

Design and Validation of a Web-Based Campus Companion for Wayfinding and Academic Assistance

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Abstract

University students often face avoidable delays when navigating complex academic buildings and seeking reliable academic information, especially when classroom locations, accessibility routes, course prerequisites, and technical course content are distributed across multiple sources. This senior design project presents AUM Companion, a publicly deployed web application that integrates indoor wayfinding and a domain-restricted academic chatbot to support students at the American University of the Middle East. The navigation subsystem models the campus buildings as a multi-floor weighted graph derived from AutoCAD floor plans and laser-meter site surveys, with measurements recorded at 0.1 m precision. Dijkstra's algorithm computes shortest paths across three floors, while elevator bridge nodes enable cross-floor routing. The chatbot subsystem applies retrieval-augmented generation using curated and administrator-approved Industrial Engineering course documents embedded in a Pinecone vector index. It answers course-specific and policy questions on prerequisites, technical concepts, worked examples, and curriculum relationships while refusing out-of-scope queries. Validation included algorithm benchmarking over 300 routing trials and chatbot testing on 70 complex student-realistic questions with 97.5% accuracy. Results showed optimal path generation with zero deviation from expected shortest-path cost and correct chatbot behavior for both in-corpus and out-of-corpus questions. The system reduces student wayfinding time, improves access to verified academic knowledge, and provides a low-cost, reproducible model for regional universities seeking practical digital campus-support solutions.

Keywords

Indoor Wayfinding, Accessibility, Academic Assistance, Retrieval-Augmented Generation, Dijkstra's Algorithm

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Biographies

Alperen Bal is an Associate Professor in the College of Engineering and Technology at the American University of the Middle East, Kuwait. His expertise includes mathematical modeling, simulation, optimization, sustainable systems, and applied industrial engineering. He teaches and supervises student projects in engineering design, decision-support systems, operations research, data analytics, and digital transformation. His academic interests emphasize the development of practical, low-cost, and scalable engineering solutions for real-world systems. He has supervised senior design projects involving indoor navigation, accessibility-aware routing, artificial intelligence,

retrieval-augmented generation, and student-support technologies. His work supports the integration of analytical modeling, computational methods, and human-centered design in engineering education and applied research.

Ali M M AlArbash is an Industrial Engineering student at the American University of the Middle East, Kuwait. His interests include software development, systems design, process improvement, and the use of computational tools to solve real-life engineering problems. He has strong coding skills and enjoys developing practical digital solutions that combine industrial engineering methods with user-focused implementation. His project experience includes web-based applications, algorithmic problem solving, and decision-support tools for improving service systems.

Ahmad Talal Ali AlShooli is an Industrial Engineering student at the American University of the Middle East, Kuwait. He is interested in artificial intelligence, software development, data-driven decision making, and applied industrial engineering. He focuses on building AI-integrated solutions that address practical problems in academic and service environments using his background AUM-UC Berkeley AI program. His background includes coding, system development, and the application of engineering analysis to improve accessibility, information retrieval, and operational efficiency.

Othman Salem Alrasheedi is an Industrial Engineering student at the American University of the Middle East, Kuwait. His academic interests include operations improvement, engineering design, systems analysis, and the development of practical solutions for real-world problems. He is interested in applying industrial engineering tools to improve service quality, reduce delays, and support better decision making. His project work reflects a strong interest in combining analytical thinking with practical implementation.

Mohammad Tariq Al Fares is an Industrial Engineering student at the American University of the Middle East, Kuwait. His interests include process optimization, applied problem solving, project planning, and the design of engineering solutions for real-life systems. He is particularly interested in using industrial engineering methods to improve user experience, operational performance, and service accessibility. His academic work focuses on practical applications that connect engineering analysis with measurable improvements.

Saleh M S AlMezaini is an Industrial Engineering student at the American University of the Middle East, Kuwait. He is interested in applied industrial engineering, systems improvement, decision-support methods, and real-life engineering applications. He is well versed in production systems and operations research. He has strong ability in developing practical solutions that address operational and service-related challenges. His project experience emphasizes problem identification, engineering analysis, research and the implementation of effective, user-centered solutions for improving system performance.