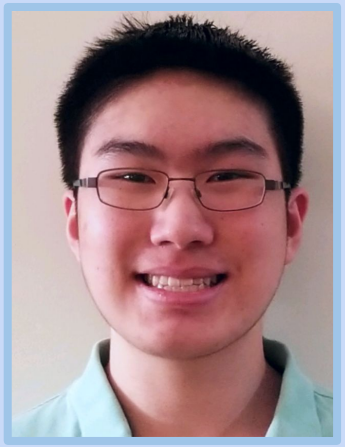
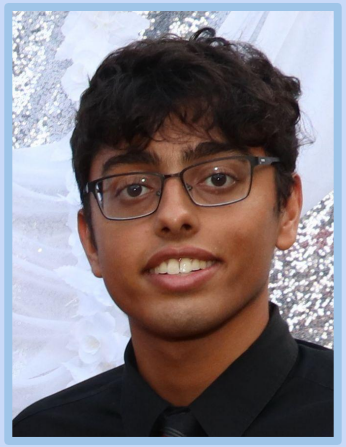
Miniature Smart Car Hardware Design

Final Presentation

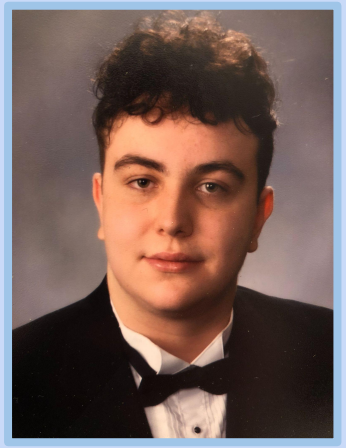
Brandon Cheng(UG)



Aamay Puntambekar(UG)

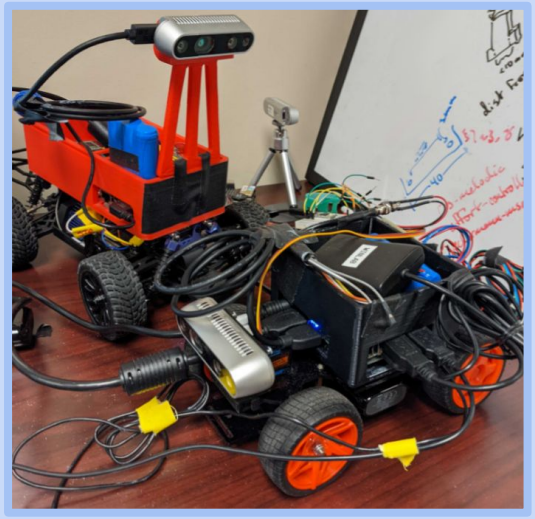


Michael Mogilevsky(UG)

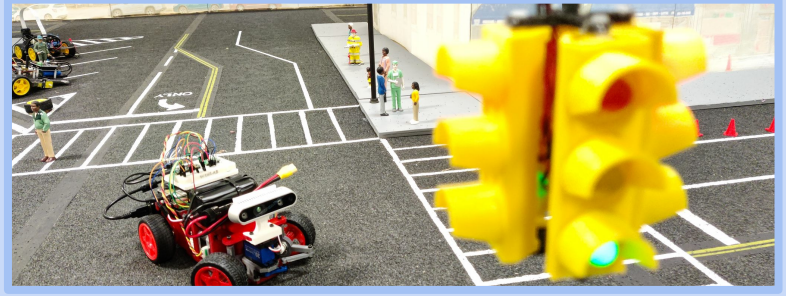


Brief Project Overview

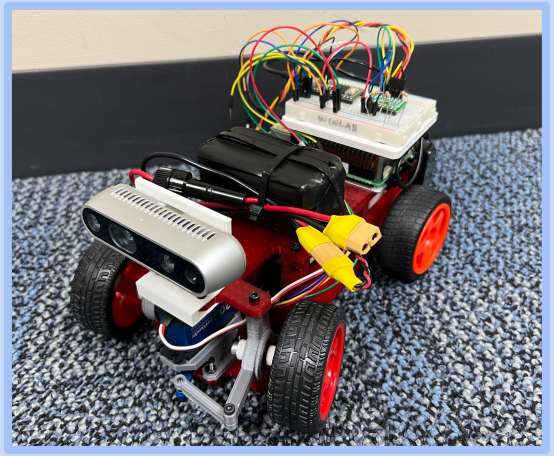
Prior car kits



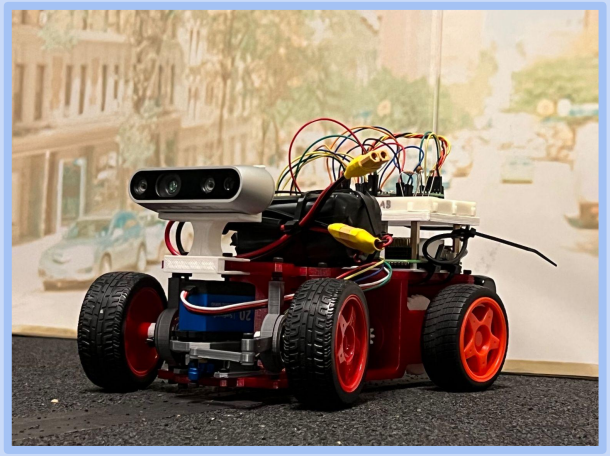
Orbit Smart City



1/15 Scale

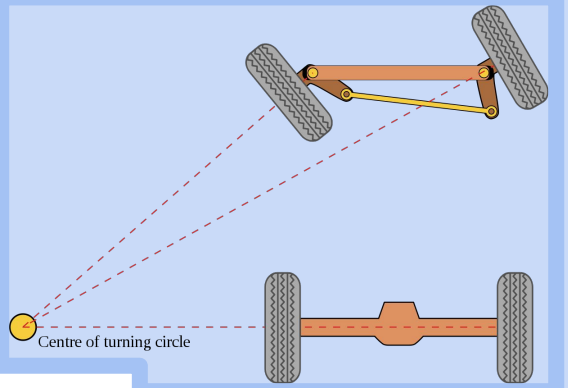


Our Car

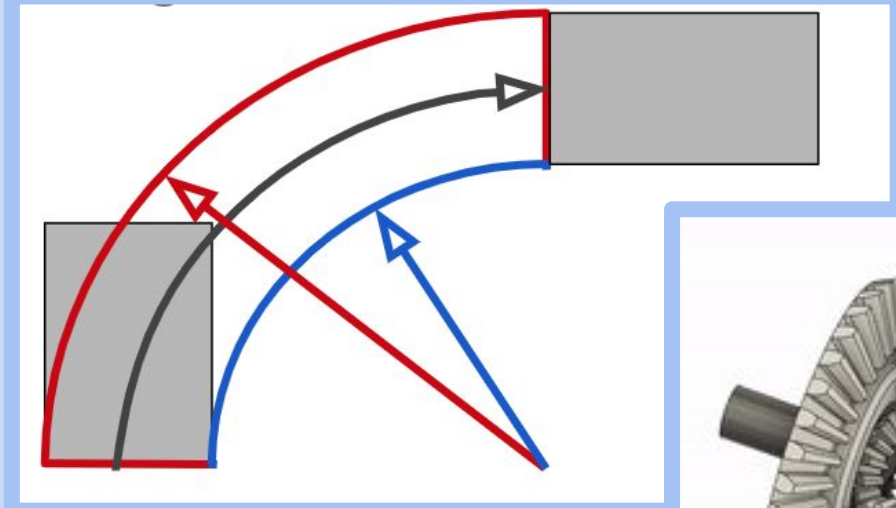


Design Principles

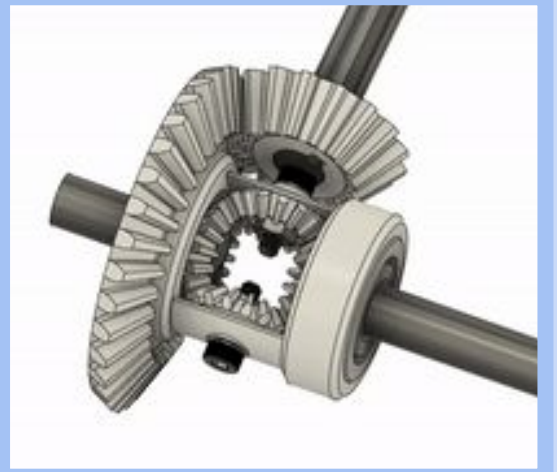
Ackerman Steering

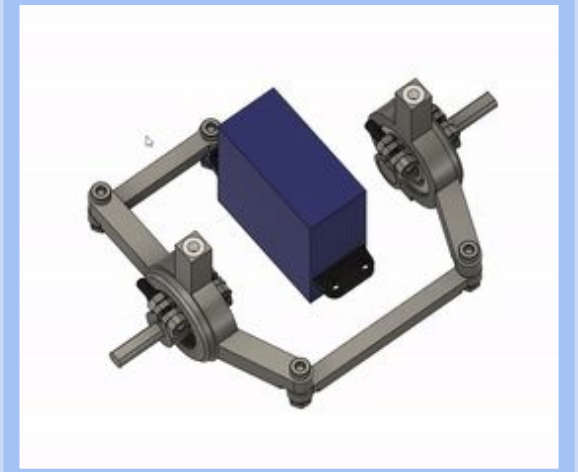


Differential Gear System



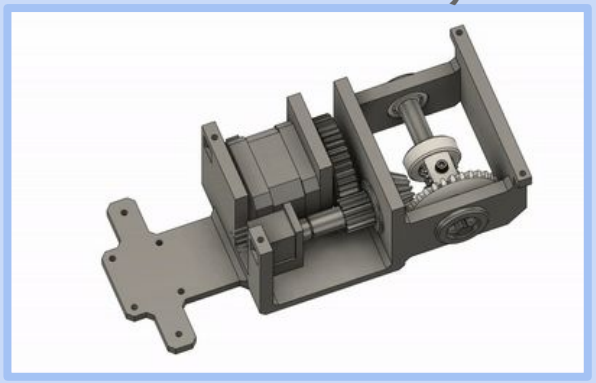
Our Designs



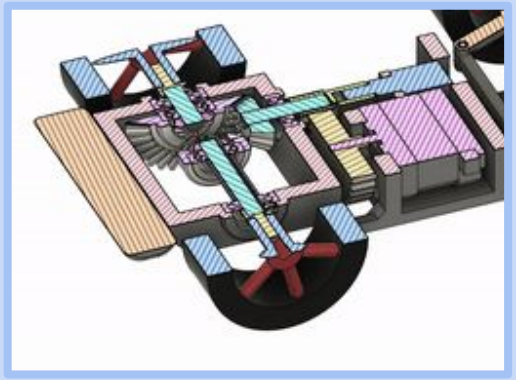


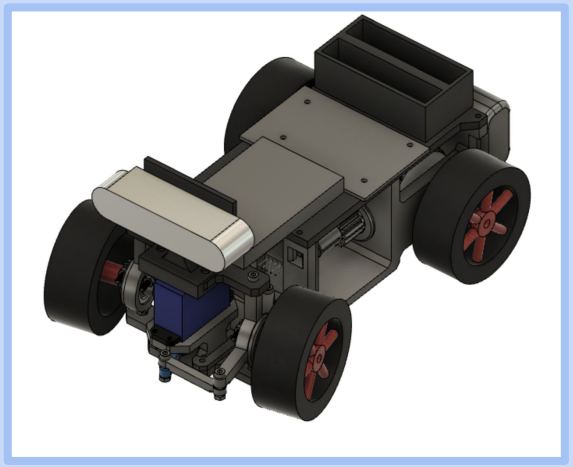
Final Design

Bottom Assembly



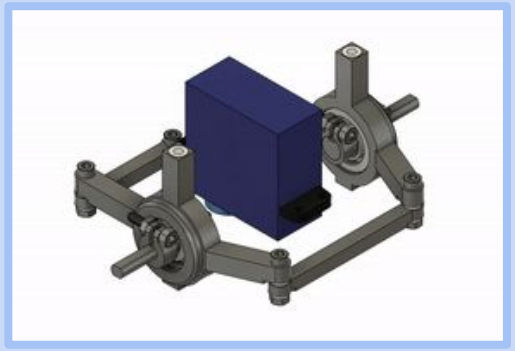
Animated Cross Section of Drivetrain



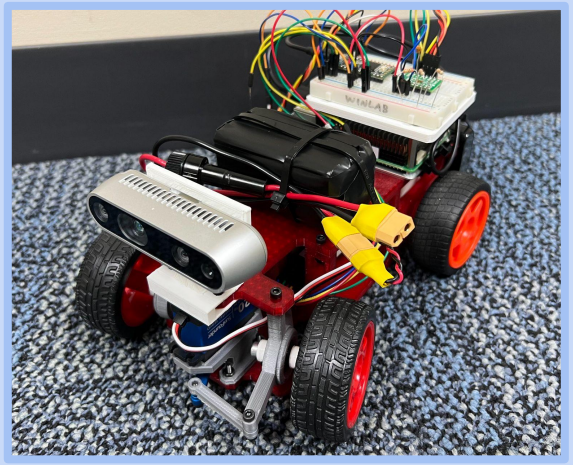


Full Car Assembled vs CAD

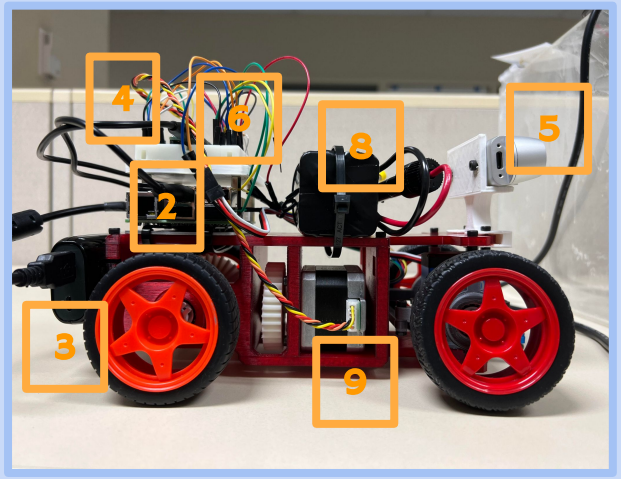
Steering Assembly



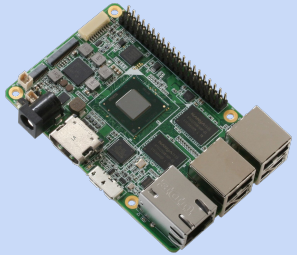
Full Assembly

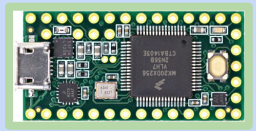


Electronics System



Up Board ↔ Teensy





Software Interface

High Level: Slow, computations

(3)5V Power Supply

(2)UP Board

(5)Camera

(4)Teensy Microcontroller

(7)Encoder

(8)16V LiPo Batteries

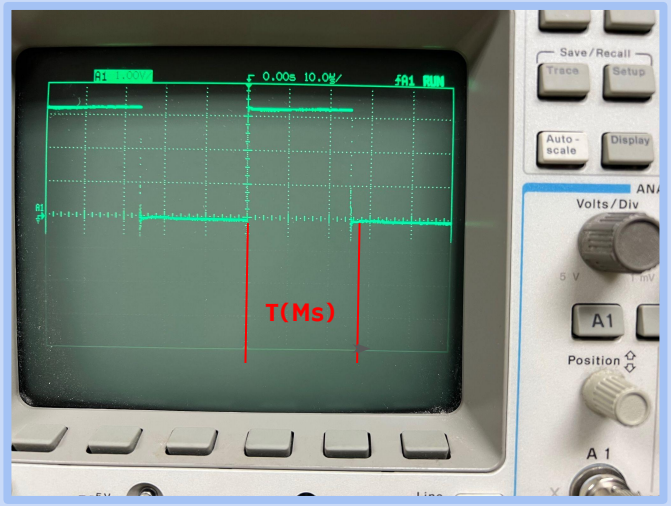
(6)Stepper Driver

(10)Servo

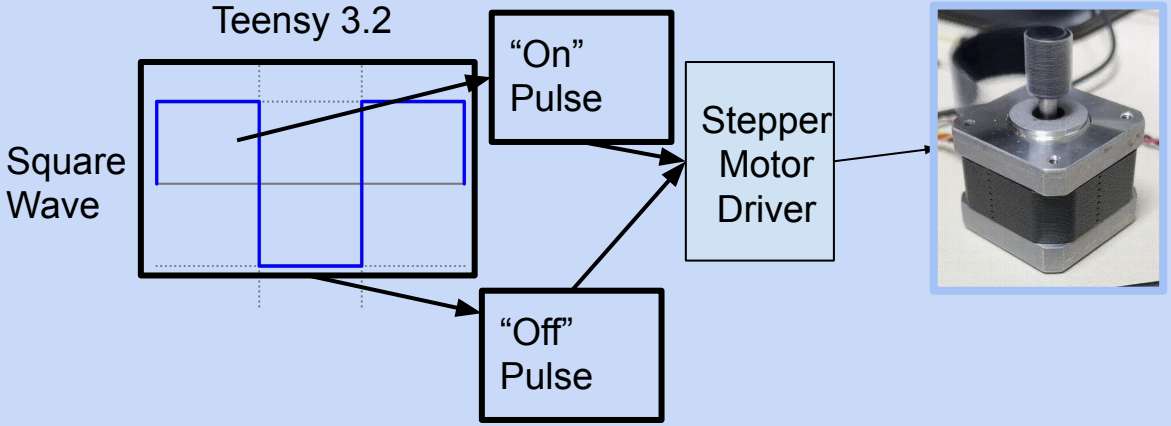
Low Level: Fast, Signals

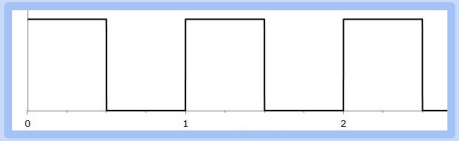
(9)Stepper Motor

Square Wave Signals



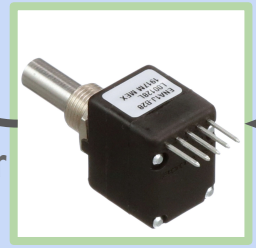
Sending Square Wave as Speed Control

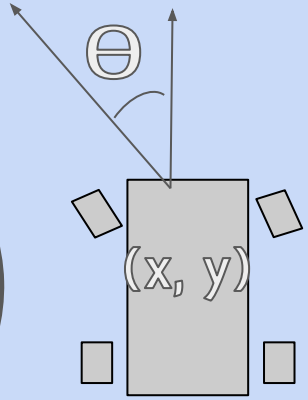




Low Frequency(Slow Motor) vs. High Frequency(Fast Motor)

Software overview





ROS

UP Board

Teensy 3.2

Desired Car Speed + turning curvature

Desired RPM + Servo Angle

Square wave control signals

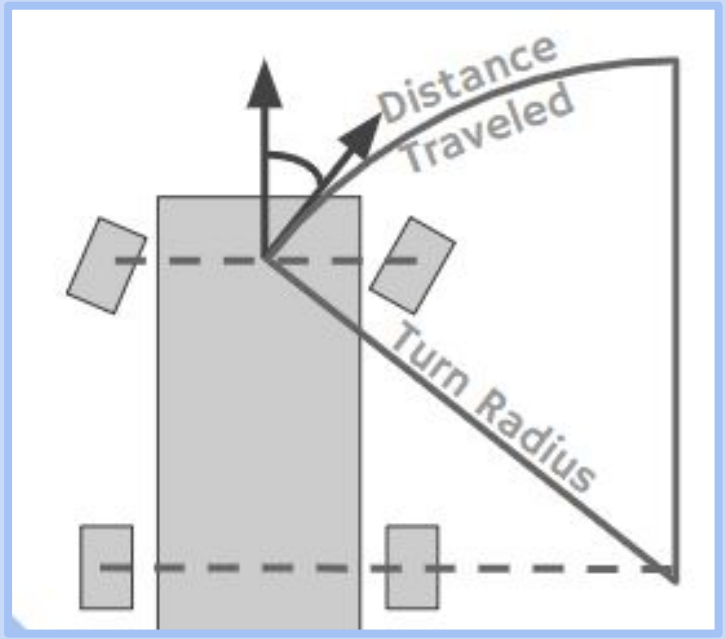
Encoder Signal

Calculated Encoder Position

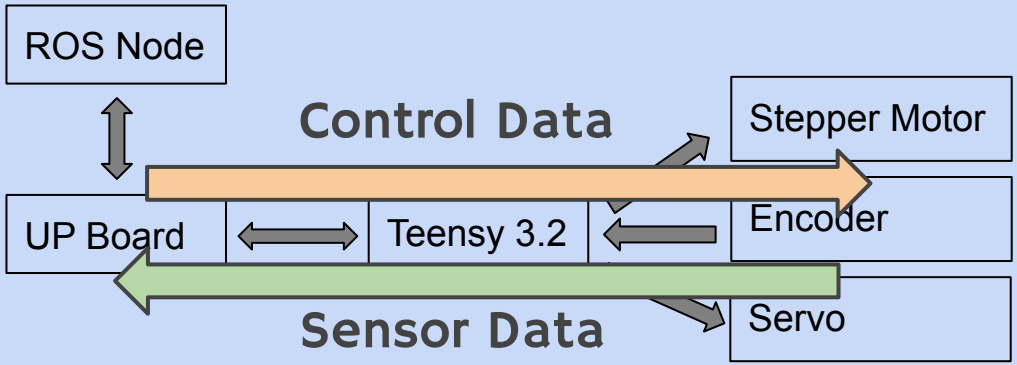
Calculated Position Data

Odometry

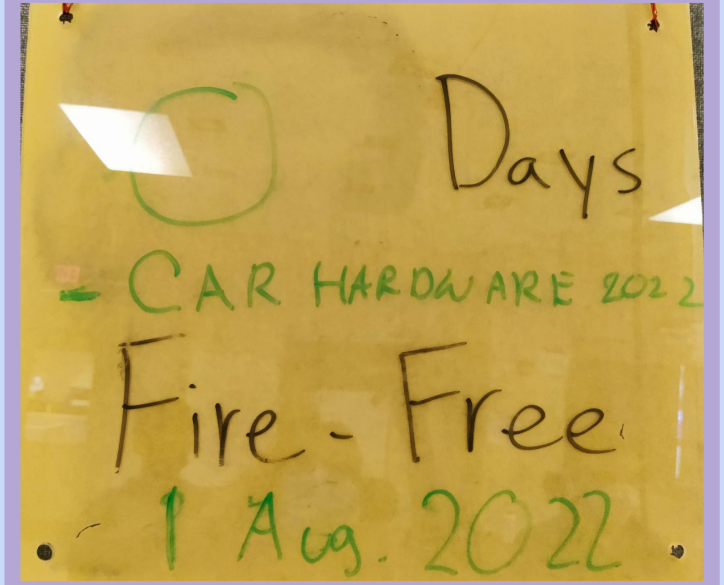
```
28.457332791094984
(x,y): (6.266691660162666, -1.9916561373785688). Angle = 310.2131139607697
phi: -55.79798245665705
b'e:16757\r\n'
27.957332791094984
(x,y): (6.269669600032228, -1.9951485327591887). Angle = 310.6948533439604
phi: -55.79798245665705
b'e:16766\r\n'
27.457332791094984
(x,y): (6.272127713876501, -1.9979873769980605). Angle = 311.082769245173
phi: -55.79798245665705
b'e:16772\r\n'
```



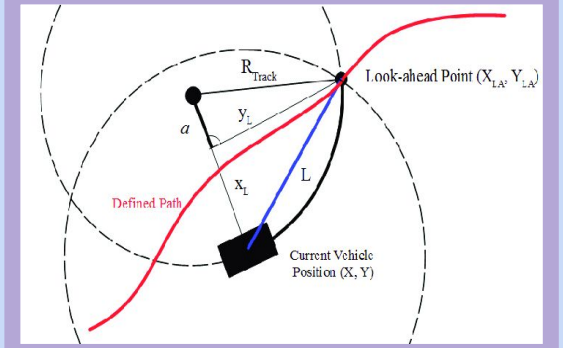
Feedback Loop Overview



Conclusion + Future Work

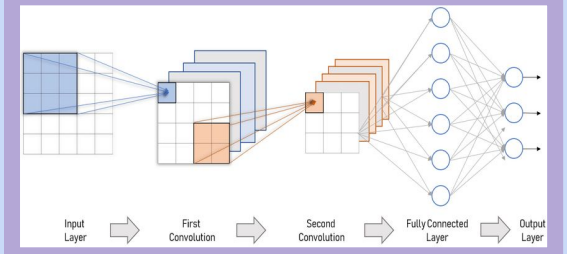


Pure pursuit spline following algorithm



Lidar Sensor odometry

Self driving AI through neural networks

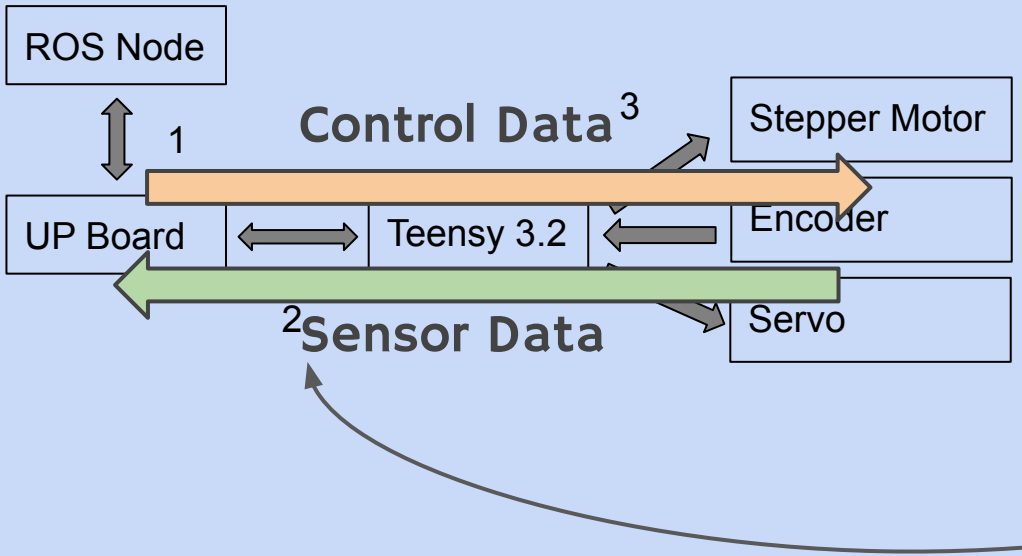


Software

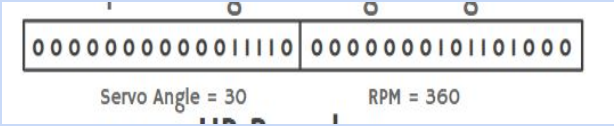
Teensy: Arduino software

UP Board: Ubuntu 20.04, Python, ROS Noetic

(x, y) φ



1. RPM, Servo Angle → UP Board
   Position, angle → ROS

2. 

3. Encoder data, pulses/delays for motors