9th World Conference on Future of EDUCATION
Toronto, Canada 25 - 27 July 2025

Automating Interactive STEM Lab Simulations Using Artificial Intelligence

Osama Mohamad Abdulghani[1], Behrang Mohajer[2], Marjan Alavi[1]

[1]McMaster University, Canada

[2]LABonWEB, Canada

Abstract

We introduce a new AI-driven chatbot agent automating and simplifying interactive simulations in (STEM) topics integrated into a designated learning management atmosphere. Utilizing large language models (LLMs), computational fluid dynamics (CFD), and molecular dynamics (MD) engines in the backend, the assistant improves user accessibility and interaction with the simulations by providing customized learning within a completely modifiable project, which distinguishes the platform from any existing animation-based platforms out there. Key improvements involve offering an accessible AI assistant that can assist users who interact with the simulation labs, optimizing the LLM using prompt engineering techniques to allow it to understand the context of the simulation. The prompted LLM enables the user to control the simulation labs using the chatbot to modify or add necessary objects (e.g., sensors, graphs) and manage simulations as well as view conversational input. Importantly, this platformed is aimed to provide inexpensive access to the labs with visual learning that traditionally have been offered with physical high-maintenance, less accessible equipment. Moreover, additional accessibility features include the automatic execution of simulation labs, hands-free interaction via the Speech-to-Text API, and listening to the LLM's responses, powered by the Text-to-Speech API. Extensive testing in projects strengthened the functionalities for different simulation types, ensuring integrity and usability. The outcomes not only made simulation creation easier but also paved the way for enhancements down the road, including open-source LLM support, greater lab assistance, and enhanced accessibility options like audio I/O. The project is an important step towards democratizing STEM education with smart automation.

Keywords: AI agent, Accessibility, Education, Prompt Engineering, Simulation