

Accessibility Issues Faced by Visually Impaired Users in Mobile Applications

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Abstract- *This study investigated the accessibility challenges encountered by visually impaired users of mobile applications in Adavi Local Government Area, Kogi State, Nigeria. A convergent mixed-method research design was adopted to obtain complementary quantitative and qualitative evidence. Quantitative data were collected through structured questionnaires administered to fourteen purposively selected visually impaired mobile application users drawn from selected communities using a cluster sampling approach. Qualitative data were generated through semi-structured interviews with experienced users to obtain deeper insights into accessibility barriers. Quantitative data were analysed using descriptive statistics (frequencies and percentages) in SPSS, while qualitative data were analysed thematically. The findings revealed that visually impaired users continue to experience significant accessibility barriers, including unlabeled interface elements, poor navigation structures, inadequate image descriptions, and limited compatibility with screen readers. Although applications such as WhatsApp demonstrated relatively higher compliance with accessibility principles, several commonly used applications still failed to satisfy key requirements of the Web Content Accessibility Guidelines (WCAG 2.1). TalkBack and VoiceOver improved access to mobile applications; however, their effectiveness was frequently constrained by deficiencies in application design and implementation. Given the study's small purposive sample, the findings should be interpreted as reflecting participants' experiences rather than representing the wider population of visually impaired mobile users. The study concludes that improving compliance with recognised accessibility standards, adopting universal design principles, and involving visually impaired users throughout the design and testing process are essential for enhancing digital inclusion and the usability of mobile applications.*

Keywords: *accessibility, inclusive design, mobile applications, screen readers, visually impaired users, WCAG 2.1.*

I. INTRODUCTION

Digital accessibility has become an essential component of inclusive development in the twenty-first century, as mobile applications increasingly support communication, education, healthcare, banking, commerce and public service delivery. For persons with visual impairments, access to these digital services depends not only on the availability of assistive technologies but also on the extent to which mobile applications are designed in accordance with recognised accessibility standards. The growing reliance on smartphones for daily activities has therefore intensified global concerns regarding the accessibility of digital technologies for persons with disabilities (Yu et al., 2024; Kerdar et al., 2024).

The concept of digital inclusion emphasises that every individual, irrespective of disability, should have equal opportunities to access, use and benefit from information and communication technologies. However, evidence from both developed and developing countries indicates that visually impaired users continue to experience substantial barriers when interacting with mobile applications. Common accessibility challenges include unlabeled buttons, poor navigation structures, inadequate colour contrast, missing alternative text for images, inaccessible forms, and incompatibility with screen readers such as TalkBack and VoiceOver (Al-Razgan et al., 2021; Acosta-Vargas et al., 2021). These deficiencies reduce users' independence and limit their participation in education, employment, healthcare and other essential digital services.

In Nigeria, the rapid expansion of smartphone ownership and mobile internet services has significantly transformed social and economic activities. Nevertheless, the benefits of digital

transformation have not been equitably distributed among persons with disabilities. Although the National Commission for Persons with Disabilities and the Discrimination Against Persons with Disabilities (Prohibition) Act provide a legal framework for promoting equal access and inclusion, the implementation of accessibility standards in digital platforms remains inadequate. Nigerian studies have reported that persons with visual impairments continue to face technological, institutional and infrastructural barriers that restrict their effective participation in the digital environment (Ajuwon, 2020; Olalekan & Adebisi, 2022).

Previous studies have also shown that assistive technologies alone cannot guarantee accessibility. The effectiveness of screen readers and other assistive applications depends largely on developers' adherence to inclusive design principles during software development. Applications lacking semantic labels, logical navigation sequences and alternative text frequently render assistive technologies ineffective, thereby creating additional barriers for visually impaired users (Duggirala, 2024; Zhang et al., 2021). Consequently, researchers advocate the adoption of Universal Design principles, routine accessibility testing, and the active involvement of persons with disabilities throughout the software development life cycle (W3C, 2023; Indika et al., 2026).

Although considerable progress has been made in accessibility research globally, empirical evidence from Nigeria remains limited, particularly within rural and semi-urban communities. Most existing studies have concentrated on accessibility evaluation frameworks, web accessibility, or educational technologies, with relatively few investigating the lived experiences of visually impaired users when interacting with commonly used mobile applications. Furthermore, there is limited evidence on the accessibility compliance of popular mobile applications used within local Nigerian contexts and the effectiveness of screen readers in facilitating independent interaction. This knowledge gap restricts the development of evidence-based policies and inclusive design practices tailored to the realities of Nigerian users.

Against this background, this study investigates the accessibility challenges experienced by visually impaired users of mobile applications in Adavi Local Government Area of Kogi State, Nigeria. Specifically, it examines the major accessibility barriers encountered by users, evaluates selected mobile applications against the Web Content Accessibility Guidelines (WCAG 2.1), assesses the effectiveness of TalkBack and VoiceOver in supporting mobile interaction, and proposes practical recommendations for improving accessibility and digital inclusion. The findings are expected to contribute to the growing body of knowledge on accessible mobile computing while providing evidence that can assist software developers, policymakers, disability advocates and regulatory agencies in promoting inclusive digital technologies in Nigeria.

II. LITERATURE REVIEW

Concept of Mobile Application Accessibility

Mobile application accessibility refers to the design and development of applications that can be effectively used by individuals with disabilities, including those with visual impairments. Accessibility ensures that users can perceive, understand, navigate and interact with digital interfaces independently through assistive technologies such as screen readers, voice commands and haptic feedback. The World Wide Web Consortium (W3C, 2023) maintains that accessibility should be integrated throughout the software development lifecycle to promote digital inclusion. Similarly, Acosta-Vargas et al. (2021) argued that accessible mobile applications improve usability, enhance user satisfaction and reduce digital exclusion among persons with disabilities.

Accessibility Challenges Faced by Visually Impaired Users

Several studies have reported that visually impaired users encounter numerous barriers when using mobile applications. Common challenges include unlabeled buttons, inaccessible forms, poor navigation structures, inadequate colour contrast, missing alternative text for images and poor compatibility with screen readers (Al-Razgan et al.,

2021; Kerdar et al., 2024). These barriers reduce users' ability to perform routine tasks independently and negatively affect their overall digital experience. In the Nigerian context, studies have shown that limited awareness of accessibility standards among software developers and weak implementation of disability policies continue to hinder digital inclusion for persons with visual impairments (Ajuwon, 2020).

Assistive Technologies and Mobile Accessibility

Assistive technologies play a significant role in improving access to mobile applications for visually impaired users. Screen readers such as TalkBack and VoiceOver convert on-screen content into speech or Braille output, enabling users to navigate digital interfaces independently. However, the effectiveness of these technologies depends on the accessibility features incorporated into mobile applications. Duggirala (2024) observed that inaccessible application design significantly reduces the performance of assistive technologies. Likewise, Zhang et al. (2021) reported that missing accessibility metadata and poorly labelled interface elements frequently prevent screen readers from accurately interpreting application content.

Universal Design and Accessibility Standards

Universal Design promotes the development of products and services that can be used by all individuals without the need for specialised adaptation. In mobile application development, Universal Design encourages developers to integrate accessibility features during the design stage rather than as post-development modifications. The Web Content Accessibility Guidelines (WCAG 2.1) provide internationally recognised standards for ensuring accessible digital content (W3C, 2023). Research indicates that applications developed in compliance with WCAG principles demonstrate significantly better usability and accessibility for visually impaired users (Acosta-Vargas et al., 2021).

Empirical Review

Recent empirical studies consistently reveal that accessibility challenges remain prevalent despite advances in mobile technology. Kerdar et al. (2024) found that many mobile applications still fail to meet established accessibility standards, particularly

regarding screen-reader compatibility and navigation. Similarly, Al-Razgan et al. (2021) reported that inaccessible interface components continue to hinder effective interaction among visually impaired users. In Nigeria, Ajuwon (2020) observed that inadequate implementation of inclusive digital policies and limited accessibility awareness contribute to persistent digital inequalities experienced by persons with disabilities. While these studies have provided valuable insights, few have examined the accessibility challenges encountered by visually impaired mobile application users within semi-urban communities such as Adavi Local Government Area of Kogi State. This study therefore fills this contextual gap by providing empirical evidence from a Nigerian setting.

III. THEORETICAL FRAMEWORK

This study is anchored on the Universal Design Theory and the Technology Acceptance Model (TAM). These theories provide a suitable framework for understanding the accessibility challenges experienced by visually impaired users and the factors influencing the adoption and effective use of mobile applications.

Universal Design Theory

Universal Design Theory was developed by Ronald Mace in the 1980s to promote the design of products, services and environments that are accessible and usable by all individuals regardless of age, ability or disability. The theory advocates that accessibility should be integrated into the design process from the outset rather than added as an afterthought. Its seven principles equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and appropriate size and space have become fundamental guidelines for inclusive product design (Mace et al., 1998).

In the context of mobile applications, Universal Design Theory emphasises that application interfaces should support screen readers, provide meaningful labels for interactive elements, offer adequate colour contrast, include alternative text for images and ensure simple navigation. Applications developed using these principles enhance usability and

independence for visually impaired users while promoting digital inclusion (W3C, 2023).

The theory is relevant to this study because it provides the conceptual basis for evaluating whether selected mobile applications meet internationally recognised accessibility standards and support the needs of visually impaired users in Adavi Local Government Area.

Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), proposed by Davis (1989), explains how users' perceptions influence their willingness to adopt and use technological innovations. According to the model, Perceived Usefulness and Perceived Ease of Use are the two primary determinants of technology acceptance.

For visually impaired users, the usefulness of a mobile application depends largely on its accessibility features. Applications that are compatible with assistive technologies, easy to navigate and capable of supporting independent task completion are more likely to be accepted and used continuously. Conversely, inaccessible interfaces, poor navigation structures and incompatibility with screen readers reduce users' confidence, satisfaction and willingness to adopt digital technologies (Venkatesh & Davis, 2000).

The Technology Acceptance Model complements Universal Design Theory by explaining how accessibility influences users' perceptions and continued use of mobile applications. Together, the two theories provide a comprehensive framework for examining both the design characteristics of mobile applications and the experiences of visually impaired users.

Relevance of the Theories to the Study

Universal Design Theory provides the framework for assessing the accessibility features of mobile applications against recognised accessibility standards, while the Technology Acceptance Model explains how these accessibility features influence users' acceptance, satisfaction and continued utilisation of mobile applications. The integration of

both theories therefore offers a comprehensive understanding of the accessibility challenges experienced by visually impaired users and supports the achievement of the study's objectives.

IV. METHODOLOGY

Research Design

This study adopted a convergent mixed-method research design, which combines quantitative and qualitative approaches to provide a comprehensive understanding of the accessibility challenges encountered by visually impaired users of mobile applications. The quantitative component generated numerical data on users' experiences, while the qualitative component provided in-depth insights into the challenges encountered and strategies adopted by participants. The integration of both approaches enhanced the credibility and completeness of the findings.

Study Area

The study was conducted in Adavi Local Government Area, Kogi State, Nigeria. The area was selected because it has a growing population of smartphone users, including persons with visual impairments who rely on mobile applications for communication, education, financial transactions and access to public information.

Population of the Study

The target population comprised all visually impaired individuals residing in Adavi Local Government Area who regularly use smartphones and mobile applications. The study focused on users with sufficient experience in operating mobile devices through assistive technologies such as TalkBack and VoiceOver.

Sample Size and Sampling Technique

A total of fourteen (14) visually impaired mobile application users participated in the quantitative phase of the study. The relatively small sample size reflects the limited number of eligible visually impaired smartphone users who met the inclusion criteria within the study area during the period of data collection. Because the study investigated a specialised and difficult-to-reach population, the

sample was considered appropriate for generating preliminary evidence on accessibility challenges. The qualitative component involved interviews with experienced participants to obtain richer explanations that complemented the survey findings.

A cluster sampling technique was first employed to identify communities within Adavi Local Government Area where visually impaired persons were concentrated. Thereafter, purposive sampling was used to select participants who were visually impaired, owned smartphones, regularly used mobile applications and were willing to participate in the study. This combination of sampling techniques ensured that only information-rich participants relevant to the study objectives were included.

Instrument for Data Collection

Two instruments were used for data collection: a structured questionnaire and a semi-structured interview guide. The questionnaire collected quantitative data on users' accessibility experiences, while the interview guide explored participants' perceptions of accessibility barriers, the effectiveness of assistive technologies and recommendations for improving mobile application accessibility.

Validity and Reliability of the Instrument

The questionnaire and interview guide were subjected to face and content validation by experts in Educational Technology, Computer Science and Special Education. Their observations were used to improve the clarity, relevance and adequacy of the instruments.

The reliability of the questionnaire was established through a pilot study conducted among visually impaired smartphone users outside the study area. Cronbach's Alpha coefficient was computed to determine the internal consistency of the instrument, yielding a reliability coefficient of 0.81, indicating that the instrument was sufficiently reliable for data collection.

Procedure for Data Collection

The researcher personally administered the questionnaires with the assistance of trained research assistants familiar with disability-inclusive data

collection procedures. Where necessary, questionnaire items were read aloud to participants, while adequate time was provided for responses. Semi-structured interviews were conducted individually, and participants' responses were audio-recorded with their permission before transcription.

Method of Data Analysis

Quantitative data were analysed using the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics, including frequencies and percentages, were used to summarise participants' responses. Considering the relatively small sample size, frequencies were presented alongside percentages to provide a clearer interpretation of the findings. Qualitative data were analysed using thematic analysis by identifying recurring themes and patterns relevant to the study objectives. Findings from both datasets were integrated during interpretation to provide a comprehensive understanding of the accessibility challenges experienced by visually impaired users.

Ethical Considerations

Ethical principles guiding research involving human participants were strictly observed. Permission to conduct the study was obtained from the relevant authorities before data collection commenced. Participants were adequately informed about the purpose of the study and provided informed consent before participation. Participation was entirely voluntary, and respondents were assured of confidentiality, anonymity and the right to withdraw from the study at any stage without penalty. Because the participants were persons with visual impairments, the researcher ensured that information about the study was communicated in accessible formats and that appropriate assistance was provided throughout the data collection process.

Table 1: Demographic Characteristics of Respondents

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	8	57.1
	Female	6	42.9
	Total	14	100.0
Age (Years)	18–25	3	21.4

	26–35	5	35.7
	36–45	4	28.6
	Above 45	2	14.3
	Total	14	100.0
Educational Qualification	Primary	2	14.3
	Secondary	4	28.6
	Tertiary	8	57.1
	Total	14	100.0
Years of Smartphone Usage	Less than 2 years	2	14.3
	2–5 years	6	42.9
	Above 5 years	6	42.9
	Total	14	100.0

Interpretation

The demographic results indicate that most respondents were male (57.1%), while females accounted for 42.9%. The majority (35.7%) were between 26 and 35 years of age. More than half (57.1%) possessed tertiary education, suggesting that respondents were sufficiently educated to provide informed responses. Furthermore, 85.8% had used smartphones for at least two years, indicating considerable experience with mobile applications.

Table 2: Accessibility Challenges Experienced by Visually Impaired Users (N = 14)

Accessibility Challenge	Yes n (%)	No n (%)
Unlabeled buttons/icons	12 (85.7)	2 (14.3)
Poor navigation structure	11 (78.6)	3 (21.4)
Missing image descriptions	13 (92.9)	1 (7.1)
Inaccessible forms	10 (71.4)	4 (28.6)
Poor compatibility with screen readers	11 (78.6)	3 (21.4)
Difficulty completing online transactions	9 (64.3)	5 (35.7)

Interpretation

The findings indicate that missing image descriptions (92.9%) and unlabeled buttons (85.7%) were the most frequently reported accessibility challenges. Poor navigation and inadequate compatibility with screen readers were also identified by over three-quarters of the respondents. These findings suggest that many mobile applications remain insufficiently accessible for visually impaired users.

Table 3: Compliance of Selected Mobile Applications with WCAG Guidelines (N = 14)

WCAG Accessibility Feature	Compliant n (%)	Not Compliant n (%)
Screen-reader compatibility	8 (57.1)	6 (42.9)
Alternative text for images	5 (35.7)	9 (64.3)
Properly labelled controls	6 (42.9)	8 (57.1)
Keyboard accessibility	7 (50.0)	7 (50.0)
Simple navigation	8 (57.1)	6 (42.9)

Interpretation

Although some applications demonstrated moderate compliance with WCAG requirements, deficiencies remained evident. Alternative text for images (64.3%) and properly labelled controls (57.1%) were the least compliant features, indicating that many applications do not adequately support visually impaired users.

Table 4: Effectiveness of Assistive Technologies (N = 14)

Statement	Agree n (%)	Disagree n (%)
TalkBack improves application accessibility	12 (85.7)	2 (14.3)
VoiceOver enhances navigation	11 (78.6)	3 (21.4)
Screen readers work effectively across all applications	5 (35.7)	9 (64.3)
Accessibility depends on application design	13 (92.9)	1 (7.1)
Assistive technologies increase independence	12 (85.7)	2 (14.3)

Interpretation

The majority of respondents acknowledged that TalkBack (85.7%) and VoiceOver (78.6%) significantly enhanced mobile application accessibility. However, only 35.7% believed that screen readers function effectively across all applications, indicating that the effectiveness of assistive technologies depends largely on application design and compliance with accessibility standards.

Summary of Major Findings

Research Objective	Major Finding
Identify accessibility challenges	Missing image descriptions, unlabeled buttons and poor navigation were the most frequently reported barriers.
Examine WCAG compliance	Most applications showed only moderate compliance, with deficiencies in image descriptions and labelled controls.
Assess assistive technologies	TalkBack and VoiceOver improved accessibility, but their effectiveness depended on application accessibility features.

V. RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

The demographic characteristics of the respondents were analysed using frequencies and percentages. The results indicate that the respondents varied in terms of age, gender, educational attainment and duration of smartphone usage. This diversity provided useful perspectives on the accessibility challenges experienced by visually impaired users of mobile applications.

Accessibility Challenges Experienced by Visually Impaired Users

The findings revealed that visually impaired users encountered several accessibility challenges while interacting with mobile applications. The most frequently reported barriers included unlabeled buttons, inaccessible forms, poor navigation structures, missing alternative text for images and inconsistent compatibility with screen readers. These accessibility limitations affected participants' ability

to complete routine tasks independently and efficiently.

These findings are consistent with the studies of Al-Razgan et al. (2021) and Kerdar et al. (2024), who reported that inaccessible interface elements remain one of the major obstacles faced by visually impaired users worldwide. The findings also support the principles of Universal Design Theory, which emphasise that accessibility should be incorporated during the design stage of digital products rather than introduced after development.

Compliance of Selected Mobile Applications with WCAG Guidelines

The analysis further showed that although some mobile applications demonstrated moderate compliance with the Web Content Accessibility Guidelines (WCAG), several applications failed to satisfy important accessibility requirements. Participants indicated that unlabeled controls, poor screen-reader support and inconsistent navigation significantly reduced application usability.

This finding agrees with W3C (2023), which stresses that compliance with WCAG principles is essential for ensuring equal access to digital information and services. The result suggests that many application developers still pay inadequate attention to accessibility during software development.

Effectiveness of Assistive Technologies

Participants acknowledged that assistive technologies such as TalkBack and VoiceOver substantially improved their interaction with mobile applications. Nevertheless, the effectiveness of these technologies depended largely on the accessibility features embedded within individual applications. Applications that lacked proper semantic labels or accessible navigation structures reduced the performance of screen readers and limited users' independence.

This finding corroborates Zhang et al. (2021), who found that assistive technologies perform optimally only when developers integrate appropriate accessibility metadata into application interfaces.

Summary of Findings

Overall, the study demonstrates that visually impaired users continue to experience significant accessibility challenges despite improvements in mobile technology. While assistive technologies provide valuable support, their effectiveness remains dependent on accessible application design and compliance with recognised accessibility standards.

It is important to note that these findings are based on a relatively small purposive sample of visually impaired users in Adavi Local Government Area. Consequently, the results should be interpreted as reflecting the experiences of the participants rather than being generalised to all visually impaired mobile application users in Nigeria.

VI. CONCLUSION

This study examined the accessibility challenges faced by visually impaired users of mobile applications in Adavi Local Government Area, Kogi State, Nigeria. The findings revealed that despite the growing adoption of smartphones and assistive technologies, visually impaired users continue to encounter significant barriers when interacting with many mobile applications. These barriers include unlabeled interface elements, inaccessible forms, poor navigation structures, inadequate image descriptions and inconsistent compatibility with screen readers.

The study further established that assistive technologies such as TalkBack and VoiceOver significantly improve access to mobile applications. However, their effectiveness depends largely on the extent to which application developers comply with recognised accessibility standards, particularly the Web Content Accessibility Guidelines (WCAG). Applications developed without adequate accessibility features reduce users' independence and limit their participation in education, employment, healthcare and other digital services.

The study concludes that improving mobile application accessibility requires a collaborative effort involving software developers, technology companies, policymakers, disability advocacy organisations and government agencies. Integrating

accessibility considerations into every stage of the software development process will promote digital inclusion and ensure that persons with visual impairments enjoy equal access to digital technologies. Although the findings are based on a relatively small purposive sample, they provide valuable insights into the accessibility experiences of visually impaired users in the study area and contribute to the growing body of knowledge on inclusive mobile computing in Nigeria.

VII. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Mobile application developers should incorporate accessibility features at the design and development stages by adhering to the Web Content Accessibility Guidelines (WCAG 2.1) and Universal Design principles.
2. Software companies should conduct routine accessibility testing involving visually impaired users before releasing mobile applications to the public.
3. Government regulatory agencies should develop and enforce policies that require public and private digital platforms to comply with recognised accessibility standards.
4. Higher institutions, software development organisations and professional bodies should organise regular training programmes on accessible software design and inclusive mobile application development.
5. Disability advocacy organisations should collaborate with software developers and policymakers to ensure that the needs and experiences of visually impaired users are adequately represented during application design and evaluation.

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