Can Free Tools Really Test Android Accessibility?

Paper: Evaluation of Testing Tools for Assessing the Accessibility of Android Apps in Accordance with EN 301 549

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Biography

Prof. Dr.-Ing. Rainer Wasinger

- From 2017 onwards:
  - Professor of Informatics / Mobile Applications, **Westsächsische Hochschule Zwickau, Germany**
- Previously:
  - Human Interface Technology (HIT) Lab, **University of Tasmania, Australia**
  - Computer-Human-Adapted Interaction (CHAI) Lab, **University of Sydney, Australia**
  - Centre for Language Technology **Macquarie University, Australia**
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Outline

1. Motivation and Objectives
2. Theoretical Background
3. Methodology and Evaluation Design
4. Analysis of the Test Tools and Results
5. Recommendations
6. Key Findings and Future Work

Motivation (1)

Why is this topic relevant?

- **Technical and Legal framework**:
  - The accessibility of mobile applications is driven by the **WCAG** 2.1 Level AA [1] and operationalised in **EN 301 549** [2].
  - Accessibility is required in the EU through Directives (EU) **2016/2102** [3] and (EU) **2019/882** [4].
- **Guidelines, Standards, and EU Directives:**
  - **WCAG**: Web Content Accessibility Guidelines
  - **EN 301 549**: European Norm for Accessibility Requirements for ICT Products and Services.
  - **2016/2102**: Directive … on the accessibility of the websites and mobile applications of public sector bodies.
  - **2019/882**: Directive … on the accessibility requirements for products and services.

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Motivation (2)

Why is this topic relevant?

- **Societal need**: In Germany, around 7.8 million people live with a severe disability (9.4% of the population) [5]; in addition, users with temporary impairments also benefit [6].
- **Market relevance**: Android dominates the European smartphone market with a share of around 60% [7].
- **Research gap**: For UI frameworks such as Jetpack Compose, there is a lack of scientific analysis of existing accessibility tools.

Objective and Research Questions

What is the aim of this work?

- **Objective**: A systematic evaluation of freely available accessibility tools for native Android app development using Kotlin and Jetpack Compose.
- **Types of tools**: Automated, semi-automated and manual test tools.

Key research questions:

- Which tools reliably cover relevant standard requirements?
- How practical and accurate are they in the development process?
- What recommendations can be derived for practical application?

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Accessibility: Concept and Fundamentals

What does accessibility mean?

- **Definition**: Accessibility means that web content and other ICT products and services are designed and developed so that people with disabilities can use them; following these requirements also often improves usability for users in general [1].
- **Basis**: WCAG provides a shared standard for web content accessibility. It defines four principles (POUR):
  - Perceivable,
  - Operable,
  - Understandable, and
  - Robust.

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Legal Framework in the EU and Germany (1)

How is accessibility embedded in law? A German Use Case

- **Public sector (EU):** Directive (EU) 2016/2102 requires that websites and mobile applications of public-sector bodies be accessible.
- **Public sector (Germany):** In Germany, this is implemented through the **BITV 2.0**, which refers to EN 301 549 as the technical benchmark; conformity with EN 301 549 creates a presumption of conformity.
  - Public-sector websites and mobile apps have had to comply with Directive (EU) 2016/2102 (in a staggered series of deadlines) **since 2020–2021**.
- **Private sector (EU):** Directive (EU) 2019/882 sets accessibility requirements for certain products and services.
- **Private sector (Germany):** In Germany, this is implemented through the **BFSG**, extending accessibility obligations to many private-sector products and services from **28 June 2025**.

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Legal Framework in the EU and Germany (2)

Scope of Directive (EU) 2016/2102

- "(45) ...imposes on the public sector body the requirement to make the **accessibility statement** available..."
- "(46) A **feedback mechanism** should be set up to enable any person to notify the public sector body concerned of any failures of the website or mobile applications to comply with the accessibility requirements..."
- "(47) Member States should take the necessary measures to **raise awareness** of, and promote web training programmes relating to, the accessibility of websites and mobile applications..."
- "(49) of the utmost importance ... to **consult with relevant stakeholders** on a regular basis."
- "(50) Conformity ... should be periodically **monitored**..."
- "(51) ... **monitoring methodology** ... "

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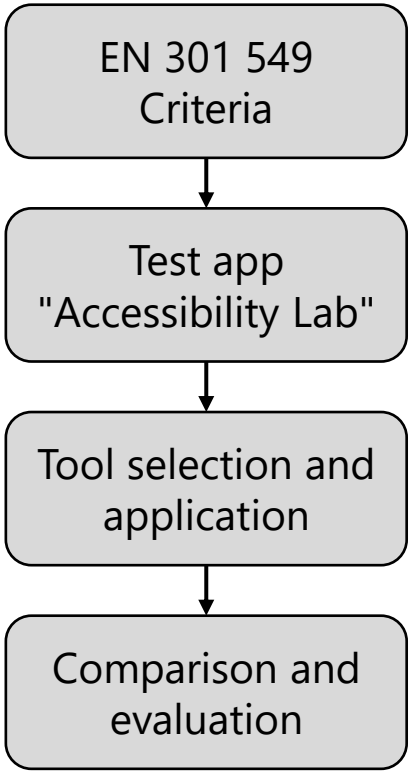
Methodological Approach

Steps for the practical investigation:

- Selection of relevant criteria from EN 301 549.
- Development of an in-house test app ("Accessibility Lab") with deliberately embedded barriers.
- Selection and application of freely available accessibility tools in this environment.
- Comparison and evaluation of the results using practice-oriented criteria.



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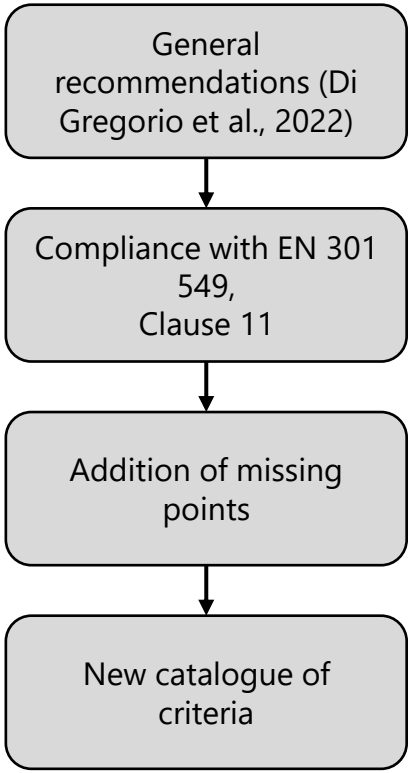
Development of the Criteria Catalogue

Based on general recommendations and standards-based test criteria

- Starting point: Table from the study by Di Gregorio et al. (2022) containing recommendations from developer documentation and W3C sources.
- Alignment with Section 11 of EN 301 549 ("Non-web software") and the addition of missing aspects.
- Result: A new criteria catalogue with testable requirements.



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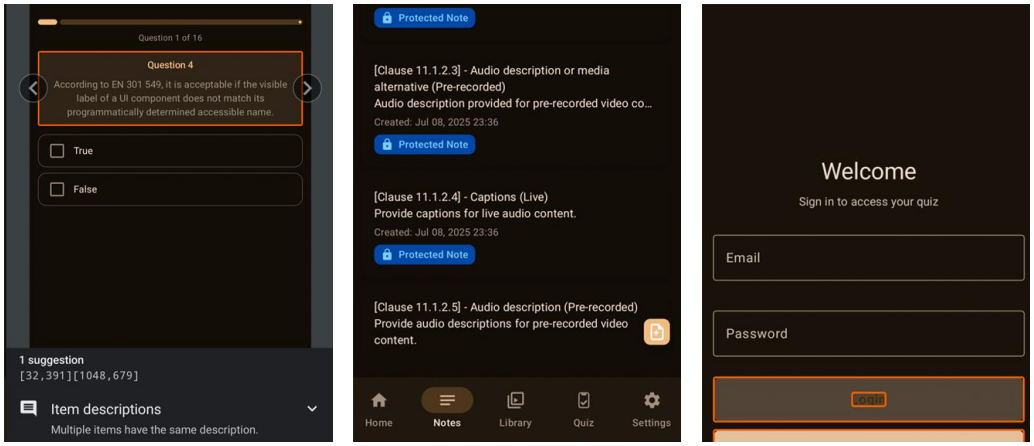
Test Environment: The Accessibility Lab (1)

Technical foundations of the evaluation

- The creation of an in-house Android app for reproducing typical accessibility barriers.
- Developed in Kotlin using Jetpack Compose.
- Serves as a common test environment for all tools.



The in-house developed "Accessibility Lab" test app.

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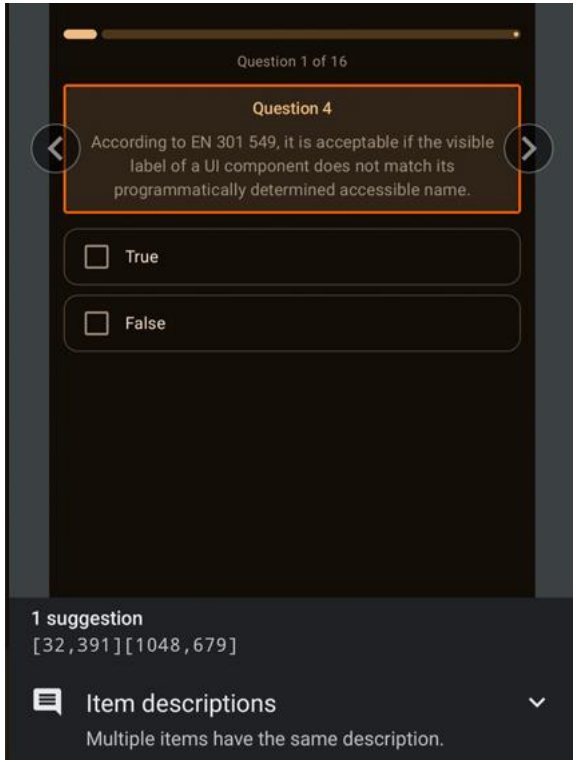
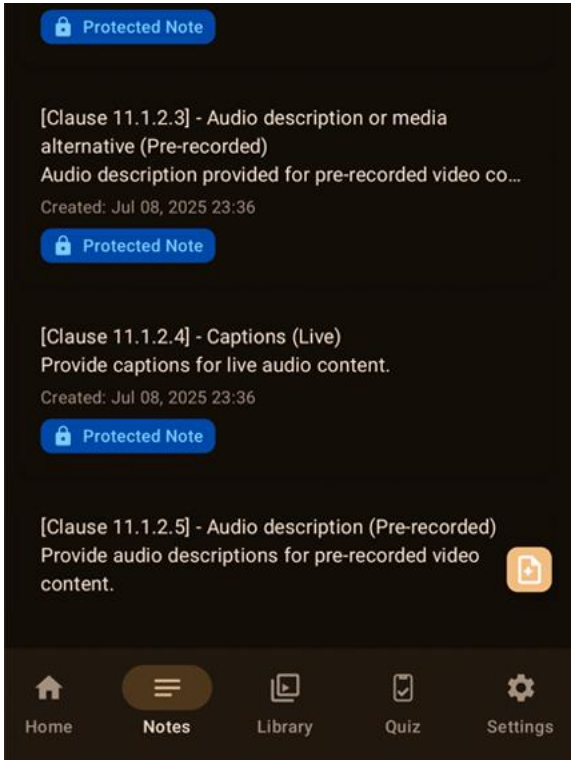
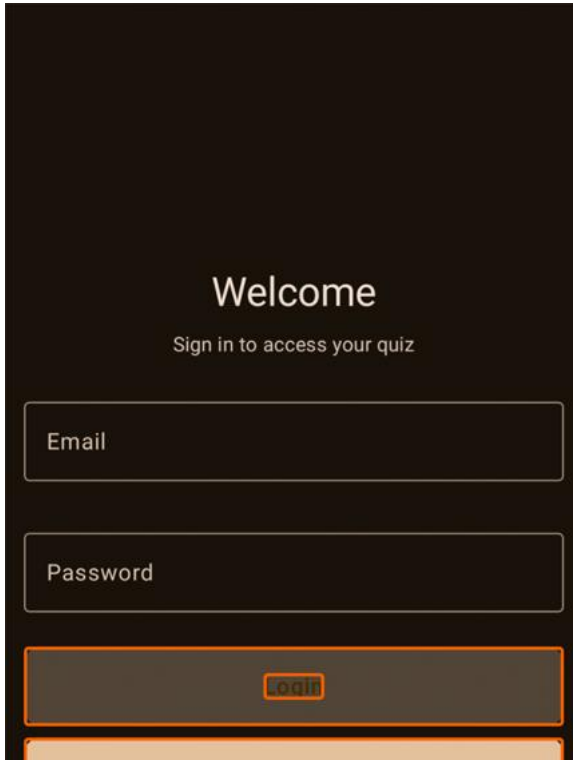
Test Environment: The Accessibility Lab (2)



Duplicate description:
Multiple items with the same description.



Button too small:
A small "Add" button is difficult to use.



Low colour contrast:
The text is barely legible.

Selection of the Test Tools

Criteria for tool selection

- Relevance for native Android projects in Kotlin (Android Studio).
- Free to use, open source, or otherwise freely available.
- Coverage of different test approaches:

Automated	Semi-automated	Manual
Android Lint	Accessibility Scanner	TalkBack
Accessibility Test Framework (ATF)		

Android Lint

Static analysis for the early detection of accessibility barriers

- **Description**: Tool integrated into Android Studio for static code analysis (i.e. checking code without actually running it).
- **Strengths**:
  - Detects typical barriers such as missing labels or non-localised text.
  - Supports structural, internationalisation, and keyboard checks.
  - Early error detection directly in the development process.
- **Limitations**:
  - No runtime analysis or semantic context evaluation.
  - Limited coverage of dynamic UI aspects.

Accessibility Test Framework (ATF)

Automated testing of semantic and technical criteria

- **Description**: Google framework based on JUnit and Compose UI tests.
- **Strengths**:
  - Precise detection of semantic accessibility barriers (roles, states, focus logic).
  - High level of integration into the development workflow.
- **Limitations**:
  - No testing of visual aspects (e.g. colour contrasts, layout).
  - High initial effort required for test setup.

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Accessibility Scanner

Semi-automated visual analysis during development

- **Description**: A stand-alone Android app from Google for visual accessibility checks.
- **Strengths**:
  - Detects missing labels and low colour contrast.
  - Results are displayed directly on the device.
  - Easy to use for quick UI checks during development.
- **Limitations**:
  - No full standards compliance.
  - Only limited coverage of semantic and interactive issues.

TalkBack

Manual evaluation from the perspective of real users

- **Description**: Android's built-in screen reader for assessing accessibility through spoken feedback and gesture-based navigation.
- **Strengths**:
  - Detects focus errors, unclear instructions, and missing feedback.
  - Evaluates contextual changes and semantic comprehensibility.
  - Provides direct insights into real user experiences.
- **Limitations**:
  - Cannot be automated and is time-consuming.

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Coverage of Key EN 301 549 Criteria

Comparison of standards coverage

Accessibility Criterion	Lint	ATF	Scanner	TalkBack
Recognisability of UI elements	✓	✓	✗	✓
Semantic roles	✗	✓	✓	✓
Navigation and Focus	✗	✓	✗	✓
Error identification	✗	✓	✗	✓
Alternative input methods	✗	✓	✗	✓

Rating scale:

✓ = Criterion addressed

✗ = Not addressed

Tool Evaluation Based on Key Criteria

Comparison of the tools:

Evaluation Criterion	Lint	ATF	Scanner	TalkBack
Standards coverage	**Medium**	**High**	**Medium**	**High**
Accuracy	**High**	**High**	**Medium**	**Medium**
IDE/CI integration	**High**	**High**	**Low**	**Low**
Usability (for devs)	**Medium**	**Medium**	**High**	**Medium**

Rating scale:

- **High** = reliable or fully met
- **Medium** = partially met
- **Low** = barely or not met

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Short-Term Recommendations

Practice-oriented measures derived from the analysis

- Early use of Android Lint to detect structural barriers.
- Integration of ATF and compliance tests into local and Continuous Integration and Continuous Delivery (CI/CD) workflows.
- Complementary visual analysis using the Accessibility Scanner.
- Regular manual testing with TalkBack.

Long-Term Recommendations

Goals for sustainable accessibility

- Embedding accessibility more firmly into training/education and day-to-day software development.
- Extend tools to include semantic and dynamic checks.
- Integrate accessibility checks directly into IDEs and build processes.
- Develop project-specific Lint rules to extend static analysis.

Over the long term, accessibility needs to become an integral part of modern software quality.

Key Findings and Future Work

Key findings

- Freely available tools proved to be practical and produced consistent, reproducible results.
- No single tool provided both consistently strong performance across all evaluation aspects and broad coverage of the assessed accessibility criteria.
- A combined-methods approach enables comprehensive and standards-aligned evaluation.

Future work

- Extend to production-scale applications.
- Make the Accessibility Lab available to others.
- Incorporate user-centred assessment by individuals with disabilities.

References

[1] W3C. Web Content Accessibility Guidelines (WCAG) 2.1. 2025. Accessed: 17.04.2026.

[2] EN 301 549 V4.1.0 (2025-11): Accessibility Requirements for ICT Products and Services, Version 4.1.0, November 2025, Sophia Antipolis, France: European Telecommunications Standards Institute (ETSI), 2025.

[3] Directive (EU) 2016/2102 of the European Parliament and of the Council of 26 October 2016 on the accessibility of the websites and mobile applications of public sector bodies, Official Journal of the European Union, L 327, OJ L 327, 2.12.2016, p. 1–15, Dec. 2016.

[4] Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services, Official Journal of the European Union, L 151, OJ L 151, 7.06.2019, p. 1–46, Jun. 2019.

[5] Statistik der Bundesagentur für Arbeit. Arbeitsmarkt für Menschen mit Behinderung. [Statistics from the German Federal Employment Agency. The labour market for people with disabilities]. 2023. Accessed: 17.04.2026.

[6] M. Di Gregorio et al. The Making of Accessible Android Applications: An Empirical Study on the State of the Practice. Empirical Software Engineering, 27(6), 2022.

[7] Statcounter Global Stats, "Mobile Operating System Market Share Europe", Web statistics, 2025, Accessed: 17.04.2026.