Project Title: **Decentralized Architecture for Loss-tolerant Robotics**

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EECS 149/249A Project Proposal, Fall 2021

Project Goal

This project will demonstrate a decentralized robot control architecture by which a user-controlled interface prescribes an objective to a semi-autonomous robotics network. This network is then able to arrange props collaboratively in arbitrary patterns safely without further guidance from the operator and is robust to losses within the network.

Project Approach

The project involves a demonstration of 2+ robots operating in collaboration within an isolated environment to arrange props in arbitrary patterns as assigned by an operator. At tasking-time, a solver will calculate a stream of paths for the robots to follow, and this path is then downloaded to all robots in the network. During execution-time, the operator is disconnected from the network, and the path-stream will be correlated with live sensor data on each robot to move toward the solution state. Furthermore, during this phase, state space measurements and path-stream progress will be communicated between all operating robots, enabling higher spatial certainty and decreasing chances of collision. To demonstrate loss-tolerance, all robots will receive redundant path-streams such that network members may be removed at any time and the same outcome will be achieved.

Resources

We plan to use the iClebo Kobuki robots as our primary robotics platform for this demonstration. On each robot will be the Nordic Semi SoC nRF52832 mated with the Berkeley Buckler daughterboard for additional sensor ICs. For the user interface, we will use Unity 2021.x+ which will enable operator interaction and solution state specification. Communication will be achieved using nRF52832's on-board Bluetooth functionality. Additional sensor hardware for spatial orientation and prop recognition includes the RPLiDAR A1M8-R6 360 Degree Laser Scanner by SLAMTEC. Finally, we will incorporate our own gripping actuator design utilizing the DSSERVO DS3218MG 20kg Metal Gear Steering Servo and a 3D printed grip mechanism.

Schedule

● Project Proposal	October 29
● Feasibility report for networking tech	November 5
● Prototype gripping actuator design and finalized driver	November 5
● Milestone 1 Delivery	November 7
● Communication protocols finalized	November 10
● Implementation of additional sensors and actuators on Kobuki	November 14
● Milestone 2 Delivery	November 14
● Milestone 2 Presentations	November 15, 17
● Path-stream solver and UI complete	November 30

- Firmware complete and functional integration of submodules December 10
- Project Poster/Demo Expo December 15
- Peer Evaluations & Project Report December 17

Risk and Feasibility

We anticipate that the most risk-prone aspects of the project will be the Bluetooth networking architecture for synchronizing odometry as well as path-stream intractability within the solver algorithm. During execution time, there exists risk for deadlock among mutually exclusive portions of the path-stream. We plan to demonstrate feasibility of networking architecture as well as necessary actuation mechanisms prior to the first milestone to minimize these risks.