Preliminary Implementation Study Plan

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Group 32

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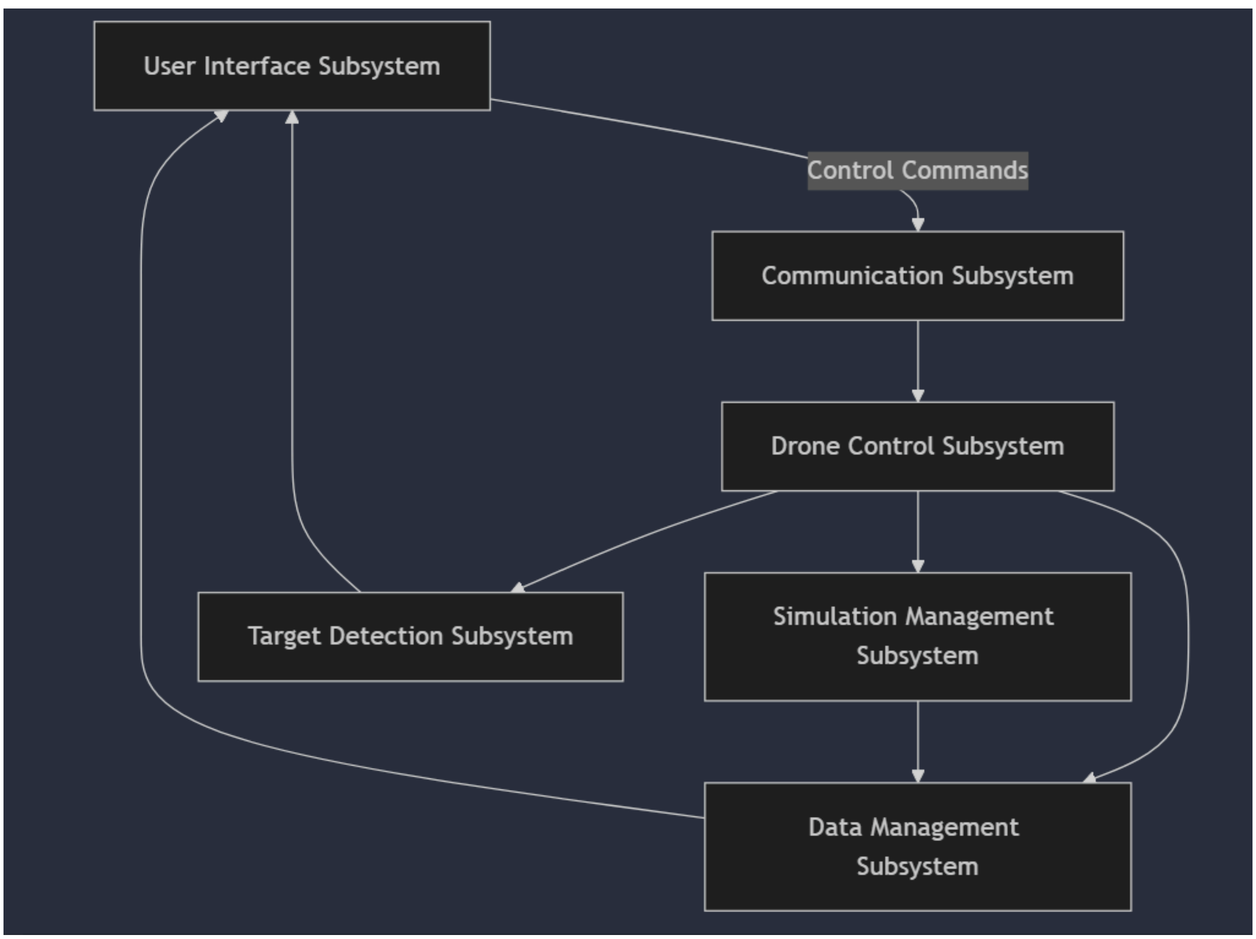
Overview of the Main Project Solution:

The Multiple Drones Coordination System is designed to enable seamless operation and coordination of multiple Unmanned Aerial Vehicles (UAVs) within a realistic 3D simulation environment. The system supports critical functionalities such as target detection, real-time monitoring, and coordinated rescue operations in various disaster scenarios, including natural disasters, power outages, and severe weather events. By integrating advanced control algorithms, robust data management, and an intuitive user interface, the MDCS serves as a comprehensive platform for testing and validating multi-drone collaboration, collision avoidance, and task management under diverse environmental conditions. This project aims to enhance disaster management and relief efforts through efficient drone coordination and real-time decision-making.

Block Diagram:



Team Member Responsibilities:

Team Member	Implementation	Description
Brenden Martins	Simulation Management Subsystem	Responsible for creating and maintaining the 3D simulation environment. This includes modeling realistic terrain, weather conditions, and obstacles to provide a comprehensive testing ground for drone coordination and target detection algorithms. This subsystem ensures that various disaster scenarios can be accurately simulated for effective testing and validation.
Tarek Kayali	Drone Control Subsystem	Manages the navigation, stability, and coordination of each drone within the simulation. Implements advanced control algorithms for smooth movement, collision avoidance, and dynamic task assignment, ensuring drones can autonomously perform missions while maintaining real-time communication with other drones and the central system.
Matthew Paternoster	User Interface Subsystem	Designs and implements a real-time interface accessible via mobile devices. This interface allows operators to monitor drone operations, view real-time data, and issue control commands remotely. It displays critical information such as drone status, target locations, and mission progress, facilitating effective mission planning and execution.
Tutku Gizem Guder	Target Detection Subsystem	Develops algorithms to process data from sensors such as cameras, LIDAR, and GPS for identifying and locating target objectives on the ground.

		Utilizes machine learning models to enhance detection accuracy under varying environmental conditions and provides real-time detection data to the User Interface Subsystem for informed decision-making during rescue operations.
Matthew Wyatt	Data Management & Communication Subsystems	Handles the storage, processing, and retrieval of real-time data generated by multiple drones. Ensures secure and efficient data handling, supports analysis and reporting, and maintains data integrity throughout the data lifecycle. Communication: Facilitates reliable and secure data exchange between drones and the User Interface Subsystem. Implements communication protocols for real-time synchronization of drone actions and user commands, monitors communication quality, and manages network connectivity to handle signal disruptions effectively.

Target Detection Subsystem
The Target Detection Subsystem is a critical component of the multi-drone coordination system for addressing challenges presented in disaster scenarios such as hurricanes and power outages. This system will enable drones to rapidly locate and identify individuals or hazards within a realistic 3D simulated environment using Microsoft AirSim. The enhanced detection capability from this subsystem would improve the effectiveness of disaster response, including rescuing, scientific research, and future real-world applications.

A huge deal of progress has been made for establishing the Target Detection Subsystem. The first phase is completed, which involves installation and configuration of Microsoft AirSim for the purpose of creating a solid environment for simulation to mimic a disaster scenario. In addition, an enormous amount of research regarding the different models and algorithms was conducted; based on that, YOLOv5 was chosen for object detection due to its real-time performance and high accuracy. YOLOv5 is very good at handling various scales of objects, making it suitable for the identification of human victims and hazardous elements in complex environments. Besides, tracking algorithms such as SORT have been selected to monitor detected objects across frames, enhancing target localization during dynamic rescue operations.
The simulation currently focuses on the detection process, integrating YOLOv5 with AirSim to process sensor data like camera feeds and validate initial outputs in simpler disaster scenarios. Further implementation will involve fine-tuning of the model by hyperparameter adjustment and transfer learning of the model on disaster-specific datasets to enhance the precision of detection. It will then be followed by the addition of more complex scenarios, like occlusions, low-light conditions, and diversity in terrains, in this simulation in order to check on the robustness of the system. Finally, comprehensive testing will be carried out on the accuracy, speed, and reliability to ensure the subsystem is prepared for real-world applications.
Time Table for the Subsystem

Task ID	**Task Name**	**Process**
1	Install and Configure Microsoft AirSim	Done
2	Research Models and Algorithms	Done
3	Simulate the Process	Doing
4	Fine tune the model	To do
5	Add complex scenarios	To do
6	Testing	To do