College of Engineering, Forestry, and Natural Sciences
Dept. of Mechanical Engineering

Solar Irradiance Measuring Device

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Overview

- Introduction
- Problem Statement
- Concept Generation
- Concept Selection
- Conclusion
- Timeline
- Resources

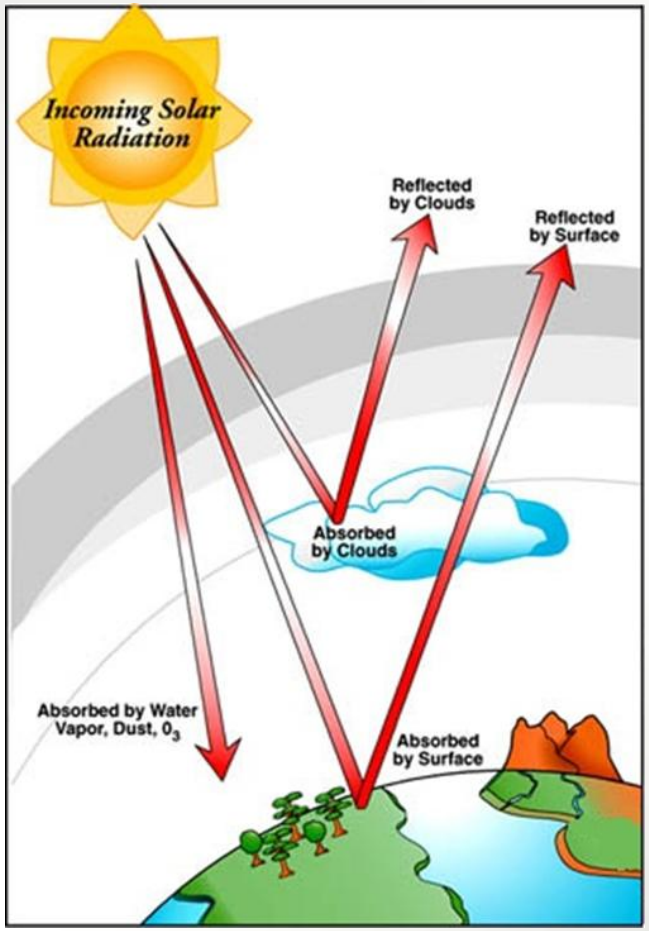
Problem Restatement

Problems with current site

- Covers to much surface area
- Data collection errors
- High cost

Goal:

Design a relatively small, portable solar irradiance measuring system that can accurately quantify variance in solar irradiance over a larger area.



Concept Evaluation

Criteria	Weight
Technical Adaptability	5%
Setup 30%	
Time Required	7.5%
Tools Required	5%
Ease of Assembly	7.5%
Number of Pieces	2.5%
Environmental Adaptability	7.5%
Durability 15%	
Weather	7.5%
Wildlife	7.5%
Portability 10%	
Packed Size	5%
Weight	5%
Cost 40%	
Initial	24%
Setup	8%
Recurring	8%

Performance Level	Score
Perfect	10
Excellent	9
Very Good	8
Good	7
Satisfactory	6
Adequate	5
Tolerable	4
Poor	3
Very Poor	2
Inadequate	1

Tripod

- Instruments mounted on simple tripods
- Tripods secured to ground
  - Stakes in earth
  - Expansion bolts in rock
- Wireless data transfer to data acquisition center

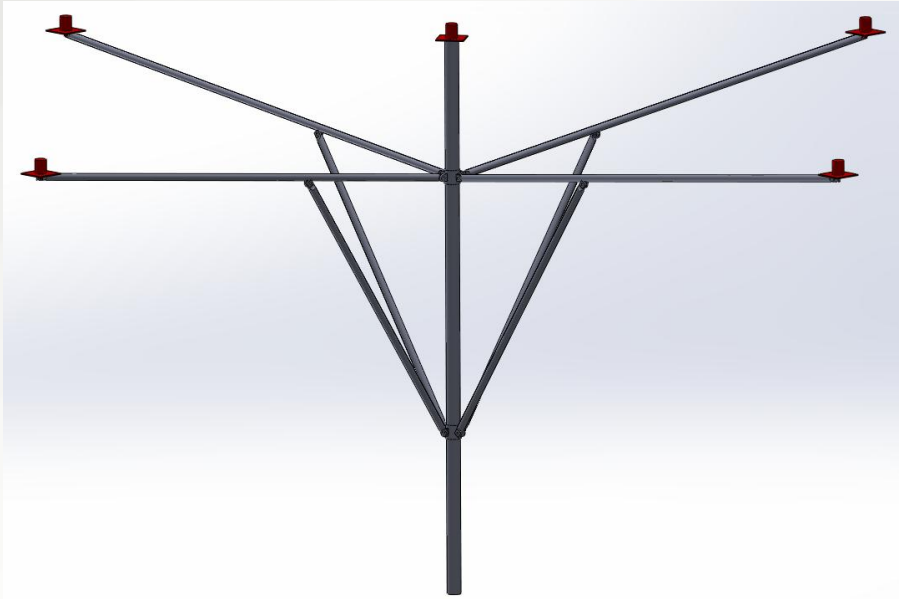
Tripod

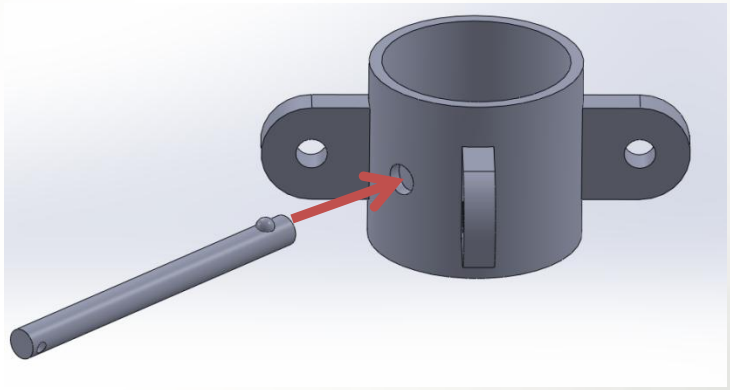
- **Pros:**
  -Easily variable setup
  -Few parts
- **Cons:**
  -Wireless issues
  -Cost of system

Criteria	Weight	Raw Score	Final Score
Technical Adaptability	5%	8	0.4
Setup 30%			
Time Required	7.5%	6	0.45
Tools Required	5%	5	0.25
Ease of Assembly	7.5%	7	0.525
Number of Pieces	2.5%	8	0.2
Environmental Adaptability	7.5%	8	0.6
Durability 15%			
Weather	7.5%	6	0.45
Wildlife	7.5%	6	0.45
Portability 10%			
Packed Size	5%	7	0.35
Weight	5%	8	0.4
Cost 40%			
Initial	24%	4	0.96
Setup	8%	6	0.48
Recurring	8%	6	0.48
	Total:	85	5.995

Umbrella

- Set up like an umbrella
- Telescoping arms mounted to two collars held up by pins
- Mounted on top of weighted tripod





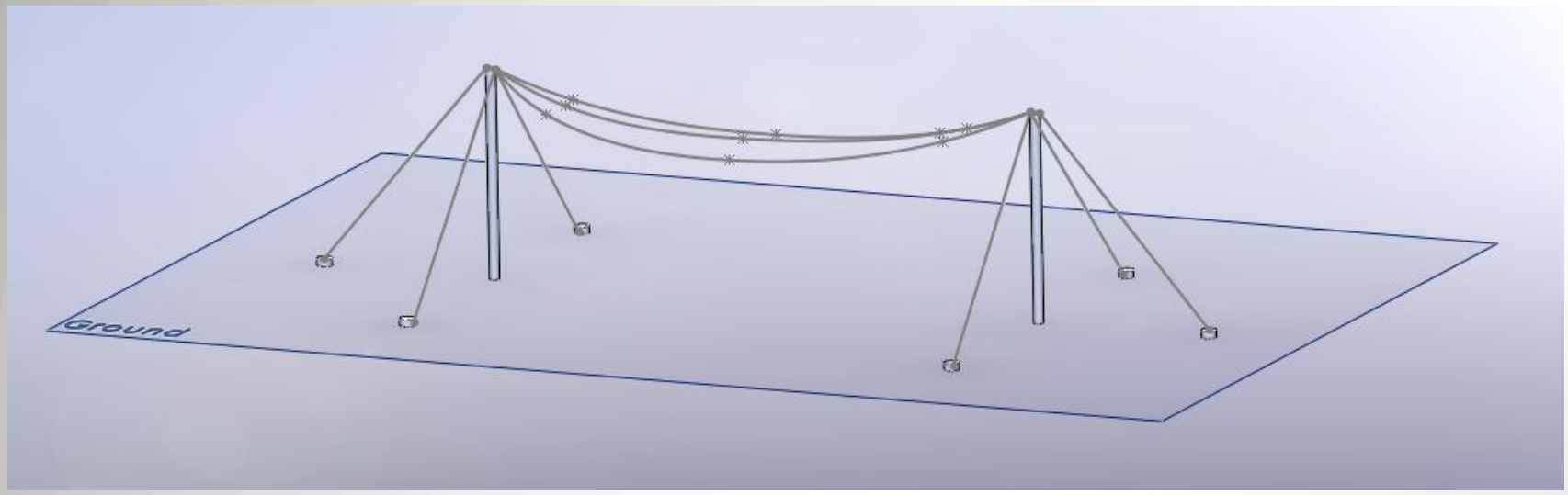
Umbrella

- **Pros:**
  - Ground conditions
  - Standard setup
- **Cons:**
  - Difficult to add sensors
  - Initial cost

Criteria	Weight	Raw Score	Final Score
Technical Adaptability	5%	5	.25
Setup 30%			
Time Required	7.5%	5	.375
Tools Required	5%	7	.35
Ease of Assembly	7.5%	6	.45
Number of Pieces	2.5%	7	.175
Environmental Adaptability	7.5%	9	.675
Durability 15%			
Weather	7.5%	5	.375
Wildlife	7.5%	7	.525
Portability 10%			
Packed Size	5%	6	.3
Weight	5%	6	.3
Cost 40%			
Initial	24%	5	1.2
Setup	8%	6	.48
Recurring	8%	8	.68
	Total:	82	6.095

Sky Net

- Support Poles
- Net mounted sensors
- Pulley tensioned cables



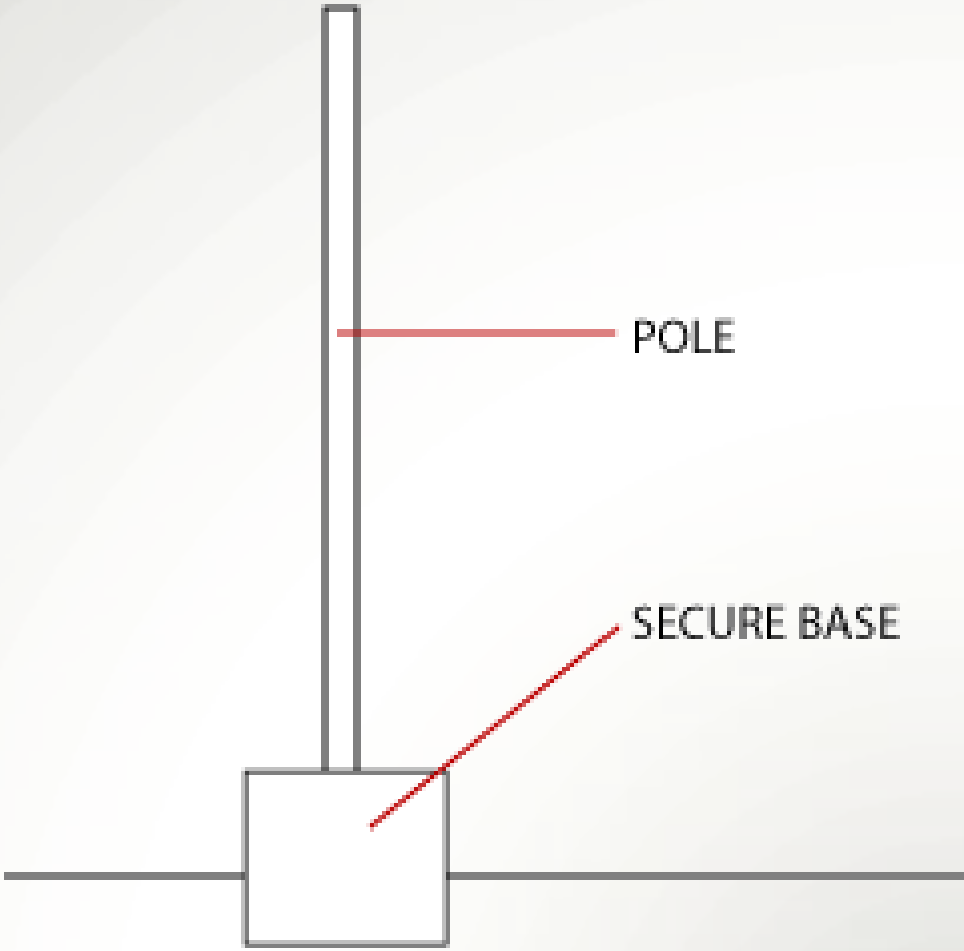
Sky Net

- **Pros:**
  - Variable sensor placement
  - Adaptable to ground conditions
- **Cons:**
  - Difficult setup
  - Weather impacts

Criteria	Weight	Raw Score	Final Score
Technical Adaptability	5%	4	.2
Setup 30%			
Time Required	7.5%	4	.3
Tools Required	5%	6	.3
Ease of Assembly	7.5%	5	.375
Number of Pieces	2.5%	8	.2
Environmental Adaptability	7.5%	6	.45
Durability 15%			
Weather	7.5%	5	.375
Wildlife	7.5%	6	.45
Portability 10%			
Packed Size	5%	8	.4
Weight	5%	8	.4
Cost 40%			
Initial	24%	7	1.26
Setup	8%	5	.4
Recurring	8%	8	.64
	Total:	80	6.17

Bucket Post

- 5 gallon buckets filled with concrete
- Sleeve formed in concrete for tee
- Sensors mounted to post



Bucket Post

- **Pros:**
  - Simple setup
  - Inexpensive
  - Few Pieces
- **Cons:**
  - Heavy
  - Large
  - Needs level surface

Criteria	Weight	Raw Score	Final Score
Technical Adaptability	5%	8	.4
Setup 30%			
Time Required	7.5%	4	.3
Tools Required	5%	8	.4
Ease of Assembly	7.5%	7	.525
Number of Pieces	2.5%	9	.225
Environmental Adaptability	7.5%	3	.225
Durability 15%			
Weather	7.5%	8	.6
Wildlife	7.5%	5	.375
Portability 10%			
Packed Size	5%	3	.15
Weight	5%	2	.1
Cost 40%			
Initial	24%	8	1.92
Setup	8%	6	.48
Recurring	8%	6	.48
	Total:	77	6.18

Concept Analysis

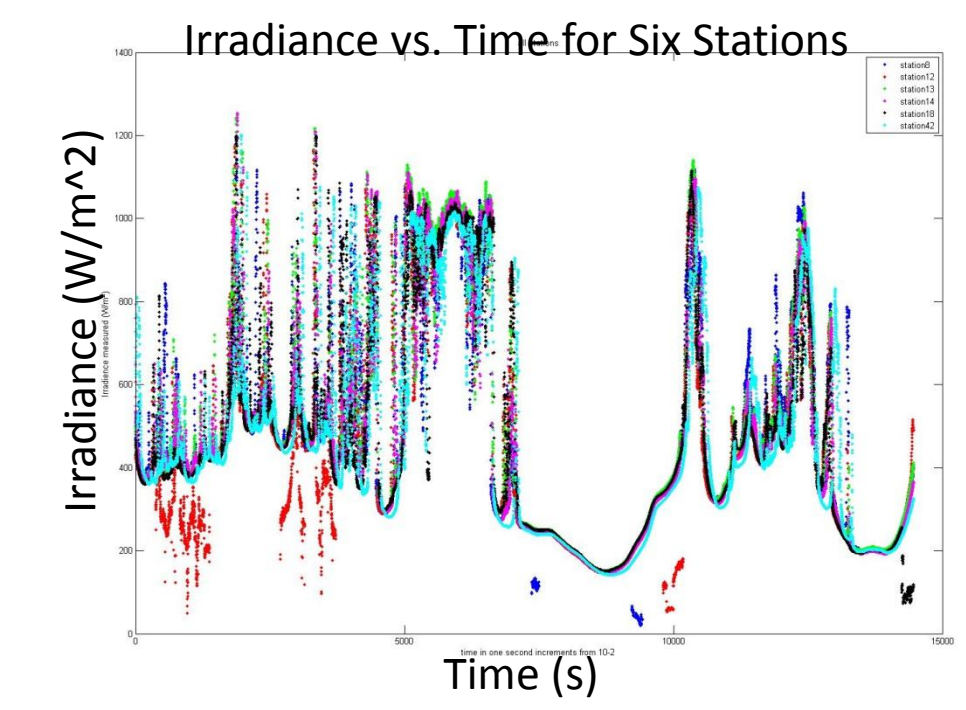
Concept	Tripod	Umbrella	Sky Net	Bucket Post
Total Weighted Score	5.995	6.095	6.17	6.18

- Bucket Post represents most fruitful concept.
- Having a system optimized for the objectives will streamline data collection and allow us to focus on correlating data to larger site.

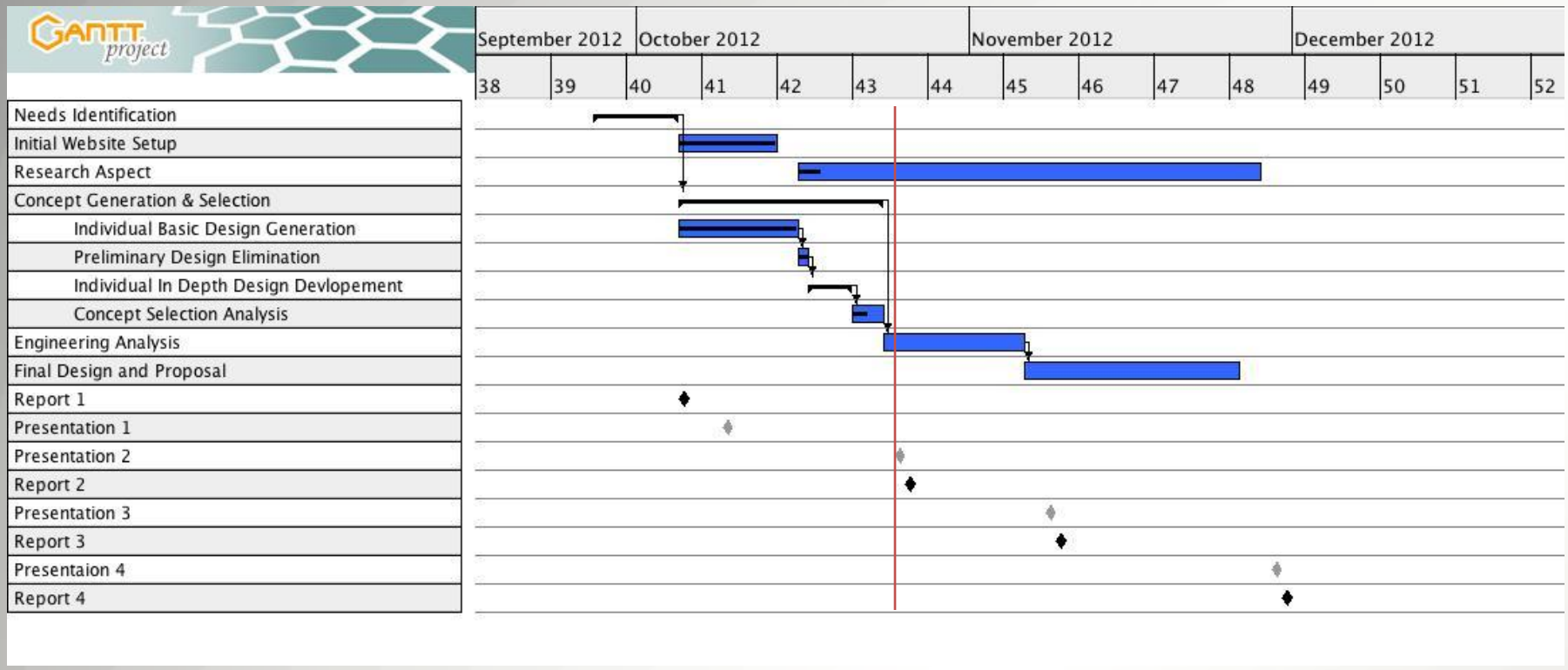
Conclusion

- No clear winner
- Compatible sensors

  -How many/exact area needed
- Data driven physical design



Timeline


GANTT project
September 2012
October 2012
November 2012
December 2012
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Needs Identification
Initial Website Setup
Research Aspect
Concept Generation & Selection
Individual Basic Design Generation
Preliminary Design Elimination
Individual In Depth Design Devlopement
Concept Selection Analysis
Engineering Analysis
Final Design and Proposal
Report 1
Presentation 1
Presentation 2
Report 2
Presentation 3
Report 3
Presentaion 4
Report 4

Resources

- **Twidell, John, and Weir, Tony. *Renewable Energy Resources*. New York: Taylor and Francis Group, 2006.**
- **www.envcoglobal.com/taxonomy/term/685/0**
- **http://www.animatedlighting.com/learn/wiretree.asp**

Questions