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Innovations in E-Transportation: Enhancing Accessibility Features for The Visually Impaired

Samar Jamal Hassan Mahmoud[1,*], Noor Maizura Mohamad Noor[1], Zuriana Abu Bakar[1]

[1] Faculty of Computer Science and Mathematics, Universiti Malaysia Terengganu (UMT), Kuala Nerus, Teremgganu, Malaysia

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ABSTRACT

This study aims to offer an innovative approach to enhance the accessibility of e-transportation applications for visually impaired users, focusing on improving mobility and independence. Nowadays, accessing and navigating mobile user interfaces is still a big obstacle for visually impaired users, even with technology enhancements. To efficiently address accessibility barriers, this study offers a pioneering method that merges cutting-edge assistive technology, user-centric development approaches, and intuitive interface design principles. With features like screen reader compatibility and voice instructions, the framework seeks to make smartphones simple and understandable for visually impaired users. This study employed a quantitative approach, surveying 357 visually impaired users familiar with popular e-transportation apps like Uber, Careem, Petra Ride, and Jeeny in major Jordanian cities. Using advanced statistical tools such as Amos and SPSS, the analysis incorporated descriptive statistics and structural equation modeling to provide actionable insights for improving the usability and effectiveness of e-transportation services. The research highlights the critical collaboration between accessibility specialists, developers, and visually impaired users in enhancing these life-changing experiences. In two phases, Phase I utilized a meticulously designed questionnaire to identify the specific needs of visually impaired users in e-transportation. Phase II built on these findings to develop a tailored mobile application, addressing the challenges identified and advancing accessible transportation solutions.The study found that innovative e-transportation applications significantly improve mobility, independence, and satisfaction for visually impaired users by addressing their needs. Collaboration between specialists, developers, and users is essential to enhancing innovation and quality of life.

1. Introduction

Current research focuses on the significance of accessibility to e-transportation interfaces for users with visual impairments. They often struggle to use public transportation alone, particularly the bus network, which frequently lacks the necessary technology infrastructure to adequately

* *Corresponding author.*
E-mail address: p5130@pps.umt.edu.my

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service them, identify the correct bus, or obtain time information about arrivals and departures. This inadequacy, as conducted by Redij *et al*., [1], restricts their mobility and career options.

1.1 Research Background

Mobile applications for e-transportation often fail to address the specific needs of visually impaired users, leading to various usability and accessibility challenges. Despite advancements in technology and the increasing integration of smartphones into urban mobility, these applications frequently exhibit complex navigation designs, inconsistent layouts, and traditional input mechanisms that are cognitively demanding for visually impaired users [2]. Consequently, these applications often strike a poor balance, either accessible but barely usable or usable but barely accessible, thereby limiting their practical value [3].

A critical issue lies in accessibility gaps, such as inaccessible controls, reliance on visual cues, and insufficient textual descriptions for graphical elements. These deficiencies lead to significant organizational and navigational issues, such as redundant screen reader information, disorganized content structures, and ineffective navigation workflows [4]. As highlighted by A. Khan, Khusro, and Alam [5], Shera *et al.,* [6], and Zahib, Effendy, and Darwiyanto [7], the lack of comprehensive accessibility guidelines and effective multimodal feedback systems significantly intensifies these challenges. This gap forces users to depend on external assistance, increasing the likelihood of navigation errors and fostering greater dependency. While previous research has addressed general usability challenges in mobile application design, a significant research gap remains regarding specialized solutions tailored to the diverse needs of visually impaired users. Specifically, prior studies have not adequately explored personalized application interfaces that account for visual impairments. Moreover, the lack of attention to user-centric customization and the integration of real-time feedback mechanisms leaves critical questions about the efficacy and inclusivity of these applications unanswered, as highlighted by Senjam [3] and Zahib *et al*., [7].

To address these shortcomings, this study aims to design an exclusive, user-friendly e-transportation application that bridges the gap between traditional mobility services and inclusive digital design. The proposed application seeks to empower visually impaired users by incorporating user-centered approaches and customizable interfaces, ensuring accessibility, functionality, and independence in urban mobility contexts.

1.2 Literature Review

A literature review illuminates the most recent technology adoption research, identifying gaps and unexplored areas. Furthermore, it delves deeply into the theories surrounding mobile user interfaces in e-transportation.

Previous studies have investigated e-transportation and aid technology tools that help visually impaired users navigate their environment, highlighting their challenges and the importance of tailored design principles to meet their needs. Bhavana, Lalitha, and Lalitha [8] concentrated on developing a prototype system that utilizes a radio interface and alerts; the system will offer real-time information about bus arrivals and departures, helping bus operators recognize and identify their visually impaired presence on the road and enhancing their navigation safety and accessibility. Hamzah and Fadzil [9] studied intelligent audio interfaces for the visually impaired. The study acknowledged the need for further optimization before commercial products can use these interfaces, but it also highlighted the possibility of using multiple sound sources simultaneously. Alfayez, Alfayez, and Abdul-Samad [10] conducted a study on developing a mobile application specifically designed for those who are visually handicapped or illiterate. The study's main objective was to identify strategies to enhance the usability and accessibility of the application's features.

According to the World Health Organization, approximately 285 million people worldwide have visual impairments, with 39 million being completely blind, as noted by Fuaad *et al*., [11]. Given the growing number of blind and visually impaired individuals, it is crucial to highlight efforts aimed at developing modern technologies to address their needs and support their daily activities. Among these efforts, Khan *et al.,* [12] proposed the design of wearable smart shoes equipped with Global Positioning System(GPS) modules for location tracking, mini vibrating devices for hands-free alerts, an ultrasonic sensor for obstacle detection, and microcontrollers with embedded software for data processing. These features collectively enhance the mobility, safety, and overall quality of life of visually impaired individuals, allowing them to navigate independently and confidently.

User interface (UI) design has become a key factor in enhancing user experience and achieving competitive advantage. Effective UI design improves satisfaction, loyalty, and engagement and drives success across various fields. For instance, voice user interfaces (VUIs) and auditory systems provide visually impaired users with accessible, cost-effective solutions. Moreover, Lee and Hsien-Hui [13] emphasized integrating multimodal interaction in public transportation to enhance trust and independence for visually impaired travelers.

In addition, Kai [14] demonstrated that combining functionality with aesthetics in UI design improves interaction and differentiates products, thereby attracting and retaining users. Similarly, Mahmoud *et al.,* [15] revealed that enhancing website design and security significantly boosts customer satisfaction and loyalty, which, in turn, strengthens e-commerce competitiveness. Thus, these studies collectively emphasize the critical role of UI design in achieving a competitive edge. Several studies have emphasized the importance of designing mobility applications for those with visual impairments. However, these applications have usually failed to give users' needs and necessities the attention they deserve. Consequently, our research intends to fill this gap by designing a user-friendly interface that meets the unique requirements of visually impaired users while also following guidelines for accessibility and usability, making the whole experience more welcoming and easier to understand.

The significance of this research demonstrates how critical it is to develop creative, user-centered solutions that enhance visually impaired people's mobility, safety, and general quality of life. So, the main objective of this paper is to design a new model of e-transportation mobile user interface application for visually impaired users that meets their needs after analyzing the relationship between mobile user interface components and competitive advantage using a technology acceptance model (TAM).

1.2.1 Theoretical framework

The theoretical framework illustrates the effects of mobile user interface components (visual design, navigation design, and information design) on competitive advantage, with the technology acceptance model (TAM) acting as a moderator factor between these relationships. Based on the above theoretical framework, we present the following model, as shown in Figure 1.

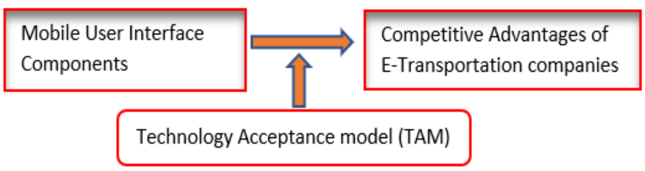


Fig. 1. Research model

1.2.2 Research hypotheses

The first phase of this study aims to explore the relationship between user interface components and competitive advantage in e-transportation companies. To achieve this, the following research hypotheses were proposed:

H_1: There is a significant relationship between mobile user interface components and competitive advantage for e-transportation companies.

- $H_{1.1}$: Visual design significantly impacts competitive advantage.
- $H_{1.2}$: Navigation design significantly impacts competitive advantage.
- $H_{1.3}$: Information design has an important impact on competitive advantage.

H_2: There is a significant moderating role of TAM in the relationship between the mobile User interface components (visual design, navigation design, and information design) and competitive advantage in e-transportation Companies.

- $H_{2.1}$: There is a significant moderating role of TAM in the relationship between visual design and competitive advantage in e-transportation Companies.
- $H_{2.2}$: There is a significant moderating role of TAM in the relationship between navigation design and competitive advantage in e-transportation Companies.
- $H_{2.3}$: There is a significant moderating role of TAM in the relationship information design and competitive advantage in e-transportation Companies.

2. Research Methodology

This section outlines the methodology employed to achieve the study objectives. It provides a comprehensive framework for the research design, population, sample selection, research instruments, and data analysis techniques.

2.1 Research Design

Following the recommendations provided by Guetterman, Fetters, and Creswell [16],this study uses a quantitative research design and a questionnaire to collect data. Quantitative research seeks to explain, regulate, and forecast social phenomena by employing numerical measurements to examine certain study questions or hypotheses.

2.2 Sampling Method

The study population comprised approximately 324,985 visually impaired individuals, as reported by the General Statistics Department of Jordan (2022). This population included males and females aged 13 years and older, representing diverse educational backgrounds and different visual difficulties. They also resided in major cities such as Amman, Zarqa, Irbid, Ajloun, Jerash, and Aqaba. This diversity is intentionally considered to ensure a representation of the population, enhancing the accuracy and reliability of the study's findings.

The focus is on the visually impaired and familiar with e-transportation applications such as Uber, Careem, Petra Ride, and Jeeny. Systematic random sampling techniques were utilized, and based on Krejcie and Morgan's [17] formula, a statistically acceptable sample size of 384 individuals was determined from the population of 324,985. This approach ensured the required number of completed and returned surveys met the recommended technical standards for robust data collection and analysis.

2.3 Questionnaire Design

Building on previous studies, the survey has been structured into multiple sections to ensure comprehensive analysis. It includes studying independent factors like visual, information, and navigation design, with the Technology Acceptance Model (TAM) as a moderating factor. Dependent factors include cost, quality, flexibility, delivery speed, and competitiveness. Each factor is evaluated using a five-point Likert scale, ranging from "strongly agree" to "strongly disagree," to capture nuanced participant responses.

2.4 Data Collection Methods

Online survey instruments were carefully developed and validated through expert assessments and pilot testing—the questionnaire aimed to gather perceptions on suitable mobile user interface services for e-transportation platforms.

3. Data Analysis

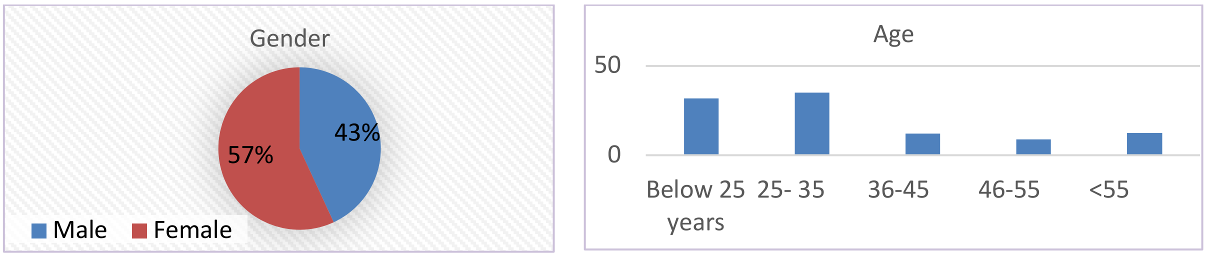
The main goal of this section is to focus on data analysis; it covers key areas such as data screening, participant demographics, reliability and validity, and the structural model's suitability using the Statistical Package for the Social Science (SPSS) and Analysis of Moment Structures (AMOS). The focus is on the relationships between mobile user interface components and competitive advantage in e-transportation, particularly emphasizing the moderating role of the Technology Acceptance Model (TAM). The findings highlight the significance of visual, navigation, and information design, along with technology acceptance, in achieving competitive advantage and improving the quality of life for visually impaired users.

3.1 Data Analysis Technique

The study utilized advanced statistical techniques to ensure robust and comprehensive data analysis. Structural Equation Modeling (SEM) and regression analysis using (AMOS) to explore complex relationships between variables. Cronbach's alpha was applied to evaluate the reliability of the survey measures, while (SPSS) was employed for descriptive statistical analysis. Together, these methodologies established a strong foundation for examining intricate correlations and relationships within the data, ensuring both the validity and reliability of the study's results.

3.2 Demographic Characteristics

We deemed 357 of the 384 distributed questionnaires valid, yielding a response rate of 92.9%. The demographic analysis revealed a higher participation rate among females (56.9%) and individuals aged 25–35 (35%), providing insights into the characteristics of the sample population. As shown in Figure 2.



(a) Gender respondents (b) Age respondents

Fig. 2. The demographic characteristics

3.3 Reliability

This investigation tested the reliability. This kind meets Cronbach's alpha with the use of SPSS. The acceptable reliability (i.e., alpha = 0.70 or above), which means it is satisfactory, as highlighted by [18]. Table 1 displays the results of the indicators of the study construct' Cronbach Alpha (CA) and composite (CR) reliability. The dependability magnitudes of the constructs used in this investigation are also displayed in the table. According to Cronbach alpha values, the lowest value was 0.811, which indicates strong dependability levels.

Table 1
The Cronbach and composite reliability for the items of the study constructs

Constructs	#Items	Cronbach Alpha	Composite Reliability
Visual Design	3	.975	.768
Navigation Design	4	.811	.748
Information Design	4	.859	.756
Perceived Usefulness	4	.938	.652
Perceived Ease Use	4	.964	.757
Enjoyability	4	.892	.738
Competition	4	.947	.787
Delivery Speed	3	.929	.671
Quality	4	.924	.741
Flexibility	4	.905	.691
Cost	4	.933	.710

Table 1 highlights the reliability of various constructs, with most demonstrating strong internal consistency. Visual Design showed excellent reliability (Cronbach's Alpha = .975; Composite Reliability = .768), while Navigation Design and Information Design displayed good reliability (Cronbach's Alpha = .811 and .859, respectively). Perceived Usefulness had high internal consistency (Cronbach's Alpha = .938) but relatively low Composite Reliability (.652), requiring caution. Perceived Ease of Use and Enjoyability exhibited excellent and strong reliability, with Cronbach's Alphas of .964 and .892, respectively. Competition, Delivery Speed, Quality, Flexibility, and Cost all showed good to excellent Cronbach's Alphas (ranging from .905 to .947). However, some had moderate Composite Reliability, suggesting the need for careful interpretation in structural equation modeling.

3.4 Variance Extracted (VE) Test

The results of the variance extracted (VE) test demonstrated that all constructs exhibited VE values surpassing the threshold of 0.50, recommended by Balgiu *et al.*, [19].

Table 2
Variance Extracted (VE) test result

Constructs	AVE
Visual Design	0.804
Navigation Design	0.831
Information Design	0.791
Perceived Usefulness	0.719
Perceived Ease Use	0.796
Enjoyability	0.780
Competition	0.832
Delivery Speed	0.593
Quality	0.782
Flexibility	0.748
Cost	0.761

Table 2 demonstrates a robust ability to explain observed variation, with all AVE values falling within the range of 0.593 and 0.832. This indicates a sufficient degree of convergent validity, which led to the determination of this investigation's convergent validity.

3.5 Normality

Normality is a fundamental principle in data analysis. It ensures that variables adhere to a normal distribution, as deviations from this can compromise the validity of statistical results. Skewness and kurtosis are key indicators for testing normality, with kurtosis reflecting the peak of the data distribution and skewness indicating the direction of the distribution tails. Urbano [20] states that these values should remain between -3 and +3. This study's skewness and kurtosis values confirmed that the data approximate a normal distribution, as shown in Table 3.

Table 3
Normality test

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Visual Design	-.015-	.129	-1.725-	.257
Navigation Design	-.129-	.129	-1.477-	.257
Information Design	.192	.129	-1.437-	.257
Perceived Usefulness	.136	.129	-1.760-	.257
Perceived Ease Use	.159	.129	-1.691-	.257
Enjoyability	.232	.129	-1.366-	.257
Competition	-.086-	.129	-1.445-	.257
Delivery Speed	.230	.129	-1.036-	.257
Quality	.041	.129	-1.339-	.257
Flexibility	.211	.129	-1.507-	.257
Cost	**-.283-**	**.129**	**-.993-**	**.257**

Table 3 confirms that all scores fall within -3 to +3, indicating that all variables follow a normal distribution.

3.6 Descriptive Statistics

Descriptive statistics elucidated the characteristics of the study variables, with most constructs rated at a moderate level. However, variables such as information design and perceived usefulness are perceived at a comparatively lower level, as shown in Table 4, indicating areas for potential improvement.

Table 4
Descriptive statistics

	N	Mean	Std. Deviation	Rank
Visual Design	357	2.89	1.558	Moderate
Navigation Design	357	2.75	1.175	Moderate
Information Design	357	2.27	1.111	low
Perceived Usefulness	357	2.26	1.240	low
Perceived Ease Use	357	2.54	1.452	Moderate
Enjoyability	357	2.62	1.424	Moderate
Competition	357	2.61	1.154	Moderate
Delivery Speed	357	2.77	1.217	Moderate
Quality	357	2.76	1.291	Moderate
Flexibility	357	2.73	1.498	Moderate
Cost	357	3.28	1.295	Moderate
Valid N (listwise)	357			

Table 4 summarizes descriptive statistics for the constructs. Most constructs, including visual design (Mean: 2.89), navigation design (Mean: 2.75), and quality (Mean: 2.76), are rated at a moderate level with moderate variability. Information design (Mean: 2.27) and perceived usefulness (Mean: 2.26) are rated lower. Cost (Mean: 3.28) is the highest-rated construct, while variability generally remains moderate across constructs.

3.7 Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) evaluates how well-measured variables represent latent constructs, often following reliability tests like Cronbach's Alpha. It assesses model fitness and validates relationships between measurement and latent variables, as Nisa *et al.,* [21] noted.

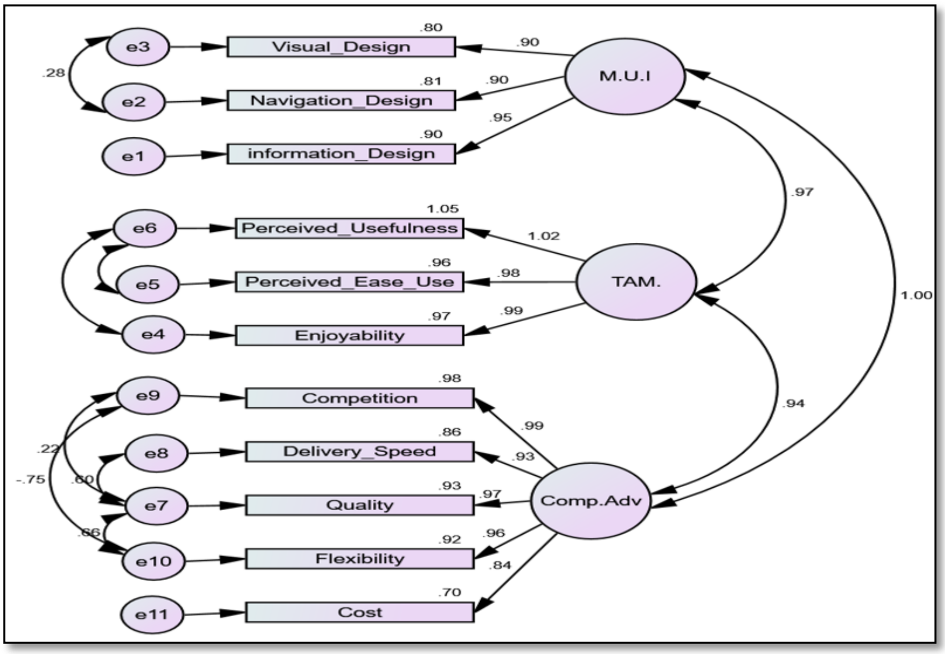


Fig. 3. CFA models

Figure 3 shows that Mobile User Interface (MUI) components—information, navigation, and visual design—strongly influence the Technology Acceptance Model (TAM) and significantly enhance Competitive Advantage (Comp.Adv). Key TAM factors, including perceived usefulness, ease of use, and enjoyment, drive technology adoption (effect: 0.97). In turn, TAM boosts Comp.Adv components like competition, quality, and delivery speed (effect: 0.99). Improved UI design fosters better technology acceptance, leading to stronger competitive advantages for businesses.

3.8 Testing of Hypotheses

This section tests the study's main hypotheses, H_1 and H_2, in which H_1 examines the relationship between mobile user interface components and competitive advantage for e-commerce companies.

Table 5
Results of testing H_1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	f	Results
		B	Std. Error	Beta				
	(Constant)	.418	.064		6.501	.000	847.431	
$H_{1.1}$	Visual Design	.345	.051	.437	6.798	.000		Supported
$H_{1.2}$	Navigation Design	.218	.049	.208	4.403	.000		Supported
$H_{1.3}$	Information Design	.358	.051	.324	6.962	.000		Supported

a. Dependent Variable: Competitive Advantage

Table 5 highlights significant relationships between visual, navigation, and information design and competitive advantage. Visual design significantly impacts competitive advantage (p-value = 0.000, $H_{1.1}$ accepted), navigation design also shows a significant relationship ($H_{1.2}$ accepted), and information design demonstrates a strong influence (p-value = 0.000, $H_{1.3}$ accepted), as emphasized by Vidgen and Yasseri [22]. Next, in the first phase of the study, the second hypothesis was also tested to examine the moderating role of the Technology Acceptance Model (TAM) in the relationship between user interface components—visual design, navigation design, and information design—and competitive advantage in e-transportation companies, as shown in Table 6.

Table 5
Results of testing H_2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Results
		B	Std. Error	Beta			
	(Constant)	.523	.028		18.893	.000	
H_2	TAM	2.325	.059	2.566	39.559	.000	Supported
$H_{2.1}$	Visual Design	-1.191-	.045	-1.509-	-26.748-	.000	Supported
$H_{2.2}$	Navigation Design	.603	.023	.576	25.840	.000	Supported
$H_{2.3}$	Information Design	-.734-	.035	-.662-	-20.747-	.000	Supported

a. Dependent Variable: Competitive Advantage

The study found that TAM significantly moderates the relationships between visual design (B = -1.191, t = -26.748), navigation design (B = 0.603, t = 25.840), and information design (B = -0.734, t = -20.747) with a competitive advantage, with all relationships being statistically significant ($p < 0.001$). These results support main hypotheses H_2, $H_{2.1}$, $H_{2.2}$, and $H_{2.3}$, aligning with the conclusions drawn by Oyelami's [23] study.

So, the study's first phase successfully achieved its primary objective of identifying the relationship between user interface components and competitive advantage in e-transportation companies. The study will proceed with the second phase, detailed in the following section.

4. Phase II: Designing an Accessible E-Transportation Mobile Application for the Visually Impaired

Accessibility is still a major obstacle for the visually impaired in today's technologically advanced world. Shera *et al.,* [6] proposed a user-focused design approach to address these issues, aiming to improve accessibility and simplify use.

This e-transportation application aims to enhance daily performance and establish new norms in accessible mobile technology by offering visually impaired users intuitive voice commands, smooth navigation, and optimum information presentation, greatly reducing cognitive burden.

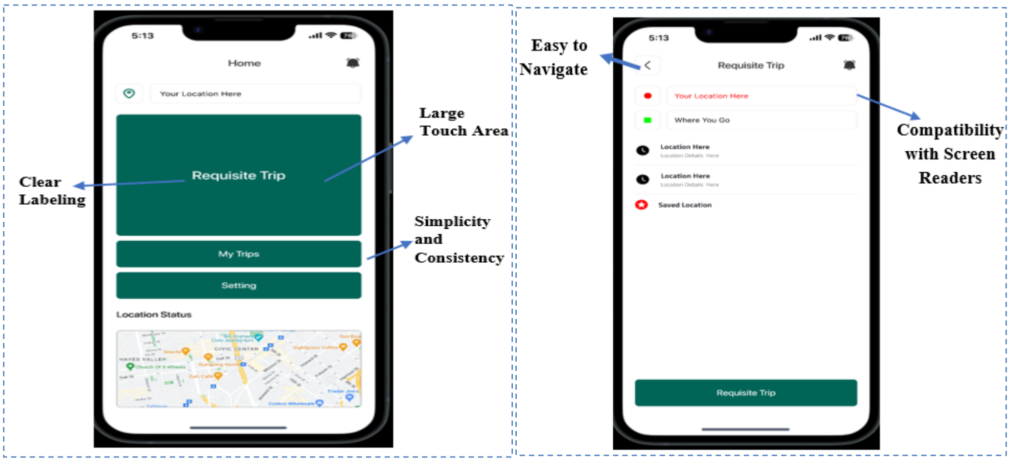
4.1 E-Transportation Mobile Application Design

The e-transportation application is meticulously designed based on feedback from visually impaired participants in Phase I of the study. It played a crucial role in identifying their specific needs and challenges in existing e-transportation services. Consequently, the design focused on accessibility, simplicity, and user satisfaction by incorporating accessibility features such as large touch areas, straightforward layouts, and clearly labeled buttons for easy navigation. In addition, plain language and concise information were used to enhance clarity, while full compatibility with screen readers ensured seamless usability for visually impaired users. Together, these design elements, guided by a user-centered approach, made the application intuitive, inclusive and well-suited to meet the needs of its target audience.

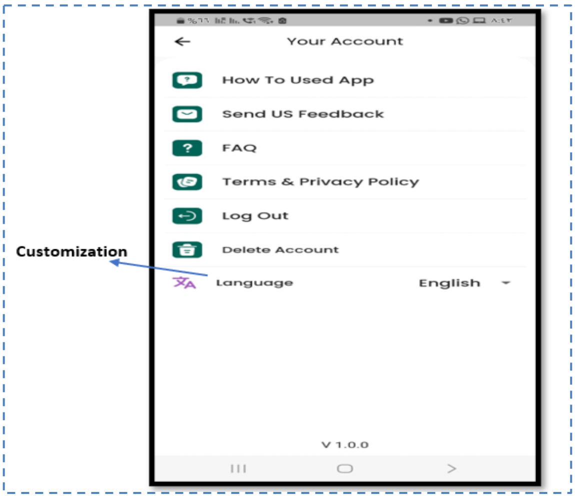
Moreover, the design process directly addressed common challenges faced by visually impaired users, such as complex navigation, information overload, and technical issues with screen readers. To overcome these obstacles, six core principles were adopted: User-Centered Design (UCD), simplicity, local language support, screen reader compatibility, consistency, and simple navigation. As a result, the application was made functional, accessible, and efficient for all users.

Furthermore, the development process began with an in-depth analysis of user needs, which informed the creation of prototypes using Figma to visualize the application's structure and functionality. A modular development approach was employed, leveraging Flutter for cross-platform compatibility and Firebase for robust backend support. Consequently, the application incorporated key features, such as accessible interfaces, seamless screen transitions, and full integration with assistive technologies like TalkBack on Android and VoiceOver on IOS.

Additionally, rigorous testing was carried out to ensure usability across various devices. Functional, compatibility and usability tests were performed, and feedback from visually impaired users was integrated into the iterative design process. As a result, the final prototype included intuitive main screens, such as Home, Requisite Trip, and Account Settings Screen, along with customizable settings to enhance user independence and satisfaction. Ultimately, this comprehensive, feedback-driven approach ensured that the application was inclusive, reliable, and tailored to the needs of visually impaired users. As shown in Figure 4.



(a) Home Page (b) Requisite Trip



(c) Account settings screen

Fig. 4. E-transportation application user interface

The application design effectively meets the needs of visually impaired users by prioritizing accessibility and simplicity. Features such as large touch areas, clear labeling, screen reader compatibility, and voice command integration ensure seamless navigation and interaction. Customizable settings and straightforward layouts enhance user independence and satisfaction, making the application intuitive and inclusive.

4. Result and Discussion

The study finds that mobile user interface (UI) components, including visual design, navigation design, and information design, are fundamental in enhancing user satisfaction and achieving sustainable competitive advantage. The Technology Acceptance Model (TAM) was used to analyze the relationship between these UI components and their impact on competitive advantage.
The study findings highlight that well-structured designs significantly improve user engagement and inclusivity, particularly for users with special needs, such as visually impaired users. Effective visual design attracts attention and facilitates seamless interaction, broadening the potential user base. Similarly, intuitive navigation reduces user frustration, ensuring a smooth and efficient experience, especially for those relying on assistive technologies. Clear and well-organized information design further simplifies trip booking, increasing user satisfaction and loyalty.

Building on these insights, the study emphasized integrating practical design principles to maximize user satisfaction. Key principles include simplicity, local language support, screen reader compatibility, consistency, and user-centered design (UCD). These principles ensure that applications are functional, accessible, and straightforward, catering to diverse user needs. For example, simplicity minimizes confusion, while local language support fosters familiarity and comfort. Consistency across the application enhances usability, while screen reader compatibility promotes inclusivity for visually impaired users. This study also confirmed that TAM acts as a moderating factor, strengthening the influence of user interface components on competitive advantage. Applications perceived as useful and easy to use are more likely to retain users and encourage loyalty. Practical strategies, such as interactive guides and introductory tutorials, enhance perceived ease of use and usefulness, making the application an essential part of users' daily lives.

5. Conclusion

The study concluded that e-transportation companies can achieve a sustainable competitive advantage by prioritizing high-quality user interface (UI) design and leveraging the principles of the Technology Acceptance Model (TAM), emphasizing the importance of visually appealing designs, intuitive navigation, clear information organization, and accessibility features such as screen reader compatibility to enhance user satisfaction, inclusivity, and loyalty. Additionally, practical strategies like interactive guides and tutorials significantly boost perceived ease of use and usefulness, making applications essential to users' daily lives and ensuring companies maintain a leading position in a competitive market. The study successfully validated its primary hypotheses, confirming a significant relationship between mobile user interface components and competitive advantage for e-transportation companies, as well as the moderating role of TAM in fostering this advantage, highlighting the importance of integrating well-designed UI components with TAM principles to drive success in e-commerce. Furthermore, the study achieved its primary objective of designing an exclusive, user-friendly e-transportation application that bridges the gap between traditional mobility services and inclusive digital design.

6. Future Research

Future research highlights the importance of designing mobile applications for visually impaired users that utilize auditory perception to enhance access to visual information. By focusing on voice commands and optimized content, we aim to bridge the accessibility gap and empower visually impaired users in the digital world.

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