A.C.E. - Autonomous Charging Environment

An Autonomous Power Solution for High-Risk Missions

Problem

As the deployment of autonomous tools in high-risk missions increases, so does the demand for a higher degree of autonomy on them.

The manual method of charging a drone or rover normally requires interrupting missions and mandatory human intervention.

An autonomous charging environment would manage each of the drone's necessities automatically.

Target Audience

Firefighters Police Navy

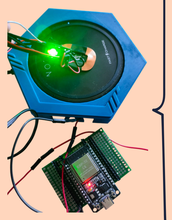
Competitors

Skydio NOKIA PERCEPTO

Solution

Drone (StampFly) a programmable open-source quadcopter kit

ESP32 for data processing and actuation



Induction Charger to charge the drone wirelessly

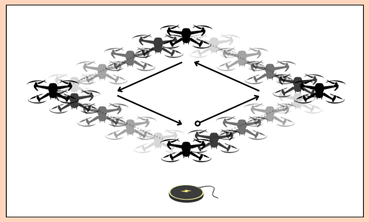
Induction USB-C Adapter

A self-managing autonomous environment composed of actors (drones) and support devices (stations).

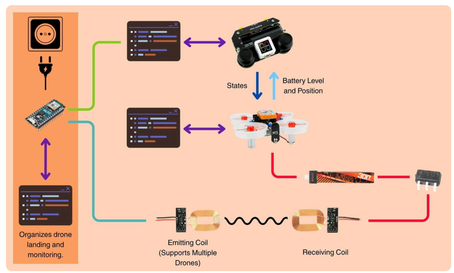
The environment changes over time with:

- Updated information;
- New devices in the envt.;
- New orders from higher-ups;

Path used for testing



Architecture



Drone

- **Power Source:** LiHV battery
- **Telemetry & Control:** Transmits real-time position and battery status to the controller while receiving mission commands.
- **Charging Module:** Equipped with a TP4067 charging IC and a wireless receiving coil.

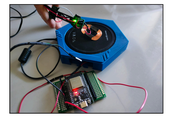
Charging Station

- **Hardware:** Features an emitting coil, a USB-C power adapter, and an ESP32 microcontroller.
- **Management:** Has an ESP32 that hosts the core software responsible for autonomous drone landing coordination and system monitoring.

Results

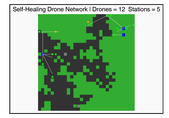
Drone with charging module

Charging Station



Drone flying autonomously

Simulation



- **Autonomous Flight Optimization:** Modified the code to achieve a stable, fully autonomous mission execution.
- **Hardware:** Designed and integrated a charging module to solve power concurrency issues between the charging circuit and the operational workload.
- **Networked Charging Infrastructure:** Developed an induction charging station capable of wireless power transfer and interaction with the central network.
- **Scalability Simulation:** Developed a multi-agent simulation to validate the environment's framework and demonstrate system scalability across larger drone fleets and multiple stations.

Conclusion

The A.C.E. project successfully demonstrates a fully autonomous, reliable power solution tailored for high-risk missions.

By designing and building custom onboard hardware to isolate concurrent charging states and optimizing the flight controller code, human intervention need was eliminated from the operational loop.

Furthermore, the integration of a multi-agent simulation validated the environment's scalability, proving that this architecture can efficiently manage expanding, multi-drone fleets in real-world scenarios.

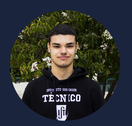
TÉCNICO LISBOA


Rodrigo Oliveira


Sara Viegas


Lena Wang


Francisco Gonçalves


Ricardo Maurício


Pedro Nantes

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