Solar Tracking
Concept Generation and Selection

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Outline

- Project Updates
- Design Concepts
- Decision Matrix Weighting
- Decision Matrix with Chosen Design
- Team Schedule
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Project Updates

- Project is now only movement of solar panels, not actual solar tracking.
- Competition early 2014 with Electrical Engineering team.

Goal Statement Re-evaluation

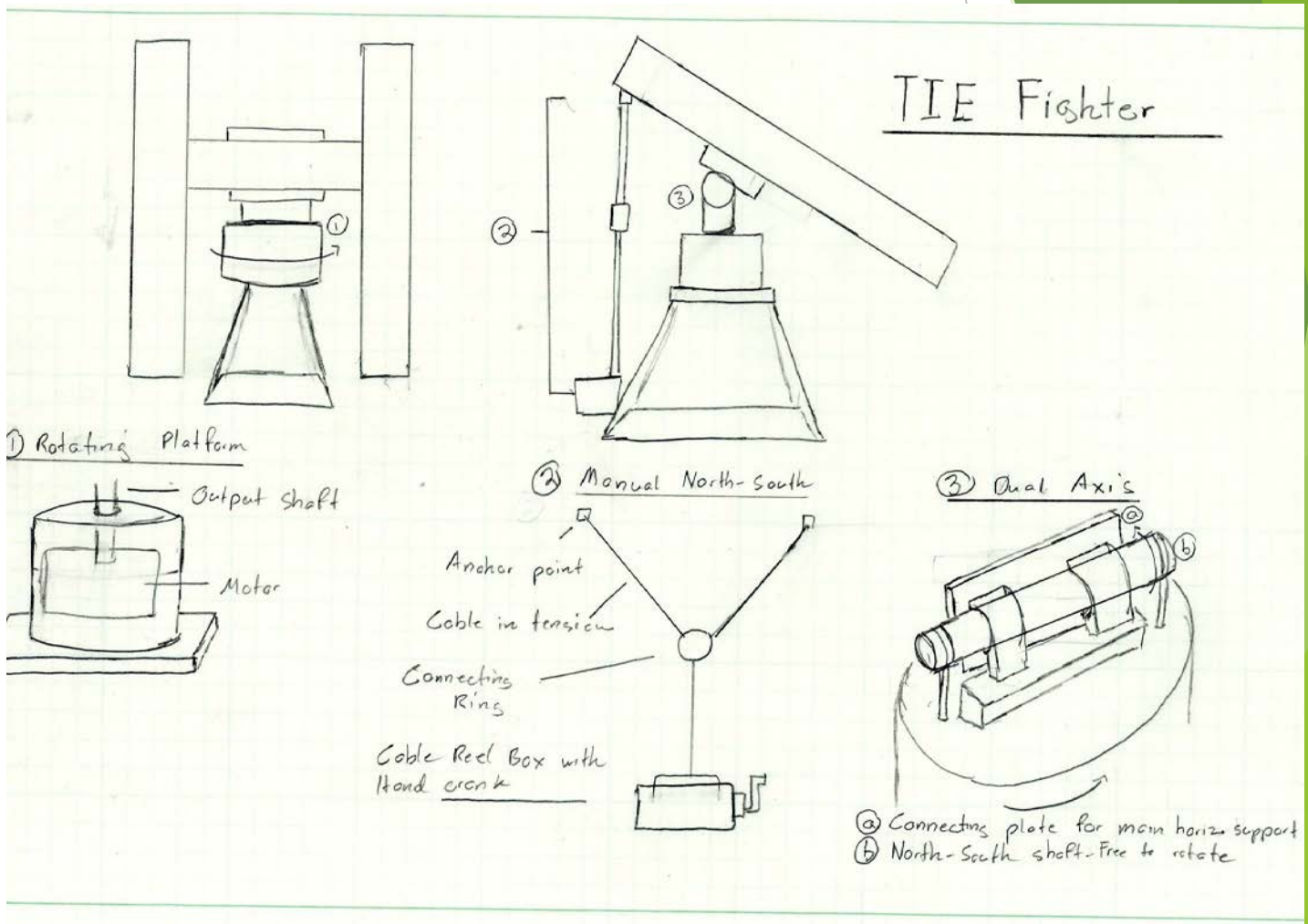
- Previous Goal
  - “Design a system that maximizes the amount of sun being absorbed by a solar panel, as well as display power output.”
- New Goal Statement
  - “Design a system that maximizes amount of sun being absorbed while minimizing the cost of operation and maximizing the reliability.”

Design Concepts

- Tie Fighter
  - Dual axis
- Nickel Titanium
  - Single axis using nitinol
- Tabletop
  - Strong weight support
- Sun Flower
  - Dual axis, very accurate
- Direct Rotation
  - Dual axis, manual

TIE Fighter

- Uses motor for East- West tracking
- North- South are manual via a hand crank
  - Cables anchored to top of structure
  - Lengthen or retract to change angle
- Advantages
  - Efficient
  - Inexpensive
- Disadvantages
  - Stability concerns
  - Area
  - Reliability



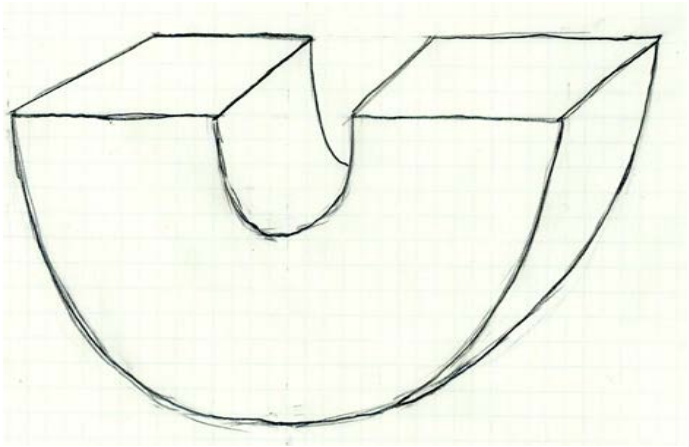
Nickel Titanium

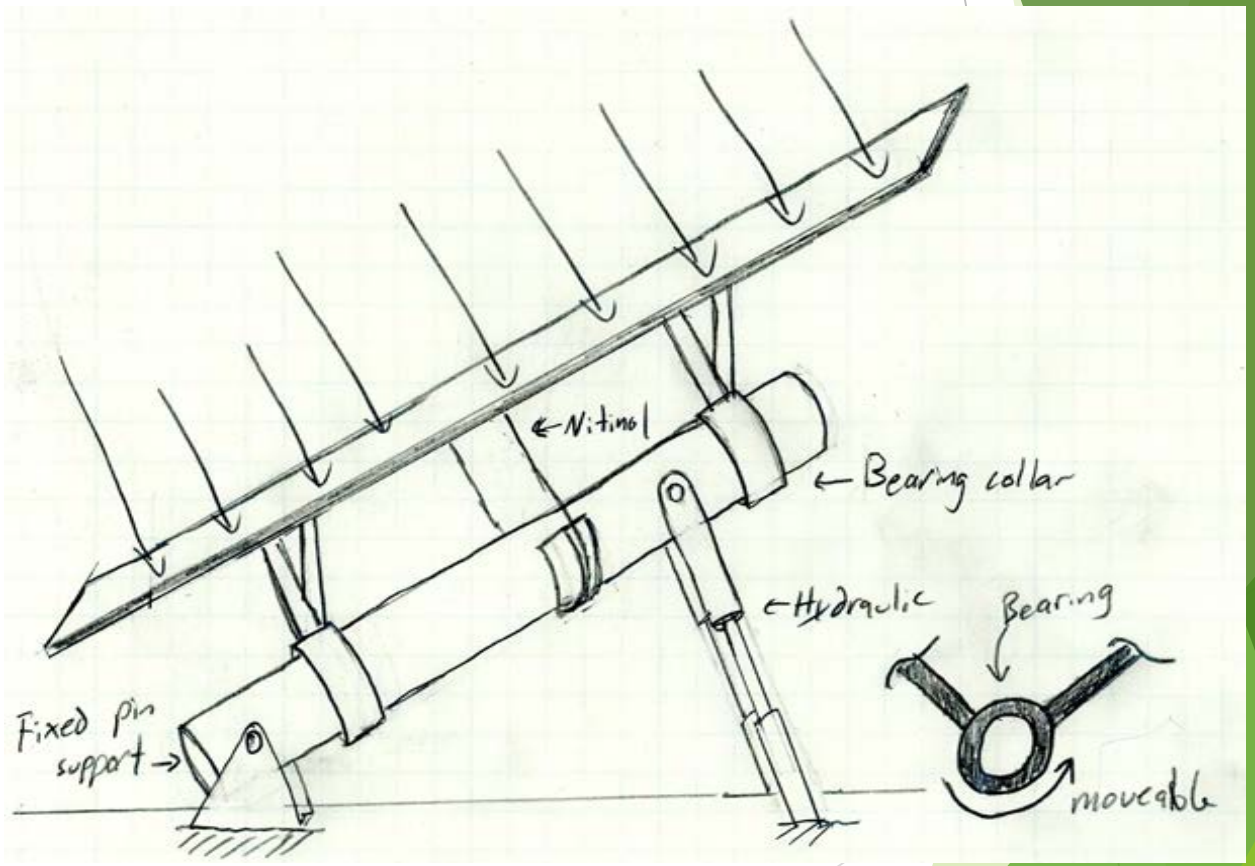
- Uses Nitinol, a shape memory alloy.
- Disadvantages
  - Temperature dependent
  - Movement is not very precise
- Advantages
  - Low energy usage
  - Very simple design
  - Removes need for electrical motor

Photo via FlexMet

Nickel Titanium

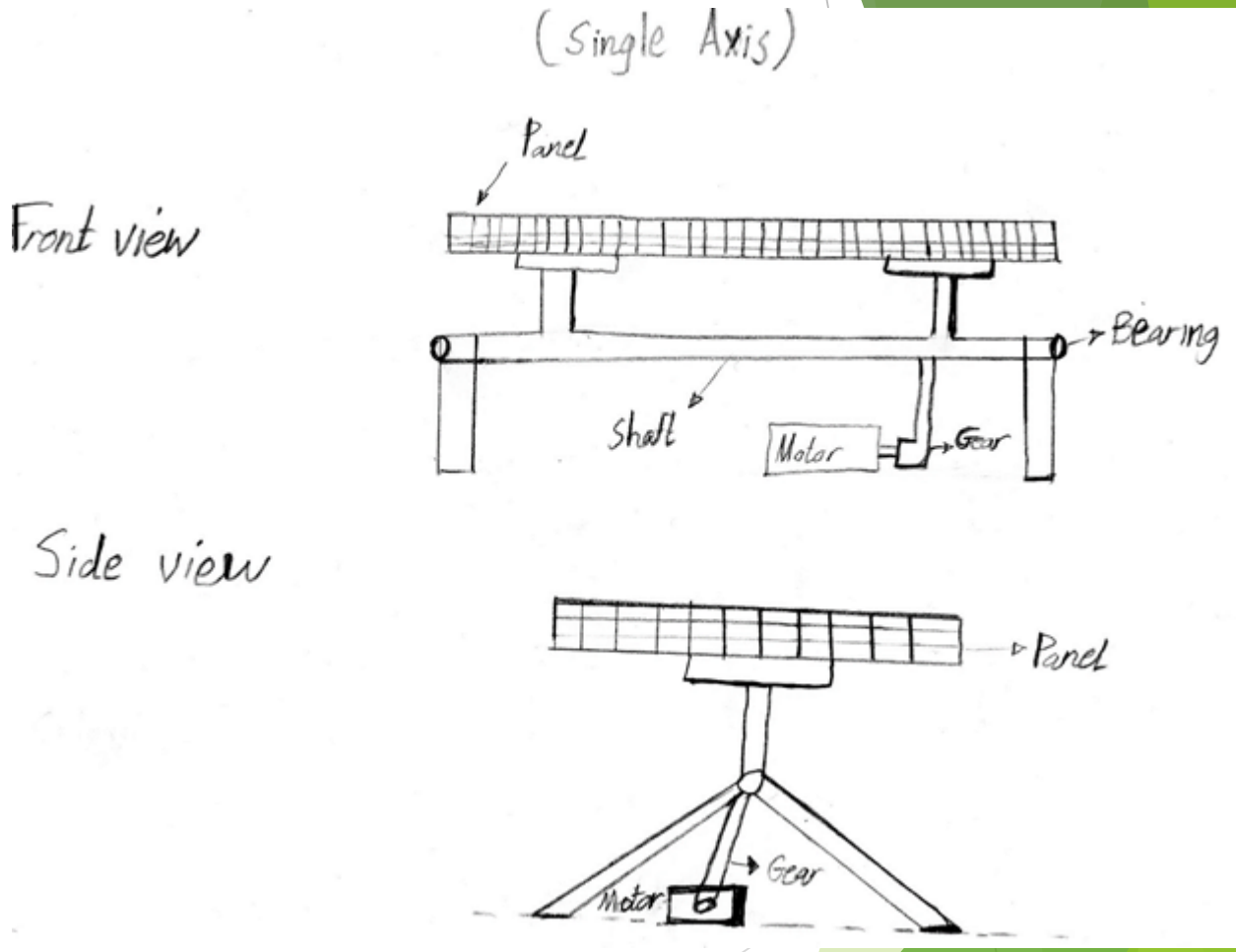
- Key is the half ellipse that provides the maximum rotational movement with the smallest linear movement.





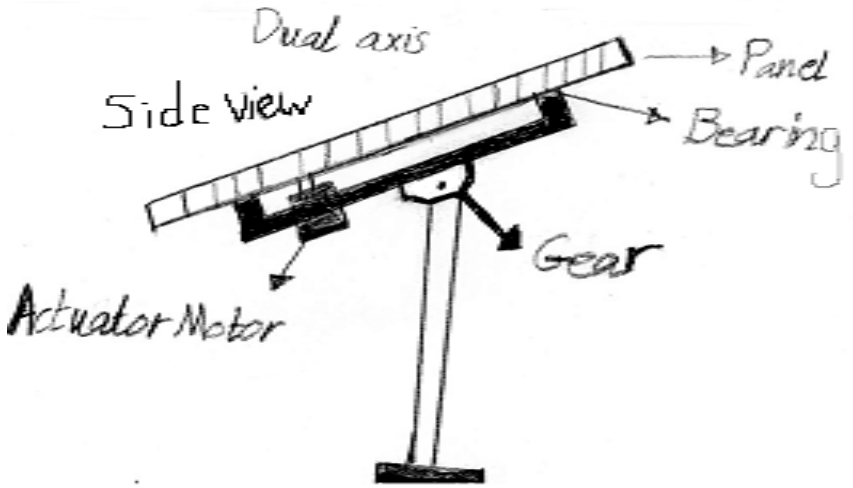
Tabletop

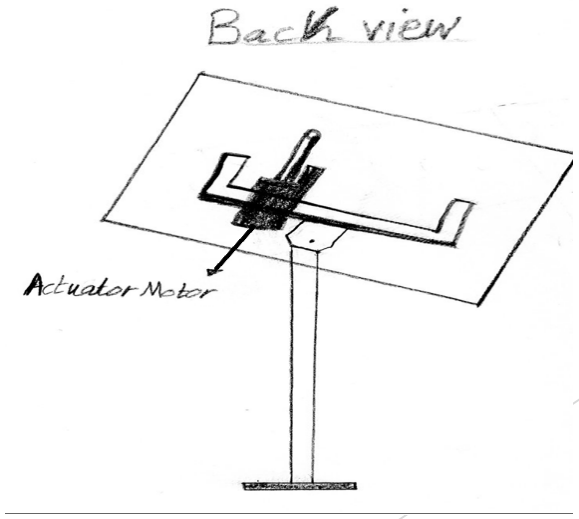
- Single axis, motor based, geared motor to use less power.
- Advantages :
  - Can have multiple panels
  - High reliability (very few parts)
  - Ease of operation (parts easily accessible)
- Disadvantages :
  - One degree of freedom
  - Poor space usage
  - Requires a powerful motor



Sun Flower

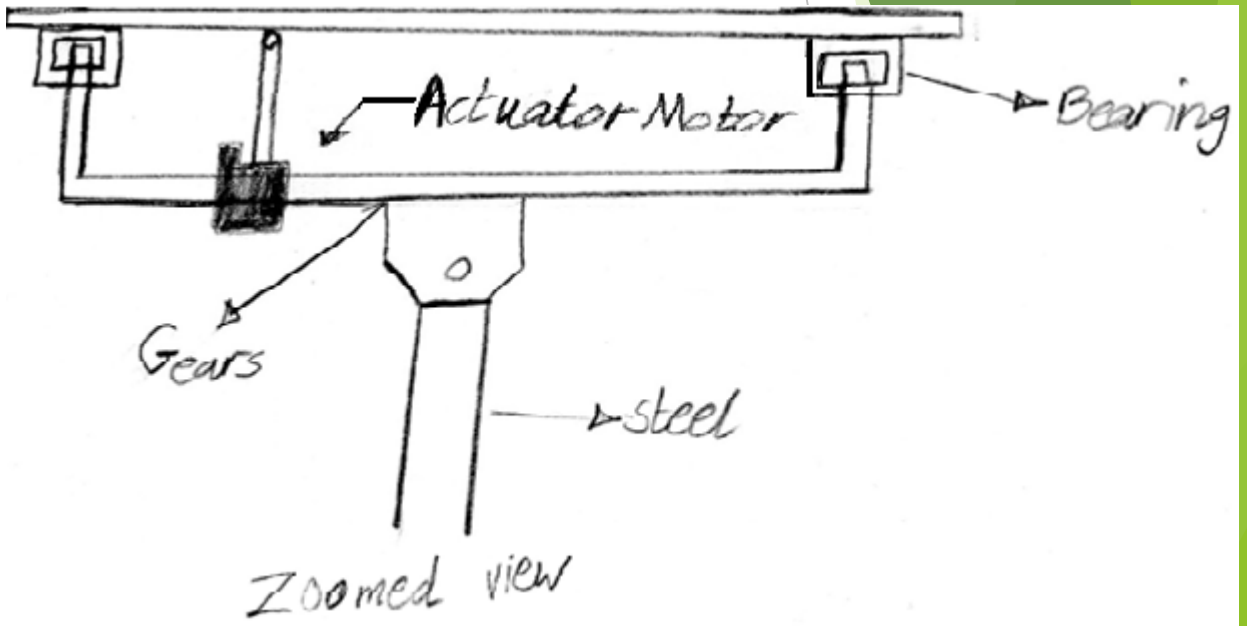
- Dual axis
- Motor based rotation for the E-W directions
- Gear based rotation for the N-S directions
- Advantages :
  - less space occupied
  - Accuracy of up to .5°
  - Portable
  - North-south and east-west movement, allow more energy to be generated





Sun Flower

- Disadvantages :
  - Maintenance is slightly more complicated due to usage of more parts
  - Only works for one solar panel
  - Cannot withstand severe weather conditions

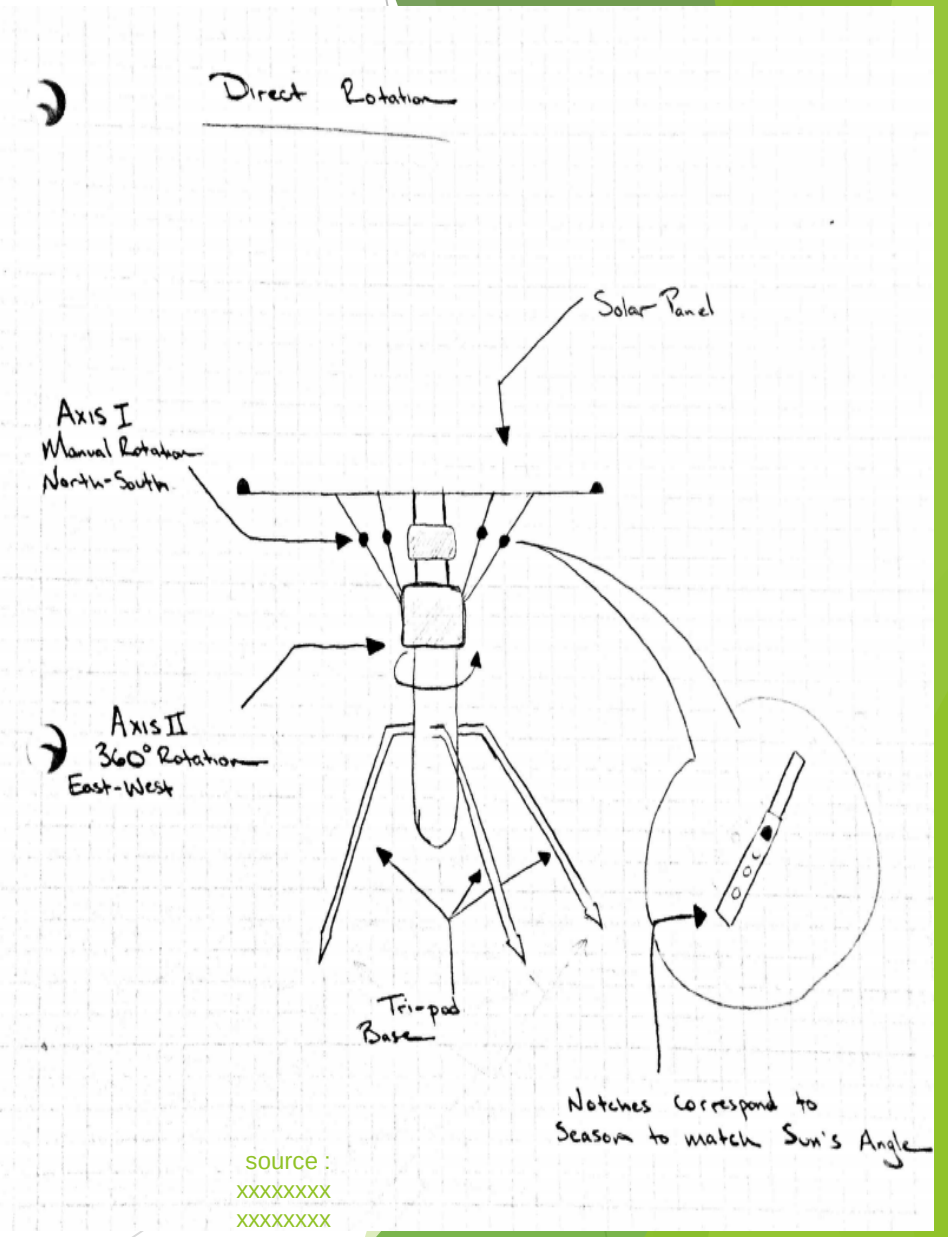


Direct Rotation

- East to West rotation is directly linked to a motor, allowing for 360° movement
- North and South are manually operated. Each notch corresponds to a specific month to match the sun's angle.

- Advantages:
  - Dual Axis
  - Cost Effective
  - Ease of Manufacturing
  - Small Area

- Disadvantages:
  - Manual Intervention Required



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Decision Criteria

Supported Weight: Weight (pounds)that the structure can support.

Cost: $ for parts and installation.

Efficiency: Energy generated.

Area: Space needed to operate tracking structure.

Reliability: System consistency, incorporates maintenance (life of parts).

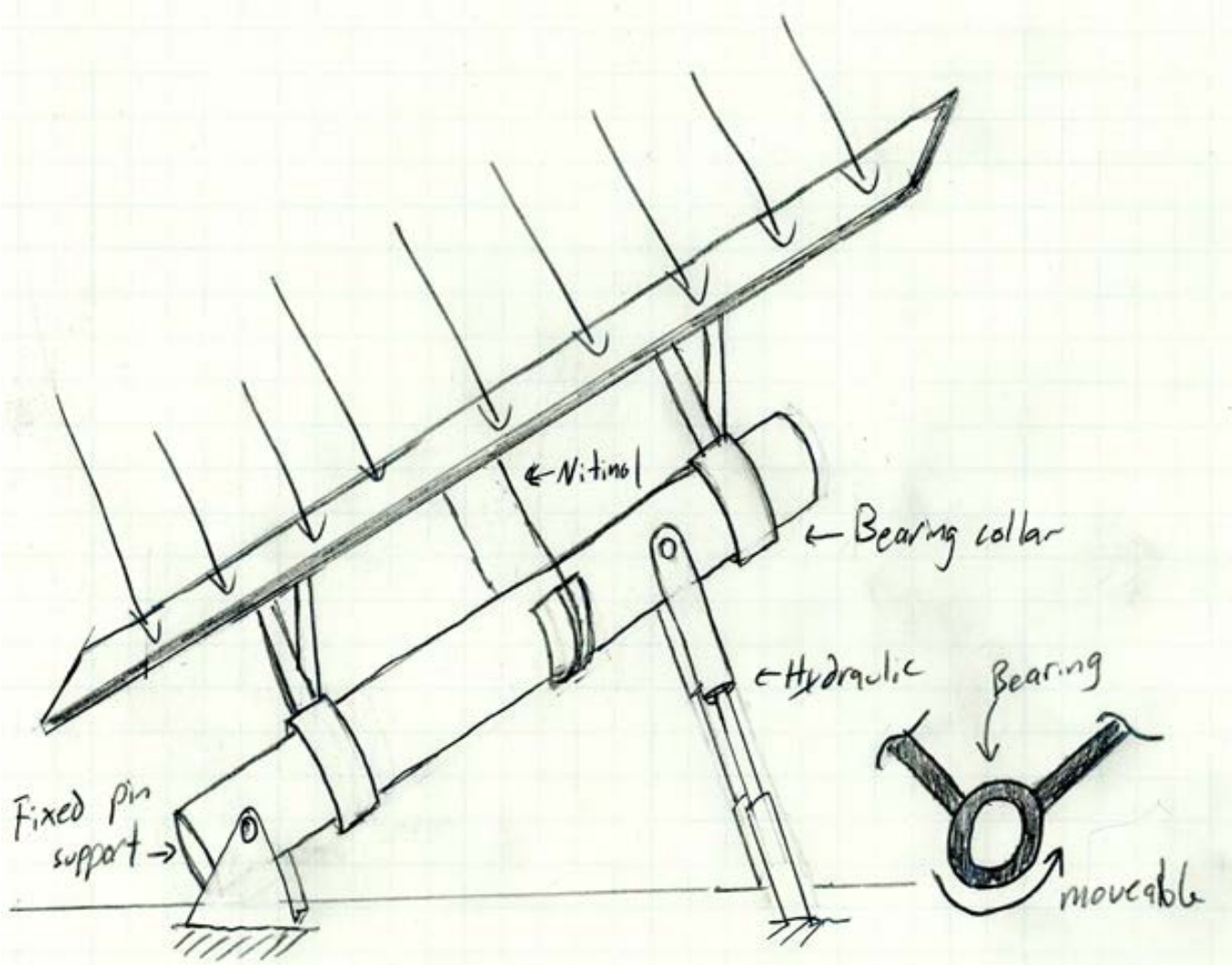
Decision Criteria and Weighting

Weight Criteria							
	Structure Weight (lbs)	Supported Weight (lbs)	Cost ($)	Efficiency (%)	Area (ft*ft)	Reliability (%)	Criterion Weight
Structure Weight	X	0	0	0	0	0	0
Supported Weight	1	X	0	0	1	0	0.14
Cost	1	1	X	1	1	0	0.29
Efficiency	1	1	0	X	1	0	0.21
Area	1	0	0	0	X	0	0.07
Reliability	1	1	0	1	1	X	0.29

Decision Matrix

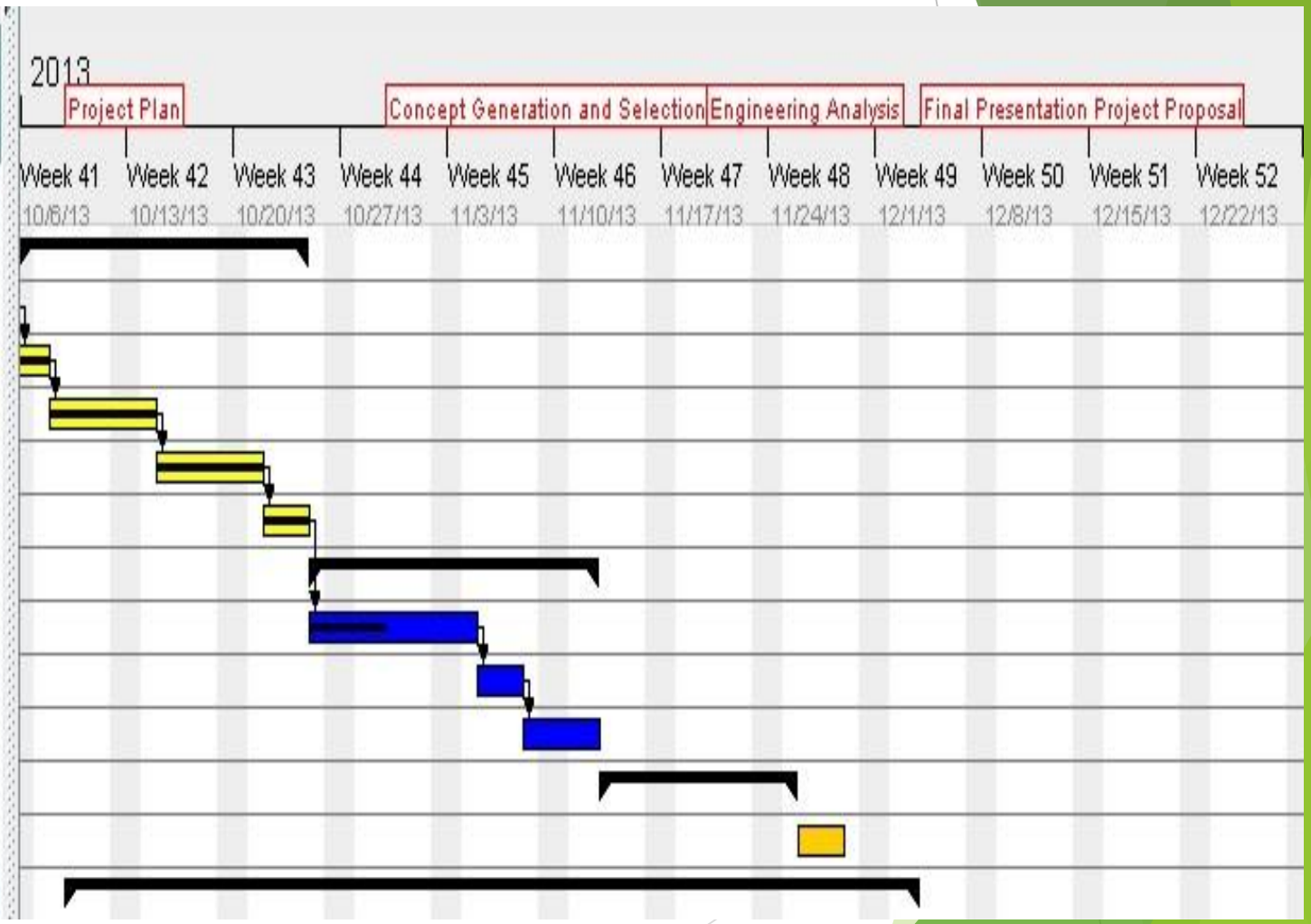
Design Decision Matrix						
Scale: 0-1-2-3-4	Criterion Weight	Nickel Titanium	Tie Fighter	Table Top	Direct Rotation	Sun Flower
Supported Weight (lbs)	0.14	3	2	4	3	1
Cost (S)	0.29	4	3	3	3	1
Efficiency (%)	0.21	2	4	2	4	4
Area (ft*ft)	0.07	3	2	2	3	4
Reliability (%)	0.29	4	3	3	3	2
Total	1	3.37	3	2.86	3.21	2.13

Chosen Design: Ni-Ti



Team Schedule Update

Name	Begin date	End date
Preliminary Design	9/30/13	10/24/13
Needs / Requirments	9/30/13	10/1/13
Background Research	10/2/13	10/7/13
SOTA	10/8/13	10/14/13
Design Slections	10/15/13	10/21/13
Narrow Design Choices	10/22/13	10/24/13
Analysis	10/25/13	11/12/13
Engineering Analysis	10/25/13	11/4/13
Cost Analysis	11/5/13	11/7/13
Program	11/8/13	11/12/13
Prototype	11/13/13	11/25/13
Finite Design	11/26/13	11/28/13
Presentation / Reports	10/9/13	12/3/13



Recap

- Project has been specified to only the movement of the solar panel, not tracking the sun.
- Cost and efficiency are the highest weighted criteria due to the preferred constraints on the project.
- The chosen design incorporates Nitinol to reduce usage costs, and is currently only a single axis tracker.
- The team is already starting the basic engineering analysis of the design.

Questions?

References

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