Tellodrone

Pranav Sitaraman, Dhruv Sheth,
Jing Cao, Ali Saffarini

The Problem

Navigating unfamiliar environments is a very difficult task!

- Features uncertainty about the shape of new environments
- Demands efficient exploration, learning, and recollection techniques

One solution is multi-agent systems!

- Several independent intelligent entities can collaborate to act intelligently

Our Hypothesis

- We can localize the environment without an explicit mapping beforehand
- Map the environment + Localize together with swarm collaboration
- Machine Learning approach to reconstruct environment iteratively

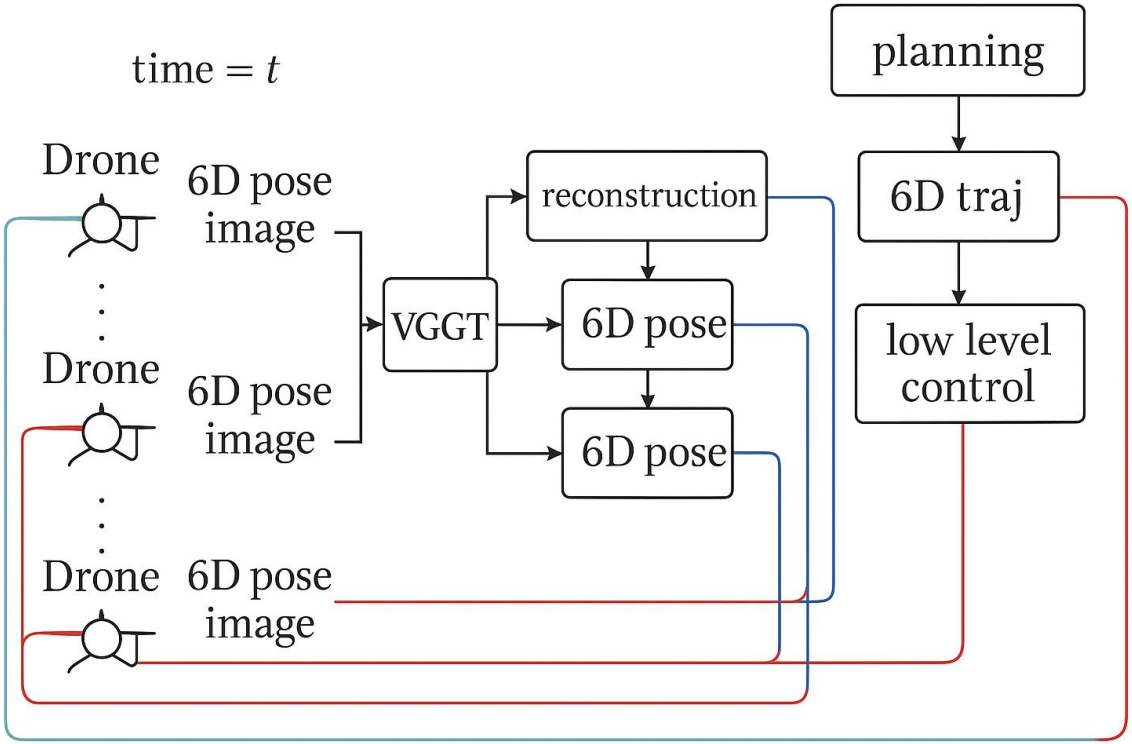
Our Goal

- Multi-drone coordination capable of exploring new environments
- Efficient localization system to enable cross-drone communication and positioning
- System to collaboratively explore and reconstruct an environment in 3D
- Figure out techniques to identify arbitrary start positions in GPS-denied environments

VGGT Algorithm

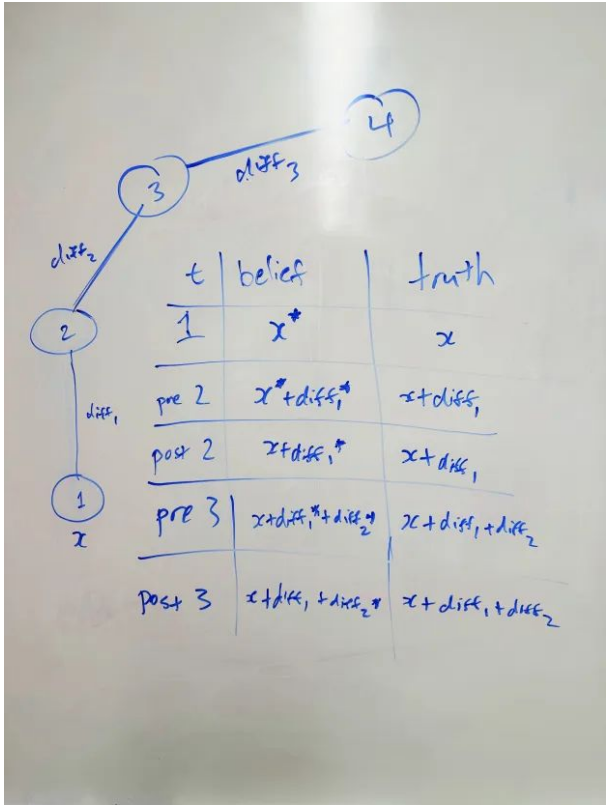
- Initializes drone at a start point relative to 3D point cloud environment constructed from camera feed
- Uses IMU and new camera feed to predict new drone pose
- Builds 3D point cloud of environment as drone moves
- Basic avoidance of walls, but would like to enhance obstacle avoidance capabilities in the future!

Our Framework

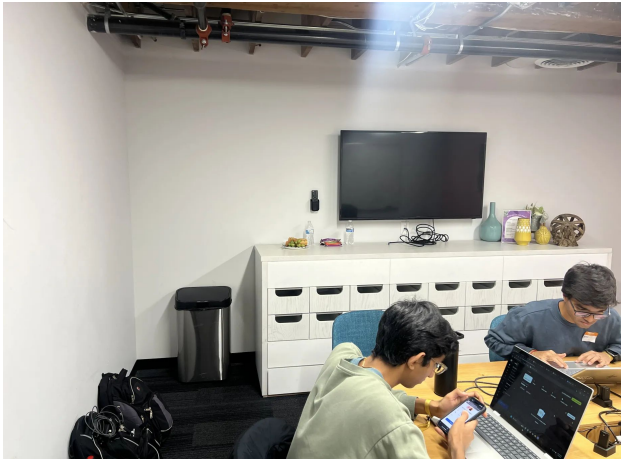


Planning Algorithm

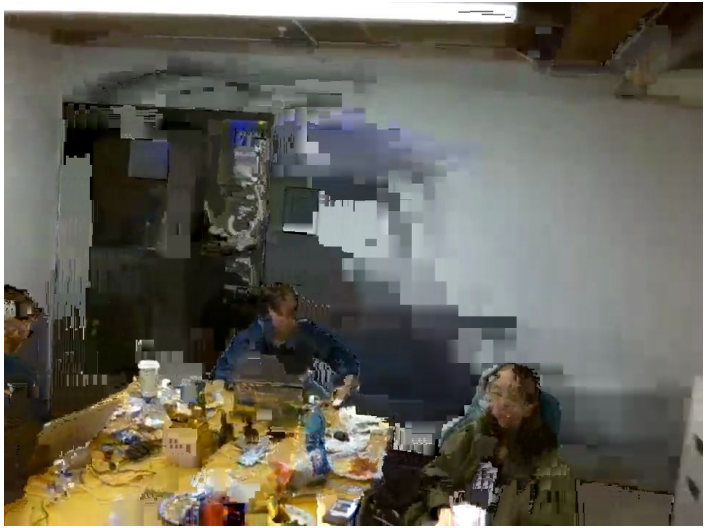
1. Splice together iterations of VGGT, with traditional planning in between
2. During planning, we update our location using the IMU, but this accrues error
3. Upon VGGT, we update our prior + re-orient believed position within new reconstruction



Images processed by VGGT



VGG19 with a Laplacian Filter

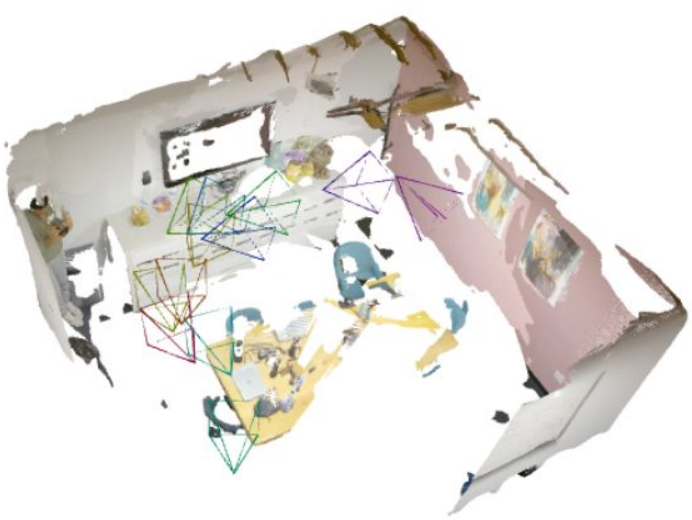


Blurry

Crisp(er)

VGGT: Constructing The Map over Time

VGGT Iteration 2



VGGT Iteration 3: Full Reconstruction

Video

Challenges

Hardware is hard! We spent a lot of time debugging the ability to control multiple drones from one source due to the ROS architecture we wished to develop.

- Ran into multiple IPS Address interference issues
- Multiple driver incompatibilities for Ubuntu system

We would like to actually build out the rest of the theoretical framework we developed in the future!

Future Plans

- Integrate individual components together
- Find the position of seeker drones relative to a base drone
- Robustifying backend server for lower latency
- Testing in outdoor settings
- Dynamic environments

Thank you!