



SAR



Team SAR

Some Assembly Required

Explorer Post 1010

Flight Readiness Review Briefing



Introductions and Flight Mission Roles

Nathan **Scoring Captain**



Muhammed **Safety Pilot/Pilot in Command**

Ethan **A.I. Developer/Air Boss**



Jasmine **Mission Planner Specialist /
Team Captain**



Introductions and Flight Mission Roles (cont'd)

Theo Safety Specialist



Veronica Strategic Technician

Lindsay Visual Observer



Bobby Aircraft Specialist/
Backup Pilot

Meet JEFF! (Joint Engineered and Fabricated Flyer)





Team Support/Training Video





System Overview - Flight Tasks Planned

1. Accomplish autonomous objectives
 - a. Map locations of scoring items while completing autonomous objectives
2. Hybrid search for further scoring items
3. Fly to targets
 - a. Record coordinates
4. Fly to pick-up targets (waypoint navigation)
 - a. Manually assisted pick-up
5. Drop-off autonomously (waypoint navigation/auto drop)
6. Autonomous takeoff and landing





System Overview - Expected Performance

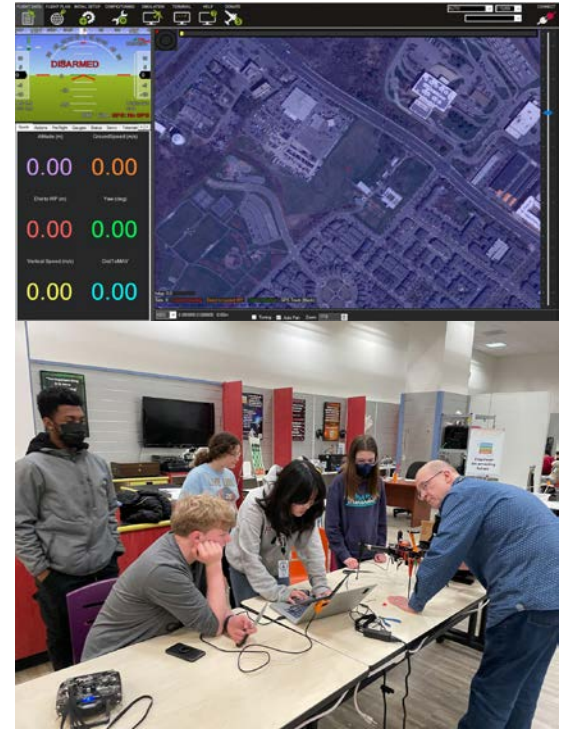
- Successfully execute Flight Mission
- All 6 target coordinates recorded
- 3 payloads transferred
- Manually assisted autonomous pick-up and drop-off
- Mission completed within <30 minutes flight time
- Autonomous takeoff and landing





System Overview - Mission Planner Usage

- Monitor aircraft telemetry data
- Safety dashboard (arm/disarm, GPS status, flight mode)
- Program autonomous missions
- Control payload mechanism servo
- Simulate missions





System Overview - Risk Evaluation

Risk	Risk Type	Mitigation
Autonomous payload procedure	Safety / Scoring	Location adjustment while landing, manually close mechanism
Payload system failure/payloads falls unexpectedly	Safety / Scoring	Attached mechanism to all four legs for additional stability, extensive testing, higher quality mechanical parts, decide action based on mission objectives
Damaged payload upon drop-off	Scoring	Replace older payloads, drop-off from lower altitude
Disabled backup compass	Safety	Low probability of primary compass failing
Flight Beyond Visual Line Of Sight (BVLOS)	Safety	Confirmed with flight directors that a visual observer will monitor the quad and communicate w/ PIC, team visual observer



System Overview - A.I. Based Autonomy

- 1) Vision based DNN/SSD to maintain target lock through delivery
- 2) Unfortunately the model's accuracy was too low (<30%), it didn't provide enough benefits.
- 3) We will implement a Hybrid approach for autonomy next year
 - a) MP for coarse navigation to target
 - b) Vision based DNN/SSD to maintain target lock through delivery
- 4) Automated payload drop for delivery
- 5) Draw a bounding box around the target
- 6) Calculate if the vertices of the square match the supposed coordinates of the target
- 7) Utilize Closed Loop software control to guide the Quad over the target and release the payload



System Overview - Monitor Usage



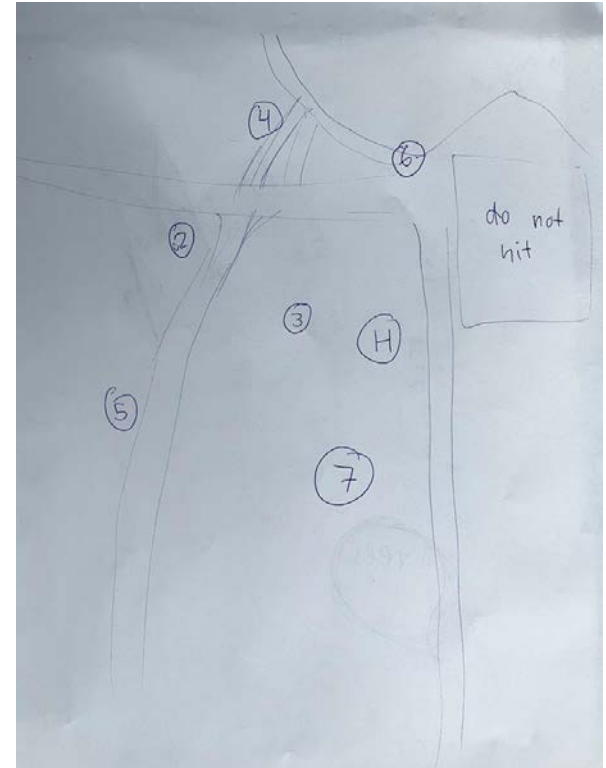
- New digital camera + receiver
- Payload capture assistance
- Flight decisions made based on:
 - Camera and receiver battery voltages
 - Temperature
 - Signal quality
 - Distance
 - Quad location



System Overview - Maps

Consolidation of Data:

- Target location relative to surface features
- Type of Target
- Latitude/Longitude
- Possible Obstacles
- Review after flight





System Safety - Operational Strategies

ALL flights conducted:

- With supervising adult
- In visual line of sight with visual observer
- BELOW 400 feet and within FAA regulations

NO flights conducted:

- Without performing pre-flight inspection
- In bad weather or bad visibility
- Over people or buildings





System Safety - Design and Operational Strategies

- High quality components (sufficient infill, appropriate layer height, high quality carbon fiber connecting components)
- Verified failsafe RTL action
- We use checklists to enforce safety
- Maintain safe altitude when crossing over obstacles
- Repairs made w/ consent from all members





Developmental Test - Test Planning

1. Prototype Completion
2. Independent System Test (off quad)
3. Integrated Ground Test (on quad)
4. Basic Flight Test (airworthiness)
5. Aerial System Test in open field
6. Mission Performance Test





Developmental Test - Ground and Mission Performance

- Successfully ground tested and flight tested quad with grabber
 - Completed autonomous objectives
 - Transferred payloads
- Simulated competition flight experience:
 - Found scoring items (autonomous map method followed by manual search)





Developmental Test - Corrective Actions Taken

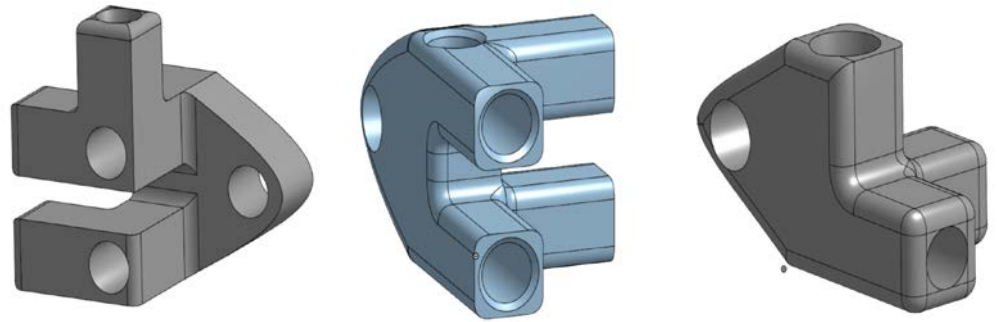
- Replaced faulty motors and ESCs, tested new propellers for motors
- Antenna mounting
 - Diversity system
 - Optimized antenna placement to reduce interference
- New digital camera
 - Custom transmitter mount
 - Optimized location





Developmental Test - Corrective Actions Taken (cont'd)

- Designed new “grabber”: reverse tablecloth magic trick (RTMT)
 - Belt driven system for smooth catching of payloads
 - Focus on reducing weight while maximizing margin of error for landing
- Iterated design (Concept → CAD Model → Low cost prototype → Final prototype)





Developmental Test - Corrective Actions Taken (cont'd)

- Cable grommet
- Clips added to reduce flexing
- Adjustable servo mount
- Changed tablecloth material
- Leg replacements
- Added second belt for more grip





Evidence of Mission Accomplishments

- Payload grabber that has transported all 3 payloads
- Trained A.I. to recognize targets
- Safety protocols effectively ensured no damage to persons or property
- Team members effectively executed assigned roles





Pre-Mission Briefing - Personnel Resourcing

- Defined responsibilities based on roles
- Roles assigned based on skills and interests
- Allocated positions and tasks based on flight vehicle condition
 - Grounded-preflight
 - Flying
 - Grounded-post flight





Pre-Mission Briefing - Team Comms

Maintaining communication with team roles:

- All non-essential activities are forbidden (sterile cockpit)
- Share essential information
- Each role has specific call outs
- Maintain records of each flight





Pre-Mission Briefing - Go/No-Go Criteria

Discussions and briefings include:

Before Flight

- Weather
- Airspace Activity
- Presence of people
- Condition of Quad

During Flight

- Aircraft Performance
- Wind Speed
- Battery Condition
- Airspace Activity





Social Outreach

- Local science day event
 - Introduce community to drones/explorer post (flight simulators)
- Explorer Post picnic
 - Fundraising event, demos for the public (Skydio drone and flight simulators)
- SciTech2U



 *Thank you for your time!*



Questions?