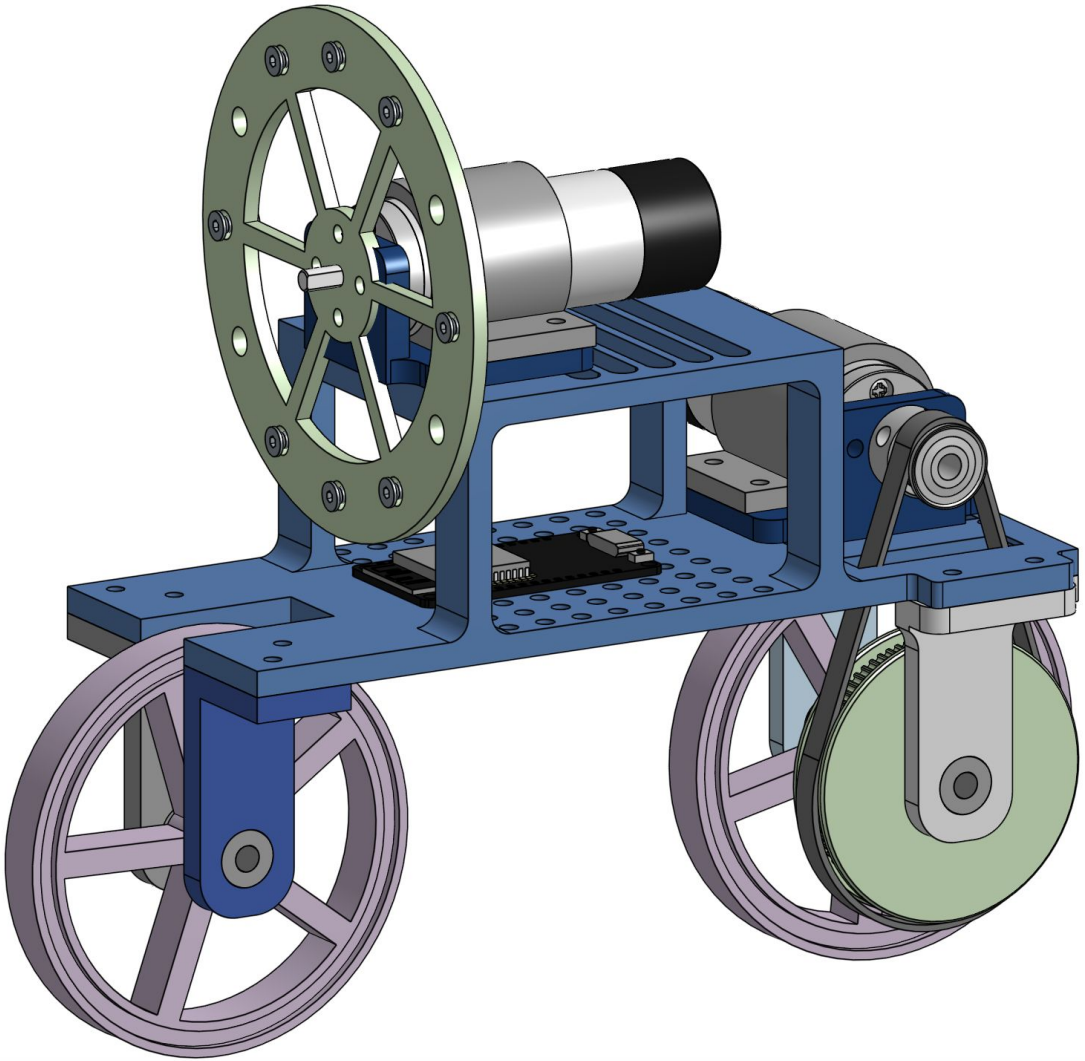
Does your bike look like this?

You are not alone!

There are over ***1 BILLION*** bikes on this planet and not ONE can balance on it's own

.... Until now



What makes Ben the Bike so great?

- Self balancing!
- **Stretch goal:** able to drive while balancing
- One of a kind
- Sleek design

Buy yours today!

Ben the Bike Bot: a Self-Balancing Bike

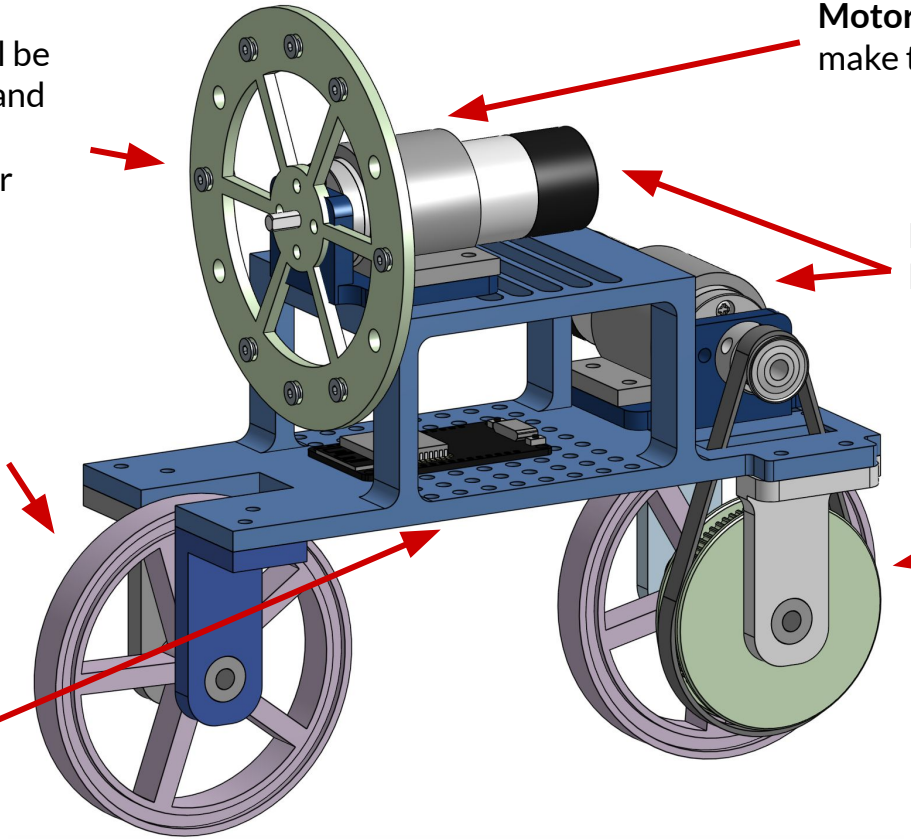
Steph, Jacob & Fo

CAD

Reaction wheel: The wheel will be controlled by a PID controller and is designed so we can easily customize the weight via longer bolts and additional nuts

Wheel placement: Moved the wheels significantly lower to allow the robot to tilt enough to balance

Electronics storage: This storage for the electronics and battery allows for optimization of wire management



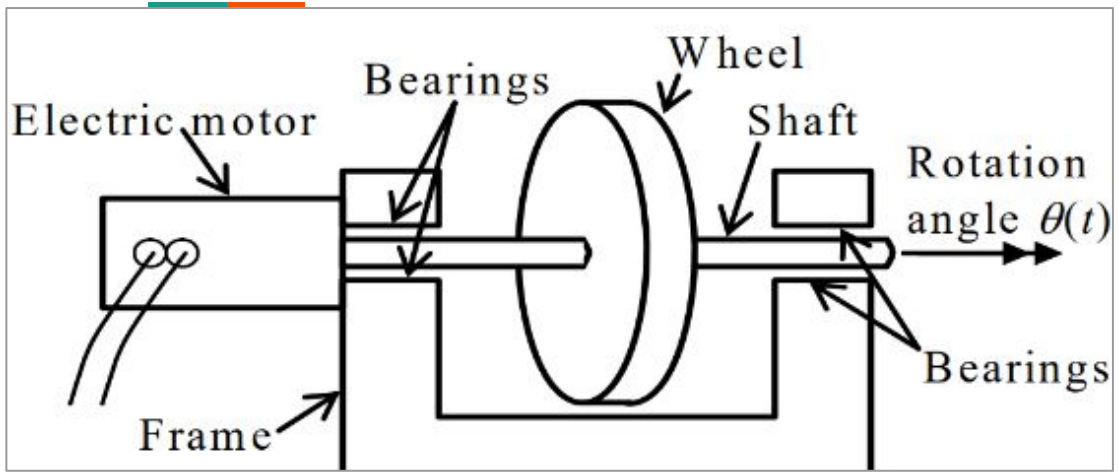
Motor mounts: New motor mounts make the motors more stable

DC motors: The DC motors have a smooth motion

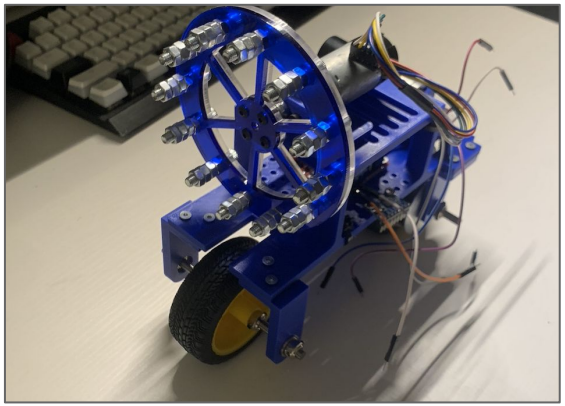
Belt system: This system converts the motion from the motor at the base to the driving wheel

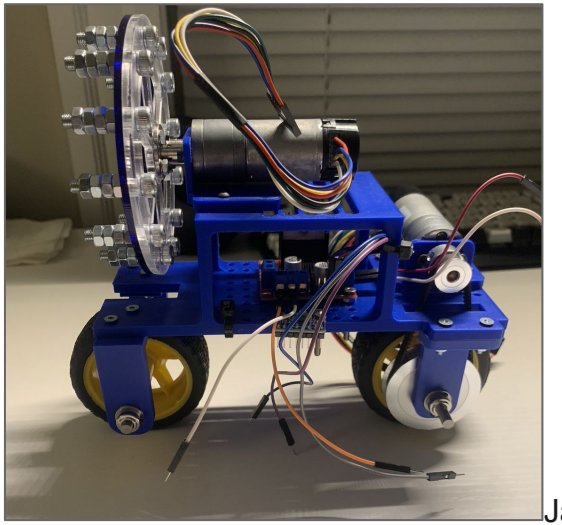
Fo

Creativity and Innovation | Reaction Wheel



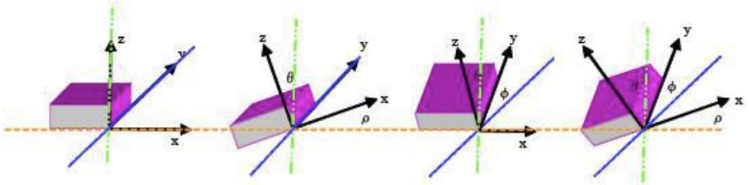
Reaction wheel diagram





Jacob Choi

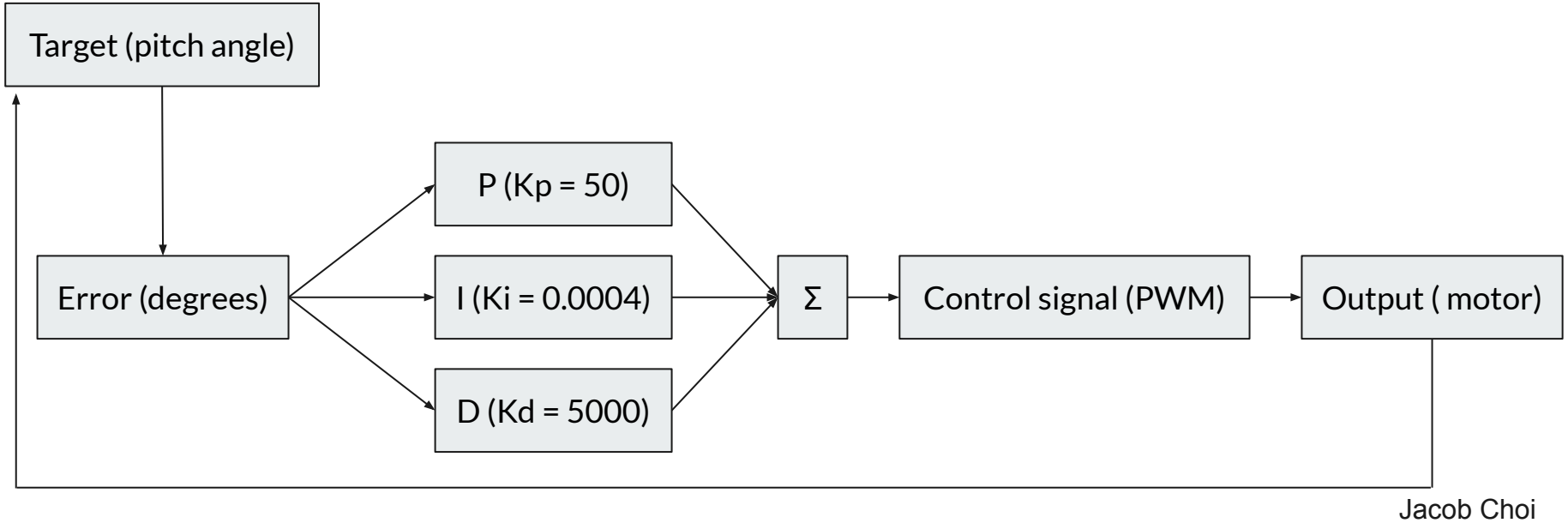
Engineering Reasoning | PID Controller



$$\theta = \arctan\left(\frac{\sqrt{A_X^2 + A_Y^2}}{A_Z}\right)$$

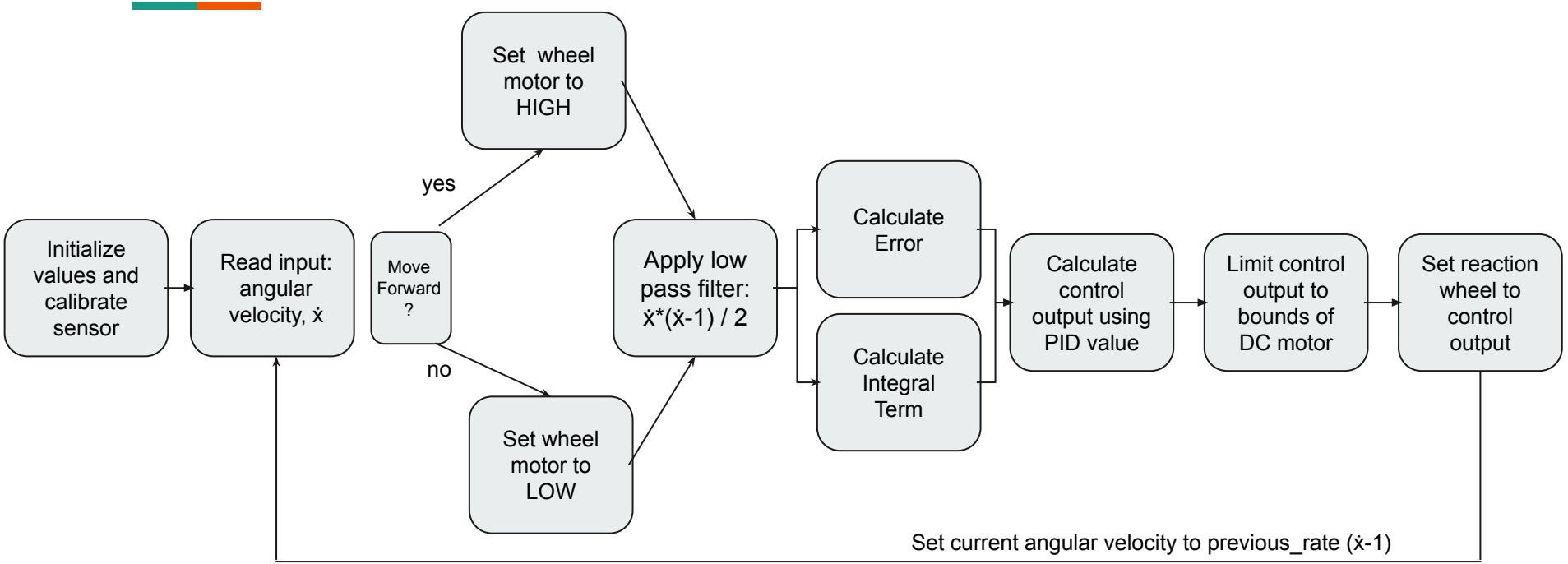
$$\phi = \arctan\left(\frac{A_Y}{\sqrt{A_X^2 + A_Z^2}}\right)$$

$$\rho = \arctan\left(\frac{A_X}{\sqrt{A_Y^2 + A_Z^2}}\right)$$



Jacob Choi

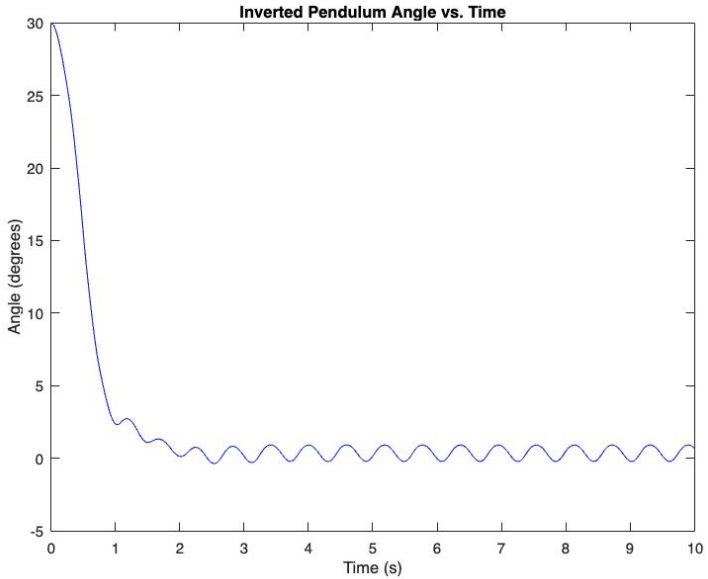
Code



Steph & Jacob

Math

- **Simple Low Pass Filter**
- **PID Tuner (diy):**
  - Models the robot
  - Tests a specified range of P, I, and D values
  - calculates the applied torque, angular acceleration, and resulting angular velocity and angle
  - **Integral of Squared Error (ISE):** integrates the square of the error over time to determine performance of PID values
    - minimising ISE will penalize large errors but will tolerate small errors (even if they persist for a long period of time)
  - **Reference tracking and Disturbance rejection:** Matlab uses these for performance which focuses more on how well output tracks setpoints and reduces disturbances



Steph

Creativity/Innovation

- **Appearance:** It actually looks like something in the real world
- **Additional forms of movement:** the two wheels can be powered that would allow movement on a plane
- **Stretch goal**: have the robot move forward while maintaining balance

Fo, Steph, Jacob

Thank you! Questions?