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Pilot testing of autonomous UAV and UGV conductive charging system aimed at vineyard monitoring

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www.agrosys-project.gr

INTRODUCTION

- The current process of charging electric unmanned aerial and ground vehicles (UAVs and UGVs) for in-field monitoring or other tasks is **time-consuming** and **lacks automation**.
- Typically, the **battery must be manually removed** from the vehicle, charged separately and then reinstalled, leading to:
  - **Reduced operational efficiency**
  - **Requires human intervention**
- An alternative solution is the use of wireless charging solutions such as **inductive charging systems** that can be easily modified to require no human intervention, but it leads to:
  - Longer charging times

SOLUTION

To address these limitations an automated conductive charging system for UAVs and UGVs was designed as part of an autonomous collaborative robotic system for precision viticulture where small-scale solar charging stations are scattered within a vineyard.

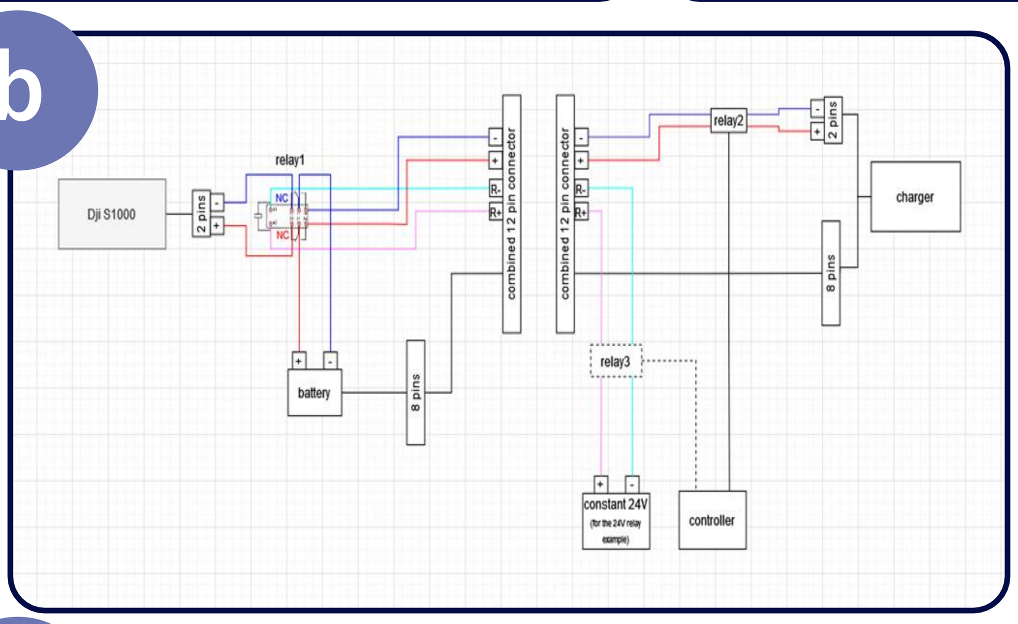
- The main charging components of the **charging station** are the battery charger, a robotic arm and an optical sensor (Figure a).
- The proposed system lightly intervenes in the **unmanned vehicles'** circuit by integrating on it a relay setup in the existing battery-vehicle interface (Figure b), keeping:
  - normal operation when carrying out tasks
  - the battery disconnected when charging
- The connection point of the two ends is a **universal plug** mounted along with the optical sensor on the robotic arm and on each of the vehicles.
- A **data matrix** is placed onto the vehicles next to the mounted plug (Figure c).
- One robotic arm is used per type of unmanned vehicle for compatibility reasons.

▶ The data matrix is being detected by the optical sensor and according to its position/orientation the robotic arm moves and aligns the plug in order for the charging sequence to be initiated.

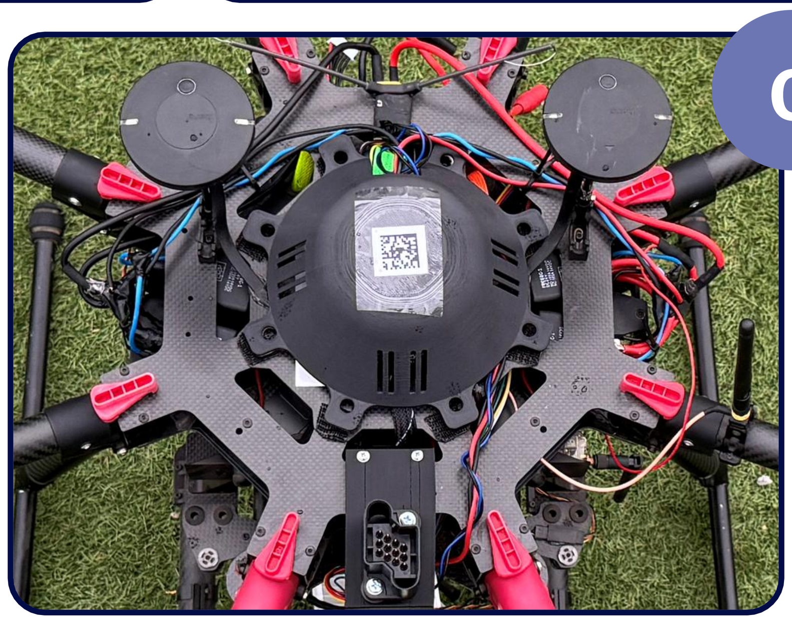
- The system works for one UAV and two UGVs (Figure d).

a

b



c



d

RESULTS & CONCLUSIONS

The tests proved that the system:

- Accurately pairs the chargers with the vehicles every time
- Successfully isolates the batteries
- Safely initiates/terminates the charging sequences
- Does not intervene with the normal operations of the vehicles

The automated system boosts overall productivity by:

- Minimizing the need for manual battery handling
- Speeding up operations
- Allowing for longer periods of crop monitoring within a given time frame

The work was carried out in the context of project AgroSYS, the main objective of which is the development of an autonomous collaborative robotic system for precision viticulture integrating electric UAVs and UGVs and small-scale solar charging stations (*www.agrosys-project.gr*).

This innovation marks a major step forward in electric vehicle charging technology for agriculture, enabling more efficient and scalable precision farming practices.

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