Antenna Deployment Mechanism

Team #6: Space Radio

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Executive Summary:

- This project aims to create a compact, lightweight, and highly reliable antenna deployment mechanism that will be attached to the base of an Orbital 2U CubeSat
- The mechanism must survive launch and orbital conditions and allow data to be relayed from the CubeSat to the ground station at UCI
- We must ensure that we design a working mechanism that fits within the limited space provided to us on the 2U Cubesat.
- We incorporated our antenna deployment design with the solar panel team's design.

Aluminum tape measure:

- The aluminum tape measure is a highly conductive material to accommodate 433Mhz for radio communication.
- The curved geometry of tape measures allows the antenna to be easily folded or rolled up into a small area but maintain rigidity once deployed.
- These antennas will be folded along the side of the Cubesat and tucked underneath the solar panels

Nichrome burn wire:

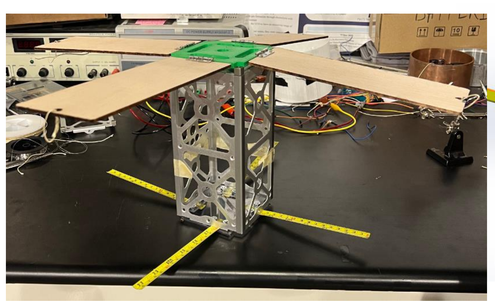
- The nichrome wire heats rapidly when an electrical current is applied to it. The heated burn wire is able to burn through the pre-tensioned Vectran tethers or fishing lines that hold the antenna before deployment.

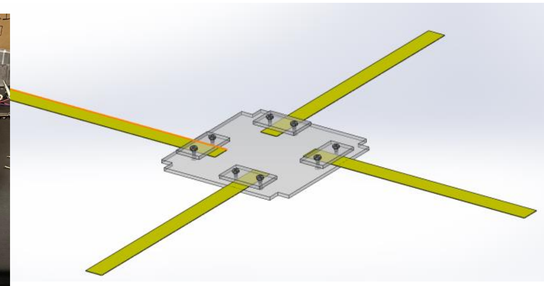
Performance difference

	Fishing Line			Vectran				
Current	1A	1.5A	2A	1A	1.5A	2A	2.5A	3A
Time	7.1s	2.4s	1.5s	>30s	>30s	>30s	9.1s	4.3s

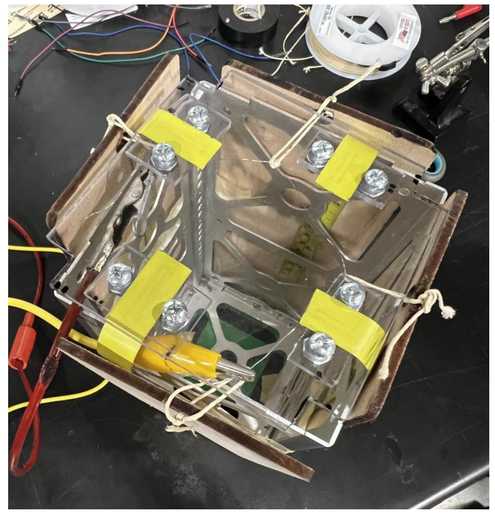
Base plate:

- The base plate is made of a sheet of Lexan Polycarbonate. This material is very sturdy and will be able to withstand the forces that are placed on it. Also, it gives us a better insight into how the CubeSat looks inside at all times due to its transparency

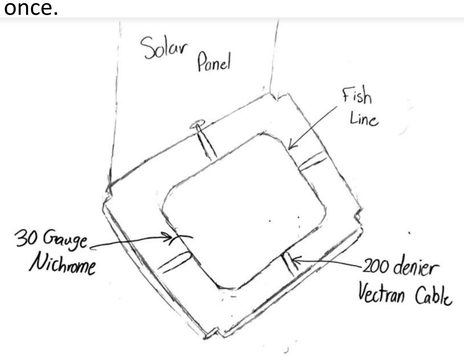




Burn wire design:



- A ring of fishing line is attached to all four Vectran cables that hold the solar panels in place. The fishing line is also attached to a Nichrome wire that burns it. When the fishing line is burned through, all four solar panel tethers are released at once.



Engineering Requirements	Units	Ideal Value	Marginal Value
Components must withstand extreme temperatures	C	-65 to +125	n/a
Device must accomodate appropriate antenna length	cm	17.3	17.2 - 17.4
Cost should be minimized	USD	<300	<750
Design should be low-weight	g	<100	<200
Vibration testing	n/a	P95/50 standard	n/a
Design must fit within 2U platform	cm x cm	10 x 10	n/a
Antennas should deploy quickly	s	5-10	1-30

Strengths	Weaknesses	Opportunities	Threats
Simplest design. No moving parts and minimal components	Burn wire mechanism in the middle of the CubeSat. Must integrate among the other components	Fewer chances for mechanical error	Solar panels might block the antennas or burn wires
Allows for a variety of antenna sizes	Burn wire is the only thing to hold down the antennas from deploying	Compact design leaves more space for other CubeSat components	Burn wires may not activate 100% of the time
Does not take up as much space as other designs	Antennas must stow either underneath or on top of the solar panels	Higher testing opportunity due to its simple design	a key challenge is an antenna design that achieves a high gain while having a small size
Low cost for materials and components	a lot of burn wire for an already compacted CubeSat	without moving parts to endure vibration	sensor may not activate burn wire

Table: SWOT Analysis of chosen solution

Future plan:

- Find ways to prevent the nichrome burn wire and the onboard PCB to disconnect due to the heavy vibration present during the launch
- Find a way to prevent the tension being lost between the Nichrome and the fishing line after the launch

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References

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