

# DRONE SWARM REPORT

TEB1113 – Algorithm and Data Structure  
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**Submitted by**

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## Introduction

This project involves developing and simulating a drone swarm in Unity using C#. The goal is to create algorithms that allow multiple drones to coordinate movements, avoid obstacles, and achieve specific tasks like pathfinding. The project explores the performance of different algorithms when controlling drone swarms of varying sizes.

## Objectives

- i) Implement basic and advanced algorithms for drone swarm coordination and obstacle avoidance.
- ii) Apply algorithms for arrays, searching, sorting, and data structures like stacks, queues, and hash maps to manage drone positions and behaviors.
- iii) Evaluate the runtime performance of these algorithms based on the size of the swarm and environmental complexity.

## How Drone Swarms Work:

Drone swarms use **swarm intelligence**, where each drone follows simple rules based on nearby drones' behavior. Without central control, drones coordinate by sharing information to complete tasks efficiently.

## Algorithms Behind Drone Swarms:

1. **Boids Algorithm:** Simulates flocking behavior with :
  - **Separation:** Drones try to avoid bumping into each other.
  - **Alignment:** Drones adjust their direction to match nearby drones.
  - **Cohesion:** Drones move toward the center of the group.

2. **Particle Swarm Optimization (PSO):** This algorithm treats each drone like a particle looking for the best solution to a problem (such as finding a target). The drones move based on both their own experience and the experiences of other drones.
3. **Ant Colony Optimization (ACO):** Drones mimic ants' food-seeking behavior by leaving digital markers for fellow drones to track. This assists them in locating the optimal routes within a region.

### **Challenges:**

Even though drone swarms are promising, there are still challenges that need to be solved:

**Collision Avoidance:** Difficult to manage as swarm size increases.

**Battery Life:** Efficient task management is crucial for energy conservation

### **Conclusion**

Drone swarms offer exciting opportunities in many fields by using swarm intelligence to work together without centralized control. The algorithms behind these swarms help them achieve complex tasks, but there are still challenges related to collision avoidance, communication, and energy efficiency. With continued research, drone swarms could have a significant impact on industries like agriculture, security, and environmental protection.