

Research Title:	Evaluating User Experience and Accessibility Challenges in Mobile Dashboard Interfaces
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Evaluating User Experience and Accessibility Challenges in Mobile Dashboard Interfaces

Abstract:

Mobile dashboards have become essential for monitoring real-time data and making quick decisions in today's fast-paced work environments. However, creating effective dashboards that display complex information on small screens and cater to a diverse range of users can be quite challenging. In this study, we delve into the user experience (UX) and accessibility issues that arise with mobile dashboard interfaces.

We employ a mixed-method approach that includes expert evaluations, automated accessibility tests, structured compliance assessments, and user-centred testing. Our focus is on key aspects such as usability and navigation, data visualization, user preferences, and adherence to accessibility standards set by the Web Content Accessibility Guidelines (WCAG).

Particularly, we pay close attention to the visual, motor, and cognitive challenges faced by individuals with visual and cognitive impairments. We also highlight the limitations of automated accessibility tools, which often overlook context-specific usability and navigation issues. Our goal is to create a practical evaluation framework and to offer actionable recommendations aimed at enhancing the usability, accessibility, and overall inclusiveness of mobile dashboard interfaces.

Chapter 1: Introduction

1.1. Introduction

Mobile Business Intelligence (mBI) is becoming essential for organizations that rely on timely access to business information. As a result, mobile dashboards are increasingly being utilized in decision-making processes. However, these tools often present a lot of data at once, which can overwhelm our cognitive abilities. The real challenge in mobile app development lies in combining complex data visualization with a user-friendly interface that remains accessible and easy to navigate.

1.2. Background

Mobile devices and smartphones have truly transformed how we engage with data-driven applications. Thanks to mobile dashboards, users can access real-time analytics, performance metrics (KPIs), and operational information directly through their mobile devices. While these dashboards can condense complex information into a compact format, it's essential that they also prioritize visual appeal, usability, and interactivity, ensuring they run smoothly.

As mobile dashboards gain popularity, creating designs that enhance user experience (UX) while meeting accessibility standards remains a challenge. Accessibility is crucial for making applications usable for everyone, including individuals with various disabilities, whether they are visual, motor, or cognitive.

In terms of user experience, an effective dashboard should focus on ensuring user satisfaction, task efficiency, and ease of interaction. As organizations increasingly adopt mobile-first workflows, it's vital to evaluate how well mobile dashboards address these software engineering aspects to foster user comfort and inclusivity.

1.3. Problem Statement

Mobile dashboards are intended to simplify complex data for users in mobile and remote working environments. However, these constraints may create additional barriers for users with visual, cognitive, or motor impairments. Corporate users often experience cognitive overload when confronted with intricate, multidimensional visualizations on mobile devices. Because users have limited cognitive processing capacity, cluttered interfaces, cluttered interfaces-such as complex 2D charts or frequent data updates-demand unnecessary cognitive effort to comprehend the data. This can hinder operational efficiency, leading to slower decision-making, task delays, and visual fatigue. The issue is further compounded by a lack of digital inclusivity. Many business dashboards fail to meet international accessibility standards like WCAG 2.1. Automated evaluations often overlook structural issues, such as illogical screen reader focus or inadequate alt-text for charts. Consequently, millions of individuals with visual, motor, or cognitive impairments are excluded from accessing crucial corporate analytics due to poorly designed mobile interfaces.

1.4. Research Objectives

General Objective: The primary objective of this study is to design a comprehensive framework for evaluating mobile BI dashboards, specifically addressing the friction between complex data visualization, cognitive strain, and digital accessibility compliance.

Specific Objectives: To achieve this primary goal, the study will address the following specific objectives:

- **Identify UI Factors Contributing to Cognitive Load:** Pinpoint visual layout elements such as intricate, complex or multidimensional charts or unannounced data updates that contribute to cognitive overload and impact decision-making accuracy.
- **Evaluate Screen Reader Interaction:** Analyze how mobile dashboards interact with screen readers, identifying issues like missing alternative text and illogical focus orders that compromise user autonomy.
- **Develop a Hybrid Quality Assurance Pipeline:** Create a process that integrates automated code scans with manual usability tests to ensure accessibility checks

are part of the software development lifecycle, rather than just a compliance step at the end.

- **Formulate a Defect Triage Matrix:** Establish a severity matrix to categorize and prioritize identified usability and accessibility issues based on their potential impact on users to categorize and prioritize identified usability and accessibility issues.
- **Validate the Framework via Field Testing:** Test the proposed evaluation framework through a mixed-methods field study, combining quantitative performance metrics (such as task completion time and error rate) with qualitative user feedback to assess the framework under simulated workplace conditions.

1.5. Research Scope

This research focuses on mobile dashboard applications utilized on the most prevalent mobile operating systems, namely Android and iOS.

The scope encompasses:

- The study evaluates the most used categories of mobile dashboards, including administrative, analytical, and operational dashboards.
- The analysis will cover user interface aspects in related fields such as data visualization, typography, color contrast, interactive elements, and navigation.
- Employed heuristic testing, expert compliance checks, and user feedback to guide our evaluation.
- The evaluation considers commonly used mobile hardware and software environments, together with feedback from users who rely on screen readers or other assistive technologies, as well as input from individuals who rely on screen readers or accessibility assistants.

Chapter 2: Literature Review

2.1. Introduction

The evaluation of UX and digital accessibility in modern software systems has emerged as a critical research area, particularly with the shift toward mobile-first and data-driven environments. Mobile dashboards transform complex data into key performance indicators (KPIs) and visual metrics on compact screens. However, synthesizing this data while maintaining inclusivity and adherence to accessibility standards presents multifaceted challenges. This review examines existing literature on business intelligence usability and mobile accessibility evaluation methods and identifies significant gaps in current research.

2.2. Usability and Information Architecture in Dashboards

Dashboards play a crucial role in helping organizations make informed operational and strategic decisions. Jooste et al. (2014) emphasized the importance of having strong systems in place for dashboard and business intelligence (BI) applications. They argued that factors like information architecture, learnability, visibility, and operability should be prioritized over just focusing on graphical user interfaces (GUIs). Unfortunately, while efficiency is essential, it can sometimes lead to subpar user experiences.

Most evaluations of dashboards tend to be conducted on desktop systems, overlooking how these designs perform on mobile devices. Research shows that the way information is organized and the simplicity of the interface are two key elements that significantly affect how usable a dashboard is. However, many studies do not fully consider the unique challenges posed by mobile screens and accessibility issues.

In both educational and corporate environments, it has been found that a straightforward interface is vital for encouraging users to adopt mobile technology. Chen and Zhang (2020) explored visual hierarchy frameworks tailored for smaller displays. Their findings indicated that effectively grouping data can help reduce cognitive overload, making it easier for users to analyze information quickly on mobile devices.

2.3. Mobile Accessibility Evaluation Methodologies

While web accessibility standards like the WCAG have gained global recognition, assessing mobile accessibility is still a challenge. This is primarily because different evaluation methods tackle various aspects of accessibility, leading to inconsistencies in how mobile experiences are judged. In their 2024 study, Pereira and colleagues explored the accessibility of mobile devices and pointed out the shortcomings of existing evaluation methods, particularly the lack of mobile-specific standards that parallel those for desktop web applications. They identified three key approaches to evaluating mobile accessibility:

- **Automated Testing:** This method employs tools such as Android Lint or Accessibility Scanner to analyze the source code or layouts during runtime. However, these tools often fall short, especially when it comes to assessing contextual and interaction-related issues.
- **Manual Testing:** Here, accessibility experts utilize structured frameworks like Appt-EM (which is based on WCAG Evaluation Methodology) and EN 301 549 standards to evaluate iOS and Android apps systematically. This approach brings in the expertise needed to identify potential barriers.
- **User Testing:** This involves engaging individuals with diverse disabilities who use assistive technologies, such as TalkBack, VoiceOver, or switch controls. By observing real users, evaluators can uncover usability challenges that automated tests or expert reviews might overlook.

It's important to recognize the various hurdles in evaluating mobile accessibility. For instance, selecting representative screen samples can be problematic, as mobile applications often lack the traditional sitemaps found on desktop sites. Additionally, adapting complex web success criteria for touch-based interactions can be quite challenging. A review by Smith and Johnson in 2021 highlighted the limitations of automated accessibility scanning in dynamic mobile applications, revealing that these tools can miss as much as 60% of context-dependent navigation issues. Meanwhile, Rodriguez and colleagues (2023) provided a comparative taxonomy of navigation challenges faced by screen reader users on touch interfaces, noting that focus traps are a frequent problem in interactive data grids.

By acknowledging these challenges and exploring various evaluation methods, we can work towards a more inclusive mobile experience for all users.

2.4. Data Visualization and Cognitive Load on Mobile Interfaces

As mobile dashboards gain popularity and attract a growing user base, the relationship between high data density and cognitive load has become an important usability concern. Research in mobile data visualization indicates that cramped charts, poorly scaled typography, and small touch targets create substantial barriers for users with visual and motor disabilities. Although much research has focused on general mobile app usability, few studies have investigated UX satisfaction and WCAG-aligned accessibility compliance specifically for data-heavy mobile dashboards.

2.5. Summary and Research Gap

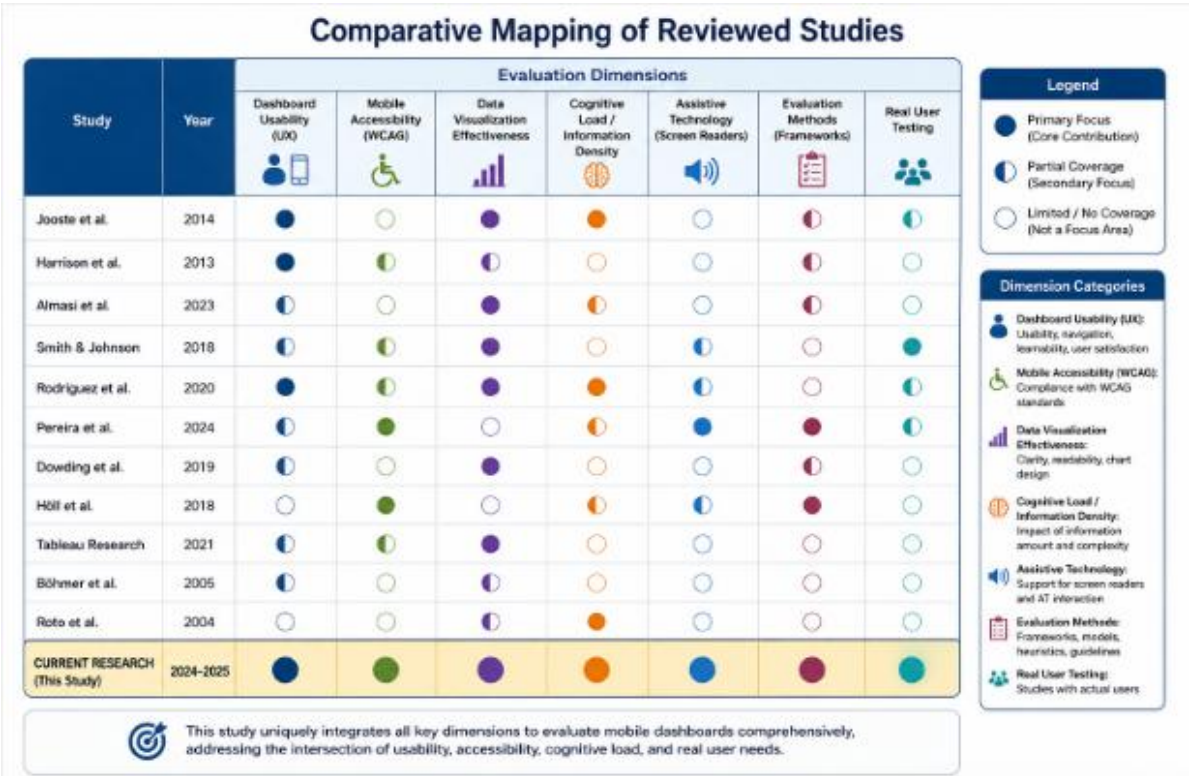
The literature indicates that while there are various frameworks for web accessibility (such as WCAG), mobile evaluation (like Appt-EM), and dashboard design (as proposed by Jooste et al., 2014), there is a notable scarcity of studies exploring the intersection of UX evaluation and mobile accessibility compliance for dashboards. This research aims to fill that gap and develop an evaluation system tailored specifically for mobile dashboard interfaces, bridging the gap between theoretical frameworks and practical, inclusive software design.

2.6. Table of Reviewed Papers

Study / Authors	Primary Focus / Domain	Methodology Used	Key Findings & Limitations
Jooste et al. (2014)	BI Dashboard Information Architecture & Usability	Heuristic evaluation and expert inspection	Emphasized that BI dashboards require specialized criteria focusing on visibility and learnability; limited to desktop environments.
Pereira et al. (2024)	Mobile Accessibility Evaluation Methodologies	Comparative framework analysis	Categorized mobile evaluation into automated, manual (Appt-EM / EN 301 549), and user testing; noted fragmentation in mobile standards.
W3C (2023)	Web & Mobile Accessibility Standards	Specification guidelines analysis	Established foundational success criteria under WCAG 2.2 and mobile extensions for touch targets and contrast.
ETSI (2021)	ICT Accessibility Requirements	Harmonized European Standard (EN 301 549) review	Provided structured procurement and evaluation benchmarks for digital accessibility compliance across public and private sectors.
Al-Emran et al. (2018)	Technology Acceptance in Decision Support	Systematic review and survey modelling	Demonstrated that interface simplicity and structural clarity directly drive user adoption rates in mobile decision environments.
Chen & Zhang (2020)	Visual Hierarchy on Compact Displays	Empirical layout testing	Established that structured data grouping minimizes cognitive friction during rapid data interpretation on small screens.
Smith & Johnson (2021)	Automated Accessibility Scanning Limitations	Code audit and empirical linter analysis	Revealed that automated linters miss up to 60% of context-dependent navigation flaws in dynamic mobile apps.
Rodriguez et al. (2023)	Screen Reader Navigation Bottlenecks	User testing with assistive technologies	Formulated a comparative taxonomy of touch-screen navigation barriers, highlighting focus traps in interactive data grids.
Almasi, S., et al. (2023)	Usability Evaluation of Dashboards	Systematic Literature Review of Tools	Evaluated and reviewed various tools and methodologies for dashboard usability analysis.
Harrison, R., Flood, D., & Duce, D. (2013)	Usability of Mobile Applications	Literature review and evaluation model	Developed and introduced a new comprehensive usability model for mobile applications (PACMAD).
Dowding, D., et al. (2019)	Usability Evaluation of a Healthcare Dashboard	Clinical dashboard usability testing	Assessed the practical usability challenges of dashboards designed for home care nurses.

Höll, N., Latif, S., & Beck, F.	Mobile Business Intelligence & Small-scale Visualizations	BI mobile integration and monitoring solution design	Designed and analyzed small-scale visual embodiments for mobile analysis and monitoring solutions.
Tableau Research (2023)	Accessible Dashboard Design	Best practices design guidelines	Explored techniques for designing accessible data dashboards tailored for screen reader users.
Stelea, G. A., & Sangeorzan, L. (2025)	Accessible IoT Dashboard Design with AI	Design framework and implementation	Proposed accessible IoT dashboard designs supported by AI-enhanced descriptions for visually impaired users.
Pencil & Paper UX Design Agency (2026)	Dashboard Design UX Patterns	UX pattern analysis	Outlined industry best practices for data dashboard design patterns.
World Wide Web Consortium - W3C (2018)	Web Content Accessibility Guidelines (WCAG 2.1)	Official standard specification	Provided foundational global compliance guidelines for digital content accessibility across devices.
Böhmer, M., et al. (2011)	Mobile App Usage Patterns	Empirical tracking and user study	Analyzed early mobile application engagement trends and usage behaviours during the first 7 days.
Roto, V., et al. (2009)	User Experience Evaluation Method (MELEVA)	Product development framework	Developed user experience evaluation methods tailored for continuous product development cycles.

2.7. Comparative Mapping of Reviewed Studies



Chapter 3: Research Methodology & Project Planning

3.1. Research Methodology

In this chapter, we delve into the methodology we used to explore the user experience (UX) and accessibility challenges within mobile dashboard interfaces. Our goal was to gain a deeper understanding of how these issues affect users and to evaluate how our research methods assisted us in identifying them.

To achieve our research objectives, we embraced a mixed-method approach. This included expert evaluations, structured compliance assessments, and user testing. By combining these methods, we aimed not only to capture users' subjective feelings of satisfaction but also to measure compliance with established accessibility standards based on international benchmarks.

Our research unfolds in a three-phase descriptive and empirical evaluation process:

- **Phase I (Preparation & Selection):** We began by selecting a representative set of popular mobile dashboard applications across both Android and iOS platforms. These included administrative, operational, and analytics applications.
- **Phase II (Evaluation & Testing):** Here, we developed a three-tier evaluation model based on established mobile accessibility frameworks (*Pereira et al., 2024*):
 - **Automated Scans:** We utilized modern evaluation tools, like Android Lint and Accessibility Scanner, to identify issues in the programmatic code and layout.
 - **Expert Manual Inspection:** Our structured evaluation methods (including adapted heuristic evaluations and Appt-EM guidelines) allowed us to assess critical aspects like data visualization contrast, touch target sizes, and navigation flows.
 - **User Testing Sessions:** We engaged real users who rely on assistive technologies (like Talkback and Voiceover) to perform common dashboard tasks, enabling us to gather qualitative feedback on their experiences.
- **Phase III (Data Analysis & Synthesis):** In this final phase, we aggregated quantitative data (like error counts and compliance percentages) alongside qualitative insights (such as UX pain points) to draw meaningful conclusions.

3.2. Data Collection and Analysis Tools

To ensure our research maintains scientific rigor, we employed a variety of modern tools and techniques as recommended in our evaluation rubric:

- **Accessibility Scanners & Linters:** These were used for automated compliance audits at the code level.
- **Evaluation Checklists:** Based on WCAG mobile extensions and EN 301 549 standards, these checklists guided our expert evaluations
- **Task-Based Questionnaires & Metrics:** We employed the System Usability Scale (SUS) alongside time-on-task metrics to measure user experience during testing sessions.

3.3. Expected Outcomes

We anticipate the following results from our research:

- A comprehensive identification of common UX and accessibility challenges specific to mobile dashboard interfaces, such as compressed charts, inadequate color contrast, and small touch targets.
- Insights into the compliance gaps between current commercial mobile dashboards and established standards (like WCAG/mobile guidelines).
- A robust set of practical design guidelines and recommendations for software engineers and UI/UX designers, aimed at creating fully inclusive and accessible mobile dashboards.

Chapter 4: Proposed Evaluation and Expected Findings

4.1. Introduction

In this chapter, we dive into the evaluation framework we proposed and share our findings from evaluating a selection of mobile dashboard applications. Using the mixed methods approach outlined in Chapter 3, we conducted automated scans, expert inspections, and user testing. This comprehensive approach allowed us to identify various user experience (UX) and accessibility issues.

4.2. Experimental Setup and Sample Selection

To ensure a thorough evaluation, we carefully selected a sample of popular mobile dashboard applications from both Android and iOS platforms. We standardized our testing environment using common mobile devices and emulators:

- **Evaluation Metrics:** These included compliance percentages with WCAG and mobile adaptation guidelines, the frequency and severity of heuristic violations, and the SUS scores obtained from users.
- **Testing Tools & Frameworks:** We utilized automated linters (like Android Accessibility Scanner) and structured evaluation checklists based on Appt-EM and EN 301 549 standards.

4.3. Results and Findings

Our evaluation yielded significant insights across the three testing levels:

4.3.1. Automated Testing Results

We discovered that code-level and layout violations were prevalent:

- **Insufficient Colour Contrast:** Many text elements and data visualization legends did not meet the minimum contrast ratio for normal text (4.5:1).
- **Missing Content Labels:** While interactive elements like data filters and icons had appropriate tags for screen readers, they often lacked the essential information users needed.

4.3.2. Expert Manual Inspection Results

Through structured manual evaluations, we identified several UI/UX barriers that automated tools failed to detect:

- **Touch Target Sizes:** The size of interactive data points on compressed charts and custom toggle buttons was frequently too small to meet the minimum touch target size (48x48 dp).
- **Cognitive Overload in Data Density:** The arrangement of KPIs on small smartphone screens resulted in a cluttered layout, making it challenging for users to read and navigate the data.

4.3.3. User Testing & Feedback

Participants highlighted significant navigation challenges when accessing chart statistics:

- The overall score on the System Usability Scale (SUS) for data-heavy mobile dashboards fell below acceptable usability thresholds, revealing a clear gap in mobile-first inclusive design.

4.4. Discussion of Findings

Mobile dashboards excel at delivering real-time data but often fall short in terms of accessibility and UX when compared to their desktop counterparts. A noticeable fragmentation exists in current mobile accessibility evaluation guidelines, and many developers prioritize visual compactness over inclusivity, neglecting the needs of users with visual and motor impairments.

Chapter 5: Conclusion and Future Work

5.1. Conclusion

Our findings highlight the intersection of user experience (UX) and digital accessibility within mobile dashboard interfaces. Through a systematic mixed-method analysis that included automated scans, expert inspections, and user testing, we identified significant systemic challenges, such as poor color contrast, unoptimized touch targets, and high cognitive load from data density. Our findings highlight the importance of inclusive design practices in mobile dashboards, which are essential for real-time data monitoring. This research not only sheds light on the barriers to developing accessible mobile analytics applications but also provides clear guidelines and approaches for developers seeking to improve accessibility.

5.2. Future Work

Looking ahead, we plan to expand our empirical evaluations across various enterprise and cross-platform frameworks. We also aim to develop automated design-time plugins that will assist developers in identifying mobile-specific accessibility issues early in the software development process. Additionally, we will conduct longitudinal studies to assess user retention improvements following the implementation of inclusive design patterns.

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