



AI-Driven Adaptive UI Generation: Personalizing E-Learning Interfaces Based on Cognitive Abilities of Undergraduates

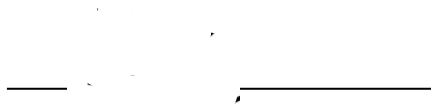
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I certify that I have read this thesis and that in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Science.



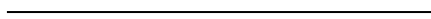
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DECLARATION

This is to certify that the work is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources). The work has not previously been submitted in any form to the Sri Lanka Institute of Information Technology or to any other institution for assessment for any other purpose.

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ABSTRACT

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E-learning platforms often adopt uniform interface designs and neglect learners' cognitive differences, leading to cognitive overload and disengagement. While content personalization is common, dynamic interface-level adaptation remains underexplored. To address this gap, this study introduces an AI-driven adaptive user interface framework to personalize the interface dynamically based on individual cognitive attributes, namely attention span, memory capacity, and cognitive load, with the consideration of layout modification, navigation structure, and information density. Three validated methods are used for cognitive profiling, namely attention via WebGazer.js, cognitive load through the N-Back test, and memory capacity via the Digit Span Test. A within-subjects experiment was conducted by using 30 undergraduates in Sri Lanka. All the participants interacted with both static and AI-driven adaptive interfaces, along with a post-interaction evaluation based on validated instruments combining NASA-TLX, SUS, and UEQ scales. Results indicated a 96.7% adaptation success rate, along with positive post-feedback evaluations ($M > 4.2/5$) across cognitive load, navigation efficiency, personalization, usability, and engagement. Correlation patterns indicated that cognitive profiles influenced perceived outcomes. The impact of the AI-driven adaptive user interface is evaluated using quantitative analysis along with statistical data analysis using statistical software. The proposed system is designed as a web-based platform, ensuring AI-driven personalization to enhance user engagement and learning effectiveness. Further, the research findings contribute to the field of Human-computer interaction and the domain of education by validating AI-driven adaptive UI generation.

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