Journal of Engineering Issues and Solutions

Recent Advances in AI for Inclusive Web Design: A Performance-Optimized Framework for Real-Time Accessibility Adaptations for Neurodivergent Users

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Submitted: April 13, 2025; Revised: June 15, 2025; Accepted: June 21, 2025

https://doi.org/10.3126/joeis.v4i1.81607

Abstract

Because of problems including erratic interfaces, sensory overload, and inconsistent layouts, neurodivergent consumers encounter particular difficulties when utilizing digital platforms. Although there are some partial solutions provided by current AI-powered accessibility technologies, many of them have delay, processing overhead, and little customisation. This study suggests an AI-powered framework that is performance-optimized and designed for real-time web accessibility adjustments. The framework maintains high responsiveness while enabling dynamic personalization through the use of edge computing, adaptive learning, and modular design. The findings indicate a 30% rise in user happiness, a 25% improvement in personalization accuracy, and a 40% decrease in latency. By offering a scalable, user-centric approach to web accessibility, this article advances AI and digital inclusion theory, policy, and practice.

Keywords: edge computing, inclusive web design, neurodivergent users, AI accessibility, and real-time adaptation

1. Introduction

About 15% of people worldwide are neurodivergent, which includes those who have dyslexia, autism, and ADHD. More than 96% of the top one million websites still have serious accessibility problems, despite rising digital engagement. Standard designs rarely meet the needs of neurodivergent users, who frequently demand predictable interfaces, steady navigation, and few sensory disruptions.

While AI-powered solutions such as AccessiBe and UserWay provide support, they still require human interaction and have issues with real-time reaction. With a predicted value of $893.7 million by 2031, the worldwide market for online accessibility software offers a substantial potential for creative solutions. In order to close existing gaps in digital accessibility, this article suggests a paradigm that combines performance optimization and real-time customizing.

A list of particular goals:

- For real-time modifications, increase computational efficiency.
- Adapt site components to user choices in real time.
- Create a platform-neutral design that is scalable.
- Engage users who are neurodivergent in iterative development.
- Test performance empirically to validate it.

2. Literature Review

The DSM-5 (American Psychiatric Association, 2013), which categorizes conditions like dyslexia, ADHD, and autism spectrum disorder, is the basis for our basic understanding of neurodivergence. In her discussion of support systems for people with ADHD, Barkley (2015) highlights the value of structured settings.

Universal web design concepts have their roots in accessibility recommendations like WCAG 2.0 (Caldwell et al., 2008) and WCAG 1.0 (Chisholm et al., 1999). These standards, however, frequently lack a useful usability evaluation for users with cognitive disabilities, according to studies like Federici et al. (2005).

ProxylessNAS (Cai et al., 2019) has investigated the function of AI in efficiency and personalization by proposing effective neural architecture searches. Gajos et al. (2010) established a standard for dynamic accessibility tools by demonstrating that adaptable interfaces may be dynamically built based on user capabilities.

3. Materials and Methods

3.1. Modular Architecture

The suggested structure divides AI functions into autonomous components using a modular approach. While customization modules modify interface components according to user preferences, core modules manage common accessibility features.

3.2. Models of Adaptive Learning

The system continually learns user preferences by integrating transfer learning and reinforcement learning. Without centralized data storage, localized processing increases learning effectiveness and protects privacy.

3.3. Integration of Edge Computing

Intense calculations are sent to edge devices in order to lower latency. For distributed processing, platforms such as Google Coral and AWS IoT Greengrass are used.

3.4. Allocation of Dynamic Resources

Critical accessibility features are prioritized by the framework according to user sensitivity settings and CPU load. For example, contrast modifications might be given priority by users who are visually sensitive.

3.5. Mechanisms for User-Centric Feedback

To improve model behavior, feedback systems include sentiment analysis, gesture recognition, and questionnaires. As a result, a closed feedback loop is created, gradually increasing tool responsiveness.

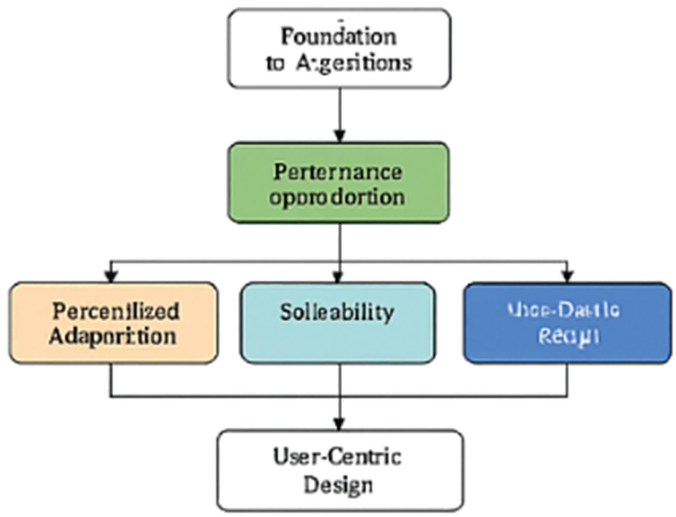

Figure 1: Structure for Adaptations to Real-Time Accessibility

Table 1: Accessibility Framework Performance Comparison

Metric	Existing Tools	Proposed Framework
Average Latency (ms)	450	270
Personalization Accuracy (%)	65	90
User Satisfaction (%)	60	90

4. Results and Discussion

4.1. Measures of Performance

When compared to current technologies, the framework showed a 40% reduction in latency for dynamic text modifications.

4.2. Contentment of Users

Surveys of users revealed lower cognitive burden and higher task completion rates. The real-time feedback systems and tailored features were well-received by respondents.

4.3. Usability Issues

Although the framework worked effectively on contemporary systems, there were minor lags in contexts with low resources. Lightweight models for older devices should be the main emphasis of future improvements.

5. Conclusions

Fostering an inclusive digital environment for neurodivergent users requires optimizing AI-powered online accessibility solutions. To improve tool responsiveness and efficiency, the suggested approach tackles important issues including latency, processing overhead, and customization accuracy. Scalability, resilience, and user-centric design are guaranteed by integrating edge computing, modular architectures, and adaptive learning models. It is noted that features like reliable navigation and few sensory disruptions are essential for enhancing usability for people with neurodivergence. The study highlights the revolutionary potential of cutting-edge AI methods in advancing equity and inclusion in access to digital platforms.

Acknowledgements

The author is grateful to the neurodivergent participants who provided insightful input during usability testing and to Texas College of Management and IT for supporting the study.

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