Individual Lab Report #3

Progress Review 4

March 21st, 2025

Yi Wu

Team B

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

Table of Contents

Contents

1 Individual Progress

After successfully implementing the gimbal functionality, my recent work has focused on refining the gimbal code. We identified that the lock-on algorithm was suffering from significant latency issues. Lance and I conducted a thorough investigation, examining various aspects including RTSP streaming latency, detection processing time, and bounding box transmission delays. Through systematic troubleshooting, I isolated the root cause: it was taking approximately 8 seconds to detect human bounding boxes from a single image. This poor performance stemmed from not enabling GPU acceleration in our Docker configuration. Lance and I collaborated to resolve this Docker-related issue, significantly improving the algorithm's speed. I also conducted a comparative analysis of open-source YOLO series detection algorithms and found that YOLO11's detection accuracy shows no significant improvement over YOLO8. Based on these findings, I developed a lightweight version of the gimbal control and lock-on code specifically for the DARPA workshop. Following the workshop, I walked Lance through my gimbal code implementation to facilitate its integration into the main codebase.

Looking ahead to the AirLab Industry Demo Day, we need to adapt our detection algorithm from RGB to thermal imaging and implement TAK for ground control. I initiated a meeting with Adi from AirLab and Lance to discuss AirLab's existing thermal detection algorithms and Adi's experience with TAK software. After evaluating AirLab's thermal detection algorithm against data collected from the DARPA Workshop, we found its accuracy to be insufficient for our needs. Consequently, I conducted a literature review on state-of-the-art human detection algorithms for thermal imagery and supported Lance in retraining our thermal detection model to improve performance. For test flights as well as AirLab Industry Demo Day, I acted as the casualty in the video footage.

2 Challenges

The key challenges we face involve adapting mainstream person detection algorithms to top-down view footage and enhancing detection accuracy for the DARPA challenge. To address these challenges, I've developed an innovative solution. My approach leverages image-generation technology to significantly expand our dataset. I then plan to utilize grounding Vision-Language Models to intelligently annotate people's bounding boxes within these generated images. If successful, this method will provide us with an abundance of supervised training data that we can use to retrain lightweight detection algorithms like YOLO for deployment on edge devices.

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 with Lance. 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