

The sort code and account number of the payee.

Page 11– Deposit

The deposit page is similar to the withdraw cash page, in that commonly used deposit amounts are displayed in grid, along with the ability to input a custom amount. Rather than pictures of notes, envelopes are used to allow for a visualisation of the amount to be made.

Images of sealed envelopes have been used in the Deposit screen, in order to differentiate from the Withdraw cash screen.

Clear instructions are given to the user.

Pages 11 and 12 – Out of order

When the ATM is out of order, the user is presented with a map, with their current location, along with that of the nearest ATM. However, should the nearest ATM be sufficiently close, they are presented with a photo trail of how to get there, as below.

Cognitive Walkthrough

Cognitive walkthroughs (CWs) aim to determine the suitability of user interfaces for a set of hypothetical users. Unlike heuristic evaluations, they are always task-centred and so focus upon the thought processes required to perform the sequences of actions necessary to use important functions. Lewis and Wharton (1997) believe this to be an important difference as, for instance, "many problems in wording will not be apparent unless examined in the context of a particular task".

 The personas discussed previously will constitute the clearly defined user backgrounds required for CWs. Below, their assumed behaviour for three different tasks will be compared to the intended way of using the system. Should they match, a 'success story', with a clear reason as to why the user would have chosen that particular action will be made. Likewise, if they do not, a 'failure story' will be detailed. These stories will be driven by the following four factors:

1. Will the user be trying to achieve the right effect?
2. Will the user notice that the correct action is available?
3. Will the user associate the correct action with the desired effect?
4. If the correct action is performed, will the user see that progress is being made?

The results of the CWs will be discussed together with those of the user testing in a subsequent section.

Task 1 – paying a bill for a travel agency

 Goal: Our busy working man, David Thomas, always uses the same travel agent whenever he wants to book flights. As this is his first time using the new ATM design, he must first input the agent's details, before choosing the amount.

1. Scan your finger
2. Enter your PIN and press OK
3. Choose the MORE OPTIONS button in the side panel
4. Touch Pay Bills
5. Press Assign
6. Enter Dave Thomas as the recipient name, choose 'travel agency' as the payment type, enter 30-11-12 as the sort code and 6016 1331 9268 19 as the account number
7. Select confirm
8. Touch 'Dave Thomas'
9. Enter £100 to pay
10. Press confirm

Entering the system – actions 1 and 2

Upon reaching the ATM, he sees the fingerprint background and the 'press finger to scan' instruction. It is clear to him what he needs to do, however, because of the box in the centre of the screen and the small biometric scanner, he is unsure for a while of where he needs to

actually place his finger. Because he has taken longer than ten seconds to complete the scan, the system provides an image message showing what to do. The 'initialising' screen provides clear feedback that the scan was successful.

He is a frequent user of ATMs and is thus well accustomed to standard PIN entry systems. This means he does not even look at any of the on screen prompts, instead just typing his PIN. The large OK button matches what he would expect, but because the biometric scan was off screen, he first tries to look for a keypad button before touching the OK button. Unfortunately, he mistyped the PIN, but he is instantly aware of this because the screen flashes red and the PIN box is cleared.

Getting to the pay bills page – actions 3 and 4

Every ATM he has ever experienced used a hierarchical menu, with all options immediately available. He is, at first, not entirely sure if this machine actually provides the service he needs. After deciding to investigate, it is clear that the more options button is what he should click to check.

Upon arriving at the more options page, it is not immediately apparent whether he should choose 'transfer' or 'pay bills'. However, because he knows he often makes payments to his travel agent, he chooses pay bills as this suggests recurrence to the action.

Choosing who he wants to pay- actions 5 - 9

At first, he is confused as to why he has been taken to a page where he is not simply entering account details Furthermore, because the colour of the button is the same as that of the option buttons, he is not sure if that is a command or another option. He then reads the instruction box and can gather from the context what assign must mean.

When entering the payment details, the form is familiar and he has no issues with the name, sort code and account details. However, the payment type option is a list, with no ability to enter a custom type. He is just about to choose a random option, when he decides to see if 'travel agency' is, indeed, an option. The scroll bar is clear, but looks too small, so he first looks for a down button on the keypad. After pressing confirm, he is not presented with any message to say the details are correct, but he can infer they are from the fact he is taken back to the payee page.

Now the name 'Dave Thomas', who he wishes to pay, occupies one of the buttons on the page. He needs no other prompting, as it is immediately obvious this is what he needs to click to make the payment. Likewise, the enter amount page is also naturally intuitive and in line with his previous experiences.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	
1	✓	✓	X	✓	**Success**
2	✓	✓	✓	✓	**Success**
3	✓	-	✓	✓	**Success**
4	X	X	X	✓	**Fail**
5	✓	X	X	✓	**Fail**

6	✓	X	✓	✓	**Success**
7	✓	✓	✓	✓	**Success**
8	✓	✓	✓	✓	**Success**
9	✓	✓	✓	✓	**Success**
10	✓	✓	✓	✓	**Success**

Task 2 – cash withdrawal

Goal: Mary is on the way to the supermarket on a Saturday afternoon. She only plans to buy a few groceries, so wants to just withdraw twenty pounds.

1. Scan your finger
2. Enter your PIN and press OK
3. Choose £20
4. Press enter
5. Wait 15 seconds for the money to be dispensed
6. Check cash and take card

Entering the system – actions 1 and 2

Although she had her finger scanned when she upgraded her bank account, Mary has since forgotten. Because she had previously never heard of biometrics, she is confused as to what she is actually meant to do, despite her being able to understand the onscreen prompt and instructions.

Choosing and receiving money- actions 3 - 6

Because she has been taken immediately to the withdrawal page, she is relieved she will not need to decipher how to navigate there. Although she has no problems reading, the notes on each option are large and so easier for her to read. After pressing the £20 option, a green border is drawn around it. However, she does not realise she must also press the 'enter' button because all the ATMs she has used previously dispensed cash immediately. It is only after no cash is forthcoming that she realises. This took 30 seconds and because it was a busy Saturday afternoon, many people were in the queue behind her so she feels very self-conscious.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	
1	X	X	X	✓	**Fail**
2	✓	✓	✓	✓	**Success**
3	✓	✓	✓	X	**Success**
4	X	X	X	✓	**Fail**
5	✓	X	X	✓	**Fail**
6	✓	X	✓	✓	**Success**
7	✓	✓	✓	✓	**Success**

Task 3 – checking how much £165 is in euros

Goal: Libiano wants to buy a new bike. Whilst he has a rough idea of the exchange rate, for such a large purchase he wants to be completely sure how much it will cost in Euros. He visits an ATM especially to check.

1. Scan your finger
2. Enter your PIN and press OK
3. Choose the MORE OPTIONS button in the side panel
4. Select Exchange Rates
5. Enter 165 on keypad
6. Press convert
7. Click EJECT
8. Take card

Entering the system – actions 1 and 2

As task 1

Getting to the exchange rates page – options 3 and 4

As Libiano has used this machine before, he knows he needs to go to the more options page. There, the clear currency symbols on the button mean he can see exactly which option he must choose. It is also the largest button on the page, so drew his attention initially.

Converting the money- options 5 and 6

The options are initially set for GBP to Euros, but he wants to convert the other way. He believes the '<->' is a button, so tries to press it, it takes him a while to realise that he must actually manually change the currency using the arrow keys. However, these are fiddly for him.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	
1	✓	✓	X	✓	**Success**
2	✓	✓	✓	✓	**Success**
3	✓	✓	X	✓	**Success**
4	✓	✓	X	✓	**Success**
5	X	X	X	X	**Fail**
6	✓	✓	✓	✓	**Success**
7	✓	✓	✓	✓	**Success**
8	✓	✓	✓	✓	**Success**

User testing and heuristics

Nielson (1992) conducted an empirical analysis that quantified the efficacy of evaluators of varying domain expertise at identifying problems through heuristic evaluation. He defined three categories of evaluator: "double specialists", those with both user interface experience

and specific domain knowledge; "regular specialists", those with user interface expertise and novice evaluators. It was found that double specialists could identify up to thirty per cent more problems than regular specialists, and up to twice as many as novice evaluators. However, due to the limited scope of this investigation, both in terms of financial resources and the necessary contacts, only novice users will be used.

Nielson discovered there are strong diminishing returns in the number of problems identified by adding additional evaluators above three. He concludes the perfect balance between cost and benefit is to use five evaluators, as it is more effective to have more frequent but smaller test phases than fewer larger ones. Therefore, this investigation will also use five evaluators, two 'normal' users, two international students and one elderly user.

Evaluations will be conducted individually, so as to minimise bias and interference. There are two distinct forms of evaluation, self-guided and task-directed. Self-guided evaluations require the user to conduct an open-ended walkthrough of the system, whereby they are free to use all or any of the features they wish. This allows a greater number of wide-ranging drawbacks to be highlighted. Task-directed evaluations, on the other hand, require the user to perform important functions of the system. In order to determine the most suitable technique for this investigation, a pilot study was conducted in which two users were asked to follow the alternatives. They were highly informal, focussing not on the design of the system itself, but rather whether the interactive PowerPoint prototype would work well with the particular style. Our self-guided evaluator reported that he felt the number of interactive hyperlinks was not sufficient to allow for free exploration, without constant direction from the observer. Furthermore, as he was a student living at home, he had little experience in the use of ATMs, other than the most simple of transactions. He thus felt that by departing so far from his typical usage pattern, the worth of his contribution would be diminished. It was decided, therefore, that task-directed evaluations would be adopted.

In order to ensure the functioning of the prototype was as similar to the intended final version as possible, all the evaluations were conducted on a touch screen computer. In addition, the keypad and biometric scanner were represented by images on a piece of paper that was placed underneath the screen.

The purpose of the evaluation was explained to the evaluators, along with a description of the task they were requested to complete. However, to ensure their feedback was as representative of how the system would perform in real life as possible, no explanation or description of the system and its input mechanisms was made. An observer sat with each evaluator, who discussed what the user was thinking as they progressed. Whenever errors were observed, a note was taken of the context and how the user resolved their difficulty. Following the ending of the task, the evaluator completed a paper based questionnaire (see appendix) that gauged important aspects of their experience. As they were volunteers, the survey was designed to be as concise as possible, whilst still capturing essential feelings. A range of qualitative and quantitative questions were posed. Where a measure of intensity of feeling was required, a five point Likert scale was used that ranged from 1 for highly unsatisfied, to 5 for highly satisfied.

What follows is a summary of the key observations of each user, along with any errors they made.

User 1

Name: Hao
User type: International student
Task: convert £165 into Euros

Observations:

- Found the need for both a finger scan and PIN to be both confusing and unnecessary
- Clicked on the 'CASH' button, rather than more options because he thought the exchange rate option would be displayed when withdrawing, rather than on a dedicated page
- The up and down arrows on the exchange rate page were too small for him, this meant he needed to touch the screen three times before being able to change the currency.
- He thought the user should be given the option of withdrawing the amount of cash they had just checked the value of, for example, if they check how many pounds 50 Euros are.
- Suggested there should be a 'switch from/to currency' button.

User 2

Name: Alexis
User type: International student
Task: convert £165 into Euros

Observations:

- Thought he needed to scan his finger on the screen itself, in the white box in the centre. This led to some confusion, as he was not sure if it was just an issue with the PowerPoint or he was doing the wrong thing.
- He went straight to the More Options page, but he thought he had to actually withdraw Euros, not just check the exchange rate. This meant he did not think he needed to press the Exchange Rate button. He did not inform the observer of his confusion, so the time taken was skewed.
- He touched the 'From' label when he wanted to change the currency because he thought that it looked like a button.

User 3

Name: Jane
User type: Elderly
Task: Withdraw £50

Observations:

- Confused that she had to press enter after touching the amount she wanted to withdraw
- Stated she would feel uncomfortable if people behind her in an ATM queue were able to see the exact notes she was withdrawing

User 4

Name: Tom
User type: Working man
Task: Assign a payee and make a

Observations:

- Found the More Options page very quickly, but pressed 'transfer' instead of pay bills
- He then became confused because he thought the highlighting of the 'Balance' tab on the sidebar was telling him he was actually on the check balance page.
- Felt the Assign button did not conform with the vivid colours of other buttons in the system
- Because there was no option to enter a custom payment type, he became unsure if he was actually on the correct page and so tried to return to the transfer page.
- When he returned to the pay bills page, he found the scrollbar to be too small and needed to touch it twice to succeed in moving it down.
- Said he would never use such a system unless it could be linked to his online banking account, so he could manage his frequent payees on his computer and then just make the actual payment on the ATM.

User 5

Name: John
User type: Working man
Task: Deposit £50

Observations:

- Found the pictures of envelopes misleading as only one envelope is ever used to make deposits, regardless of the amount
- Felt he did not receive sufficient feedback, he said other ATMs he had used provided him with a receipt, including scanned pictures of any cheques used.

Bar chart to show average evaluator Likert scores for elements of the UI
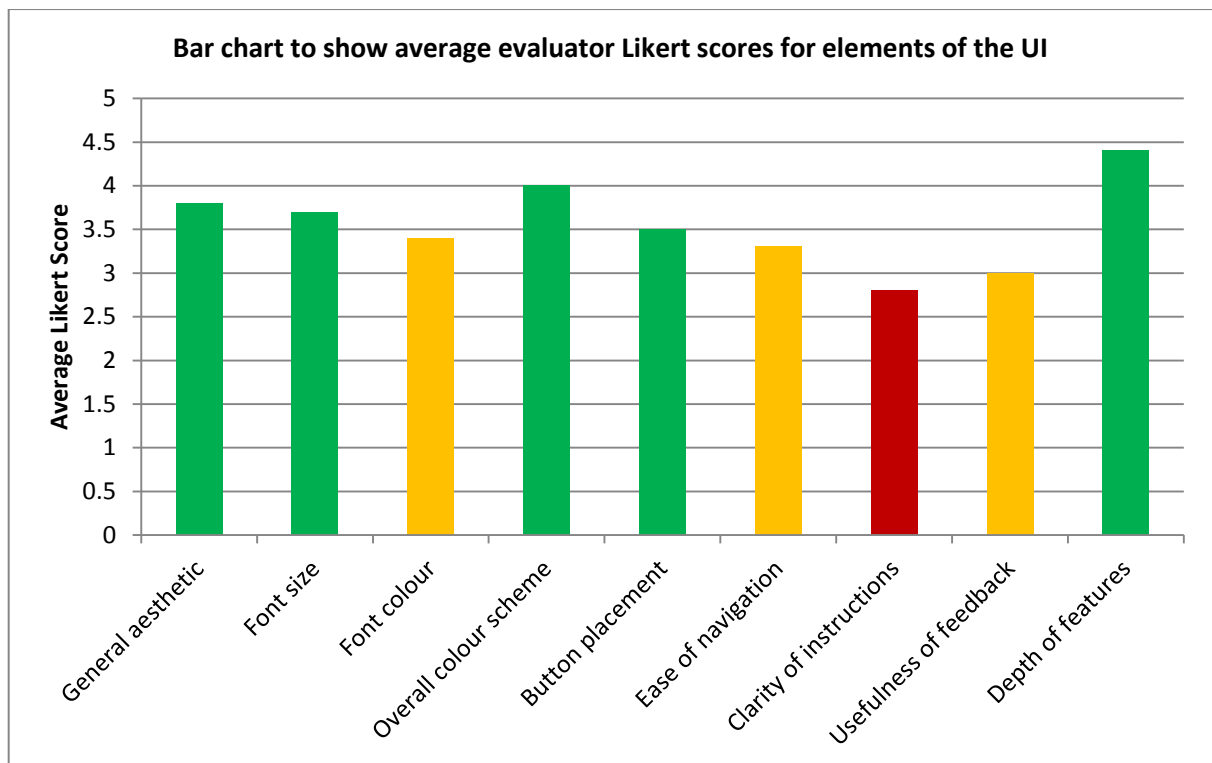
Key – Green (3.5+): by no means suggests it is perfect, but not of major concern

Orange (3-3.5): needs work

Read (less than 3): urgently needs addressing

Discussion of results

Both the CWs and user testing revealed numerous positive aspects of the system, along with many areas in which to improve. There are few errors that fatally undermine the effectiveness of the system, but there are many minor issues that need resolving.

The bar chart above displays the average score given by those who completed the Likert scale section of questionnaire, in relation to each aspect of the system's design.

The chart clearly demonstrates that communication between the machine and user was insufficient. This is both in terms of on screen instructions and what the user is told after an error was made. This is especially disappointing, as this was identified in our literature review as a major drawback of current ATM design. The finger scan page, in particular, was poor at informing the user what they needed to do, leading to much confusion.

It also shows that some problems, for which an attempt was made to address in the second prototype, still require some work. Font colour, for instance, was identified as a serious problem in the first prototypes for users with poor eyesight and the scores from the second prototype suggest that this has not changed.

Ease of navigation is shown also to need some attention, but given the average score for the depth of features of the system, this was acceptably high. There may come a point at which

the system is so feature rich that the only way to make the menus more navigable is by removing some elements of the system's functionality. The part of the system which is perhaps the most difficult to navigate, and at the same time the most advanced in terms of functionality, is the facility for editing payees in the 'pay bills' section.

The table below draws upon both the CWs and user testing to conduct a final heuristic analysis.

Heuristic	Severity	Discussion / ways to solve
#1 – Visibility of system status		
Clear instructions of how to locate an alternative ATM if the system is down	___	After completing the testing, each evaluator was presented with the example nearest ATM map screen. They all suggested they would find this to be very useful, however, its effectiveness would diminish in areas with long distances between ATMs. Unfortunately, it may actually cause problems for users with memory problems – such as Mary Mason, as in attempting to follow the instructions, they may forget where to go and get lost.
The red light on the initial biometric scan page may suggest there is a problem with the system.	___	Although no evaluators commented on it, the cognitive walkthrough revealed that for users with limited technology experience, the colour red may signify the system being down, rather than just not being logged on. Indeed, as it performs no real function, it should just be removed.
#2 – Match between the system and the real world		
Unclear whether the flags displayed for the changing of language are the only languages available or not.	1	The presence of Greek, a language with few international speakers, may suggest to users those displayed are the only languages available, as one would expect the most common to be shown.
Confusion between 'transfer' and 'pay bills' on the more options page	3	Central to effective design is having clearly demarcated actions available. Both of these options are separated only insofar as a transfer suggests a one-off payment, whereas paying bills would normally be recurring. Yet there could well be a unique bill that never need be paid again. This was the design flaw that caused the greatest confusion, both in the CW and user testing. They should be merged into a single 'Make Payment' option that could deploy the functionality available in both.
Short, descriptive button options (transfer notwithstanding) reduce cognitive load	___	There is neither unnecessary repetition, nor are there superfluous words. Some users were unsure what would be contained in the 'More Options' page, but this could be considered

		the price of launching on the withdraw page, rather than poor descriptions.
As visual as possible	___	Wherever appropriate, a picture was used to supplement text. For example, having bank notes on the 'CASH' button. Our evaluators found these drew their attention and meant they did not even need the text. The balance between allowing vulnerable users to engage with the system and not being off-putting for standard users was correct.
Strange wording of 'equals to the amount' on the exchange rate page	1	A user commented that he found the English to be off-putting and not how it would be said in real life
The deposit page button used multiple envelopes for larger amounts, when the user would only ever actually deposit using one envelope	2	Unlike the notes on the withdraw cash page, the envelopes do not actually aid in the visualization in any way. Furthermore, unlike withdrawals, deposits are much more unlikely to be of a standard size.
#3 – User control and freedom		
Ever present side bar gives a sense of control and minimizes the number of clicks necessary to access functions	___	The large buttons, with easy access to the most common transactions means users feel more comfortable to explore functions requiring multiple steps. Furthermore, it is reassuring for inexperienced users as it increases continuity and consistency throughout. One user commented the presence of the 'More Options' tab made the 'back' button present on some pages redundant. However, it would seem likely, especially for those who forget how they arrived at their current location, that it is necessary.
The loud 'EJECT' button meant that users never forgot they could exit at any time	___	
#4 – Consistency and standards		
The 'balance' option on the side bar is highlighted, instead of the current page	2	This proved very confusing for most of the evaluators. Whilst it is useful to differentiate the balance page from others, the use of text highlighting, something so commonly associated with indicating current position was misleading. The reinstating of the star on the third of the first generation prototypes will mitigate this
Some buttons look like labels, whilst some labels look like buttons	2	- The 'Assign' button on the pay bills page, in particular, caused confusion as it was the same colour as the buttons to select an individual payee.

		- The 'From' and 'To', along with the '<->' labels on the exchange rate page were often confused for interactive components. These issues could be resolved through the creation of a standardized non critical button and descriptive label, that would be implemented on all relevant pages
The notes on the withdrawal page are meant only as a representation of what that amount could look like, but nowhere is this stated	**3**	A mismatch between what systems suggest and do in reality is a major usability flaw. A feature that seeks to help the most vulnerable of users, could actually cause worry and confusion.
#5 – Error prevention		
After touching an option, many pages require the pressing of a confirmation button	**2**	This provides the user an opportunity to correct their own mistakes, yet both the CWs and user testing revealed that this was actually counter-intuitive for many people. Rather than so strong a prevention system, greater explanation should be displayed, so users are prevented from making the mistakes in the first place.
#6 – Recognition rather than recall		
Considerably fewer options on each page	___	The use of the side bar means users will quickly become well accustomed to picking choosing their most frequently used transaction types. Furthermore, it allows pages like 'More options' to remain feature rich, without inundating the user with choices.
Buttons are big, bold with clear text and high contrast	___	The ease with which buttons could be read was the most frequent positive qualitative feedback.
#7 – Flexibility and efficiency of use		
The side bar means both novice and experienced users can reach what they want quickly. Likewise, by starting on the cash withdrawal page, the system responds to how it will be used in reality	___	This improves the speed with which users, novice and advanced alike, can complete involved transactions. Those comfortable with the system can also assign their most frequently used payees to further options, allowing experienced users to use the system more efficiently.
Many features allow for a wide range of options and customization	___	- Many languages, currencies and payees on the pay bills page can be selected/chosen

#8 – Aesthetic and minimalistic design		
Strong background colour	___	Allows buttons and titles to clearly stand out, especially important for those with poor eyesight.
Low contrast between the colour of the option buttons and their text	**2**	Increases the likelihood of text being missed
A few individual elements are difficult to read	**3**	- The £100 notes on the withdraw cash page – showing notes was designed to help users like Mary Mason, yet the smallness of the pictures for larger values is not appropriate - The 'Please cover the keypad…' message on the PIN entry page is difficult to discern. Perhaps an image could be displayed to depict it
#9 – Help users recognise, diagnose and recover from errors		
Other than informing the user when the system is offline, there are no displayable error messages	**3**	This was identified as a serious problem in the literature and should certainly be implemented in future version of the system.
#10 – Help and documentation		

Recommendations

In order to allow the system to be deployed in the real world, a number of issues raised in the above analysis would need to be address.

Even after the issue was raised in first-generation prototype 1, there remain potential problems with ambiguity of language and uncertainty about functionality of the system. This is most evident in the confusion surrounding the difference between the 'transfer' and 'pay bills' features.

There also remain a number of minor aesthetic issues which, while not huge problems in terms of usability, should be remedied before the system is released for wide use. Highlighting of incorrect options in the side bar, similarity between the appearance of buttons and labels in some cases, and some remaining contrast issues, are a few example of such problems.

Another major failing was the lack of communication when there are issues. This could be remedied through the use of pop up messages that would require active closing by the user before they could continue.

If the system is to achieve its ultimate goal of making the process of using an ATM more efficient for a variety of users, some features such as surplus button-presses should be eliminated from the final product.

Summary

This report analysed current systems, drawing upon observations from their use and criticisms from the literature. Based upon these findings, three first generation prototypes were presented that aimed to solve the needs of our three well defined personas. A final prototype was presented that amalgamated the best elements of each of the first generation prototypes, along with new ideas created in the meantime.

Through the use of realistic potential users, along with our own observations, a thorough evaluation of the final prototype was conducted. The results suggested ours was a system that, although minorly flawed in place, was nonetheless nearly fit for purpose. The original aim of this project was to develop the foundations of an ATM that adhered to accepted usability criteria. In this regard, it could well be considered a success, as the intention was never to strive for the unrealistic target of perfection. What follows is an evaluation as to how the process itself might have been improved, as well as an identification of those areas in which it succeeded.

The findings from the literature were useful in shaping our subsequent designs. Yet, although we collated a wide range of expert opinions, we failed to actually implement a great number of them in any of our designs. This was because we treated the first section as distinct from the main bulk of the project and as such, did not return to it when designing. This was a missed opportunity as it ignored a great deal of advanced research.

The project began with our agreeing an overall goal that the system should aim to achieve, that is, generally improved efficiency of ATM use. As the project progressed, this goal was pushed in to the background in favour of aesthetic decisions and attempts to adapt the machine for use by various classes of user.

Whilst the system we produced does cater to the users that we intended, many of the features implemented in order to do so took the system still farther away from achieving the overall aim of efficiency. A prominent example of this is the need in the final prototype for both biometric and PIN verification. This feature neither addresses any of the issues raised in our analysis of user requirements nor achieves the original aim of making the transaction more efficient.

Although we have a delivered a system that, with minor rectifications, could be taken forward, we made too many assumptions. Our research into whether such things as the feasibility of an ATM actually being connected to the internet, the actual cost of biometrics and ticketing options, were limited. This means that, in reality, the system may not be fit for purpose, meaning many of the key features could not actually be deployed.

It often felt as though we were developing features for the sake of having new things to discuss in the evaluations, with little chance of success. Therefore, it might have been better to iterate designs for features within the first generation itself. For instance, if for the original first generation prototype, we thought of an amazing feature, in the next first generation prototype, we could have improved that further, rather than designing something entirely new. This would have meant that, by the final prototype, we would have had better thought out features.

We knew the scope of the project from the outset. Therefore, rather than developing a full accessibility version, as we did in the second of the first generation prototypes, it would have been better to have designed a more standard interface, that incorporated accessible features in. This would have reduced the problems in the second generation prototype of trying to force elements in that were originally conceived for an entirely separate context.

In terms of how our team performed as a group, we all too often worked as individuals, with minimal interaction and sharing of ideas. This led to redundancy and a lack of continuity. At one point this became so bad, that we were forced to redo great swathes of our project. Towards the end, however, we became more unified as a group.

For similar projects in the future it would be sensible for all team members to have a clearer idea when the team meets of what the goals of the other members are. This would have led to reduction in duplication of effort. Spending more time being physically together would have helped this.

Appendix

A copy of the questionnaire presented to the user testing participants

About you

First name: **Gender:**

Age: **Nationality:**

Do you have any form of physical impairment?   ☐ Yes   ☐ No   ☐ Prefer not to say

If yes, please describe: _____

On average, how many times per week do you use an ATM?   ☐ 0-1   ☐ 2-3   ☐ 3-5   ☐ 5-6   ☐ 7+

The task

Your task: ☐ Widthdraw £20   ☐ Assign and pay bill   ☐ Check exchange rate

Were you able to complete the task?   ☐ Yes   ☐ No

If not, why? _____

Overall impressions

1 = Very unsatisfied   5 = Very satisfied

	1	2	3	4	5	N/A
General aesthetic						
Font size						
Font colour						
Overall colour scheme						
Button placement						
Ease of navigation						
Clarity of instructions						
Usefulness of feedback						
Depth of features						

Do you have any comments about the general layout or usability of the system? Was there anything you particularly liked or not?

Completion of the task

How could the system have helped you complete your task more effectively?

A copy of the observer's observation form, filled out whilst the user was completing their task.

Observer observations

Name of participant:
Time taken:

Errors:

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Comments:

References

Cremers, A., de Jong, J., & van Balken, J. (2008). User-centered design with illiterate persons: the case of the ATM user interface. *Computers Helping People with Special Needs*, 713-720.

H Curran, K., & King, D. (2008). Investigating the human computer interaction problems with automated teller machine navigation menus. *Interactive Technology and Smart Education*, *5*(1), 59-79.

Hendy J., Xu K., Welsman-Dinelle M.,Viriyakattiyaporn P., Zoghbi S.(2007), *Next Generation ATM*

Krug S.(2000), *Don't Make Me Think,* New Riders

Mankoff, J., Dey, A. K., Hsieh, G., Kientz, J., Lederer, S., & Ames, M. (2003, April). Heuristic evaluation of ambient displays. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 169-176). ACM.

Preece, J. (2004). Human Computer Interaction. Addison-Wesley Educational Publishers

Nielsen, J. (1992, June). Finding usability problems through heuristic evaluation. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 373-380). ACM.

Nielsen, J. (1994). How to conduct a heuristic evaluation. *On the World Wide Web*.

Nielsen, J. (1994, April). Usability inspection methods. In *Conference companion on Human factors in computing systems* (pp. 413-414). ACM.

Nielsen J.(2003), *Usability 101: Introduction to Usability,* Retrieved from
http://www.useit.com/alertbox/20030825.html

Nielsen, J. (2005). Ten usability heuristics.

Smith-Atakan, S. (2006). *Human-computer interaction*. Thomson Learning Emea.

Rogers, W. A., Cabrera, E. F., Walker, N., Gilbert, D. K., & Fisk, A. D. (1996). A survey of automatic teller machine usage across the adult life span. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *38*(1), 156-166.

Taohai, K., Phimoltares, S., & Cooharojananone, N. (2010, March). Usability Comparisons of Seven Main Functions for Automated Teller Machine (ATM) Banking Service of Five Banks in

Thailand. In *Computational Science and Its Applications (ICCSA), 2010 International Conference on* (pp. 176-182). IEEE.

Thatcher, A., Shaik, F., & Zimmerman, C. (2005). Attitudes of semi-literate and literate bank account holders to the use of automatic teller machines (ATMs). *International journal of industrial ergonomics*, *35*(2), 115-130.

The International Organization for Standardization (ISO-9241, 1998), Retrieved from
p://www.upassoc.org/usability_resources/about_usability/definitions_of_usability.html