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# Collaborative Collective Algorithms to Coordinate UGVs

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# Collaborative Collective Algorithms to Coordinate UGVs

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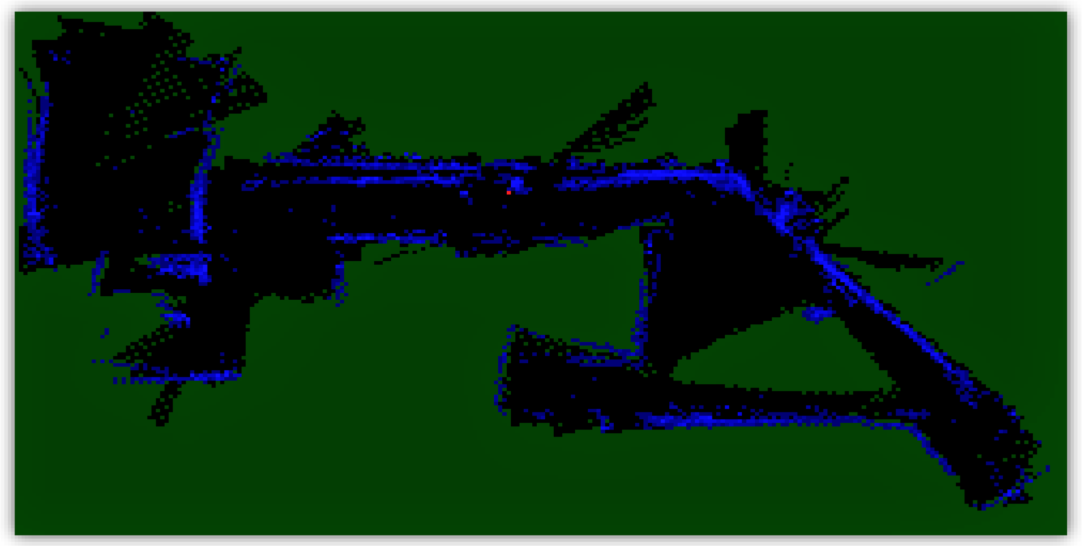
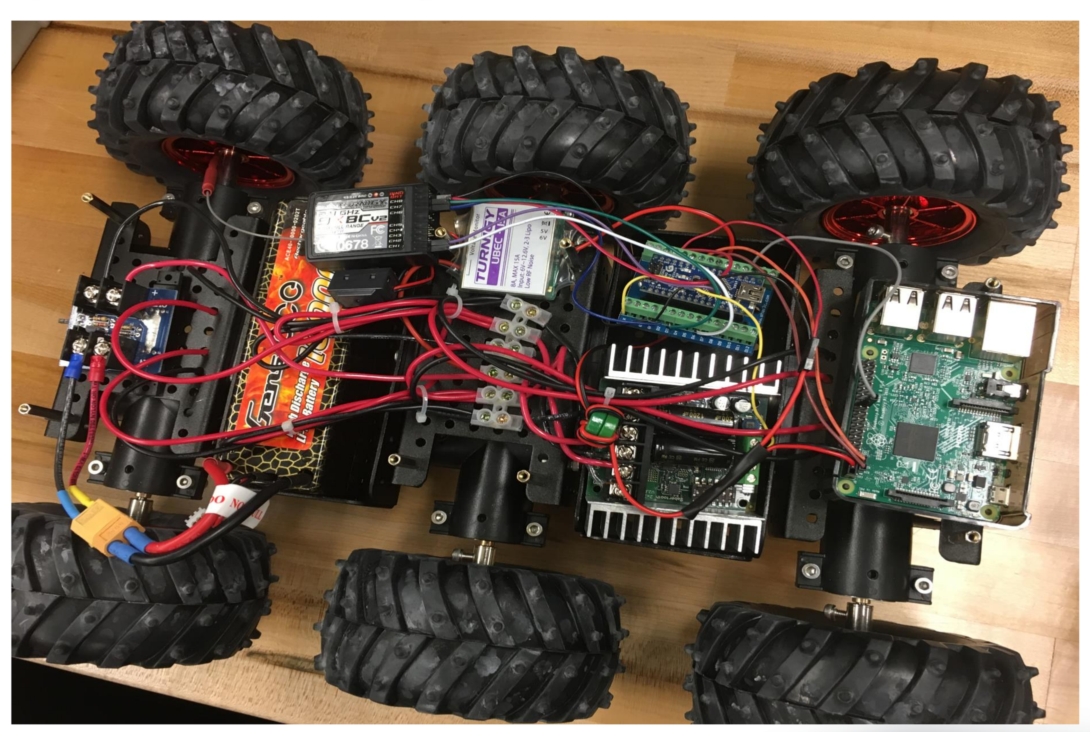
## Mission

Sentel / Brilliant Innovations designed and constructed an automated mapping UGV. This UGV explores an environment and generates a map of the layout using the infrared on a Yellowstone Tablet.



Brilliant Innovations asked us to take this concept and develop a map-stitching algorithm so that two or more UGVs could be used to efficiently explore and generate a map of an unknown location.

We were provided kits to construct two UGVs and the pre-existing code for individual drone map generation and navigation.



## Criteria

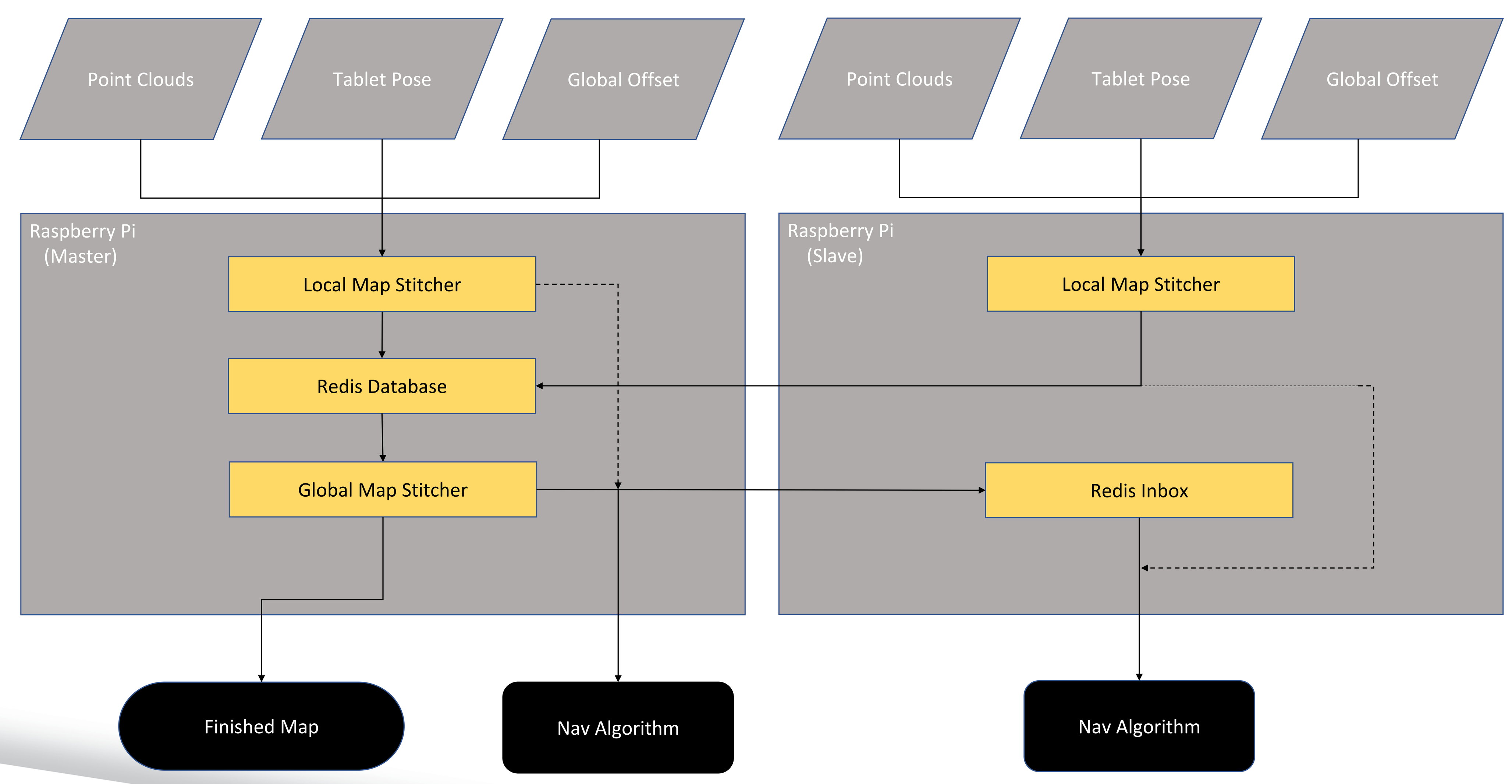
- The individual maps should be stitched together in a comprehensible way for the human user.
- The drones should exhibit a master/slave configuration in terms of map stitching.
- The drones should work together to efficiently explore and map a location based on the stitched global map.
- The drones should avoid each other's paths while exploring the area.
- The design should be easily expandable to work with more than the two drones provided and any other future improvements.

## Design

The rovers use a combination of a Google Tango tablet, a Raspberry Pi 3 Model B, an Arduino Nano, and a Sabertooth 2x25 Motor Driver to handle it's navigation, exploration, and mapping.

**Navigation**
The Raspberry Pi runs Sentel's obstacle avoidance and exploration code and sends a target to the Arduino Nano. The Nano takes this target and tells motor controller what to do.

**Mapping**
The Google Tango tablet uses its infrared camera to scan the room. It uses this data to create a point cloud that is sent to the Pi. The point clouds are then processed into local maps which are sent to a global Redis database. From there they are pulled out by a master drone and stitched together into a unified map. This map is used along with the rovers' positions to make exploration decisions.




## Background

- The Yellowstone Tablet is part of Google's Tango Project, which is an effort to use computer vision techniques to allow devices to detect their position in the world around them without external signals such as GPS.
- The tablet does this with the use of a built-in infrared camera. The camera captures reflected light to generate a field of dots, producing the point cloud data.
- The Raspberry Pi is a small single-board computer system that is often used for processing in small projects like this.
- The Arduino Nano is a compact microcontroller used for simple electronics prototyping. It runs the motor controls on our rovers.
- Redis is a database software that can store data in non-volatile memory. This means that the data will persist even if the device is turned off. The publish / subscribe functionality is used as a messaging system in our project.
- A point cloud is a list of 3D points that describe the features of a room. We use these to generate maps.
- Map stitching is the overlaying and re-aligning of data to combine two individual maps of the same space into a complete whole.
- The Sabertooth is a motor driver that helps us control the current flow to the motors.