Ontology Driven Augmented Reality Environments for Neurodiverse Learning

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Declaration

I declare that this dissertation does not incorporate, without acknowledgment, any material previously submitted for a Degree or a Diploma in any University and to the best of my knowledge and belief, it does not contain any material previously published or written by another person or myself except where due reference is made in the text. I also hereby give consent for my dissertation, if accepted, to be made available for photocopying and for interlibrary loans, and for the title and summary to be made available to outside organizations.

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Date- 26.06.2025

Supervised by-

Dr. Thushari Silva

Name of Supervisor(s) Signature of Supervisor(s)

Date- 26.06.2025

Dedication

To all neurodiverse children, whose vivid capabilities light up the world in extraordinary ways.

To their parents, whose unwavering love nurtures endless possibilities.

And to the educators, therapists, and innovators who believe in every child's potential and strive to build a more inclusive, compassionate future.

Acknowledgement

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Thank you very much!

W. B. T Withanage

Abstract

The goal of this research is to construct, design, and analyze the effectiveness of ONLEARN, an augmented reality (AR) platform designed to assist children with autism in the ages of three to eight years old. The research focuses on addressing the absence of adaptive individualized learning technologies tailored for neurodiverse learners as there are significant cognitive, sensory, and social differences within the autism spectrum. The technology of ONLEARN is built around a formally defined ontology developed in Protégé with important concepts including sensory features, and social communication skills hierarchy. The ontology was hosted in a Stardog semantic reasoning engine, which allows dynamic inferencing. Learning content personalization and extraction is done using SPARQL queries and interaction data gathered in real time from the users.

ONLEARN employed Unity with the UnityIIS semantic bridge to embed the AR child-friendly interface, thus ontological intelligence could easily integrate into it. Additionally, ONLEARN incorporated a 3D conversational agent powered by Convai to interact with children emotionally and during instructional activities. Expert analysis validated the ontology's complexity, the realization of the AR interface's design for autistic learners, and the pedagogical rationale behind the seamless content structuring.

The results show that ontology-driven reasoning enhances the degree of personalization and effectiveness of augmented reality educational interventions for children with neurodiversity. Further work will center on increasing the degree of sensory customization, incorporating functional communication training units, improving cultural adaptability, and developing integration with educational and clinical systems for wider practical deployment.

Keywords: Ontology-Driven Systems; Augmented Reality; Autism Spectrum Disorder; Semantic Reasoning; Stardog; SPARQL; Personalized Learning; Neurodiversity; Unity Development; Conversational AI; Adaptive Educational Technology

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