



FAMU-FSU
College of
Engineering

Solar Wind Generator (K.A.R.E.N) Final Presentation

Team 303 04/04/2024

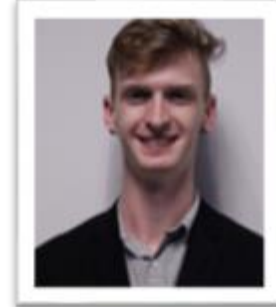
Team Introductions



William Touza
- *Team Lead*



Andrew Putnam
- *Technical Lead*



Tristan Witkowski
- *CAD Designer*



Alberto San Segundo
- *CAD Designer*



Brandon Ortiz
- *Treasurer*



Carlos Vilarino
- *Documentation Specialist*

Sponsor and Advisor



Bruce Morrison
-Sponsor



Dr. Simon Foo
-Advisor

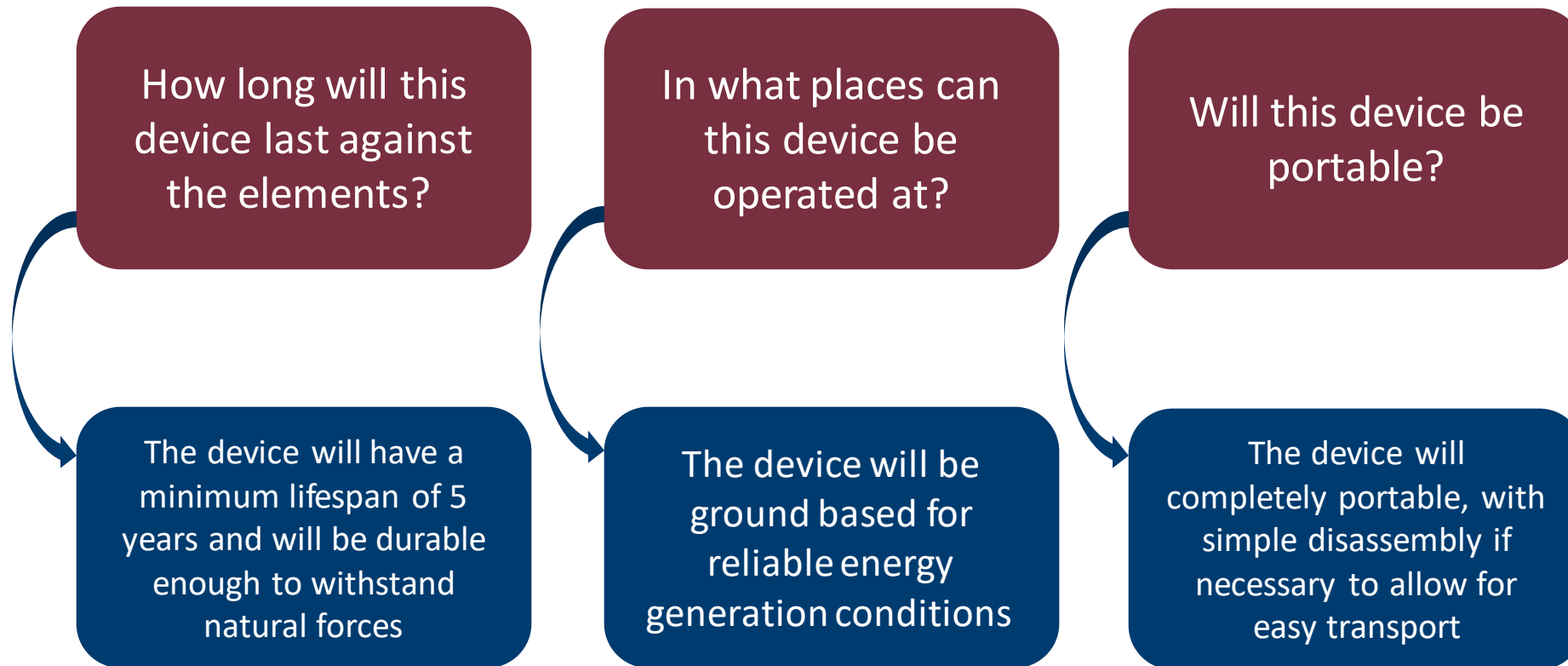
Project Summary



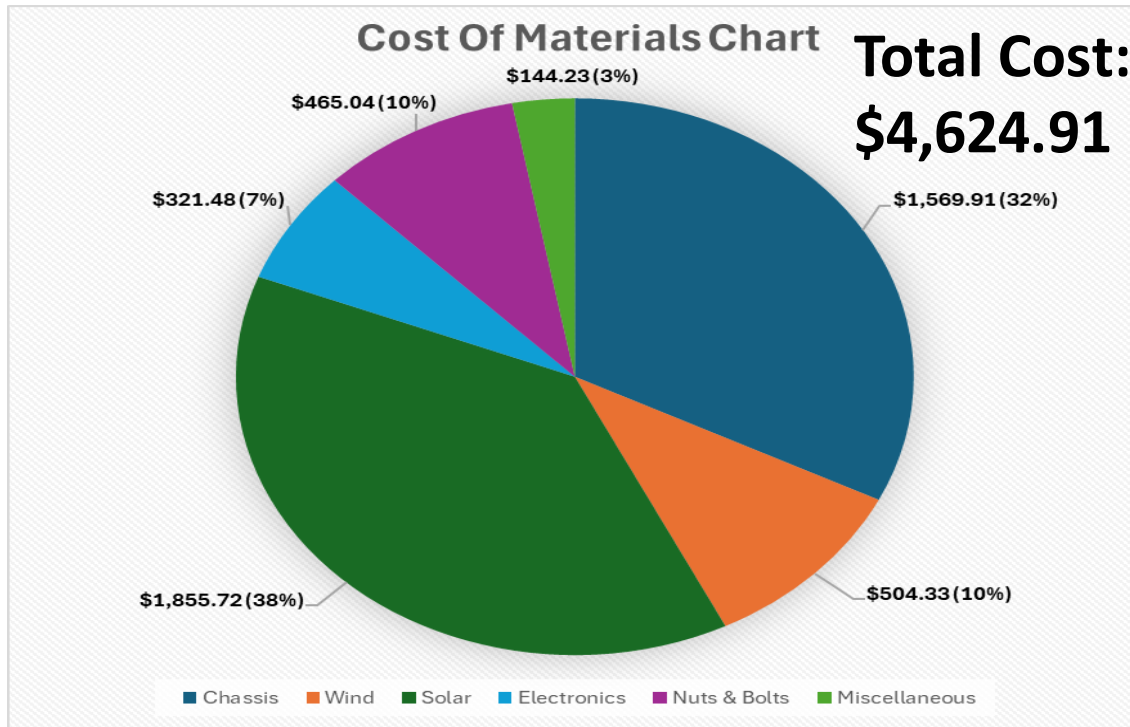
Abstract

- 100 W Power Generation
- Easily Transportable
- Sunflower Concept
- Horizontal Axis Wind Turbine
- 45 Mph maximum wind speed

Customer Needs



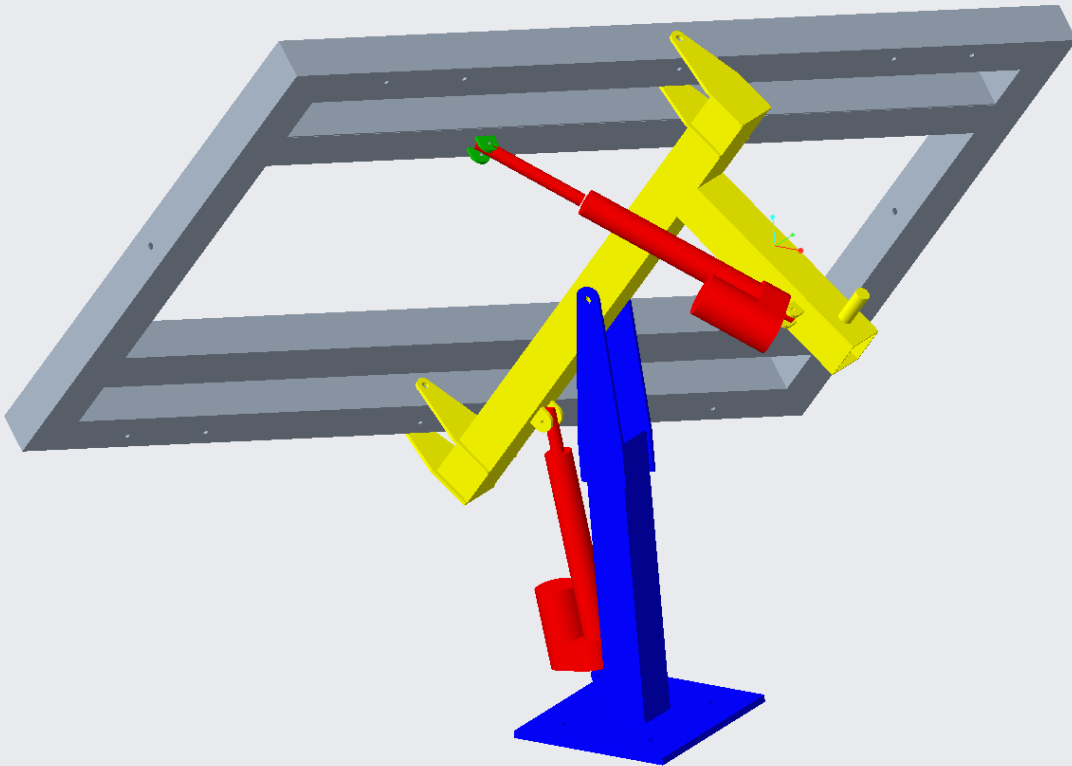
Material Cost



Color	Category
Blue	Nuts and Bolts
Orange	Electronics
Green	Solar
Red	Wind
Yellow	Chassis
Purple	Miscellaneous

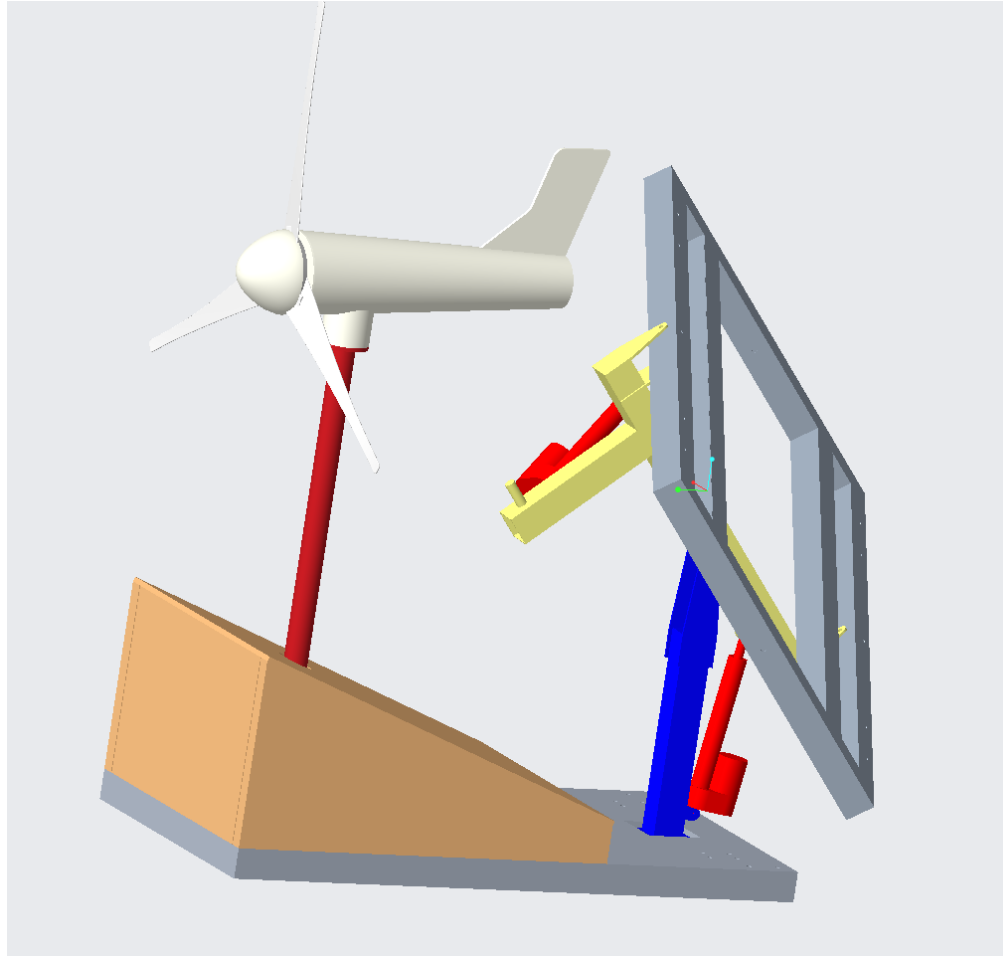
Structural Design

Final Solar Mount Design

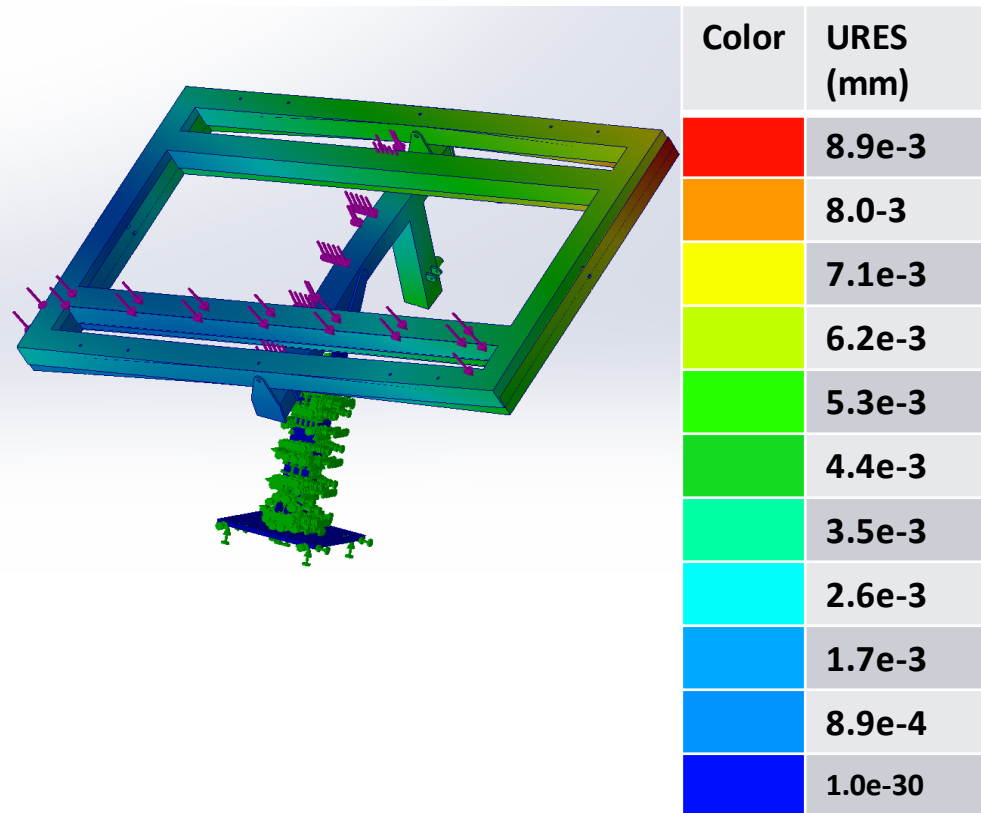
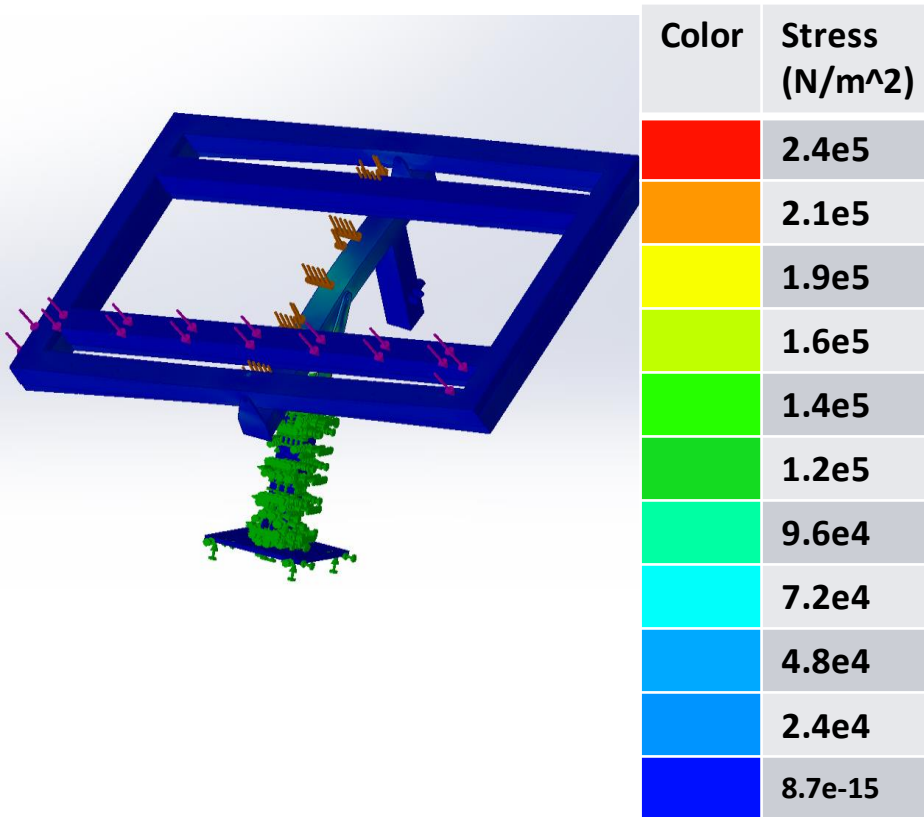


- Uses Two linear actuators
- Rotates between 102 to 248 degrees north to south
- Rotation angle 115 to -20 degrees east to west

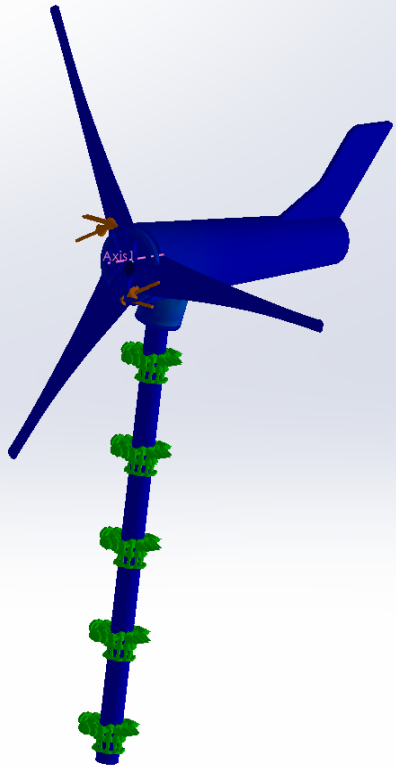
Final Design



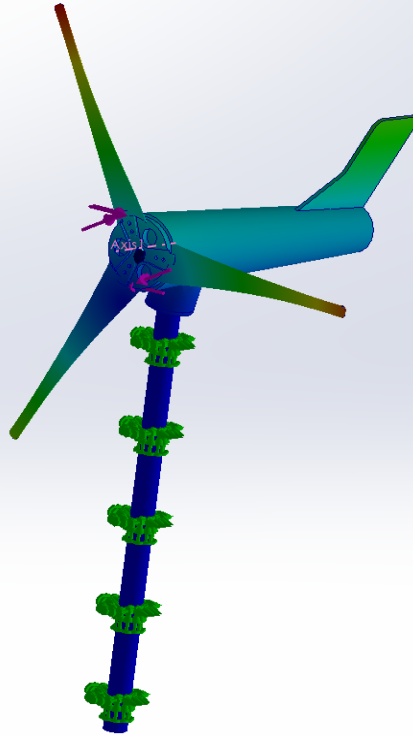
Structural Simulations



Structural Simulations



Color	Stress (N/m ²)
Red	1.869e7
Orange	1.682e7
Yellow	1.495e7
Light Green	1.308e7
Green	1.121e7
Dark Green	9.343e6
Cyan	7.474e6
Light Blue	5.606e6
Blue	3.737e6
Dark Blue	1.869e6
Very Dark Blue	0



Color	URES (mm)
Red	5.820e-2
Orange	5.238e-2
Yellow	4.656e-2
Light Green	4.074e-2
Green	3.492e-2
Dark Green	2.910e-2
Cyan	2.328e-2
Light Blue	1.746e-2
Blue	1.164e-2
Dark Blue	5.820e-3
Very Dark Blue	1.000e-30

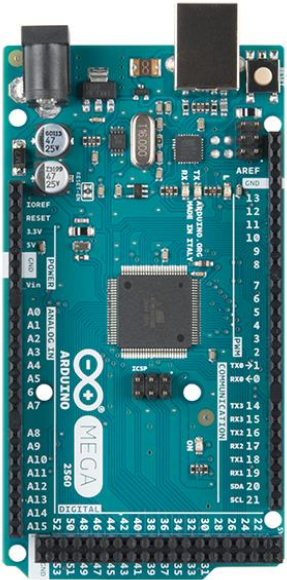
Lessons Learned

- Increased understanding of utilizing CAD software
 - Structural Design
 - Structural Analysis
- Measure twice, cut once
- Solidify detailed design sooner

Electrical Design



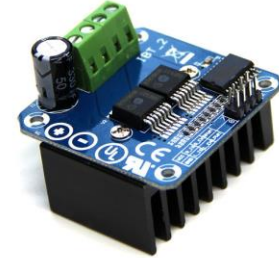
Arduino and Components



Arduino Mega



Linear Actuator



Motor controller

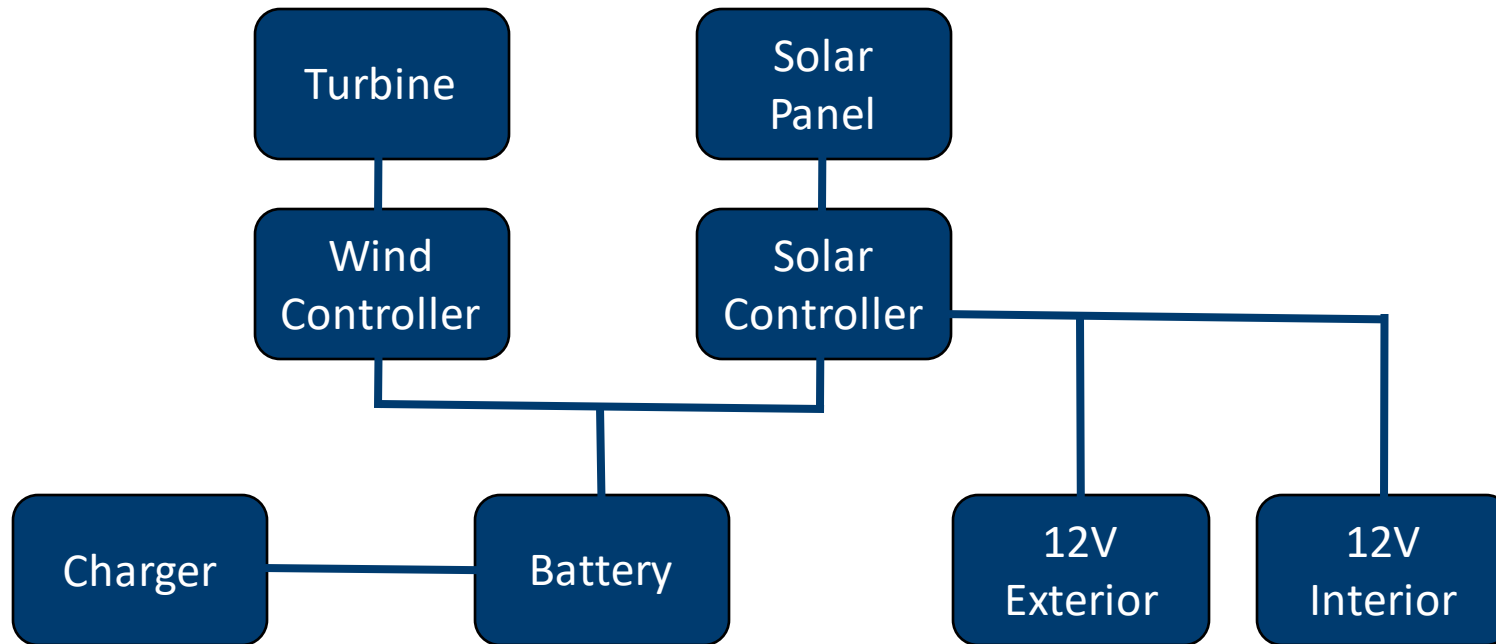


2X16 LCD



Anemometer

Final Electrical Design



K.A.R.E.N. Psuedo Code

- Initialize libraries, pins, and variables
- Start Continuous Loop
 - Read switch values
 - If (solarTrack == HIGH)
 - Enter Solar Tracking function
 - Enter battery Indicator function
 - Enter wind speed function
 - Enter display function
- End

LCD Display Function

Top Display Line:

- If(dispLoop >= 10)
 - displayLoop = 0
- If else(dispLoop < 5)
 - Display WindSpeed
 - dispLoop++
- If else(dispLoop < 10)
 - Display Battery Level
 - dispLoop++
- end

Bottom Display Line:

- Display "KAREN – Team 303"

Solar Tracking Psuedo Code

Solar Tracking function:

- Read Photoresistor Values
- Calculate Photoresistor ratio and sums
- If (start = 0)
 - Extend linear actuators and assign vertical and horizontal positions to 100
- If else (Sum < Night)
 - Adjust linear actuators to standby position
 - Enter Low Power mode for 15 minutes
- while (vert > 1 + Error or vert < 1 – Error and sum > Night)
 - Extend or retract Vertical linear actuator
 - Display moving direction
- while (horz > 1 + Error or horz < 1 – Error and sum > Night)
 - Extend or retract Horizontal linear actuator
 - Display moving direction
- end

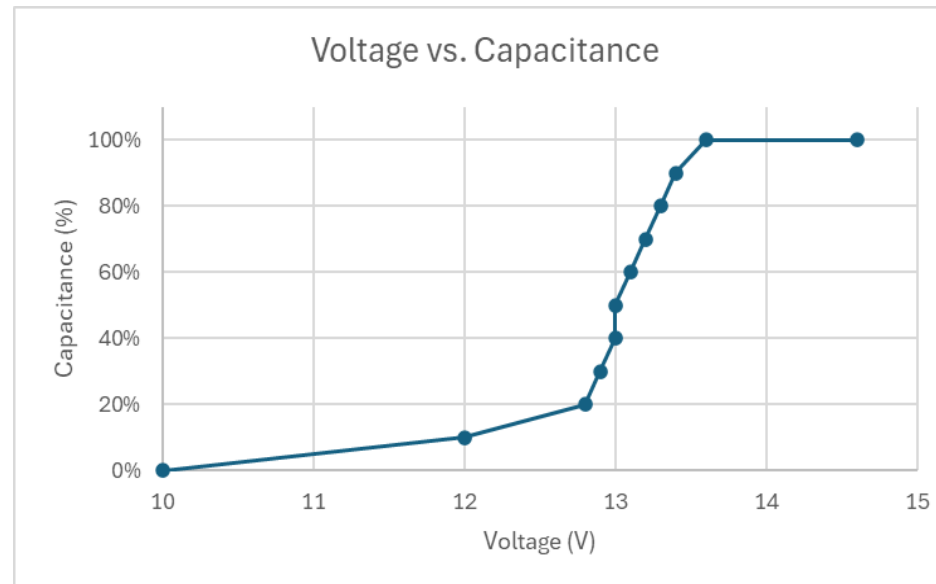
Battery level Psuedo Code

Battery Level Function:

- Read Analog value of voltage divider
- Calculate true voltage level
- Calculate Battery Level based on voltage
- Return Battery Level to main function
- End

Display for Battery Level:

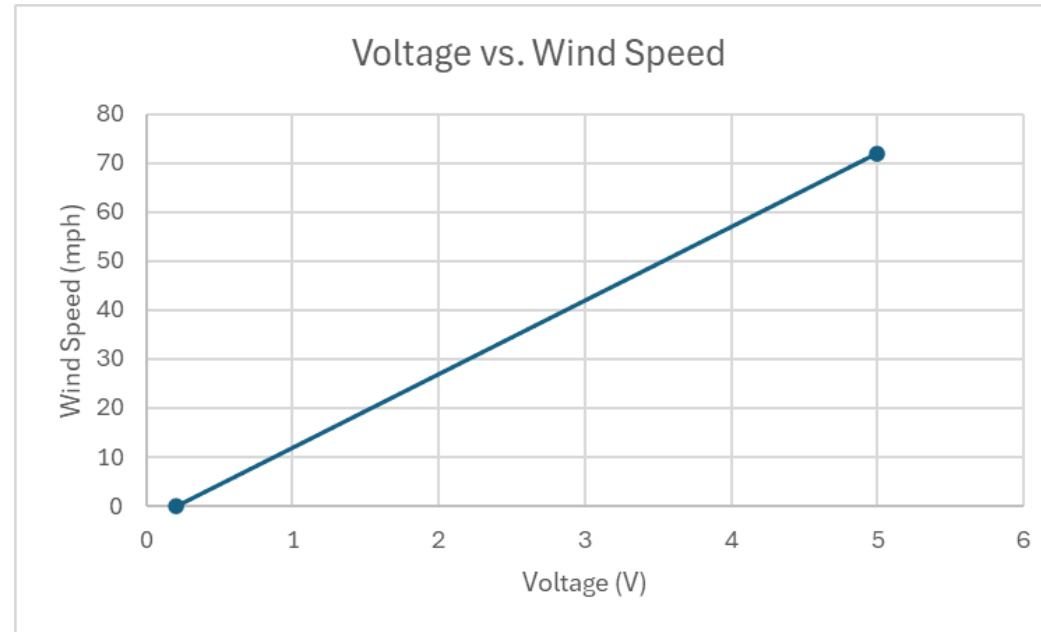
- If (Battery Level < 20 %)
 - Display "Low Battery"
- Else
 - Display Battery Level
 - If (Battery Level > 100%)
 - "Display 100% Charging"
- End



Anemometer Pseudo Code

Wind Speed Function:

- Read Analog input
- Calculate analog voltage
- If(voltage \leq minimum)
 - Return 0 mph
- Else
 - Calculate wind speed
 - Return Calculated Wind Speed
 - If(wind speed $>$ maximum)
 - Sound Buzzers
- End



Lessons Learned

- Increased understanding of Arduino
- Improve cable management
- Complete extensive hardware testing

Up and Coming



Future Work and Improvements

- **Testing and Validation**
- **Increase Solar Panel Range**
- **Pulley System Improvements**
- **Waterproofing Improvements**

Testing and Validation

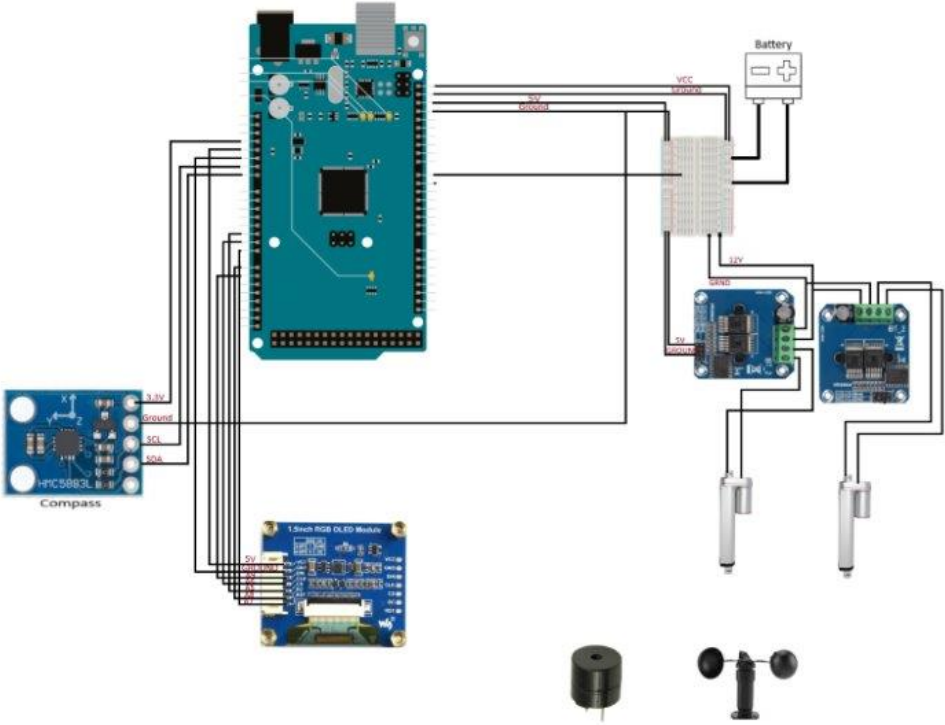
- Power Generation Testing
- Measurements of voltage to determine power loss
- Structural Simulations
- Measurements of code output for solar panel angle corrections
- Testing of windmill safety system

Questions?

Backup Slides



Arduino Connections



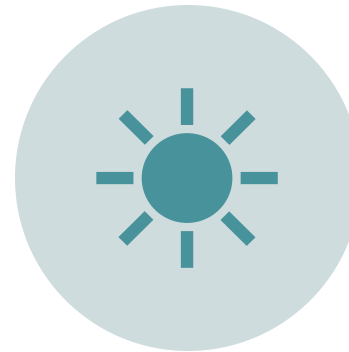
Key Goals



GENERATE 100W

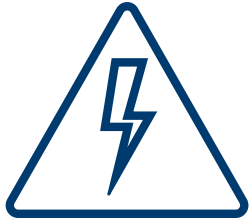


SEMI PORTABLE

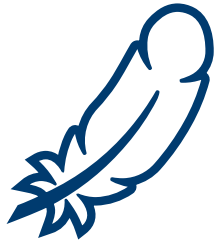


HARNESSES SOLAR
AND WIND ENERGY

Technical Challenges

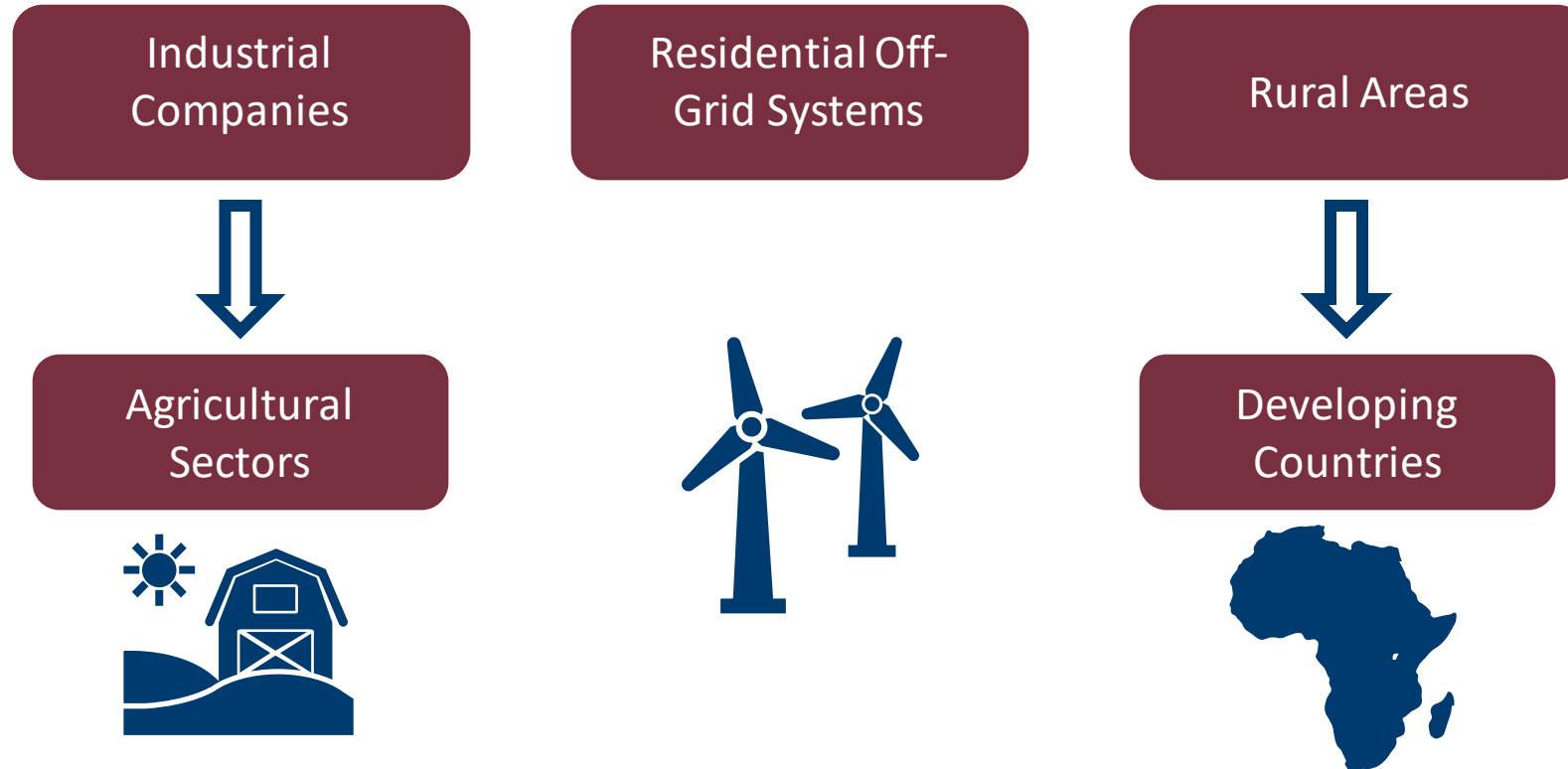


Designing a device that can capture both wind and solar energy efficiently



Creating a structurally sound device that is also portable

Expected markets



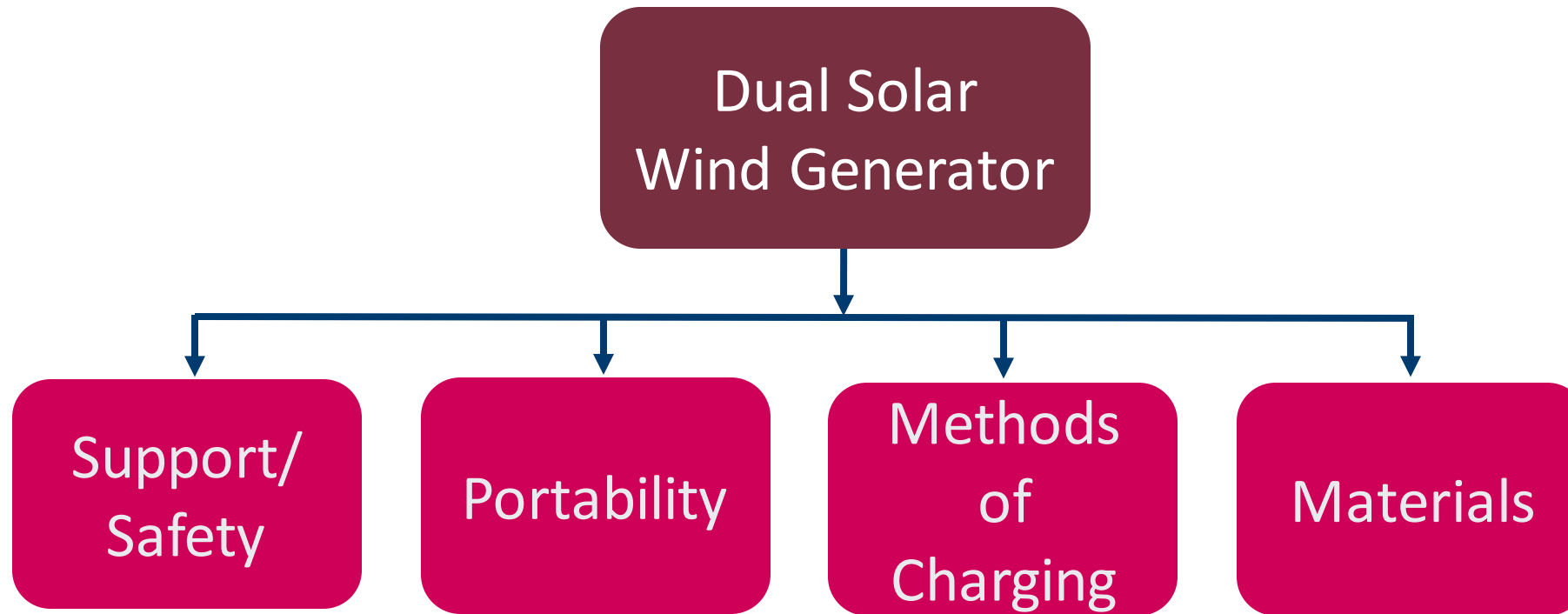
Assumptions

Device will be placed outside

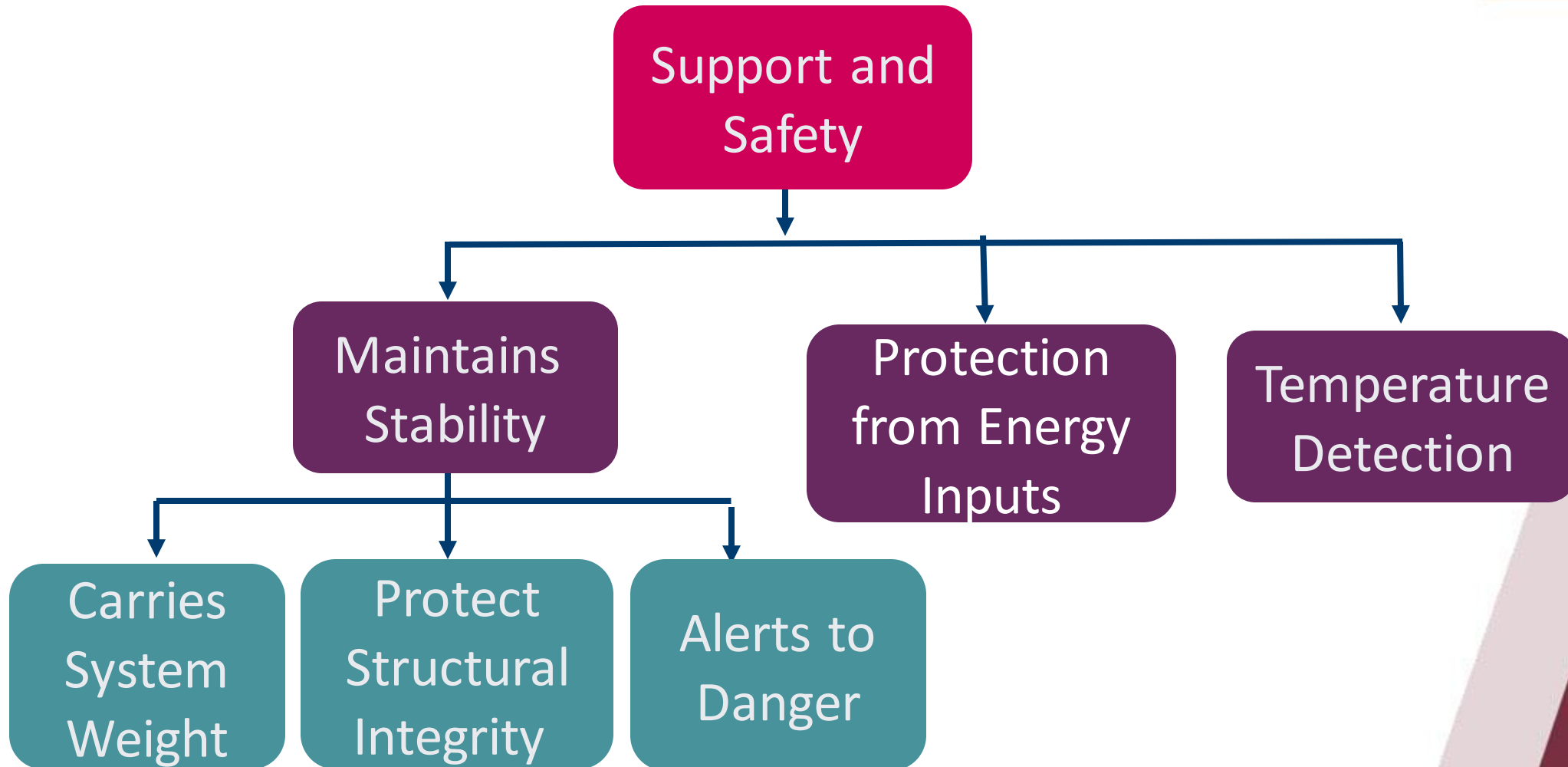
Sufficient solar and wind energy provided

Proper usage of the device is expected

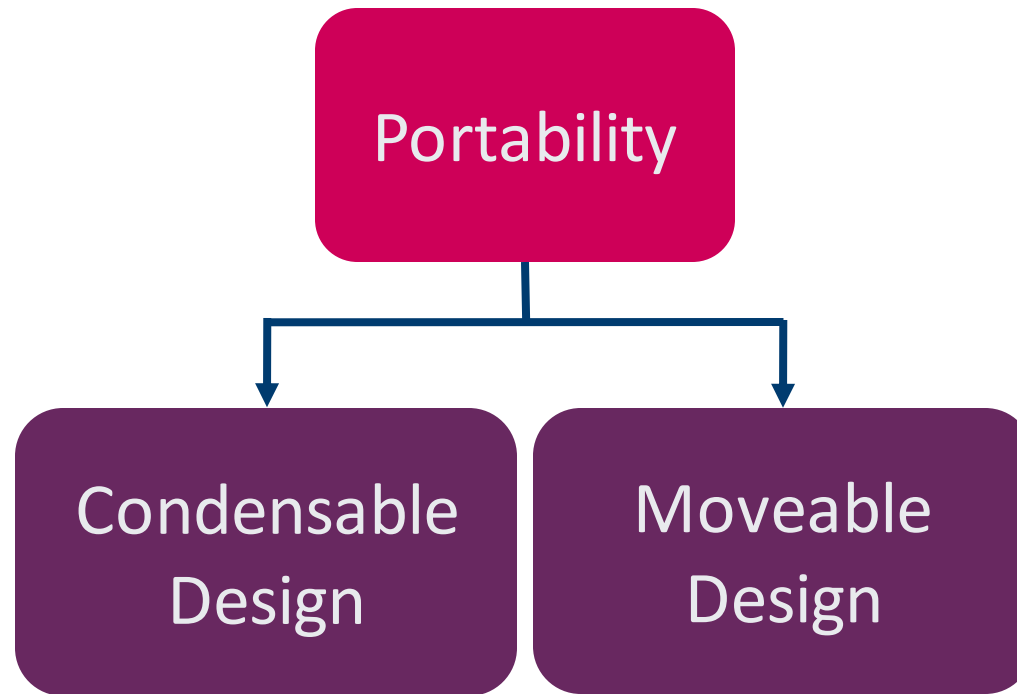
Functional Decomposition



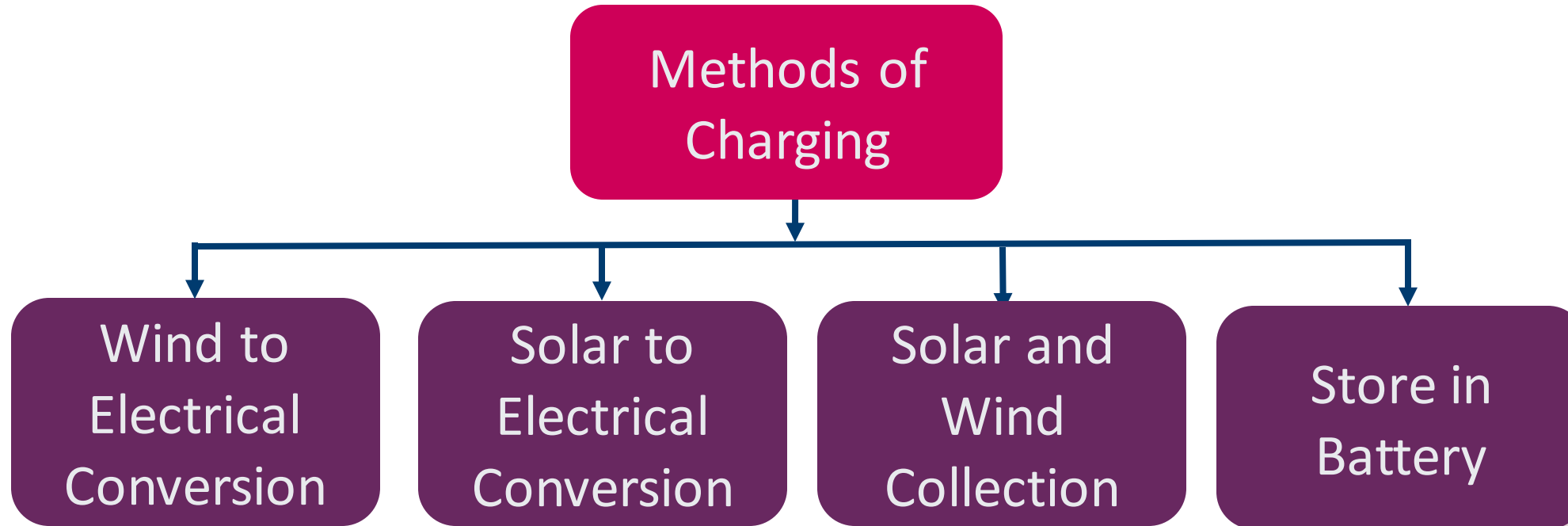
Functional Decomposition



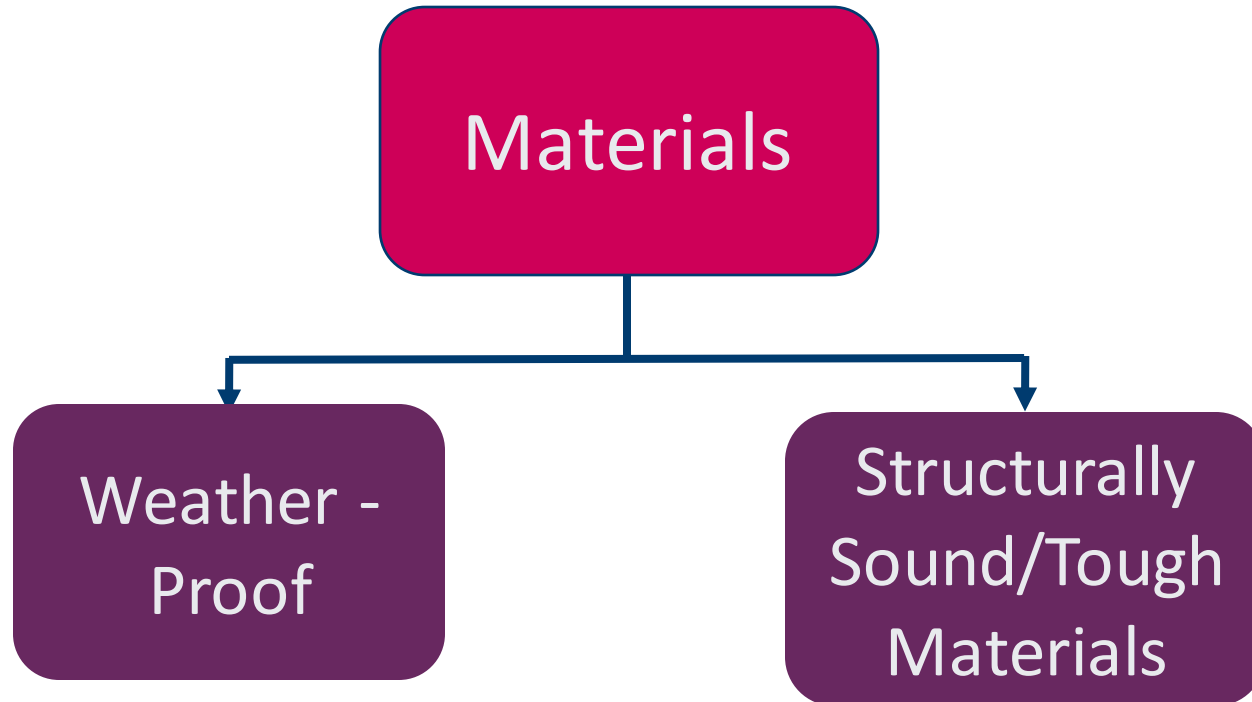
Functional Decomposition



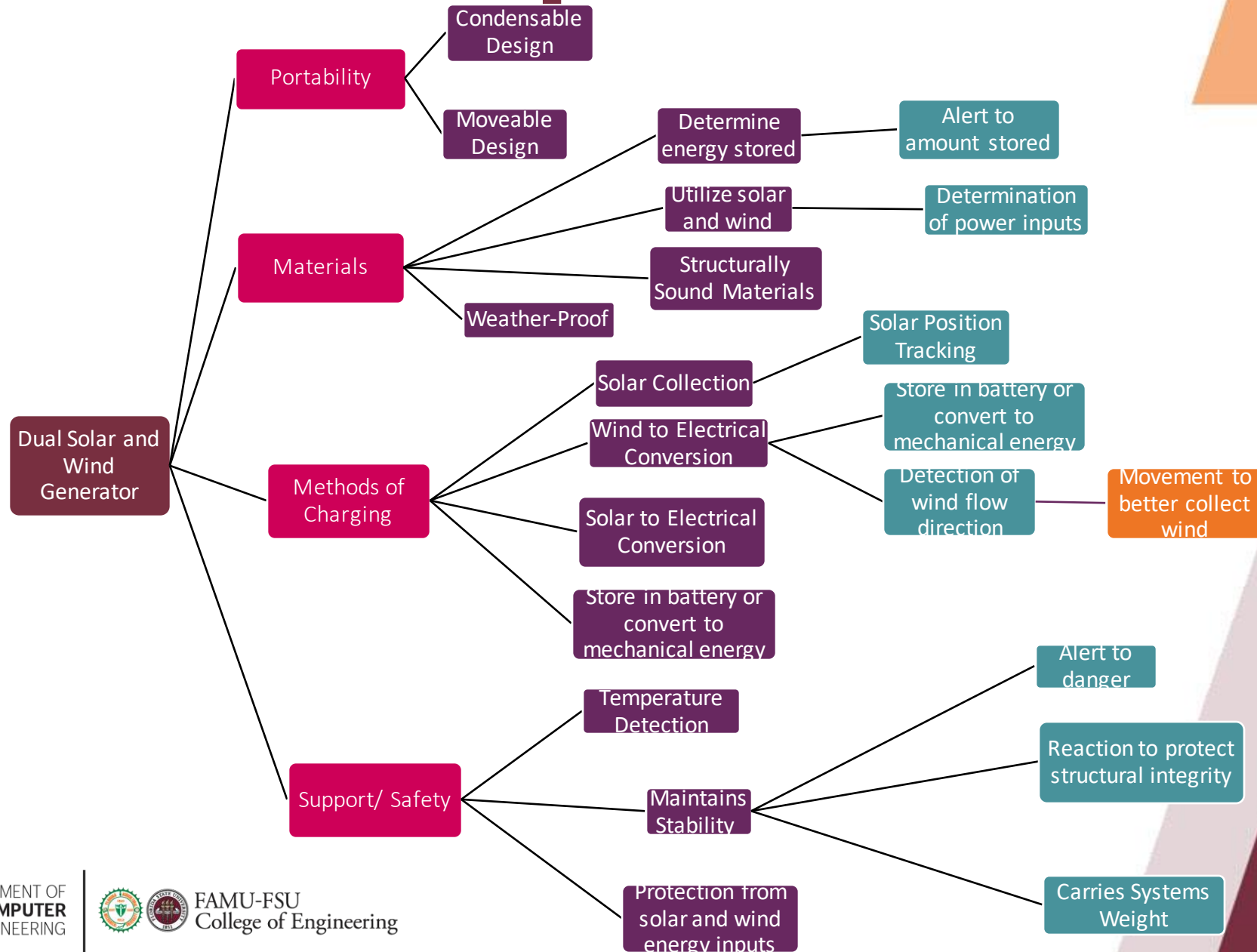
Functional Decomposition



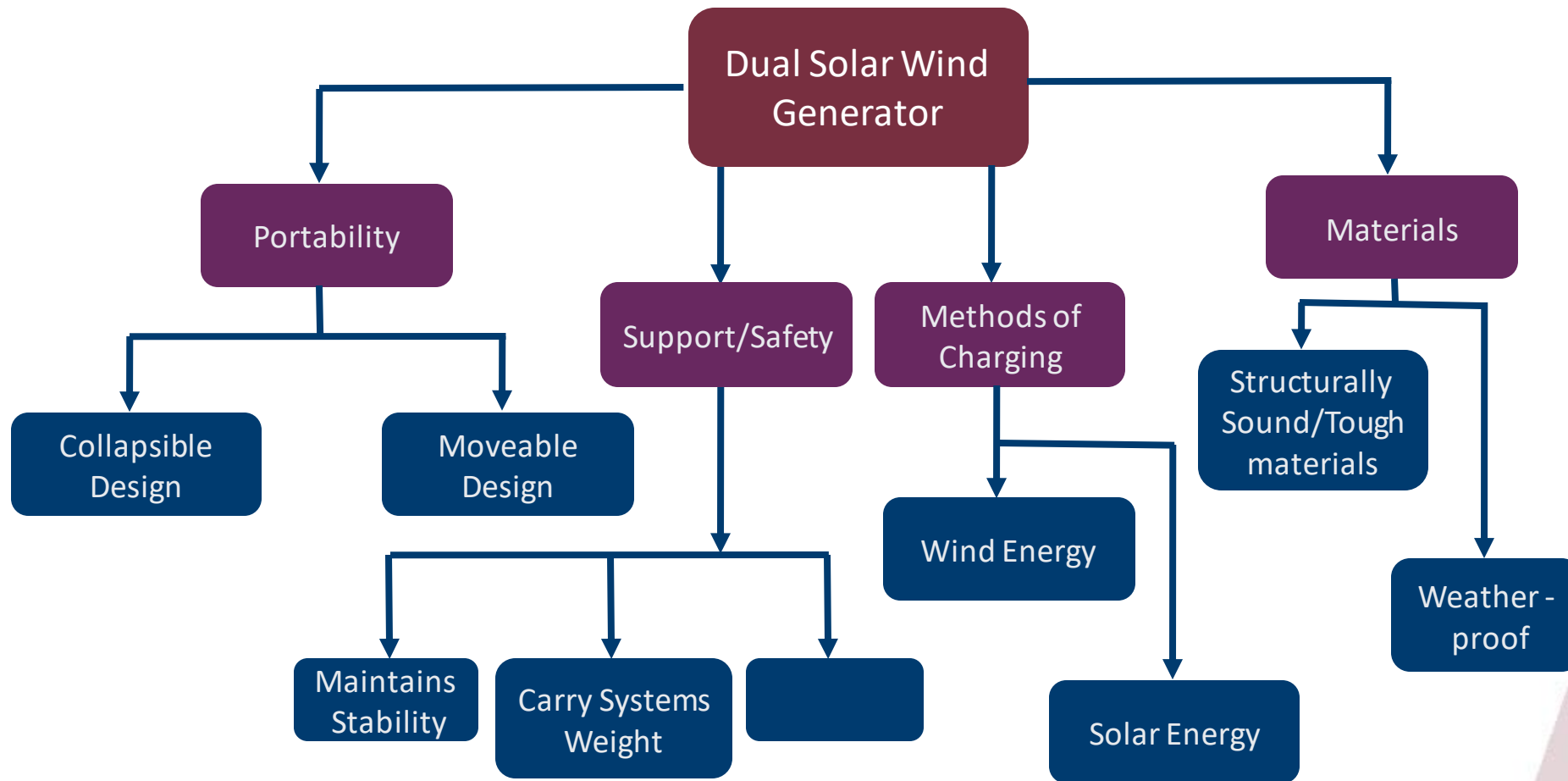
Functional Decomposition



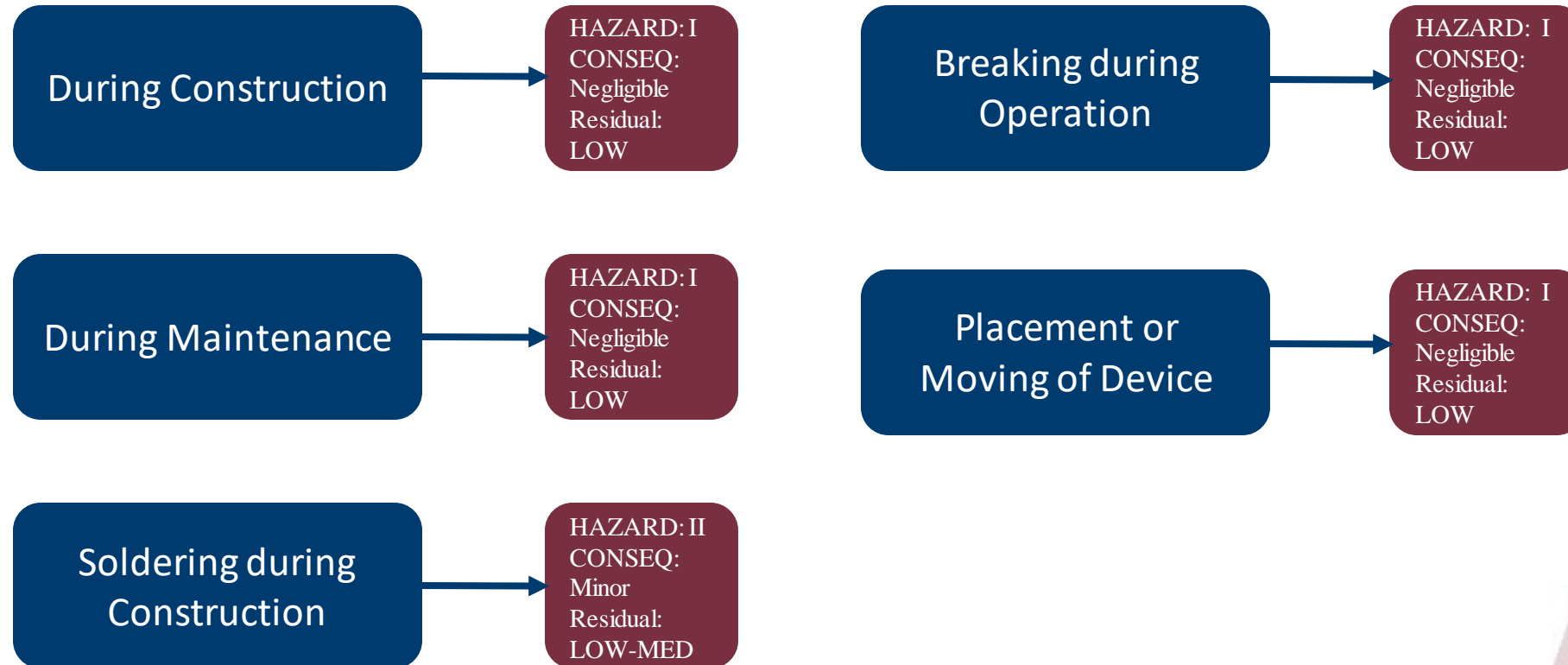
Functional Decomposition



Functional Decomposition



Risk Assessment



Binary Pairwise Chart

Customer Need	Priority
Generating Solar/Wind Energy	7
Charges Battery	6
Transportable	5
Single Structure	4
Environmental Forces	3
5 Year Durability	2
Ground Based	1
Doesn't Need Scalability	0

House of Quality Results

Engineering Characteristic	Criteria Weight
Structurally Sound (MPa/m ²)	16.88%
Energy Generated by Solar (Wh)	13.96%
Energy Generated by Wind (Wh)	13.96%
Energy Stored (Wh)	12.50%
Force Required to Move (N/m)	10.71%

Pugh Chart Results

Concept	Fish Turbines	Solar Cylinders	Sunflower
Number of Pluses	2	3	1
Number of Minuses	1	0	2

Analytical Hierarchy Process

Concept	Alternative Value
Fish Turbines	0.250
Solar Cylinders	0.329
Sunflower	0.421

Concept Generation

Medium Fidelity:

- Heat Cylinders
- Fish Turbines
- Solar Cylinders
- Turtleneck
- Car Spinner

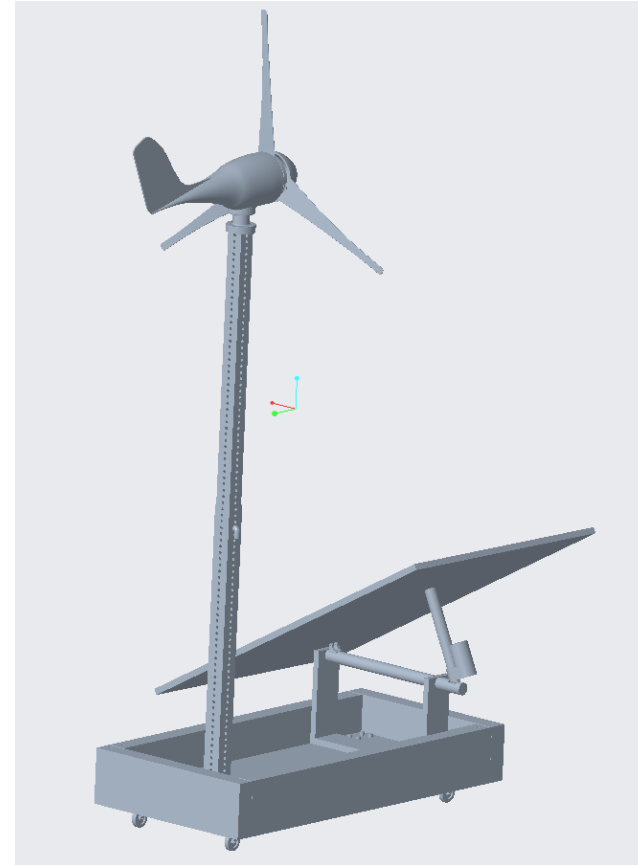
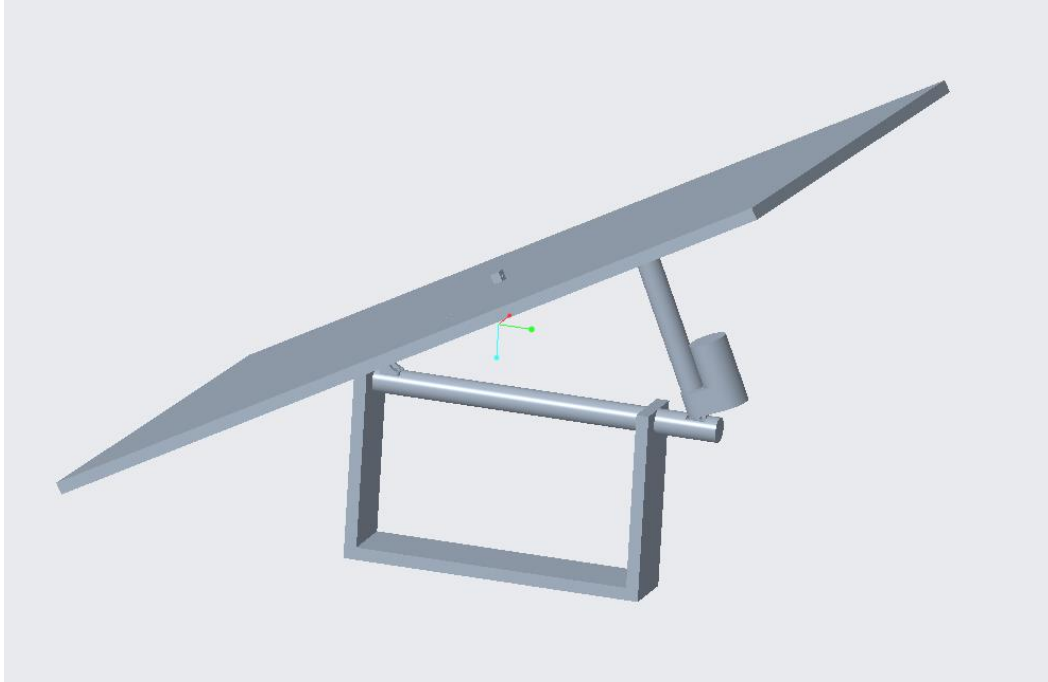
High Fidelity:

- Parallel Solarness
- Box Man
- Sunflower

Old Solar Mount Design



Old Solar Mount Design



Critical Targets

- 100 W power generation
- 10% max electrical losses
- 45 mph max wind speed
- 5 Year Durability
- 50 m portability

Bill of Materials

1	Vendor	Item	Part Number	Quantity	Unit Cost	Total
2	Amazon	US stainless steel 316 square pad eye ring 5/16"	USS320-0080	4	\$10.98	\$43.92
3	Amazon	Wind Direction Sensor 5v DC Supply 0-5V Output	YGC-FX-5V	1	65	65
4	Amazon	LiTime 30 Amp MPPT 12V/24V/Auto DC Input Solar Charge Controller	B0BJ75NLRM	1	109.98	109.98
5	Amazon	BougeRV 20 Feet 10AWG Solar Extension Cable with Female and Male Connector	B075424L8R	1	29.99	29.99
6	Amazon	Bayco KW-110 Cord Reel, Orange	BAYKW-110	1	8.15	8.15
7	Amazon	Maximm Extension Cord 30 Ft Black Power Cords	B0CLFF3VMR	1	\$16.49	16.49
8	Amazon	waveshare 1.5inch RGB OLED Display Module	B07DBXMFSN	1	\$18.59	18.59