Department of Computer Science  
Introduction to Human-Computer Interaction

Improving Train Ticket Machine Interfaces

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1 Introduction

The primary aim of this project is to re-design the interface of existing train ticket vending machines (TVMs) to improve the quality of information provided to passengers and help them make purchasing decisions appropriate to their journey needs. TVMs are now in the majority of stations in the UK, and for regular users, they are an efficient and effective way to purchase tickets for trains. However, numerous reports and articles have noted that they are both complicated and difficult to use. As such, we have looked into TVMs and found that there are several ways in which the system can be improved and made more convenient.

2 Review of Existing Systems

In this section, we assess the positives and negatives of the systems currently implemented, as well as learning lessons to take forward to the design and implementation of prototypes. We will then explore the principles and methodologies which are rooted around selecting the type and quantity of tickets, and choosing a payment method by exploring the literature available.

2.1 University TVM

![Figure 1: University TVM: Starting screen](image1)

![Figure 2: University TVM: Collecting tickets](image2)

![Figure 3: University TVM: Choose date and time of travel](image3)

![Figure 4: University TVM: Summary of purchase](image4)
A common problem when using TVMs is the lack of relevant information provided about tickets and journeys. For example, information is not provided on travel restrictions for train ticket types unless prompted. This makes TVMs problematic as they are hard to use for inexperienced users who do not have knowledge of the restrictions. Furthermore, this leads to an increase in users having to request assistance from staff, negating the benefit of using the system. For those with mixed ability or those who lack technological proficiency, it makes the process time consuming as does not offer clear instructions or information.

The TVM at University station provides 3 language options: English, French and German. The lack of additional languages is problematic, given research from UK council for International Student Affairs (UKCISA) stating there were 3.5 times as many students studying in the UK from China, than there was from France and Germany combined.[1] This indicates that there should be a wider range of languages available on TVMs covering a broader geographic, and that the current TVMs do not cater for an inexperienced or non-European market, which can be problematic for tourists.

Collecting pre-paid tickets using the current system can be time consuming as it requires the user to insert the card they used for the transaction followed by a unique reference number. This makes it difficult for users to collect tickets that other people, such as family members, have purchased. This is a problem that we think can be alleviated through the use of various methods widely used in society at present such as QR codes and electronic ticketing.

Rail discounts and group travel are also areas that present problems. There is a lack of clarity around what can be purchased via each railcard option nor is there the ability to benefit from 'GroupSave' offers offered by Rail companies which are online only. This means individuals who are not regular users and would like to purchase their tickets via TVMs are unable to take advantage of the discounts due to the lack of information presented.

In summary, the current ticket vending machine (TVM) system implemented at University station does not cater for simple scenarios and people therefore favour a kiosk over TVMs as they can receive the more travel information and assistance.

Strengths:

- Displays all the different kinds tickets available.
- Can choose to depart from other stations.
- Can choose the date and time of departure.
- Displays the most common routes from the current station.

Weaknesses:

- Users of mixed ability such as those with visual impairment, colour blindness or those less technologically proficient.
- Users who lack understanding of English, German or French i.e. tourists.
- lack of group booking and discount card information and functionality
- Collecting pre-paid tickets.
2.2 China TVMs

Strengths:

- Displays destinations on a map, and routes are colour coded for clarity.
- Displays current station.
- Choose the number of tickets by entering digits.

Weaknesses:

- Only two system languages to choose from: Chinese & English.
- Single tickets only.
- Cannot buy tickets to depart from other stations.
- Cannot choose the destination by inputting the name of a station.

Figure 5: China Subway TVM
2.3 Japan TVMs

**Figure 6**: Japan Metro TVM

**Strengths:**

- Displays the different kinds of tickets available to buy.
- Making choice by press a button helps avoid the difficulties associated with touch-pad input.
- Destinations are organised by price indicating distance (Figure 7).

**Weaknesses:**

- No language options.
- Single journey tickets only.
- Cannot buy tickets to depart from other stations.
- Cannot choose the destination by inputting the name of a station.
2.4 France TVMs

Figure 8: France TVM: Choose payment method
Figure 9: France TVM: Station to depart

Figure 10: France TVM: Destination

Figure 11: France TVM: How many tickets (Adult & Child)

Figure 12: France TVM: Choose the date

Strengths:

- Making choices by switching a button avoids the difficulty of interacting with the touch-pad.
- Audio help provided.
- Can choose to depart from other stations.
- Choosing the number of people by picking digits.

Weaknesses:

- Displays date to depart in such a way users cannot obtain the relevant information quickly.
- Cannot choose the destination by inputting the name of a station.
3 Literature Review

3.1 The history of the vending machine

Vending machines are a type of automated machine that sells merchandise such as cigarettes, beverages, tickets, and hot drinks. The first vending machine, invented in England in 1880, was coin-operated and primarily used to distribute postcards, envelopes, and notepaper. In 1887, a company called Sweetmeat Automatic Delivery was founded as the first vending machine provider, and in 1888, vending machines were introduced to the US market. Now vending machines can be produced to offer a wide range of products, from photo booths and newspaper vending, to food and snack vending.

3.2 Review of previous research

Ticket machines are a common type of vending machine, designed to provide convenience for passengers when buying train tickets compared with other options such as ticket offices. Thousands of passengers use TVMs every day for immediate tickets and ticket collection, and most passengers have high expectations for TVMs.

As stated by the National Passenger Survey (Spring 2008), the utilisation of TVMs to buy tickets is lower than ticket offices (71% vs 79%). It is necessary to understand the reason why passengers prefer the ticket offices over ticket machines. To analyse this problem, discussed below are three reports on the use of TVMs and the problems associated with their use.

According to Transport Focus (2017), there are several reasons why passengers are reluctant to use TVMs:

- Lack confidence to use TVMs (especially when there are queues)
- Lack of confidence to select an appropriate ticket
- Older passengers prefer the convenience of ticket offices
- Face-to-face transactions provide assurance for some passengers
- Some types of tickets are not available from TVMs (tickets for reservations, tickets from other places/stations etc.)
Research from Passenger Focus (2014) about ticket machines also mentioned some changes TVMs should take. In this research, some more specific problems of current TVMs have been listed:

- The volume of information is scarce, which makes it difficult to locate the information you want. Some information boxes are located at the bottom of the screen and can be missed easily. Furthermore, some information is written in inappropriate colour, which will not be readily visible to all customers.

- The age band for children tickets are not showed in TVMs, so passengers are unaware of what is defined as a child.

- There are several different types of machines provided by different operators, sometimes located in the same station. The processes and functionality tend to differ from each one. This is a normal phenomenon confusing lots of passengers. For example, one TVM may offer a rail card without requesting a photo card number while another machine at the same station requires it.

- At hub and terminal stations, TVMs are located next to each other but are provided by different TOCs which may offer different products. The range of tickets on offer and priority given to them is varied, and from the passenger’s perspective, without an obvious rationale. This includes not providing tickets to some regional towns serviced by the station.

- Some ticket machines nationally do not provide the option to purchase tickets to local stations built within the last 6 years. Train companies cite the high cost of reprogramming some manufacturers TVMs as a key factor preventing the updating of machines. ATOC have advised they are working to develop an automatic feed to correct this matter but have not offered a date when this development will be in operation.

- The presentation of TVMs offers no information as to the range of products available.
• Even at unstaffed stations passengers are offered no advice as to what to do if they are unable to purchase the required ticket from the TVM. Permits to travel tickets are rarely available. This exposes passengers to the risk of unpaid fares, and penalty fines.

• Some stations only provide TVMs on one side of the platform

• Some TVMs only accept credit cards

• Some TVMs are subject to glare on screens during daytime

In short, the TVM in its current form is not able to dispense a full range of products or provide sufficient information about routes and restrictions to satisfy the purchasing needs of all passenger groups. There is evidence to show that many passengers benefit from using TVMs to collect pre-booked tickets on departure, and regularly purchased tickets. So TVMs are beneficial for passengers as part of an overall retailing strategy, but are not a universal solution to ticket retailing, or reducing the cost of running the railways.

From Figure [14], people who do not consider TVMs now might try to use TVMs if they were to be improved. TVMs are expected to be easier to use, have shorter queues, provide discounts and more information on journeys.

![Figure 14: Reasons passengers might consider using TVMs](image)

According to the report from Office of Rail and Road (2017), current train vending machines are not enough for passengers to purchase tickets. The results suggest that 20% of passengers cannot select the right tickets for their journey, and around 13% of them would suffer from financial detriment. There is another 7% of them who have chosen discounted tickets, while some tickets have limitations, like restrictions on routes or certain train operator services.
Five key areas of concern have been summarised and emphasised from the passage above, which are:

- The misunderstanding of the jargon
- Large range of ticket types
- Ticket restrictions
- Timing of off-peak/advanced sales
- Filtering of fares

Referring to problems of TVMs displayed above, two issues have been highlighted and concluded as the most important. First, TVMs should not include jargon, since it could confuse passengers or provide too many options. The purchasing process should be as simple as possible. Especially, for those who lack confidence in using TVMs and are unsure of what ticket they need. TVMs should have the functionality to guide them to find the most appropriate ticket. Secondly, it is mentioned that some tickets are not available using TVMs, like GroupSave or DayRangers tickets. This suggests some of the most appropriate tickets for passengers are not available in TVMs. For this kind of problem, the solution may be to connect the operator to the correct the price later in the process.

3.3 Brief Recommendations

- To reduce passenger confusion, TVMs should display the valid tickets at the certain time. For example, during the peak times, off-peak and super off-peak should not be displayed. Another alternative would be for TVMs to display the cheapest and most appropriate ticket for the passenger based on the number of passengers they are travelling with. Currently, the machine could display some tickets which are more expensive than what is needed. For example, when passengers are purchasing tickets in off-peak times, anytime tickets will still appear on the screen, which may confuse passengers and result in overpaying. Also, super off-peak tickets are not clearly available on TVMs.

- TVMs should permit the sale of GroupSave and DayRanger tickets. It might be convenient for passengers who are planning to buy tickets for a group of people. It is unfair to people who know there should be a discount for groups, to be charged full prices because of using TVMs.

- TVMs should include more information about the time, the train operator etc. Day Ranger tickets are a good choice for the journey in question (tourists), however, the Day Ranger ticket seems never appears in TVMs.

- All TVMs should allow passengers to purchase tickets to all stations. The system and program should be updated to allow new stations to be added automatically.

- The price structure should be reconsidered. For example, the pricing of the single and return ticket is somewhat confusing. The single ticket is just 1 pound less than the return ticket, while it should be half price of the return ticket. However, it must be stated that this is a problem with rail travel in general and is not solvable via TVMs.
Regarding ticket restrictions, TVMs should recognise the passengers needs when they are purchasing tickets on certain routes and the operators that provide services on the route. This will reduce the surcharge and penalty resulting from choosing the wrong tickets. Further, the restrictions should be printed on the ticket, which at present is not clear for passengers.

Towards the end of peak time, all the TVMs, ticket offices and websites should remind passengers to consider a cheaper solution to split the journey into two and purchase the peak time ticket for the first part and off-peak for the second part. For example, assuming a passenger is going to departure from Kettering to Exeter at 8:56, which would be at the peak time and the Anytime Single ticket might cost around £185. Alternatively, super off-peak tickets are available from Paddington to Exeter at 11:06 and cost £46, purchasing an Anytime Single ticket from Kettering to London for £64.50 saving £74.50.

Different languages should be offered on TVMs. At present, German and French are generally provided, while other languages such as Chinese and Spanish are not. A wider collection and variation of languages should also be considered given the blend of nationalities, languages and cultures in the UK at present.

3.4 The Future of ticketing

In the rail transport industry, change tends to happen slowly, despite it being a system which handles millions of passengers using every day. However, with the rate of technological development increasing, it is increasing the rate of change in the rail industry, which will help to improve the efficiency and reduce costs. The main purpose is that systems should be simple to use and understand, and reassure passengers so they can select the right ticket for their journey. For example, smart ticketing technologies, such as contactless payments, QR codes, electronic tickets etc. can be adopted and adapted for use by rail companies. In the last decade, smart-card based systems are overtaking traditional paper-based tickets in part of transport networks and we expect this trend to continue.

At this year’s UITP World Congress & Mobility and City Transport Exhibition in May, transport IT and services specialist Cubic Transportation Systems proposed a ticketing concept that it hopes will lead to a new wave of high-tech innovation for the transport sector. NextAgent is a ‘virtual’ ticket office, combining the functionality of ticket offices, vending machines and call centres. The system is designed to provide all the benefits of the traditional manned ticket office with the streamlined operational advantages of vending machines. The NextAgent vending machine is equipped with a high-definition screen that provides a video connection between the ticket purchaser and a remote ticket agent. Compared to buying tickets online or via mobile phone, many passengers still prefer using ticket windows. According to the research carried out by the company, it is because they want to speak to somebody, especially when they travel alone. In that case, NextAgent would be a good system to combine everything together to satisfy most requirements of passengers.
4 User Requirements Analysis

In order to generate user requirements that improve TVMs based on our initial analysis, we have developed 4 well-defined personas based on different demographics in today’s society. Each Persona represents a different set of personal requirements and goals from using TVMs and has varying levels of technological aptitude, which we believe will help direct the design of our first generation prototypes to fit more users.

4.1 Technology Use

In order to provide an accurate description of the technological capabilities and interests of our personas, we have based the technology use criteria on Rodgers Diffusion of Innovation theory. The theory outlines the rate at which innovation and new technology is diffused and consumed by groups within society. Each persona has been placed among the various groups along the innovation curve, providing a better view of how likely they are to interact with and use new technologies. A summary of the groups defined by Rodgers is provided below:

- Innovators - 2.5% of the population. Risk takers and Trend Setters. They spend considerable time and energy on thinking up new ideas and adopting new gadgets, even if they will ultimately fail. They enjoy being the testers.

- Early Adopters - 13.5% of the population. Strategic technology users. They tend to adopt new technologies when they are successful and they can find a link between the innovation and their personal needs.

- Early Majority - 34% of the population. Pragmatic individuals who will only adopt new technologies when solid proof of the benefits has been provided. They are influenced by mainstream ideas, but are looking for value for money and do not take risks.

- Late Majority - 34% of the population. Driven by the fear of not fitting in, they often follow mainstream fashion and established trends. They are risk averse and uncomfortable with new ideas.

- Laggards - 16% of the population. They hold out until the very end and find adopting new technologies high risk. They often find arguments not to adopt new technology and prefer traditional methods.
4.2 Persona 1 - The Young Tourist

James Francois

Goals
- James wants to travel to as many tourist attractions as possible.
- His partner wants to maximise the benefits of travelling planning and advance tickets.
- He wants to pay by card as he has a zero interest card.
- He wants to use trains to get to as many places as possible to get a better experience of his surroundings.
- He wants tickets to be available from his phone so he does not have to carry around paper tickets.

Frustrations & Pain Points
- James would like to avoid machines that do not accept contactless payments.
- James wants to book a group ticket without having to go online or to the kiosk.
- The current TVM means you can only purchase one ticket at a time when multiple people have 16-25 railcards.

Bio
James is a Small Business owner from Brussels where he runs an online web design company. He is a flexible worker and can work anywhere in the world. He always carries a Surface tablet to ensure he can surf the web and work on the go. He has started a 6 month travel period around Europe with his partner and is currently doing the first month of it in the UK. He has decided to stay in Birmingham as it was cheaper than London and in the centre of the UK which means it will have good transport links all over the country.

James is fluent in French and Dutch (Flemish) and has a basic spoken understanding of English. He is keen to improve his spoken English and has minimal motivation for the written aspect of the language.

James and his partner would like to explore as much of the UK as possible and go to as many events as possible. They have earmarked London, Edinburgh and Lake District as key destinations, and would like to find out more information on events and locations that they could do whilst in the UK.

Technology Use
- James is an innovator, and is in love with new and emerging technologies. He often queues or signs up for the latest technologies or software and is keen to test out the bugs to discuss with his friends and advise them on it.
- He owns a Samsung Galaxy S8 and is likely to upgrade to the S9 when it comes out. He is keen on wearable technology and wears a smart watch and fitness bands.
- He also carries around a Surface pro for work reasons.
4.3 Persona 2 - The Local Head Teacher

Mary Elizabeth-Weir

Goals
- Mary wants to be able to use train tickets for large family outings and school trips.
- She wants to pay with her company card for school trips.
- Her husband wants to put all family travel expenses on their shared credit card.
- Her kids want to be able to pick up tickets that their mum has purchased for them.

Frustrations & Pain Points
- Mary would like to use trains more but thinks the hassle is not worth it.
- She often has to rent a bus/coach for school trips and has begun to adopt the same method for family trips.
- She is finding it difficult to find out about discounts on group travel.
- She feels there is a lack of clarity and additional wait time for group tickets.

Scenarios
- Mary would like to book a family trip for 4 days to London for her husband and kids. She would like to book seats on the train to ensure everyone gets a seat and sits together throughout the journey and would like a train which has a shop.
- Mary would like to encourage teachers to use public transport as much as possible and has identified an upcoming trip to the University of Birmingham for a talk on careers in chemical engineering as a trip that should make use of public transport given there are only 12 year 13 pupils who are interested applying for the course. She would like information on group travel to be easily available so she and the teachers can discuss travel options and price with the students.
- Mary and her husband have spent £70 on train tickets for their two daughters to travel to a festival in Nottingham. They would like for their children to be able to collect the tickets without having to give them to their card to collect the tickets.

Bio
Mary is a Mother first and a teacher second. She enjoys spending time with her family and enjoys working with children and seeing them progress. Her passion for working with children has led to a successful career as a teacher and she was recently appointed by the Kind Edwards consortium as the Head of the School in Harbourne. Her mode of transport to and from work is via car with 2 of her kids who study at the same school.

A topic that has become a big part of Mary’s job is agreeing transport with teachers for school trips. She is an advocate of using public transport for trips within West Midlands and encourages her teachers to use this mode whenever possible, particularly in cases where the trip is restricted to just once class (<30 pupils) but she often makes exceptions given the ease of use for Coach and Bus rental as opposed to booking train tickets for trips.

Outside of work, Mary spends the majority of her time with family, often planning trips and days out. As the family is quite large, and includes her parents who live nearby, Mary prefers to use public transport wherever necessary and has grown accustomed to making family travel journeys. However, she would like to find a more effective way of doing this, as she has been forced to download the app given the lack of options and information on TVMs, and the limited time that the ticket is generally open at her local station.

Technology Use
- Mary is keen to exploit technology when needed and uses it work extensively. However, she relies on her husband to handle the technology at home.
- She likes to read and the only technology she is concerned with is a Kindle.
- She is keen to adopt to new technologies and prefers reliable and consistent systems and software.

Persuasive

Caring

Family-Orientated

Motivations

Cost

Time

Convenience

Accessibility
4.4 Persona 3 - The Undergraduate Student from London

Adam Khan

Goals
- Adam would like to buy cheap tickets wherever possible.
- He would like to keep up to date with fashion and the latest technology products.
- He likes things that are convenient and easy to understand.
- He has an affinity for Apple products and would like to use his phone and its functionality wherever possible.
- Want to be a neurosurgeon.

Frustrations & Pain Points
- Adam is frustrated by the complexity of train ticket machines in comparison to other service machines.
- He would like to use his phone to complete the payment but there is a lack of mobile and contactless payment points.
- He would like all options available for him to be displayed so he can see the cheapest ticket. He has only just found out about super off-peak tickets, which are cheaper.

Bio
Adam is a medical student at the University of Birmingham who wants to specialise in neurosurgery and is determined to pursue a masters in the subject to attain this goal. He lives in Edgbaston with his course mates and they live a very social lifestyle, choosing to relax where possible as their course is demanding.

He enjoys fashion and likes to keep up to date with the latest technology, particularly Apple products. Due to this affinity with Apple, he has become cashless and uses his phone for all his problems and payments where possible, also storing the bulk of his personal information on his phone and on iCloud.

Adam travels home on the majority of weekends to see his family and get some food. As such, he likes to book tickets on the day for flexibility as he does not know what time he will go and what time he returns and, so he prefers open returns.

Technology Use
- Adam is an early adopter, generally purchasing new technology items within a week of two of their release.
- He loves Apple products and has a complete suite of Apple goods.
- His phone is his most important thing in his life and he uses it for everything where applicable.

Scenarios
Adam would like to go home on Friday afternoon after his lecture and would like to come back on Sunday morning. He would like to see all ticket options available to him at the train station, and what restrictions apply to each so he can review the options and choose the most suitable ticket.

Adam would like to see how many stops the journey would have and the difference in the length of the journey when booking at a local train station compared to the mainline train station. He would like to pick the fastest train with the least amount of stops, but does not find this information available to him on ticket machines.

Adam would like to know if there was the option to buy a travel card or season ticket to travel between Birmingham and London as he does this journey frequently. He would like to know whether this would be more cost effective than buying tickets on a weekly basis.

Motivations
- Cost
- Time
- Convenience
- Accessibility

Fashionable
Social
Competitive
Determined
Opportunistic
4.5  Persona 4 - The PhD Student from Chang Zou, China

Lin Chen

Goals
- Lin wants to visit every majority city and major attraction in the UK.
- Lin would like to do this with friends on occasion and alone the rest of the time.
- She would like to finish her PhD in Computer Science before she is 30 to undergo some professional working experience.
- She would like to become a competent badminton player.
- She prefers long commutes to do some work or reading on the go.

Frustrations & Pain Points
- Lin is frustrated by the lack of functionality and language options on self-service machines in the UK.
- She finds train travel more complex than it should be as the machines are slow and there are long queues.
- She would like the information on changepots on routes to be explained and displayed when travelling.
- She finds it hard to read some of the information as it is unclear and has on occasion had to use the kiosk.

Bio
Lin is a Computer Science PhD student from China, focusing her research on blockchain technologies. She is keen to contribute to the field and aims to produce research into the use of blockchain for e-voting. She lives in a shared house with fellow PhD researchers in Harborne.

She grew up in China and studied her undergraduate and masters degrees in Hong Kong before coming to the UK to continue her education. She has had mild dyslexia from a young age and has developed a learning method, preferring visual learning methods and collaborating with others as it makes it easier to absorb and validate the research that she is carrying out.

She has been in the UK for 6 months and is becoming more and more use to the language and people, and has begun to meet more people and explore more, picking up the hobby of badminton with her friends to keep her fit and active. In addition to this, she would like to see as much of the UK as possible and has begun making use of the travel options available to her by going on train trips to other cities and other major UK attractions.

Technology Use
- Lin is part of the early majority, which means she is quite up to date with technology, but often wait a month or so before purchasing.
- She uses technology when needed, and uses her laptop and tablet when travelling so she can do some research on the go.
- She likes technology, and has a deep understanding of its use and is researching how it can be more beneficial to society.

Age: 27
Occupation: PhD student
Family: Lives in shared house with 3 friends
Location: Harborne, Birmingham
Technology Level: Early Majority

Motivations
Cost
Time
Convenience
Accessibility
5 First Generation Prototypes

In this section, we present our three first generation prototypes based on the needs and requirements summarised in our review of related systems, literature review and user requirements analysis. A summation of the points that we aimed to cover in our first generation prototypes can be found here:

1. The option to select from a wider selection of languages.
2. Provide information on ticketing and travel options
3. Provide instructions which are easy to follow and understand.
4. To have the ability to navigate through the various screens and options with ease.
5. Accounting for users with varying levels of technological proficiency and/or less able users through multiple input options. i.e. audio alongside written information.

In addition to this, we have critiqued our designs based on Shneiderman’s Eight Golden Rules of interface design.

1. Strive for Consistency - standardising the way information is conveyed and the terminology and processes used within the system.
2. Enable Frequent Users to use shortcuts - Certain shortcuts and sequences that enable those familiar with the system to perform actions more efficiently.
3. Offer informative feedback - Offer an appropriate level of feedback based on the magnitude of the action performed by users.
4. Design dialogue to yield closure - Ensure the user understands when the process has ended.
5. Offer simple error handling - If mistakes happen, users are offered clear and informative instructions to enable them to recover.
6. Permit easy reversal of actions - Allow the user to return to the previous state of the system whenever they choose to, to reduce anxiety from mistakes and encourage system exploration.
7. Simple internal locus of control - The user is in control of the system, which is responsive to the user actions.
8. Reduce short-term memory load - Keep displays simple and enable the consolidation of multiple pages (in this scenario, screens) where possible to provide time for learning action sequences.

Each prototype is to be ranked out of 5 against each of the 8 Golden rules to reflect how adequately it addresses each of the rules. This will enable us to identify the strengths and weaknesses of each of our prototypes, and provide impetus to build our second generation prototypes. Please refer to the table below for our scoring criteria.
Table 1: Prototype scoring criteria

<table>
<thead>
<tr>
<th>Score</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does not address the rule at all</td>
</tr>
<tr>
<td>2</td>
<td>Poorly addresses the rule</td>
</tr>
<tr>
<td>3</td>
<td>Adequately addresses the rule</td>
</tr>
<tr>
<td>4</td>
<td>Covers the majority of the rule</td>
</tr>
<tr>
<td>5</td>
<td>Addresses the rules completely</td>
</tr>
</tbody>
</table>

5.1 Prototype 1

5.1.1 Route 1 - Collecting tickets

5.1.2 Route 2 - Local travel
Choose the line from the top. For journeys at different times, press other time.

Choose the destination on the selected line.

Select single or return ticket.

Select the number of passengers by choosing the numbers for each category.

Do you have a railcard?

Select the type of railcard and enter the number of cards for each type.
5.1.3 Route 3 - Intercity travel

Choose whether to collect a ticket or buy a ticket.

Choose local or inter-city train line.

Inter-city tickets: Enter the destination in the text box or select region on the map.

Choose the destination on the map or one of the line options next to the map.
Choose first or standard class and select the seats.

Single ticket, return, or open return.

Choose the date and time of departure.

Select the number of passengers by choosing the number for each category.

Do you have a railcard

Select yes or no.

Select the type of railcard and enter the number of cards for each type.
5.1.4 Description

Prototype 1 is a simple design that addresses some of the common problems with ticket vending machines such as a lack of language options, an arduous collection process, and not being able to book multiple tickets with a railcard. The layout is simple without too much information on one screen, with good contrast between the white background and black text. Every screen has a back button to allow users to go back one step, a cancel button to clear all data and close the session, and a help button to call for assistance.

This prototype offers a faster collection process for pre-paid tickets by giving users the option to scan a QR code, avoiding having to insert the card and reference number. Six language options are available, with the addition of Mandarin, Japanese, and Spanish to the default English, French, and German. This caters to a wider demographic of tourists and international students.

Users can select their routes by picking one of the colour coded lines on the map, allowing the stops on a particular route. Once they have selected their preferred route, they can add the number of adult and children tickets and the appropriate railcards for all passengers where necessary. This is useful for those travelling as a group or as a family as they can purchase all tickets in one transaction. This makes purchasing multiple tickets with multiple railcards faster and easier. Users can also purchase inter-city tickets for multiple passengers with railcards in one step. After confirming the destination, date and time of travel, users have the option to select between first and standard class tickets, and whether they wish to reserve their seats.

5.1.4.1 Shneiderman Analysis
5.1.4.2 Strengths

- Dialogue - Prototype 1 scored highly in dialogue as it provides clear and concise information on every screen, ending the process with a clear summary of what has happened and what is required to complete the process.

5.1.4.3 Weaknesses

- Shortcuts - There is a distinct lack of shortcuts in prototype 1, which means the system does not benefit frequent users. Instead, there are multiple routes which are beneficial where there are multiple tourists or individuals unfamiliar with TVMs, but time-consuming and inefficient for frequent users, resulting in a poor score in this category.

- Error Handling - Prototype 1 scored poorly for error handling as there is insufficient information provided on the options available and on what steps to take given an error.

5.2 Prototype 2

5.2.1 Route 1 - Collecting tickets
5.2.2 Route 2 - Local travel

Choose whether to collect a ticket or buy a ticket.

Choose local or inter-city train line.

Select the first letter of your destination.

Select the destination station.

Single or return ticket.

Select the number of passengers by choosing the number for each category.
5.2.3 Route 3 - Intercity travel
Select the first letter of your destination.

A B    M N O
C      P Q R
D E F G H S T U
I J K  V W X Y Z

Select the first letter of the destination.

Choose the Station you are going to.

Choose the destination station.

Choose first or standard class and select the seats.

First Class

Axle        Window

Second Class

Choose the date and time of departure.

From  Birmingham  To  Edinburgh

XXXX-XX-XX

14:05+19:20 £88.05
14:30+20:05 £88.05
14:55+19:40 £88.05

Select the number of passengers by choosing the number for each category.

From  Birmingham  To  Edinburgh

Adult

0 1 2 3 4 5 6 7

Child

0 1 2 3 4 5 6 7

Pay for the Ticket
5.2.4 Description

For prototype 2, the main aim was to simplify the buying process for passengers purchasing train tickets, and it can be generally divided into three routes. Route 1 is for passengers looking to collect tickets. They can collect tickets by either: inserting their payment card along with a reference number, or by scanning a QR code, which makes it possible for someone to collect tickets on behalf of others. If the passenger chooses to buy tickets rather than collect, then they must go through route 2 or 3.

Route 2 is for passengers looking to buy local tickets, i.e. they’re travelling within the region. They are then asked to select the route they will be travelling on and the station they will be getting off at, making it easier for people who are new to the city and unsure of the different station. Route 3 is for inter-city tickets, i.e. passengers travelling outside the region. When passengers choose their destination, they only need to enter the first few letters of their destination as the machine can begin to narrow down the results by letter. The ticket type and the number of tickets are displayed using graphics, which is clearer and easier to understand.

Furthermore, a big improvement in prototype 2 is the ability to add multiple railcards to the system by scanning the railcards through sensors. The sensors can then recognise the type of railcard and to whom it belongs. This function can benefit groups of passengers with multiple railcards between
them. Visibility is good throughout the system with clear text on the screen accompanied by images providing clear information to customers. Options are displayed logically so the customer can switch through tabs and re-make their choices. This is done via the toolbar at the top of the screen. Efficacy is prioritised over efficiency as customers must make a decision at every stage of the process even if it is not necessary.

5.2.4.1 Shneiderman Analysis

![Shneiderman Analysis Diagram](image)

**Figure 16:** Prototype 2 score based on Shneiderman analysis

5.2.4.2 Strengths

- **Consistency** - The clear text and large on-screen icons throughout the system provide a consistent theme, providing clarity throughout the process and information for passengers so timely decisions can be made.

- **Dialogue** - like Prototype 1, prototype 2 scores highly in dialogue as it provides clear and concise information on every screen, ending the process with a clear summary of what has happened and what is required to complete the process.

5.2.4.3 Weaknesses

- **Error Handling** - There is a lack of information on screens for simplicity. This, in addition to not having an 'ask for assistance' sign when errors are made, prevents customer errors from being dealt with efficiently. Instead, you have to go back a screen or begin the process again.
5.3 Prototype 3

![Diagram of the prototype](image)

- **Welcome**
  - Text: Welcome, Bienvenue, Willkommen, Bienvendo, etc.
  - Instructions: Please scan your QR code to access your profile or press the screen to begin.

- **Choose a Language**
  - Select a language.

- **Buying or Collecting**
  - Question: Are you Buying or Collecting?
  - Options: Buying, Collecting.

- **Passenger Information**
  - How many people will you be travelling with today?
  - Options:
    - Children: Under 12
    - Teens: 13 - 17
    - Young Adults: 18 - 25
    - Adults: 26 - 64
    - Seniors: 65+

- **Date and Time**
  - Please select the time and date of travel.

- **Destinations**
  - Where would you like to travel to today?
  - Options:
    - Tap here to input destination manually.

- **Additional Note**
  - Either tell the machine using voice recognition, or type in the destination manually.
5.3.1 Description

For prototype 3, we focused our design on being as innovative as possible, considering new technologies such as natural language processing systems. Like the Amazon Echo or Apple’s Siri, prototype 3 is a ticket vending machine that will be able to understand the input of the user and guide them to the ticket they are looking for through verbal communication and interaction. There is an option at the start to turn off the voice assistant and go with written communication via touch input. This feature is extended throughout the system, with the option to play, pause and stop the voice assistant on every page. This is a particularly good for those of mixed abilities, providing a variety of options to guide passengers through the process. Aligned to the research carried out by NextAgent, this combines the comfort of being able to speak to someone, whilst enabling you to use a TVM, providing the benefits of a manned ticket office.

Additional features added for this design include the profile button at the top of the screen. This enables owners of the train line or national rail app to log into the machine by scanning their personal QR code. This will produce the information on their account, including frequent and favourite journeys, enabling the process to be simplified and amplifying the benefit of creating a user
account. Another important feature is the ability to choose from a variety of different languages. The spoken language is limited to English, however, the on-screen language will be changed to reflect the language chosen by the user. Other features include a trip advisor sponsorship, providing information on locations once they are selected, the passenger information screen which includes a variety of passenger types and options, and the discount cards section, which primarily displays the main discount cards, however, it also provides an option to access additional group save and travelcard options if required by passengers.

5.3.1.1 Shneiderman Analysis

![Shneiderman Analysis Diagram]

**Figure 17:** Prototype 3 score based on Schiedermann analysis

5.3.1.2 Strengths

- Feedback - A key strength of prototype 3 is the ability to provide appropriate feedback for user actions. This is primarily a function of using a natural language system, however, the options available on the screens also provide this.

- Action Reversal – Prototype 3 excels in the action-reversal phase, enabling the customer to go back and forth on each screen, enabling easy transition and movement between the various screens. Additionally, you can play, pause and stop the virtual assistant on each page, enabling customers to listen to and/or read information when and where they feel is necessary.

5.3.1.3 Weaknesses

- Dialogue - Prototype 3 performs poorly in this area as there is no end to the process as shown in the prototype, and therefore no function to close out the process other than the last payment page displayed. This needs to be added and thought through.

- Short Term Memory – prototype 3 scores poorly in short-term memory load due to the amount of information displayed on each screen to achieve it. Pages such as the railcard page or the ticket booking page are cluttered with information. This mitigates the cascading of pages and floods the user with information.
6 Evaluation of 1st Generation Prototypes

6.1 Shneiderman’s Eight Golden Rules

Based on our scoring of our first-generation prototypes, we have drawn the following conclusions which will aid the development of our second-generation prototype. The prototype with the highest total score will be used as the basis, with areas of strength in the other two being incorporated into the design.

Table 2: Prototype scores

<table>
<thead>
<tr>
<th></th>
<th>Prototype 1</th>
<th>Prototype 2</th>
<th>Prototype 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency</td>
<td>4</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Shortcuts</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Feedback</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Dialogue</td>
<td>5</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Error Handling</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Action Reversal</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Locus of Control</td>
<td>3</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Short Term Memory</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Totals</td>
<td>24</td>
<td>28</td>
<td>30</td>
</tr>
</tbody>
</table>

Each golden rule is summarised and marked Satisfactory or Needs Improvement based on the average of the first generation prototypes. Satisfactory denotes an area where minimal improvement is needed and or the prototypes have effectively met the rule, whereas Needs Improvement denotes an area in which our prototypes did not adequately satisfy, and requires significant improvement to meet the criteria in that area.

1. Each prototype has provided a consistent theme for its interface, presenting simple and understandable information. SATISFACTORY

2. Prototype 3 is the strongest when providing shortcuts for those familiar with the system. However, this is only a 3, with the remaining 2 prototypes not providing features which benefit regular users. NEEDS IMPROVEMENT

3. All prototypes show consideration for providing feedback based on user input, which is to be expected given the system being based on user input. This is a key area of strength in prototype 3. SATISFACTORY

4. Prototypes 1 and 2 both provide clean and clear information on process closure, providing the information required to help users understand when the process has finished. SATISFACTORY

5. Error handling is relatively poor in prototypes 1 and 2, whereas it is somewhat strong in prototype 3, which provides information and options to move on from errors. SATISFACTORY

6. Action Reversal is an area of strength in all prototypes, with each providing a feature to reverse actions and go to previous stages in the process. SATISFACTORY
7. Locus of control is relatively consistent across all prototypes, with each system responding to users input, as you would expect. Improvements can be made, but they are minimal. SATISFACTORY

8. Short Term Memory is an area of weakness in all prototypes as there is no consolidation of pages, and where there is, there is an information overload. NEEDS IMPROVEMENT

In Summary, having reviewed all prototypes based on Shneiderman’s Eight Golden Rules, we have found that our prototypes are satisfactory in providing sufficient features to meet 6 out of the 8 Golden Rules. We have also found 2 areas which need some extra thought, Short Term Memory and Enabling Frequent users to use Shortcuts.

In addition to this, having totalled up all the aggregate scores, Prototype 3 scored 30 out of a possible 40, with prototypes 1 and 2 scoring 24 and 28 respectively. Prototype 3 will, therefore, be used as the foundation for our second-generation prototype.

6.2 Scenario Based Evaluation

6.2.1 Prototype 1

James Francois

- Scenario 1: In route 3 of the prototype, users are able to book inter-city tickets by choosing their destination on the map or by entering the name of the city. James can choose tickets for London, Lake District and Edinburgh using this feature. After selecting his destination, he can view different options for dates, travel times and journey duration along with the prices. This prototype is suitable for this scenario.

- Scenario 2: This prototype does not have an option to view popular destinations, especially for tourists.

- Scenario 3: In the start screen, users can choose between 6 languages. While Dutch is not available in this prototype, French is available as an option and James is fluent in French.

Mary Elizabeth-Weir

- Scenario 1: After selecting dates of travel in route 3, Mary has the option to select seats for the passengers. She can also choose the return ticket option. However, the design does not provide information about the services offered on the trains.

- Scenario 2: After selecting the destination in local travel, users can enter the number of passengers in adult and children category. Since students over 12 years fall under the adult category, they have to pay the full price of the ticket and the prototype does not provide information about discounted tickets for groups.

- Scenario 3: When users book a ticket online, they are provided with a QR code. If Mary sends this QR code to her daughters, they can collect the tickets without using the card that was used to make the payment. This can be done from the start screen by selecting the “Collect tickets” option which will allow them to scan a QR code that will print out their tickets.

Adam Khan
• Scenario 1: Adam can see different travel times and prices for the trains to London and he can book return tickets. However, he cannot view the restrictions that apply to each option.

• Scenario 2: When selecting the destination, Adam can see the route that the train will take on the map along with all the stations where it will stop. This will give him the option of picking the train with the least stops. After selecting his preferred train, the screen shows the duration and different departure times for the selected line.

• Scenario 3: The prototype does not offer options to purchase season tickets or travel cards

Lin Chen

• Scenario 1: Lin can book tickets to Swansea using the inter-city option. A map that shows the routes and the stops made by the train is also displayed. Lin can use this map to check if she can stop at Cardiff. Although ticket prices are displayed, Lin cannot check for more information on ticket types on the machine.

• Scenario 2: This prototype offers 6 language choices selectable from the start screen, including a Mandarin option.

• Scenario 3: Lin has the option to select her seat so she can choose a seat in the quiet carriage. She is also presented with the departure and arrival times of different trains so she can select the option that best suits her needs.

6.2.2 Prototype 2

James Francois

• Scenario 1: James can enter the first letter of his destination, activating the predictive suggestions. He will be presented with options to select the station at the destination city. This might be slightly confusing for tourists as they are not familiar with stations in the city. After selecting his destination, he can view different options for dates, travel times and journey duration along with the prices. This prototype is not entirely suitable for this scenario.

• Scenario 2: There is no option in this prototype to view popular stations, especially for tourists.

• Scenario 3: Users are presented with 6 language options from the start screen. French is available as one of the options and it is a language that James is fluent in.

Mary Elizabeth-Weir

• Scenario 1: After choosing her station in London, Mary can choose the number of passengers travelling with her. Then she can book a return ticket, so she can travel back after 4 days. After this, she can select the seats for everyone travelling with her to ensure they are sat together. However, there is no option that shows the services available on the train, so she can’t check if the train has a shop.

• Scenario 2: Through the local travel option in route 2, she can select the number of tickets she would like to purchase in adult and children categories after selecting the destination. However, students over the age of 12 have to purchase an adult ticket and the design does not provide options for group bookings with discounts.
Scenario 3: When Mary pre-purchases the tickets for her daughters, she is provided with a QR code. She can send this code to her daughters who can select the “Collecting tickets” option from the start screen followed by the “Scan QR code” option. This will print out their tickets without having to use the card that was used to purchase the tickets.

Adam Khan

Scenario 1: Adam can check the departure times for different trains to his destination along with ticket prices for each. When he selects the return option, he can select the train that arrives at his preferred time. However, he cannot check ticket restrictions.

Scenario 2: There is no map in this prototype that shows the route nor the different stations that the train will stop. Adam can see the departure and arrival time of the train and can calculate the journey duration, but this number is not displayed on the screen.

Scenario 3: This prototype does not offer services to purchase season tickets or travel cards. After selecting his destination, he can view different options for dates, travel times and journey duration along with the prices, proving suitable for this scenario.

Lin Chen

Scenario 1: This design does not show different tickets types, nor does it show the route taken by the train, so Lin cannot check if the train will make a stop in Cardiff nor can she check what type of ticket she will purchase. However, she can see various price options for different trains.

Scenario 2: This prototype offers 6 language choices that can be selected at the start screen, including a Mandarin option that Lin can select.

Scenario 3: Lin can select her travel date and she is also presented with the option to pick her seat. After confirming her travel dates, she can choose her train based on its arrival time in Leeds and similarly for her return train to Birmingham.

6.2.3 Prototype 3

James Francois

Scenario 1: When James enters his destination, he has the option to select between different ticket types, so he can save money. The different ticket types might be confusing for James to understand as a tourist but there is an information button next to each ticket type that provides more detail, enabling James to buy based on his budget.

Scenario 2: There is a Trip Advisor link sponsorship which only provides information when the location is known and not when individuals want to explore other destinations.

Scenario 3: This design has a wide variety of languages to choose from. James is fluent in French and this language option is available for him to pick from the start screen.

Mary Elizabeth-Weir

Scenario 1: Mary can book return tickets for her family but there is no option to select seats so she cannot make sure that her family sit together. Details about the services offered on the train are not provided, so she cannot check if there is an onboard shop.
• Scenario 2: Mary has the option to look for GroupSave options when she purchases tickets for her students.

• Scenario 3: When Mary pre-purchases a ticket, she is given a shareable QR code. Her daughters can use this code on the machine which will print out their tickets without using the card that was used to purchase the ticket.

Adam Khan

• Scenario 1: Adam can view different ticket types after he has selected his destination (anytime, off-peak etc.). The information button available next to each ticket option will provide him with more information about the different ticket types and their restrictions.

• Scenario 2: Adam cannot check the number of stops nor can he check the journey duration or the arrival time of the train.

• Scenario 3: Adam can look at weekly, monthly or annual travel card options to see if he can save money by purchasing tickets every week or month. However, he cannot check for season tickets.

Lin Chen

• Scenario 1: Lin can be cost efficient by comparing the different ticket types available. The information button next to each ticket type will provide her with more details about when the tickets can be used and their restrictions. However, there is no information available about the train route and the stops it will make so she cannot check if the train will stop in Cardiff.

• Scenario 2: This design has a wide variety of languages to choose from on the start screen and Lin has the option to choose Mandarin.

• Scenario 3: Lin cannot choose her seats in this design nor can she check the arrival time of the train at her destination. So, she cannot ensure that she will arrive in Leeds by 12 pm or return to Birmingham by 11 pm.

6.3 Summary

In summary, we have evaluated our first generation prototypes against Sheniedmman’s eight golden rules of interface design and the scenarios developed through user requirements analysis. As a result, we have concluded the following:

• The designs did not provide sufficient elements to provide shortcuts to frequent users of the system nor did they provide efficient consolidation of information, often requiring customers to follow the process fully or providing too much information on screens. There needs to be a middle ground between the two.

• Prototype 3 was the best prototype when scored against the Golden Rules, however, features such as arrival time and the live maps need to be included in the design to provide a more rounded system.

• There were two key features which we found missing in both prototypes when analysing against the prototypes: The ability to choose where you sit and the ability to provide more information on tourist locations.
None of the prototypes met all the scenarios set out in our user requirements analysis. We need to ensure we cover as many features as possible to handle these scenarios, whilst maintaining a simple interface.

This provides us with a checklist of features and functionality that will need to be considered for our second-generation prototype.

7 2nd Generation Prototype

7.1 Description

Our Second Generation prototype uses prototype 3 as a foundation and replicates the natural language processing feature, combining it with a number of features from our first-generation prototypes. A breakdown of the features and how we aim to address certain issues can be found in the image and description below.

7.2 System Features

There are a number of different elements of the design which can be summarised as the following:

- A home button has been added to the display, to enable the user to return to the start page and restart the process whenever they feel.

- The intercity and local options have been incorporated into the design, providing clearer information on where individuals can travel and the length the journey will take. This includes the option to choose between different routes and train journeys that can be made. The map feature, in combination with text and voice input, provides customers with multiple input options. The Trip Advisor feature has also been upgraded to include tourist recommendations in the local region, making it more predictive and beneficial for tourists and visitors.

- There is now the option to select a departure time and date and a return time and date, giving the customer more choice and control over their travel arrangements.

- The tabular function has been added, allowing you to switch to relevant pages and sub-pages at various points of the process. This provides more choice and room for manoeuvre when using the system.

- The option to choose your own seat has been provided on the trip summary page. This page has been separated from the payment page, as we have looked to declutter the pages and provide more useful information in a condensed fashion.
7.3 Design

The images depict a user interface with several sections:

1. **Welcome**
   - Welcome message in multiple languages.
   - Scanner prompt to access your profile or begin.

2. **Choose a Language**
   - Selection of languages.

3. **Buying or Collecting**
   - Options for buying or collecting.
   - Ticket options: season ticket or weekly travel pass.

4. **Where will you be Travelling to?**
   - Options for local or inter-city travel.
   - Option for beginning your journey from another station.

5. **Destinations**
   - Map interface for inputting destination.
   - Tourist information link.

These sections are designed to guide users through the process of accessing and using a transportation service, selecting languages, and choosing routes or passes.
8 Evaluation

Having created our second generation prototype based on the evaluation and analysis of our first generation prototypes, we will now perform an in-depth evaluation of our improved prototype against Shneiderman’s heuristics, our user requirements analysis, and the learning point from our initial prototype analysis.

8.1 Heuristic Analysis

1. Consistency is provided throughout the design of this prototype. Building on the strength of the first generation prototypes, there is a consistent theme throughout of providing the same options at the top and the bottom of the screen, with the content displayed clearly and consistently throughout.

2. As an area that needed improvement based on our initial analysis, we have developed more shortcuts through the buttons and options provided. In addition to this, the tabular function and the ability for frequent users to use their profile to skip through screens with greater freedom and effectiveness.

3. Feedback is provided via text and speech, providing sufficient means to receive the correct feedback based on user input. This feature has been carried through from prototype 3.

4. Using the strengths of prototypes 1 and 2, this prototype incorporates aspects such as providing simplified and condensed information on relevant pages. This is best shown by the payment and summary pages, which have been separated to provide clarity and effective closure.

5. Error handling is enabled throughout the design, primarily through the information button at the top right corner of the screen. This, in addition to the speech assistant, will enable information to be both spoken and displayed on screen when errors occur.

6. Building on the strengths of the first generation prototypes, the option to press the home button to return to the start of the process has been added. The ability to flick through
multiple tabs and go back and forth through screens also provide action reversal options where possible.

7. The locus of control is strengthened in this system through increased simplicity in the on-screen options and information. Providing the correct information for them to make suitable decisions.

8. The inclusion of tabs and consolidation of pages previously mentioned in points 2 and 4 provides this functionality as clear information and system paths and sequences are linked throughout.

8.2 Scenario Based Analysis

James Francois

- Scenario 1: James can book tickets by selecting the inter-city option and choosing his destination on the map. Alternatively, he can use the text or speech input. After selecting his dates, he is presented with different ticket types that allow him to buy cheaper tickets if available.

- Scenario 2: On the screen that asks users to select their destination, there is an option to view local tourist information and sites, provided by Trip Advisor. This option will be useful to James in looking for local tourist attractions.

- Scenario 3: This design offers a large number of language options that can be selected from the start screen. James has a moderate understanding of spoken English and is therefore able to use the voice assistant.

Mary Elizabeth-Weir

- Scenario 1: Mary can choose to buy return tickets after selecting London as her destination via the inter-city option. In the trip summary section, Mary can reserve seats for her family to ensure they sit together. However, there is no option to check the services offered on the train so she cannot check if the train has a shop.

- Scenario 2: After selecting the number of passengers, Mary can select the group travel option to view different prices for the group of students that are travelling.

- Scenario 3: When Mary buys the ticket, she is given a QR code that she can share with her daughters. They can use this code on the machine by selecting the “Collecting tickets” option to collect the tickets.

Adam Khan

- Scenario 1: Adam can view the different ticket types for his chosen date of travel. The information button next to each ticket type provides more details including routes and time restrictions.

- Scenario 2: When Adam selects the map option, he can see the various train routes along with all the stations along the journey. This enables him to choose a route with the least stops. Although he is unable to see the arrival time, he is able to work this out via the departure time and journey length displayed on the map.
• Scenario 3: On the start screen, there is an option to purchase season tickets or travel passes. More details about these tickets and their prices are available to Adam if the option is selected. He also has the option to create a profile, which will enable him to get tickets for regular and frequent journeys with more ease and efficiency.

Lin Chen

• Scenario 1: Lin can select Swansea as her destination on the map. She is then shown the different train routes to Swansea along with the stops made by the train along the way. She can select the route that makes a stop at Cardiff. After selecting her travel date, she can choose between the different ticket options (anytime, off-peak etc.).

• Scenario 2: This design offers a wide variety of language options that can be selected from the start screen, providing Lin with the ability to select a language she is more comfortable with.

• Scenario 3: Lin is presented with train options via the routes on the map and their departure and arrival times after she selects her departure date. She can select the train that arrives in Leeds before 12 and arrives back in Birmingham before 11 pm based on the journey lengths. In the trip summary page, she can select her seats.

8.3 Summary

The first two summary points from the first generation analysis, which was insufficient shortcuts and overloaded information resulting in short-term memory load, have been negated through combining the strengths of our first generation prototypes. The live map and the ability to pick an arrival and departure time have been added, along with the ability to skip parts of the process with a profile and a multi-tab system to link closely related pages. Having carried out a heuristic evaluation against Shneiderman’s Eight Golden Rules, we conclude that the design has improved on the first generation prototypes and provides a more rounded system for all users.

The main features missing from the prototypes when evaluated against the scenarios were the ability to choose your seat on the train and information on tourist locations. The ability to choose your seat has been added to the trip summary page via a drop down in the passenger summary section. This provides an easy and convenient option when required, without cluttering the screen. In addition to this, the Trip Advisor feature now has the ability to recommend tourist locations to travellers who are unsure of where they want to go or are searching for local tourist locations. This provides a helpful alternative to paper-based tourist maps. However, this is restricted to local travel only, with information on inter-city tourist locations only being provided if the destination is known.

During our scenario-based analysis of our second generation prototype, we have found that our prototype had some limitations. One limitation we found was that there was no arrival time. Although this is somewhat mitigated by providing the journey length and departure time, it would be simpler and easier for all users if this information was a feature of the second generation prototype. Another limitation we found was the inability to see train specific information such as the coach with the shop in it, or whether there is an on-board shop. Although considered, we found this to be a desirable and not essential feature of the prototype and found it difficult to incorporate with the current design. Overall, however, the second generation prototype has been able to satisfy many of the requirements set out in the scenarios and provides more options and information in a simpler
form than the current TVM systems. It offers a breadth of options on ticket types, journey routes and languages, enabling it to handle a variety of users of differing ability and backgrounds.

9 Summary and Recommendations

The purpose of the project was to improve the interface and user experience of train vending machines, focusing on problems such as: booking multiple tickets using a railcard, collecting pre-paid tickets, group booking and catering to users of varied ability. The project has solved most of these problems to an extent.

To understand user requirements clearly, four user requirement platforms have been investigated and created in the form of our personas. The literature review critically analysed related research in the area to provide a theoretical basis for the project. Some ideas about the future railway systems were included as well, which proved helpful when designing prototypes. First generation prototypes included three different prototypes to meet requirements of users. Apart from the literature review, the design of first-generation prototypes was based on Shneiderman’s Eight Golden Rule of interface design, which is a commonly used standard to evaluate the heuristics of a design, and what we should be aiming for. After evaluating the first generation prototypes, we made our second generation prototype by extending prototype 3. The analysis of the second generation prototype was done again using heuristic analysis to check the new features and overall usability in alignment with the Golden Rules.

9.1 Project Achievements and Drawbacks

9.1.1 Problem Definition

The project identified several common problems of TVMs correctly, which, if solved, can benefit a great number of users in the UK. However, there is still the possibility of some problems that have not been discovered. In the investigation stage, we reviewed the TVMs in and around the University, whereas in the UK, TVMs are provided by train operators and TVMs are therefore likely to be different in other locales. As a result, TVMs, such as the ones around University, do not contain complete UK coverage. While the project is based on the Birmingham area and the problem definition of it is still successful, comprehensive consideration is needed in any future project of these issues.

9.1.2 User Requirements Analysis

During the project, four well-defined personas were developed to represent the diverse demographics of society at present. This ensures the various needs and requirements users may have were considered and examined. Alongside this, Rodgers Diffusion of Innovation theory was used a further barometer to assess technological use, adding another dynamic to the personas. The Four personas that were considered throughout the project were a young tourist, a local head teacher, an undergraduate student from London and a PhD student from China. This was done to provide a holistic view, and to an extent, achieved this by ensuring we considered different backgrounds and abilities.
9.1.3 Second Generation Prototype

The second generation prototype is the culmination of our work. Primarily based on prototype 3, it combines all the best features from our first generation prototypes and analysis. Prototype 3 was a more innovative prototype compared with prototypes 1 and 2 and contained some new technologies, like natural language processing system. It contained functionality for verbal communication and interaction with users, which is a key feature in the majority devices around the world at the moment. Additionally, if users do not want to communicate via this method, they have the option to use the touchscreen. Users can also build profiles and make accounts which, when connected to the application, provide passenger favourites, regular routes and help to simplify the selection process. These features would be beneficial to less technologically proficient people who do not like or use touch screens and disabled people who cannot use the touch screen by themselves in some circumstances. By combining our ideas with advanced technologies, our second generation prototype could drastically improve the user experience and the efficiency of TVMs.

However, despite the improvements we made, there were several weaknesses with the initial prototype. Firstly, it was not possible to end the process and start over until the last payment page, which is inconvenient if users change their mind and want to start again. Furthermore, compared with prototypes 1 and 2, prototype 3 did not contain the arrival time and live maps, which should be taken into account in the second generation prototype. The ability to pick your seating position was a weakness that needed to be added and more information on tourist locations needed to be provided in the second generation prototype.

In order to mitigate the weaknesses of the prototype, we incorporated new features in our second generation prototype. In addition to adding a home button to allow users to restart the process, clearer routes, a map feature and the tabular functions from prototype 1 and 2 were all featured in the design. The Trip Advisor feature was upgraded to provide more useful and effective information. Linked to the voice system, this would be a balanced combination of information, convenience, and access. Furthermore, to meet users’ sitting preference, the option of choosing their own seats had been added to the ticket summary page. Consequently, the second generation prototype is a successful improvement over the previous version. However, some potential weaknesses still exist. For example, the language processing system may be problematic for users with different accents as their voice may be hard to recognise. This is mitigated somewhat by the multiple input options but highlights that the design is not yet perfect.

9.2 Tools and Approaches used

To do the project, several tools and approaches have been used. Adobe Photoshop was used to process and edit the pictures as many features like cropping and highlighting etc. were used. All prototypes were designed using Balsamiq Mockups, giving the prototypes a more professional design look. At first, we used Adobe InDesign to compose the report, but later we decided on the use of Latex, which has more functionality and is easier to use. In the evaluation and analysis stage, Shneiderman’s Eight Golden Rule and Rodgers Diffusion of Innovation theory were applied to encourage discussion and user-based thinking.

9.3 Recommendations

The understanding of user requirements and the analysis of existing relative systems are key as they aid the design process in early stages of analysis and identify features of the prototypes. By
assessing the strengths and weaknesses of the existing system, a clear list of what can be improved and what the group can take advantage of was created. However, it may not be desirable to do this first as the group felt it may be more beneficial to approach the design task by reviewing literature firstly, which can promote innovation in the design. The differences among the three first generation prototypes made contributions for the group to think outside the box and unearthed new user requirements and errors that had not been considered previously, and also generated some new ideas that may help the system work better. The group recognised the benefits of innovation and the importance of interaction as a more efficient and effective approach to ticket vending machine and focused on designing a system with innovative aspects and more interaction with users in addition to a clear and conventional interface.

We found it beneficial to evaluate the first generation prototype with personas, despite the difficulty in applying fictional personas to realistic situations. The evaluation process contributed to identifying areas for improvement in second-generation design. By combining this with evaluation alongside the scenarios, the group was able to discover which aspects can be added, taken away or modified.

The group has learned from the process that images with comments can be a good way to illustrate and present information. Compared with text, in this way, information is displayed in a simplified way which can help users to make choices easily. The group also recognised that considering the perspective of users allowed the group to gain further clarity about users requirements, which is the key to creating a truly user-friendly design. Additionally, the group learnt the benefits of designing prototypes by hand and then using computer-aided design tools. It is a quick way to form a rough sketch of the prototype to share conceptual ideas and prompt a discussion to fine-tune designs, and helps to develop the system in a well-rounded way; especially in early stages of the design. However, this method is time-consuming if done incorrectly or without a clear plan. When details of the prototype had been fully discussed, the group felt it is preferable to finish it via computer-aided design - given the complications with editing handmade designs - and the additional clarity, professional presentation style and ease of modification of design that was achieved.

The group also felt it was good to come up with personas at the first stage of the design, understanding user requirements made contributions for the group in developing functions of the system and modifying features, and it is key to consider to as wide an extent as possible in the future. Furthermore, the group felt suggest conducting a questionnaire about the market and collecting answers of users to identify their requirements which can make contributions to the future design and add an empirical platform for research. As aforementioned, the literature review should be finished before any review of related systems, as the former shapes approach to the design element in an innovative way and the latter will build on this by discovering and examining the advantages and disadvantages of existing system in relation to the literature to identify common areas of improvements. The evaluation of first generations prototypes with personas aided the collation of advantages of each prototype and refined the list of system requirements to consider, enabling well rounded and holistic final design.

We enjoyed learning from the process and collaborated well as a team. The tasks were evenly shared and everyone played an equal part. We had meetings regularly and kept notes during the meeting which greatly assisted us in producing the designs. All the time spent in meetings was productive and We suggest this adopted for future research projects in the subject.
References


