

UAV-LLM Research Lab Platform

Karthisri Meghana Guntupalli Ashok Vardhan Raja, Ph.D.

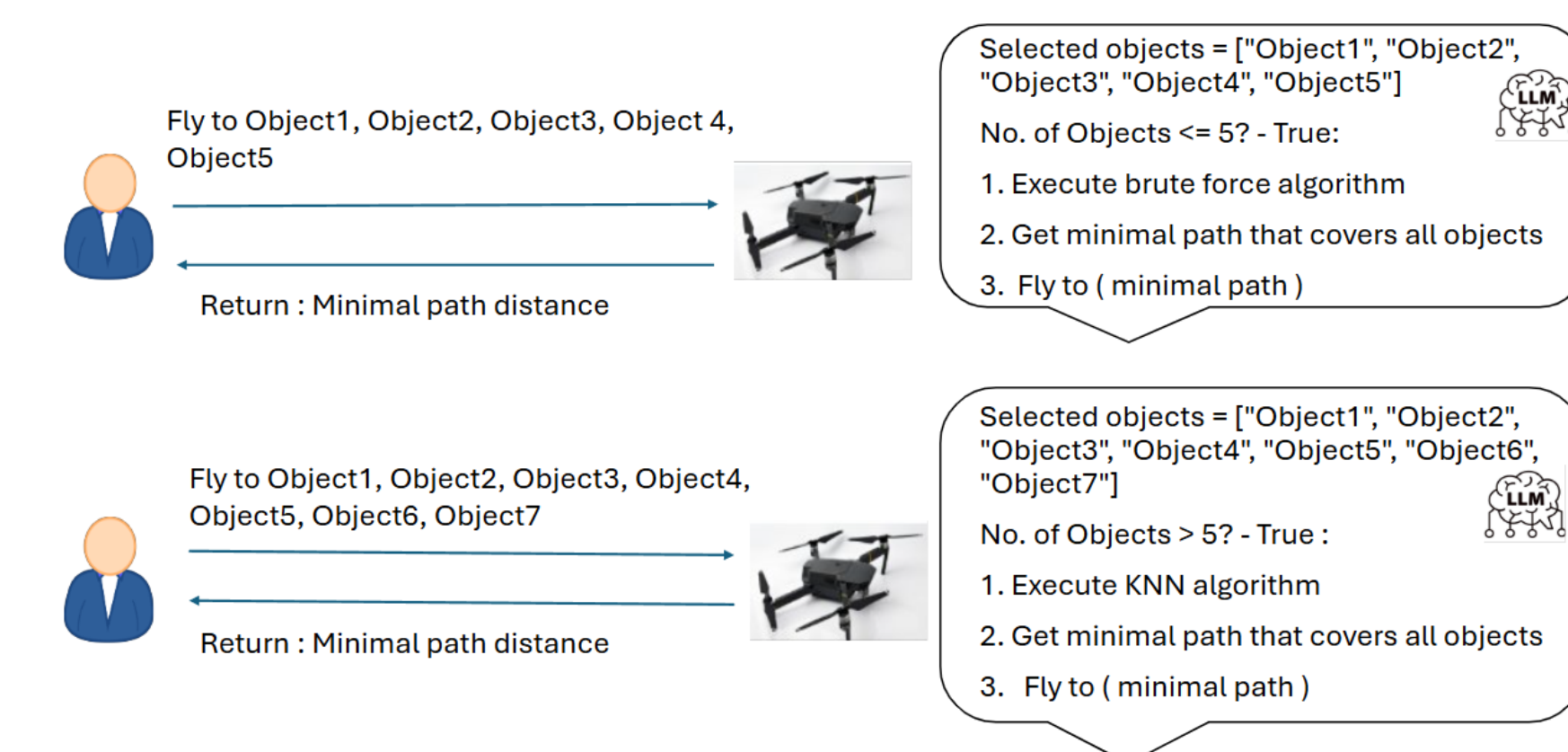
Introduction:

- Rise of LLMs and AGI:** The rapid advancement of Large Language Models (LLMs) has significantly propelled the development of Artificial General Intelligence (AGI), showcasing capabilities in logical reasoning, decision-making, and natural language processing.
- Integration of LLMs with UAVs:** These LLM capabilities can be integrated with Unmanned Aerial Vehicles (UAVs) to enable autonomous, generative tasks across diverse operational scenarios, enhancing efficiency and reducing human intervention.
- Growing Deployment and Challenges:** The increasing deployment of UAVs in various sectors necessitates robust robotics, secure communication, and resilient systems to ensure efficient operation and mitigate cyber threats.

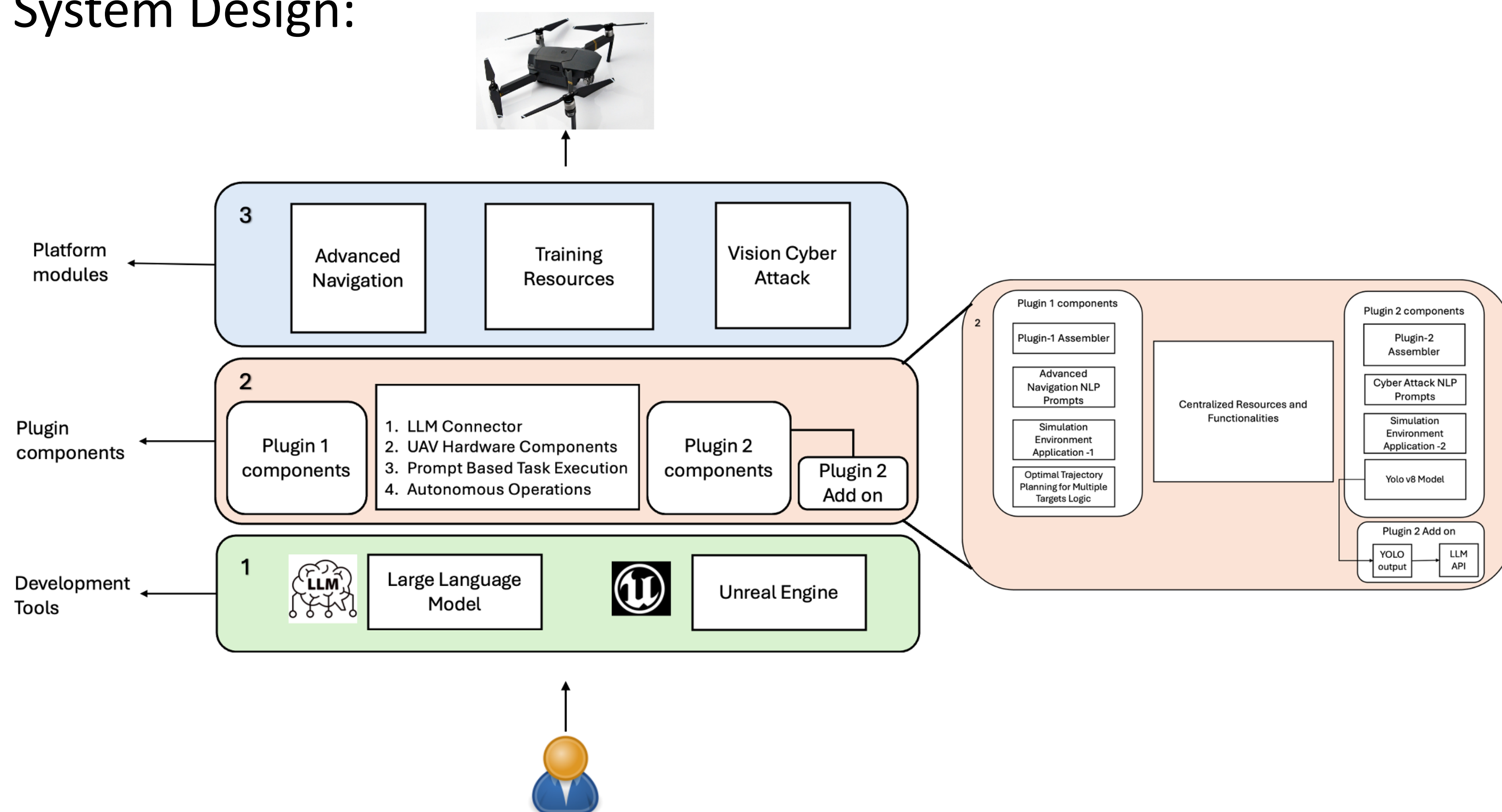
Motivation:

- Educational and Training Gap:** There's a critical need for accessible and affordable educational modules to train students and professionals on the potential and safety aspects of autonomous UAVs, as traditional real-world training is often expensive and impractical.
- Lack of LLM-UAV Integration in Training Platforms:** Existing UAV training platforms do not adequately demonstrate the potential of integrating LLMs with UAVs, leaving a significant learning gap.
- Need for Practical, Simulated Learning Environments:** To overcome these limitations, there is a strong motivation to develop lab-based simulation platforms that provide practical exercises, allowing users to experience and understand the complex relationship between LLMs and UAVs.

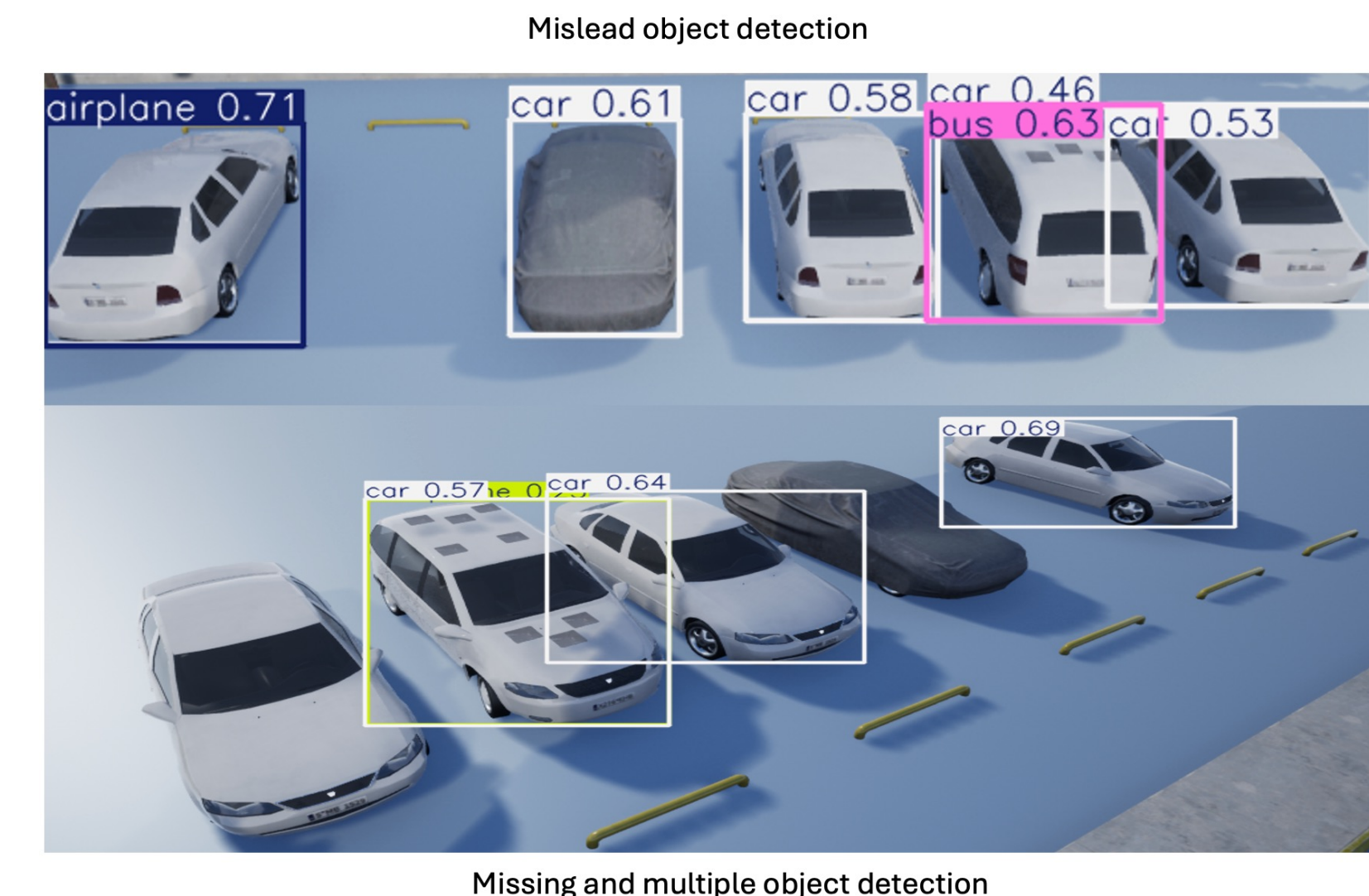
Module 1: Advanced Aerial Navigation:



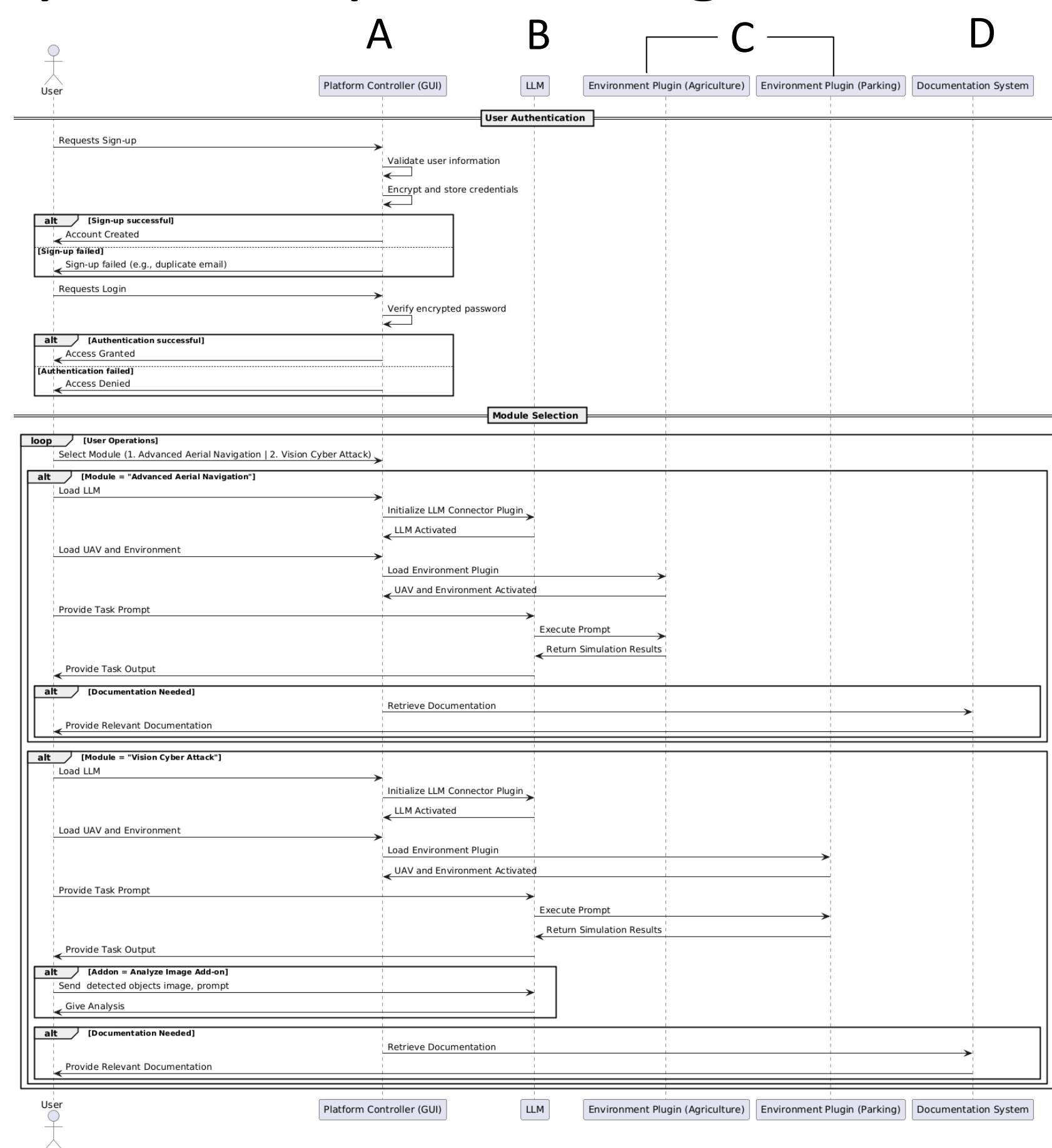
System Design:



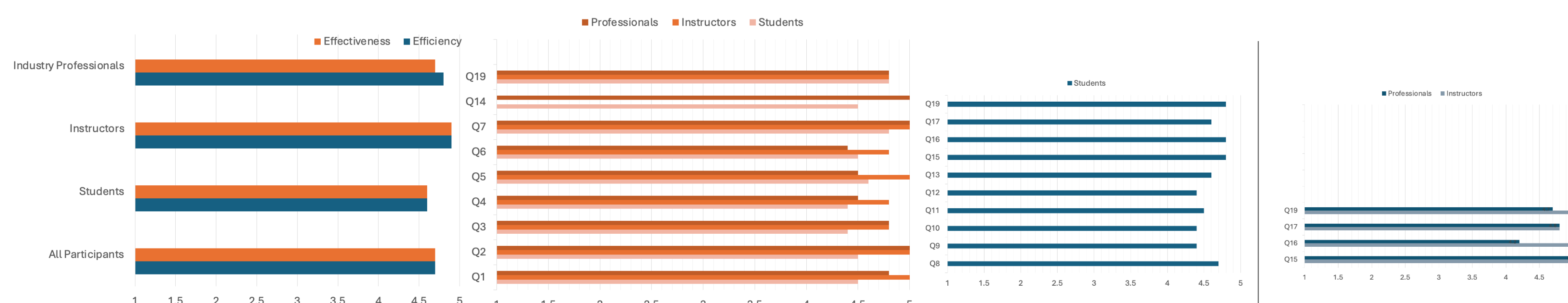
Module 2: Vision Cyber Attack:



System Sequence Diagram:



Evaluation & Results:



Conclusion:

The UAV-LLM Lab Platform, a novel lab platform designed to address the growing need for education and training in integrating LLMs with UAVs. The UAV-LLM Lab Platform's customizable simulation environment enables users to gain practical experience with LLM-driven UAV control, including navigation and cyberattack scenarios, through a modular design and plugin mechanism. This hands-on approach fosters a deeper understanding of the complex relationship between LLMs and UAVs.

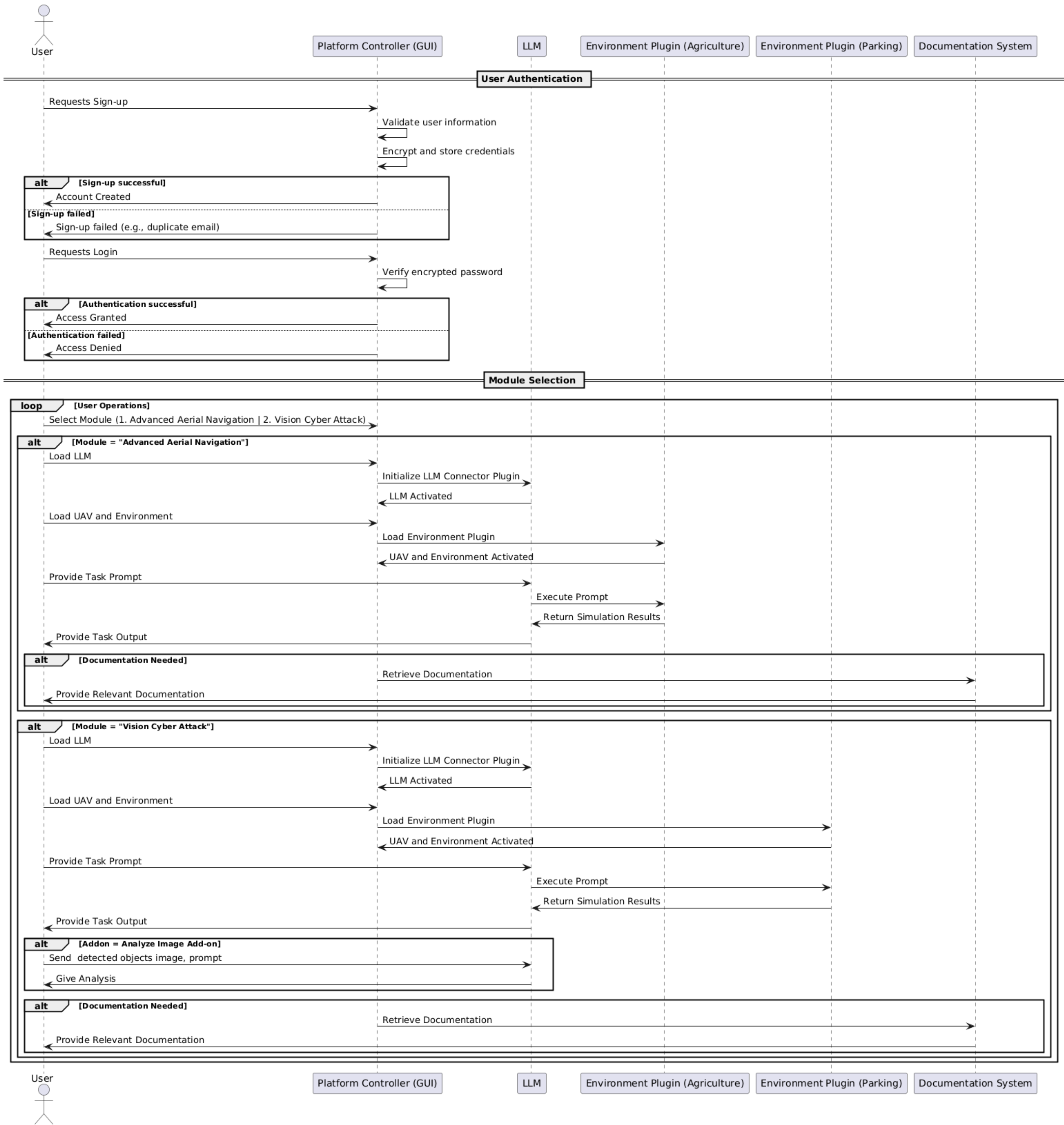
Future Works:

- Optimization of LLM Communication:** Investigate and implement methods to optimize the tokens sent to the LLM, reducing communication overhead and improving real-time performance.
- LLM Fine-tuning for UAV Tasks:** Explore fine-tuning LLMs on UAV-specific datasets to improve their understanding of UAV operation promoting accuracy, reliability, and task performance in diverse UAV applications.

UAV-LLM Research Lab Platform

Karthisri Meghana Guntupalli Ashok Vardhan Raja, Ph.D.

System Sequence Diagram:



Survey Questions:

Questions for All Participants:

1. The LLM-UAV Lab Platform can be **easily set up** on your computer.
2. The process of **defining prompts and executing UAV tasks** is straightforward.
3. The platform is more **efficient** and **cost-effective** compared to traditional UAV control methods.
4. The LLM-based system **reduces the complexity** of UAV task execution.
5. Using the platform helps me **save time** on software/hardware configurations for UAV operations.
6. I was able to complete the lab tasks in **under 50 minutes**.
7. The **difficulty** level of the lab tasks is **well-balanced**.

Questions for Students Only:

8. I am interested in conducting **more lab experiments** using this platform.
9. I would like to use **LLM-driven UAV operations** for research or future projects.
10. I have a **better understanding** of AI-driven UAV decision-making after completing the lab.
11. I am satisfied with the cyber attack **knowledge, gained** from this cyber security plugin.
12. The agricultural plugin taught me **new skills** related to **advanced navigation and UAV control**.
13. I understand the working between the **prompts** and the UAV is implementing tasks in the environment.
14. The **documentation** provided helped me understand the tasks better

Questions for Instructors and Professionals Only:

15. The **customizable prompt-based design** makes it easy to modify or create new lab tasks.
16. I was able to **define and execute my own UAV task prompts** using the platform.
17. I want to **contribute to new lab tasks or modules** to enhance the platform.
18. I recommend adopting this platform for **teaching or professional training** in UAVs and AI.
19. **Navigating** between plugins and **demonstrating the multiple tasks is convenient** in a lab setting