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Literature Review

1) AI in navigation systems:

Lv, Zhihong, et al. "Research on Global Off-Road Path Planning Based on Improved A* Algorithm." ISPRS International Journal of Geo-Information 13.10 (2024): 362.

This article explains the use of A* and improved A* algorithms to construct paths on terrains where manipulation, such as dataset fusion or preprocessing, has been applied. By integrating low-resolution satellite imagery with GPS trajectory data, the study enhances pathfinding accuracy, even in challenging environments. It highlights early and late fusion strategies to combine data sources effectively, demonstrating the superiority of the enhanced A* approach over traditional methods. The methodology is validated using diverse datasets, proving its ability to detect optimal routes in areas lacking detailed mapping. The difference between this and my project is that this research focuses on off-road navigation for vehicles, whereas my project aims to create optimal routes for individuals on foot.

Project Contribution: The techniques discussed can help us understand how to efficiently implement AION's ability to analyze and classify terrain from satellite imagery and topographical data, optimizing route planning for users in off-road areas.

Qureshi, Ahmed Hussain, and Yasar Ayaz. "Intelligent bidirectional rapidly-exploring random trees for optimal motion planning in complex cluttered environments." Robotics and Autonomous Systems 68 (2015): 1-11.

This article talks about a new motion planning algorithm called **Intelligent Bidirectional-RRT*** (IB-RRT*), which improves on existing methods like RRT* and Bidirectional-RRT* (B-RRT*). It is specifically designed for navigating complex and cluttered environments efficiently. IB-RRT* uses bidirectional trees and an intelligent sampling heuristic to converge faster to optimal path solutions. The experimental results show that IB-RRT* outperforms its predecessors in terms of efficiency and effectiveness in challenging scenarios.

Project Contribution: Overall improvement algorithm wise, could be used alternate to A* algorithms and its counterparts for better performance and efficiency.

Amani, Mani, and Reza Akhavian. "BIM-based Safe and Trustworthy Robot Pathfinding Using Scalable MHA* Algorithms and Natural Language Processing." *arXiv*, 23 Nov. 2024.

This article explores the integration of Building Information Modeling (BIM) with a multi-heuristic A* (MHA*) algorithm to enhance robotic pathfinding in dynamic construction environments. The approach combines spatial and semantic data using artificial potential fields (APFs) and large language models (LLMs) to optimize paths, avoid obstacles, and enhance decision-making transparency. Gaussian smoothing techniques and semantic data from BIM create safer and more natural navigation paths, improving over traditional A* algorithms. The difference between this and my project is that the study focuses on robotic navigation in structured environments, whereas my project aims to provide optimal navigation routes for individuals on foot in uncharted off-road areas.

Project Contribution: The techniques discussed, such as integrating semantic data and dynamic path adjustments, can enhance AION's functionality by improving terrain analysis and navigation optimization in off-road pedestrian use cases.

2) Geospatial data analysis and integration.

Xu, Yuexue, et al. "Extracting terrain texture features for landform classification using wavelet decomposition." ISPRS International Journal of Geo-Information 10.10 (2021): 658.

This study focuses on landform classification by analyzing terrain texture features extracted from Digital Elevation Model (DEM) images using multilevel Discrete Wavelet Transform (DWT). The method captures spatial and frequency information of terrain structures, enabling accurate classification through wavelet coefficients and Random Forest models. It demonstrates improved accuracy in identifying landforms compared to traditional approaches by representing terrain features at multiple scales.

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3) Environmental and terrain factors in navigation.

Rahi, Adibuzzaman, et al. "Deep Semantic Segmentation for Identifying Traversable Terrain in Off-Road Autonomous Driving." *IEEE Access* (2024).

This article discusses the use of deep semantic segmentation for identifying traversable terrain in off-road autonomous driving. It focuses on how machine learning techniques can help vehicles recognize and navigate challenging terrains by classifying different surface types. The research aims to improve autonomous vehicles' ability to make real-time decisions in unstructured environments, enhancing off-road navigation.

Competitors:

Maps.me does allow route calculation, but it's mainly focused on existing paths like driving, cycling, and hiking routes. It offers basic route planning but doesn't create routes through completely uncharted or off-road terrain. Routes are typically calculated based on mapped trails.

Gaia GPS allows users to create custom routes, but it doesn't automatically calculate routes in the way Google Maps does for driving. Instead, you manually select waypoints and plot routes for outdoor activities like hiking, backpacking, and off-roading. It's more of a manual planning tool than an auto-routing navigation system.

Amud Anan doesn't offer route calculation in the conventional sense. It allows users to explore existing trails and points of interest, but you cannot input starting and ending locations to automatically generate routes. The app is more focused on providing information about trails and places along the way.