Team Report

Team Number: 32
Project Title: Multi-Drone Coordination System
Report Date: 01.14.2025

Part One: Progress Status as a Team

Are all team members' tasks detailed in Teams Planner?
yes

1. Have you met as a team this past week?

Answer:

NO

2. Have you met with the sponsor as a team?

Answer:

No

3. Tasks Completed the Past Week and Challenges Faced

A presentation was made during the lesson.

1. **Simulated 3D Environment Creation:**
    - Developed a virtual disaster scenario using **AirSim** to simulate drone behavior, including navigation paths, obstacle avoidance, and target detection. This environment helps test and validate the drones' response without the need for real-world testing.
2. **MySQL Database Setup:**
    - Established a **database system** to store critical information, such as drone locations, detected targets, and mission logs. This enables efficient storage and retrieval of real-time data for further processing and analysis.

Challenges Faced:

1. **Integration Issues:**
    - Encountered difficulties in integrating the API with the database and UI, particularly in ensuring **real-time data flow** between subsystems. Debugging and troubleshooting these issues took additional time.

2. **Sensor Data Processing Accuracy:**

- The initial version of the **target detection model** faced challenges with **accuracy**, such as false positives and negatives during testing. This highlighted the need for **further refinement** of the machine learning model.

3. **Simulation Complexity:**
    - Developing a realistic disaster scenario in **AirSim** proved to be more complex than expected. Efforts were needed to fine-tune the simulation environment to accurately replicate diverse disaster situations.
4. **UI Design Challenges:**
    - Ensuring that the **React-based UI** provided **real-time updates** without delays required additional optimization work. Performance issues arose when handling **large data streams**, which required further improvements.

4. Tasks to be Completed in the Coming Week

1. **Refining the Target Detection Subsystem:**
    - Further refine the **machine learning model** used for real-time target detection to improve **accuracy** and **processing speed**.
    - Optimize the model to reduce **false positives** and **false negatives** in the simulated environment.
2. **Expanding Simulation Scenarios in AirSim:**
    - Create additional **disaster scenarios** in **AirSim**, such as earthquakes, floods, and wildfires, to cover a wider range of real-world situations.
    - Test the drones' adaptability to different environmental conditions and improve their navigation and detection capabilities.
3. **Integrating Machine Learning Models into the Simulation Environment:**
    - Embed the refined **machine learning model** into the **AirSim simulation** to ensure it can process **sensor data** from drones in real time.
    - Achieve seamless integration between the **target detection system** and the simulation to validate its performance.
4. **Preparing for Field Testing:**
    - Begin **planning real-world testing scenarios** for the Multi-Drone Coordination System.
    - Identify **test locations**, prepare **safety protocols**, and ensure the system is ready for **live demonstrations** in controlled environments.
5. **UI Optimization and Data Visualization Enhancements:**
    - Work on improving the **React-based user interface (UI)** to enhance **real-time data visualization**.

- Add **filtering options** for detected targets and **alerts** for high-priority hazards.
- Optimize the **UI performance** to handle **large data streams** efficiently without lag or delays.

Detailed Individual Report on Multi-Drone Coordination System Development

Project Title: Multi-Drone Coordination System

Report Date: 01.14.2025

Team Member: Tutku Gizem Guder

Executive Summary:

The Multi-Drone Coordination System aims to revolutionize disaster response by leveraging the power of autonomous drones equipped with advanced target detection capabilities. The system is designed to enhance the efficiency of search and rescue missions in disaster scenarios by minimizing human risk and reducing response times. This report outlines the key components of the system, the progress made so far, the challenges faced, and the next steps planned for further development.

1. System Overview:

One of the key components of the Multi-Drone Coordination System is the **Target Detection Subsystem**, which plays a critical role in identifying victims and hazardous areas in disaster zones. The subsystem relies on real-time sensor data from drones, which is processed using a machine learning model to detect specific targets efficiently and accurately.

The system consists of the following core components:

- **3D Simulation Environment**
- **MySQL Database**
- **API using ExpressJS**
- **React-based User Interface (UI)**
- **Target Detection Subsystem**

Each component has been integrated to create a cohesive system that ensures seamless communication and coordination between drones and human operators.

2. Completed Tasks:

Tasks Completed the Past Week:

A presentation was made during the lesson.

1. **Created a Simulated 3D Environment**
    - Developed a virtual disaster scenario using AirSim to simulate drone behavior and navigation paths.
    - **Completion Date:** 01.14.2025

2. **Set Up MySQL Database**
    - Created a database to store critical information such as drone locations, detected targets, and mission logs.
    - **Completion Date:** 01.14.2025

3. Current Tasks:

Ongoing and Planned Tasks (next week)

1. **Refining the Target Detection Subsystem**
    - Improving the accuracy and speed of the machine learning model for real-time data processing.
2. **Expanding Simulation Scenarios**
    - Adding more disaster scenarios in AirSim to cover a wider range of potential situations.
3. **Integrating Machine Learning Models**
    - Embedding machine learning models into the simulation environment for better target identification.
4. **Preparing for Field Testing**
    - Planning real-world tests to validate the system's performance in actual disaster scenarios.

4. Implementation Details:

Multi-Drone Coordination System

The system integrates various components to create a robust solution for search and rescue missions.

1. **3D Simulation Environment**
    - The simulation environment in AirSim provides a virtual testing ground for drone behavior, reducing the need for costly and time-consuming field tests.
2. **Database and API Integration**
    - The MySQL database stores real-time drone data, while the ExpressJS API ensures efficient communication between subsystems.
3. **User Interface Development**
    - The React-based UI offers a dashboard for operators to track drone missions, view detected targets, and receive updates on hazardous areas.
4. **Target Detection Subsystem**
    - The machine learning model processes real-time sensor data to detect survivors, obstacles, and danger zones, prioritizing rescue efforts.

5. Testing and Results:

Testing in Simulated Environments

The system is being tested in various simulated disaster scenarios to validate its functionality and improve its accuracy.

- **Testing Focus:**
    - Drone navigation paths
    - Data logging in the database
    - Real-time UI updates
    - Target detection accuracy

Results Achieved So Far:

- Successful integration of all core components
- Promising results in real-time data processing
- Accurate identification of targets in simulated disaster scenarios

6. Problem Statement:

In disaster situations, first responders often face challenges in locating victims and assessing dangerous areas. Traditional methods can be time-consuming, inefficient, and risky for rescue teams. The need for a faster, safer, and more efficient solution is evident in disaster response efforts worldwide.

Proposed Solution:

The Multi-Drone Coordination System aims to address these challenges by deploying autonomous drones in disaster zones. These drones are capable of identifying victims, assessing hazardous areas, and providing real-time data to rescue teams, minimizing human risk and improving response times.

7. Key Accomplishments:

- Created a simulated 3D environment for testing drone behavior.
- Set up a MySQL database and API for real-time data communication.
- Developed a React-based UI for operators to interact with drone data.
- Integrated the initial version of the Target Detection Subsystem.

8. Next Steps:

1. **Refining the Machine Learning Model**
    - Focus on improving the model's accuracy and reducing processing times.

2. **Expanding Simulation Scenarios**
    - Include a broader range of disaster scenarios in AirSim to test the system's adaptability.
3. **Field Testing Preparation**
    - Plan and execute real-world tests to validate the system's performance in actual disaster scenarios.
4. **System Optimization**
    - Work on optimizing the system's components for better performance and efficiency.

9. Conclusion:

The Multi-Drone Coordination System has shown promising progress so far, with successful integration of core components and positive test results. The ongoing development of the Target Detection Subsystem and upcoming field tests will be crucial in ensuring the system's effectiveness in real-world disaster scenarios. With continued efforts, this system can significantly enhance search and rescue missions, saving lives and reducing risks for first responders.