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Designing a User-Friendly E-Transportation Mobile Application for Visually Impaired Users

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Abstract

In today's age of digitization, the integration of information systems and computer science is essential in developing technologies that enhance user experiences, particularly among visually impaired individuals. As e-transportation services continue to grow, many applications still do not meet the requirements of visually impaired users, thereby limiting their ability to use the services independently. To develop a model that is user-friendly for visually impaired users, the study aims to examine the impact of visual, navigation, and information design of mobile interfaces on the competitive strength of e-transportation apps. The study, which employed a quantitative method in surveying 357 visually impaired users in Jordan, showed that information design, navigation, and visual aspects significantly affect the extent to which e-transportation businesses are competitively positioned. The research consists of two components: first, it determines the requirements and issues of blind users; second, it applies these findings to the design of an accessible and usable e-transportation application. Significantly, the research also identifies some usability measures and provides statistical evidence. Visual design had the largest positive effect on competitive advantage ($\beta = 0.328$, $t = 4.541$, $p = 0.000$), followed by navigation design ($\beta = 0.268$, $t = 3.456$, $p = 0.001$) and information design ($\beta = 0.213$, $t = 3.399$, $p = 0.001$). Additionally, the Technology Acceptance Model (TAM) contributed significant explanatory power to the model ($\beta = 0.472$, $t = 6.549$, $p = 0.000$) and moderated the interaction effect between UI features and competitive advantage ($\beta = 0.170$, $t = 5.000$, $p = 0.028$). The results validate the importance of customizing applications to the specific needs of visually impaired people. With intuitive interfaces and voice-based interactions, these innovations not only facilitate ease of access but also contribute to an overall positive user experience, providing e-transportation businesses with a competitive edge in the long term. The outcomes of this study indicate that these design improvements are the highest priorities for developing inclusive, usable applications and increasing the independence of visually impaired application users.

Keywords: User Interface Design; Visual Impairment; E-Transportation Applications; Competitive Advantage; Visual Design; Navigation Design; Information Design; Accessibility.

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1. Introduction

According to WHO (2019), there are at least 2.2 billion people worldwide who have a vision impairment or are completely blind. These people face severe physical, psychological, social, and financial difficulties, especially in terms of mobility, which significantly impacts their quality of life. Public transport is their lifeline for independence, access to school, employment, and basic services. Most blind people use white canes, some help from others, or assistive technology for information about the world around them (Chaudary, 2022). Artificial intelligence (AI) based applications are becoming increasingly important and reliable tools for visually impaired users, recognizing the orientation of pavements and generating suitable information, even in the absence of network connectivity (Abadleh, 2025a). The investigation into such technologies dates back to the 1960s and has since advanced to electronic systems that augment or replace vision and support users in sensing and understanding their environment (Abadleh, 2025b). With an increasing number of visually impaired people, the need for high-quality mobile interfaces that are accessible to a wide audience in e-transportation is growing rapidly. Owing to a lack of usability studies, poor adaptation to local conditions, feedback mechanisms, and user satisfaction, most e-transportation systems are not designed for visually challenged users, which affects their mobility and independence (Alfayez et al., 2023; Zahib et al., 2022. Other research has demonstrated that there is some variation in the effectiveness of assistive applications based on AI (Abadleh, 2024). For instance, indoor walker assistive applications (e.g., ASSIST) may perform better but have limitations. As for field studies, such as All_Aboard, they may perform more efficiently than standard maps in helping users reach their destination (Baniata et al., 2024). These findings suggest the importance of performing user-centered design and formal evaluation in the development of e-transportation solutions for visually impaired populations.

The main originality of this study lies in the design and development of an advanced mobile e-transportation model for visually impaired users, particularly for those in the low vision group. Unlike existing assistive transport applications, this study integrates the Technology Acceptance Model (TAM) to systematically examine how critical mobile user interface components visual design, navigation, and information presentation directly influence user acceptance and competitive advantage. In addition, a rigorous theoretical model is integrated with user-centered design to develop a novel and comprehensive method of enhancing accessibility while simultaneously evaluating business performance in the e-transportation field.

The research paper is divided into several sections. Firstly, the introduction describes the problems faced by visually impaired users in e-transportation. Next, the research background explains the usability challenges that already exist. The research methodology section presents the design of the study and the analysis of the data. The findings and discussion then explore the effect of design factors on competitive advantage. Lastly, the conclusion summarizes the results and findings, and we recommend further improvements in the accessibility of application design for future research.

2. Related Work

Previous studies have extensively explored the challenges and proposed solutions for improving the mobility and independence of visually impaired users, particularly in transportation and navigation systems.

ATICI et al. (2023) highlighted specific challenges visually impaired users encounter when using e-transportation applications. They proposed leveraging familiar guides and conceptually related skills to improve the navigation experience, thus facilitating smoother travel for users. Although the study highlights the importance of familiar concepts in navigation, it overlooks issues like application response delays and data updates, which can frustrate users in fast-paced environments that require real-time information. To tackle real-time transportation challenges, Yu et al. (2020) introduced the BusMyFriend application, designed to assist visually impaired users by offering bus reservation services, notifying bus drivers, and using tactile indicators at bus stops. While this application provides innovative transportation solutions, its reliance on tactile indicators and bus-stop infrastructure may not be practical in regions with limited public transportation. Real-time accessibility also depends on local infrastructure quality. In response to the interface design challenges highlighted in the above studies, Khan & Khusro (2019) developed the Universal Accessibility Framework (UAF), focusing on consistency, minimal cognitive load, and simplified navigation for blind and visually impaired users of touchscreen devices. While UAF addresses critical usability issues, the framework may not sufficiently accommodate diverse user needs, particularly those who rely on alternative input methods beyond touchscreens.

Expanding on the need for training and adaptability, Senjam et al. (2021) emphasized that many applications still rely heavily on visual interfaces, thereby limiting their accessibility to visually impaired users. They argued that comprehensive training alongside the development of more inclusive designs is crucial for improving application usability. Although training is important, the study overlooks the need to train developers in accessibility. Responsibility should not fall solely on users; developers must be better educated in accessibility principles. Building on these findings, Zahib et al. (2022) contributed to improving and developing the "Grab" application by applying User-Centered Design (UCD) methodology, providing practical solutions such as voice and haptic feedback to enhance the experience of visually impaired users. While the study offered effective solutions, its small sample size and limited testing scope reduced the generalizability of the findings. Expanding the research could lead to more comprehensive results and further improvements to the application. On the technological front, Paul et. al. (2023) integrated computer vision, sensor fusion, and haptic feedback to improve spatial interaction for visually impaired users, but the study overlooks challenges in low-light or confined spaces where computer vision is less effective, and the high costs may limit accessibility in lower-income regions.

Taking a minimalist approach, Alfayez et al. (2023) developed a mobile application specifically for visually impaired and illiterate users, focusing on simplicity and auditory feedback. While the minimalist interface ensures ease of use, it may limit functionality for more advanced users. There is a delicate balance between simplicity and offering enough features to accommodate users with varying degrees of technical expertise, Building on this notion of accessibility, Hashim et al.(2021) contributed by identifying the key usability requirements for visually impaired users in mobile e-book applications, emphasizing features like screen reader compatibility, ease of navigation, and text-to-speech, but the study's limited sample size and reliance on a single data collection method may limit the depth of its findings. Continuing this trend, Tak (2022) introduced guidelines to improve accessibility by reducing keystrokes and enhancing the contrast between foreground and background, with additional focus on voice commands and ethical considerations like user privacy. Tak's guidelines provide a comprehensive solution to existing design challenges, but the study does not delve deeply into the technical challenges of implementing these recommendations across diverse platforms and systems. Moreover, the ethical considerations around privacy need further exploration in the context of data collection in transportation systems. Additionally, to achieve a competitive advantage, Kim et al. (2013) found that using haptic interfaces in digital platforms helps visually impaired users navigate more easily, allowing companies to differentiate their products and expand market reach. However, the study does not explore the benefits of combining haptic technology with other modalities, such as audio, nor does it fully address the cost implications of large-scale implementation.

Similarly, (Sahib et al., 2015) evaluated a search interface designed for visually impaired users, showing that tools like speech-based screen readers improve accessibility and allow companies to attract a wider audience, thereby gaining a competitive advantage, though the study does not explore the potential of incorporating technologies like haptic interfaces or AI for further enhancement. Table 1 shows that existing mobile and web-based transportation applications for visually impaired users offer assistive features but face limitations such as regional restrictions, minimal functionality, and limited scalability. While some apps focus on reading support (Kibo, KNFB Reader) or navigation (BlindSquare, Seeing Eye GPS), even advanced tools like StopInfo are transport-specific. The above deficits highlight the need for inclusive, scalable, multilingual, and universally designed solutions that consider the needs of various visually impaired users.

Table 1. Mobile Applications for Transportation

Approach	Origin	Platform	Purpose	Technology	Limitation
TransmiGuia	Columbia and Greece	Mobile Applications	Transport	Geolocation and voice recognition	Uses Spanish, applicable to transportation systems for one specific region
NavTU	Thailand	Mobile (Android)	Transport	GPS and Camera-based technology	It works only in the Thai language
Busalert	São Carlos, Brazil	Android, Windows	Bus	Voice Recognition	Only notifies of distance in meters and estimates of wait time
iMove	USA	Android, iOS	Bus, train	Location Service, Voiceover	Only notify current location and obstacles
StopInfo for OneBusAway	USA	Android, iOS, Web	Bus	Visual navigation tool with GPS Blinput and multisensors for the white cane	Only for bus transportation

However, despite these developments, designing accessible user interfaces including visual design, information design, and navigation design remains a serious challenge. The lack of visibility of color contrast, the poor layout of the structure, and the absence of audio feedback are additional sources of frustration and a lack of autonomy for the users (Shera et al., 2021). Therefore, addressing these issues is crucial for creating more efficient solutions, which is reflected in the need for further research and development activities related to e-transportation. This research paper seeks to address this gap by recommending a framework to integrate these solutions with the constraints that exist in user interface design, accessibility, and usability for visually challenged users, and to assist e-transportation companies in gaining competitive advantages.

3. Theoretical Framework

The theoretical framework covers related models and theories (e.g., Technology Acceptance Model, TAM) to explore factors affecting access to mobile applications by visually impaired users and to guide the design of inclusive and competitive user interfaces. The TAM is a relatively popular model of user acceptance of new technologies that is largely founded on two constructs, perceived usefulness (PU) and perceived ease of use (PEoU) (Davis, 1989). TAM, especially, will be helpful in exploring how successful the implementation and use of mobile applications can be in the case of visually impaired customers.

Perceived usefulness is a significant construct, defined as the extent to which visually impaired users believe that the utilization of an e-transportation application will make them more independent, enhance their access to transportation services, and decrease their reliance on external assistance. It is also important to consider perceived ease of use because visual impairments may influence the ease of navigation of mobile interfaces, as users may have poor vision or must utilize aids like screen readers and voice feedback. It has been demonstrated that the more intuitive an application interface is, the more accessibility tools it provides and the less cognitive load it has, the more likely such a population is to accept and use it consistently (Alqaraleh et al., 2025).

3.1 Hypotheses

Three main hypotheses must be tested in this study as follows:

H1: There is a significant relationship between mobile user interface components and the competitive advantage of e-transportation companies.

- H1.1: There is a significant relationship between visual design and competitive advantage in e-transportation companies.
- H1.2: There is a significant relationship between navigation design and competitive advantage in e-transportation companies.
- H1.3: There is a significant relationship between information design and competitive advantage in e-transportation companies.

H2: There is a significant relationship between TAM and competitive advantage in e-transportation.

H3: There is a significant moderating role of TAM in the relationship between mobile user interface components (visual design, navigation design, and information design) and competitive advantage in e-transportation Companies.

Accordingly, based on the above presented framework, the following model is presented to test the Phase 1 model of this study, "User Interface and Competitive Advantage Improved Model", as shown in Figure 1.

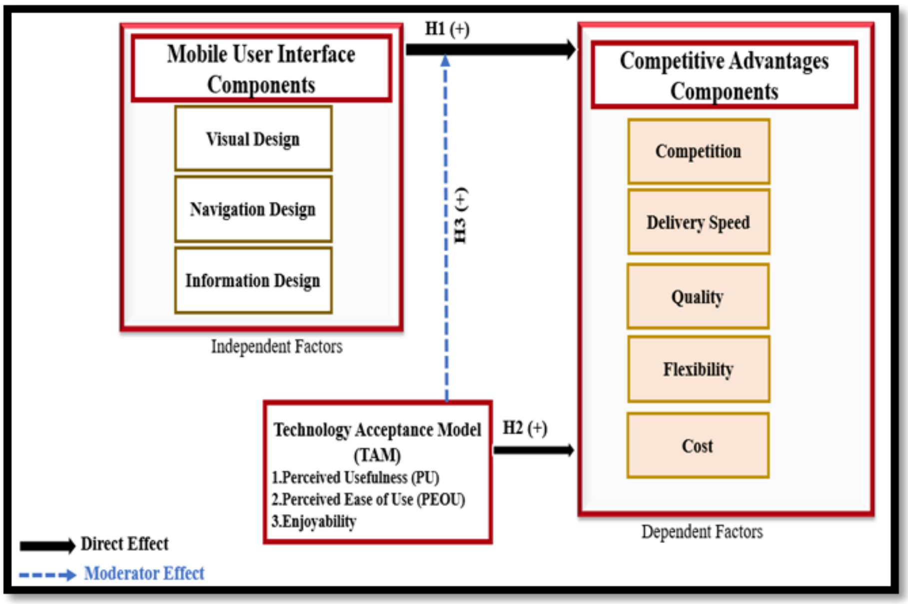

Figure 1. User Interface and Competitive Advantage Improved Model

4. Research Methodology

The research methodology of this study is divided into two main phases, each building upon the other to design and evaluate an e-transportation application tailored for visually impaired users. Through these two phases, this research systematically addresses the challenges faced by visually impaired users and develops a solution tailored to their needs, with data collection methods ensuring that the findings are both reliable and reflective of the target population.

4.1 Phase 1

This study in this phase aims to investigate the relationship between mobile user interface components (visual design, navigation design, and information design) and competitive advantage to analyze the needs of visually impaired users before starting to design the user interface. To understand the needs of visually impaired users, we give special attention to their demand for TAM factors such as perceived ease of use and perceived usefulness, as well as competitive advantage factors, such as quality, cost, flexibility, competition, and speed of delivery. The practice is informed by a series of principles from prior research, including a study by Khan and Khusro (2019), that emphasizes the importance of user-centered design. During this phase, an extensive literature review is conducted to help reveal the key design principles applied in prior mobile applications designed for visually impaired individuals.

4.2 Data Collection

The study participants were selected based on certain criteria to obtain pertinent and valid information. The eligible respondents were visually impaired persons aged 13 years or above who had already obtained a basic education (school, college, or university). Typically, the term low vision impairment is used to refer to the decreased quality of vision caused by blurred vision or a low capacity to distinguish shapes or read tiny text. They also had to possess previous experience in using e-transportation applications (Uber, Careem, Petra Ride, or Jenny) and know how to use a smartphone and operate mobile applications. Individuals meeting these requirements were approached through associations and organizations that assist visually impaired citizens. The survey was only conducted only with those individuals who satisfied all the criteria, which helped ensure that the information collected was sound and could be analyzed.

Furthermore, the research utilized an online survey instrument to collect data through the experiences of participants with the available e-transportation applications in Jordan. The questionnaire aimed to receive feedback about interactions, preferences, and challenges that could assist in better defining specific needs in mobile application design for this user group. Jordan was selected as the field of study due to various factors relevant to the social, cultural, and technological environment of the country. The Department of Statistics (2021) reported that visual disability is the most prevalent of all disabilities among the Jordanian population aged five and above, with a prevalence of 6%, followed by mobility disability (4.8%) and hearing disability (3.1%) (Department of Statistics [DoS], 2021). Moreover, Qutishat et al. (2020) conducted a study in Jordan, the results of which indicate that 74.9 percent of individuals with low vision cannot comfortably complete near tasks (reading, using digital devices, etc.).

In Jordan, digital services are not readily available to the visually impaired population due to both a deficiency in technological infrastructure and a lack of applications accessible to this group, both culturally and socially. In addition, the Higher Council for the Affairs of Persons with Disabilities (2021) indicated that the proportion of individuals with visual impairments in Jordan who do not have health insurance coverage is substantial and, consequently, contributes to the fact that many individuals with disabilities do not have access to assistive technological devices and services. Thus, high-end assistive technology and better design of mobile user interfaces are necessary steps towards greater inclusion of visually impaired people in digital society, particularly in low-resource nations like Jordan. Finally, the outcome of this phase is to compile a list of design principles for e-transportation applications, which will serve as a foundation in the second phase when designing a specific e-transportation application tailored to visually impaired users.

4.3 Research Design

This study employs a quantitative research design, utilizing a questionnaire to reach a broad audience. The quantitative approach aims to explain, control, and predict social phenomena and is effective for testing specific research questions or hypotheses (Alqaraleh, 2024). The total population is 479,491 individuals (General Statistics Department, Jordan, 2022), and the dataset is based on responses from 357 visually impaired users across four major Jordanian cities, selected via random sampling according to Krejie & Morgan's (1970) guidelines. Evaluation criteria included reliability (Cronbach's alpha), convergent and discriminant validity, and hypothesis testing via PLS-SEM. These details are explained in the sampling design and data analysis sections but can be highlighted more explicitly in future revisions.

4.4 System Architecture

The system architecture, as shown in Figure 2, illustrates how visually impaired users (VIUs) interact with the mobile application through the user interface (UI/UX layer), which integrates visual, navigation, and information design components. The application services layer manages trip booking, payment, and trip management, while the backend server and database handle authentication, data storage, and trip records. External APIs such as Google Maps, Firebase, and payment gateways are incorporated to ensure real-time navigation, secure authentication, and efficient payment processing.

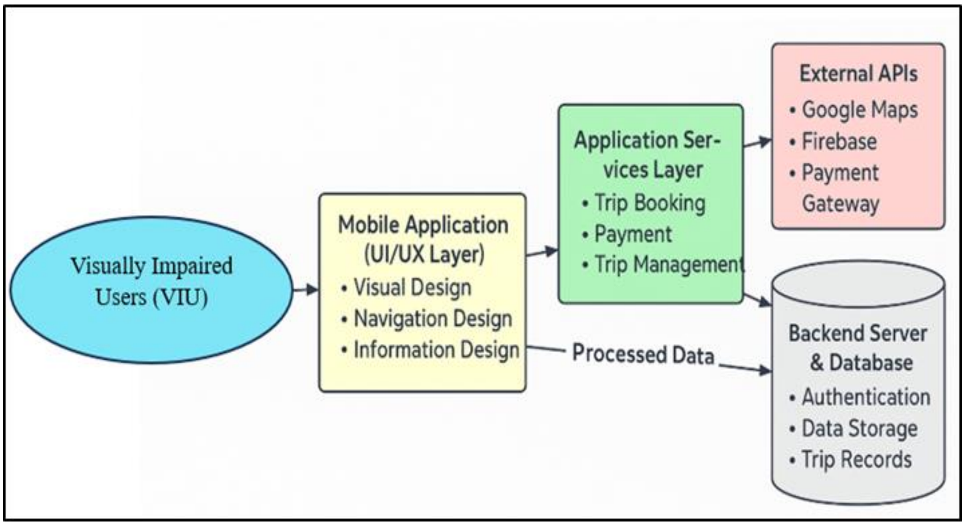

Figure 2. System Architecture of Visionary Journey Application

5. Data Analysis

Data were processed using the Statistical Package for the Social Sciences (SPSS) Version 26 for descriptive analysis, while Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed using SmartPLS4 software. PLS-SEM enables robust analysis of complex relationships among latent variables and provides reliable estimates, making it particularly suitable for exploratory and predictive studies. Due to its focus on prediction and variance explanation, it is suitable for assessing the impact of mobile UI components and TAM constructs on competitive advantage (direct and moderating effects). The methodology, therefore, supports the design of a mobile e-transportation model for visually impaired users and directly relates to the research goals (Hair et al., 2021).

Based on user surveys and pilot studies, we opted for voice and touch input modalities, as they are familiar and easily accessible, and had lower usage error rates compared to haptics or gesture-based control, which were avoided due to learning challenges or inconsistency in user experience (Khan and Khusro, 2019). Cronbach's alpha was used to check for the reliability of the measures, and the variance extracted (VE) test was used to check for an adequate model. These methods establish a strong foundation for analyzing the relationship between mobile user interface components, competitive advantage in e-transportation, and the moderating effect of the Technology Acceptance Model (TAM), all of which are crucial for ensuring the accuracy and robustness of the research findings.

5.1 Test of Multicollinearity

The collinearity statistics for the independent variables, as shown in Table 2, indicate that multicollinearity is not a concern in this regression model. The tolerance values range from 0.436 to 0.554, all well above the critical threshold of 0.10, suggesting that each predictor contributes unique variance and is not overly correlated with the others. Similarly, the VIF values range from 1.805 to 2.294, which are far below the commonly accepted cut-off of 10 (Hair et al., 2021), confirming that multicollinearity is minimal. These results indicate that the independent variables, including Mobile User Interface Component, Information, Navigation, Visual, TAM, and the interaction term TAM × Mobile User Interface Component, can be reliably included in the model, and the regression coefficients are likely to be stable and interpretable.

Table 2. Tolerance and Variance Inflation Factor (VIF)

Model	Tolerance	VIF
Mobile User Interface Component -> Competitive Advantages Components	0.482	2.074
Information -> Competitive Advantages Components	0.436	2.294
Navigation -> Competitive Advantages Components	0.521	1.920
Visual -> Competitive Advantages Components	0.497	2.011
TAM -> Competitive Advantages Components	0.554	1.805
TAM x Mobile User Interface Component -> Competitive Advantages Components	0.463	2.160

5.2 Assessment of the Measurement Model

The reliability and validity of the items were examined based on the reflective measurement model, given the interchangeable nature of the indicators. Reliability was assessed using Composite Reliability (CR), while validity was evaluated through Convergent Validity (Average Variance Extracted – AVE) and Discriminant Validity (Cross-loading and Fornell–Larcker criterion).

1) Composite Reliability

The factor loadings ranged from 0.655 to 0.894, exceeding the recommended cut-off value of 0.6 (Hair et al., 2021). In this study, to enhance construct validity, the items with loadings lower than the recommended value of 0.7 were eliminated. By doing this, only strong indicators were included, which improved convergent and discriminant validity; simultaneously, the content validity of the constructs was preserved (Hair et al., 2021). The values of composite reliability were between 0.801 and 0.938 and above the minimum acceptable value of 0.6 (Fornell and Larcker, 1981), which reflects good internal consistency among constructs.

2) Convergent Validity

Convergent validity is the degree to which a measure correlates favorably with other measures of the same construct (Hair et al., 2021). Average variance extracted (AVE) has become a standard method for verifying convergent validity at the variable level. To guarantee enough convergent validity, each latent variable's AVE needs to be greater than 0.50; this suggests that the latent variable accounts for at least half of the variance in its items (Hair et al., 2021). The current investigation's Table 3 shows that all retained items had loadings above 0.50, confirming satisfactory item contributions to their respective constructs (Hair et al., 2021). Cronbach's alpha values ranged between 0.732 and 0.929, exceeding the 0.7 threshold for acceptable internal consistency (Nunnaly, 1978). The AVE values ranged from 0.502 to 0.778, all above the 0.5 benchmark, confirming that the constructs captured a substantial proportion of variance in their indicators.

The loading of indicators is the correlation between individual observed variables (items) and the underlying construct. When the loadings on the indicators are higher than 0.7, it means that the latent construct explains a large proportion of the variance of the observed variable. Such a high correlation supports convergent validity, meaning that the indicators effectively measure the same underlying construct and that the construct itself is well represented by the indicators (Hair et al., 2021).

Table 3. Results of Measurement Model Assessment

	Factor loadings (>0.6)	**Cronbach's Alpha (>0.7)**	**Composite Reliability (>0.6)**	**Average Variance Extracted (>0.5)**
Competitive Advantages Components		0.929	0.938	0.576
Competition		0.761	0.849	0.587
Competition1	0.799			
Competition2	0.844			
Competition3	0.655			
Competition4	0.754			
Delivery		0.732	0.801	0.575
Delivery1	0.793			
Delivery2	0.678			
Delivery3	0.798			
Quality		0.857	0.913	0.778
Quality1	0.891			
Quality2	0.894			
Quality3	0.860			
Quality4	0.675			
Flexibility		0.886	0.921	0.744
Flexibility1	0.846			

	Factor loadings (>0.6)	**Cronbach's Alpha (>0.7)**	**Composite Reliability (>0.6)**	**Average Variance Extracted (>0.5)**
Flexibility2	0.862			
Flexibility3	0.866			
Flexibility4	0.877			
Cost		0.848	0.899	0.692
Cost1	0.851			
Cost2	0.873			
Cost3	0.886			
Cost4	0.704			
TAM		0.820	0.833	0.502
Usefulness		0.864	0.903	0.700
Usefulness1	0.812			
Usefulness2	0.824			
Usefulness3	0.887			
Usefulness4	0.821			
Ease		0.854	0.901	0.695
Ease1	0.804			
Ease2	0.847			
Ease3	0.839			
Ease4	0.843			
Enjoyability		0.862	0.906	0.707
Enjoyability1	0.846			
Enjoyability2	0.854			
Enjoyability3	0.827			
Enjoyability4	0.835			
Mobile User Interface Component		0.920	0.932	0.534
Visual		0.787	0.862	0.610
Visual1	0.771			
Visual2	0.801			
Visual3	0.800			
Visual4	0.751			
Navigation		0.857	0.904	0.701

	Factor loadings (>0.6)	Cronbach's Alpha (>0.7)	Composite Reliability (>0.6)	Average Variance Extracted (>0.5)
Navigation1	0.835			
Navigation2	0.795			
Navigation3	0.858			
Navigation4	0.859			
Information		0.84	0.893	0.676
Information1	0.845			
Information2	0.816			
Information3	0.809			
Information4	0.818			

3) Discriminant Validity

Discriminant validity stipulates the uniqueness of each construct compared to the rest of the constructs (Peter & Churchill Jr., 1986). It was assessed using cross-loadings and the Fornell–Larcker criterion (Fornell & Larcker, 1981). All items loaded higher on their own constructs than on others, with loadings above the 0.5–0.7 threshold (Chen, 1998), and items below 0.4 were removed (Hair et al., 2021). The square roots of AVE values exceeded inter-construct correlations, confirming good discriminant validity, as shown in Table 4.

Table 4. Discriminate Validity

#	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Competition	**0.766**													
2	Competitive Advantages Components	0.623	**0.758**												
3	Cost	0.601	0.686	**0.832**											
4	Delivery	0.661	0.674	0.569	**0.758**										
5	Ease of Use	0.636	0.698	0.554	0.613	**0.834**									
6	Enjoyability	0.62	0.663	0.506	0.587	0.719	**0.841**								
7	Flexibility	0.595	0.69	0.796	0.56	0.54	0.52	**0.863**							
8	Information	0.577	0.63	0.576	0.455	0.593	0.565	0.456	**0.822**						
9	Mobile User Interface Component	0.628	0.619	0.619	0.529	0.69	0.648	0.536	0.605	**0.731**					
10	Navigation	0.548	0.659	0.579	0.505	0.627	0.601	0.504	0.678	0.629	**0.837**				

#	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
11	Quality	0.579	0.673	0.615	0.632	0.559	0.579	0.679	0.473	0.559	0.527	**0.882**			
12	TAM	0.675	0.633	0.571	0.647	0.626	0.627	0.571	0.623	0.721	0.661	0.612	**0.708**		
13	Usefulness	0.471	0.333	0.428	0.515	0.334	0.347	0.322	0.42	0.317	0.306	0.407	0.472	**0.837**	
14	Visual	0.569	0.648	0.505	0.464	0.644	0.582	0.483	0.643	0.656	0.698	0.506	0.659	0.321	**0.781**

5.3 Assessment of the Structural Model

The structural model was assessed using the standard bootstrapping procedure with 5,000 samples (Hair et al., 2021) and 357 cases to test path coefficient significance. Model fit was evaluated via the coefficient of determination (R^2), which represents the variance in endogenous variables explained by exogenous variables (Hair et al., 2021). R^2 values were highest for navigation (0.862), enjoyability (0.860), and ease of use (0.858), and lowest for delivery (0.598). According to Chin (1998a), these results indicate substantial explanatory power ($R^2 \geq 0.67$) and model stability, as adjusted R^2 values closely matched the R^2 values, as shown in Table 5.

Table 5. Variance Explained in the Endogenous Latent Variables

Variables	R-square	R-square adjusted
Competition	0.677	0.676
Competitive Advantages _Components	0.622	0.619
Cost	0.786	0.786
Delivery	0.598	0.597
Ease of Use	0.858	0.858
Enjoyability	0.860	0.859
Flexibility	0.793	0.792
Information	0.819	0.818
Navigation	0.862	0.862
Quality	0.645	0.644
Usefulness	0.754	0.753
Visual	0.732	0.731

5.4 Hypotheses Testing

Table 6. shows that the hypotheses were tested using path coefficients (β) and significance levels (p-values) via the PLS algorithm and bootstrapping with 5,000 samples (Hair et al., 2021). Results show that mobile user interface components have a significant positive effect on competitive advantage (H1: $\beta = 0.390$, $t = 6.018 > 1.96$, $p = 0.000$) (Siegel, 2011), with sub-hypotheses confirming positive effects for information (H1.1: $\beta = 0.213$, $t = 3.399$, $p = 0.001$), navigation (H1.2: $\beta = 0.268$, $t = 3.456$, $p = 0.001$), and visual elements (H1.3: $\beta = 0.328$, $t = 4.541$, $p = 0.000$), the latter having the strongest impact. TAM also demonstrated a strong positive effect on competitive advantage (H2: $\beta = 0.472$, $t = 6.549$, $p = 0.000$), while its moderating role between mobile UI and competitive advantage was significant though smaller in magnitude (H3: $\beta = 0.170$, $t = 5.000$, $p = 0.028$).

Table 6. Test Result of Hypotheses

		β	**Mean**	**SD**	**T Statistics**	**P Values**
H1	Mobile User Interface Component -> Competitive Advantages Components	0.390	0.394	0.065	6.018	0.000
$H_{1.1}$	Information -> Competitive Advantages Components	0.213	0.214	0.063	3.399	0.001
$H_{1.2}$	Navigation -> Competitive Advantages Components	0.268	0.265	0.078	3.456	0.001
$H_{1.3}$	Visual -> Competitive Advantages _Components	0.328	0.329	0.072	4.541	0.000
H2	TAM -> Competitive Advantages _Components	0.472	0.466	0.072	6.549	0.000
H3	TAM x Mobile User Interface Component -> Competitive Advantages Components	0.170	0.170	0.034	5.000	0.028

Figure 3 shows the Phase I structural model assessed via PLS-SEM, with high R^2 values, significant path coefficients, and indicator loadings above 0.70, confirming reliability. The model links mobile user interface components (visual design, navigation, information quality) with TAM constructs (usefulness, ease of use, enjoyment) and competitive advantage factors (competition, quality, flexibility, delivery, cost). Results confirm that user interface design and perceived technology significantly enhance usability, user adoption, and competitive advantage. The high number of factor loadings provides important evidence that the measure has convergent validity. Furthermore, items with loadings below 0.7 have been systematically removed to achieve a significant internal consistency threshold.

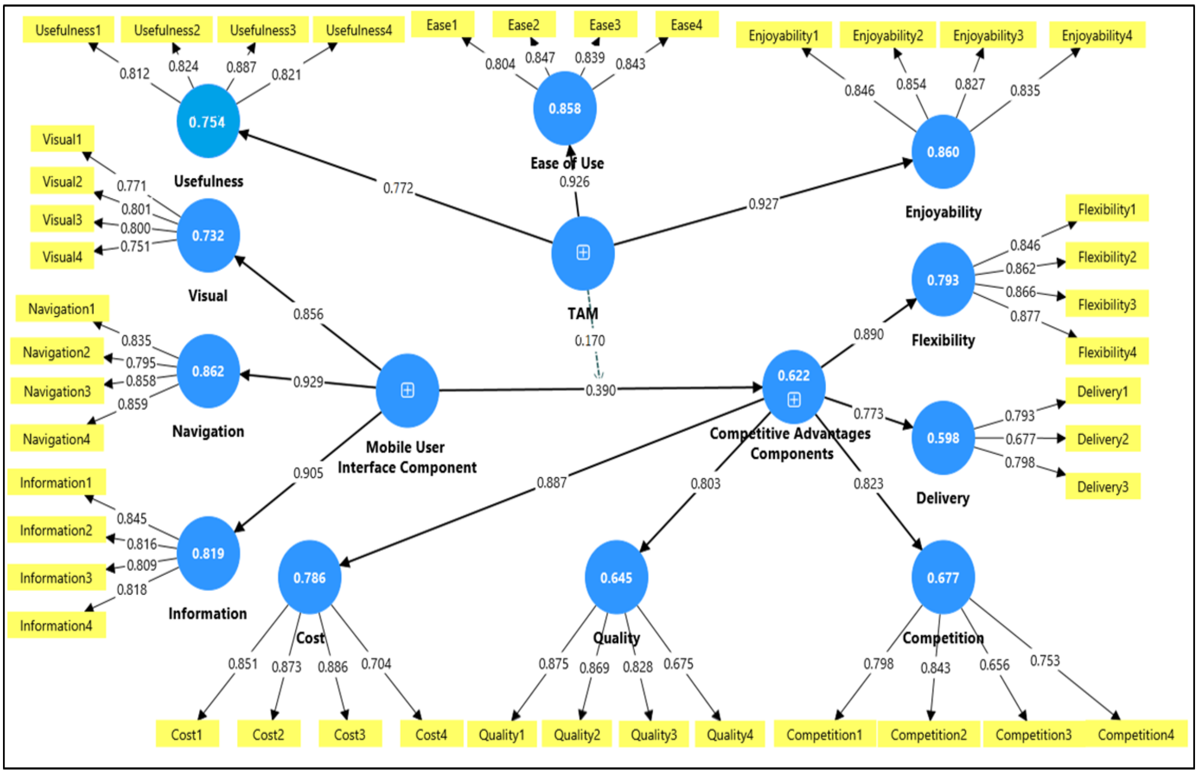

Figure 3. Structural Model of Phase I

6. Phase 2: Designing mobile e-transportation for visually impaired users

The study in this phase applies the insights from Phase 1 to design a user-friendly interface for the Visionary Journey e-transportation application for visually impaired users, incorporating the identified listing of design principles, such as user-centric design (UCD) principles, including accessibility, simplicity, consistency, screen reader support, and easy navigation. In the system design phase, a Figma prototype was created by integrating UCD principles. The design framework was based on simplicity, support for local languages, compatibility with screen readers, consistency, and simple navigation with detailed specifications for all components.

Although the study acknowledged the different categories of visual impairment, such as low vision, partial blindness, and full blindness, the participants in this study were exclusively from the low vision category. To this end, the design was made to suit their particular requirements by increasing the visual accessibility features, including clear labeling, high-contrast features, font size, and streamlined screen designs. The information obtained during the initial part of the current investigation, as well as recommendations provided by predecessors, will be useful in reducing cognitive load and increasing user satisfaction by helping to bridge the gap between the existing limitations of mobile apps and the needs of users with visual impairments.

This study embraced voice commands, touch-based interactions, and supporting screen readers to assist visually impaired users with a slight loss of vision by making touch more accurate, enlarging icons, and providing audio feedback, while haptic and gesture-based controls are more appropriate for visually impaired users with more profound vision loss.

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Moreover, the application design is kept simple, with large and easily tappable buttons and flows to enable the user to navigate the application without feeling overwhelmed by the complexity of unnecessary features. Additionally, a certain degree of similarity in the layout, arrangement of buttons, and use of language on all screens helps to reduce confusion and provide a more logical experience for users. Also important is that the application be screen reader–accessible, for example, TalkBack and VoiceOver for the Android and iOS operating systems, respectively, to provide visually impaired users with valid feedback for all interactive controls. Clear communication via these screen readers is made possible by giving buttons, icons, and menu items clear labels. In addition to the language used, short and succinct sentences are used to improve the readability of texts and labeling, making it easier for users to understand the information and take desired action. Finally, guides are provided with local language support, allowing users to choose the language they want to use, such as English and Arabic (Kraleva, 2017).

E-transportation mobile applications have been designed with considerable attention to the special needs of visually impaired users. By embracing the principles of simplicity, accessibility, and user-friendliness, the application aims to empower its users by providing them with a reliable and convenient way to get around and enjoy their mobility and sense of independence. In addition, assistive technologies like screen readers were used to make the platform user-friendly for those who may need to use assistive technologies to manage their transportation needs independently. Beyond benefiting and empowering the visually impaired, this design will help develop a more accommodating and equal transport system capable of positively impacting the lives of these individuals. The home screen of the e-transportation mobile application is shown in Figure 4.

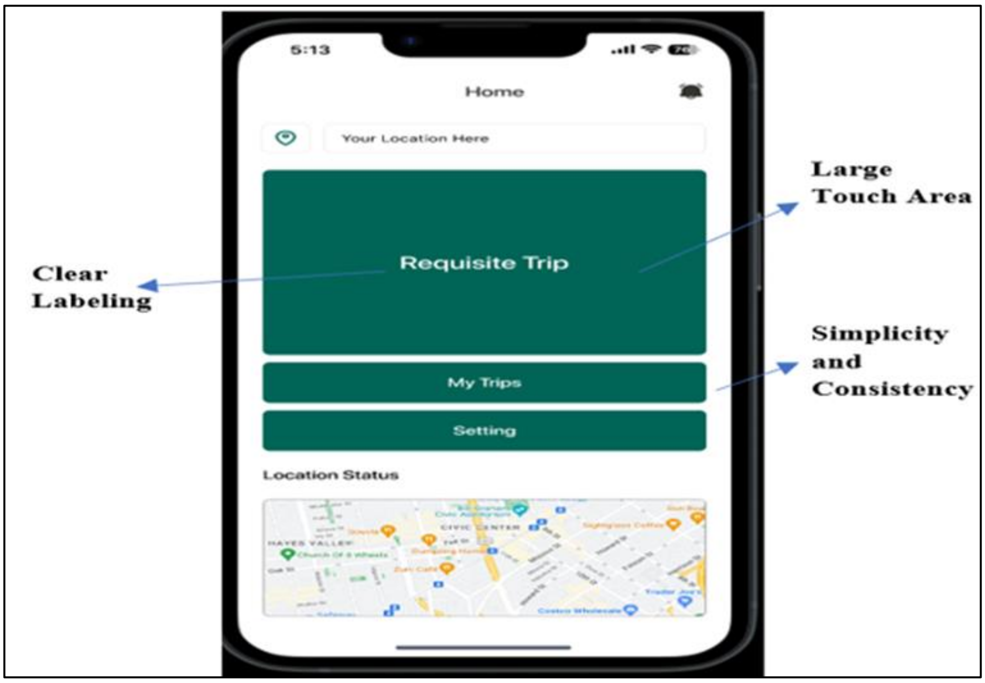

Figure 4. Home Screen of the Application

The application is designed to be compatible with built-in accessibility features on both Android and iOS, including screen readers (TalkBack and VoiceOver), text-to-speech, voice assistants, zoom magnification, and contrast adjustments (Senjam et al., 2021). This ensures that visually impaired users can interact with the application effectively across different devices, maintaining a consistent and user-friendly experience regardless of the operating system. The interface provides immediate auditory notifications and alternative input methods to address some issues they face, such as GPS failures, network delays, or ride cancellations, ensuring visually impaired users stay informed and can continue tasks safely.

By adhering to design principles such as simplicity, consistency, text legibility, and clear labeling, as outlined in previous studies, the application successfully meets the needs of visually impaired users. These principles contribute to an intuitive interface, reducing user errors and enhancing overall usability, helping e-transportation companies gain a competitive advantage. The application was tested on iOS and Android for compatibility, followed by the evaluation of navigation, data entry, and key features under simulated user loads while monitoring processing speed, crash frequency, and capacity; performance was also assessed under Wi-Fi, 4G, and 5G networks, issues were resolved and optimizations made based on user feedback, and after obtaining the necessary approvals.

7. Results and Discussions

The findings of this study reveal a significant relationship between mobile user interface (UI) components specifically visual design, navigation design, and information design and the competitive advantage of e-transportation companies. The results indicate that all UI components positively and significantly influence competitive advantage, with visual design ($\beta = 0.328$) demonstrating the strongest effect, followed by navigation design ($\beta = 0.268$) and information design ($\beta = 0.213$).

This prominence of visual design can be attributed to its ability to create an immediate and impactful user experience. The layout and color contrast, the size of the icon, and general aesthetics are all immediate hints that can increase satisfaction and interest even for people with partial visual impairments. Besides, the visual design determines the initial impression, interaction, reuse, and thus the competitiveness of e-transportation companies. These results are similar to those of Mahmoud et al. (2024) and are aligned with the results of Azmi & Bakar (2025) which indicate that visual design is one of the most significant factors in enhancing the experience of users and attracting customers.

In addition, another determinant of competitive advantage is the design of navigation. A clear and logical structure of navigation reduces cognitive load, helps people in their tasks, and improves accessibility for people with low vision. Although visual design has a bigger impact on engagement than navigability, good navigation still helps with engagement and loyalty, as revealed by Khan and Khusro (2019). Similarly, although the impact is smaller, information design still has a clear effect on user satisfaction. Better-organized content is better understood, trustworthy, and interoperable with assistive technologies—all of which contribute to competitiveness (Shera et al., 2021; Djamasbi et al., 2014).

Moreover, the correlation between the Technology Acceptance Model (TAM) and competitive advantage ($\beta = 0.472$) was higher than that of navigation ($\beta = 0.268$), since TAM includes more generic variables that affect user adoption (e.g., perceived usefulness and ease of use) (Davis, 1989). All these factors are associated with overall satisfaction, engagement, and loyalty. Therefore, TAM is associated with more competitive advantage than a single UI feature like navigation (Alhumoudi & Johri, 2024).

As for moderation, the effect of TAM (β = 0.170) on the relationship between mobile user interface components and competitive advantage was relatively small, but its direct effect was larger (β = 0.472). Multicollinearity among all variables was checked, and tolerance and VIF values did not show any serious problems, suggesting that the regression results are reliable. These results are consistent with other studies claiming that moderation effects in technology acceptance models are weak but statistically significant (Agarwal & Prasad, 1999). In this study, the incremental effects of mobile user interface components on competitive advantage were strong enough. However, the moderating effect of TAM is found to be meaningful in explaining how competitive advantage through technology acceptance can improve the interface–competitive advantage relationship. Finally, the results have been confirmed by statistical analysis, which shows high beta coefficients for all UI components and high t-values and p-values (p = 0.000). These findings indicate that visual attractiveness, ease of navigation, comprehensibility, and availability of information are important measures for e-transportation applications seeking to build a competitive advantage. The findings also correspond to those of Vidgen and Yasseri (2016), thereby ensuring the soundness of the data gathered.

8. Future Research

It is indicated that more research is needed to explore the development of complex mobile applications, which would benefit the blind population, and how the technology, i.e., artificial intelligence and machine learning, can be applied in order to bring more personalization to the application and make it easier to use. Further research could also be undertaken to learn how accessible design impacts user satisfaction, retention, and competitive advantage in the long term and how user feedback could be used to optimize accessibility functionality. In order to assess interface issues further, one may consider the extension of the Technology Acceptance Model (TAM) to include the properties of accessibility (i.e., text readability, color contrast, compatibility with screen readers). Additionally, to enhance the explanatory power of usability and technology acceptance for users with visual impairment, the TAM can be enriched with haptic feedback.

Moreover, it is suggested to apply covariance-based structural equation modeling (CB-SEM) to test the structural model when the sample size is large to increase the external validity of theory and theory testing (Hair et al., 2021). Larger multi-regional samples should also be used in future research to determine the external validity of results across cultures and locations. Since the current research was carried out among users with visual impairments in Jordan, further research is needed to determine the external validity of the results for other groups and contexts.

9. Conclusion

This paper confirms that mobile UI elements assist e-transportation enterprises in acquiring a significant competitive advantage. In terms of usability, accessibility, and user satisfaction, the strongest impact comes from visual design, followed by navigation and information design. To optimize the user experience and stay ahead in the market, it is necessary to simplify the UI, make it easier to use, and enhance its visual appeal. The connection is established using the Technology Acceptance Model (TAM), which is a user-based model. Text resizing for visually impaired users, screen reader compatibility, voice instructions, and other features facilitate adoption and increase competitive success in the market. The combined results can be applied to guide the practical deployment of more inclusive, more accessible, and more profitable e-transportation applications.

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