HASAN KALYONCU UNIVERSITY
Electrical-Electronics Engineering Department
EE 499 Project Proposal Form

Part I. Project Proposer

Name Last name		**E-mail**	
		Date	

Part II. Project Information

Title of the Project	Autonomous Drone Swarm Navigation Using Reinforcement Learning				
Maximum Cost of implementation (TL)	1500 - 2000 TL	**Conceptual Design Dead Line**	**in 7 weeks**	**Prototype Production Deadline**	**in 10 weeks**
Standards and licenses to be used in the project. example; IP65, IEEE, APACHE, MIT, etc.	IEEE 2030.5 (Smart Energy), ISO 50001 (Energy Management)				

Project Description

This project aims to design and implement a swarm of autonomous drones that can collaboratively navigate complex and dynamic environments using advanced reinforcement learning (RL) techniques. Unlike conventional single-drone systems, this project emphasizes collective intelligence, where multiple drones operate in a coordinated manner to achieve common objectives. The swarm will be trained to perform tasks such as **environmental monitoring, disaster assessment, precision agriculture, and search-and-rescue operations**, where rapid coverage of large areas and adaptability to unforeseen conditions are essential.
To achieve this, the project will focus on:

1. **Simulation Environment Development:** Creating a realistic 3D simulation framework (e.g., ROS + Gazebo or Unity ML-Agents) to model multi-drone dynamics, communication constraints, and environmental hazards.
2. **Reinforcement Learning Algorithms:** Implementing state-of-the-art RL algorithms (e.g., Deep Q-Networks, Policy Gradient, and Multi-Agent Reinforcement Learning) for decision-making under uncertainty, enabling drones to learn cooperative strategies such as formation control, obstacle avoidance, and resource allocation.
3. **Communication and Coordination:** Establishing efficient protocols for inter-drone communication to share positional data, sensor readings, and learned policies, ensuring real-time synchronization without central dependency.
4. **Prototype Deployment:** Testing the trained swarm algorithms on small-scale physical drones (e.g., DJI Tello, Parrot) equipped with onboard sensors, to validate performance in real-world conditions.

This project aims not only to demonstrate **autonomous swarm navigation** but also to contribute to the growing field of **multi-agent AI systems**, offering scalable, resilient, and applicable solutions in real-world scenarios that require autonomous cooperation.

Project Justification

Novelty	
New aspects	**End-to-End Learning: Integrates image feature extraction and sentence generation in a single model.**
Complexity	
Challenging problem and issues	
Related electrical-electronics science fields and subfields	This project combines mechatronics, AI, and robotics in a novel application with strong research and industrial value.
Tools	Python, OpenAI Gym, ROS, Gazebo, DJI Tello/Parrot drones
Risk involved	
Potential problems and alternative solutions	
Minimum work required	10 weeks, 2 developers