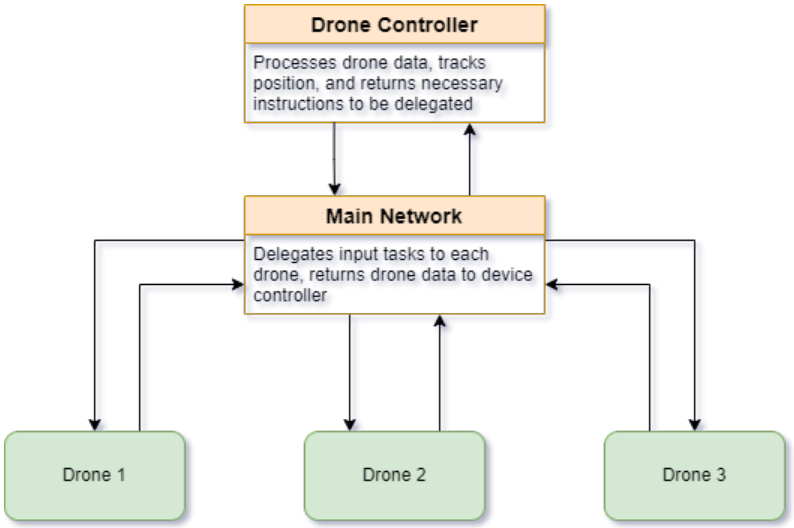
Drone Braiding: A Lightweight Approach to Space Manufacturing

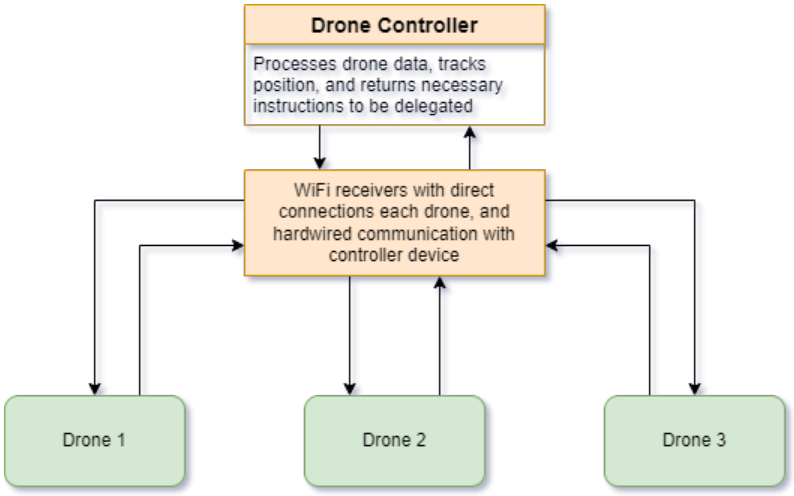
Project H96 Notebook

Connecting To Multiple Drones:

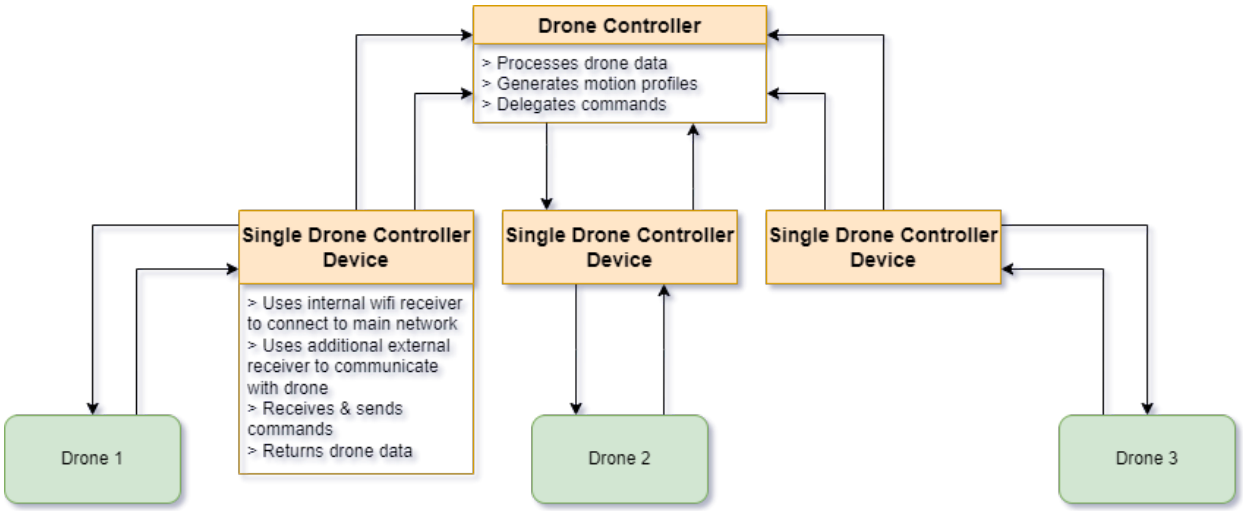


- Each Tello drone comes equipped with its own wifi network
- We had initially intended to reconfigure the software on each drone
    - However, attempts at reconfiguring the drones in this way failed, as the sdk prevented alteration of the device firmware

- Consequently, we decided to use multiple wifi communicators on a device to connect to each drone
    - This approach proved difficult as well, since each drone came packaged with the same unchangeable local ip address
    - Using different wifi interfaces provided by each communicator and attempting to create websockets to connect to them was not sufficient to overcome this identical ip issue



- Finally, we decided to instead use a multi-device system, each using two wifi receivers to communicate with the drone, as well as a unified server
    - By connecting each device to both the drone and a custom server, tasks could be delegated to each drone, and drone states could be tracked to ensure each drone was

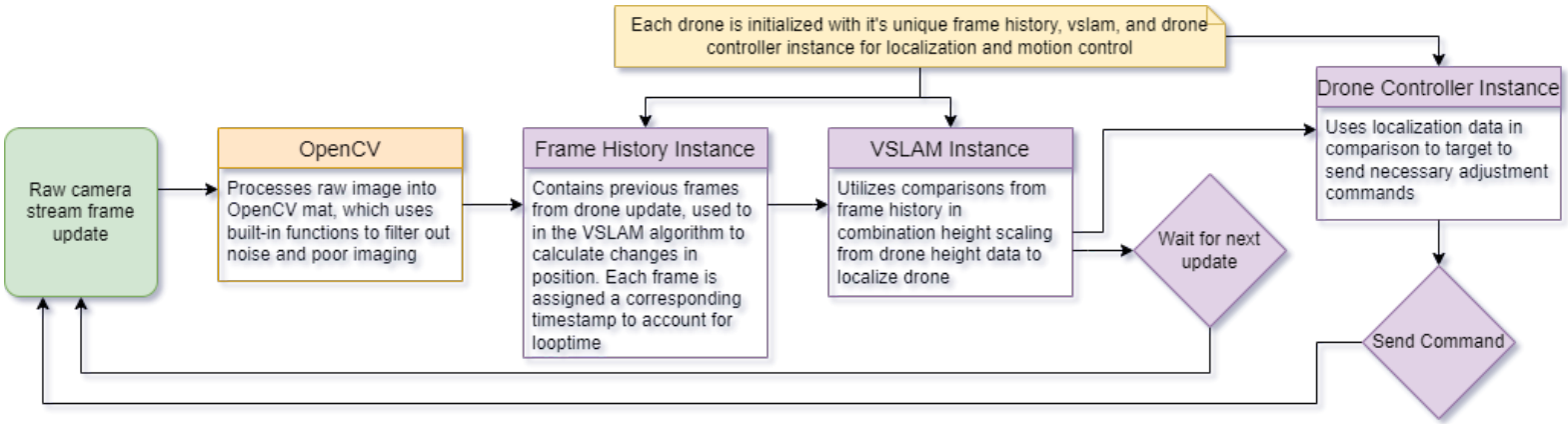


operating in synchronicity

Localization:

- The Tello drone contains two infrared sensors as well as a built-in downward facing camera
- Although the Tello sdk provides localization using these sensors, we decided to attempt to find more consistency with a custom localization method
    - Using an existing VSLAM library combined with OpenCV
        - OpenCV provides a platform for processing the image stream given by the drone
        - VSLAM stands for visual simultaneous localization and mapping, which is used to simultaneously localize the drone using landmarks mapped in previous frames

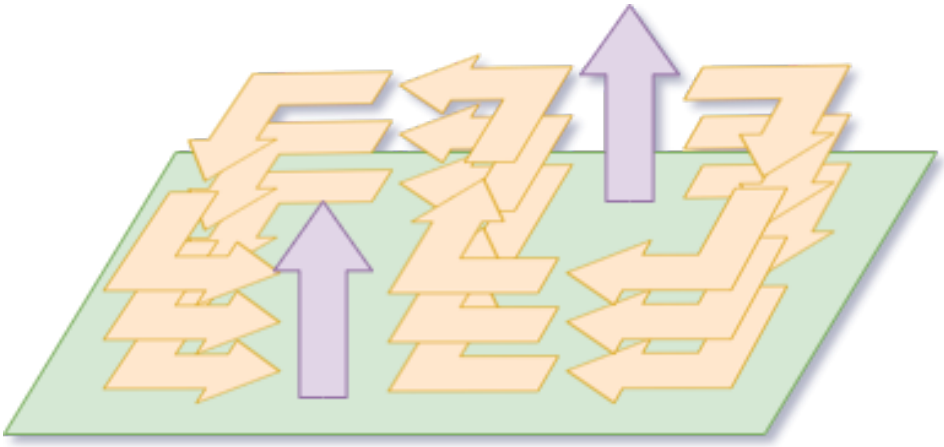
Motion Profiling:



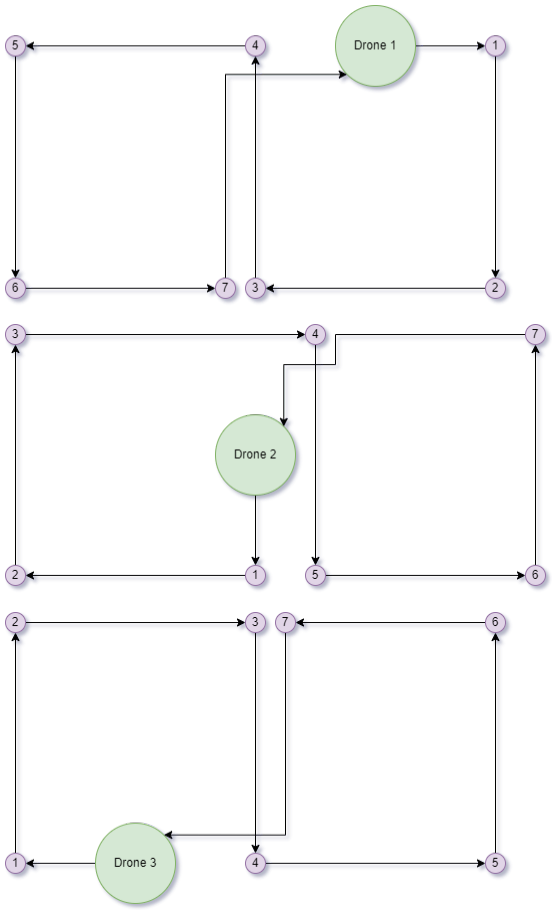
- The Tello sdk provides premade commands for moving to locations and holding position according to their localization method
- However, these methods would not be effective usage of our localization
- Consequently, we simply used motor output methods for finer control of the drone
    - These output methods are packaged using a custom controller, which converts a target motion vector into motor outputs
    - A PID loop takes current velocity (derived from localization) feedback and adjusts from error accordingly
- The motion vector's direction and magnitude is determined by a trapezoidal path algorithm, which is generated when the drone is given a target destination

Path Generation:

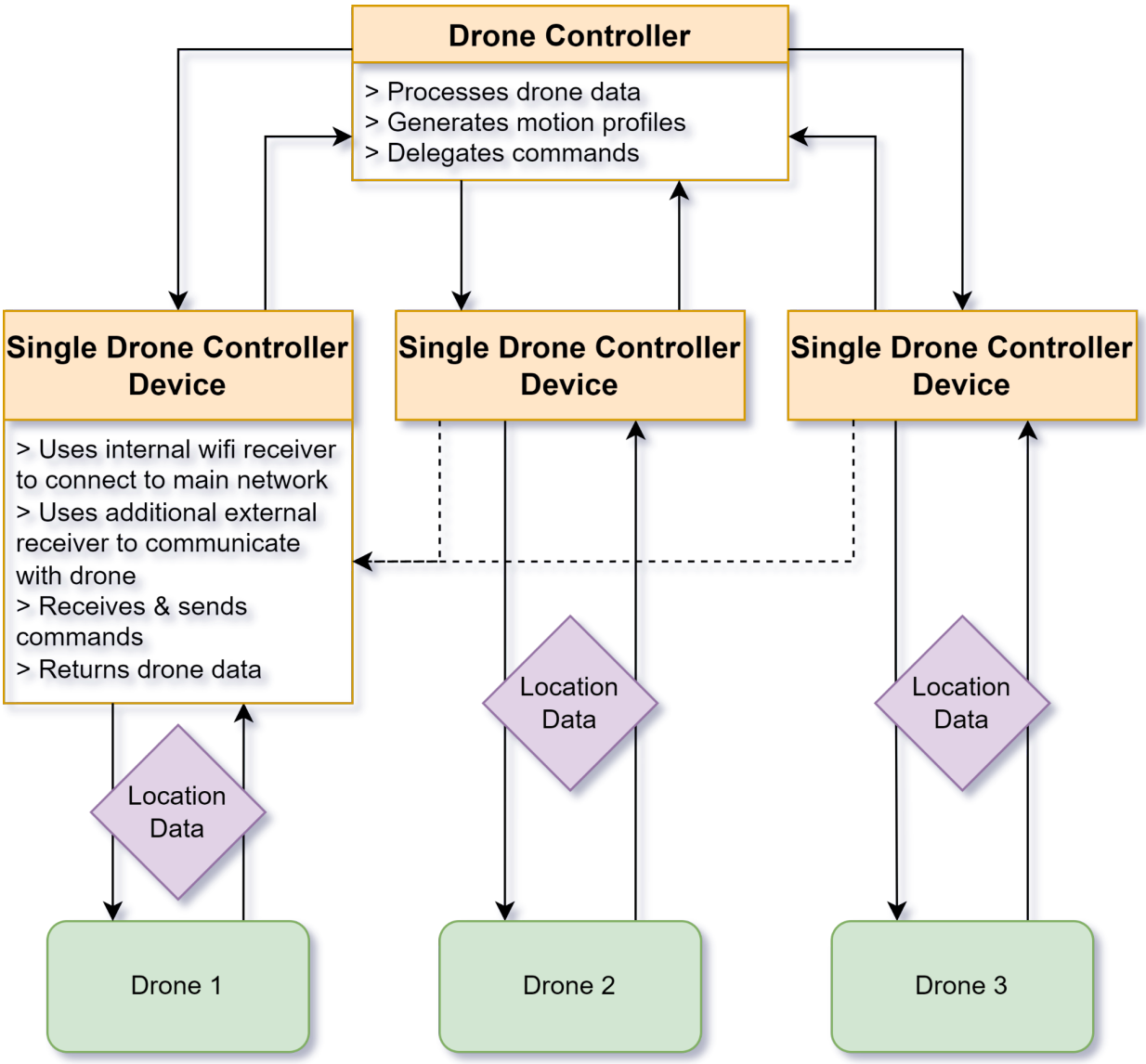
- Currently, each trajectory is a series of states
    - Each state represents the target position of each drone
    - Every drone is given their respective target position
    - Once each drone is within a certain tolerance level of their target position, the state progresses to the next
    - If the series of states complete, a new series is generated, at a higher target position



- When utilizing 3 drones to braid, each follows a figure 8 pattern, with two operating in the same direction, and the other in the opposite



Commanding Drones



Spool Attachment

Iteration #1

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TELLO