Individual Lab Report #4

Progress Review 3

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Team B

Teammates: Jet Situ, Lance Liu, Yi Wu, Joshua Pen

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1 Individual Progress

1.1 PCB Assignment

For this PCB assignment, I mostly caught up and learned from my teammates, Jet and Lance, who primarily focused on the PCB assignment. Their work was very important since our drone has experienced a power issue which making such PCB can potentially help us resolve it.

Throughout this process, I learned that they methodically added a detailed block diagram and an introductory overview based on feedback from instructors, ensuring clarity and proper illustration of our project's context for Milestone 2. In addition, one of the key design was the complex integration of a hot-swappable auxiliary battery system which can greatly enhance our drone's operational capabilities, with an appropriate buck converter for reducing the 24V source to the required 5V output.

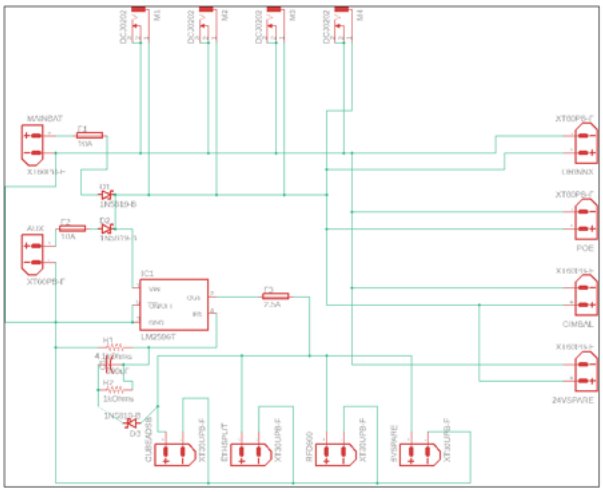

Figure 1: Schematic submitted to replace our drone's existing board

1.2 MRSD Project

For the MRSD project, I mainly worked on overall project management and operational support. Specifically, I am responsible for issue tracking and risk management via team discussion in-person and online conversation, along with feedback from airlab staff and advisors. Since our project has also attened Airlab Industry Day Demo, I helped with various operational/logistics work such as site setup, communication with airlab, media and industy visitors.

More over, I worked on SVD, FVD 1 pager, Progress Review slides, project management slides, Airlab Industry Demo slides, PDR slides, as well as editing/labeling footage we got from each test flight as well as darapa workshop.

Techinically, I tested 8 batteries presented in airlab which we may use for our drone. We conducted the test primarily because our drone has not fullfilled the flight duration yet, and the batteries in airlab generally being used at least 2 years, and some of them are a bit swelling which cannot be used anymore. I did so by searching for battery's serial number and related registration information, with additional voltage testing.

2 Challenges

2.1 PCB Assignment

nitially, the design included a simple internal buck converter sufficient for our basic subsystems. However, introducing the auxiliary battery brought many new questions and challenges. Jet specifically had to learn and research extensively, focusing on selecting a battery type that was lightweight and operationally efficient.

They had hard time figuring out if the auxiliary battery should charge while the main battery was active and how to prevent unwanted discharge. This required in-depth research on reverse currents and voltage leaks. Observing Jet carefully manage these complex issues taught me a great deal about thoughtful system integration and practical circuit design.

2.2 MRSD Project

The drone's current flight duration is 12 minutes, but it should has at least 15 minutes of aerial time if we choose to switch batteries during the 25 minutes of competition. There are several issues behind it. First of all, DJI batteries are not compatible with PX4 autopilot which means we could not directly monitor battery level and "health condition" like we did with DJI its own autopilot. In addition, we wanted the drone to be able to perform triage and detection of casualties from 6 meters of stand off distance, so that our drone has to be restricted to 3.3kg of weights. In this case, we could only have 1 battery to support the drone instead of 2 (DJI supports dual power, but each battery weights 700g). In addition, the DJI batteries stored at Airlab were generally used for at least 2 years, which may result in less optimal performance in flight duration and increase safety concerns. We have placed a DJI battery which will arrive in 1 month.

3 Team Work

3.1 MRSD Project

Name	Contribution
Jet Situ	Represented the MRSD team at the DARPA Triage Workshop 2 event in Georgia, working alongside Lockheed Martin engineers to integrate their drone prior to competition data collection. Then worked to coordinate drone flight permissions and capability prior to the Team Chiron Demo Day event. Acted as safety pilot and speaker during the Industry Demo Day, and performed flight testing on the days prior for drone endurance and capability integration. Designed and submitted the PCB final draft creation materials.
Joshua Pen	Assisted in fully integrating and test Path Planner for searching the Geofence Zone and Local Search of Patient Planner with behavior tree (also integrate with Patient Detection), Design, integrate and test Triage Planner. Triage Data Collection from Test Flight. Design new mount for Rajant DX2 radio. Contribute to wire management. Contributed to project management and logistics. Helped Setup Industry Demo day, and create slides for Demo Day presentation. Helped construct presentation for PDR and PR3. Helped construct SVD and FVD one-page description.
Lance Liu	1. Autonomy: Resolved takeoff interruption issues through EKF sensor data analysis; Debugged compass instability; Assisted in drone battery monitoring module; Supported Foxglove UI development; Integrated improved geofence mapping algorithm; Initiated NDAA-compliant RTK integration; Refined overall autonomy system robustness. 2. Detection System Enhancements: Tested multiple detection models with flight recording; Optimized person detection model deployment (30x faster inference); Configured Docker for PyTorch on edge devices; Improved gimbal lock functionality for detected persons (in progress); Initiated intelligent autonomy pipeline (in progress); Enhanced thermal detection through data augmentation and model fine-tuning; Established real-time casualty GPS coordinate estimation and transmission pipeline. 3. Ground Control Implementation: Deployed ground control station with reliable drone communication; Ensured robust command execution; Resolved ROS2 FastDDS middleware issues between containers. 4. Additionals: one-line autonomy launching draft; preflight checklist draft; power distribution PCB board and tracing; Initiated ATAK integration; Provided technical support for demonstrations and workshops.
Gweneth Ge	Provided operational support including communication with airlab and media for the Industry Day demo, making slides for Jet presentation, and video review and editing of collecting data from various test flights and darpa workshop. In addition, I primarily contributed to the issue tracking and presentations required by MRSD project including SVD, FVD, project mangaments, and PR 1, 2, 3.
Yi Wu	Debugged the low latency issue of the people detection algorithm. Wrapped up the gimbal code for Darpa Workshop. Assist Lance with the thermal detection algorithm. Volunteered as the casualty in the AirLab Industry Demo Day.

4 Plans

4.1 MRSD Project

Name	Contribution
Jet Situ	Will work on robustness and cleaning procedures prior to SVD flight tests. Will coordinate and work on integrating gimbal software with Lockheed Martin and Lance. Will work with Wuyi and Lance on software reorganization and documentation prior to SVD. Will assist Josh on mechanical redesign of drone to increase performance.
Joshua Pen	Contributed to project management and logistics. Design new mount for all components on drone (to reorganize components and drone wiring). Help design the Inter-UAV De-conflict algorithm.
Lance Liu	1. PX4 Autonomy Enhancement: Complete NDAA-compliant RTK integration; Further refine autonomy system robustness through comprehensive testing; 2. Detection System Completion: Finalize person detection model optimization; Complete gimbal lock functionality for detected persons; Implement and test intelligent autonomy pipeline in field conditions; Explore ID&Re-ID capabilities beyond person detection. 3. System Integration: Complete ATAK integration for drone control; Finalize GPS coordinates estimation accuracy for detected casualties; Optimize real-time data transmission pipeline; Integrate all subsystems more cohesively. 4. Testing: Conduct extensive field testing
Gweneth Ge	I will continue working on overall project management and communication with airlab, potential media/sponsors as well as NREC/Mill19. In addition, I will help with Josh on reorganizing components and drone wiring, along with the inter-uav deconflict algorithm.
Yi Wu	Integrate the human pose detection algorithm in the perception module; upgrade the pose detection with known gimbal specs like intrinsic matrix. Working with Lance, check if AirLab has implemented the Re-ID algorithm; if not, review SOTA Re-ID algorithm and wrap it into ROS2 pkg.

Table 1: Team Members and Their Plans