AIMM-ICC

Mechanical Engineering

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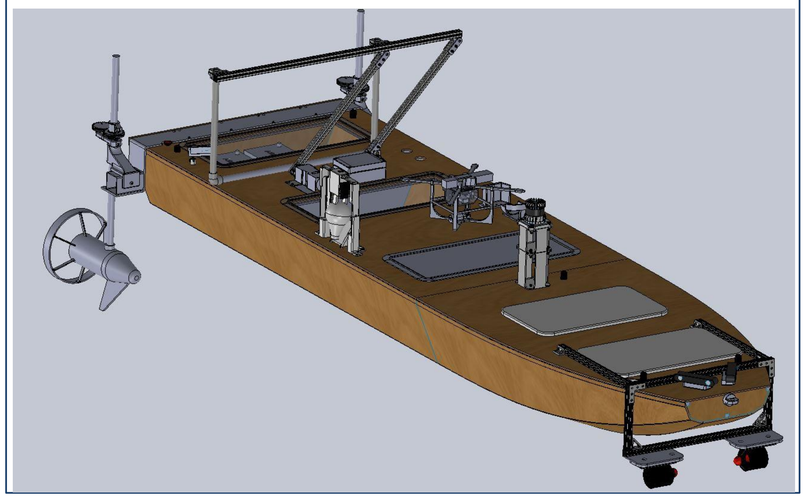
Abstract

The AIMM-ICC team was challenged to build a boat that runs by itself to complete a series of challenges ranging from buoy slalom courses to picking up objects in the water. The boat needed to run without any human or remote-control intervention, while completing the challenge course faster than other college competitors. To complete the tasks, subsystems were designed to allow full functionality of the boat, all backed by autonomous and mechatronics programs. The Trine team consisted of six students to make the project possible: 2 ME students, 2 DET students, 1 MRE student, and 1 CSIT student.

Design Solution

- Dedicated subsystems for each task
- 3-camera + LiDAR visions system to build 3D environment and see colors
- AI-Path Planning, ROS for tasks, RC override
- Wired POE communications for cameras
- Wireless subsystem communications mainly via ESP32



Customer Needs and Requirements

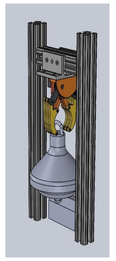
Customer Needs

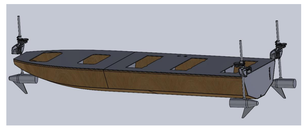
- Maneuver through a slalom course of five buoys.
- Identify a specific-colored buoy and make physical contact with it.
- Identify a designated drop site, deploy a sensor, and transmit data back to the shore.
- "Launch" a NERF Vortex football from the boat onto a designated target.
- Retrieve a brief-case-like object from the water.
- Total project costs must not exceed the allotted budget of $10,000.
- The team must not commit any safety violations
- The customers expect a final report detailing the design process and justifications of the competition boat.

Design Requirements

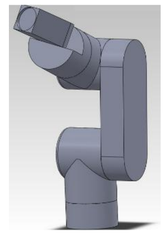
- 4-6" freeboard
- 0-degree static and standard operating heel and trim angles
- Must be able to identify objects 60ft away
- Must be able to identify color 40ft away
- Must be able to maneuver with 360-degree unrestricted motion
- Must produce a minimum 60lbf of straight-line thrust
- Obtain 3ft turning radius within 8ft at max straight-line speed
- Must be able to operate in full autonomy, with an RC safety option
- Must have a kill switch built into the boat
- Must supply a minimum of 2400Wh of available power
- Must be able to retrieve a 13"x5.8"x9.7" case from the water
- Must be able to drop a NERF Vortex football 3' away from the hull
- Must be able to deploy a floating sensor that communicates wirelessly with a shore display

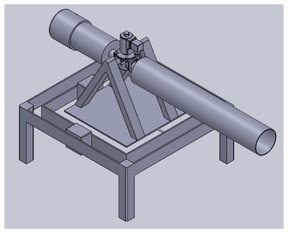
Concept Selection

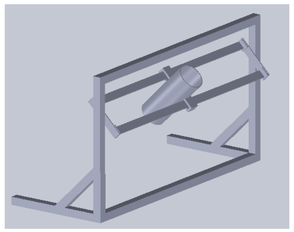




- The design was broken down into 6 subsystems: Propulsion, Retrieval, Projectile, Sensor Deployment, Navigation, and Controls
- 3-5 concepts were generated for each subsystem





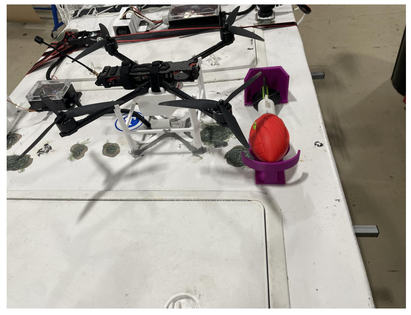


Manufacturing

Retrieval

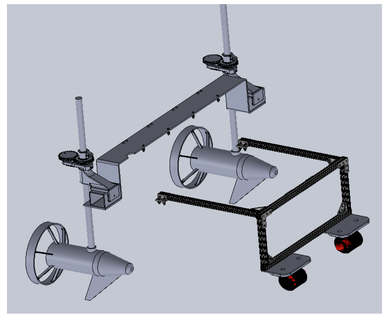
Captions:
- 4-Bar Net
- REV-NEO Motor
- 38"x24" Catch Area
- 45lb Capacity

Projectile



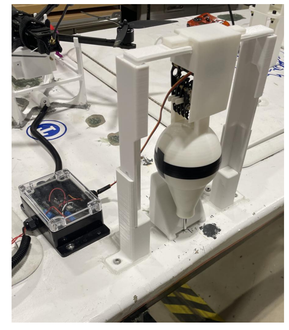
Captions:
- Drone
- Servo Payload Drop
- Solenoid Harness
- Fishing Line Football Connection

Propulsion



Captions:
- Two Trolling Motor
- Steel Rear Mount
- Front Thruster Steer
- Aluminum Front Harness

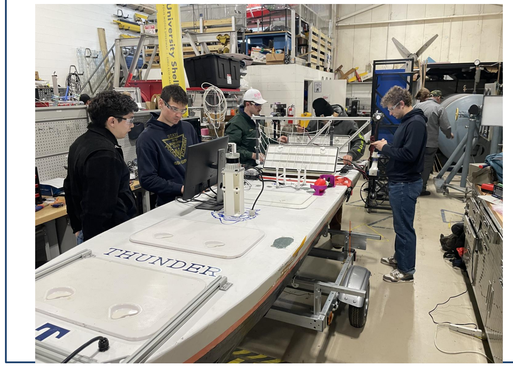
Sensor Deployment



Captions:
- Servo Gripper
- Static PLA Harness
- PLA Buoy Housing Temperature Sensor

Testing and Validation

Test 1:
- Functionality Check
- Off-water RC Run
- Thruster Direction Fixed
- Built subsystems worked



Test 2:
- On-water RC Run, Motors Pinned
- Visions system operates
- Projectile Not Yet Operational
- All other subsystems worked

Test 3:
- On-water AI Run, ROS Functions
- Path Planning Fails
- Competition run in semi-autonomy
- Projectile Integration untested

Results

- Full RC functioning boat, highly efficient retrieval capabilities
- Laid the foundations for a SLAM-based AI navigation system
- Functioning ROS for semi-autonomy
- 2nd in presentation and report, 5th in competition run

Course Run was done without testing projectile integration. The boat lost communication with the remote due to interference, causing the team to lose most points that could have earned prior.

Acknowledgments

Thank you to the TPOC's who helped give us information on the competition as it became available, and thank you to NSWC Crane for sponsering the event.