Solar Powered Remote Controlled Vehicle`

AEROSPACE1

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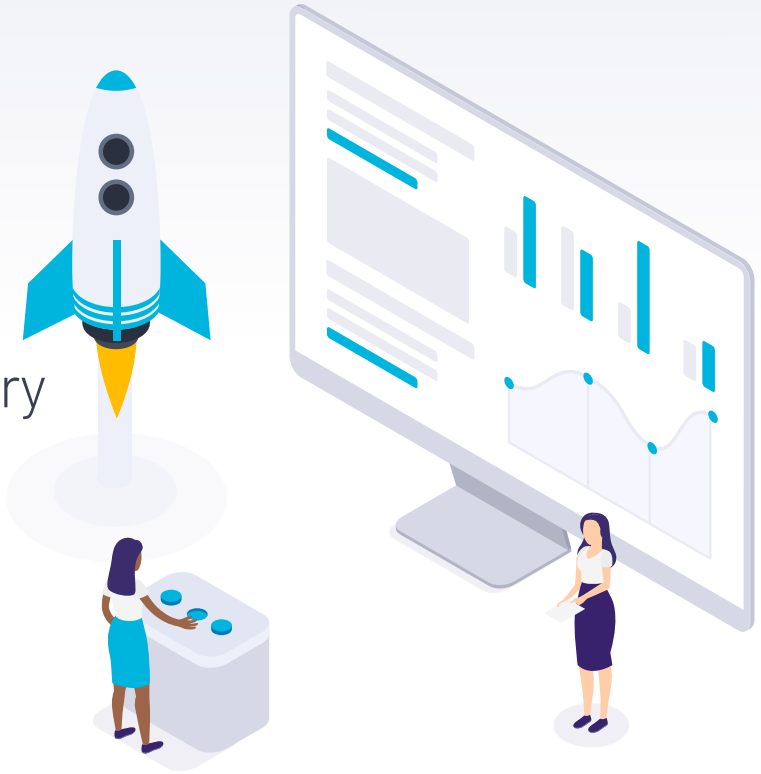
Sponsored by Aerospace

Background

- Aerospace is the customer
- Long term goal: Develop low latency telemetry and improve use of GaN-FET technology.
- Aerospace industry requires low latency telemetry and Gan-FET technology to implement in their satellite and sensor technologies



Needs/Demands

- DC/DC Converter for charging NiMH batteries from solar panels
- Energy efficient remote controlled vehicle
- Data logging telemetry
  - Keeping track of system health and efficiency (solar array outputs, estimated battery charge etc)

Problem Statement

The need of Aerospace in the current situation requires an efficient engine and power conversion, and control of the car with low latency.

Design Requirements

Charging Station

Solar Panels (Off-the-shelf)

DC-DC Converter (Solar Panels ->; Battery)

o Interface/Connector -> Vehicle

o Maximum Power Point Tracking

o Digital (or Analog) Controller

Battery Protection Circuitry (Overcharge Batteries, Short Circuit, etc)

Platform (Enclosure)

Kill-Switch (Safety)

State of Health Monitoring (Solar Efficiency, DC Converter Efficiency)

Vehicle

Wireless Control (Wifi MCU [ESP32 Maybe?])

Motor Driver Circuit

Basket (Optional Heated, Insulated)

State of Health Monitoring (Battery state of charge)

Battery (18650 Cells, Lithium Ion, NiMH)

Chassis, Wheels, Axles [Mechanical Assembly]

Standards and Regulations

AIA's National Aerospace Standards (NAS) are voluntary standards developed by the aerospace industry since 1941

- FCC(Federal Communications Commission) Regulations- limit the amount of electromagnetic interference, maintains jurisdiction over broadband and radio
- OSHA(Occupational Safety and Health Administration) Regulations- security precautions ensuring safe assembly
- Cyber Security (NAS9933) - protection of unclassified information

Constraints

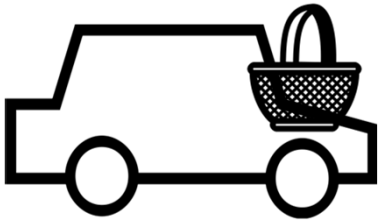
- Cost: Price physical components (car, charging station, remote control)
- Time: Limited to two semesters (one to find a solution, one to implement)
- Environmental:
  - Must be able to navigate a college campus
  - Energy consumption must be limited to lessen the impact on the environment

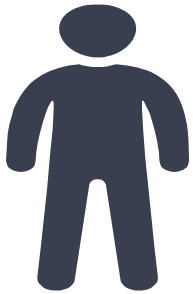
Idea 1: Farm Security Car

- Background: many farms use dogs for protection of smaller livestock creating a high cost and low reliability security method
- The substitution of dogs for solar powered cars to patrol farms will provide a more cost effective approach to protect livestock

Idea 2: On-Campus Food Delivery

- A solar powered delivery vehicle designed to deliver snacks/meals to students on college campuses
  - Ex. A student studying in LKD could have pasta from Punchout delivered to them

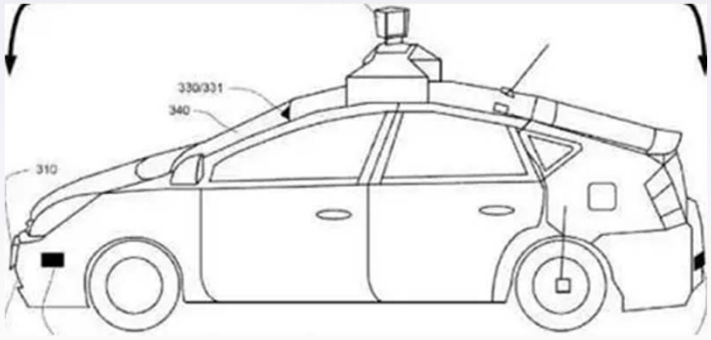




Idea 3: Emergency First Responder

- Autonomous rough terrain first responder vehicle
  - Intended to find the exact location of those in need of help for entry and evacuation
  - Can be used in public or private sector and would be available to all 195 countries

Idea 4: Security Surveillance



- A solar powered vehicle equipped with a 360-degree camera designed to patrol college campus and maintain surveillance of any area it is placed in.
- Vehicle would charge throughout the day using solar energy, and use that conserved energy to patrol throughout the night.

Top 2 Designs

1. Farm Security Car
2. On-Campus Food Delivery
3. Emergency First Responder
4. Security Surveillance

Pros & Cons:

On-Campus Food Delivery

- Pros:
  - Eliminates time spent walking to dining hall
  - More time to study /no waiting in long lines
- Cons:
  - Difficult to navigate on a college campus
  - No security (the wrong person could take the meal)

Farm Security Car

- Pros:
  - Protects livestock
  - Consistent defense on farms
- Cons:
  - Can't physically protect livestock (from prey / people)
  - Also can't protect itself from animals on the farm (in case it runs into a cow etc)

Decision Matrix

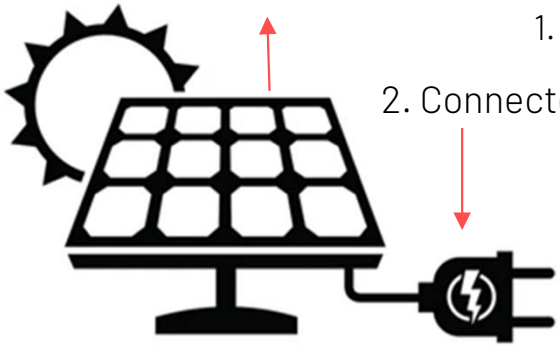
- Decision Scale: 0-5 (0 being worst, 5 being best)

	On-Campus Delivery	Farm Security
Cost:	4	3
Implementation time:	2	1
Environmental Impact:	4	3
Total:	10	7

Top Design

ON-CAMPUS FOOD DELIVERY

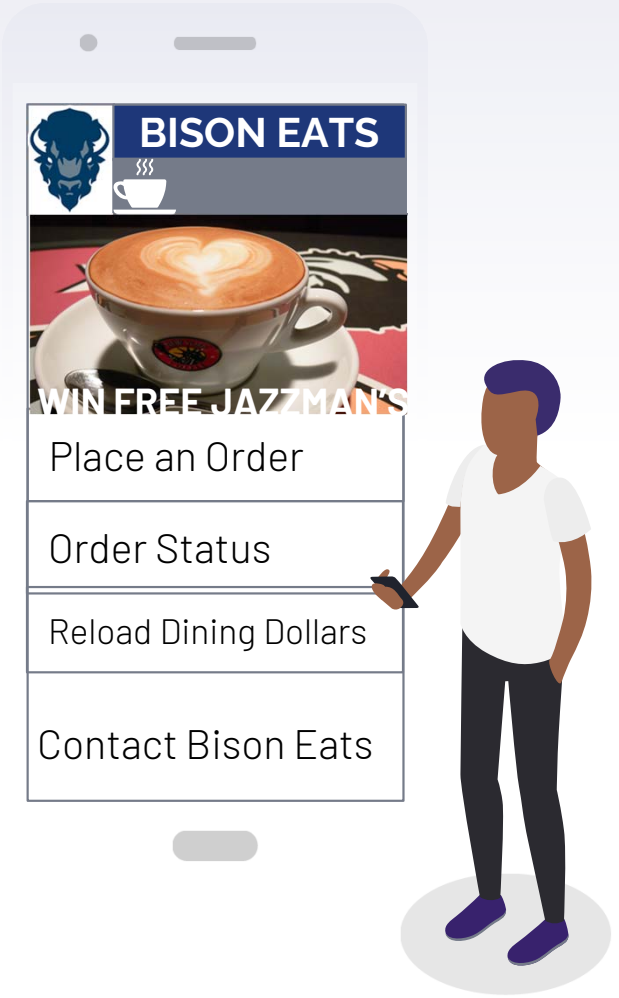
1. Solar Panels



2. Connector

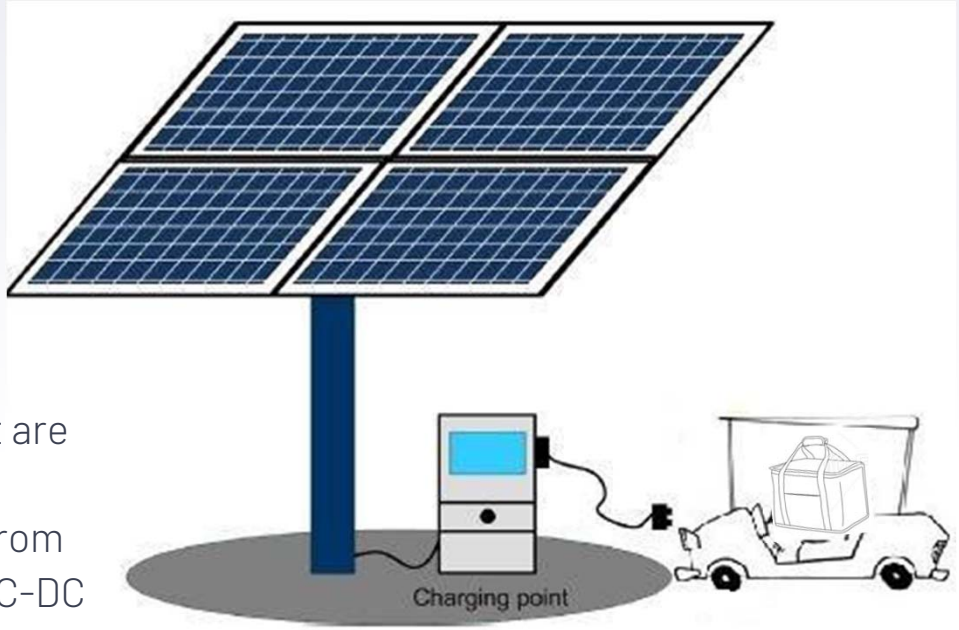
1. Remote controlled vehicle

2. Basket (to hold food)



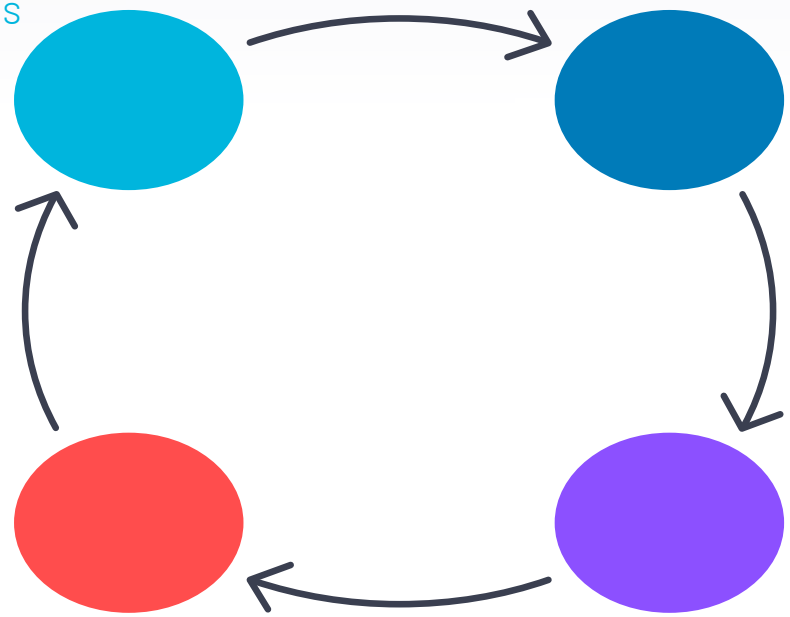
Description of the design

- The car will be equipped with rechargeable batteries, that are charged at a charging station.
- The charging station will be powered by energy retained from solar panels. The solar energy is then converted using a DC-DC converter and is then able to charge the car batteries.
- The vehicle would then operate off said charge, being controlled by a WiFi/bluetooth connection to a remote control.
- Equipped with a food basket, the vehicle will be loaded with a food order and then transport it to the given destination.



Operation of the solution

A hungry student places an order for delivery



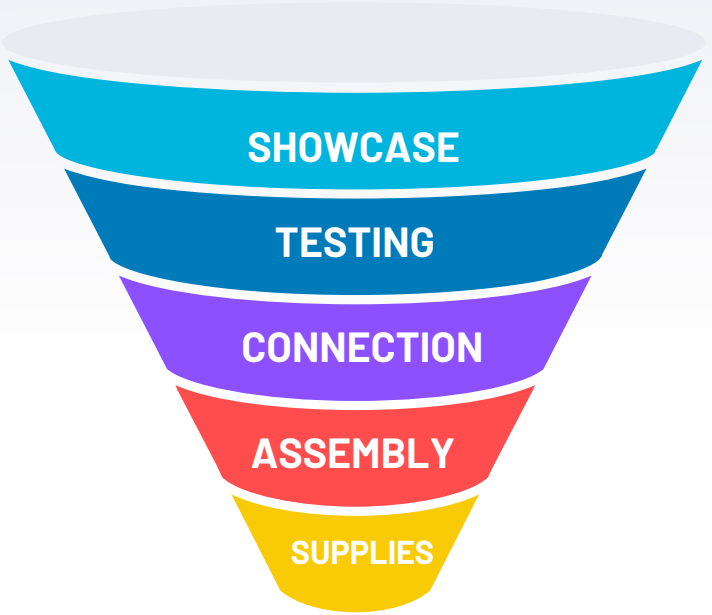
The food is prepared and placed in the vehicle's basket, it is sent on its way

The vehicle reaches its target destination and the food is delivered

The vehicle returns to its charging station

What's Next?

1. Order and gather all the materials needed for the implementation
2. Assemble/program the vehicle / charging station
3. Connect the vehicle to wifi / bluetooth system
4. Perform testing / debugging
5. Senior Design Showcase



Conclusions

Background
- Solar Powered Vehicles
- GaN-FET technology

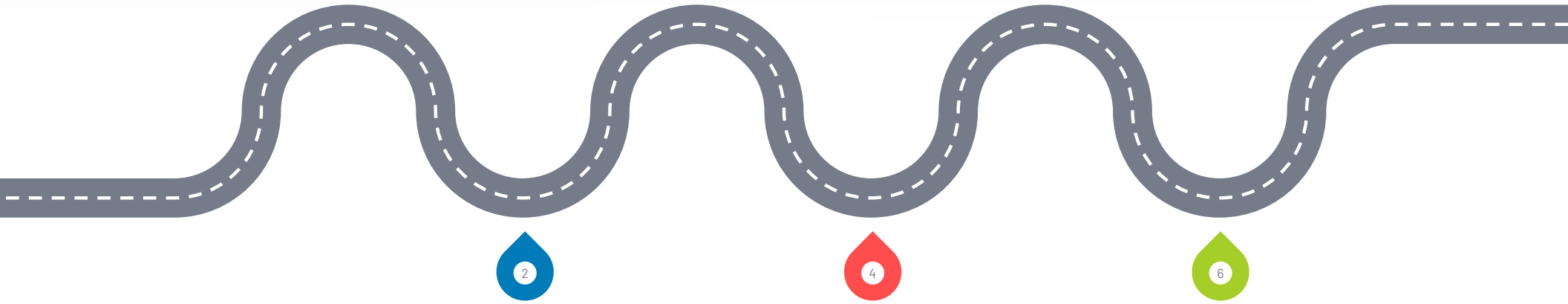
Problem Formulation
- Problem statement
- Design Requirements
- Standards and Regulations
- Constraints

Solution Generation
- Individual Ideas
- Pros & Cons
- Decision Matrix

Top Solution Design
- On-Campus Food Delivery

Next Steps
- Gathering materials
- Building design
- Testing/debugging

Senior Design Showcase



THANK YOU!

Questions?