

Addressing Digital Divide in Tyne and Wear Metro Newcastle

Designing Alternative Method for Contactless Payments for Ticketing

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CCS CONCEPTS • Human-centered computing • Interaction techniques • Accessibility technologies

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1 TOPIC AND MOTIVATION

1.1 Topic and Motivation

Post-pandemic cashless payments have become ubiquitous, Tyne and Wear metro is also utilising this technology to improve the experience and efficiency of their services whilst also addressing the ecological effects of physical ticketing. Literature shows that not everyone can accept these new technologies [28], thus I aim to investigate and propose strategies for enhancing the Tyne and Wear Metro experience for individuals who may face challenges in accessing digital services, particularly after the integration of cashless and contactless ticketing by Nexus. As public transportation systems increasingly rely on digital technology for ticketing and service information, it is crucial to ensure inclusivity and accessibility for all passengers, including those who may have limited digital literacy or are incapable of using digital services [21].

The United Kingdom is currently experiencing a demographic shift towards an increasingly older population, which is expanding rapidly. Statistics show the number of people over the age of 65 increased by 23% between 2009 and 2019, at a time when the whole UK population only increased by 7% [15]. The persistent nature of this challenge implies that unless it is addressed, it will continue across multiple generations and the amount of people that will be digitally divided will become greater with time. With the growth of services being held exclusively online, there is an increasing disparity in digital access. Ensuring equitable access to these services has become crucial [3]. However, older adults may face accessibility barriers that limit their ability to engage with such services. As a user experience researcher and designer, it is crucial to acknowledge the existing digital divide and proactively address it through the facilitation of accessible and user-centric design [14] practices. By prioritizing equitable access and employing user-centred design principles, the divide between service providers and consumers can be bridged. It is paramount that we ensure future designs encompass inclusivity and cater to the diverse needs of all demographics to ensure that those who are at the edge of being digitally cut off can have their basic needs met.

Due to the increased cost of operations [10], user interface designers are facing increasing pressure from employers to generate sales. This has stemmed a new wave of deliberately manipulative design known as “Dark Patterns”. These tactics are grounded in psychology and designed to increase profit and customer retention but are often implemented at the cost of user experience and trust [22]. Research [4] has found that users are becoming increasingly aware of these tactics which is further exacerbating the digital divide as there is an increasing unwillingness to engage with technology in general. This website [4] has revealed dark patterns on over 1200 shopping websites and has concluded that 95% of mobile applications contain dark patterns that control user behaviour. Cybercrimes are at their peak making it even more difficult for users to trust online and contactless payments [26]. This phenomenon compels users to develop a sense of mistrust towards technology, leading them back to more secure payment methods such as using cash. This has been a motivator for the project as the general population is becoming increasingly aware of these deceptive tactics and is further distancing people from having a digital presence.

Additionally, considering the environmental issues associated with printing 7.3+ million non-recyclable tickets in the year 2019-2020 for the passengers of the Tyne and Wear metro alone [7]. The tickets have a magnetic strip which cannot be recycled, resulting in the loss of more than 130 trees to produce these tickets every year. Greenhouse gas pollution is on the rise due to people preferring the convenience of using a car despite the huge onset cost. Rethinking how these systems may appeal to users to provide a better individual and group experience will make it possible to cut emissions by more than half [27].

This proposal outlines the specific focus of the research, the research questions, and the methods that will be employed to conduct the study:

1.2 Research Questions

1.2.1 What are the challenges faced by digitally excluded and new passengers in using metro services?

1.2.2 How can interactive technology enhance metro journeys for digitally excluded and new passengers?

1.2.3 What are effective ways of developing digital services with and for people who are digitally excluded?

2 INITIAL BACKGROUND RESEARCH

2.1 Background Research

2.1.1 Nexus Report

Brand Value Report from February 2023 [9] highlights that a significant majority of respondents express that they would find it easy to use alternative modes of transportation if the Metro were unavailable. Additionally, cash remains the primary method of payment for Metro tickets, accounting for 23% of transactions.

Moreover, age plays a significant role in the perception of contactless payment convenience, with 55+ year-olds (72%) being less likely to find it convenient compared to those under 35. Similarly, individuals with disabilities are less likely (68%) to agree that contactless payments increase convenience. A considerable proportion (81%) of individuals aged 55+ do not carry smartphones while travelling [8].

Data from last year highlights a concerning trend of experiencing a significant usage decline, dropping from 76% in October 2022 to 68% in February 2023 [9]. Furthermore, negative sentiments regarding the metro service have increased over the past three years, rising from 14% to 26%. 28% of users perceive the service as unreliable, and 21% consider it to be too expensive. More than half of the customers (54%) do not recommend using the metro.

The survey conducted in 2018 [6] revealed that 45% of participants expressed their willingness to adopt an account-based ticketing system, enabling direct payment from their bank accounts, which aligns with the goal of enhancing the Tyne and Wear Metro experience for individuals facing challenges with digital services integration. Furthermore, Nexus's plans to introduce a Pay as You Go system, integrating payments across various platforms (bus, rail, and metro operator), though time-consuming, demonstrate their commitment to improving the overall ticketing process.

2.1.2 Digital Divide

The adoption of new contactless payment methods faces several issues that need to be carefully evaluated. Firstly, with a significant portion of the UK population projected to be over 65 within our lifetimes [15], it is crucial to consider the unique needs and challenges faced by older individuals in embracing these technologies. Recognizing older people as "victims of technological change" highlights the importance of understanding their perspectives [32]. Moreover, their wealth of life experience allows them to view the world within a broader context, which can influence their acceptance of new technologies. Balancing the preference for technological innovation with the availability of low-tech solutions is necessary to ensure inclusivity. Ultimately, emphasising the value and benefits of technology is crucial for widespread acceptance among both older and younger generations.

2.1.3 Digital Exclusion and Access

The digital divide and limited access to technology pose significant challenges in today's society as digitally excluded means being unable to access essential civic services. Furthermore, the ability to adapt to new technologies is crucial, as rapid advancements can leave certain individuals at a disadvantage. In Newcastle, for instance, approximately one-third of the population is digitally excluded [28], highlighting the magnitude of the issue. Specific groups such as disabled individuals face additional hurdles due to poor service design, while asylum seekers encounter barriers such as limited access to funds.

2.1.4 User Trust on Contactless Payment

It was found that [23] investigating the dominating factors of user trust in adopting new technologies that user trust was the most significant contributor to adoption rates. The paper discusses ways that digital trust can be instantiated and built-in users, such as information transparency and accuracy. This research has provided a useful and robust framework for considering trust in the development of my prototype. However, it is important to acknowledge that dark patterns in UX design can also significantly impact users' ability to trust technologies [22]. Dark patterns refer to deceptive design techniques that manipulate user behaviour and can erode trust in digital products and services. While the research paper [23] focuses on aspects such as information transparency and accuracy, it does not directly address the negative impact of dark patterns on user trust. Dark patterns can exploit users' cognitive biases and deceive them into taking actions they did not intend to, leading to a breakdown in trust. These unethical design practices can create a sense of manipulation and deception, undermining users' trust in the technology. Therefore, it is essential to consider the role of dark patterns in UX design and work towards promoting transparent, ethical, and user-centric design principles to foster trust [29]. Furthermore, when addressing the issue of digital exclusion, it is crucial to recognize the physical barriers that some individuals face in adopting new technologies. Physical presence, as demonstrated in studies involving robots [2], has been shown to contribute to higher levels of trust and cooperation. For instance, this research [28] proposes the use of a robot called GeeBot to provide verbal information about services available to asylum seekers facing digital access and language barriers in a host country. While this technology addresses trust in digital products and services, it does not directly tackle the concerns of individuals who may be considered "victims of technological change." However, innovations like GeeBot show promise in bridging the gap for those on the brink of being left behind due to digital exclusion, by providing them with access to information and services in a more accessible and trusted manner.

2.1.5 Adoption of Contactless

The COVID-19 pandemic has accelerated the adoption of contactless payment methods and moved us further towards a cashless society [31]. This shift is driven by several compelling reasons. Firstly, contactless payments offer unparalleled convenience, allowing services such as Tyne and Wear metro to board people faster and for customers to spend less time waiting. Hygiene and safety are addressed by minimising physical contact and reducing the risk of spreading germs and viruses. In addition, contactless payment methods easily integrate with digital platforms and services, enhancing the overall user experience and enabling innovative financial technologies for those who have sufficient digital competency [25]. The robust security measures associated with contactless payments, such as biometric authentication, provide users with increased confidence in their transactions. Despite these benefits, it is crucial to address the concerns of individuals who face barriers to digital access or prefer using cash, ensuring alternative payment options and financial inclusion measures are available. The widespread adoption of contactless payments represents a paradigm shift in the financial landscape for those accustomed to older technologies, highlighting the need for further exploration and understanding of these technologies in the broader contexts of the people who use them and the people who fall victim to these changes.

2.2 State of the Art

2.2.1 Delhi Metro Rail Corporation

The Delhi Metro Rail Corporation (DMRC) has implemented several convenient methods for accepting ticket payments, providing commuters with a range of options to facilitate their journeys. DMRC witnesses a daily footfall of approximately 5.5 to 6 million trips [24].

Smart cards: These are one of the most popular and widely used payment methods on the Delhi Metro. 78% of the users use smart cards to travel [11].

Token system: For those who prefer not to use smart cards, passengers can visit the ticket counters and can purchase a token by paying in cash. These tokens are reusable as they are RFID tags. [20].

QR code-based ticketing: DMRC has introduced QR code-based ticketing, allowing passengers to use their smartphones to purchase and display tickets [34]. They are planning to phase out tokens as they are made of plastic and are non-biodegradable.

2.2.2 The London Tube

The London Tube, operated by Transport for London (TFL), caters to more than 5 million passengers daily [19]. They have taken all scenarios into account for local and international travellers.

Oyster card: Commuters can load their Oyster smart cards with credit or season tickets at ticket machines, online, or at Oyster Ticket Stops. It offers discounted fares and is valid on the Tube, buses, trams, DLR, London Overground, TFL Rail, and some National Rail services [16].

Contactless Payment Cards: Passengers can use their contactless debit or credit cards directly to pay for their journey. The fare is automatically calculated and charged to the card associated with the contactless payment [17].

Mobile Payments: TFL has integrated mobile payment solutions such as Apple Pay, Google Pay, and Samsung Pay, unlike Nexus [17].

Paper Tickets: While the focus has shifted towards contactless and digital payment methods, TFL still offers paper tickets for single journeys and day travel [18].

Based on an analysis of the demographics of diverse metropolitan transportation systems across various cities and countries, it becomes evident that a notable inconvenience gap exists, leading to discouragement among passengers regarding the utilization of Nexus services, particularly in relation to contactless ticketing. The aim of my research is to address and mitigate this identified gap.

3 APPROACH AND METHODS

3.1 Aim

Investigate how to enhance the Tyne and Wear Metro experience for people who might have difficulty accessing digital services after Nexus integrate cashless and contactless ticketing.

3.2 Objectives

3.2.1 Background literature review on the digital divide

My first objective will be a thorough literature analysis to understand the reasons for the digital divide and how the human-computer interaction (HCI) community is currently responding to this exclusion. To ensure a current understanding of the topic, this evaluation will incorporate academic research and relevant grey sources for additional information. The literature review will establish the foundation for identifying the potential target audience and participants for further research, such as conducting focus groups and interviews.

3.2.2 Competitive analysis of payment methods on public transport in various countries

The objective of this task is to perform a competitive analysis of payment methods employed in public transportation systems in different countries. The purpose is to ascertain the demographics of contactless payment within the UK and globally. To better inform about the development of an inclusive digital service for Tyne and Wear Metro, it is important to comprehend the current landscape, including trends, obstacles, and user preferences.

3.2.3 Understand the challenges for individuals with difficulty accessing digital services.

Drawing on the insights obtained from prior research, I will recruit participants from the Voice North Organisation [33] and students as participants from Newcastle University to conduct a few focus group studies. Additionally, a survey form will be distributed to the Nexus group's recruited participants to obtain further quantitative data. This approach will facilitate the identification of the challenges and concerns faced by the participants, ultimately leading to a set of design objectives and requirements for the initial prototyping phase.

3.2.4 Designing prototypes as a response to the identified problems

After transcribing the focus group conversation, a thematic analysis will be done where I will come up with common themes which will indicate the common issues the participants are facing around using public transport or contactless payments. Based on these findings, I will go forward with the brainstorming [35] and card-sorting exercise to generate a range of potential solutions, evaluate these ideas, and subsequently shortlist the top three or four concepts for further development as solutions. These designs will adhere to a human-centred design approach [37].

3.2.5 User testing and evaluating the prototype(s)

To evaluate the efficacy and usability of the developed prototypes a workshop will be organised to assess the designs with the management of the partner organisation Nexus, the most suitable design will be taken further to develop using an iterative design process [12]. These designs could be in various formats such as paper-based, electronic, or mobile device-based.

3.2.6 Refining the prototype(s)

This objective entails enhancing the prototypes' user experience based on the feedback received from the evaluation session with Nexus. This refinement process will involve multiple modifications to enhance the user experience of the proposed prototype and/or service.

3.2.7 Document and communicate

The final objective of this research is to document and communicate the outcomes of the entire research process. The results and perceptions will effectively convey the significance and potential benefits of the proposed research. The dissertation report will allow others access to knowledge, encourage empathy and understanding when implementing new technologies, and support future research within this domain.

3.3 Methods and Activities

3.3.1 Report collection from Nexus

A thorough analysis of the quantitative data gathered from Nexus will be carried out to finalise the user base and gain insights into the project. As quantitative data [1] provides opportunities to collect data about the existing Metro users, their demographics, travel patterns, and preferences, it will help identify specific challenges faced by these individuals. The analysis of this data will serve as a foundation for the following research activities.

3.3.2 Conduct focus group with students from Newcastle University and Voice North Organisation

Conducting focus group sessions with Newcastle University students and engaging with Voice North, a local advocacy organization for individuals with lifelong valuable experiences, will provide qualitative insights of their experience with the Tyne and Wear metro service. This method will involve organizing structured group discussions facilitated by a moderator experienced in qualitative research methods.

The focus group participants will be recruited by sending a generic email to all the students in the School of Computing. They will be requested to take part in the focus group based on their experience with the Tyne and Wear Metro services. On the contrary, Voice North participants will be invited to a project on the Voice digital platform where researchers can create opportunities to involve Voice members in their work [33]. By engaging with these stakeholders, the research will gain an in-depth understanding of the challenges faced by these individuals. The insights from the focus group discussions will be analysed thematically, allowing for a nuanced exploration of the participants' perspectives. This method aligns with the project's context, as it emphasises the importance of user-centred design and inclusivity.

3.3.3 Survey Questionnaire

To gather a broader range of perspectives and opinions, a survey questionnaire will be administered to a representative sample of Tyne and Wear Metro users. The questionnaire will be designed to explore the accessibility challenges faced by users after the integration of cashless and contactless ticketing, as well as their expectations for improved digital services. The survey will include both closed-ended and open-ended questions to capture quantitative and qualitative data.

By conducting a survey, the research will be able to collect data from a larger and more diverse user base. It will also allow to explore the state of practice taking a broader perspective [30].

3.3.4 Design a Prototype or/and Service

Understanding the participants' requirements can clarify how an inclusive design advisor tool should and could work to inform designers of inclusive design practices [38]. This method involves creating interactive design mock-ups of a mobile application on Figma, a tangible product which can be used in replacement of a contactless metro card or a debit/credit card, and/or a new proposed service for improved user experience.

The development process will incorporate established principles of inclusive design [5]. User feedback and iterative design cycles will be employed to refine the prototypes or services.

3.4 Gantt chart

(A.2)

4 INTENDED OUTCOME AND RESEARCH CONTRIBUTION

Firstly, the project will conduct novel research to investigate the reasons behind passengers' preference for using the contactless payment for purchasing paper tickets rather than utilizing contactless metro cards. Statistics have revealed that despite metro cards being more cost-effective, 83% of passengers still opt for paper tickets [8]. Through this research, a deeper understanding of user behaviour and preferences will be gained, shedding light on the underlying factors contributing to this gap. This research contribution will add valuable insights to the existing body of knowledge in human-computer interaction (HCI) and transportation systems, enabling informed decision-making for future ticketing system enhancements.

Moreover, by exploring innovative approaches, such as intuitive interfaces and seamless interactions, the project intends to design and develop a tangible product that can be utilised as an alternative to contactless or cashless payment methods when purchasing a metro ticket. This design outcome, coupled with a focus on HCI integration, will enable a more accessible and user-friendly ticketing experience, aligning with the goals of enhancing usability and user satisfaction.

Furthermore, the project seeks to create a comprehensive service that not only enhances the user experience but also aligns with sustainability objectives. By considering the environmental impact of transportation systems, the proposed solution will aim to decrease the overall carbon footprint through increased utilisation of public transport and the introduction of a contactless reusable and recyclable product. This dual focus on user experience and environmental sustainability contributes to addressing broader societal concerns and aligns with the ongoing efforts to promote eco-friendly practices in public transportation systems.

By following this approach, the project aims to obtain valuable insights and gather feedback, potentially revealing additional requirements to act as a framework for future designers in this space.

5 COLLABORATORS, PARTICIPANTS AND RESOURCES

Simon Bowen will be my project supervisor for this research endeavour. His experience conducting co-design surveys for a new Tyne and Wear Metro design in cooperation with Nexus will assist me in connecting with stakeholders. He will also assist me in conducting focus groups with Voice North volunteers.

5.1 Nexus Collaborators and Participants

5.1.1 Nexus

The owner of Tyne and Wear Metro is my first confirmed collaborator. I have already managed to have two meetings with the Head of Communication and Marketing at Nexus. They have shared the previous year's Brand Tracking Report [9], contactless payment survey [6] and Metro customer segmentation [8] from the quantitative analysis front. This will help me to find out the exact demographic of people who are reluctant to use contactless payments while using metro services. They have already planned the aims and objectives of how and when they will install contactless payments kiosks all over the metro stations for the next two years as they will be taking down all the cash-accepting booths from most stations.

Nexus will help me with my survey form as they have already recruited participants at their end. Lastly, they will help me evaluate the prototype or/and the service which will be designed because of my research and if it needs more improvement or changes.

5.1.2 Voice North

Voice North is a global organisation of people who have professional experience of more than 30, 40 or 50 years who come together to better address global challenges [33]. I selected this organisation at the suggestion of my supervisor as this community works with many older adults. As is concluded by Michael et. al. that application-based services exclude many potential users, majorly older adults [3]. I will be conducting focus groups with the participants from the Voice North Organisation as gaining access to an open discussion forum will help reveal their experiences and knowledge unlike encasing responses to any direct interview questions [13].

5.1.3 Newcastle University Students

Students shifting to Newcastle Upon Tyne for the first time to pursue studies are considered first-time users of the metro services. As students generally don't own a car or a private vehicle, they are bound to use cheap public transport such as buses and the metro. Coming from different cities/countries and backgrounds, talking to them via focus groups can lead to some insightful discussions and will make a good case of why they use or do not use the service. I will be recruiting the students from the School of Computing by emailing them to volunteer for focus group studies. As it is summer break, the responses will be significantly fewer, but I am still hoping that the international students are staying back for the break.

5.1.4 Ethical considerations

I have got the approval of the ethics form as my project is ethically low-risk and defined by the Newcastle University Ethics Form (A1). I will still take into consideration all the necessary practices and will circulate the consent form before organising focus groups or surveys. I will also maintain the privacy of the participant and will not use any kind of sensitive topics if by any chance it comes up while discussing in the focus group study room.

5.2 Resources

5.2.1 Academic research papers and grey literature

My first approach will be to carry out a thorough examination of literature sources such as academic journals, industry reports, and policy documents to investigate the current knowledge and best practices regarding digital accessibility, inclusive design, and public transportation systems. The primary goal of the literature review is to identify the difficulties that individuals with limited digital access face.

5.2.2 Reports shared by Nexus

These reports contain information on the reasons for the transition, the infrastructure of the technology used, user feedback, and challenges faced during the implementation phase. These reports can be analysed to generate significant insights that can be used to inform the research findings and suggestions.

5.2.3 A quiet room to conduct focus groups

A focus group will be conducted, consisting of individuals from Voice North and students from the School of Computing, at Newcastle University. The focus group will provide a platform for participants to express their problems regarding contactless payments and why are they reluctant to use this service. A quiet room will be arranged to ensure a comfortable and focused environment for the participants.

5.2.4 Meeting Recording

To precisely document the conversations and ideas exchanged during the focus group, a microphone will be utilized to record the session. The recorded audio will be transcribed and examined to recognise shared patterns,

issues, and common themes for thematic analysis. The information will play a crucial role in shaping the final idea of the prototype or/and service to improve the user experience of Tyne and Wear Metro. Strict protocols will be implemented to ensure that the recorded information is kept private and confidential.

5.2.5 Prototyping software: Figma

Using the widely used prototyping tool Figma, I will design an interactive digital prototype or a strategy for a new service. These prototypes will be created using the Laws of UX [36], considering input from the focus group and background research. The Figma prototypes can further be used to make concrete suggestions for the Tyne and Wear Metro system with iterative design improvements.

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A APPENDICES

A.1 Ethics Approval

Ethics Form Completed for Project: To investigate how to enhance the Tyne and Wear metro experience for people who might have difficulty accessing digital services (digitally excluded and new passengers) like contactless payment, pop card or pop/metro ...

Policy & Information Team, Newcastle University <noreply@limesurvey.org>

Tue 06/06/2023 11:51 PM

To: Diksha Sharma (PGT) <D.Sharma4@newcastle.ac.uk>

⚠ External sender. Take care when opening links or attachments. Do not provide your login details.

Ref: 33599/2023

Thank you for submitting the ethical approval form for the project 'To investigate how to enhance the Tyne and Wear metro experience for people who might have difficulty accessing digital services (digitally excluded and new passengers) like contactless payment, pop card or pop/metro app' (Lead Investigator: Diksha Sharma). Expected to run from 23/06/2023 to 14/08/2023.

Based on your answers, the University Ethics Committee grants its approval for you to start working on your project. Please be aware that if you make any significant changes to your proposal then you should complete this form again, as further review may be required. This confirmation may be used within a research portfolio as evidence of ethical approval. Please note: this confirmation will be the only correspondence you should expect to receive as evidence of ethical approval. There will be no other confirmation provided. You may now proceed with research. If you have any queries, please review the internal and external ethics FAQ pages before contacting res.policy@ncl.ac.uk.

Best wishes

Research Policy Intelligence and Ethics Team,

Research Strategy & Development

res.policy@ncl.ac.uk

A.2 Gantt Chart



