GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF AEROSPACE AND MECHANICAL ENGINEERING
The UNIVERSITY *of* OKLAHOMA

Modular Spray System for a Hexacopter UAV

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THE TEAM



PROJECT OVERVIEW

- **Context:** UAV spraying improves accuracy & efficiency while reducing waste
- **Problem:** Current systems are costly and lack flexibility
- **Solution:** Design an intuitive, affordable, and adaptable Modular Spray System

MOTIVATION

- **Intuitive:** Easily assembled, operated, adjusted, and repaired
- **Affordability:** Provide a low barrier-to-entry solution for small-scale and local operations
- **Adaptability:** Easily adjustable and swappable components

OBJECTIVES

- **Modularity**: Quick mounting and UAV compatibility
- **Spray Performance:** Adjustable nozzles and tunable flow
- **Assembly:** Commercial off-the-shelf (COTS) components
- **Spray Control:** Simple pilot operation, future automation
- **Structure:** Durable and vibration resistant
- **Tank:** Compatible with agricultural chemicals

CONSTRAINTS

- **Budget:** ≤ $500
- **Payload:** ≤ 2.5 kg (wet)
- **Tank Capacity:** ≤ 1-Liter
- **Flight Performance:** ≥ 7.5 minutes at full payload
- **Spray Control:** Stable pressure, flow, and droplet size
- **Modularity:** Fit different UAVs without custom mounts
- **Structural:** Withstand vibration, landings, and minor impacts
- **Chemical Compatibility:** Materials safe for agrochemicals
- **Electrical:** No interference with UAV flight operations
- **Safety:** FAA Parts 107 and 137, EPA labeling requirements
- **Assembly:** Simple, minimal tool installation and removal
- **Schedule:** Must be completed within one academic term

IMPACTS

- Global food demand is rising rapidly
- UAVs improve yield and efficiency
- Reduces chemical use and runoff
- Lowers labor and operating costs
- Enhances worker safety and health
- Supports sustainable farm practices

ENGINERING STANDARDS

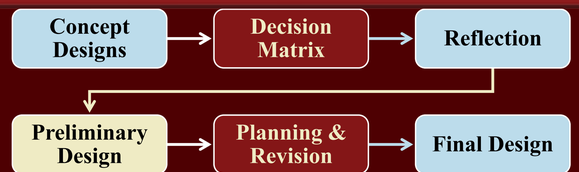
FAA Guidelines
- Part 107 – Small UAS operation rules
- Part 137 – Agricultural chemical dispensing

EPA Guidelines
- Chemical labeling and handling requirements
- Drift prevention and environmental protection

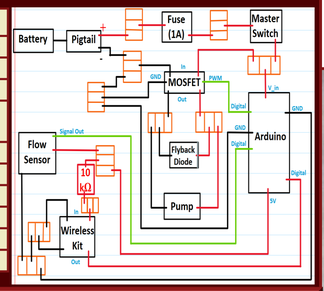
State Licensing
- Oklahoma Aerial Applicator License (Category 15)

ANSI/ASME Standards
- ASME Y14 – Engineering drawing documentation, GD&T

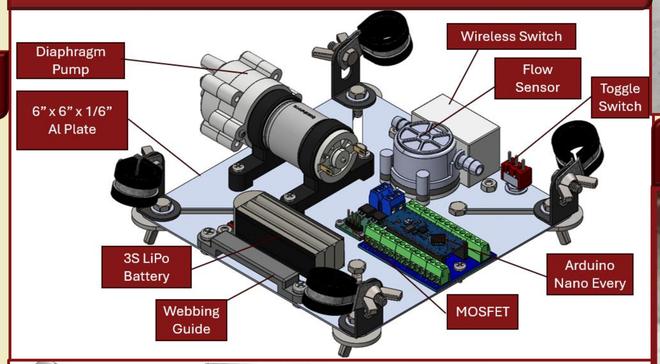
DESIGN PROCESS

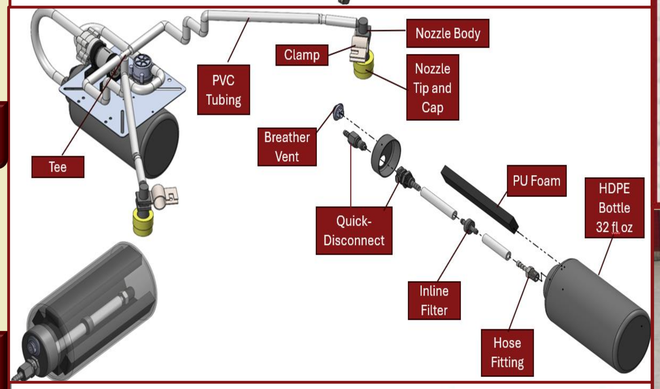


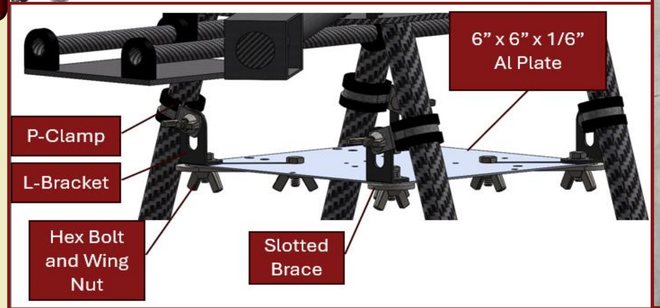
Decision Matrix		Design Scores		
Category	Weight	D1	D2	D3
Modularity	4	**3**	2	2
Weight	4	2	2	2
Spray Performance	3	**3**	2	2
Assembly	3	3	3	**1**
Safety	2	2	2	2
Stability	2	3	3	3
Cost	2	2	2	**3**
Electrical Power	1	3	3	3
Totals		**55**	48	44



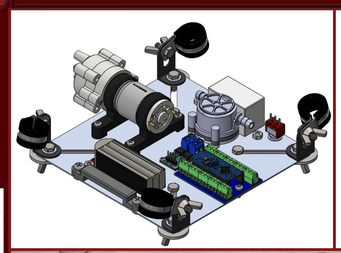
DESIGN COMPONENTS

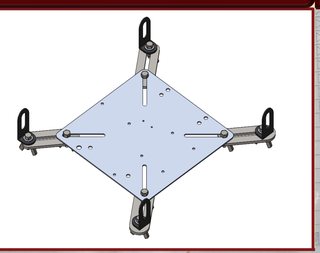






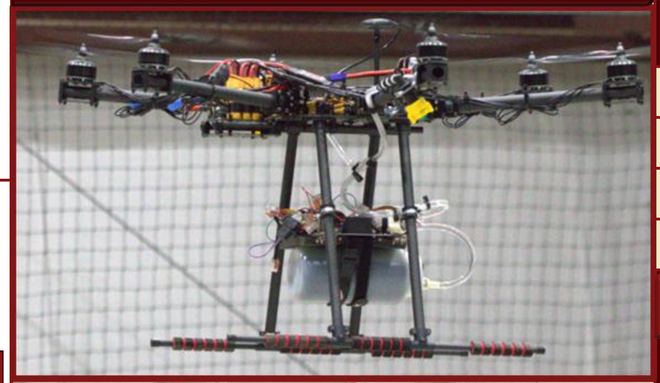
SPRAY SYSTEM ASSEMBLY





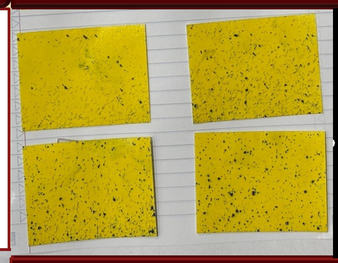


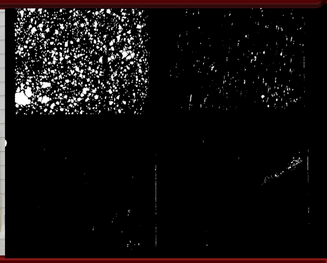
TESTING





RESULTS





Ground Tests	
Full-to-Empty Capacity:	0.627 Liters
Average Flow Rate:	0.522 L/min
Nozzle Percentage:	L – 50.3% R – 49.7%

Hover Tests	
Average Droplet Diameter Size:	778 µm
Estimated Swath Width:	2.0 m
Percentage Area Covered:	2.5%

Flying Tests	
Average Droplet Diameter Size:	502 µm
Estimated Swath Width:	1.8 m
Percentage Area Covered:	0.67%
Coefficient of Variation	47%

CONCLUSION

- ❑ Successfully designed, assembled, and tested Modular Spray System
- ❑ Met project constraints: Cost = $479 & Weight = 2.2 kg
- ❑ Achieved all project objectives
- ❑ The resulting design is intuitive, affordable, and adaptable

FUTURE WORK

- ❖ **Further Testing:** Different speeds, flow rates, nozzles, etc.
- ❖ **Refine Design:** Increase quality & performance with larger budget
- ❖ **Scalability:** Larger liquid capacity, automation, drone swarms

ACKNOWLEDGMENTS

The team would like to formally thank the University of Oklahoma for the Undergraduate Research Opportunities Program (UROP) funding that was critical for testing the spray system.