Team 9: Kite Power Generator

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Presentation Overview

- Project Scope
- How it works
- Conceptual Designs
- Demonstration Schematic
- Challenges
- Future Plans

The Problem at Hand

- Worlds energy consumption expected to increase by 48% by the year 2040[1]
  - Wind turbine
  - Solar energy
  - Nuclear energy
- Water shortage in Greek Islands[2]

Design a power generating kite that will also bring moisture from the air to the ground

Project Goals

- Demonstrate that magnet in electrical coil will generate usable electricity
  - Power a lightbulb
  - Varying tension in line/spring
- Concept for a method for optimization of energy output based on wind speeds
  - Scale for a 100kW kite
- Show commercial potential
  - Efficiency comparison

Constraints

- Altitude between 500 and 1500 feet
- Must deliver AC power to grid
- Limited to off the shelf products
- Optimized for Greek Islands

Figure 1. Picture showing mountainous Greek islands

General Schematic

Kite flies in unsteady wind conditions

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String and spring are tensioned → Magnet moves through coil

Hooke's Law $F = -k\Delta x$

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Spring pulls back on magnet → Magnet moves back through coil

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Faraday's Law

$$V = -N * \frac{\Delta(BA)}{\Delta t}$$

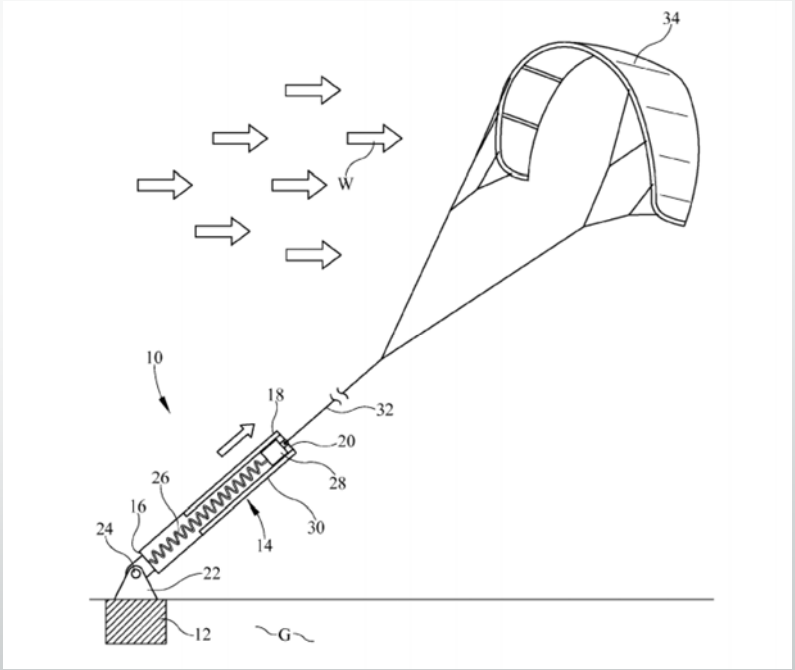
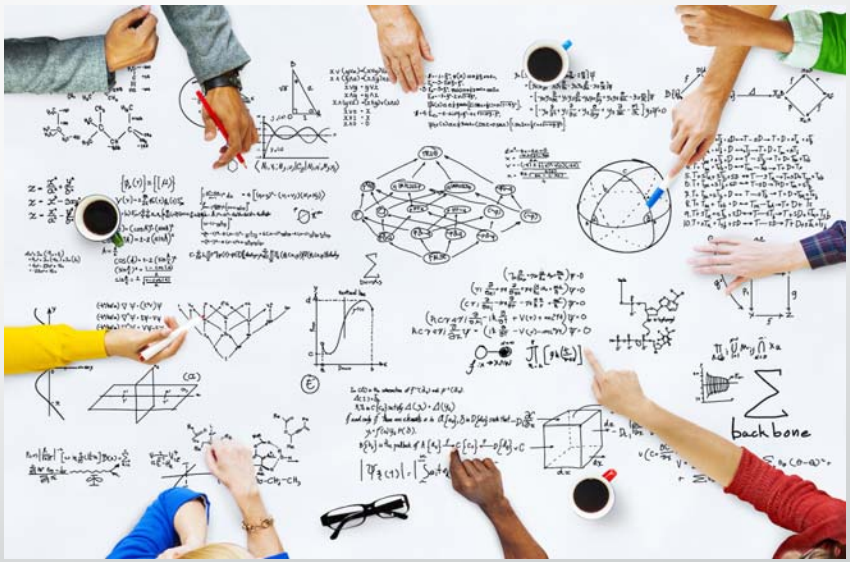


Figure 2. Jeff Phipps patent of power generating kite (diagram not to scale)[3]

Design Considerations

- Max power generation
- Kite control
- Mobility
- Ease of deployment
- Maintenance



Design 1: Four String Kite

- Advantages
  - Full control over kite position
  - Mechanical winches close to the ground
- Disadvantages
  - Energy loss due to multiple strings
  - Less tension in each line

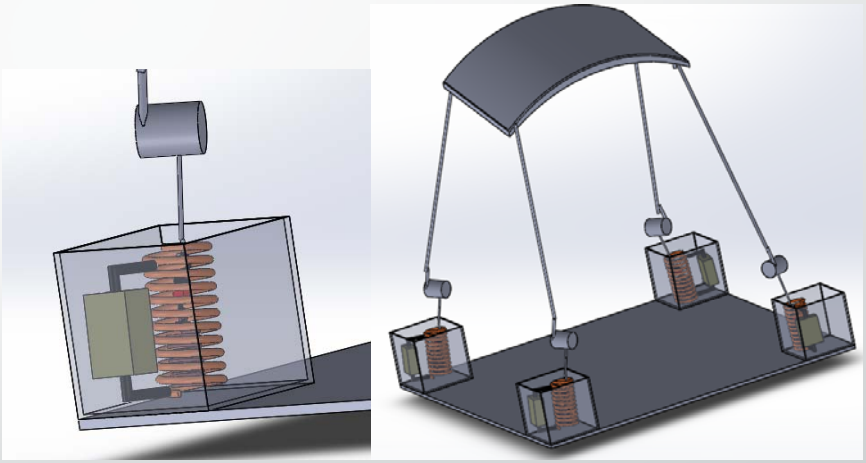


Figure 3. Four String Kite concept idea (not to scale)

Design 2: Two String Kite

- Advantages
  - Less loss of energy from strings
  - More tension per string
  - Mechanical winch close to ground
- Disadvantages
  - Less control over kite

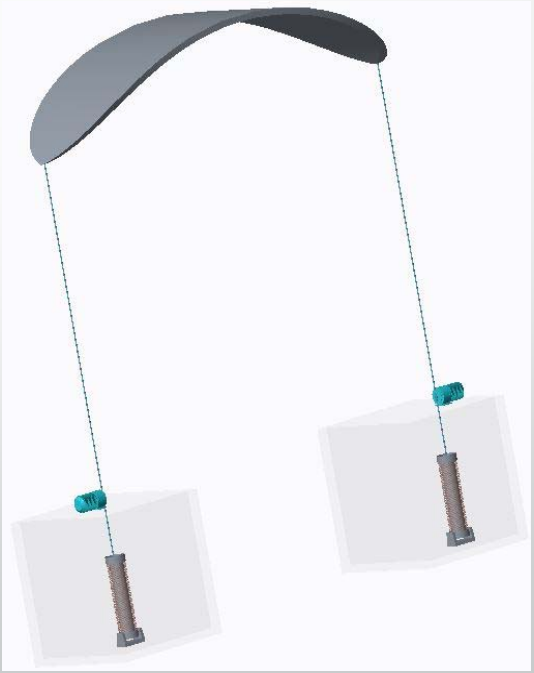


Figure 4. Two String Kite concept idea (not to scale)

Design 3: In-Air Winch

- Advantages
  - All tension goes into one string
  - Less surface area on ground
  - Less hardware
- Disadvantages
  - Winch higher in air
    - Maintenance issue
  - Less yaw control

Figure 5. In-Air Winch concept design (not to scale)

Comparison

Criterion	Baseline	Weight	4-String Kite	2-String Kite	In-Air Winch
Power Generation	0	6	0	0	1
Kite Control	0	5	1	0	-1
Ease of Deployment	0	3	-1	1	0
Mobility	0	2	-1	0	1
Maintenance	0	1	-1	1	-1
Cost	0	4	-1	0	1
Sum	0	-	-5	4	6

Demonstration Schematic

Things to Consider

- Mechanical input
  - Stationary bike
  - Balloon in windy condition
- Spring stiffness
- Magnet strength/size
- Number of wraps in coil

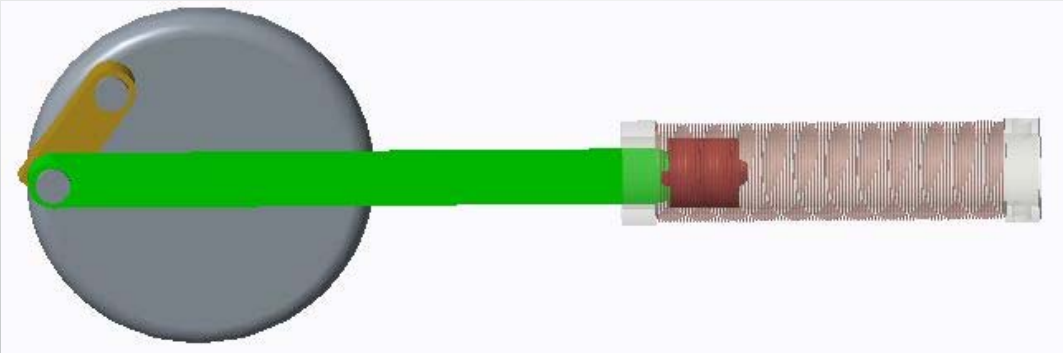


Figure 6. Concept for end of year demonstration (not to scale)

Challenges

- How to vary the tension in the spring/string for varying inputs
- Method to retract the kite safely
- Where to mount the grounding plate
- How to dissipate lightning strike

Future Plans

- Design Selection
- Model system with 2nd order Equation
- Optimization for oscillation
  - Increase spring tension in high speeds
- Select demonstration model
- Water Collector
  - Material
  - Method of transporting water
- Order Materials

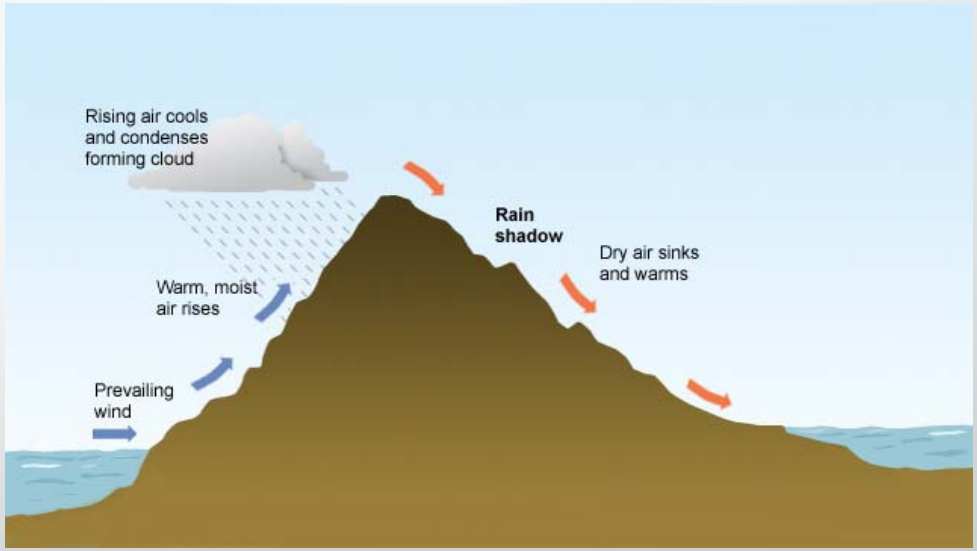
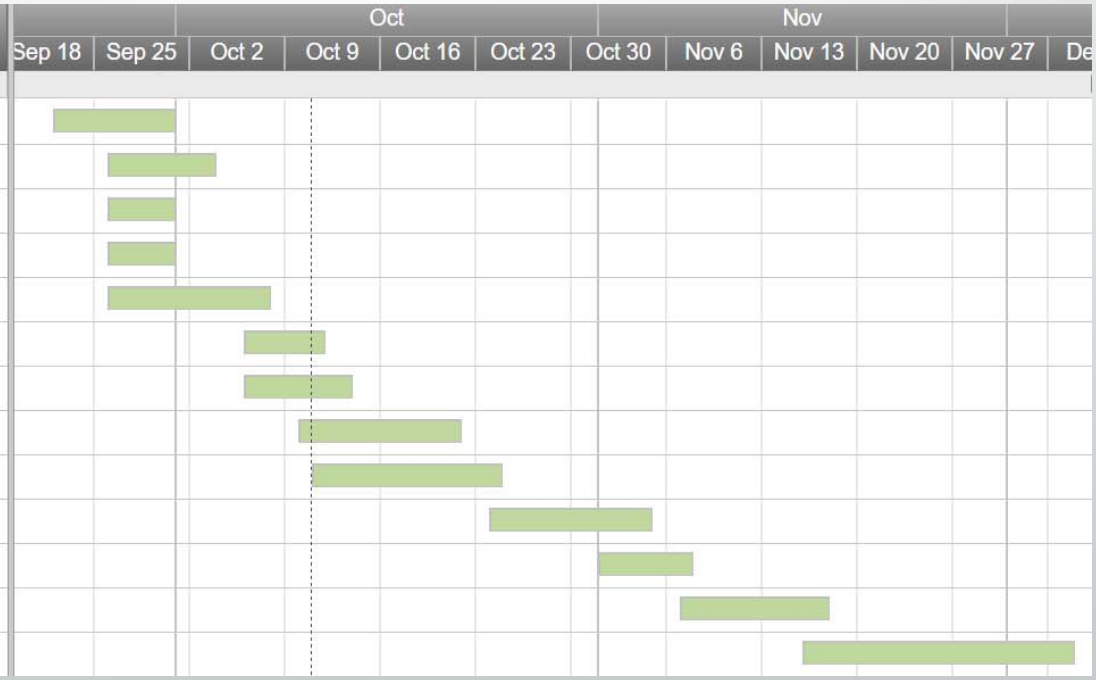


Figure 7. Diagram showing fundamental reason for water collection[2]

Gantt Chart

Table 1. Gantt Chart for semester

Task Name	Duration	Start	Finish
Meet group and advisor	7d	09/22/16	09/30/16
Contact sponsor	6d	09/26/16	10/03/16
Determine constraints	5d	09/26/16	09/30/16
Develop needs statement	5d	09/26/16	09/30/16
Conceptual design sketches	10d	09/26/16	10/07/16
CAD Drawings	4d	10/06/16	10/11/16
Concept Evaluation	6d	10/06/16	10/13/16
Midterm 1 Report	10d	10/10/16	10/21/16
Optimization Concepts	10d	10/11/16	10/24/16
Concept Selection	10d	10/24/16	11/04/16
Material Selection	5d	11/01/16	11/07/16
Order parts	9d	11/07/16	11/17/16
Midterm 2 Report	14d	11/16/16	12/05/16



References

[1] http://www.eia.gov/todayinenergy/detail.php?id=26212

[2] http://www.climatechangepost.com/greece/fresh-water-resources/

[3] https://www.uspto.gov/patents-application-process/search-patents

[4] http://www.conserve-energy-future.com/Disadvantages_SolarEnergy.php

[5] https://www.windfinder.com/weather-maps/forecast/greece#6/38.367/23.810

[6] http://www.kitenergy.net/technology-2/key-points/

[7] https://adrienjousset.wordpress.com/2009/09/15/kitano/

[8] https://www.ted.com/talks/saul_griffith_on_kites_as_the_future_of_renewable_energy?language=en

Questions?