

The Creation of a Self-Balancing Security Robot

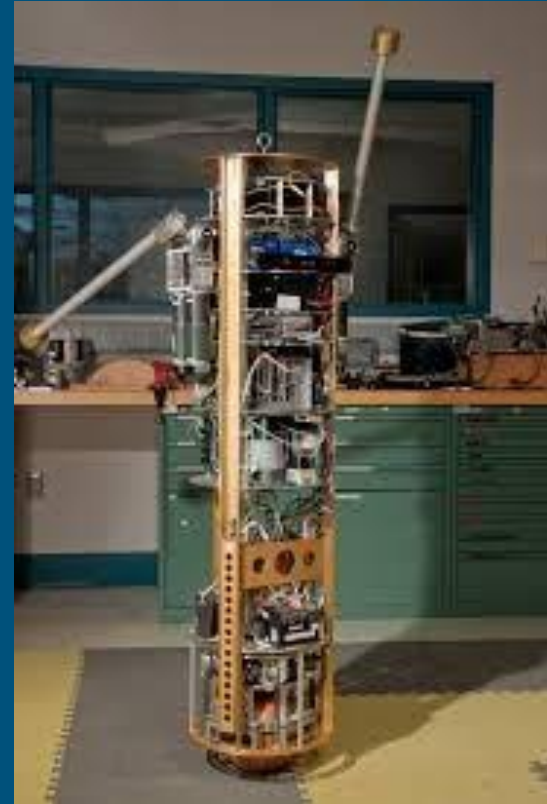
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and Amir Megherhi
Professional Partner: Dr. George Kantor

Problem and Solution

- Security - Reliance on human security
 - Prone to mistakes
 - Possible drastic negative impact on lives
- Growing reliance on technology
 - Robotics
 - Computer Vision
- Combine security and technology to create a security robot

Thesis

- To create a self-balancing human interactive robot with the ability to detect and recognize human faces
- Autonomously roams school halls
- Compares what it detects to SciTech student and staff database
 - Assures permission to be on campus
 - Protects students and staff



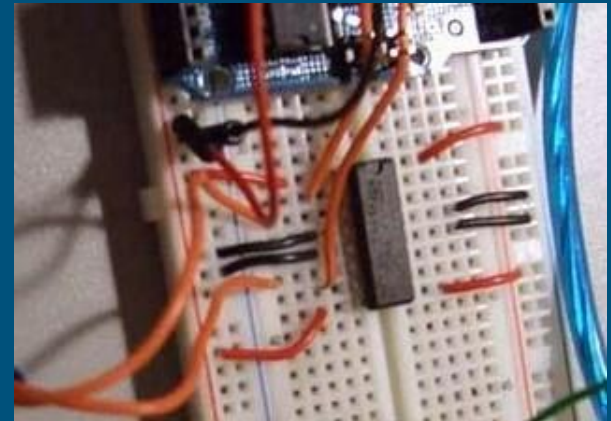
Hardware

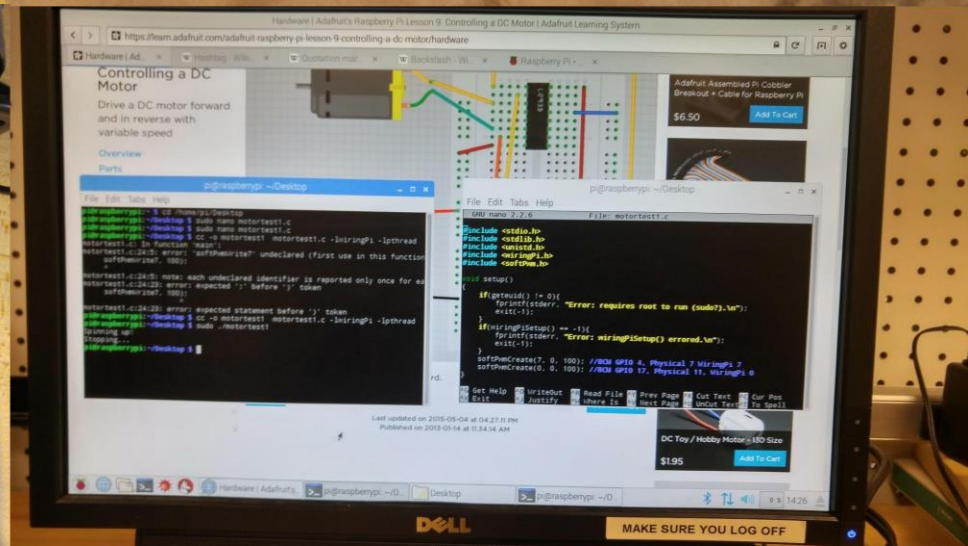
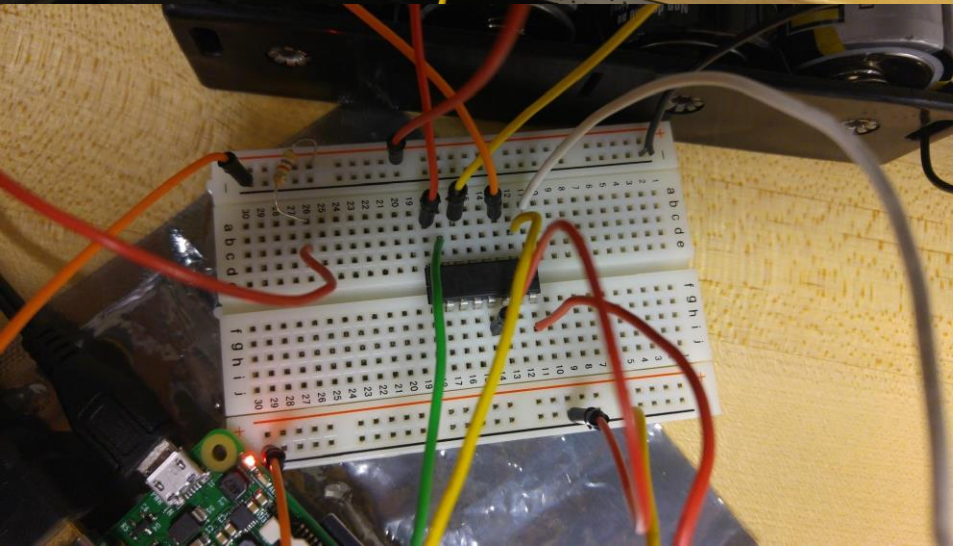
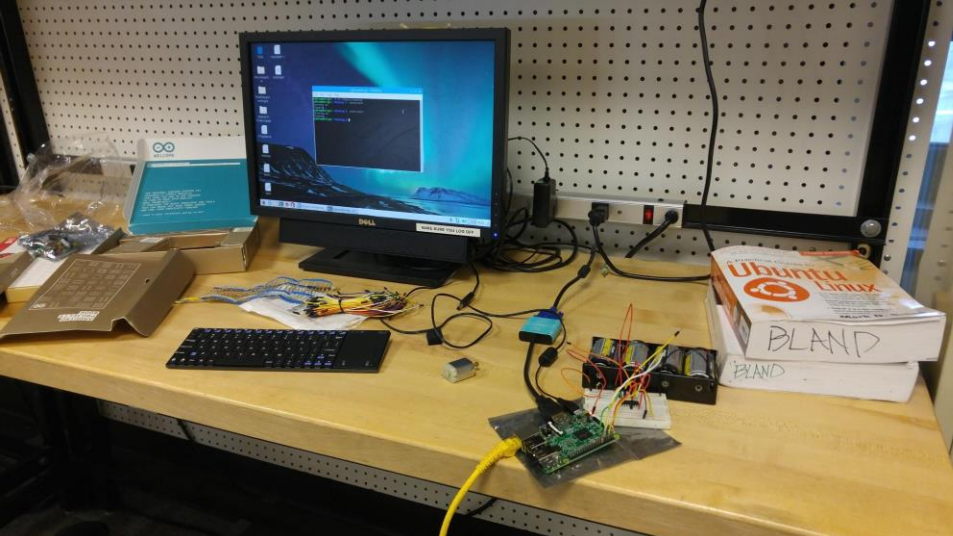
- Structure - Material Types
 - Aluminum
 - 80 20
 - Plastic base
 - Easy to cut
 - Cheap
 - Laser Cutting
 - Water Jet



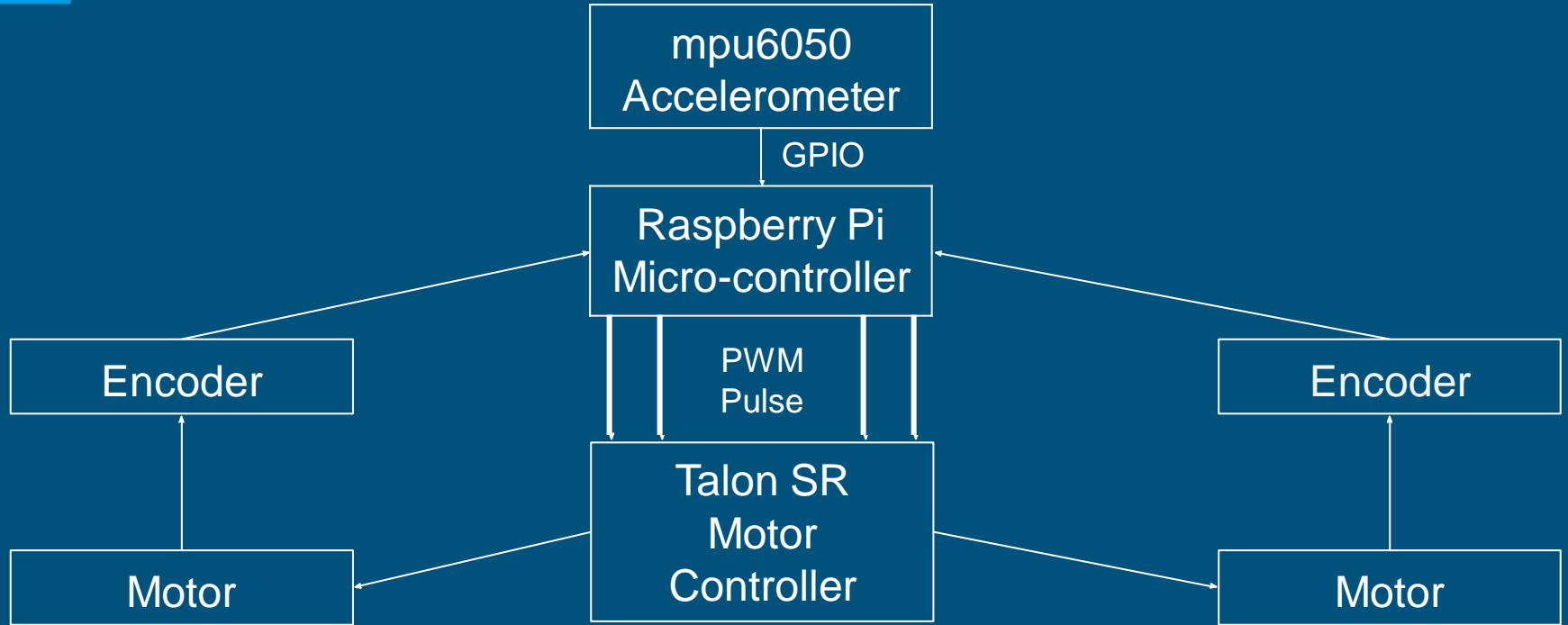
Electronics

- Raspberry Pi 3B → Microcontroller
- mpu6050 → Accelerometer
- Talon Sr → Motor Controller (With PWM)
- Motors and Battery
 - 12 volt
- Pi Camera Module





Block Diagram (PWM)



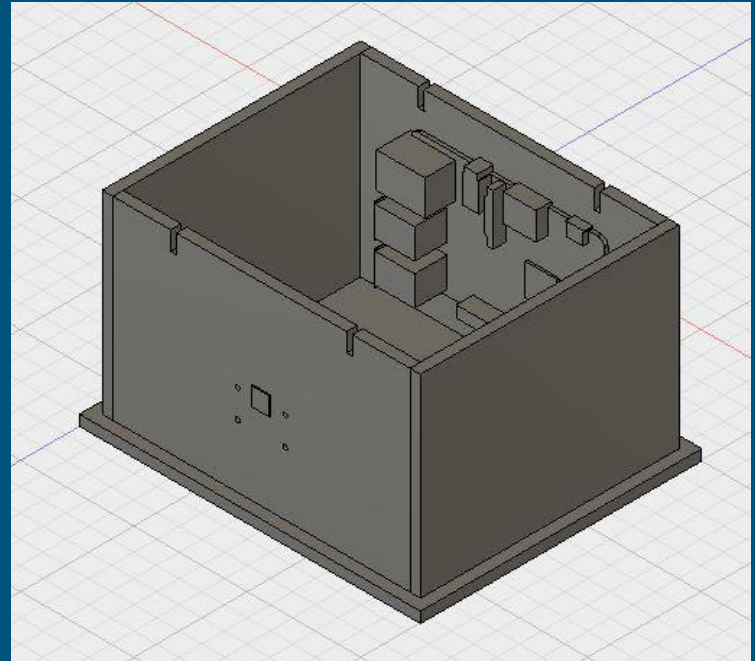
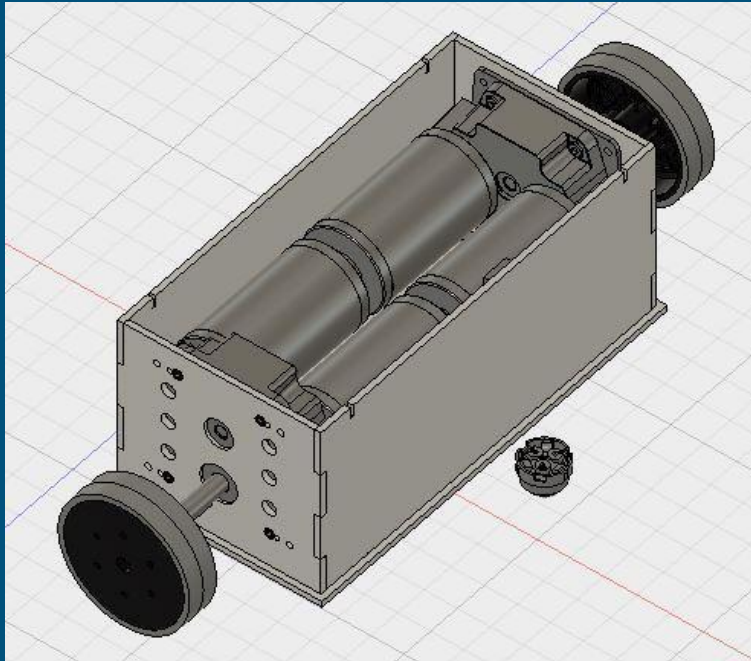
Program for Motors

In order to test the the motors with the motor controllers, we programmed through Python using Pulse Width Modulation.

This gives us the ability to control the speed direction of the motors via xbox 360 controllers or autonomously.

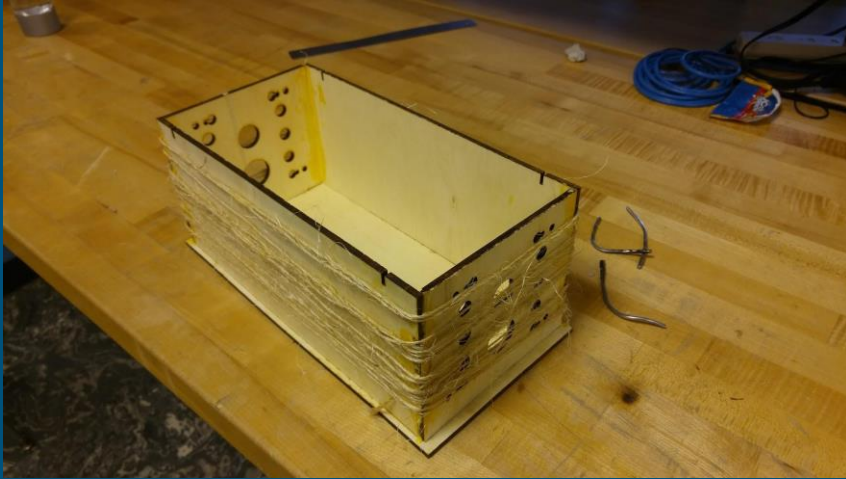


Prototype Sketches

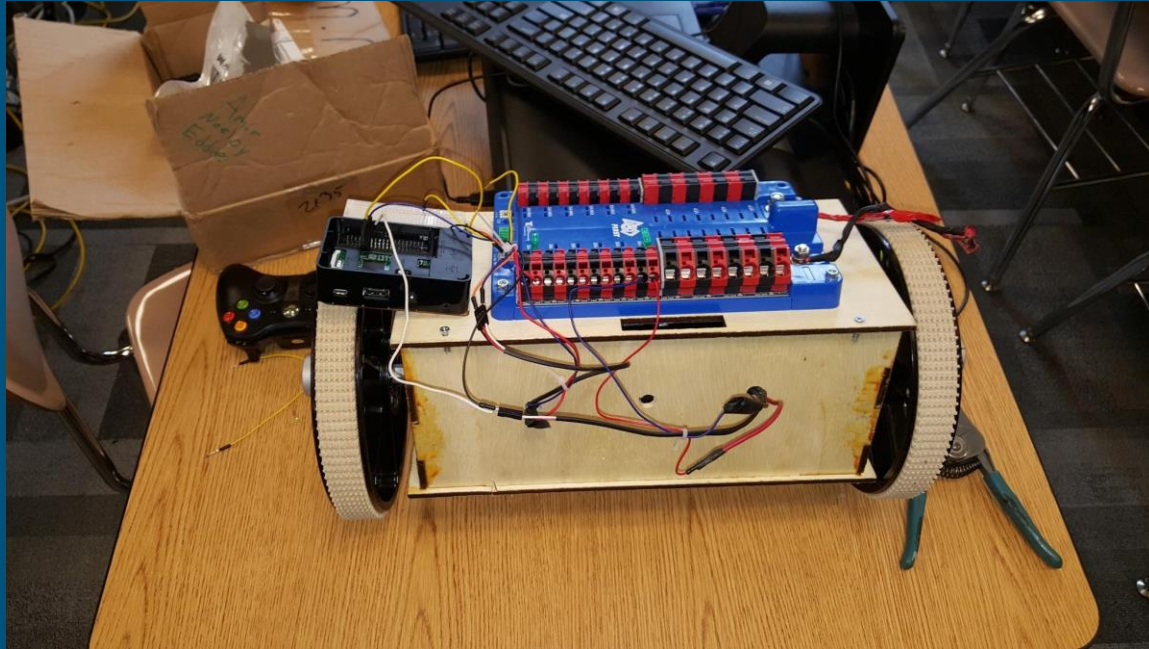


First Prototype

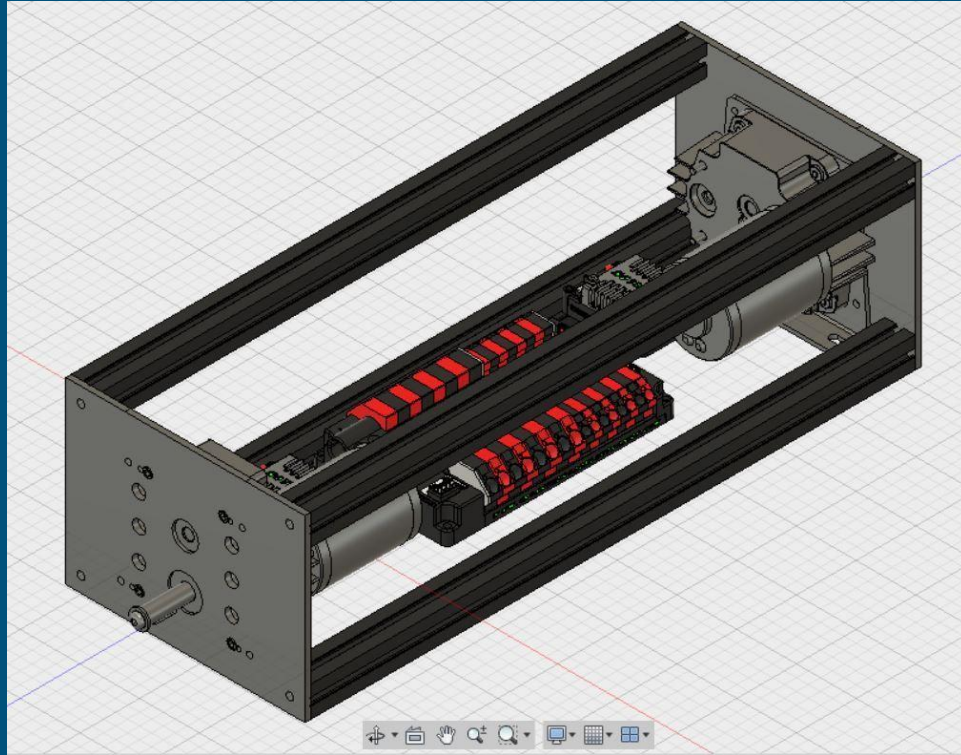
- ¼ inch plywood
- Laser cut



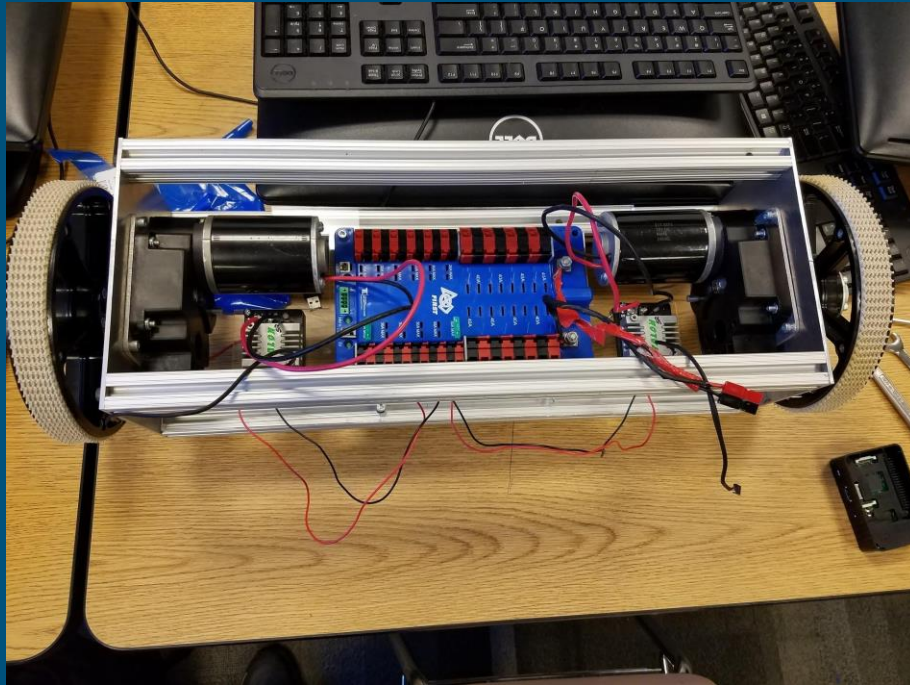
Coming Together



New CAD

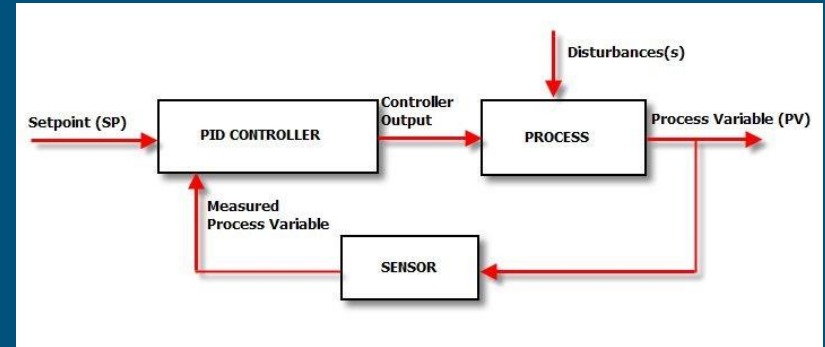


UPGRADE!!!!!!



PID

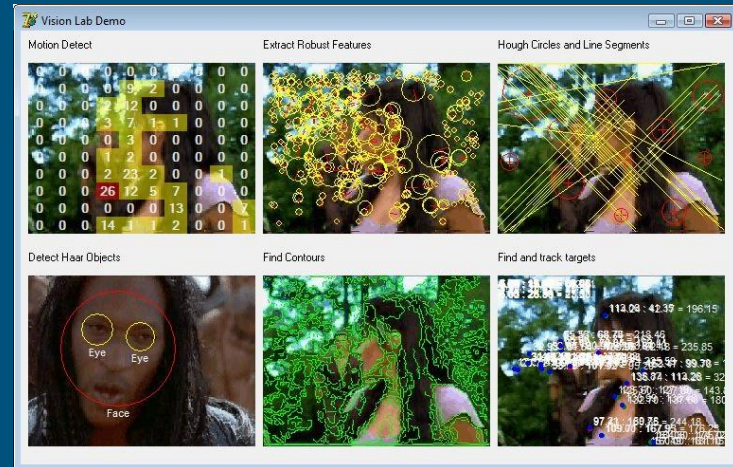
- Mass causes overshoot
- Proportional = Present
 - When an object changes to a non desired set point then the proportional attempts to fix it by adding the opposite
- Integral = Past
 - Looks at previous occurrences
 - Sees changes from the past and slowly fixes it overtime
- Derivative = Future
 - What's going to happen next
 - Fix proportional overshoot



What is Computer Vision?

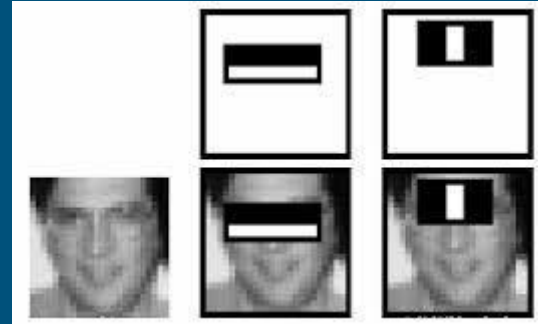
Computer vision is a subfield of computer science that allows computers to “see” their surroundings. There are several algorithms (or processes) that allows for computer vision to work, and each are used for different applications.

- Applications:
 - Biometrics
 - Face detection/recognition
 - Security
 - Optical Character Recognition
 - Mapping



Computer Vision Face Algorithms

- Detection
 - Haar Cascade
- Recognition
 - Eigenface
 - Fisherface
 - Linear Binary Pattern Histogram

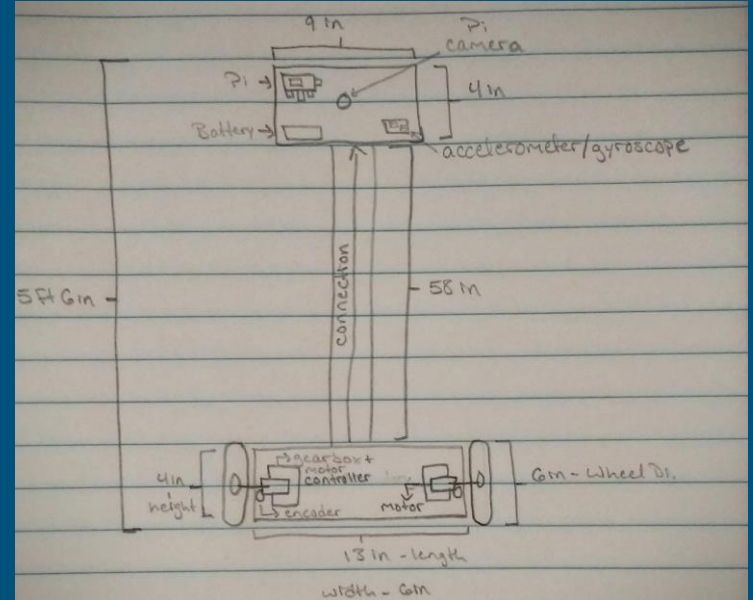


Potential Testing

- Qualitative and Quantitative
- Computer Vision
 - Ability to recognize faces
 - Clarity and distance from robot
 - Percent error
 - Speed at which faces are being detected
 - How does environment impact robot's detection ability?
- Robot
 - Movement/versatility
 - Speed
 - Balance
 - Do alarms go off when person is not recognized?

The Dream

- Segway like self balancing ability
 - Used for easy maneuverability
- Can traverse halls of schools at safe speeds
- Software to allow the robot to detect and recognize people's faces
 - Alarm to go off in case of person not recognized



Acknowledgements

- Dr. George Kantor
- Mr. Michael Miller
- Mr. Maurice Bajcz

– Thank You!

Questions?