LLM-NavAgent: Adaptive Ground Robot Navigation Using Large Language Model-Based AI Agents

T.E Vhurumuku[1], C. Kuchwa-Dube[2] and P. Leeuw[3]

[1]MSc Student, School of Mechanical, Industrial Aeronautical Engineering, University of the Witwatersrand, Johannesburg, 2017. Email: tinashe.erwin@gmail.com
[2]Senior Lecturer, School of Mechanical, Industrial Aeronautical Engineering, University of the Witwatersrand, Johannesburg, 2017. Email: Chioniso.Kuchwa-Dube@wits.ac.za
[3]Senior Lecturer, School of Mining Engineering, University of the Witwatersrand, Johannesburg, 2017. Email: Paseka.Leeuw@wits.ac.za

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ABSTRACT

Large Language Models (LLMs) are finding new frontiers in promoting the autonomy of robots, understanding high-level commands, and navigating the robots in a way that adheres to the many variations in the environment. This study presents LLM-NavAgent, an AI agent that harnesses the power of LLMs for Ground Robot Navigation in an underground mining environment. The underground mining is of peculiar interest; it is characterized by moving objects, changing elevations and mining faces, obstacles, and little or no light making it extremely difficult thus demanding a high level of adaptability and quick decision-making. With the LLM-MNav advancements in LLM-based navigation such as LM-Nav's use of language, vision, and action for autonomous instruction and integration with dynamic navigation in cluttered environments, LLM-NavAgent modifies the challenges posed for mining inventive systems. The agent merges LLM-derived natural language processing and ground robot operating control systems to facilitate the successful execution of high-level commands such as navigation in congested underground mining environments, obstacle avoidance and mission completion in a short period. This research applies LLM-NavAgent to the minimum viable product for mining operations and addresses scenarios that include performing inspection and mapping as well as autonomous exploration. Accordingly, our work contributes to the comprehension of LLM usage in mining robotics, where it brings a versatile and practical way of accomplishing adaptive navigation in extremely hostile environments for autonomous systems.