Emergency Medical Drone Design Overview

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Project Background

- Inspired by Natural Disaster such as Hurricane Harvey and winter snowstorm in Texas
- Proposed the customer senior capstone project, recruited peers, and secured funding from the Walker Entrepreneurship Program at Texas A&M University.

<u>Problem Statement</u>

- Design a climate-controlled unmanned aerial vehicle (UAV) storage container capable of securely, reliably, and accurately storing and delivering prescriptions and vital medications to patients in urban environments.

Hurricane Harvey Causing Catastrophic Flooding in Houston, August 2017

Snowstorm Causing Power Outage in Texas, February 2021

HOQ Analysis

Performed a House of Quality Analysis and compared with existing products.

Major Components

- Customer Needs
- Metrics
- Correlation Matrix
- Existing Product analysis
- Importance and Specifications

Important Metrics

- Takeoff Weight
- Structural rigidity
- Volume of Storage unit

Correlation Ratings
Little Correlation = 1
Medium Correlation = 3
Strong Correlation = 9

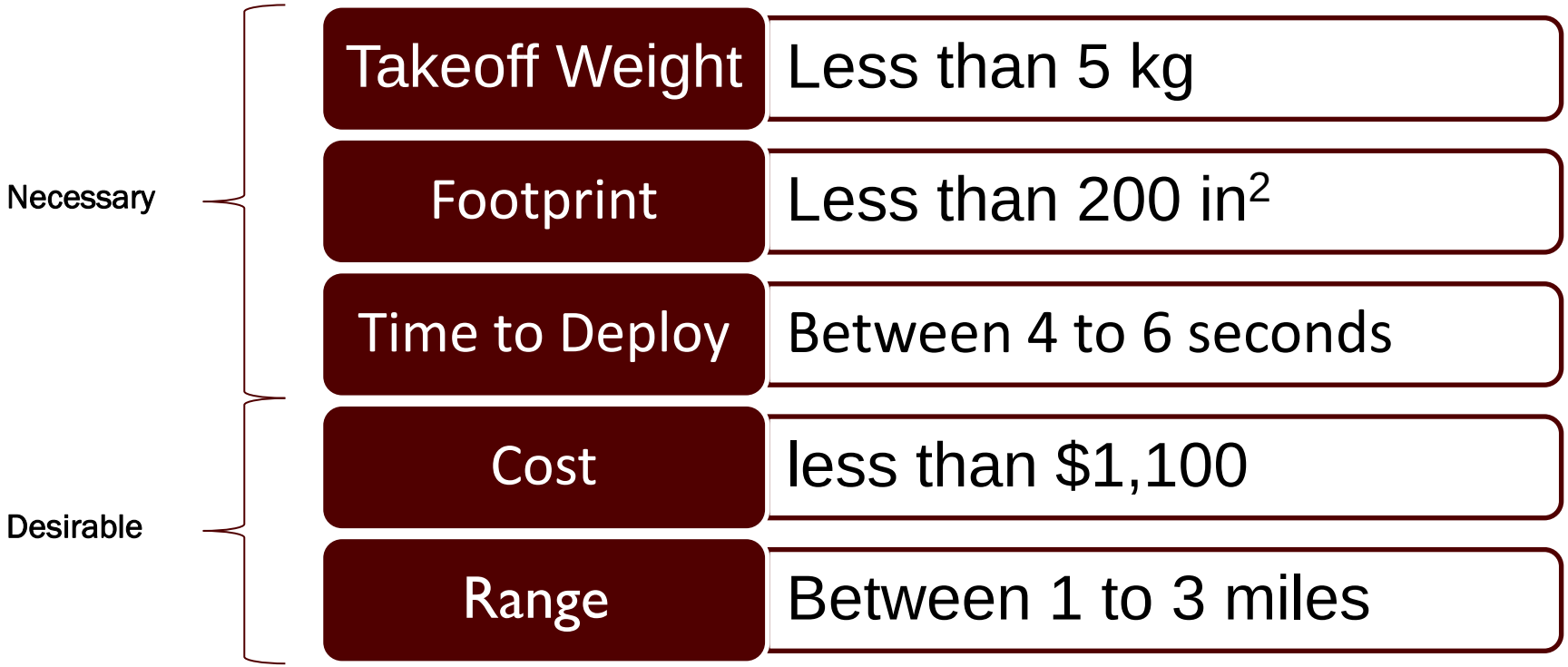
Medical Drone	Importance	Two-way radio range	Structural rigidity	Thermal/FLIR cameras	Hovering Time	Signal Range	Mass of drone	Takeoff weight	Volume of Storage unit	Max flight distance	Operating temperature range	Battery Life	GPS system Accuracy	Wind Resistance	Existing Product	GRIFF 135	Splash Drone 3+
min (-), max(+), nom(*)		(+)	(+)	(*)	(+)	(+)	(*)	(+)	(*)	(+)	(+)	(+)	(+)	(+)			
Communciate with target	5	9				3							3			1	1
Support significant payload	5		9			3		9		3	1	9		3		5	2
Reconnaissance	3			9	3					9			3			4	5
Large storage unit	5		9				3	9	9							5	1
Accessible storage unit	5						3	3	9				1			4	2
Aerial Deployment	3.5				9							3		3		2	5
Ensure target stays alive	4	9		1												1	3
Weather proof	4		3								9			9		5	5
Locate lost drone/unit	4.5												9			4	5
Units		miles	GPa	Y/N	min	miles	kg	kg	in^3	miles	K	Hr	miles	m/s			
Absolute importance		81	102	31	40.5	30	30	105	90	42	41	55.5	69.5	61.5			
Relative importance		10.4	13.1	4.0	5.2	3.9	3.9	13.5	11.6	5.4	5.3	7.1	8.9	7.9			
Technical difficulty		3	3	1	3	5	3	5	1	3	5	4	4	5			
Existing Product - GRIFF 135		n/a	70	N	30	n/a	60	30	n/a	9	n/a	45	0.5	n/a			
Existing Product - Splash Drone 3		n/a	2.05	N	23	1	2.008	3	n/a	1	313	0.38	0.5	8.0			
Targets		2	70	Y	30	10	5	15	675	10	255 to 317	1	0.5	10.0			

Waterproof Drone “Splash Drone 3+”

Heavy Duty Drone “GRIFF 135”

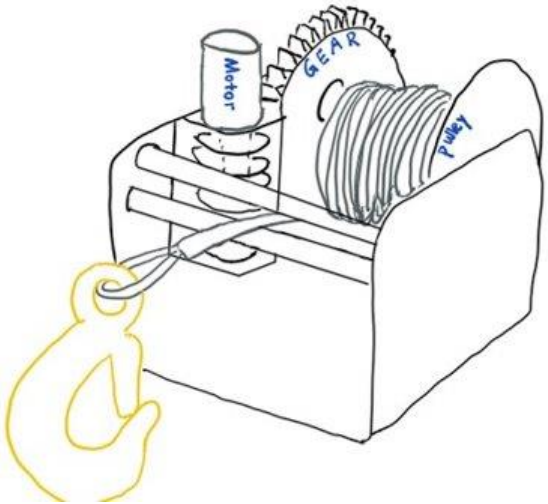
House of Quality Results / Project Goals

Using the calculated HOQ results, specific metrics target of the drone were set:



Selected Design after Brainstorming

3D Printed Bracket for Release Mechanism on an example drone



Pulley System will be attached at the bottom of the drone

Optional Package for medical supplies that required to be temperature controlled: Expanded Polypropylene Insulation case

Embodiment Design - Drone

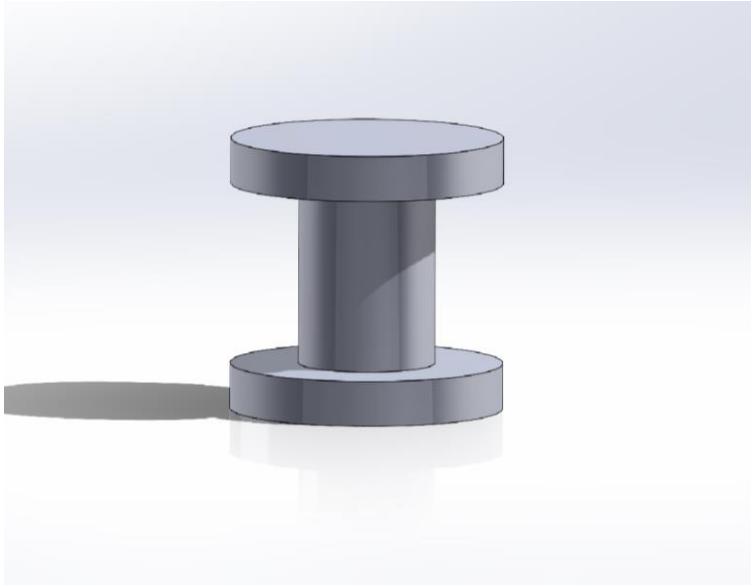
- Hubsan Zino Pro Plus
  - Affordable Price (<$ 500)
  - Customizable for connecting to the release mechanism

Hubsan Zino Pro Plus

Embodiment Design – Pulley Spool & Rope

- Pulley's Spool:
  - Geometry: Circular
  - Material : ABS
  - Width: 3.81 cm
  - Outer Radius: 1.91 cm
  - 1:2 Ratio for Inner to Outer Diameter

- Rope:
  - Fishing Line
    - Tensile Strength: 485 MPa
    - Yield Strength: 241 MPa
    - Weight and Tensile Strength specifications met
  - Attached to hook and around spool of pulley

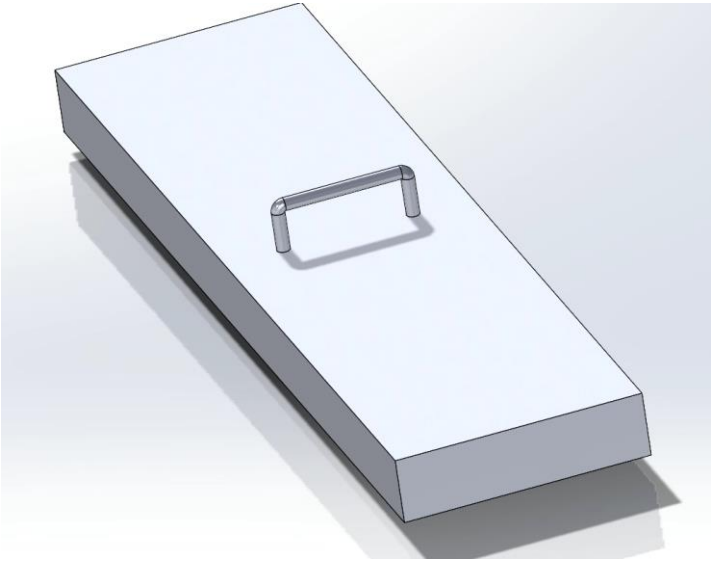


Pulley's Spool

Embodiment Design – Clasp for Velcro Attachment

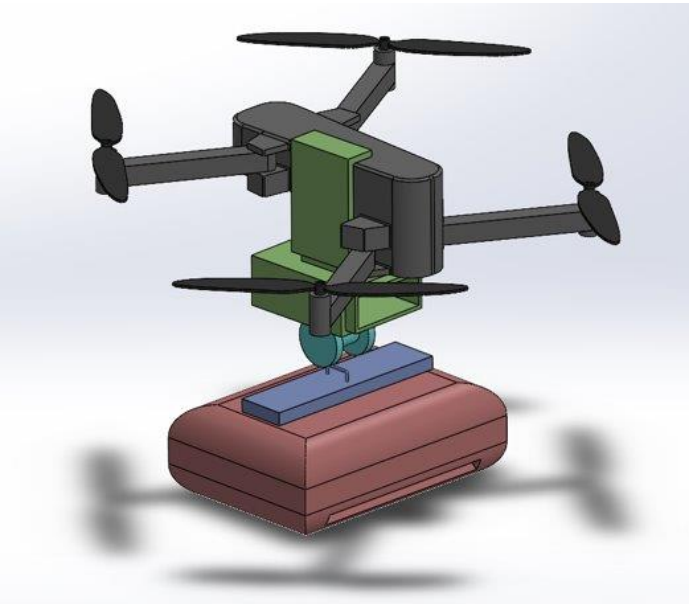
- Velcro Square Loop
  - Material: ABS (Lighter than PLA)
  - Size
    - Height: 1 cm Tall
    - Length: 15 cm
    - Width: 4 cm
    - Handle:
      - Width: 2 cm
      - Height: 0.7 cm

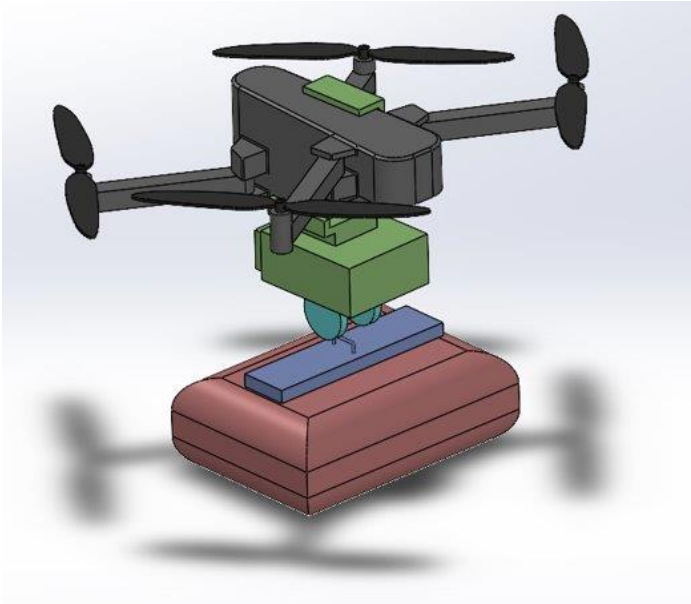
- Plastic Bracket:
  - FDM 3D Printing
  - Material: ABS (Lighter than PLA)
  - Geometry: Rectangular



Plastic Bracket

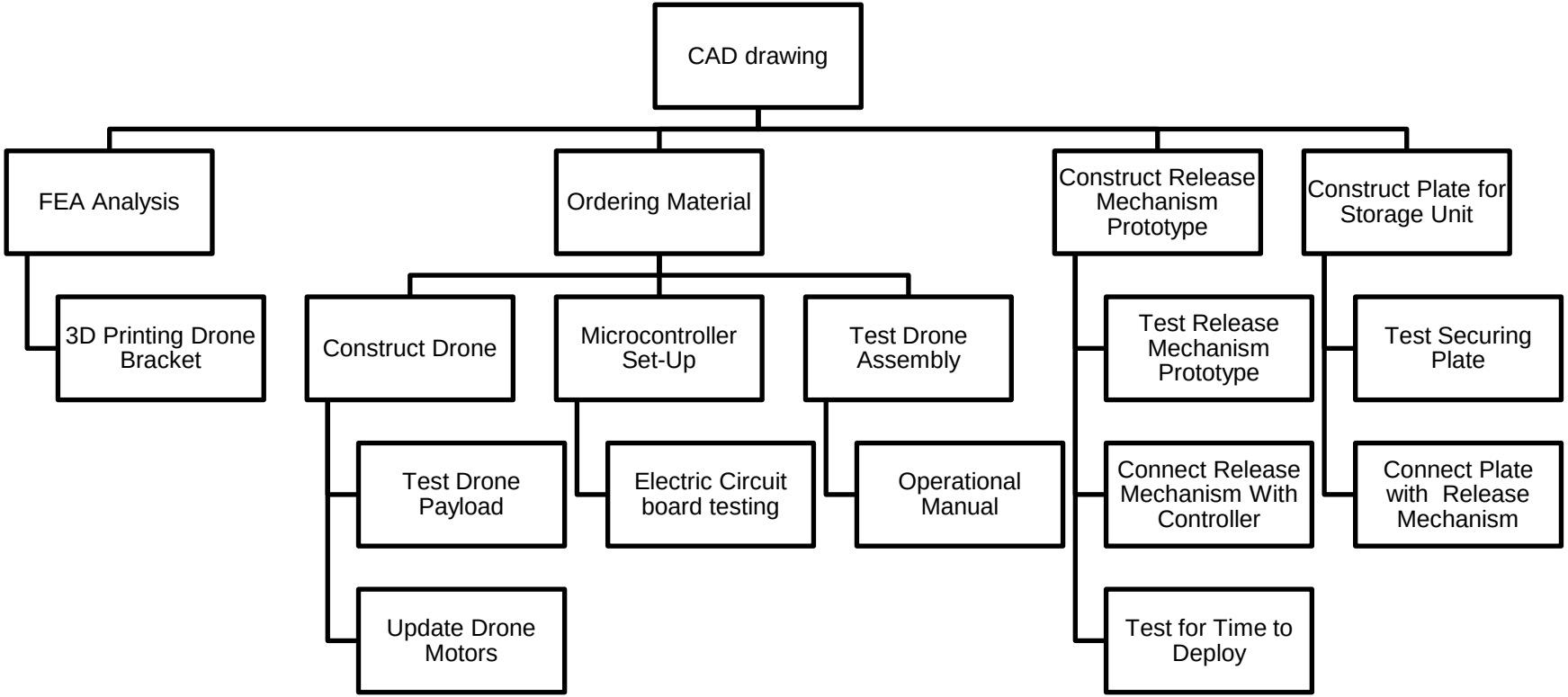
Embodiment Design – Digital Model





Isometric Views of Emergency Medical Drone mockup

Work Breakdown Structure



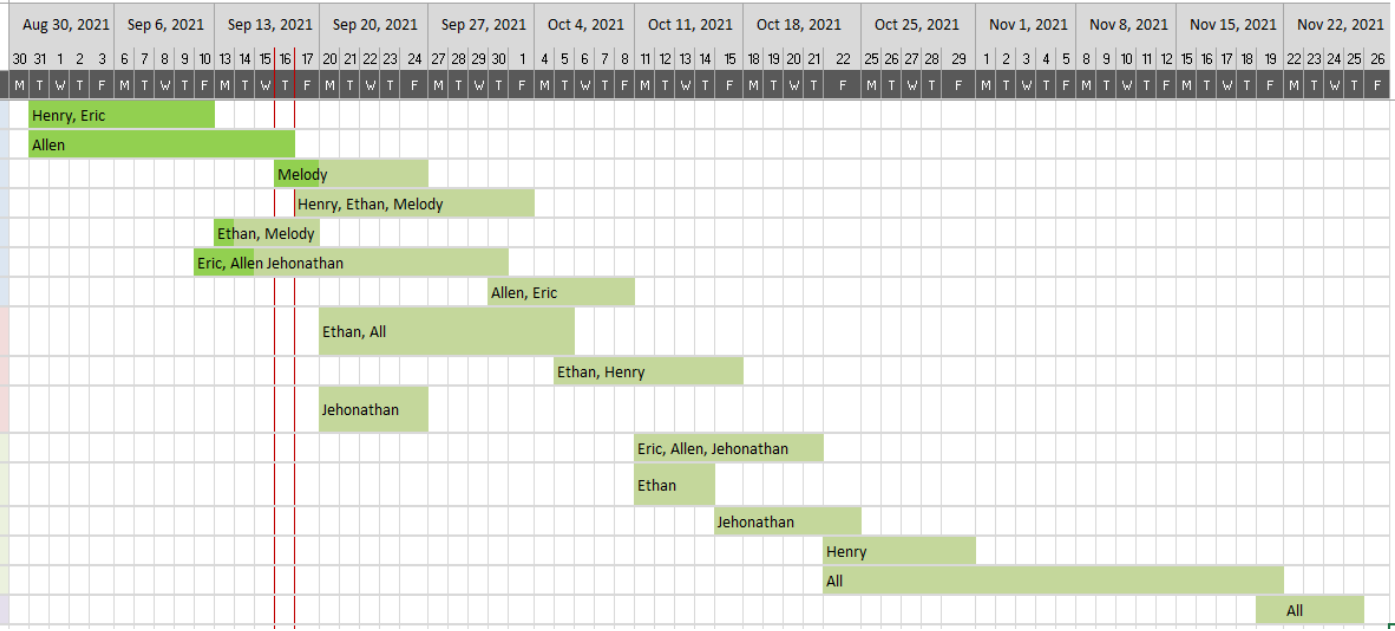
Gantt Chart for Building Prototype

Oct 1st - Mid Term Project Evaluation
Nov 1st – Scheduled Project Due Date
Nov 2nd – Nov 26th Troubleshooting Period

MEEN 402 - 502
Team Avian

Project Start: 8/31/2021
Display Week: 1

TASK	PROGRESS	START	END
Purchasing Materials	100%	8/31/21	9/10/21
CAD Model	100%	8/31/21	9/16/21
FEA Analysis	20%	9/16/21	9/26/21
3D Printing Bracket	0%	9/17/21	10/1/21
Test Drone Payload	20%	9/13/21	9/19/21
Microcontroller Research & Setup	25%	9/10/21	9/30/21
Electric Circuit Board Testing	0%	9/30/21	10/10/21
Construct Deployment Mechanism	0%	9/20/21	10/5/21
Test Deployment Mechanism	0%	10/5/21	10/15/21
Assemble Storage Unit Components	0%	9/20/21	9/26/21
Controller & Drone Integration	0%	10/11/21	10/21/21
Integrated Deployment Time Testing	0%	10/11/21	10/14/21
Drone Assembly Final Test	0%	10/16/21	10/22/21
Compile Instructional Manual	0%	10/23/21	10/29/21
Grace Period & Troubleshooting	0%	10/22/21	11/20/21
Formal Project Presentation	0%	11/20/21	11/26/21



Future Work

- FEA Analysis
- Construct Full Prototype
- Connect Drone/Controller to Release Mechanism
- Validation Testing
- Project Demonstration Video
- Operational Manual

Hubsan Zino Pro Plus