

Demonstration and TRL 5 Validation of AI-Generated Adaptive User Interfaces

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ABSTRACT

We present a demonstration of A(I)BILITIES, a platform built on the principles of digital accessibility, ability-centered design, and AI as a service for the automatic generation of adaptive user interfaces for mobile devices. To support these principles, a software architecture and a software development kit are provided to enable developers to readily integrate AI-generated adaptive interfaces into mobile applications. In this paper, we present the platform at Technology Readiness Level 5, at which individual components have been validated, integrated, and implemented in a functional prototype. We demonstrate this functionality through a WCAG-based before-and-after evaluation of a mobile graphical user interface.

AUTHOR KEYWORDS

Digital accessibility; artificial intelligence; mobile applications; touch input; user interfaces.

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Introduction

Digital accessibility refers to the universal right to equitable access to and interaction with digital content and services, regardless of how they are presented to users, for example via a mobile application on a personal device. The implementation of this concept has evolved from compliance checks against standards such as the Web Content Accessibility Guidelines (WCAG) [1] toward adaptive interfaces that consider both the user's individual profile and the interaction context. From an implementation perspective, integrating generative AI into the adaptation process represents a promising approach for improving the accessibility of digital content and services. Starting from a default design, the interface could be dynamically adapted and personalized according to specific user needs, provided either as explicit interaction preferences, inferred from actual application usage, or retrieved from large

electronic databases of representative gesture input [6]. Furthermore, adaptation involves both how the graphical user interface is presented and how input can be customized according to each user's ability to perform gestures on the small screens of mobile devices. For example, the touch input performance of people with upper-body motor impairments may vary according to the characteristics of touch targets [3] and the interaction session [4], while different machine learning models can differ largely in recognition accuracy rate [2].

Software Architecture

The software architecture of the A(I)BILITIES platform comprises three layers responsible for information collection, data processing, and user profile storage. Information is collected through an SDK that logs user information, and user profiling is based on both modeled touch input performance and self-reported preferences. During onboarding (see Figure 1a), the system first assesses users' touch input performance in terms of touch time and target offset, as well as their swipe input performance during a drag-and-drop task that requires superimposing two targets with a stroke gesture [2, 5]. Users then answer a set of questions, where the first six concern a self-assessment of their input abilities, such as "How easily can you touch the screen?" and "How easily can you flick the screen?," while the remaining six address general interaction preferences for mobile applications and graphical user interfaces, such as "How strongly do you prefer drawing on the screen?" and "How strongly do you prefer auditory feedback?" The initial user profile is updated by monitoring the same metrics during application usage, and new interface adaptations are automatically generated, transferred, and applied to the user's mobile device.

TRL 5 Validation

Validation at Technology Readiness Level 5 (TRL 5) focuses on providing evidence that the integrated system components

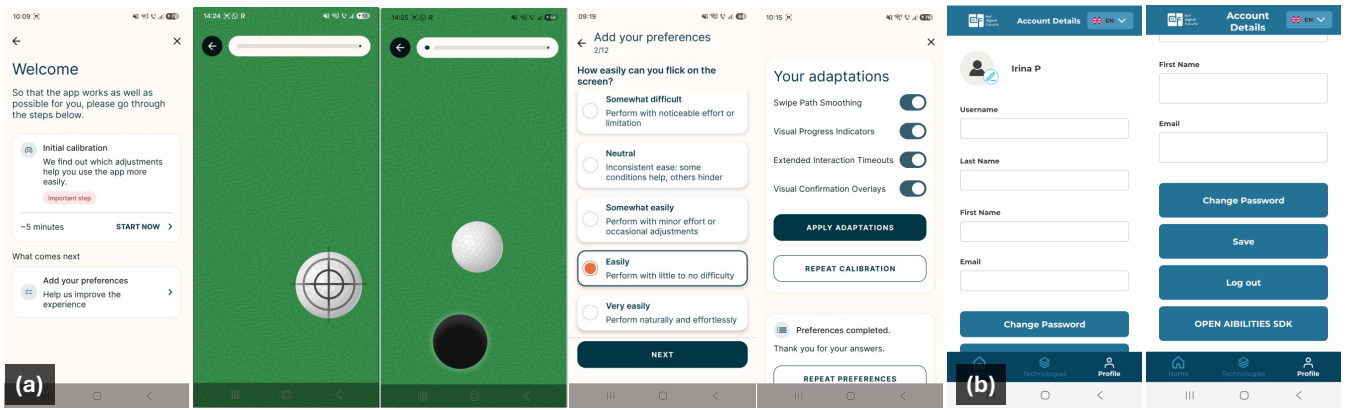


Figure 1: (a) Onboarding flow for user profile creation with welcome screen, initial touch input data collection, and preference settings; (b) Example of user interface adaptations achieved based on the compiled user profile.

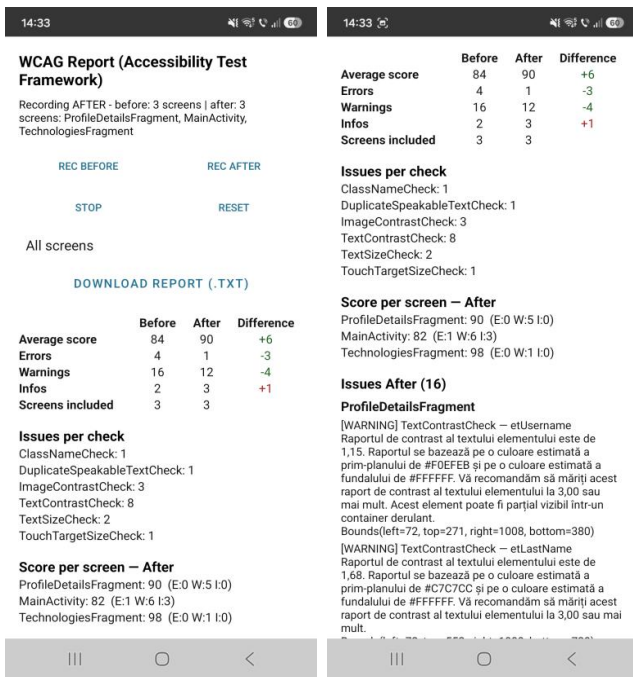


Figure 2: Example of WCAG evaluation of interface adaptations, showing overall scores, errors, warnings, and recommendations about identified accessibility issues. Note the better performance in the generated user interface and the detailed report on accessibility issues.

perform robustly under conditions closely resembling real-world use. Figure 1b illustrates how the application automatically detects a user's need for larger controls and text, based on the stored profile, and adapts the interface accordingly. Figure 2 presents an automated WCAG [1] evaluation report comparing two graphical user interfaces before and after adaptation, including descriptive statistics about the average accessibility score, number of errors and warnings, and applied changes to the original interface, along with recommendations for remaining issues. For example, inappropriate labels and button sizes are identified as accessibility issues in the original interface, corresponding to an average WCAG score of 84. The difference in performance metrics is equally

highlighted, e.g., the updated user interface reduced accessibility warnings from 16 to 12.

Demonstration

At the conference, we will demonstrate the functionality of A(I)BILITIES through a use case showcasing user onboarding, entering preferences, and the initial ability assessment of gesture input performance. We will illustrate how interface adaptations are generated for a graphical user interface based on the compiled user profile, along with before/after WCAG evaluations.

Conclusion

We reported on the TRL 5 validation of the A(I)BILITIES platform for generating adaptive user interfaces, showing user interactions processed across the software architecture under representative operating conditions and functionality achieved in interface adaptation according to WCAG criteria. These results support the feasibility of the proposed approach and provide the foundation for TRL 6 deployment in realistic operational environments involving end users.

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