Individual Lab Report #2

Progress Review 1

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Team B

Teammates: Gweneth Ge, Lance Liu, Yi Wu, Joshua Pen

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1 Individual Progress

1.1 PCB Assignment

In the PCB assignment, I completed Sections 1 and part of Section 2. This involved creating a custom library for components by sourcing standard parts and designing footprints for those not in the default library. I analyzed datasheets to determine correct pin configurations, ensuring accurate integration into the design.

A key task was designing reverse voltage protection and fuse integration circuits. This included determining appropriate capacitor placement for the MIC29300 voltage regulator, a high-current, low-dropout regulator handling up to 3A. Proper capacitor placement ensures stability and minimizes output noise. According to the datasheet, a minimum output capacitor of 10µF is required for stability at full load, and a 0.1µF capacitor between the input and ground is recommended when the regulator is powered from a source with high AC impedance.

I designed four voltage outputs—24V, 12V, 5V, and 3.3V—each with protection circuits against short circuits, overvoltage (10 percent above nominal), and reversed input polarity. These features ensure reliable and safe power supply to various components.

The design also included six input/output connectors and four status LEDs to indicate active voltage outputs, providing clear visual feedback on the system's status. I specified a fast-blow fuse rated at 150 percent of the motor's maximum current (10A at 24V) to protect against overcurrent situations, balancing protection and operational efficiency.Calculating correct resistor values was essential to set appropriate current for the status LEDs. Additionally, I configured a Transient Voltage Suppression (TVS) diode to protect against voltage spikes, safeguarding sensitive electronics by clamping excess energy.

After determining board dimensions, I strategically placed components per assignment guidelines to optimize performance and manufacturability. Upon completing my portion, I forwarded the remaining tasks to my teammate, Jet, ensuring seamless project continuation.

1.2 MRSD Project

In the MRSD project, I focused on upgrading the drone's hardware components and developing the geofence path planner. I assisted in integrating and configuring the Hadron 640R payload with the Cube Blue ArduPilot and NVIDIA Orin NX, ensuring seamless communication between the flight controller and the companion computer for advanced processing capabilities.

I initiated the development of a geofence path planner by creating an algorithm that generates lawnmower-style waypoints within a defined bounding box. This approach systematically covers the area of interest, ensuring comprehensive surveillance or data collection. The algorithm filters out waypoints outside the geofenced area, establishing an initial search path for the drone post-launch and enhancing operational efficiency by focusing on designated zones while avoiding restricted areas.

To improve the drone's performance, I replaced the Rajant Breadcrumb radio with a more efficient communication module, enhancing data transmission and reducing latency. I also upgraded the gimbal attachment plate to a lighter version, reducing overall weight and improving flight dynamics. Additionally, I renewed the rubber padding on the drone's

legs to ensure better shock absorption during landings, protecting sensitive components from potential damage.

Beyond technical contributions, I played a role in project management and logistics. I ensured all team members were aware of assignment deadlines and facilitated communication to keep everyone updated on project progress. This involved coordinating team activities and managing timelines, ensuring the project progressed smoothly and met its objectives.

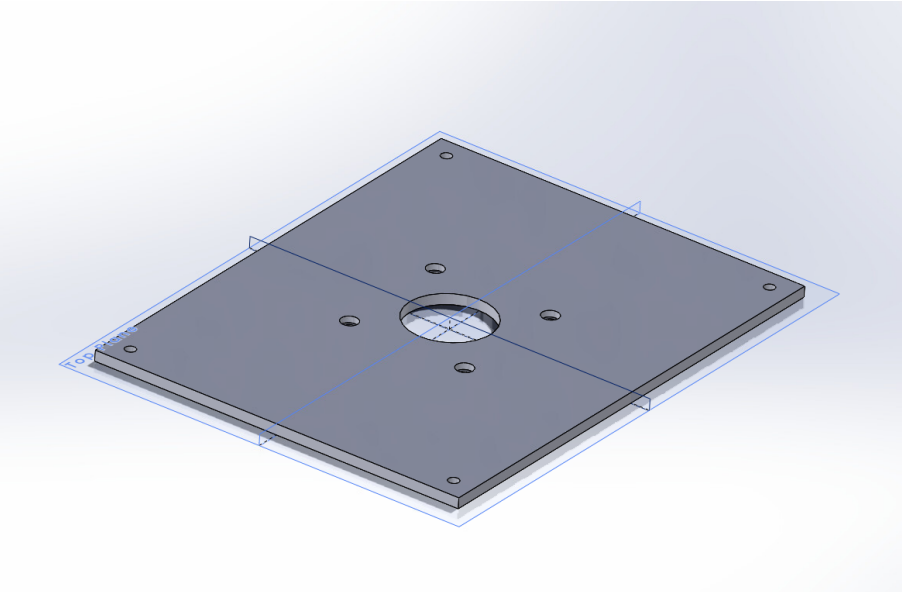

Figure 1: New Gimbal Mount

2 Challenges

2.1 PCB Assignment

One of the primary challenges I faced was determining whether to use the MIC29300 voltage regulator, the Murata UWS-12/4.5-Q48N-C DC-DC converter, or both. Due to uncertainty about which component was necessary, I created a custom part in EAGLE for the Murata UWS 3.3V and 5V converters, utilizing their datasheets for accurate footprints and specifications, since I was only able to find the Murata UWS-12/4.5-Q48N-C on SnapEDA. Another challenge involved interpreting the datasheets to correctly wire the Transient Voltage Suppression (TVS) diode, capacitors, and the MIC29300 regulator. Understanding the function and proper placement of these components was essential to ensure effective protection against voltage transients and to maintain circuit stability. This process required a thorough analysis of the datasheets to comprehend each component's operation and their interactions within the circuit.

2.2 MRSD Project

The main challenge in this MRSD iteration was the gimbal control system, hindered by limited documentation beyond a basic quickstart guide. After initial setup, we had to download and integrate GTune software to assist with the Gremsy gimbal. A debugging

session with the Lockheed team, building on their insights, eventually helped resolve the issue after hours of troubleshooting. Due to poor error handling in the Gremsy SDK, diagnosing the problem was difficult, requiring Lockheed's guidance to align our gimbal state with theirs. Fortunately, this was resolved, removing a major roadblock.

3 Team Work

3.1 MRSD Project

Name	Contribution
Jet Situ	Worked on primary integration of the gimbal control and camera interface. Was able to tune, calibrate, and control the gimbal via integration of the Gremsy SDK, in collaboration with Lockheed Martin. Worked on ROS2 integration with the ground station, validating communication infrastructure to onboard MAVROS system. Removed Doodle Labs Radio and electronic infrastructure, replaced with Rajant Breadcrumb radio, and actively working on the electrical section to integrate the newer radio. Held meetings with Prof. Scherer and Yaoyu Hu to realign timelines and priorities in preparation for the DARPA March workshop.
Joshua Pen	Assisted in integrating and configuring the Hadron 640R payload with Cube Blue ArduPilot and NVIDIA Orin NX. Initiated development of a GeoFence path planner, creating an algorithm for generating lawnmower-style waypoints within a bounding box and filtering out those outside the geofence to establish an initial drone search path post-launch. Replaced the Rajant Breadcrumb radio on the drone, upgraded the gimbal attachment plate to reduce weight, and renewed the rubber padding on the drone's legs. Contributed to project management and logistics.
Lance Liu	Worked on radio, IssacSim, and gimbal integration. Primary work was on configuring the new RFD900 radio and integrating for use as a primary RC link between the CubePilot and the ground station. Work was done on integrating our design and the MAVROS behavior tree into IssacSim, where simulation of the drone and tree can be done in a safe environment. Contributed to attempted test flight and follow-up analysis of the drone's new payload configuration. Assisted in gimbal configuration process and debugging the SDK system.
Gweneth Ge	Primarily worked on communication with AirLab and lockheed team for the overall plan of our team participating the workshop in March, and the role to the DARPA Triage Competition this year. Additionally, worked on the Spring Test Plan, settling down the milestones for each Progress Review with other team members. Assisted in reintegration of the drone after gimbal control and Radio system issues resolved.
Yi Wu	Created a pull request for the AirLab/HumanFlow GitHub repository, implementing two ROS2 packages for 3D&2D pose estimation and pose visualization. The package enables human pose visualization in RViz2 and includes NLF algorithm (https://github.com/isarandi/nlf) testing on DARPA datasets. Additionally, started to implement YOLOv11 for comparative analysis of 2D joint pose detection performance.

Table 1: Team Members and Their Contributions

4 Plans

4.1 MRSD Project

Name	Contribution
Jet Situ	Will work on coordinating all key features needed for the March workshop, developing software psuedocode and baseplates needed to aid other team members in developing feature packages. Will assist with IssacSim simulation of drone behavior to develop safety features needed to qualify the drone for the workshop. Will redevelop the electrical configuration of the drone to appropriately route power to the motors and all newer subsystems, and test tuning to ensure that the ESCs produce the expected output. Will work on mechanical integration of newer drone components and hardening in preparation of outdoor test flights.
Joshua Pen	Collaborate on developing gimbal control protocols and implement mechanical enhancements. Design and code a GeoFence path planner, creating algorithms for lawnmower-style waypoint generation within a bounding box and filtering out waypoints outside the GeoFence to establish an initial search path for drone deployment. Contribute to developing the IsaacSim pipeline for testing path planners. Additionally, manage project logistics and oversee project management tasks. Will also replace boken motors on drone.
Lance Liu	Will work on integrating the new control protocols for the RFD900, and the Rajant Breadcrumb radio, and work on setting up the ROS2 communication and router nodes between them. Will continue to work on IsaacSim integration and develop a simulated environment to test the behavior tree in, integrating Josh's software code and testing it within the virtual environment. Will also assist in overall code architecture and structuring for deployment within ground station, Docker containers, and deployment onto aerial computer.
Gweneth Ge	Now that the gimbal and radio issues resolved, I will continue working on on Inter-UAV collision logic and planner launch. Moreover, I will assist gimbal control and sensor nodes development, detection launch, visualization and clicking interaction. I will continue supporting on project management and logistics, including the plan for the DTC workshop in March, as well as the demo and space setup for National Robotics Day in April.
Yi Wu	Deploy the current pose estimation algorithm (NLF) on the Jetson Orin, and test its performance. Finalize the YOLOv11 pose estimation ROS2 packages. Initiate development of pose estimation algorithms for thermal camera data. Implement gimbal control functionality by tracking a designated target patient point within the camera frame.

Table 2: Team Members and Their Plans