FAN FLYER:
FINAL PROPOSAL

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Figure 1: Fan Flyer

2 PROJECT DESCRIPTION

- The team is to design and prototype a pitch control actuator for the fan blades of a Fan Flyer
- Project Client
  - Jim Corning of Novakinetics Aerosystems

Jim Corning

NOVAKINETICS AEROSYSTEMS

3 PROJECT DESCRIPTION

What is Fan Flyer and what its purpose ?

- VTOL (Vertical Take-Off and Landing) aircraft
- spray crops
- carry water to forest fires
- carry supplies to remote locations,

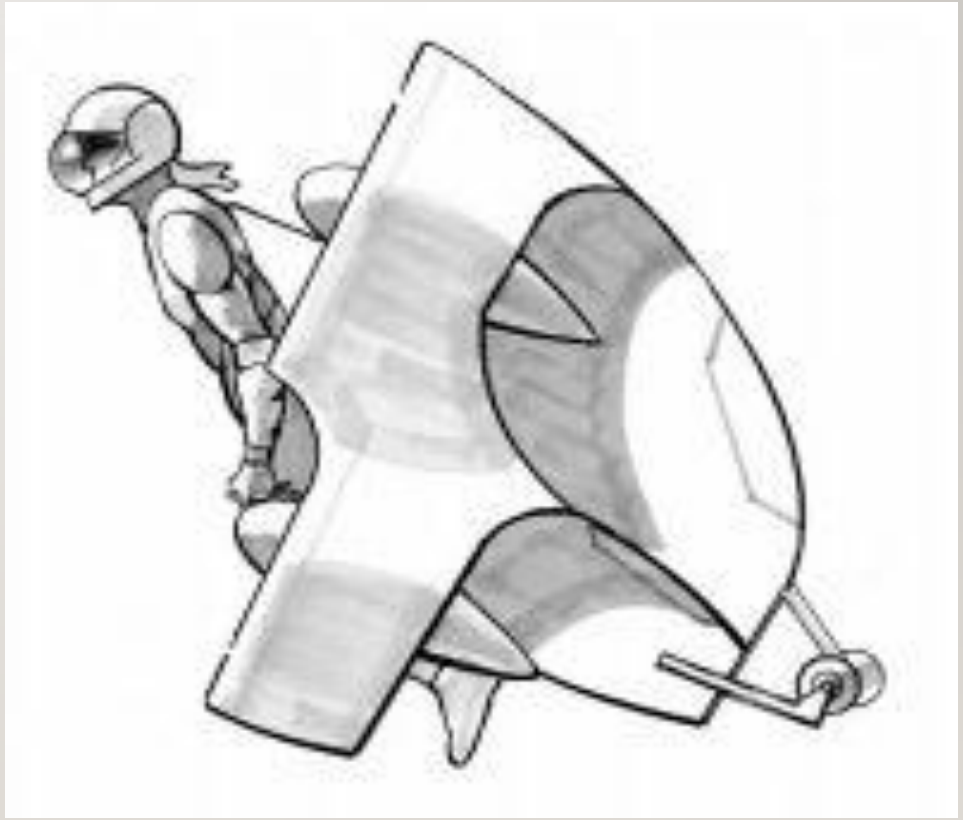


Figure 2: Fan Flyer

4 BLACK BOX

- The use of a Black Box model is very crucial since it allows for a full scale understanding of what the system requires to accomplish

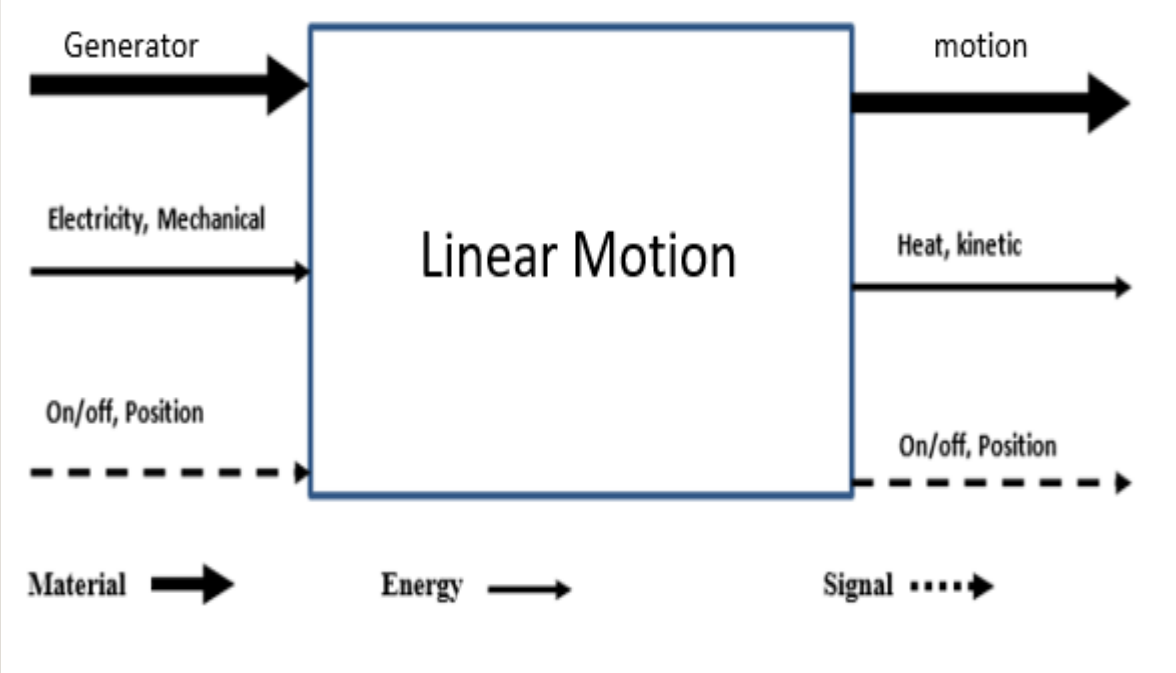


Figure 3: Black Box Model

5 FUNCTIONAL DECOMPOSITION

- The functional model is a breakdown of how the team theorized the working of pitch actuator system.
  - Both the black box and the functional model were critical for us to come up the our concepts

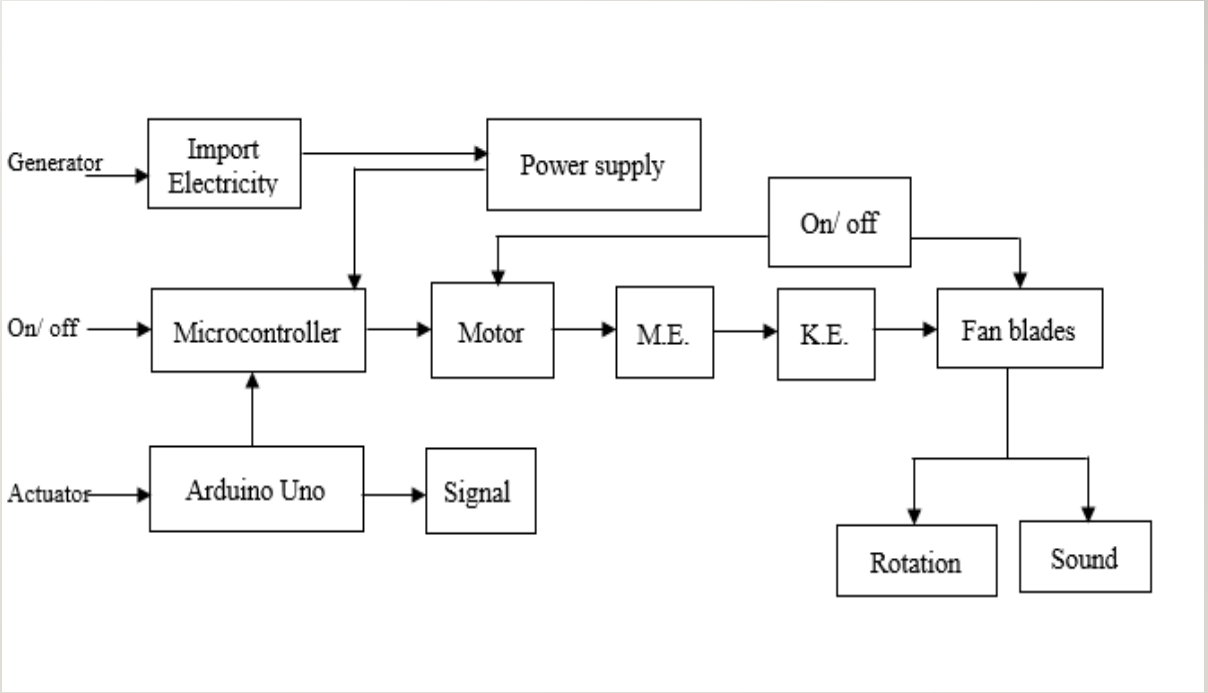


Figure 4: Functional Model

6 DESIGN DESCRIPTION

- CAD Draft
- Motor, Gears, aluminum bar

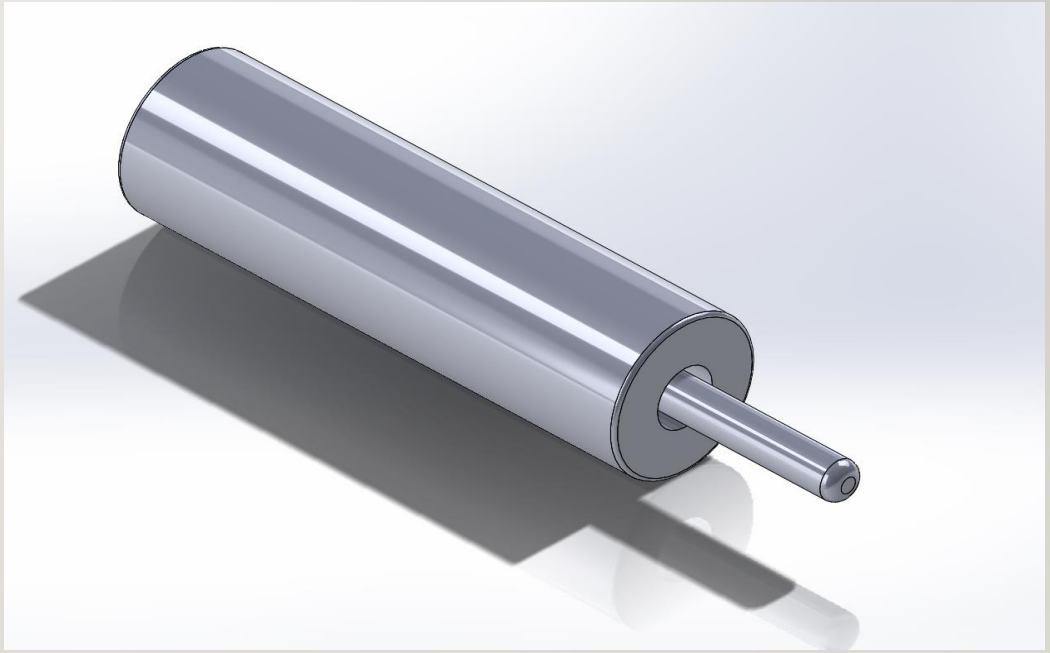


Figure 5: Actuator

7 BILL OF MATERIALS

Bill of Materials						
Materials	**Part No.**	**Manufactor**	**Description**	**Number of part**	**Cost per Part**	**Total Cost**
Servo Motor	NEMA23-AMT112S	CUI, INC.	Stepper Servo Motor	1	$ 132.25	$ 132.25
Servo Motor	NEMA11-13-01D-AMT112S	CUI, INC.	Stepper Servo Motor	1	$ 120.91	$ 120.91
Brushless DC Motor	EC044A-20D0-803-SP	Haydon Kerk & Pittman	44mm Brushless DC motor	1	$ 105.00	$ 105.00
Stepper Motor	STP-MTRH-23079	Automation Dlrect	Stepper motor - 5.6 Amp	1	$ 52.00	$ 52.00
3D Model	N/A	Maker Lab NAU	PLA 3D Printed object	1	$ 6.76	$ 6.76
Steel Bar	ASTM A36	Discount Steel	Hot Rolled Steel Square Bar	1	$ 25.23	$ 25.23
Aluminum Bar	ASTM B221-08 6061-T6	Discount Steel	Aluminum Sqaure Bar	1	$ 47.88	$ 47.88

8 ANALYSES 1: MOTOR

Now, for moving a load of 25lb. The actuator force is:

$$F_{actutor} = \left(\frac{w_t}{g}\right)a + F_{applied} + \mu W_{Load}$$

Where, W_L = 25lb that is considered as load that is to be moved using this particular force:

g = 32.2ft/s^2

μ = 0.9

$W_t = W_{Load} + W_{actuator}$

$W_t = 25 + 10$

$W_t = 35$lb

For acceleration, a = $\frac{\Delta v}{t} = \frac{\Delta s}{t^2} = \frac{7}{10^2}$ = 0.07 in/sec^2

Substituting all the values in the formulae:

$$F_{actutor} = \left(\frac{35}{32.2}\right)\frac{0.07}{12} + 0 + 0.9\left(25\right)$$

$$F_{actutor} = 22.5\ lb$$

This is the force applied by the actuator considering the effect of friction.

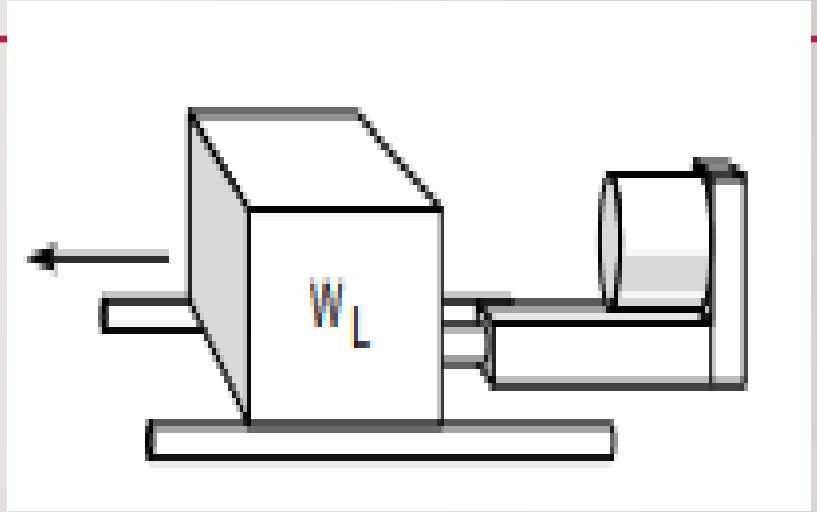


Figure 6: Actuator

9 ANALYSIS 2: MOTION STUDY

- How the Design will fit into the blades
- Actuator purpose
- How the Actuator interacts with the parts of the fan

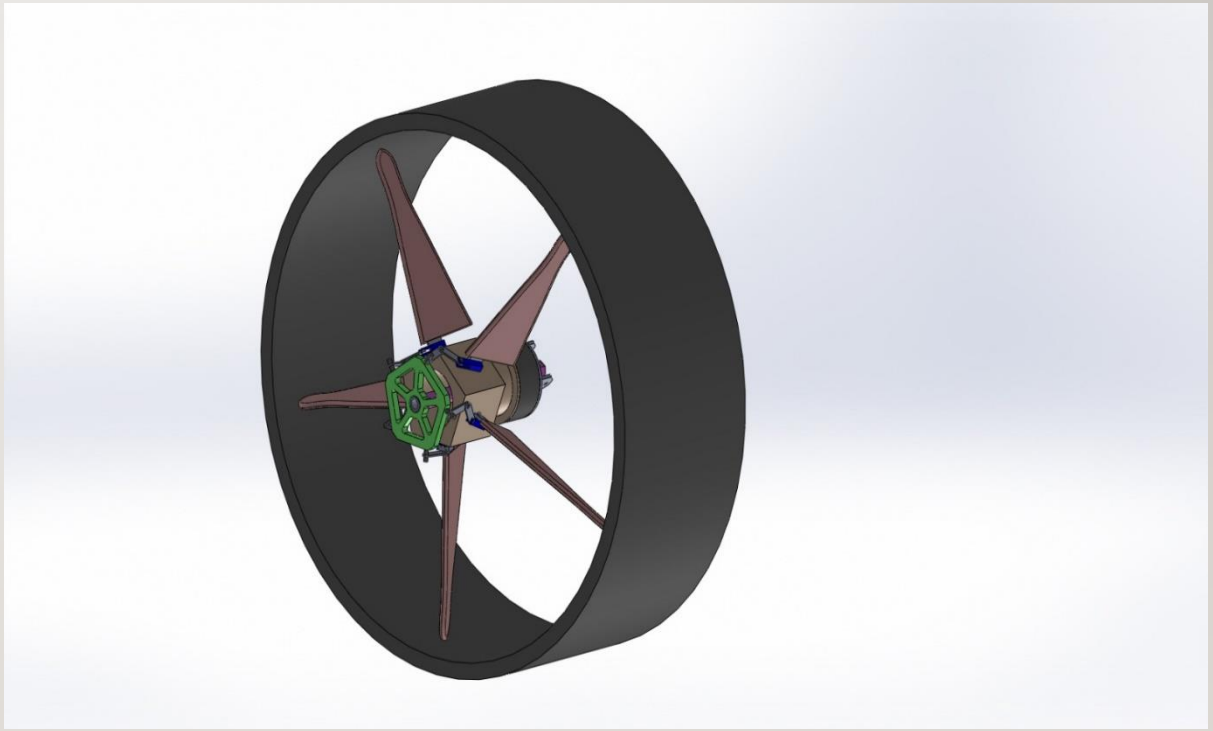


Figure 7: Fan Cad Model

10 ANALYSIS 2

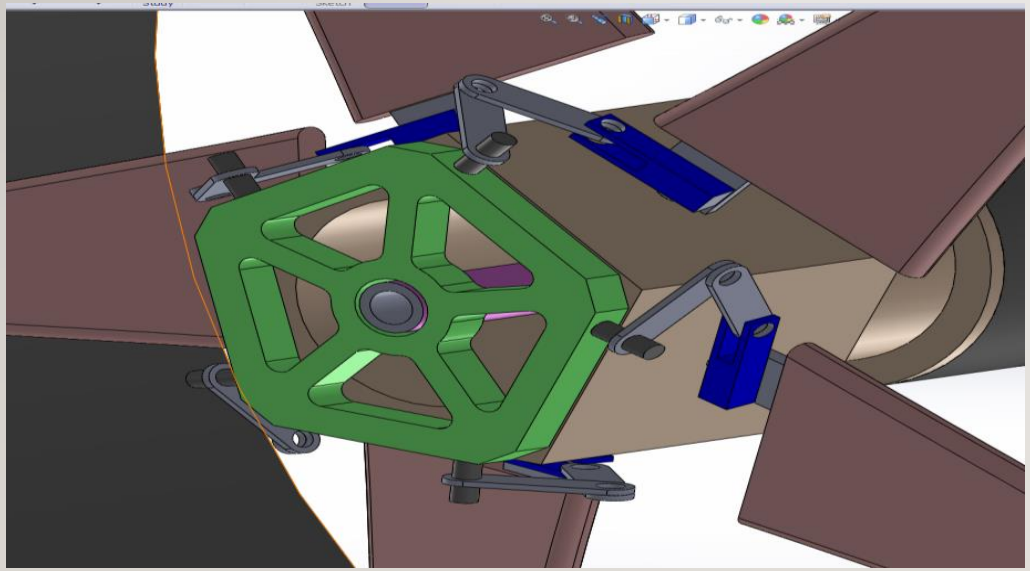


Figure 8: Mechanisms in stowed condition

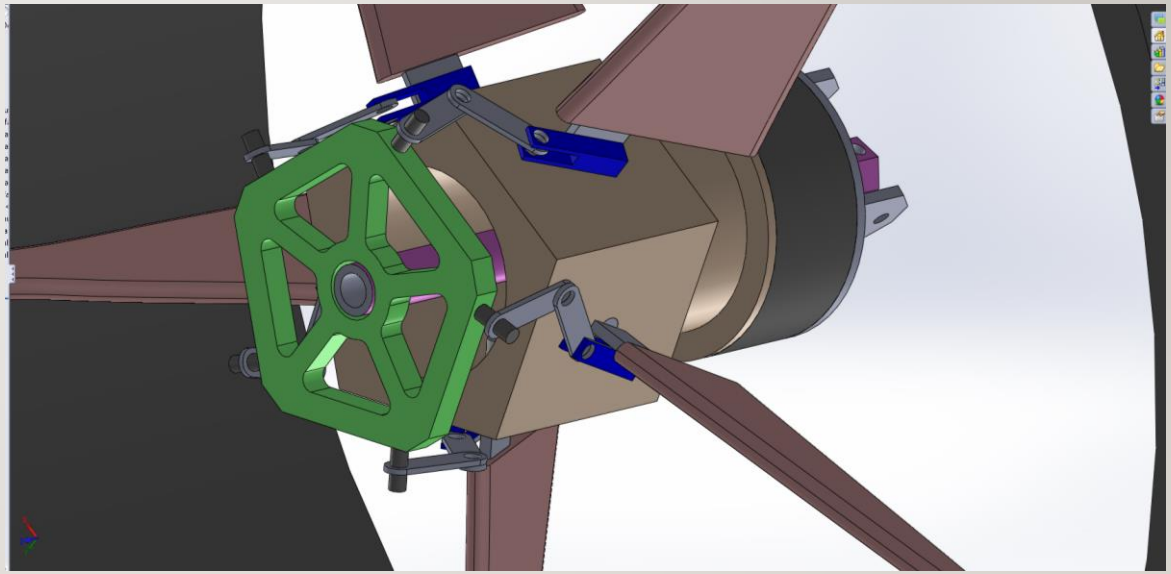
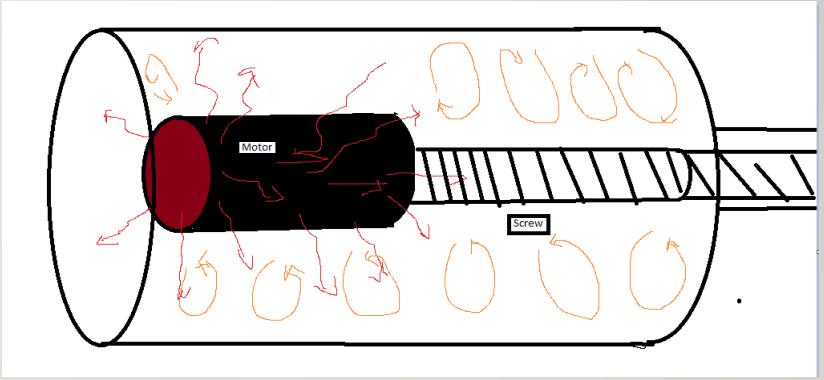


Figure 9: Mechanisms in fully deployed condition

11 ANALYSIS 3 :THERMAL ANALYSIS

- Equation for conduction for the aluminum.
- $q^{"} = k * \frac{T_1 - T_2}{L}$
- $q^{"} = 177 \frac{W}{K*m} * \frac{(293-343)K}{1m}$
- $q^{"} = -8850\ W/m\text{^}2$
- Equation for convection in the actuator
- $q^{"} = h * (T_s - T_\infty)$
- Experiment to be conducted on April 22,2019



12 ANALYSIS 4: POWER ANALYSIS

- Conversion of electrical power into mechanical power by DC motors
- More power is in association with large size motor.
- Analysis of Mechanical power due to work load.
- 25 Pounds x 4.448 Nt = 111.2 Nt
- Mechanical power output of 111.2Nt x 0.0254rpm = 2.8245 W.
- Relationship of current and torque $E_f I_a = \Gamma \omega_m$
- Analysis of Electrical power due to current and voltage.
- 12V DC and 0.01 horsepower for an actuator
- Taking in account of resistive losses, more power is required.

13 CUSTOMER REQUIREMENT

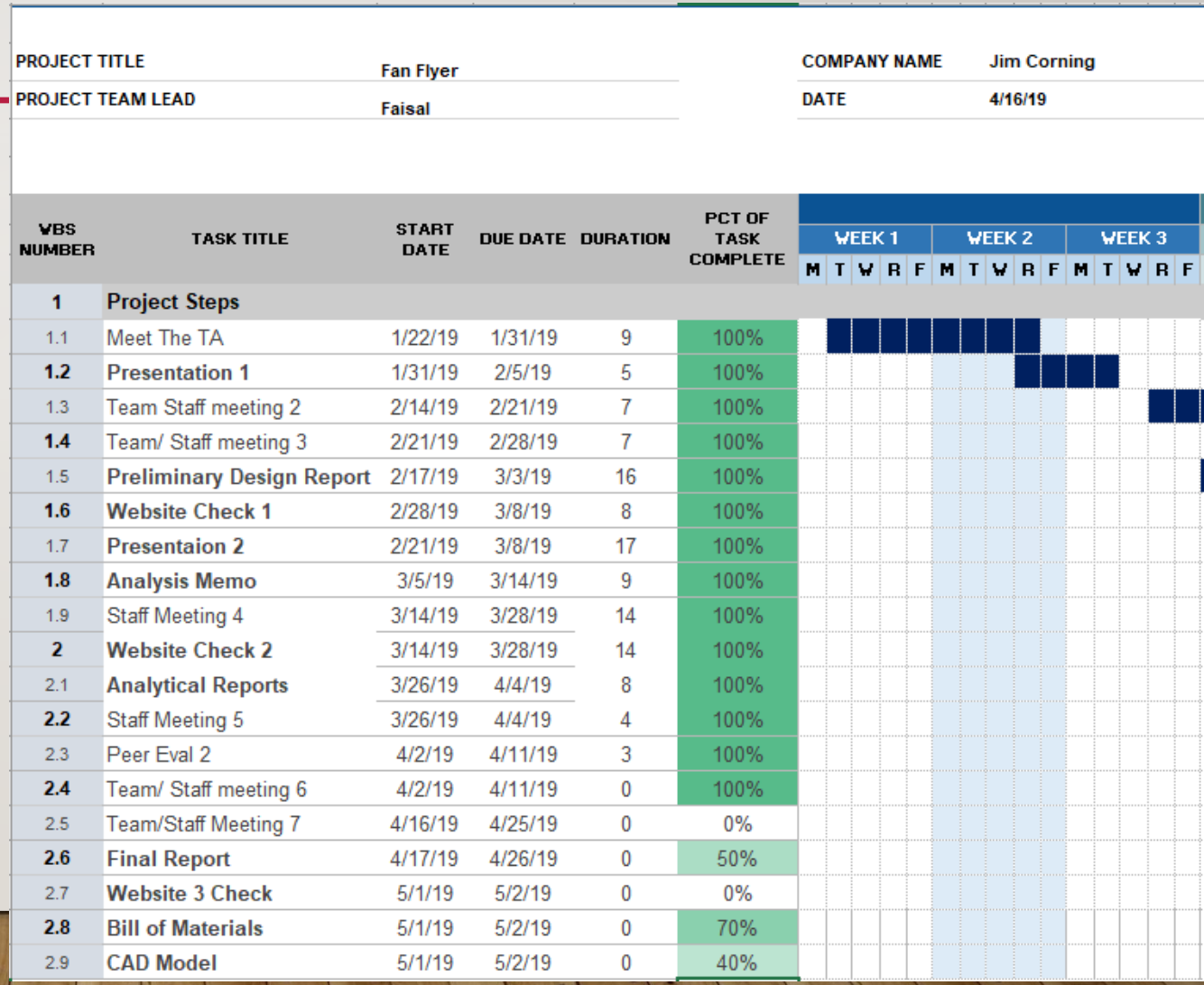
- Actuator Size (4”x4”x12” in)
- Actuator Weight (>2 lb.)
- Overall Travel (1.5” in)
- Force to move Rod (>25 lb.)
- Motor power (12 Volt)
- Duty Cycle (100%)
- Actuation Speed (>1 in per sec)

14 SCHEDULE

- We are currently up to date.
  - Remaining assignments
    - Team staff meeting
    - BOM, CAD package, Final Report
- These will be complete in the upcoming days
- Full Gantt Chart in Appendix A

PROJECT TITLE	Fan Flyer	COMPANY NAME	Jim Corning
PROJECT TEAM LEAD	Faisal	DATE	4/16/19

WBS NUMBER	TASK TITLE	START DATE	DUE DATE	DURATION	PCT OF TASK COMPLETE
1	**Project Steps**				
1.1	Meet The TA	1/22/19	1/31/19	9	100%
1.2	**Presentation 1**	1/31/19	2/5/19	5	100%
1.3	Team Staff meeting 2	2/14/19	2/21/19	7	100%
1.4	Team/ Staff meeting 3	2/21/19	2/28/19	7	100%
1.5	**Preliminary Design Report**	2/17/19	3/3/19	16	100%
1.6	**Website Check 1**	2/28/19	3/8/19	8	100%
1.7	**Presentaion 2**	2/21/19	3/8/19	17	100%
1.8	**Analysis Memo**	3/5/19	3/14/19	9	100%
1.9	Staff Meeting 4	3/14/19	3/28/19	14	100%
2	**Website Check 2**	3/14/19	3/28/19	14	100%
2.1	**Analytical Reports**	3/26/19	4/4/19	8	100%
2.2	Staff Meeting 5	3/26/19	4/4/19	4	100%
2.3	Peer Eval 2	4/2/19	4/11/19	3	100%
2.4	Team/ Staff meeting 6	4/2/19	4/11/19	0	100%
2.5	Team/Staff Meeting 7	4/16/19	4/25/19	0	0%
2.6	**Final Report**	4/17/19	4/26/19	0	50%
2.7	**Website 3 Check**	5/1/19	5/2/19	0	0%
2.8	**Bill of Materials**	5/1/19	5/2/19	0	70%
2.9	**CAD Model**	5/1/19	5/2/19	0	40%



15 BUDGET

- Budget - $500.00
- Anticipated expenses - $475.00
  - Manufactured Parts - $100
  - Materials - $225
  - Motor - $100
  - Miscellaneous – $50
  - Total remaining anticipated - $25
- Expenses to date - $6.76
- Remaining Budget - $493.23

Project Budget Reporting

5/3/2019

PROJECT TITLE	Fan Flyer		**CLIENT**	Jim Corning
PROJECT TEAM LEAD	Faisal		**DATE**	4/17/19
Total Budget :	**$ 500.00**			
*NOTE THIS BUDGET PLAN IS A ROUGH ESTIMATE				

Expenses	Plan ($)	Actual ($)	Date Recorded	Purchaser
Manufactured parts	$ 100.00	$ 6.76		
3D Part	$ 10.00	$ 6.76	4/15/2019	Khaled
	$ -	$ -		
	$ -	$ -		
	$ -	$ -		
	$ -	$ -		
Aluminum Bar	$ 75.00	$ -		
Steel Bar	$ 150.00	$ -		
Materials used	$ 50.00	$ -		
Motor	$ 50.00	$ -		
Unused	$ 75.00	$ -		
Total For parts	**$ 500.00**			

QUESTIONS?

18 APPENDIX A : GANTT CHART

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2.7	**Website 3 Check**	5/1/19	5/2/19	0	0%
2.8	**Bill of Materials**	5/1/19	5/2/19	0	70%
2.9	**CAD Model**	5/1/19	5/2/19	0	40%