An Enterprise-Grade EdTech Solution for Real-Time Handwriting Assistance: A Usability and Accessibility Approach

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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is entirely my own and not of any other person, unless explicitly acknowledged (including citation of published and unpublished sources).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

An Enterprise-Grade EdTech Solution for Real-Time Handwriting Assistance

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The research presents Fun Letter Tracing as an educational technology system which provides real-time handwriting assistance for primary school students. The system uses React for its browser-based front end and Flask for its lightweight scoring service to create a practice loop that analyzes user input after tracing followed by tip generation and retry functionality. The system evaluates handwriting quality through a 50-dimensional feature vector which includes smoothness and consistency and spatial spread and completeness and temporal cues and uses Random Forest and small FFNN models with letter-specific geometric checks based on keypoints and pixel corridors. The system provides a limited API set which includes /analyze and /letter-info/<letter> and /progress-summary and /health endpoints to make school integration easier while maintaining privacy protection through default operation. The development team focused on creating an accessible system which follows WCAG 2.2 standards through its design of large touch areas and visible focus indicators and non-color based alerts and TTS functionality and simple language for children. The evaluation strategy combines three assessment methods which include expert walkthroughs and controlled testing and classroom-based trials involving 30-50 students and 10-15 teachers. The evaluation uses both quantitative metrics including SUS scores and completion rates and time-to-first-success and latency performance at 150 ms or below and expert rubric assessments and qualitative feedback from teachers and students. The thesis presents detailed information about system architecture and security measures and accessibility standards and testing procedures for school implementation.

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List of Abbreviations

Abbreviation	Description
AI	Artificial Intelligence
API	Application Programming Interface
CDN	Content Delivery Network
E2E	End-to-End
EdTech	Educational Technology
IT	Information Technology
JSON	JavaScript Object Notation
KPI	Key Performance Indicator
KR	Knowledge of Results
KP	Knowledge of Performance
LLM	Large Language Model (optional future AI extension)
LRU	Least Recently Used (caching policy)
ML	Machine Learning
NFR	Non-Functional Requirement
OS	Operating System
p95	95th Percentile (latency measure)
PII	Personally Identifiable Information
RF	Random Forest (machine learning model)
SLO	Service-Level Objective
SUS	System Usability Scale
SPARC	Spectral Arc Length (smoothness index in movement analysis)
TTS	Text-to-Speech