Self Driving Robotic Car

Background & Motivation

- Donkey Car - Link
- MIT Race Car - Link
- UPenn Car - Link
- Amazon Deep Racer - Link
- Autonomous Cars - Waymo, Tesla, startups like drive.ai, etc
- Applied Computer Vision, Deep Learning, Machine Learning project.

Hardware

What is a RC Car?

- Size - 1/10, 1/16, 1/8, 1/5, etc
- Radio Receiver
- Motor - Kind of DC motor - Brushed or brushless - Link
- ESC - Electronic Speed Controller - Link
- Servo - Steering - Another kind of DC motor
- Battery
- Wikipedia - Link

https://www.instructables.com/id/The-COMPLETE-Guide-to-RC-Cars/

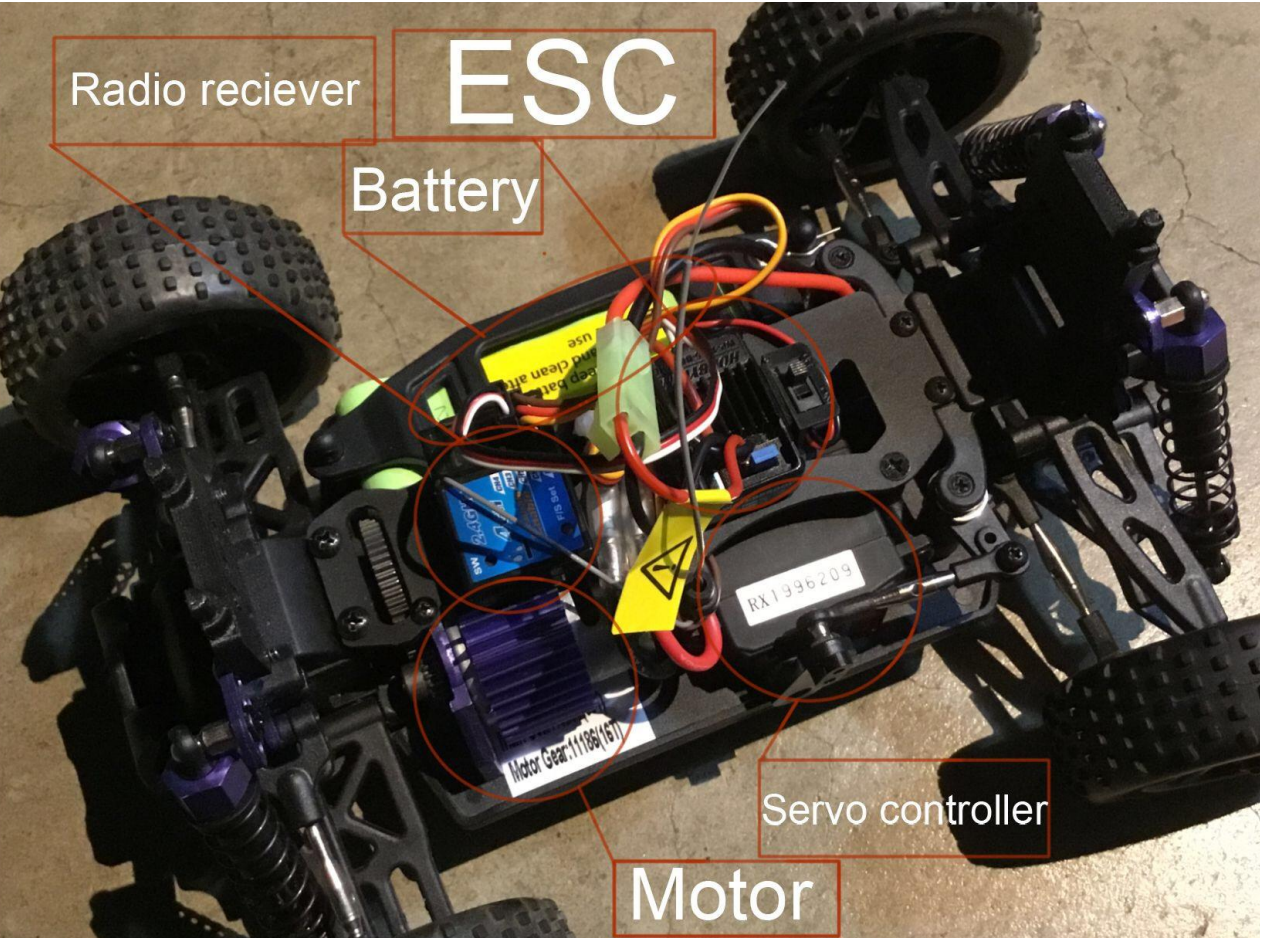
Choose a car (1/16, ~$90)

- Exceed Magnet Blue, Red
- Exceed Desert Monster Blue, Red
- Exceed Short Course Truck Blue, Red
- Exceed Blaze Hyper Blue, Yellow
- Traxxas Models are there too
- Exceed RC 1/16 2.4Ghz Blaze EP Electric RTR Off Road Buggy (Max Red)

https://www.amazon.com/gp/product/9269802140/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

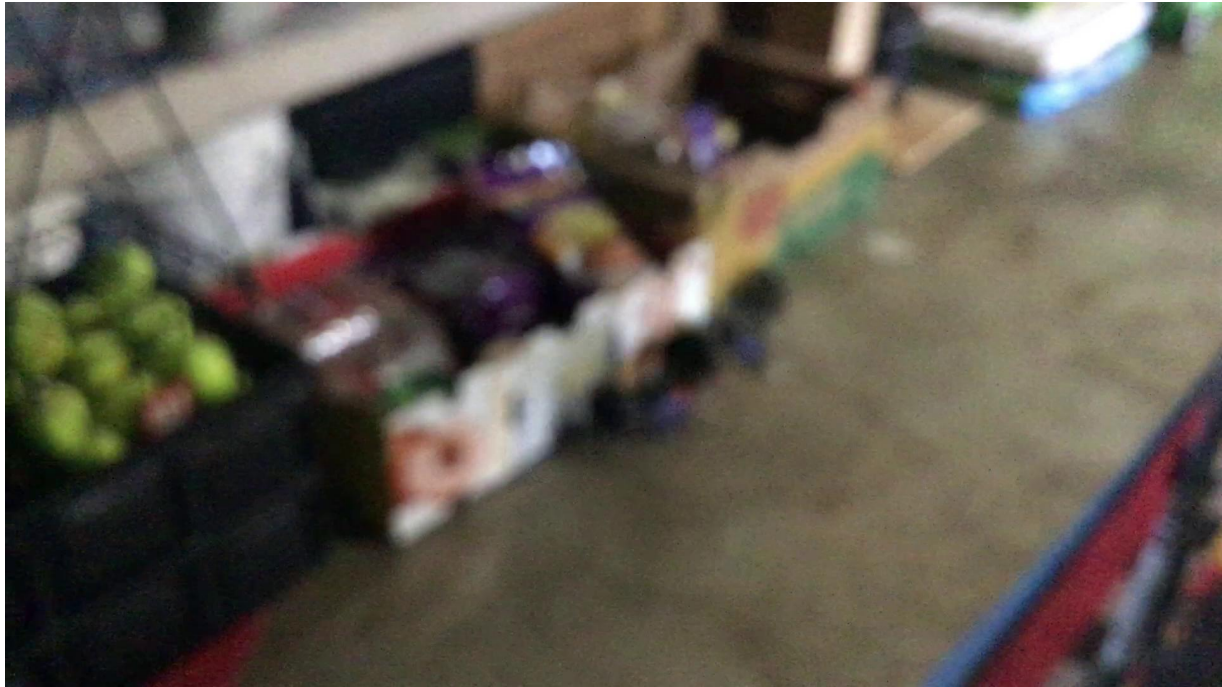
After we took the top off

The individual parts of the car



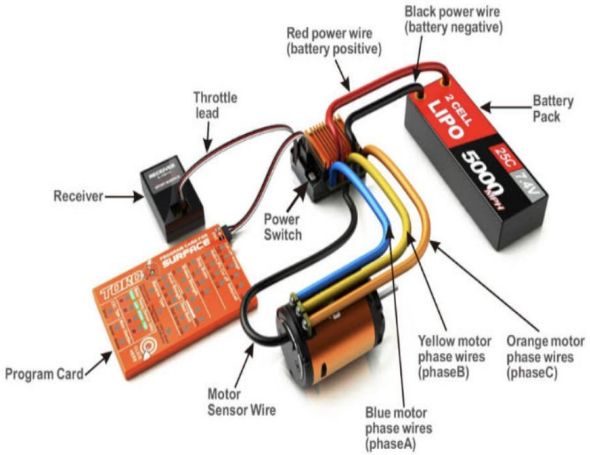
How it originally drives

This is a video of me driving the car normally using the controller that came with it, before adding the computer.



How RC car works?

- Size - 1/10, 1/16, etc
- Radio Receiver
- Motor - Kind of DC motor - Brushed or brushless - Link
- ESC - Electronic Speed Controller - Link
- Servo - Steering - Another kind of DC motor
- Battery (Ni-Mh or Lipo)
- Wikipedia - Link



Electronic Speed Controller

What is PWM & ESC?

- PWM is how the esc controls the voltage applied to the motor, to be less than full battery voltage. It is like turning on a switch, thousands of times per second, to control the percentage of time the power is applied to the motor.
- For brush controllers, this is about it, and the percentage of on time, is proportional to the throttle level.
- For brushless motors, they are approximating an AC sine wave, to the 3 phases, to get the AC motor to run. The height of the sin waves is proportional to the throttle settings.

https://www.electronics-tutorials.ws/blog/pulse-width-modulation.html

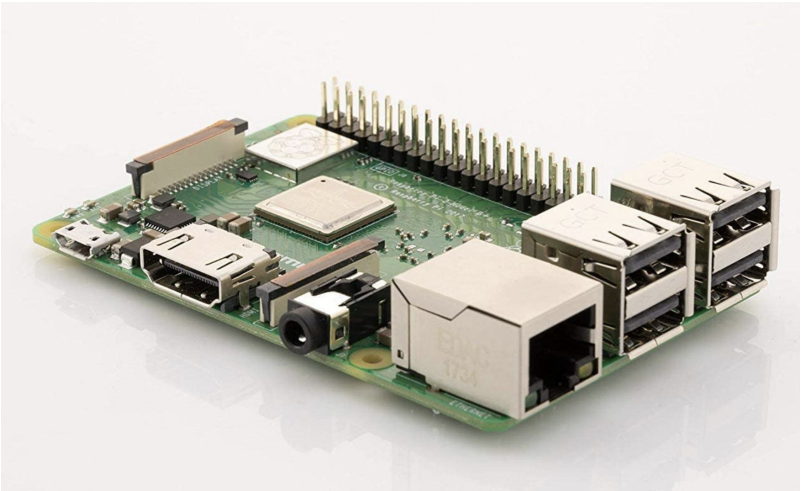
What is Robot?

- Actuation - Subsystem that interact directly with robot’s wheel or arms or anything that moves
- Sensing - Interact directly with sensor hardware like camera, laser scanner, et
- Computing - Intelligent processing that tie actuator and sensing together.

https://www.brighthubengineering.com/robotics/26214-robotics-construction-of-a-robot/

Choose a Computing (~$45)

- **Rasbperry Pi 3 Model B+**
- Jetson Nano
- Jetson TX2



Pi 3 Specs

- 1.4GHz 64-bit quad-core ARMv8 CPU, 1 GB RAM
- 802.11n Wireless LAN, 10/100Mbps Lan Speed
- Bluetooth 4.2, Bluetooth Low Energy
- 4 USB ports, 40 GPIO pins, Full HDMI port, Combined 3.5mm audio jack and composite video
- Camera interface (CSI),Display interface (DSI), Micro SD card slot (now push-pull rather than push-push), VideoCore IV 3D graphics core

https://www.amazon.com/gp/product/B07BDR5PDW/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

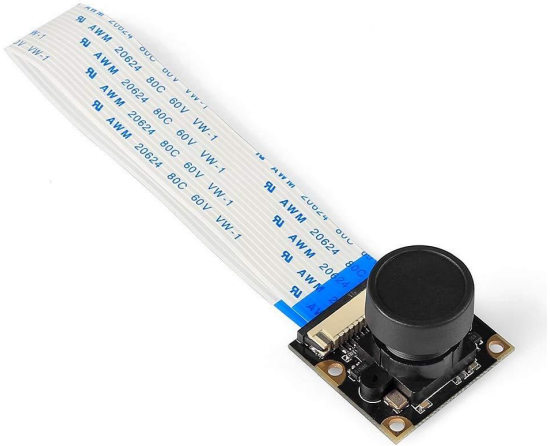
PI 3 Accessories (~$35)

Part Description	Link	Approximate Cost
MicroSD Card (32GB - 128 GB)	amazon.com/gp/product/B01HU3Q6F2	$12 - $25
USB Battery with microUSB cable (any battery capable of 2A 5V output is sufficient)	Anker 6700 mAh	$19 - $25

Other Options

- amazon.com/gp/product/B01HU3Q6F2

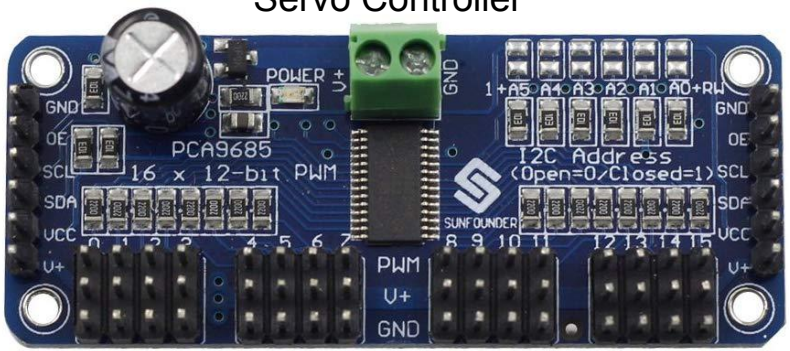
Sensor



https://www.amazon.com/gp/product/B00N1YJKFS?tag=donkeycar-20

Arduino Controller

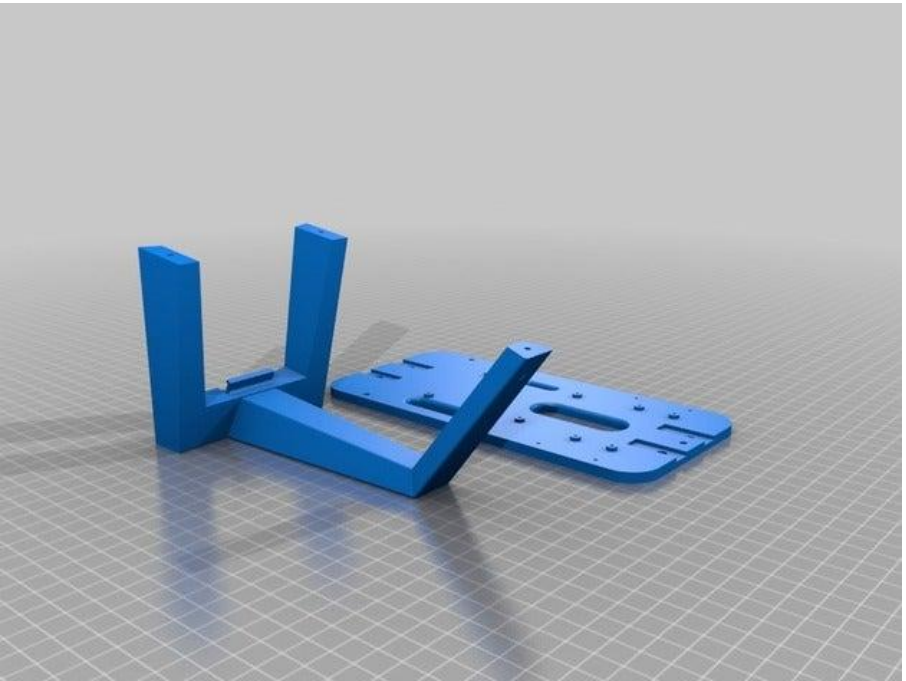
Servo Controller



https://www.amazon.com/gp/product/B014KTSMLA?tag=donkeycar-20

The frame

I 3D printed a frame at Microsoft Garage, which i used to hold the computer. I got the file for the 3D print from https://www.thingiverse.com/thing:2566276.



The frame and the computer