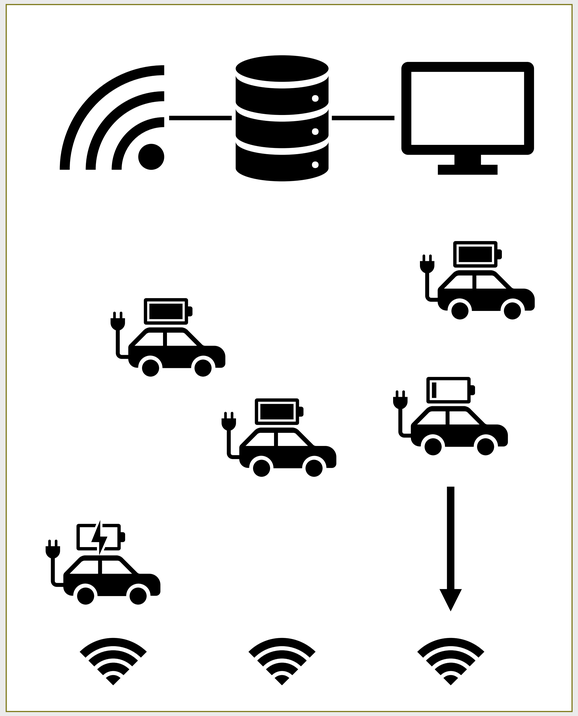
POWER MANAGEMENT FOR COLLECTIVE GROUND ROBOTS

Human Machine Teaming Lab Collective Robotics Testbed

OVERVIEW

- **Objective #1:** To implement a system which automatically monitors and manages battery power levels of unmanned ground vehicles, exposing system metrics through a flexible endpoint and scalable to general forms of swarm robotic data.
- **Objective #2:** To modify the design of a large volume of UGVs to utilize automatic Qi wireless charging, including repair efforts for existing wireless charging pads.
- **Work Context:** This project supports the ongoing research and development of Oregon State University's Human Machine Teaming Lab, which focuses heavily on research in the domain of collective swarm robotics. By implementing abstract infrastructure that supports conducting more complex experiments, we lay fundamental groundwork for future research and undergraduate learning experiences.
- **Domain Context:** Tasks readily able to be automated by robots are rapidly appearing, and some application domains including networking and search/rescue are especially conducive towards solutions with high volumes of autonomous agents. Dedicated research and prototyping of such technologies are essential towards the synthesis of best practices and mechanisms for implementing robotic solutions to these domains.



SOFTWARE ARCHITECTURE

The system exposes an optional **client-server architecture** connecting the robots and a central server. It efficiently and effectively collects and stores abstract robot data, communicating information back to individual robots in the testbed on demand.

In this application, robots exhaustive record their activities and battery sensor measurements to the server. Insights from this data are used to inform robots as to the optimal times to automatically recharge. The server also exposes a browser-based user interface which allows the human operator to monitor the status of the experiment in terms of metrics ordinarily invisible to the naked eye and unable to be determined without physically inspecting individual robots with measuring instruments or serial monitors.

HARDWARE ACHIEVEMENTS

- A new **sensor processing board** is added to the robots which allows for a variety of essential functionalities for advanced swarm research in the lab, such as local positioning systems and cameras. In addition to its plethora of generic communication ports and embedded temperature sensor, it exposes a microSD interface as an alternative to the client-server data collection interface.
- A modular Qi charger extension to the sensor processing board supports robots' efficient and automatic recharging.
- A new 3D-printed chassis was designed to accommodate these additions.
- Extensive repairs were performed on the testbed charging infrastructure.

RESULTS AND FUTURE WORK

- All systems are operational; scaling will commence in the upcoming summer to at least 100 UGVs.
- Server software will be handed off to continuing lab members, with short term plans involving local positioning system data.
- Sensor processing board will continue development with libraries supporting new sensors.
- Main unmanned ground vehicle libraries will be refactored to natively include the capstone methods for automatically recharging and communicating with the server.
- Charging infrastructure repair protocol will expand to the remaining several dozen damaged charging pads.

THE TEAM

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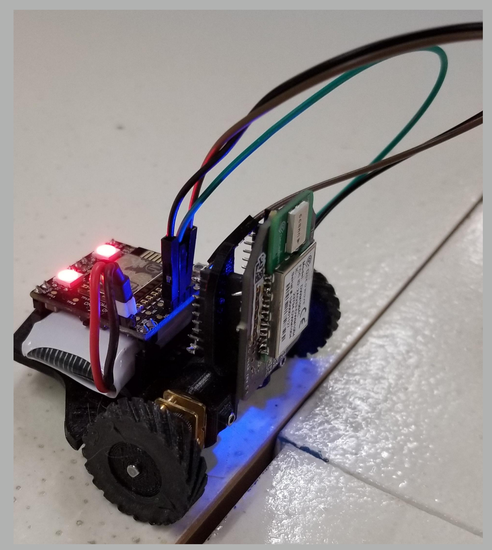

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