Individual Lab Report #2

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Team B

Teammates: Gweneth Ge, Lance Liu, Josh Pen, Jet Situ

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1 Individual Progress

1.1 PR2 Review

Participated in drafting the slides for the PR2 Review. Updated the MRSD project website, including the system design, system performance and system implementation pages.

1.2 MRSD Project

I work on person detection at AirLab, focusing on human pose estimation. I submitted code to AirLab's repository that uses the NLF algorithm (https://github.com/isarandi/nlf) for 2D and 3D pose detection. The code includes three message types ('HumanPoseConstants28.msg', 'HumanPose28.msg', and 'HumanPoseArray28.msg') and two ROS packages ('PoseEstimator28' and 'PoseVisualizer28'). The names include '28' because NLF detects 28 joints. The system can show both 3D human poses in RViz2 and 2D human poses on real-time video, and has been tested with last year's DARPA data.

2 Challenges

2.1 PR2 Review

My previous work focused on the software aspects, specifically human pose estimation algorithms. While preparing PR2 Review slides and Robot Platform content for our website, our teammates helped me to understand the hardware setup. Now that our drone's hardware integration is nearly complete, I will do more on ROS2 development for the drone system in the future.

2.2 MRSD Project

Testing various 3D human pose detection algorithms on single RGB images was straightforward, but converting the detected 3D skeleton into real-world coordinates proved challenging. This required understanding computer vision fundamentals, particularly camera intrinsics and extrinsics matrix calculations.

In reviewing the NLF algorithm paper, I found they used a dummy intrinsics matrix for estimating 3D human pose from single RGB images. However, when applying their dummy matrix, the predicted 3D pose didn't align with the 2D pose on the image. Since the actual intrinsics matrix wasn't provided for the test images, I resolved this issue by scaling and shifting the matrix. Instead of using a universal dummy matrix for all images, I created unique intrinsics matrices for each image, enabling perfect alignment between 3D joints in space and their corresponding 2D poses on the images.

Alos, once our group completes the gimbal repairs and collects real flight data, we will have the actual intrinsic matrix to accurately project 3D poses into world frame coordinates.

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 broken 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