LAND BASED AUTONOMOUS VEHICLE (LBAV)

Team 22:

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Sponsor: Aero-Propulsion Mechatronics and Energy Center

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Advisor: Dr. Nikhil Gupta

Date: October 22, 2015

Overview

- Intelligent Ground Vehicle Competition (IGVC)
- Must detect and avoid various obstacles
- Must remain in a path that is not predetermined
- Frame constraints and sensor integration

OBJECTIVES

- The goal of this competition is to design a land-based autonomous vehicle that can detect and navigate around obstacles in its path.
- Due to the time constraint of this project, there is a primary goal as well as short term goal.
  - Primary goal is to have a competition ready vehicle
  - The team goal is to be able to qualify for the competition by completing the 44 foot straight-away

BACKGROUND

- IGVC was established in 1993
- Includes top universities around the nation
- Always a need for improved autonomous vehicles
- Perfection of autonomous vehicles would reduce the need for career drivers

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HOUSE OF QUALITY

	Engineering Characteristics		
Design Requirement	Material	Cost (USD)	Weight (lbf)
Frame	3	9	6
Speed	3	6	9
Sensor	3	9	3
Power	9	6	3
Locomotion	9	3	3
Absolute Importance	27	33	24
Relative Importance	32	39	29
E.C. Rankings	2	1	3

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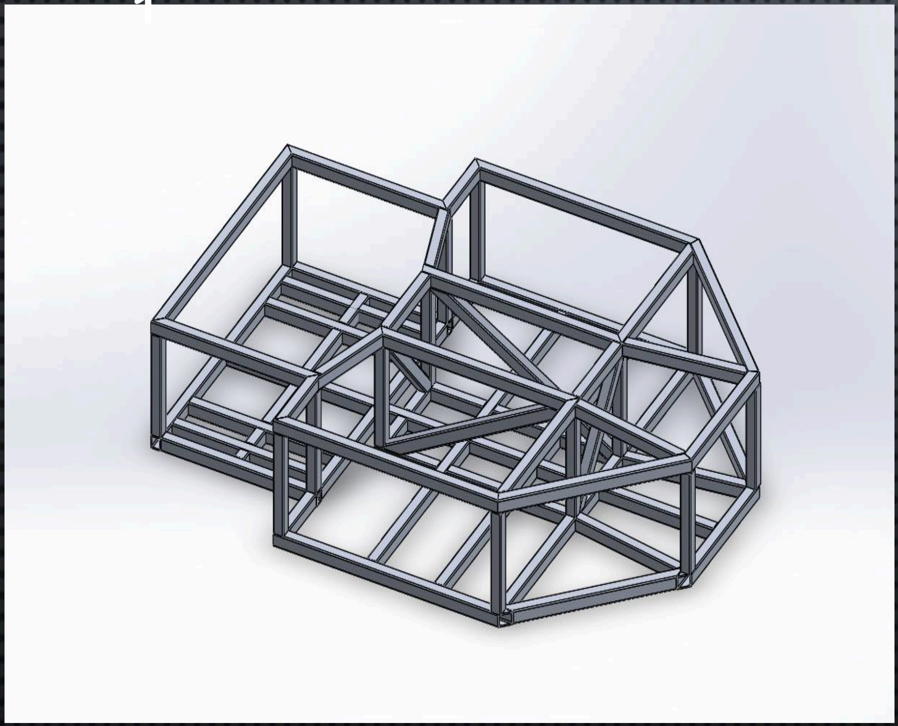
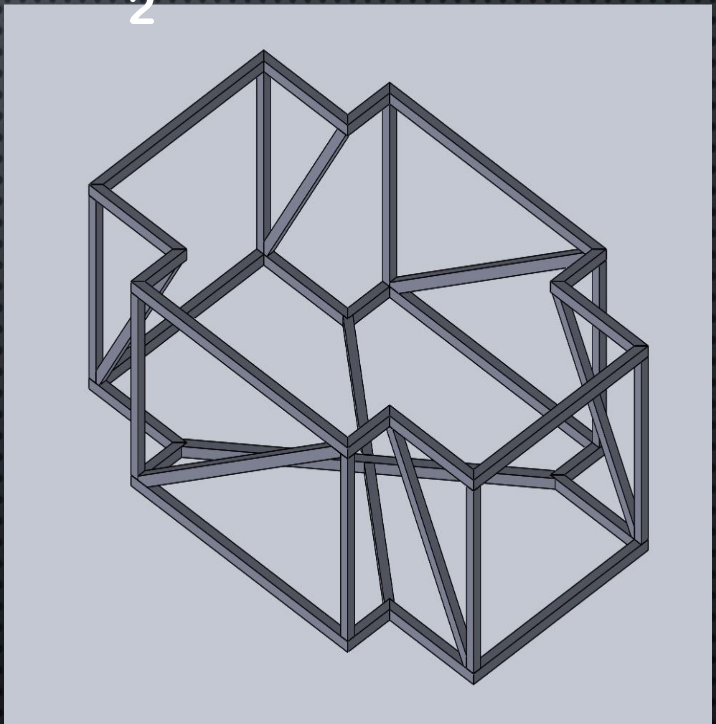
LBAV FRAME DESIGN

LBAV Frame rev 1



48" long by 30" wide by 12" tall

LBAV Frame rev 2



42" long by 30" wide by 18" tall

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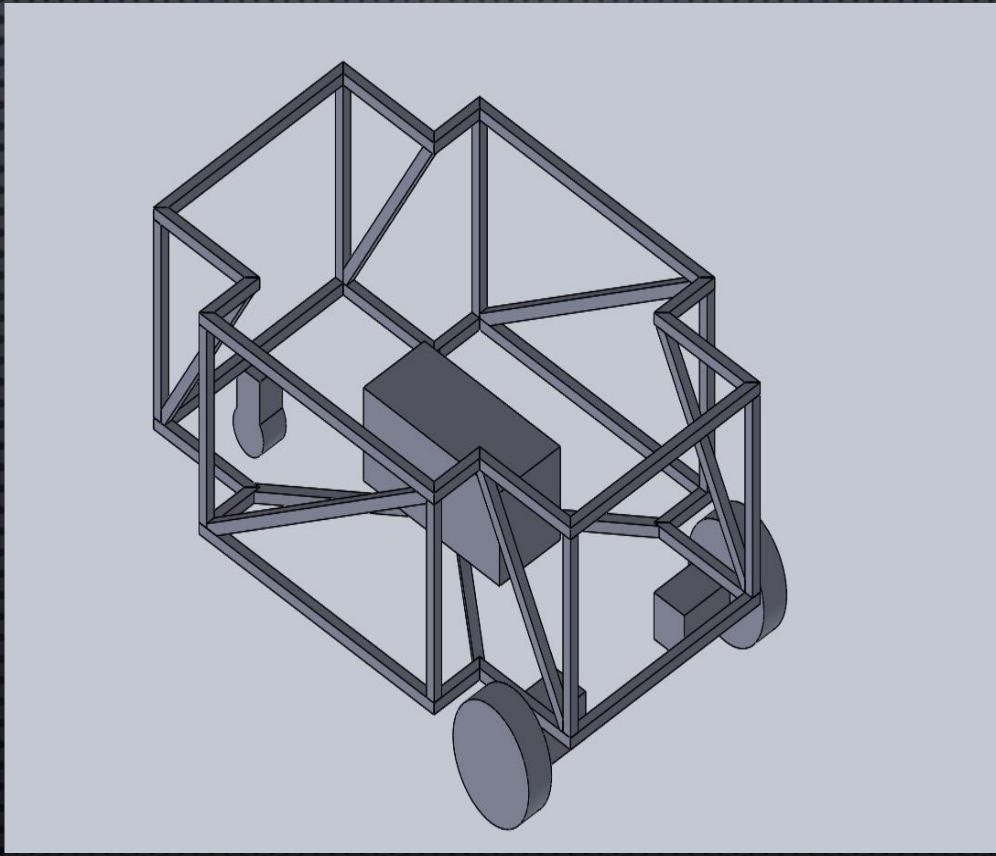
LBAV FRAME MOCKUP



Example locations for caster wheel, motors, wheels, and payload

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HARDWARE

Steering (0-10)	Programmability	Ease of Control	Weight	Cost	Total
Differential Steering	9	9	8	8	34
Skid Steer	7	7	6	6	26
Tank Tread	7	8	4	5	24
Steering Fans	2	2	9	6	19
Steering Motor	8	6	7	7	28

Body Structure (0-10)	Manufacturability	Weight	Availability	Cost	Total
Tubing Frame	8	7	8	7	30
Sheet Material	6	5	6	4	21
3D Printed	2	9	1	2	14
Floating (Hovercraft)	2	10	2	3	17

Materials (0-10)	Machinability	Weight	Availability	Cost	Total
4130 Steel	7	4	4	4	19
Aluminum 6061	8	7	9	8	32
ABS	9	8	7	7	31
Wood	7	6	9	9	31

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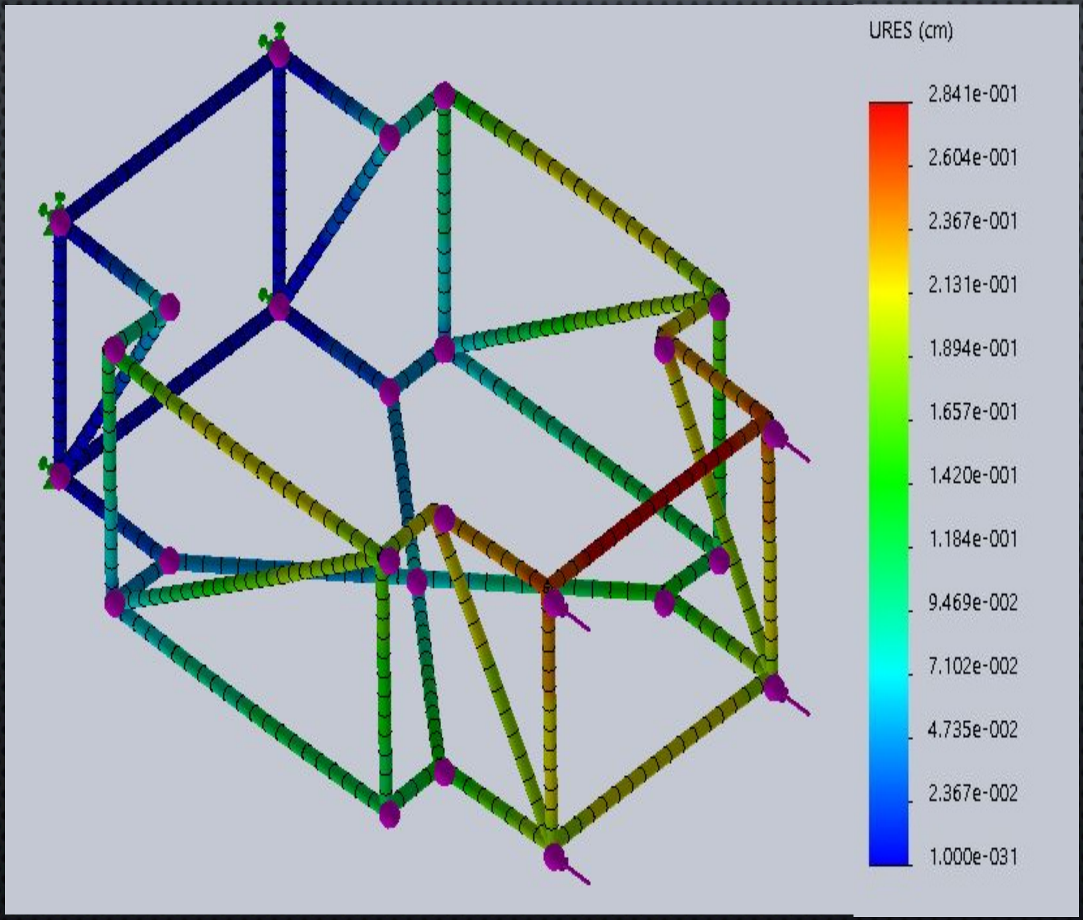
FINITE ELEMENT ANALYSIS - THEORETICAL FRONT LOADING DEFORMATION



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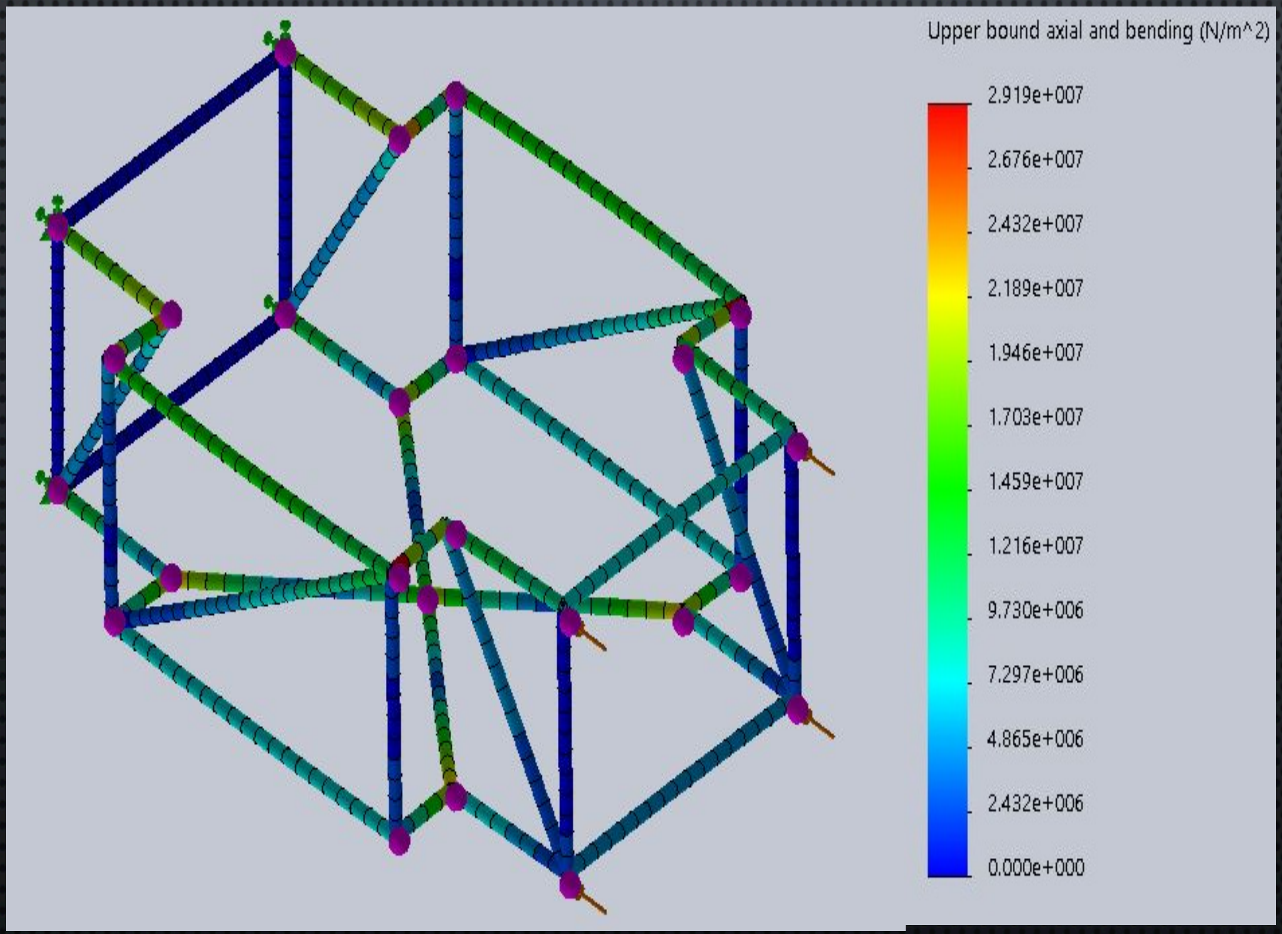
FINITE ELEMENT ANALYSIS - THEORETICAL FRONT LOADING STRESSES



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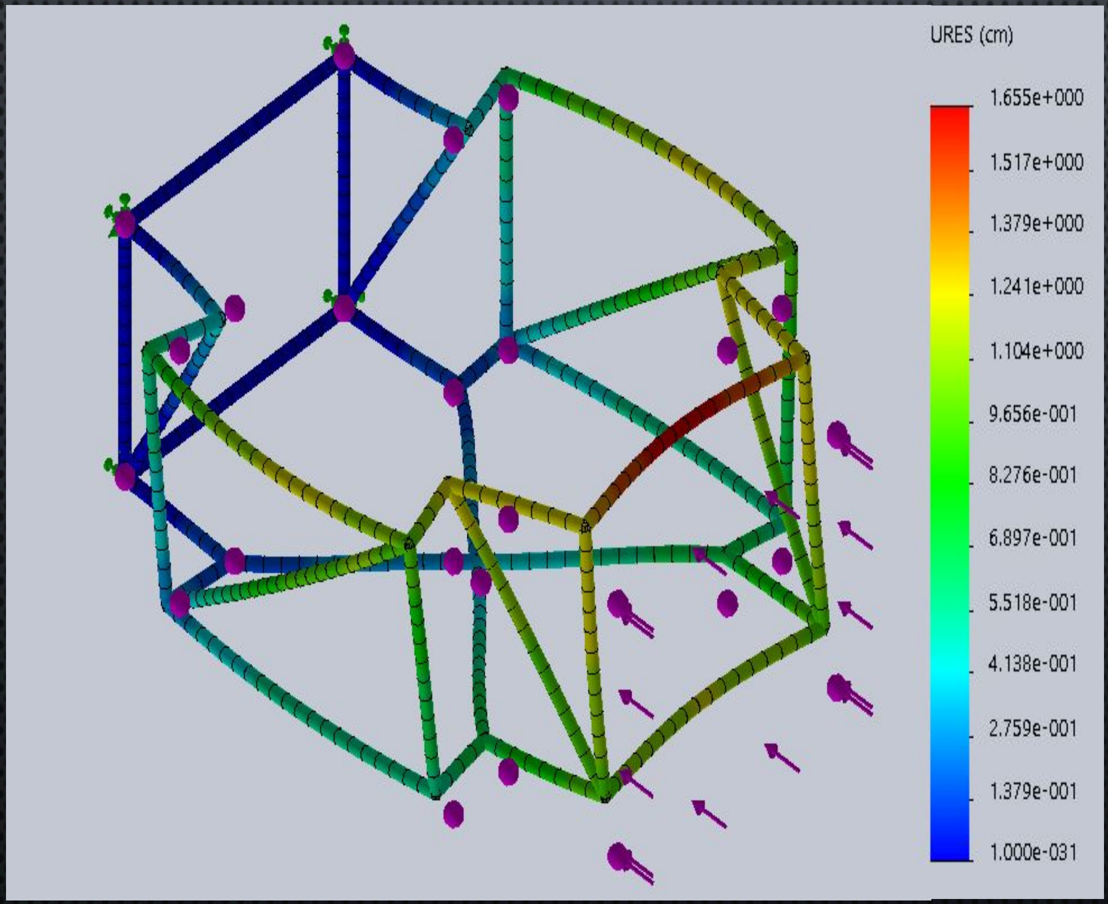
FINITE ELEMENT ANALYSIS - OVERLOADED FRONT LOADING DEFORMATION



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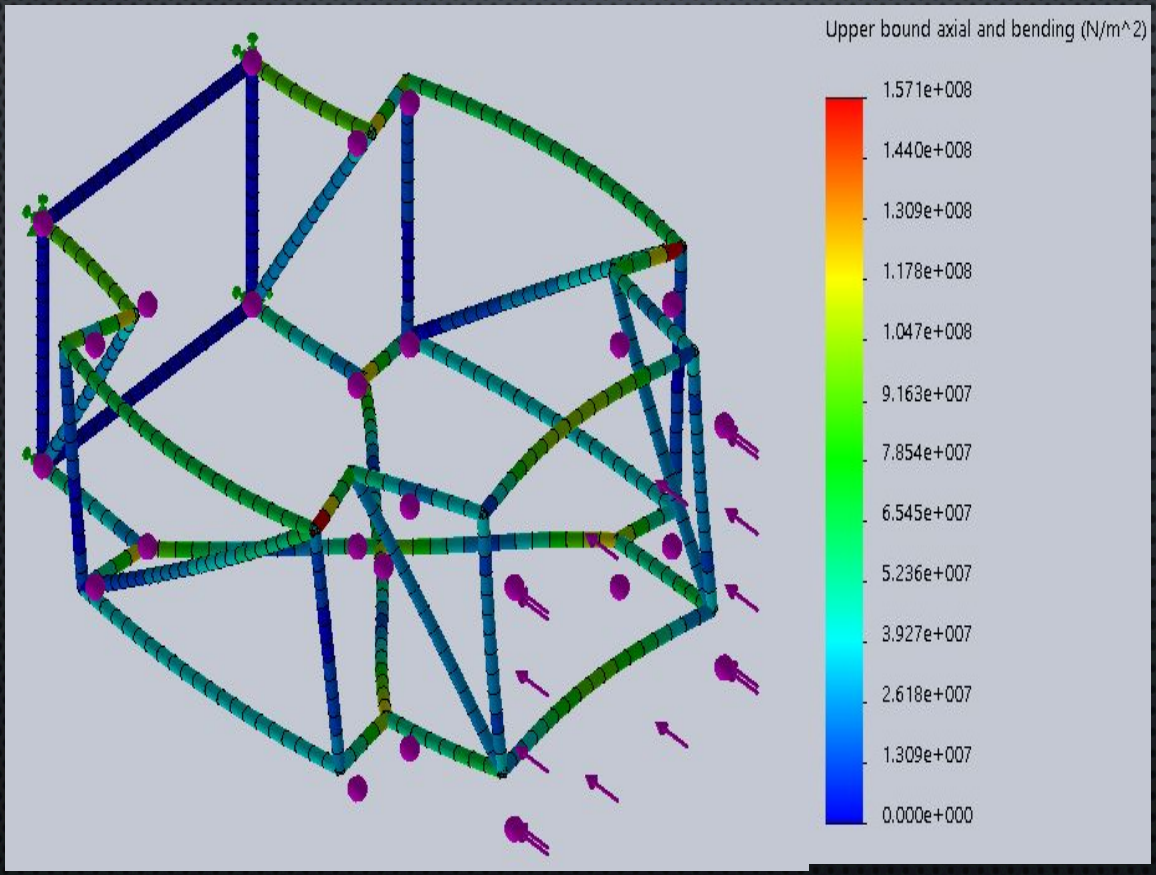

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TECHNOLOGY

Processor	Power	Weight	Cost	Total
NI MyRio 1900	8	5	6	21
Raspberry PI 2	7	7	7	21
Arduino	7	7	6	20
MSP430	5	6	7	18

Sensor	Accuracy	Weight	Cost	Total
LR Infrared	8	9	9	26
Ultrasonic	8	9	8	25
Radar	5	7	6	18
Lidar	9	8	0	17

Vision	Resolution	Weight	Cost	Total
Pixi Cam	8	8	8	24
Camcorder	5	4	9	18

Power	Life Expectancy	Weight	Cost	Total
Lead Acid	6	6	9	21
Lithium Ion	9	9	6	24
Nickel-Metal Hybrids	5	5	8	18
Lithium Polymer	5	6	6	17

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RISK ASSESSMENT-FMEA

Mode	Cause	Severity	Risk
Frame Collapsing	Overload of stress	High, Frame is damaged	Frame damage could effect other components
Short Circuit	Overload of Current	High, Damage microcontroller	Malfunction in the entire vehicle
Battery Overheat	Overcharging	High, Motion controller	Ceases motor, No motion.

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CHALLENGES

- Dual University and Interdisciplinary teams
  - meshing Computer/Electrical and Mechanical Engineers
  - coming to sound decisions
  - distance teamwork
- Gaining Knowledge
  - learning image processing
- Availability of Products
- Time Constraints

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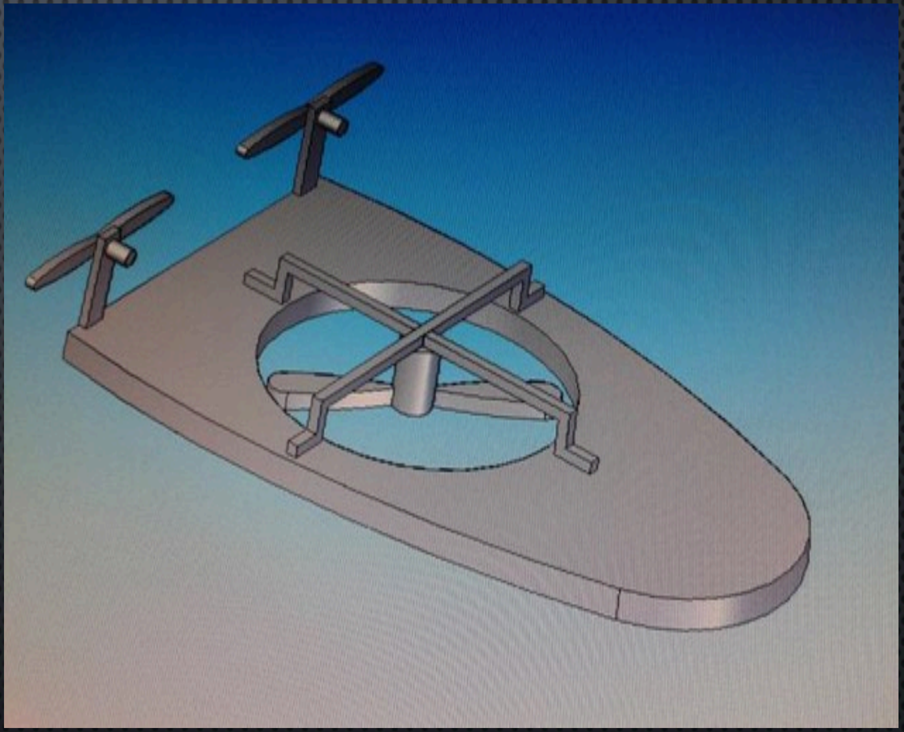
FLORIDA INSTITUTE OF TECHNOLOGY

- DESIGN 1: HOVERCRAFT
  - LIFT IS GENERATED BY A SINGLE FAN
  - TWO FANS ARE USED FOR DIFFERENTIAL STEERING AS WELL AS PROPULSION
- HEIGHT: 5.2 IN
- LENGTH: 20 IN
- WIDTH: 14.5 IN



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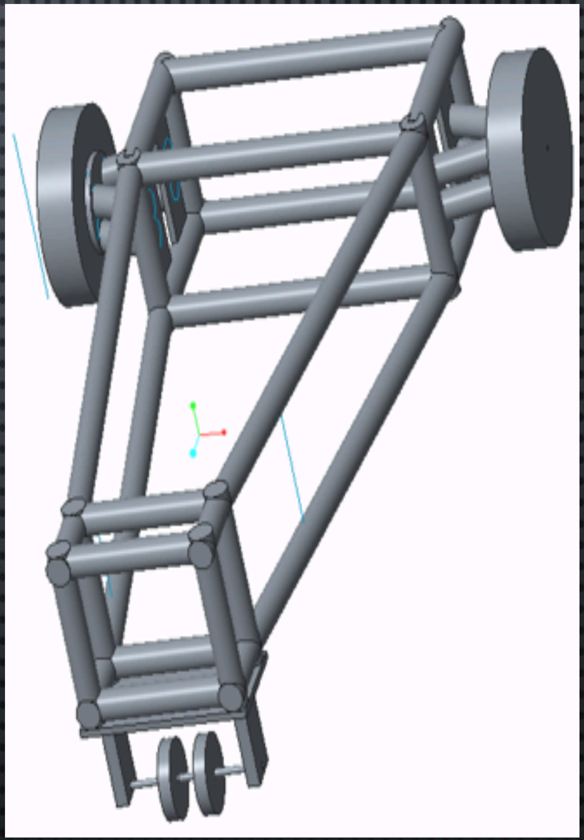
Florida Institute of Technology

- Design 2: Wheeled Vehicle

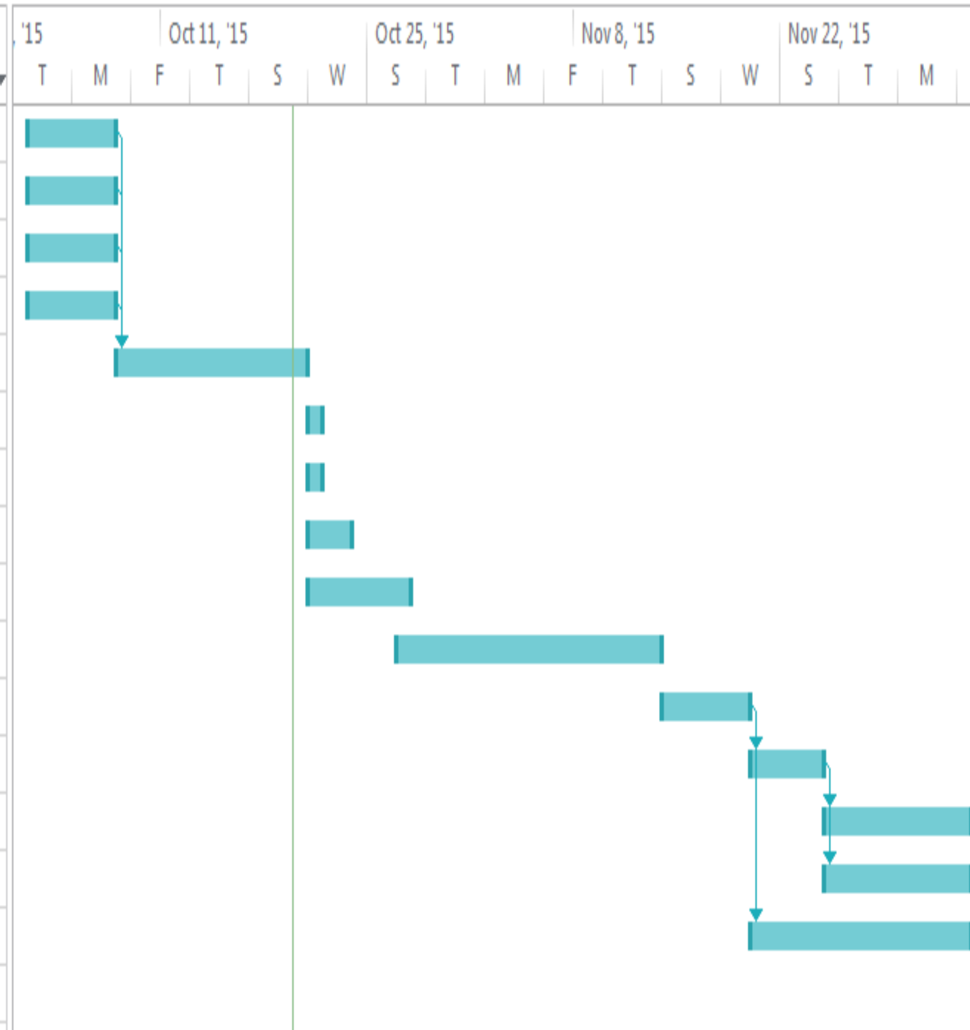
  Parts involved in the design of the wheeled vehicle includes:

  - Chassis: proposed selected material is Aluminum tubes or carbon fiber tubes.
    - Length: 3.2ft - 3.5ft; Width: 3ft; Expected weight: 6.6 lbf
  - Speed controller: Full speed regulation with linear range control from 0 to 100%.
  - Motors: No load speed is 3200 RPM, rated load is 2700 RPM.
  - Wheels: Front differential



GANTT CHART

Task Name	Duration	Start	Finish
Frame Design	4 days	Fri 10/2/15	Wed 10/7/15
Motor Specifications	4 days	Fri 10/2/15	Wed 10/7/15
Sensor Specification	4 days	Fri 10/2/15	Wed 10/7/15
Processor Specifications	4 days	Fri 10/2/15	Wed 10/7/15
Market Research	9 days	Thu 10/8/15	Tue 10/20/15
Frame Material Selection	1 day	Wed 10/21/1	Wed 10/21/15
Motor Selection	1 day	Wed 10/21/1	Wed 10/21/15
Sensor Selection	3 days	Wed 10/21/1	Fri 10/23/15
Processor Selection	5 days	Wed 10/21/1	Tue 10/27/15
Finalize Design Plan	14 days	Tue 10/27/1	Fri 11/13/15
Order Materials	5 days	Sat 11/14/15	Thu 11/19/15
Frame Machining	3 days	Fri 11/20/15	Tue 11/24/15
Sensor Mounting	8 days	Wed 11/25/1	Fri 12/4/15
Motor Mounting	8 days	Wed 11/25/1	Fri 12/4/15
Begin Coding	11 days	Fri 11/20/15	Fri 12/4/15



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FUTURE PLANS OUTLINE

- Meeting with FIT colleagues.
- Finalizing frame design.
- Finalizing of parts selection.
- Ordering of parts.
- Initial coding.
- Final web page design.

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REFERENCES

- HTTP://WWW.IGVC.ORG/2016IGVCRULES.PDF

QUESTIONS?