Project Plan

Cordova Diego

Purpose

The purpose of this project plan is to structure the tasks I will be performing during my internship, specifically focusing on digital twin interoperability and path planning for lunar rovers. This involves developing a way for different systems and physics engines to work together and share information seamlessly. Digital twin interoperability is essential because it allows various simulation environments, data models, and AI-driven systems to communicate effectively, ensuring accurate and efficient decision-making in real-world applications.

Additionally, I will work on path planning in Unity using the PhysX physics engine. This will involve manually controlling the VIPER rover on the Moon’s surface (which is already set up in Unity), storing waypoints from manual navigation, and then using these waypoints to automate path planning via scripting. The objective is to create an efficient autonomous navigation system for the rover.

My main objective is to design an agentic AI that can use Retrieval-Augmented Generation (RAG) as a method for retrieving information. By integrating RAG, the AI will be able to pull relevant data from multiple sources, improving accuracy and reducing reliance on pre-trained models alone. This approach will enhance the AI’s ability to process complex queries and adapt to dynamic environments. By improving interoperability, this project aims to enhance data exchange, cross-platform compatibility, and automation, ultimately optimizing system performance.

Objectives

Goals - Develop a scalable AI agent with a simple structure that ensures efficiency. I aim to deepen my understanding of AI systems particularly in structuring and scaling them efficiently. Additionally, I will implement path planning for the lunar rover in Unity, utilizing the PhysX physics engine and scripting for autonomous movement.

Starting Point - My background includes knowledge of large language models (LLMs) and machine learning structures. This foundation will be crucial as I approach the specific requirements of the AI agent for this project. Additionally, I will familiarize myself with Unity and its properties, reading online resources to gain a better understanding before implementing the path planning system.

Assumptions - The project assumes that Retrieval-Augmented Generation (RAG) is a suitable method for this AI due to its effectiveness in reducing hallucinations and improving response accuracy by pulling from relevant data. For the path planning component, it assumes that manually controlling the rover and storing waypoints in a JSON file will provide a structured approach to later automating the navigation process.

Criteria for Success - Success will be measured by:

1. The AI agent’s ability to accurately understand and respond to user prompts, thereby automating processes and reducing the need for human intervention.
2. The successful manual control of the VIPER rover in Unity, including accurate tracking and saving of waypoints.
3. The ability to use stored waypoints for autonomous navigation, reducing reliance on manual control and enabling scripted path planning.

Expected Outcome - The successful outcome will be a fully functional AI agent that supports various user prompts and executes the appropriate actions automatically, significantly improving the efficiency and effectiveness of digital twin technologies at JPL. Additionally, an efficient path planning system for the lunar rover in Unity will be developed, allowing for both manual and autonomous navigation.

Approach

Methodology - The project will utilize the Retrieval-Augmented Generation (RAG) technique to develop the AI agent. This method will help in providing accurate and relevant responses based on the extensive database and previous interactions. For path planning, Unity’s PhysX physics engine will be used to simulate rover movement, first through manual control, then by storing waypoints and using them for autonomous navigation.

Milestones -

1. **Literature Review**: Complete a comprehensive review of existing papers and reports on similar AI agents and path planning techniques in Unity (Duration: 2 weeks).
2. **Familiarization with Unity**: Read and explore Unity’s properties, specifically related to physics and scripting for rover control (Duration: 2 weeks).
3. **Manual Rover Control Implementation**: Implement manual controls for the VIPER rover in Unity and ensure smooth movement (Duration: 3 weeks).
4. **Waypoint Tracking**: Develop a system to record waypoints while manually controlling the rover and store them in a JSON file (Duration: 2 weeks).
5. **Autonomous Navigation Script**: Use stored waypoints to script autonomous path planning in Unity, ensuring smooth and accurate movement (Duration: 4 weeks).
6. **Prototype Development**: Develop an initial prototype of the AI agent using RAG (Duration: 4 weeks).
7. **Testing and Refinement**: Test the AI prototype and refine its capabilities based on feedback. Test and refine the rover’s navigation system for accuracy and efficiency (Duration: 6 weeks).
8. **Final Review and Implementation**: Conduct a final review with mentors and prepare both the AI agent and the path planning system for deployment (Duration: 4 weeks).

Challenges and Solutions - Anticipated challenges include integrating RAG effectively and ensuring the AI agent can handle a diverse range of prompts without errors. For path planning, challenges include accurately recording waypoints and ensuring smooth autonomous movement. Regular consultations with mentor and incremental testing will be employed as solutions.

Resources Needed - Access to databases for retrieval, computational resources for model training, software tools for developing and testing the AI agent, Unity with PhysX for simulation, and documentation on Unity scripting.

Collaboration - I will collaborate with coworkers at JPL, as well as receive ongoing guidance from my mentor.

Project Schedule

Timeline: A detailed timeline will be constructed using a Gantt chart to visualize the phases of the project, from the initial literature review through to the final implementation.

References

Literature: Literature: A list of key papers and foundational texts that inform the structure and function of AI agents, especially those utilizing RAG, as well as references for Unity-based path planning and waypoint tracking.

Input from Others: Insights and preliminary advice from my mentor and JPL's AI research team which have helped shape the initial approach of the project.

A screenshot of a computer

AI-generated content may be incorrect.