FLORIDA A&M UNIVERSITY-FLORIDA STATE UNIVERSITY

COLLEGE OF ENGINEERING

Formula 1/10

Autonomous Vehicle

Team 303 Members:

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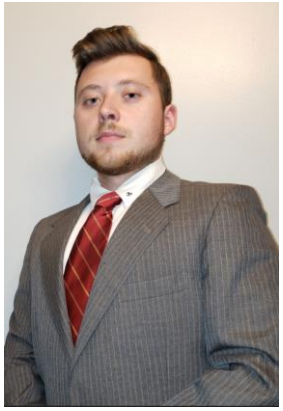
Team Members

Cody Vanderpool
PROJECT MANAGER



Steven Roy
MECHANICAL ENGINEER

Derek Swenson
SOFTWARE ENGINEER

Nicholas Stiles
SOFTWARE ENGINEER

Michael Calisi
ELECTRICAL ENGINEER

Competition Background

- The Formula 1/10 competition gives students an opportunity to learn about perception, planning and control for autonomous vehicles [1].

Fig. 3: F/10 competition logo. [1]

- Formula 1/10 offers racing competitions and conferences such as Embedded Systems Week and Cyber Physical Systems week.
- Formula 1/10 hopes to inspire students to become educated in the realm of autonomous vehicles. As technology improves, autonomy hopes to lead to safer roads, less accidents, and improved travel time [1].

Video[1]

Project Summary

Fig. 1: An autonomous 1/10th scale vehicle. [1]

Fig. 2: A Winnebago capable of space travel. [2]

- Inspired by the Formula 1/10th Autonomous Racing Competition
- Design and build a vehicle that can analyze surroundings and navigate obstacles autonomously

Background

- Autonomous vehicles work through the combination of sensors and software to make decisions and navigate.
- Sensors send out signals and gain information about the surrounding environment. Some types of sensors include (but are not limited to): Cameras, Lidar, Sonar, or Lasers.
- The sensors then relay data to the microprocessor which then utilizes the information [4]

Fig. 5: An artist's representation of an autonomous vehicle's sensors. [4]

Background

- Robot Operating System (ROS) is commonly used to implement autonomous navigation.
  - It is a robotics middleware which provides a framework for writing robot software.
  - Runs on Ubuntu Linux and utilizes a graph architecture, with nodes which can publish or subscribe to one another.
  - A ROS master will serve as a lookup table for the addresses of all other nodes.

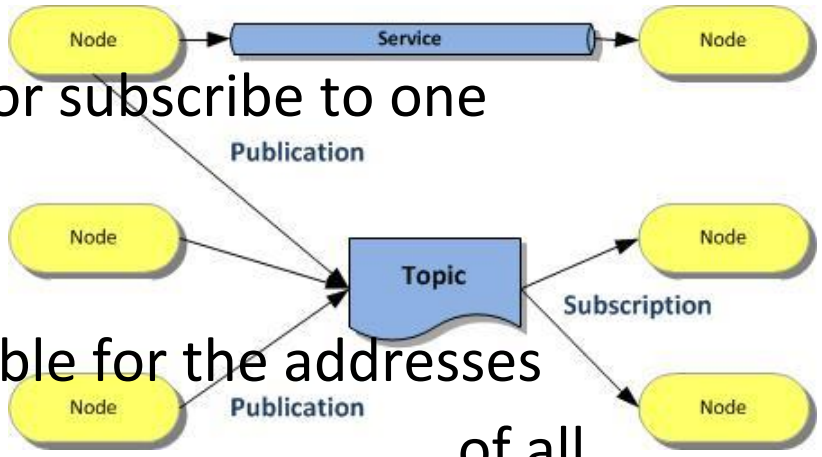


Fig. 4: Example of graph architecture. [3]

Project Scope

- Project Description
  - Design and build an autonomous 1/10th scale race car (space Winnebago).
- Key Goals
  - Navigate around obstacles autonomously.
  - Make decisions in real time.
  - Operate at a safe and controlled speed.
  - Ability to switch between autonomy and remote control.
- Market
  - Primary- The F1/10 competition
  - Secondary- RC car enthusiasts, the autonomous vehicle market, and cult movie enthusiasts.

Project Scope

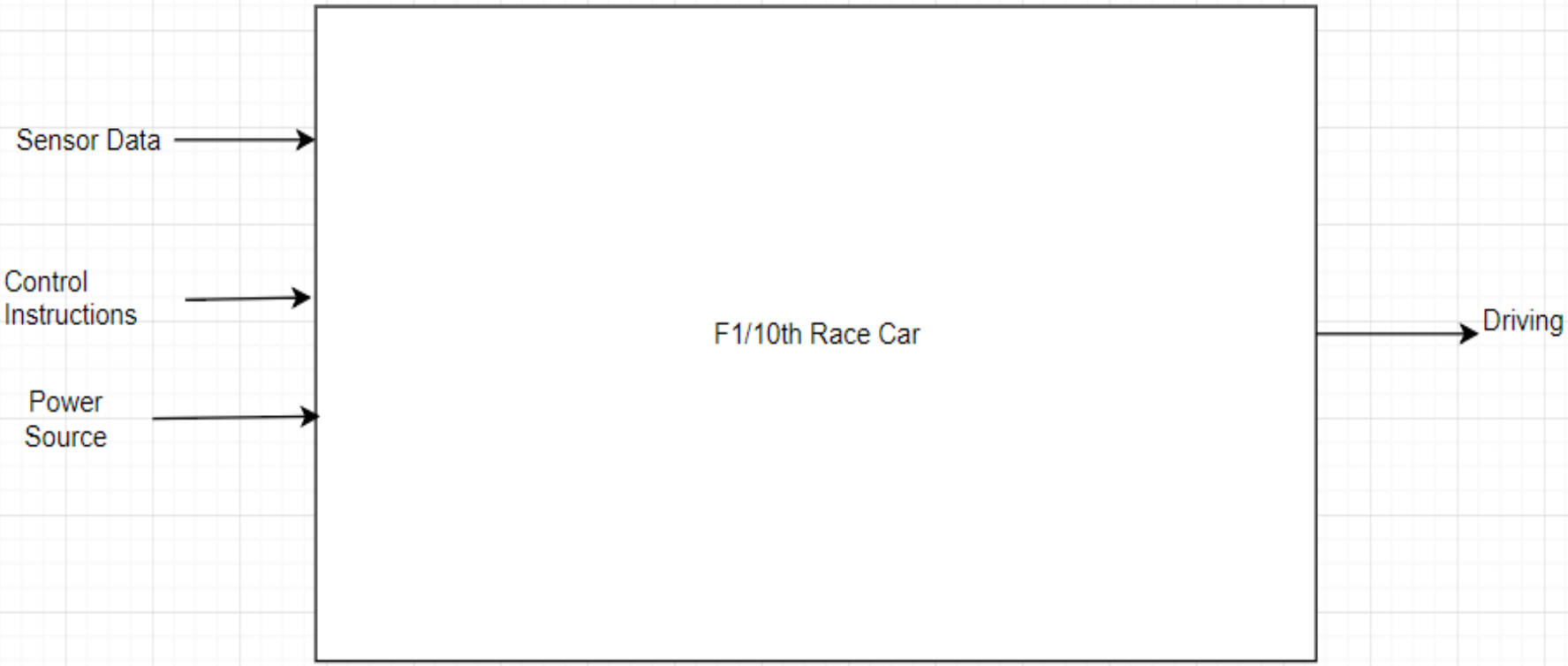
- Assumptions
  - Design will adhere to the rules and guidelines presented in the F 1/10 Autonomous Racing Competition Rule Book.
  - Physical prototype will be constructed by the end of the Spring 2019 semester.
  - Full access to ME and ECE labs and equipment to facilitate design and testing.
- Stakeholder
  - Sponsor: Dr. Hooker
  - Advisor: Dr. McConomy
  - F 1/10 Autonomous Racing Competition
  - FAMU-FSU College of Engineering

Customer Needs

Question	Customer Statement	Interpreted Need
Operation	F1/10 Car should be capable of navigating from one room, down the hall, to another.	The car should have sensors that allow the car to interpret its surrounding environment and make decisions of where to go.
	Needs to have the ability to switch between autonomous navigation and user control	The car should include a feature which will override the autonomous navigation and allow a user to control the car via remote.
	All Decision making needs to be done on board the car itself	No relaying of information to an external system is allowed.
	Needs to abide by the F1/10 Rules and Regulations	The cars' dimensions, electronics and features should all coincide with the competition rulebook.

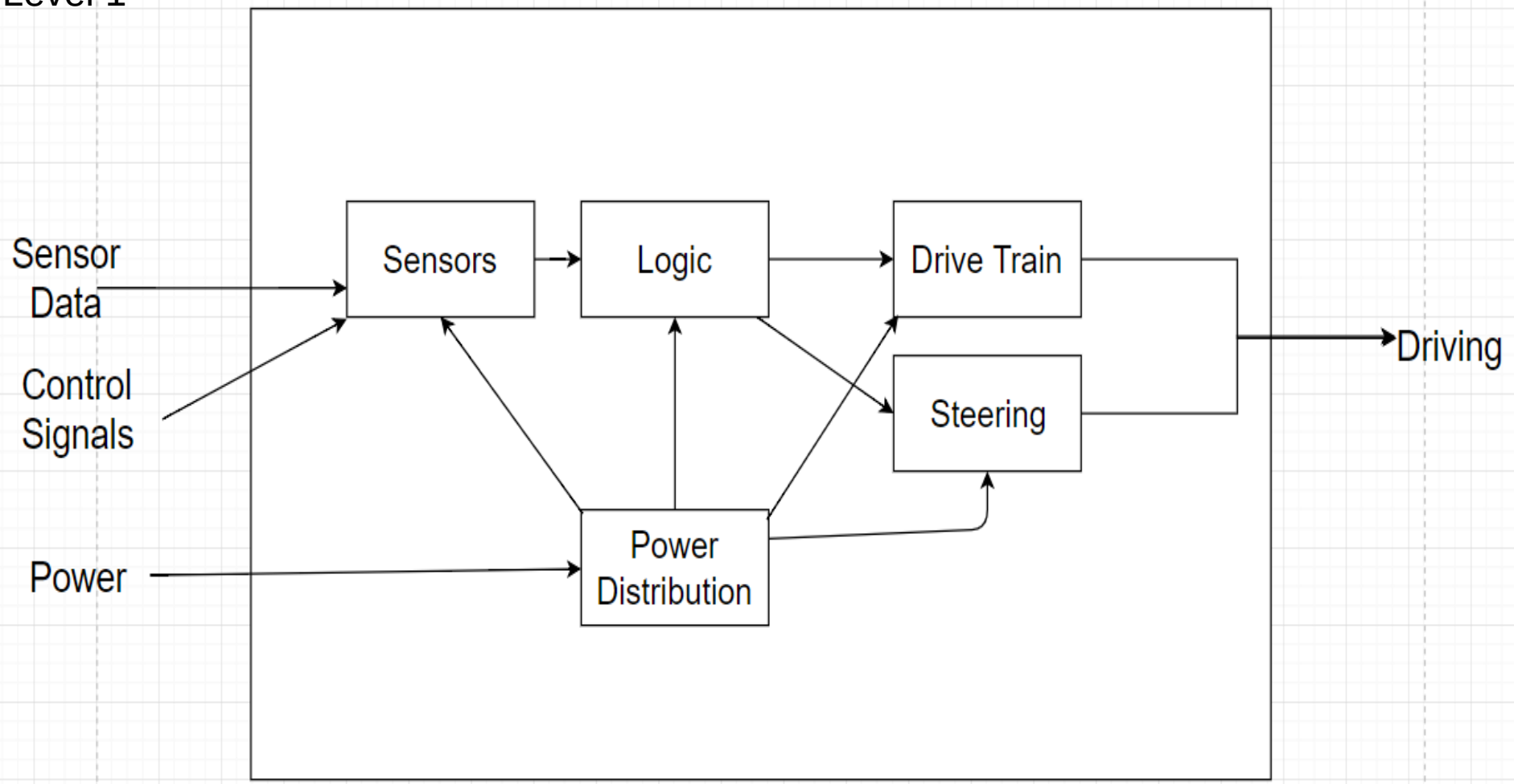
Functional Decomposition

Level 0



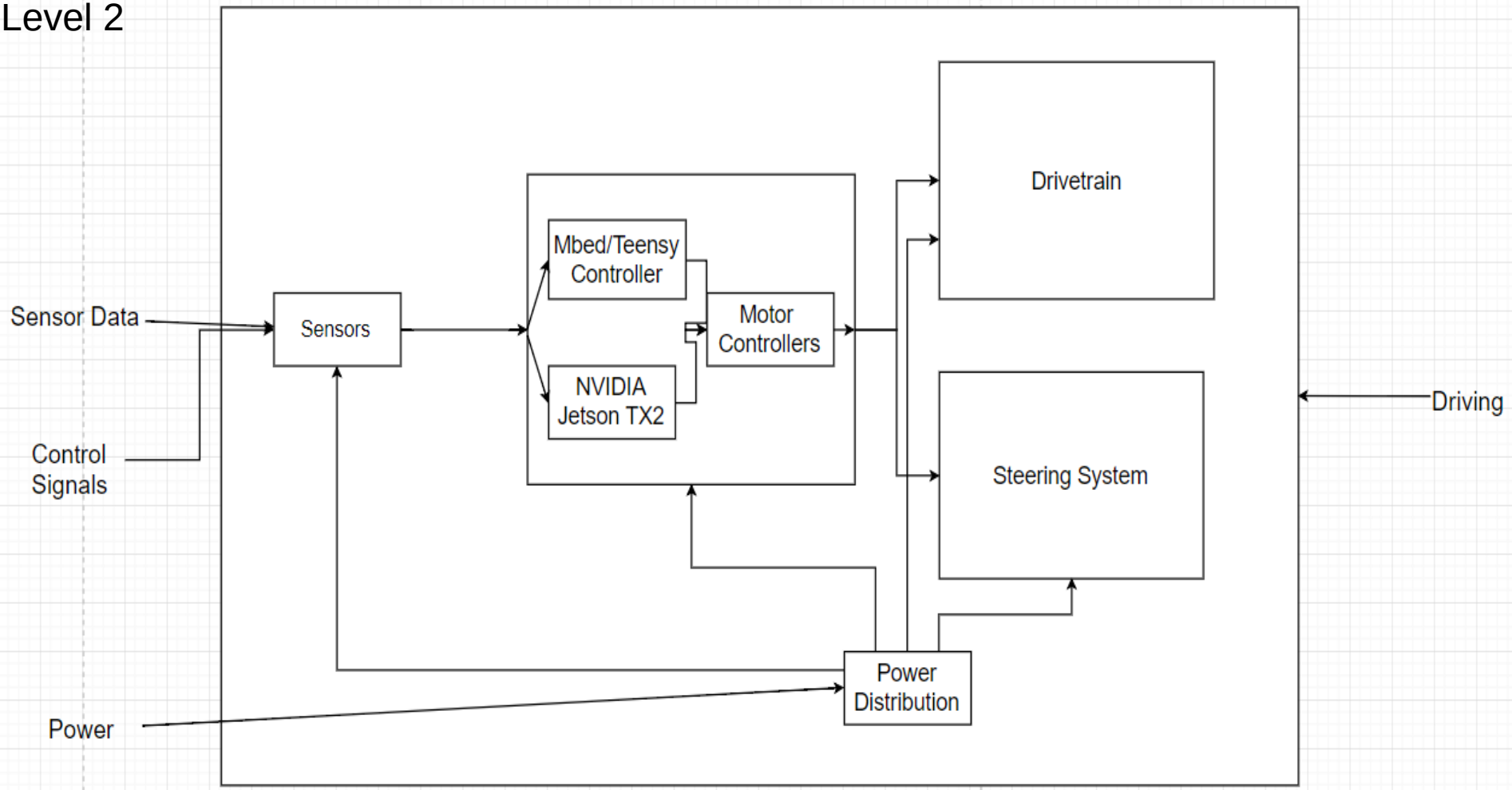
Functional Decomposition

Level 1



Functional Decomposition

Level 2

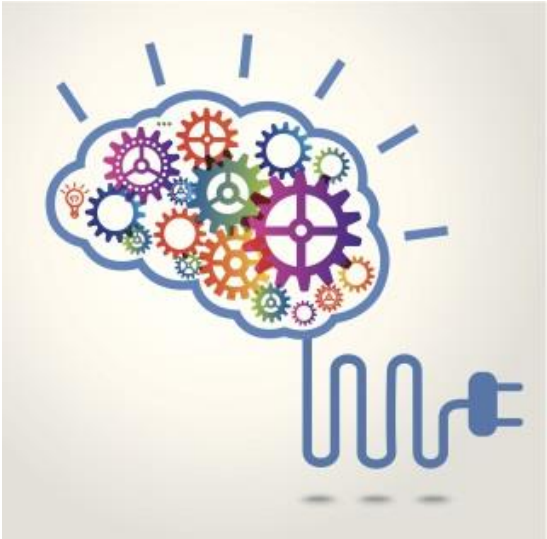


Trade Offs

- Speed vs. Accuracy
  - A faster vehicle needs data to be processed faster and it becomes more of a task to navigate without errors or collisions.
- Weight vs. Cost
  - Lighter materials will improve cornering, acceleration, and handling of the vehicle.
  - light materials: aluminum, titanium, and carbon fiber
- Accuracy vs. Cost
  - To navigate more efficiently a high processing speed is needed. The more powerful the processor, the higher the cost.

The Next Step

- Concept Generations
  - Brainstorm ideas on types of sensors and controllers to use.
  - Determine the best systems to use for steering , drivetrain and propulsion.
- Project Plan
  - Research similar projects
  - Develop a design plan
  - Research materials and components
  - Design and test



The Next Step

- Research and learn ROS.
- Become familiar with NVIDIA Jetson TX2, which will serve as the main computer for their system.
- Become familiar with the ZED stereoscopic camera and how to integrate it into the system.
- Research is also being conducted into what will be the best chassis design and best steering apparatus.

References

[1] About F1/10. Retrieved September 28, 2018 from http://f1tenth.org/about

[2] 'Spaceballs' Winnebago, Dark Helmet helmet go up for auction. Retrieved October 1, 2018 from https://www.cnet.com/news/spaceballs-winnebago-dark-helmet-auction-profiles-in-history-rick-moranis/

[3] ROS - Robot Operating System. Retrieved October 1, 2018 from https://www.generationrobots.com/blog/en/ros-robot-operating-system-2/

[4] Self-Driving Cars Explained. Retrieved September 28, 2018, from https://www.ucsusa.org/clean-vehicles/how-self-driving-cars-work#.W66ioGhKhEY

[5] Engineering Strategic Planning Process. Retrieved October 1, 2018 from http://web2.eng.fsu.edu/strategic/

Questions?