

Milestone 2

Refined Project Checklist

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I. ANNOTATED BLOCK DIAGRAM

The annotated block diagram of the Child drone is given in Figure 1 and the annotated block diagram of the Parent drone is given in Figure 2.

II. EXTERNAL BEHAVIORAL SPECIFICATION

Our project consists of two drones - a larger Parent drone and a smaller Child drone, hereinafter "Parent" and "Child". The Parent switches the battery of the Child while it is still flying. We listed the behavioral specifications of our project in the order that our demo is expected to go.

1. The Parent carries a spare battery that will replace the Child's battery. The Child carries two batteries - one battery is the Child's main source of power while the other is an auxiliary power source for keeping the Child powered during the battery switch.
2. The Parent will fly to a height of 10 ft. and stabilize its position using a combination of signals from the 9 Degree-of-Freedom IMU and the barometer.
3. The Parent has a GPS module, so it will send its location to our mobile app via Bluetooth. The mobile app will send the Parent's location to the Child via Wifi.
4. The Child will fly towards the Parent using its own GPS module. In addition, the Child will fly an additional 5 ft. above the received Parent's height.
5. The Child's OpenMV camera will search for an AprilTag that is printed and visible on the upper mount of the Parent's chassis. Once the Child locates the Parent and determines its orientation with respect to the Parent, it will align itself directly over the Parent and descend directly downwards.
6. Once the Child is close enough to the Parent, it will lower its rotors' speed and latch onto the Parent. The Parent has four poles on its top side, with two electromagnets located on a set of two poles that are diagonally opposite from each other. The Child has magnets on its underside that are aligned with the location of the electromagnets on the poles. Latching is complete when the two drones are held together by the magnets.
7. Once latching is complete, the Child's propellers will stop spinning and the Parent will carry the Child entirely. The Parent will re-stabilize itself after the entire latching process with the help of the DJI Naza-M V2 flight controller.
8. The Child's batteries are hooked up in parallel (for seamless battery switching while keeping the Child powered through the auxiliary battery). The boxes that contain the batteries are connected to the underside of the Child drone. The batteries can be moved by sliding them in one direction - if we slide a new battery into the compartment from one side, the old battery will slide out of the compartment on the other end, effectively completing a battery switch. The Parent has two horizontally-sliding rods that will change the batteries in this manner.
9. The "dead" battery will be secured to the Parent by attaching itself to the rod when it pushed out of the compartment. After the switch is complete, a servo latch to secure them in place, to prevent them from sliding out during flight.

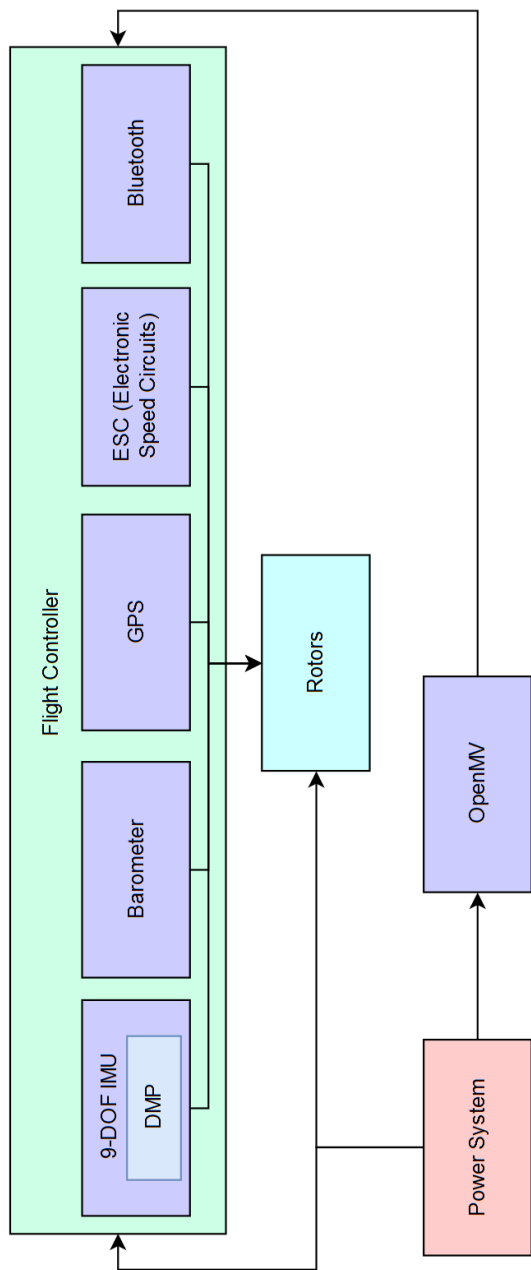


Figure 1: Block Diagram of Child Drone

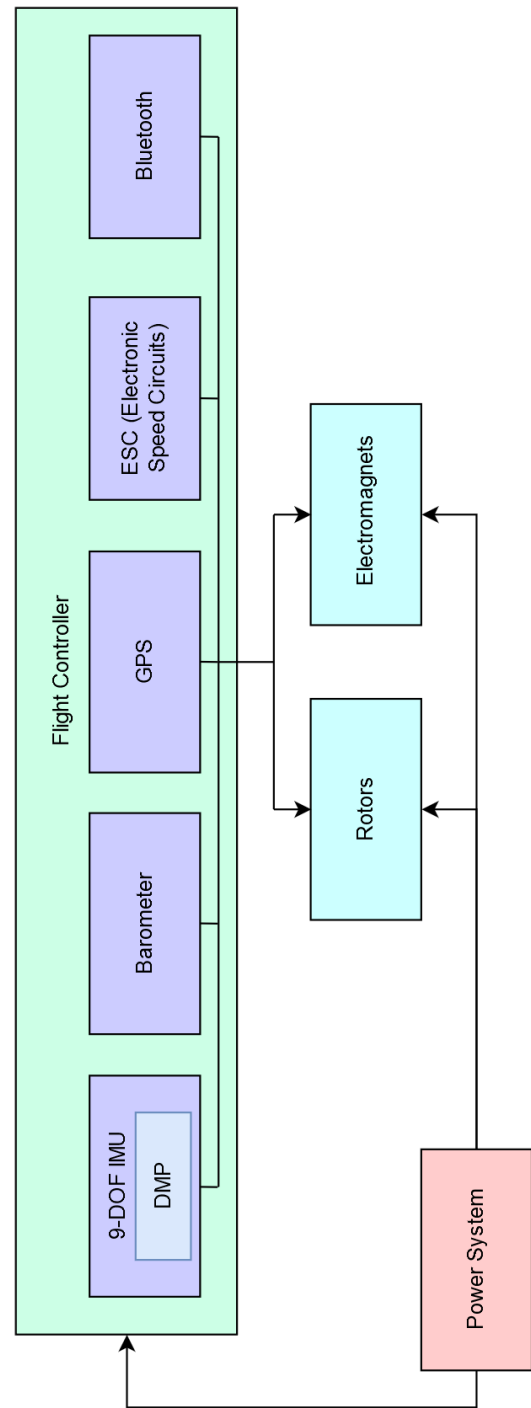


Figure 2: Block Diagram of Parent Drone

10. After the new batteries are secured, the Child will begin to spin its propellers again. The Child will also send a signal to the Parent indicating that it wants to unlatch. When the Parent receives this signal, it reverses the polarity of the electromagnets, repelling the Child.
11. After the Child unlatches, it can fly freely and resume what it was doing before its battery depleted.

III. MEMBER RESPONSIBILITIES

The responsibilities of each member are given in Table 1.

Battery Switching is a task that two members will work on because it is a large task that has many small parts that must be done. Specifically, this task requires designing the compartments that will hold and secure the batteries. In addition, this task will require some 3D printing for the parts that will be involved in the battery switching.

Parent & Child Drone Construction is another task that two members will work on. For this project, we are building both the Parent and Child drones from scratch. The construction itself will take a substantial amount of time, but this task also requires a lot of testing to ensure stable flight, which is integral for our project. In addition, this task also includes integration of sensors, peripherals, and other custom parts that we will design for this project.

Name	Responsibilities
Richard Boone	Electromagnetic Latching System, Battery Switching
Kyle Douglas	Parent & Child Drone Construction
Sayali Kakade	Camera Latency Measurement, Image Recognition
Sang Min Oh	Parent & Child Drone Construction
Aditya Wadaskar	On-Board Development with DJI's SDK, Battery Switching

Table 1: Group Member Responsibilities