Smile-Mobile Autonomous Vehicle

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Background

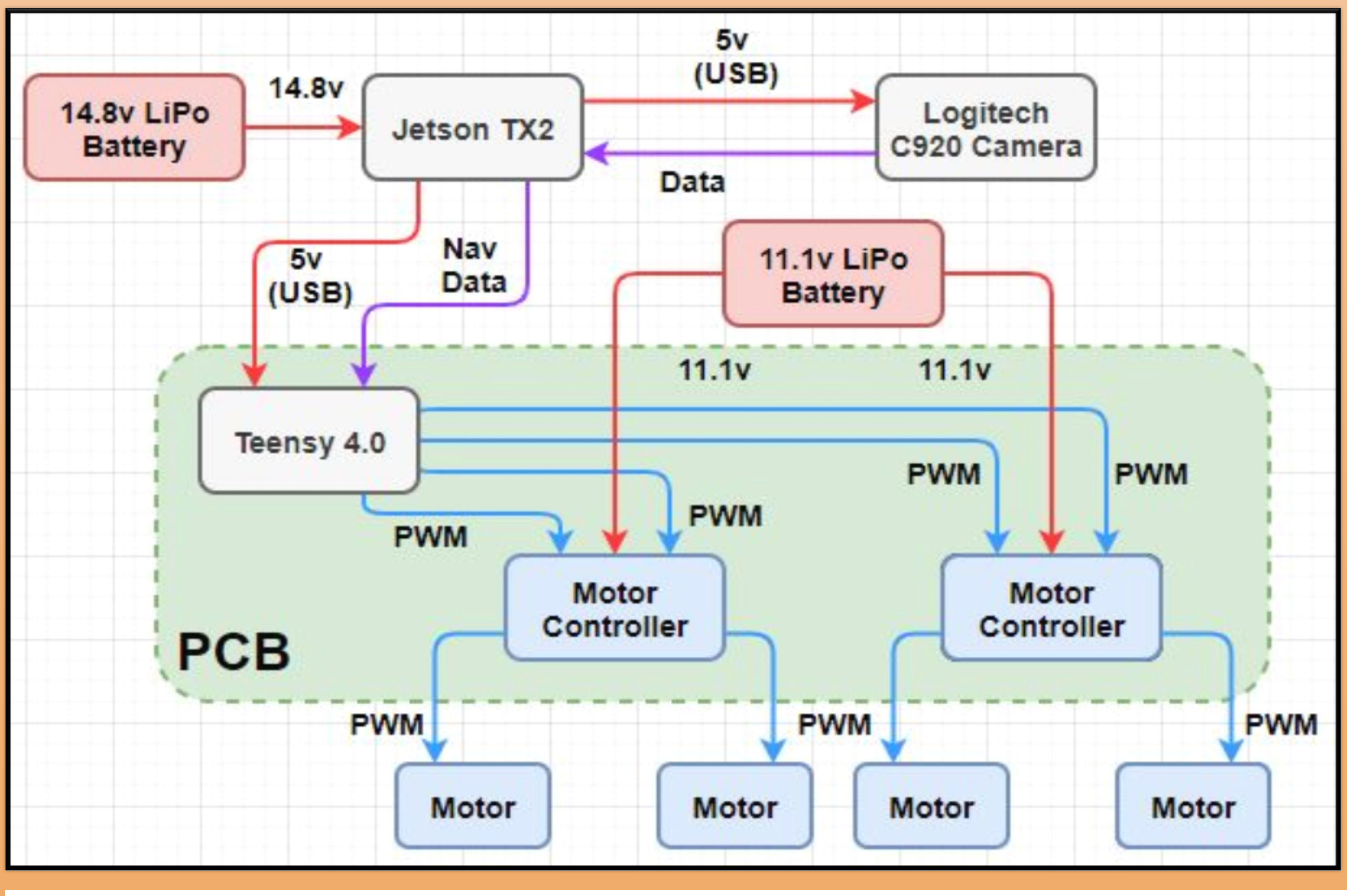
Currently, autonomous vehicles are made possible through a combination of computer vision, lidar sensors, and radar sensors. The most expensive components in these vehicles are the two sensors, lidar and radar.

Some lidar sensors cost upwards of $8000, and radar sensors can be as expensive as $2000. If these costs could be completely disposed of, the overall cost of making an autonomous vehicle could be drastically decreased, allowing for great advancements in making autonomous vehicles available to people of all economic backgrounds.

Overview

Our goal: make an autonomous without need of any radar sensors or lidar sensors. By focusing all of the processing power in the computer vision aspect and using high-end object-detection algorithms, we will be able to avoid needing lidar or radar. This will reduce the overall costs of autonomous vehicles while simplifying the procedure of development. We have created a small-scale vehicle with an on-board GPU and camera using the YOLOv3 object detection algorithm to allow the car to make decisions autonomously in a closed course to simulate real-life driving scenarios.

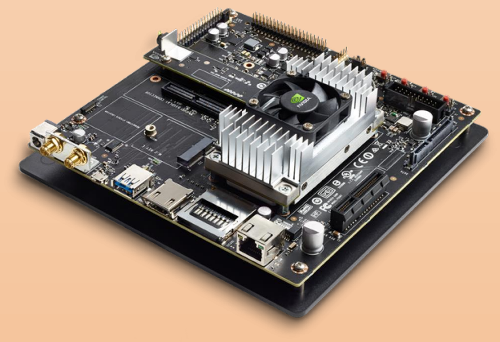
System Hardware Diagram



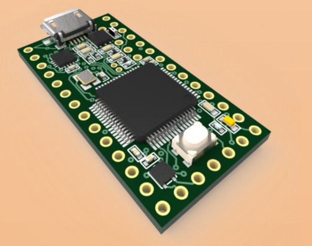
Overview / Product Name

The Smile-Mobile consists of a vehicle frame with batteries and boards mounted internally and a camera mounted on the external frame.

Hardware / Key Components

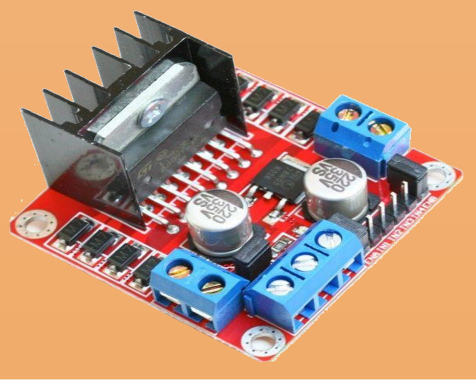


Jetson TX2/Teensy 4.0
Fastest, most power-efficient embedded AI computing device. Useful for its 256 core GPU for image processing.



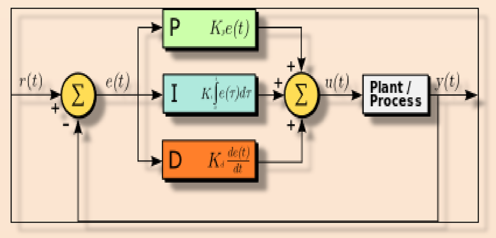
Teensy
Multiple PWM pins allows for processing data and sending signals to motor controllers.

Logitech C920 Camera
A 1080P camera which includes built in H.264 video compression. Used with TX2's H.264 decoder, we achieve 30 FPS while running YoloV3 Tiny weights.



Motor Controller (x2)
Drive Voltage — 5V - 35V
Drive Current — 2A
Maximum Power — 25W

Key Software Components



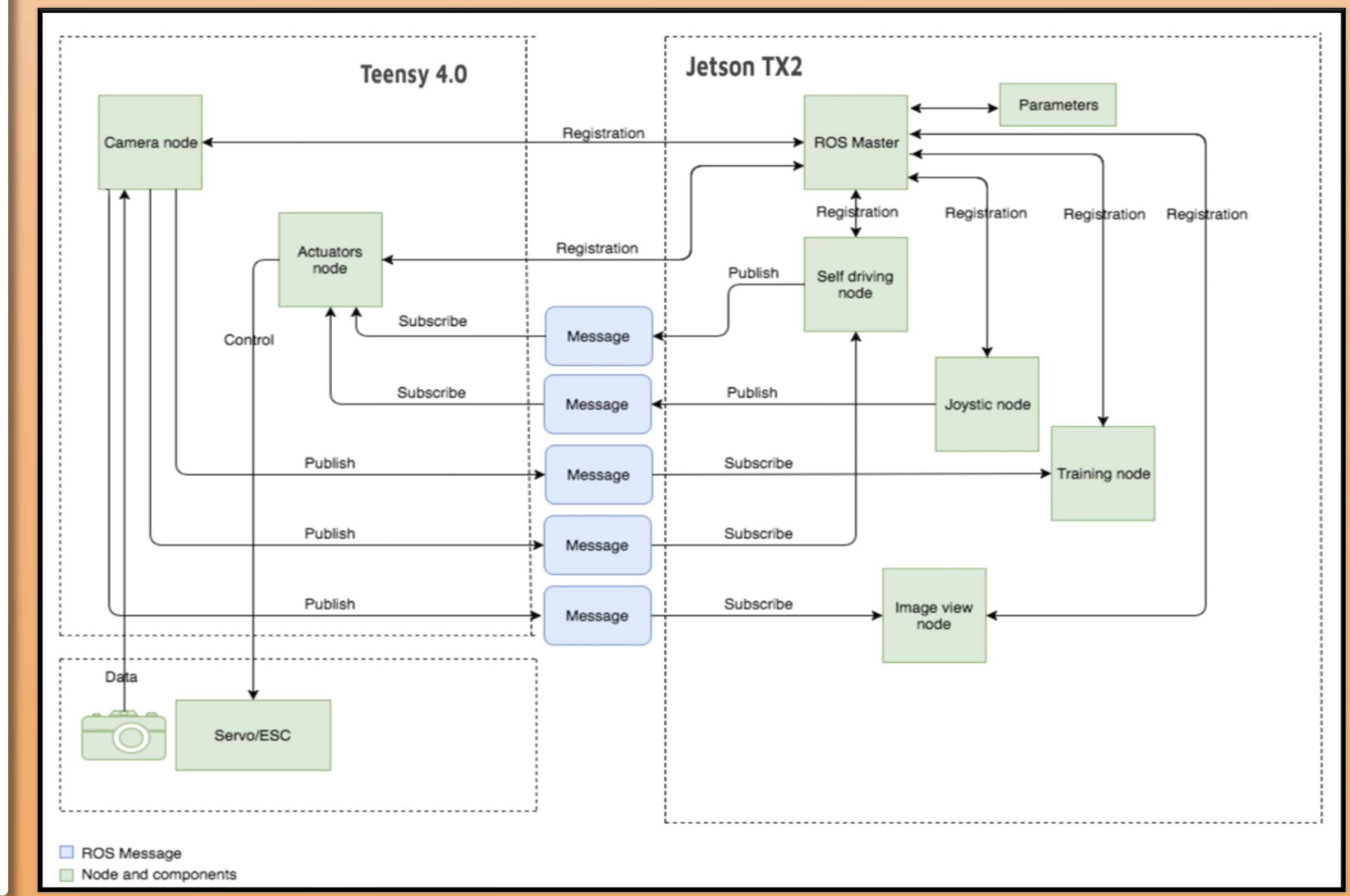
PID Controls
Allows the car to make smooth acceleration, deceleration, and turns based on detection results.

ROS
ROS is a node based publisher/subscriber communication system. It manages all of the data flow both internally (message passing) and externally (machine-to-machine).

YOLOv3
Deep learning based real-time object detection algorithm. It is capable of recognizing objects and their location for a given frame.

Gazebo Simulator
Gazebo is a 3D simulator featuring a physics engine. Coupled with ROS as an interface, it provides a powerful tool for modeling, simulating, and testing robots in a given environment.

System Software Diagram



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