
An evaluation of and design concept for Automated Teller Machines (ATM)

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Abstract

This paper describes the evaluation and design for a smart automated teller machine, conceptualized as InstaATM. The research was conducted on current academic work, existing technology and users were interviewed to obtain user feedback on their experiences with ATMs to improve the design for InstaATM. The results concluded that the interface could be improved by having fingerprint recognition and a touch screen interface to improve user interaction and accessibility, the ability to deposit coins, cash and cheque and withdraw cash using contactless services to provide flexibility and efficiency.

Introduction

InstaATM aims to address the inadequacies of current ATMs by providing an all-in-one, smarter and improved quality of service to enhance interactivity and facilitate customers with an enjoyable experience. Bank customers will access banking services, at any time and from anywhere without having to visit their bank and possibly not having to carry their bank cards wherever they go. InstaATM will allow banks to have the right balance between physical and digital services for customers while embracing technology and offering bespoke services. Today, people have multiple bank accounts, which means they carry many bank cards on

them. Therefore, depositing and withdrawing money should be easy and not stressful because they already have the stress of remembering their bank card Personal Identification Number (PIN) and usually have to wait in long queues at the banks which can be time-consuming. "An automated teller machine (ATM) is a computerized telecommunications device that provides the customers of a financial institution with access to financial transactions in a public space without the need for a human clerk or bank teller to be present". ^[1] Having an ATM increases convenience for bank customers to carry out banking transactions such as deposits, withdrawals, transfers, balance enquiries and clear cheques. The most recent statistics show that "During the previous 12-month period, an average of 230 million transactions using Link cash machines take place every month, accounting for an average of 10 billion British pounds in withdrawals". ^[2] The statistics for ATMs worldwide show that "in 2018, there were 41.6 ATMs for every 100,000 adults worldwide. This number has been steadily increasing for the past decade, up from 27.2 in 2008". ^[3] These statistics suggest that there is an importance of ATMs in people's daily lives.

Current Academic Work

An article was published in 2017, where the research was conducted on 'Smart Intelligent ATMs using LabView'.^[1] They aimed to identify and verify bank customers by biometric techniques such as fingerprint recognition. ^[1] The research showed that "fingerprint recognition is the most accepted and mature biometric method". ^[1] Fingerprints are separate and distinct for each person which means every user has a unique identification so the templates cannot be reversed to recreate someone's personal information. This means that using a biometric technique helps to make your data tremendously secure. ^[1] Therefore, users' data cannot be stolen by criminals/fraudsters to access someone's personal information. The research showed that fingerprint recognition is simple to install, it takes less time and effort to acquire one's fingerprint with a fingerprint identification device and is therefore considered among the least intrusive of all biometric verification techniques. ^[1] InstaATM aims to provide a smarter and convenient way of banking which is safe, secure and user-friendly. These features can be achieved through fingerprint recognition as the user only scans their fingerprint rather than inserting a bank card. This will ensure efficiency as this method is simple to follow and not time-consuming. Also, the user does not have to worry about losing or forgetting their bank card as it will not be required when accessing InstaATM. Cardtronics, "manages self-service financial kiosks providing the physical conduit through which consumers interact with their funds and financial institutions". ^[4] Through research they found that "over the past four years, the frequency of attacks at ATMs has risen by an average of 22% each year, with attacks increasingly moving from urban centers to rural

areas".^[5] This research explains the advantage of having fingerprint recognition in the eventual design for InstaATM because, people will not have to carry their bank card, so it is less likely to get stolen.

An article "A Survey on Human-Computer Interaction Technology for Financial Terminals" conducted research to test and evaluate users' experiences when using ATMs. ^[6] Using heuristic analysis on traditional ATMs, they found that the system had several usability issues affecting labelling, navigation and controls which made the user experience frustrating and less user-friendly.^[6] They figured that the "ATMs should be designed to not include its inherent usability but also its perceived usability". Therefore, the four characteristics they came up with to ensure a good user interface were: effectiveness, efficiency, safety and enjoyability. ^[6] These will be core necessities when designing InstaATM. The first change they proposed was designing a touch screen system compared to the original version. This idea was meant to speed up the user's interaction with the ATM, thus, increasing efficiency. ^[6] Users described a problem of having to reinsert their bank card to carry out another transaction. So, they designed a facility to eliminate the need to reinsert a bank card to carry out an additional transaction. This improved the speed of transaction time and the user's basic everyday transaction experience. ^[6] This research also highlighted another inconvenience faced by users, this was forgetting to take the bank card after using the ATM. So, a design was proposed called 'a no card operation ATM system'.^[6] For example, once the customer has withdrawn cash (from an in-branch ATM), a prompt appears asking if they want to do another transaction. This will help them not to forget their bank card.

However, this could cause a security problem because the user could forget to remove their card and walk off after taking their cash, without responding to the prompt. To solve this problem, a fail-safe was introduced to ensure the safety of the transaction. If the user does not respond within a given time e.g. 5 seconds, the session ends. ^[6] This research was carried out to resolve problems users faced with existing ATMs and this is helpful for InstaATMs eventual design because it will be based on the solutions the researchers have found and it provides necessary information and ideas to ensure an aesthetically pleasing user interface for InstaATM.

Existing Technology

Smart ATMs have been introduced in the market and I evaluated the following existing products: Bankwest ATMs ^[7], Westpac smart ATMs ^[8], Barclays contactless cash service ^[9] (for images, see appendix A) because they have similar concepts to that of InstaATMs. I evaluated both the BankWest ATM and the Westpac ATM through their website as these ATMs were not available locally using Jakob Nielsen's 10 heuristic principles ^[10]. These principles helped me analyse and discover the usability problems if any, to produce a good interface for InstaATM and to meet users' needs and expectations. Proposed new technology implemented within the Westpac and Bankwest ATMs followed the heuristic principles as follows: they have visibility of system status by providing feedback when the user takes an action for example when depositing cash, it shows a successful deposit message to the user. Then, there is a match between the system and the real world as they have the option of changing the ATM language according to the user's preference. The

users have control and freedom over the ATM screen providing flexibility and efficiency because of a touchscreen interface. The keypad layout is aesthetic and has a minimalistic design to make transactions easy for the user when pressing the keys. Errors are prevented because of the confirmation option provided at each step and they are recognised and diagnosed by the system making these ATMs user-friendly. Also, there is an audio plug-in option for the visually impaired which considers the accessibility of users. Lastly, they provide help on their website which is easy to search with step by step instructions, focusing on the user's task. The other essential features are withdrawing and depositing cash and cheques instantly, transferring funds between accounts, checking the account balance and changing the PIN. The Westpac smart ATM had an additional option of paying bills, this is a bonus as it would attract more users to use this ATM. It has an option of depositing coins, cash and cheques with or without the bank card; this is a feature that provides flexibility and efficiency as some people tend to forget to carry their bank card on them.

I used cognitive walkthrough ^[11] to evaluate Barclays contactless cash service for withdrawing cash because I was able to access the Barclays ATM. I chose this technique because I could 'walk through' ^[11] the process step by step, to note any possible design errors and identify lack of feedback for actions, and poor choices in the terminology and labelling. I ensured that I considered the heuristic principles at the same time whilst performing these tasks. I had two options to choose from and these were either using a contactless Barclays debit card or an Android smartphone; this provided user flexibility. I started by using the smartphone option. I had to tap my smartphone on the

machine's reader which is customised to support my needs and I could choose the amount of cash to withdraw depending on my daily limits. The same steps were followed when using my Barclays debit card. Both these methods are quick and easy, and they provide user accessibility, flexibility and efficiency. The option of tapping your smartphone screen provides user efficiency because users do not have to carry their bank card on them. The ATM had on-screen instructions which were short and straightforward to follow, thus, showing an aesthetic design for a good user interface. However, the problem with this design was that the option of only using an Android smartphone is not a feasible idea as not everyone uses Android and not everyone would prefer downloading an application on their mobile phone to access this service. Also, the user's smartphone battery may be low, or they might not have access to the internet. Users would have to eventually use their bank card to access this service. After evaluating these existing products, my goal is to improve the design for InstaATM. Overall, the features in these existing products show a good user interface, user accessibility and ease of use. Therefore, I would implement most of these features when designing InstaATM.

Participant Research

The first methodology I used was making personas to help me decide whom InstaATM is specifically targeted towards and what to expect as users to stimulate design exploration (see Appendix B: Personas). Then, I interviewed Reema Bhanote, a banking assistant at Barclays in my local area. We went into depth on the experience she has had with bank customers who use their ATMs. However, due to the timeframe, I could

only conduct a one transcript interview (see Appendix B: Interview). From the interview, I can conclude that bank customers have been struggling to interact with ATMs effectively. Reema pointed out that due to language barriers customers have had issues, thus, language preferences will provide a match between the system and the real world. She also mentioned that long queues increased the waiting times which caused frustration among customers because people forget their PIN and start looking for it on their phone/handbag. To overcome this problem, having fingerprint recognition and a contactless cash service would provide user flexibility, user efficiency, and a faster and secure way of interacting with InstaATM, thus, reducing the queue size. The importance of a touch screen interface was emphasized, and this related to the academic work in the article 'A Survey on Human-Computer Interaction Technology for Financial Terminals'.^[6] Also, having short and illustrated on-screen instructions would help the customer focus on their task with ease and it would provide an aesthetic design. Reema was impressed with the design proposal for InstaATM that was described during the interview (see Appendix B, Interview: Question 7).

In addition, I conducted a questionnaire to get the users' perspective to help me design InstaATM (see Appendix B: Questionnaire). The results showed that 80% of the 10 respondents think that there is a need for InstaATM and 100% said they were likely to use it if it were available, indicating a positive response. 50% of the 10 respondents use the ATM weekly and 40% use it every day indicating that users rely on and use ATMs regularly, thus, they should have an easy and convenient experience every time. The survey showed that the main reason for using ATMs (including in-

branch ATM) is to withdraw cash, deposit cash and to transfer money. This means that users would want it to be a fast process, therefore, the idea of having a contactless cash service would accommodate this. Also, if security is taken into account, using fingerprint recognition is safe, secure and fast. It also provides flexibility because the users would not have to carry their bank cards on them as they could forget them in the machine or not have them on their person. In the response, the users have mentioned facing difficulties using the ATMs that were similar to the issues that were mentioned in the interview and the academic work conducted in the article 'Smart Intelligent ATMs using LabView'.^[1] These included users forgetting their bank card and PIN, waiting in long queues, going to the bank to deposit cash and cheques and slow cash dispensing from the ATMs at times. This feedback supports the design features that will be developed for InstaATM as they will focus on avoiding customer dissatisfaction by providing users flexibility and efficiency. In addition, the proposed design for InstaATM showed a positive response as 90% found finger recognition, depositing coins, cash and cheques without the help of a bank assistant, contactless cash service and a touch screen interface appealing. Some suggested voice assistance, and this relates to the existing products, Bankwest^[7] and Westpac smart ATMs^[8] that have an audio plug-in option. This will be considered because it provides accessibility to visually impaired users. The ease of using an ATM was rated as 4 (on a scale of 1-5 where 1 is easy and 5 is hard). This shows users are dissatisfied and there is room for new technology like InstaATM.

Conducting participant research helped me design InstaATM to provide an aesthetically pleasing

interaction and a good user interface. Lastly, I created a table for user requirements which summarized the users' needs and requirements when designing InstaATM (see Appendix B: User Requirements).

Design

I designed wireframes and a mock-up of InstaATM so that users can interact directly, to engage in a conversation and to exchange views (see Appendix C). InstaATM is designed to provide an all-in-one, smarter and improved quality of service for users, at any time and from anywhere. Therefore, one of the main features is that it allows users to deposit and withdraw coins, cash and cheques without having to visit the bank and waiting in long queues for assistance. Findings from 'A Survey on Human-Computer Interaction Technology for Financial Terminals'^[6], the article 'Smart Intelligent ATMs using LabView'^[1] and feedback from the interview and questionnaire led to InstaATMs design having the following features. The first is the use of fingerprint recognition for faster and secure access to InstaATM. There is also a touch screen interface as users will have control and freedom over the ATM screen, thus increasing efficiency and flexibility. There is feedback provided by the system at every stage to ensure user satisfaction. Based on feedback from the interview, the buttons on the number keypad are likely to break or not work with continuous use, thus, it is integrated to be part of the touch screen. Short and illustrated on-screen instructions are provided to help users understand their task with ease. In addition, after evaluating existing products, InstaATM was designed to have an audio plug-in option to ensure accessibility for the visually impaired users. It has contactless cash service when

withdrawing cash for faster user experience as they do not have to insert their bank card and increase the chance of forgetting it in the ATM. There is a coin tray to allow users to insert coins in one go, this provides an aesthetic design (see Appendix C: Figure 2). InstaATM is designed to avoid confusion and provide ease of use such that the card related transactions and the cash related transactions are separated on either side. The fingerprint recognition is at the bottom so that users can easily place their finger on the fingerprint reader.

Research Plan

Having a universal design and ensuring accessibility is a core requirement when designing InstaATMs interface. I need to ensure that InstaATM is usable and beneficial to every user regardless of their age, gender, culture etc. by adhering to the equality Act 2010 ^[12]. The star model shows the following steps: requirements, analysis and design, testing and evaluation ^[13]. Following the star model, the next steps of designing InstaATM will include recording, analysing and evaluating users' reactions and performance to scenarios, the mock-up I designed (see Appendix C: figure 3) and high-fidelity prototypes. The designs will be changed iteratively and when problems are found they will be fixed and evaluated which is key to give a well-defined design.

I will use the 'think-aloud' ^[14] method which will test participants to use the system while continuously verbalising their thoughts as they move through the user interface. For example, I will provide the user with a task to complete such as, asking the user to deposit £5 into the ATM. Then, I will ask the user to explain what they are thinking, what their next step would be and what they are expecting. This will allow me to

evaluate what users think about the design. If the user has a misconception, it will help me learn why the user finds it difficult to interact with that task. This is a procedure that can help me redesign the prototype to make it easy to use. Also, using the think-aloud method provides flexibility as I can video, or audio record the process with the permission of the user and analyse it later. In addition, as this is the start of designing InstaATM, cognitive walkthrough ^[11] is a good way to analyse the interaction of users with InstaATM by setting tasks for them to do, thus, the cognitive walkthrough is an important method of the iterative cycle of designing InstaATMs prototype. When I get to a stage of evaluation where I have a good idea of how InstaATM could work, I will use real-world data. After participants have interacted with InstaATM, they will be given questionnaires to answer by scaling their interaction experience. Overall, these steps and procedures will help design InstaATM to give a satisfactory user interface.

Conclusion

In conclusion, InstaATM is an innovative solution for bank customers to access banking services at any time and from anywhere without having to visit the bank. From this project, I have learnt invaluable skills and have had a positive experience. I have learnt that when designing any product, an easy, efficient and flexible user interface is crucial for user satisfaction. I believe InstaATM has great potential. With more time, further research and improvements, I would be able to finish the design of InstaATM to achieve a high standard product to make users' banking easy and enjoyable.

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[16] *Appendix A, Image 2*: "Westpac ATM in Melbourne Central". (26 February 2017). Available at: https://commons.wikimedia.org/wiki/File:Westpac_ATM_in_Melbourne_Central.JPG (Accessed on: 23.12.2019)

[17] *Appendix A, Image 3*: Available at: <https://www.barclays.co.uk/ways-to-bank/contactless-cash/> (Accessed on: 23.12.2019)

Appendices

Appendix A: Existing Products



Image 1: Bankwest ATM ^[15]



Image 2: Westpac smart ATM ^[16]



Image 3: Barclays contactless cash service ^[17]

Appendix B: Participant Research

Personas:

Gabriella is 20 years old. She and her friends love going out, so they usually need to withdraw instant cash. They have to carry their bank cards and a few times her friends have lost their bank cards. That leads to security issues. They heard about InstaATM and are looking forward to using an ATM without the need of a bank card as InstaATM provides access to an account with the user's fingerprints.

Margaret is 26 years old. She owns a business. She uses the ATM everyday for personal and business reasons. She usually has a limited amount of time when at the bank and thus, she wants to avoid the long queues when wanting to deposit cash and cheques. After hearing about the launch of InstaATM she wants to give it a try as it will help her save time massively because it provides all the help, she would get without joining the queue in the bank and that is from depositing cash to checking the balance to paying bills.

David is 45 years old. He has a busy lifestyle, so he tends to forget his PIN numbers as he has multiple bank cards. Also, he sometimes forgets to carry his cards on him, and he finds this very frustrating. He saw InstaATM in a TV advertisement, and he is excited to use it because it offers contactless cash service, so he does not need a PIN. Also, due to its biometric technology he will not need his bank card for verification and authentication if he forgets to carry his bank card on him.

Interview: Mrs. Reema Bhanote

Question 1: Tell me a bit about yourself?

Good afternoon, my name is Reema Bhanote and I am 29 years old. I have been working as a bank assistant at Barclays for 3 years.

Question 2: How often do you use the ATMs at Barclays?

I use them everyday for my personal account and when helping bank customers which is part of my job.

Question 3: What part of the ATMs are user friendly for example the number keypad buttons size?

Having a touch screen provides ease of use as nowadays, we are all used to that technology. Large font size is user friendly as the information can be read easily. The keypad buttons size is universal which means everyone is used to the keypad when entering their PIN. But sometimes some keypad buttons have broken or stopped working which has caused issues as the ATM becomes inaccessible.

Question 4: What age groups use these ATMs and require help most of the time?

The younger people are always good at using technology, so it is very rare for them to have problems when using these ATMs. However, when it comes to older people, they usually have difficulties so, my colleagues and I have to help them through this process from the beginning to the end which can be

time consuming and as a result, we are not able to help other customers waiting in the queues and this frustrates them which leads to bad customer service.

Question 5: When using these ATMs, what do bank customers find difficult?

Most of the time, I have seen people having problems due to language barriers and not understanding the screen instructions. Also, people tend to forget their bank card PIN so, they start looking for it in their bags and diaries which causes other customers in the queue to wait for longer until the ATMs are available, resulting in longer queues. This has caused inconvenience and customers have walked out of the bank without being served due to frustration.

Question 6: From your perspective, what do you think could help reduce these issues and improve customer service?

Well, I would say to install more ATMs because that will reduce the queue size! Having an option for language preferences would help customers interact with the ATMs rather than the staff helping them.

Question 7: What do you think of the concept of InstaATM – a smart ATM?

"InstaATM is a smarter and improved service quality to enhance interactivity and facilitate customers with an enjoyable experience. Firstly, it will have the biometric technology, that is a fingerprint recognition for bank customers to access and verify their account. This is because it is safe, secure, simple to use and requires less

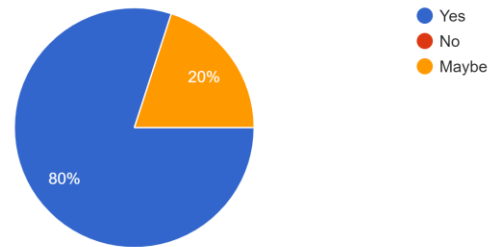
time and effort as the user only scans their fingerprint rather than inserting a bank card. It has a touch screen interface to enhance the user experience. It will allow bank customers to withdraw and deposit coins, cash and cheques without the help of bank assistants. There is contactless cash service which means you can tap your bank card on the machine reader to withdraw cash instantly without having to insert your card. This provides faster and easy user experience and it reduces the chances of forgetting your card in the ATM, thus, providing user flexibility and efficiency of use. When depositing coins, the customer will deposit all the coins in a tray and tilt it in one go, this provides a flexible, fast and easy user experience. Customers can pay bills and transfer money between accounts, this provides flexibility and user efficiency. It also provides on-screen instructions to help users when using InstaATM by focusing on the user's task, so they do not get stuck in the process. The user can check their balance which is an essential part of banking and they can change their PIN too. InstaATM will print receipts for every task the user decides to do as this a sign of good user interface because the user is provided with feedback. The design for the number keypad will be a touch screen number keypad as this is an enhanced way of providing good user interaction and it also provides a solution to the problem of buttons breaking or not working on the keypad. The bank customers do not have to visit the bank to perform any of these tasks as some people cannot visit during their working hours. So overall, it provides flexibility."

This is a very interesting and thoughtful concept! After all, every company has an aim to provide the best customer service. According to the description about InstaATM, I think this is a solution to improve the design of current ATMs.

Questionnaire:

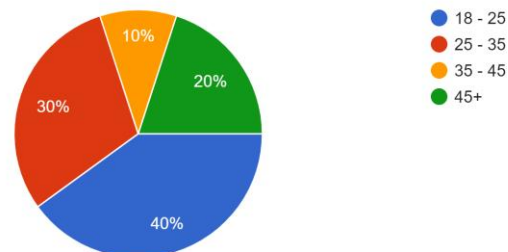
Do you think there is a need for InstaATM?

10 responses



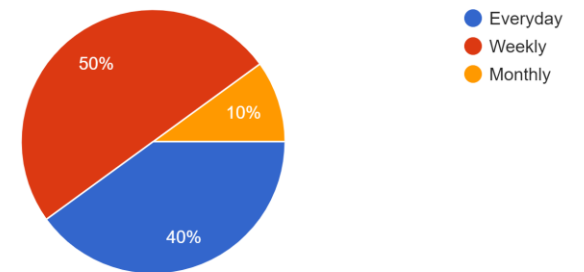
How old are you?

10 responses



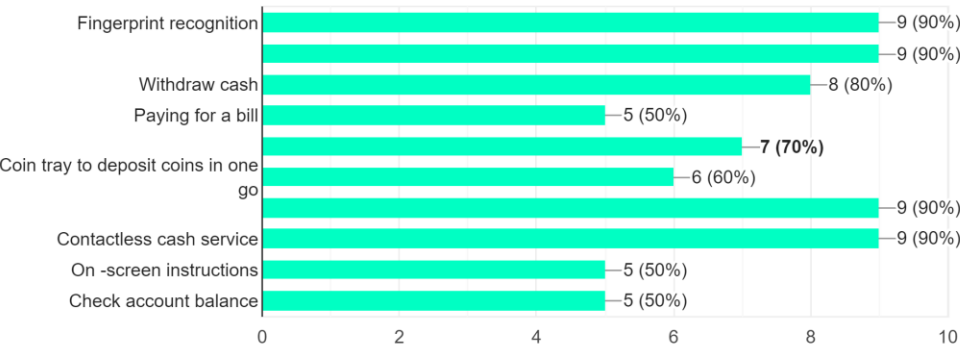
How often do you use the ATM?

10 responses



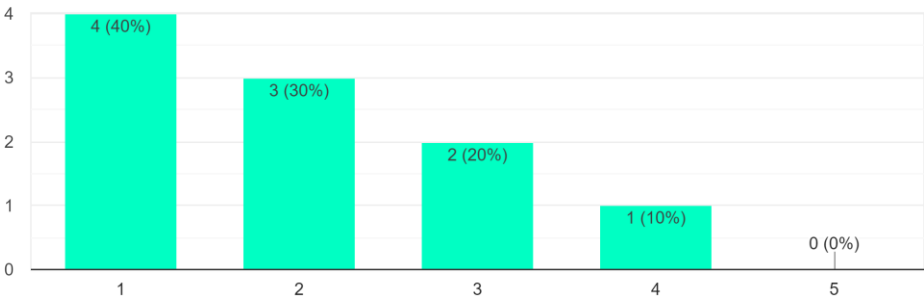
What features sound appealing to you if InstaATM were available?

10 responses



Rate the ease of using an ATM.

10 responses



What is the main reason for using an ATM?

10 responses

| |
|--|
| Cash withdrawals |
| Withdrawing cash |
| Withdraw cash, pay people |
| Withdraw cash and check my account balance |
| Withdraw cash and check balance |
| Transfer money |
| Deposit cash and cheques at the Bank |
| Instant cash on evenings out |
| Transfer money and deposit cash in the bank ATMs |
| Deposit cash in the ATM at my local bank |

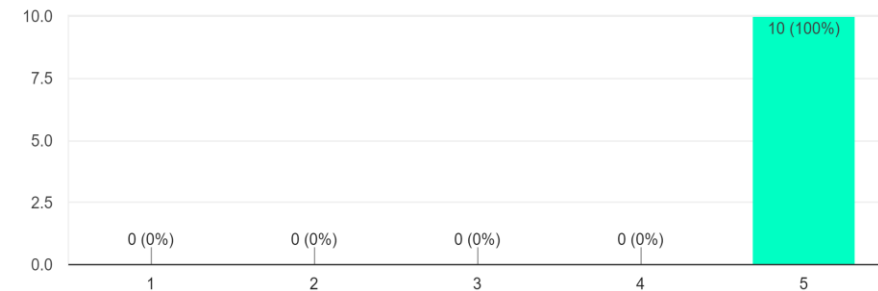
What would you add to InstaATM to make your experience easy and enjoyable without the help of bank assistants?

10 responses

| |
|---|
| Option of voice assistance |
| The features above sound appealing |
| Access multiple bank account with one fingerprint |
| Check my daily balance |
| A number keypad. I have seen that at every ATM |
| Deposit cash on the go |
| I like all the proposed features! |
| No need to carry my card |
| nothing |
| language preferences |

If InstaATM were available today, how likely are you to use it?

10 responses



User requirements:

| ID | Requirement | Importance | Source |
|------|---|---|---|
| RQ 1 | Users can interact with the screen through a touch screen interface | Makes it easy and user friendly. People are used to the interaction on mobile phones etc. | Interview, questionnaire, academic research and existing products |

| | | | |
|------|--|---|---|
| RQ 2 | Users can access and verify their bank account using fingerprint recognition | It is safe, secure, simple to use and requires less time and effort as the user only scans their fingerprint rather than inserting a bank card. So, a bank card is not required | Academic research and questionnaire |
| RQ 3 | Users can withdraw and deposit coins, cash and cheques | Users will not need bank assistants to help them and they will not have to visit the bank in order to use the ATMs. They will not have to wait in long queues | Questionnaire, interview and existing products research |
| RQ 4 | Users can withdraw instant cash using contactless | Users will only need to tap their bank card on the machine reader | Existing products, interview and questionnaire |

| | | | |
|------|--|---|---------------|
| | cash service | without having to insert the bank card. This provides a faster and easy user experience and it reduces the chances of forgetting your card in the ATM, thus, providing user flexibility and use of efficiency | |
| RQ 5 | When depositing coins, the customer will deposit all the coins in a tray and tilt it in one go | This will provide a flexible, fast and easy user experience when using InstaATM | Questionnaire |

| | | | |
|------|---|--|-------------------------------------|
| RQ 6 | Users can pay bills and transfer money between accounts | This provides flexibility and user efficiency as users do not have to go to the bank to do this | Questionnaire and existing products |
| RQ 7 | Users can follow on screen instructions when using the ATM for specific tasks | It will help users when by focusing on the user's tasks, so they do not get stuck in the process | Questionnaire and academic research |
| RQ 8 | Users will get printed receipts for every task | This is good user interface because the user is provided with feedback | Existing products |
| RQ 9 | Users can interact with the number keypad | This is an enhanced way of providing | Interview |

| | | | |
|--|----------------------------------|---|--|
| | integrated into the touch screen | good user interaction and it also provides a solution to the problem of the buttons breaking or not working | |
|--|----------------------------------|---|--|

Appendix C: Design

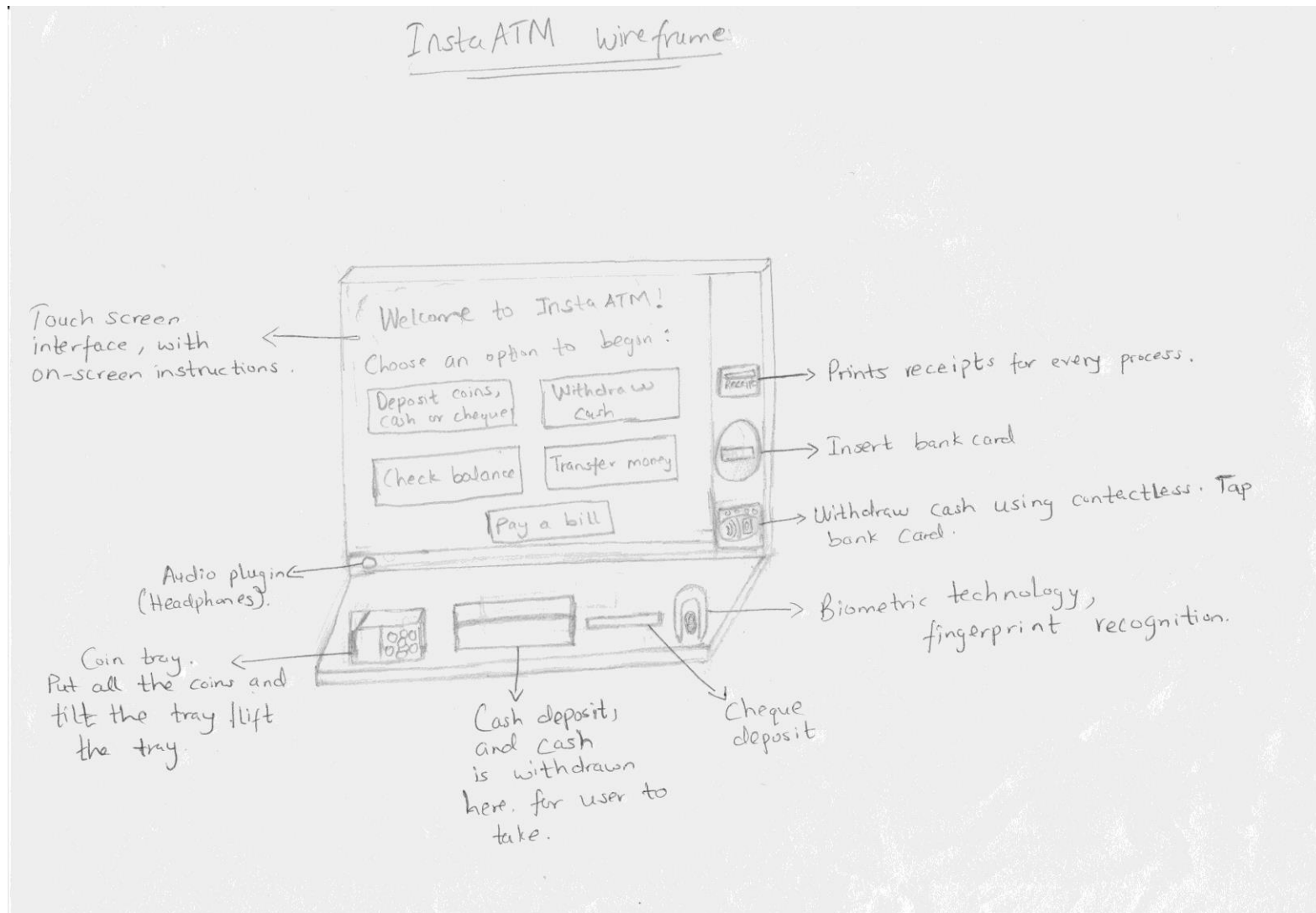


Figure 1:
Wireframe
showing
the design
of
InstaATM

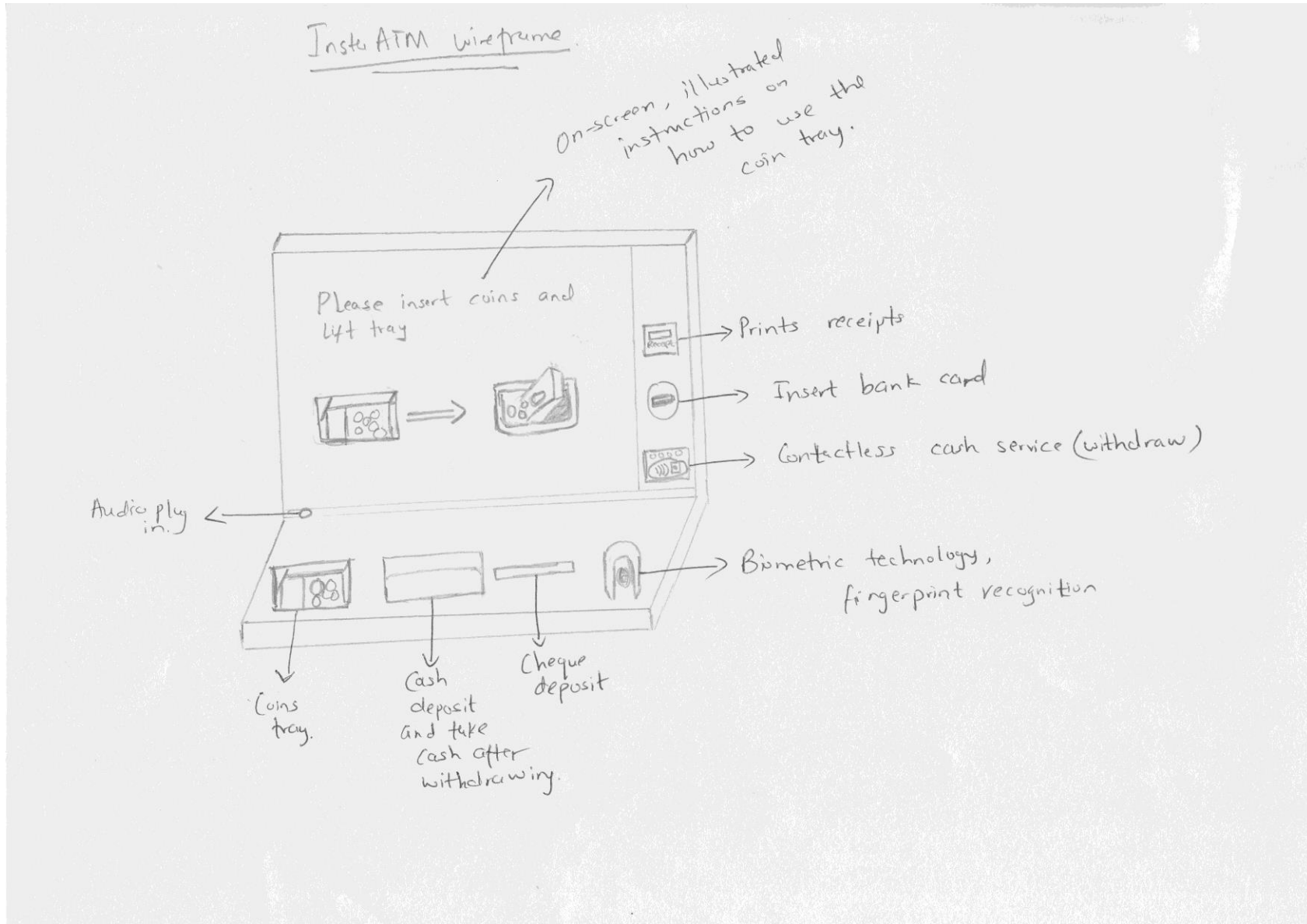


Figure 2: Wireframe showing an example of an on-screen instruction

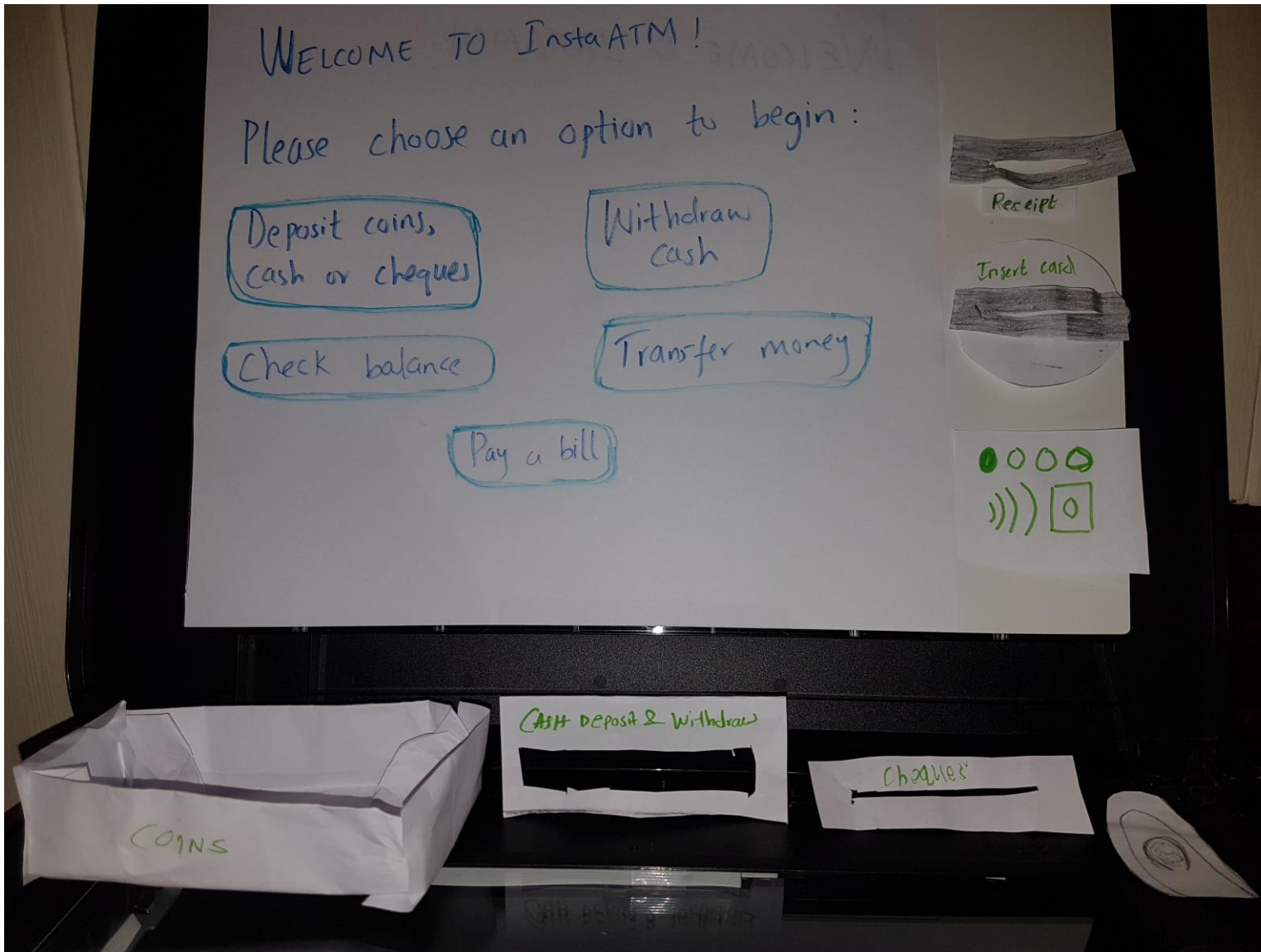


Figure 3: I built a mock-up of InstaATM