Fan Flyer:
Concept Generation & Evaluation

CHRISTIAN RIGGS
FAISAL ALMUTAIRI
KHALED ALAZEMI
ALI ALMARI

Figure 1: Fan Flyer

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

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

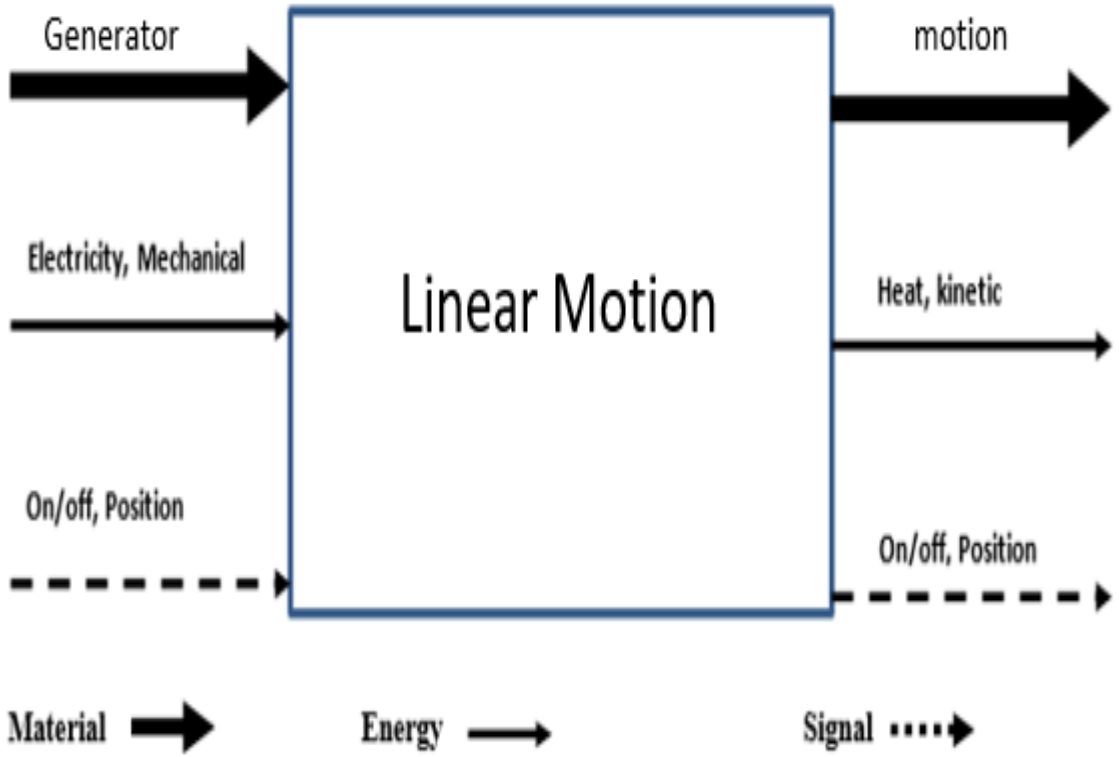


Figure 2: Black Box Model

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

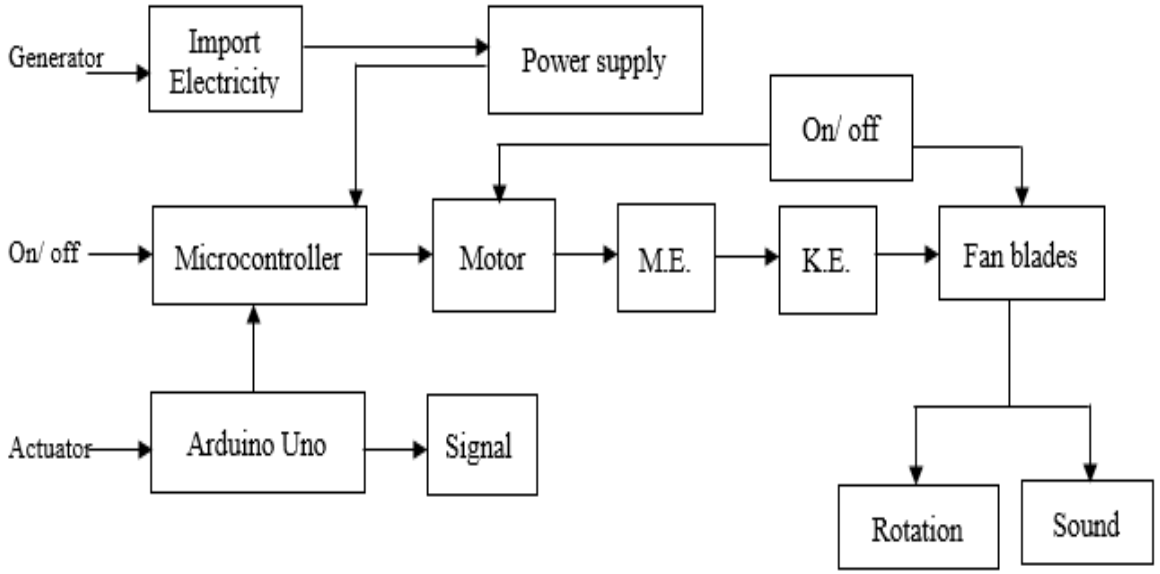


Figure 3: Functional Model

Concept Generation

Hydraulic pitch system

- This design is of a hydraulic pump comprising of specialized control valves and distribution blocks of pressure

Advantages

- Speed control, High torque, high forces in a small package, No need of gears, Efficient

Disadvantages

- Increased incidences of leakage.
- Requires regular maintenance

Back of the Envelope

- Force = Pressure / Area

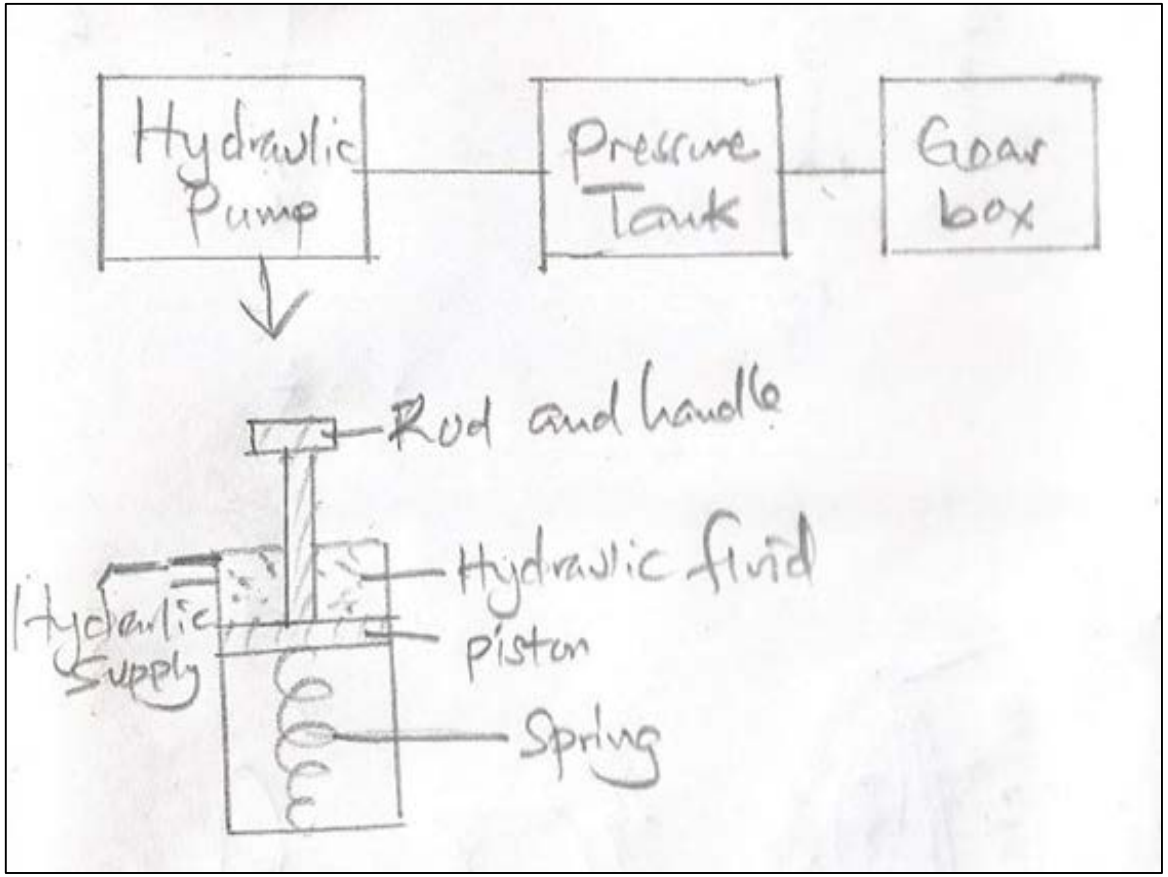


Figure 4: Hydraulic System

Concept Generation

Electric pitch system

- This design is of a power source of a battery. The battery is charged from an external source or from an on board solar panel

Advantages

- Low cost, high torques at low speeds,

Disadvantages

- Duty Cycle is not achieving 100 percent. Materials in motor will not withstand that much heat.

Back of the Envelope

- Angular Speed = velocity x length

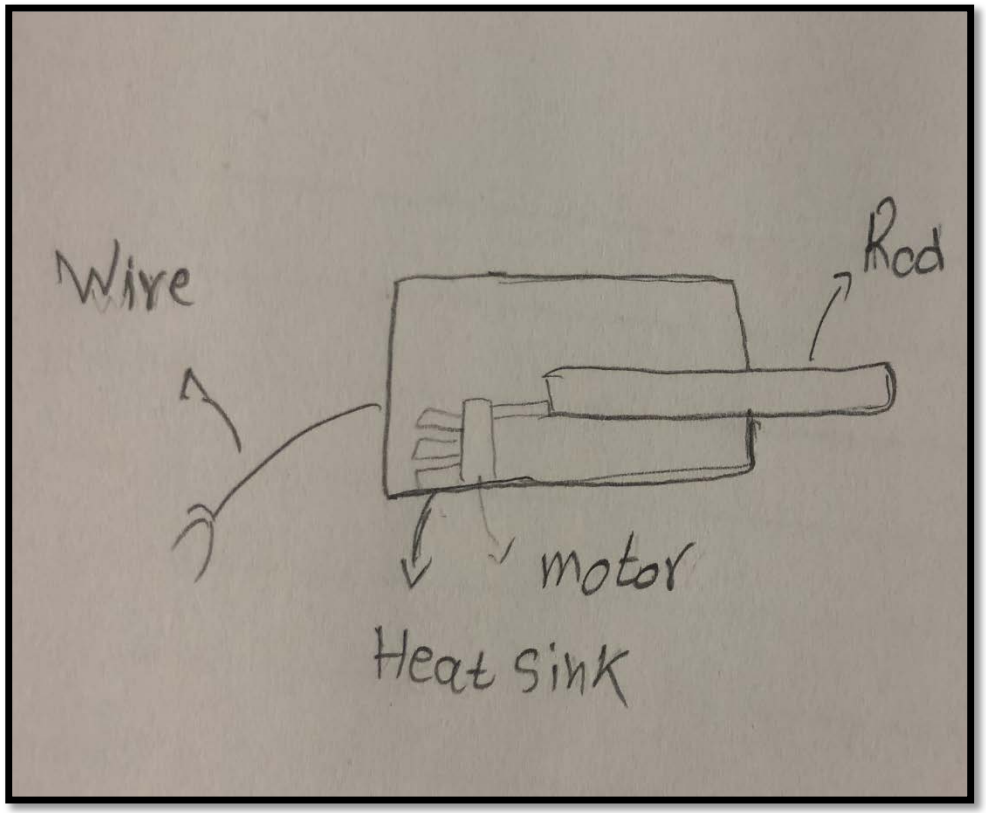
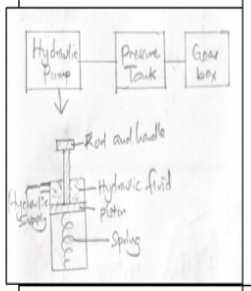
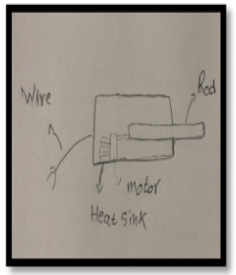
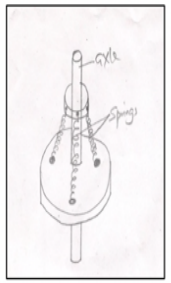
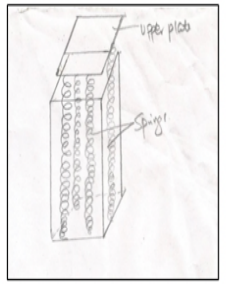
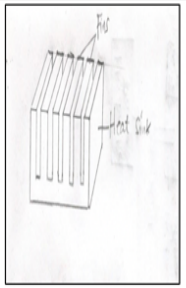


Figure 5: Electric System

Pugh Charts Decision:

Requirements	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5
					
Reliability	+	S	S	-	-
Durability	+	-	+	S	+
Actuator Size	S	S	-	S	S
Safety	S	S	S	+	+
Weight	-	-	+	S	-
Efficiency	+	+	+	S	S
Steer Rod Travel Rate	S	+	S	-	+
Actuator Force	S	-	-	S	S
No. of '+'	**3**	**2**	**3**	**1**	**3**
No. of '-'	**1**	**3**	**2**	**2**	**2**
No. of 'S'	**4**	**3**	**3**	**5**	**3**
Score	**2**	**-1**	**1**	**-1**	**1**

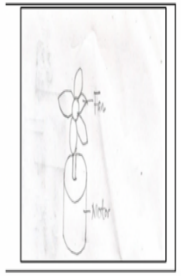
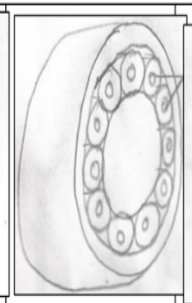
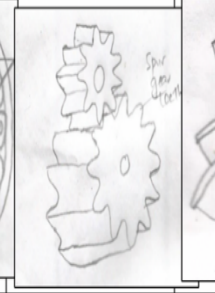
Requirements	Concept 6	Concept 7	Concept 8	Concept 9	Concept 10
					
Reliability	-	S	S	S	+
Durability	S	+	+	S	S
Actuator Size	-	-	S	-	S
Safety	S	S	+	S	S
Weight	S	+	-	-	S
Efficiency	S	+	S	S	S
Cost	S	-	+	+	-
Actuator Force	S	-	S	S	S
No. of '+'	**0**	**3**	**3**	**1**	**1**
No. of '-'	**2**	**3**	**1**	**2**	**1**
No. of 'S'	**6**	**2**	**4**	**5**	**6**
Score	**-2**	**0**	**2**	**-1**	**0**

Figure 6: Pugh Charts

Decision Matrix

The decision matrix helped to determine the most appropriate design.

The best concept is the hydraulic actuator which is concept 1 in the decision matrix.

Criteria	Weight	Concept 1		Concept 3		Concept 5		Concept 8	
		Score	WS	Score	WS	Score	WS	Score	WS
DutyCycle (100%)	5	5	**25**	4	**20**	3	**15**	4	**20**
Actuation Speed 1' per second	5	4	**20**	3	**15**	4	**20**	3	**15**
Stock length of 1.5"	4	3	**12**	3	**12**	4	**16**	3	**12**
force of 25lbs	3	4	**12**	4	**12**	3	**9**	4	**12**
Weight of 2lbs	2	2	**4**	3	**6**	2	**4**	2	**4**
Reliability of Actuator	1	2	**2**	3	**3**	2	**2**	2	**2**
Total			**75**		**68**		**66**		**65**

Figure 7: Decision Matrix

CAD Model: Hydraulic Actuator

Advantages

- It is easy to control
- It has a 100% duty cycle
- It has actuation speed more than 1” per sec.
- Generates high force

*Rough CAD Model

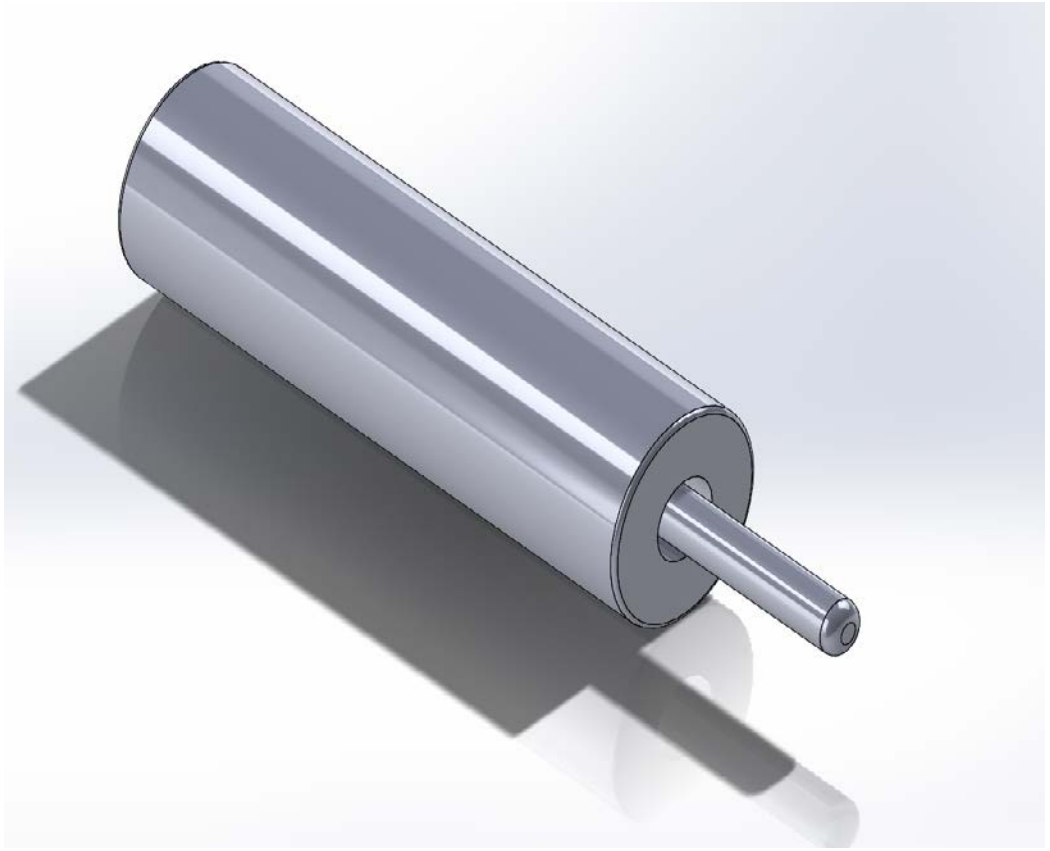


Figure 8: hydraulic Actuator

Schedule

Gantt Chart

Shows the key assignments

- The bold tasks are the important tasks that need to be completed in a timely manner

Shows Due dates

Currently on time as the website has not been finalized.

VBS 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	50%
1.7	**Presentaion 2**	2/21/19	3/8/19	17	100%
1.8	**Analysis Memo**	3/5/19	3/14/19	9	0%
1.9	Staff Meeting 4	3/14/19	3/28/19	14	0%
2	**Website Check 2**	3/14/19	3/28/19	14	0%
2.1	**Analytical Reports**	3/26/19	4/4/19	8	0%
2.2	Staff Meeting 5	3/26/19	4/5/19	4	0%
2.3	Peer Eval 2	4/2/19	4/11/19	3	0%
2.4	Team/ Staff meeting 6	4/3/19	4/12/19	0	0%
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	0%
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	0%
2.9	**CAD Model**	5/1/19	5/2/19	0	0%

Figure 9: Gantt Chart

Budget

Total Budget of $1000

- Client will sit down with the team to discuss this into further details

Anticipated to use $850 of the budget

Have not purchased any items related to the project at the moment

Project Budget Reporting

PROJECT TITLE	Fan Flyer		**CLIENT**	Jim Corning
PROJECT TEAM LEAD	Faisal		**DATE**	3/4/19
Total Budget :	**$ 1,000.00**			
***NOTE THIS BUDGET PLAN IS A ROUGH ESTIMATE**				
Expenses	**Plan ($)**	**Actual ($)**	**Date Recorded**	
Manufactured parts	$ 200.00			
Aluminum Bar	$ 150.00			
Steel Bar	$ 250.00			
Materials used	$ 100.00			
Motor	$ 150.00			
Unused	$ 150.00			
Total For parts	**$ 1,000.00**			

Figure 10: Budget Report

Questions?