

# AUTONOMOUS FORKLIFT ROBOT

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# PROJECT GOAL

- Use Improved sensors and feedback control
- Create a more efficient forklift system and replace the claw
- Create an efficient/cost effective mechanical design
- Use computer vision with PixyCam to detect boxes and shelves.
  - Color Coded system.

# SOLUTION

Robot Detects  
a Color  
Coded Box

- Robot moves to box
- Pick up designated box

Robot Detects a  
Color Coded Shelf

- Robot moves to shelf
- Robot aligns box with shelf and drops off the box.

Robot Searches  
for Another Box

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## MATERIALS

Pixy  
CMUCAM5  
Camera

Adafruit  
VL53L0X  
Laser Sensor

Arduino Uno

Adafruit  
Stepper/Motor  
Shield V2.3

4 DC Motors

Elegoo Smart  
Robot Car  
Frame

4 AA Battery  
Case

Limit Switches

Raspberry Pi 3

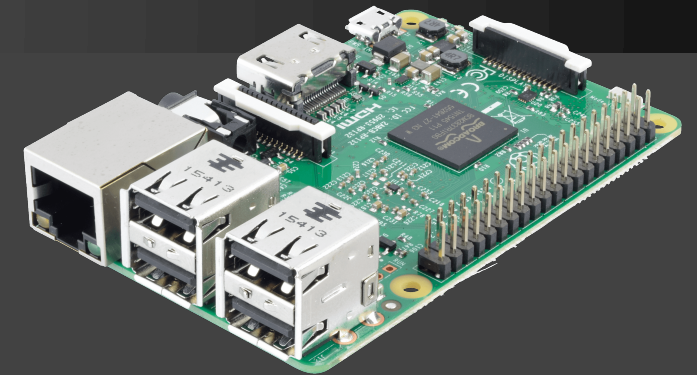
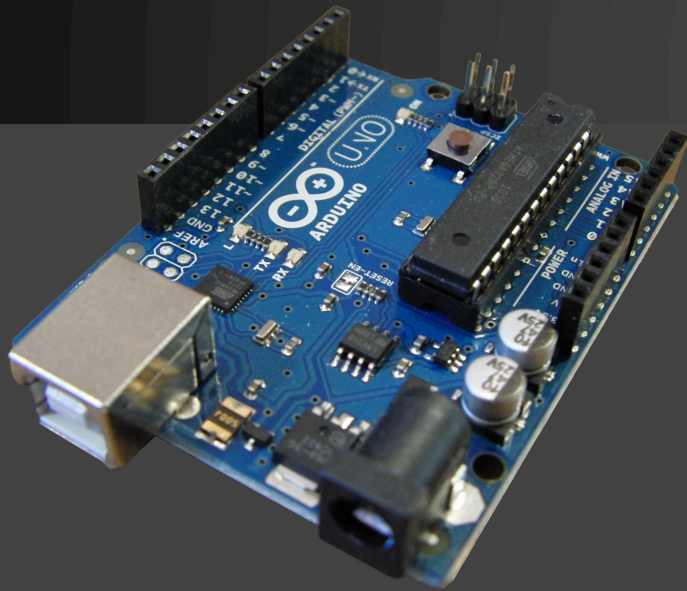
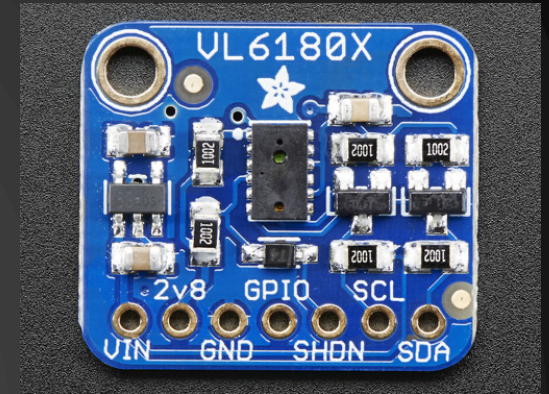
BNO055  
IMU

VEX Battery  
Packs

Elegoo  
18650 Battery



# SENSORS And Microcontrollers





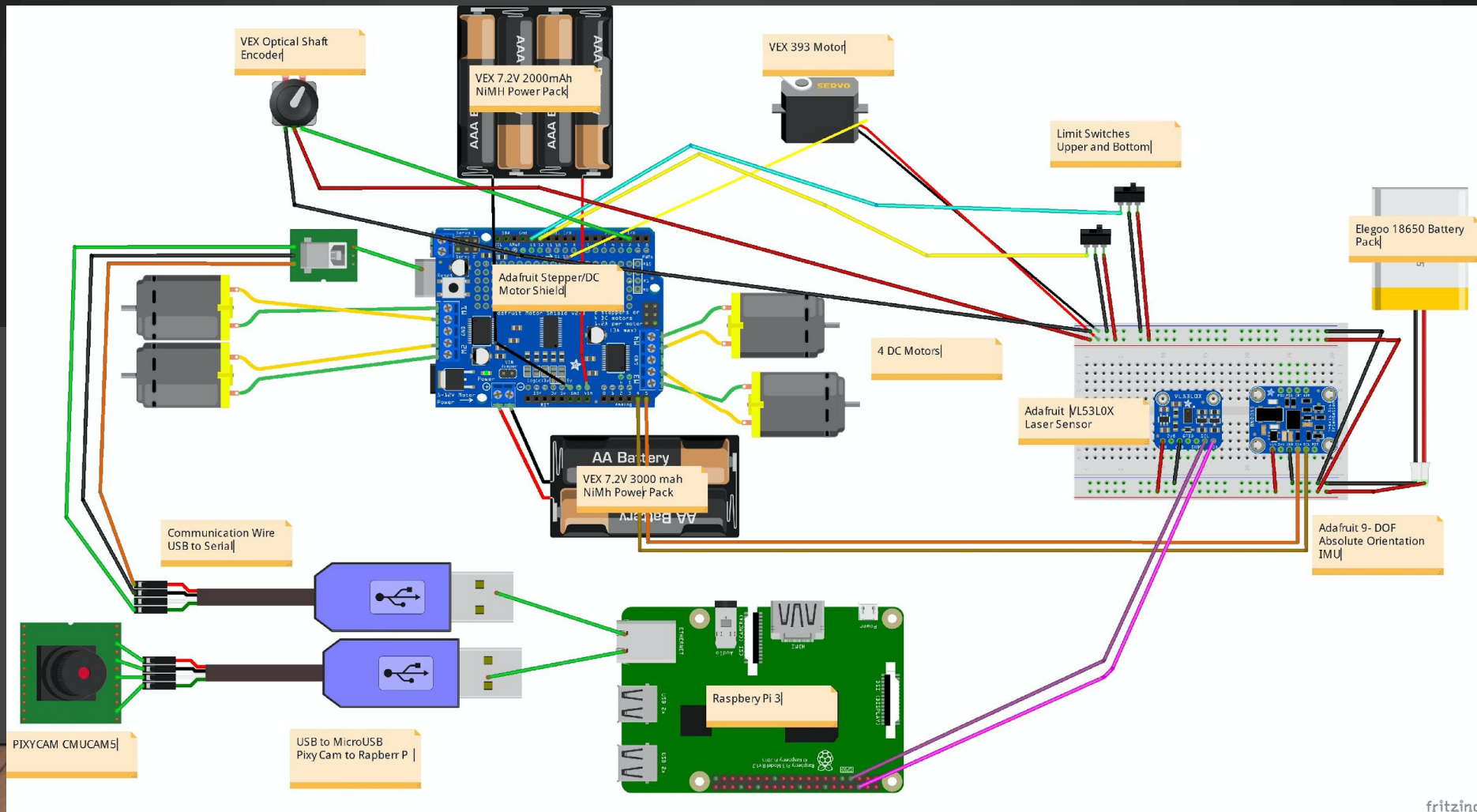


## DESIGN



- Color Codes to reduce false positives

# WIRING DIAGRAM



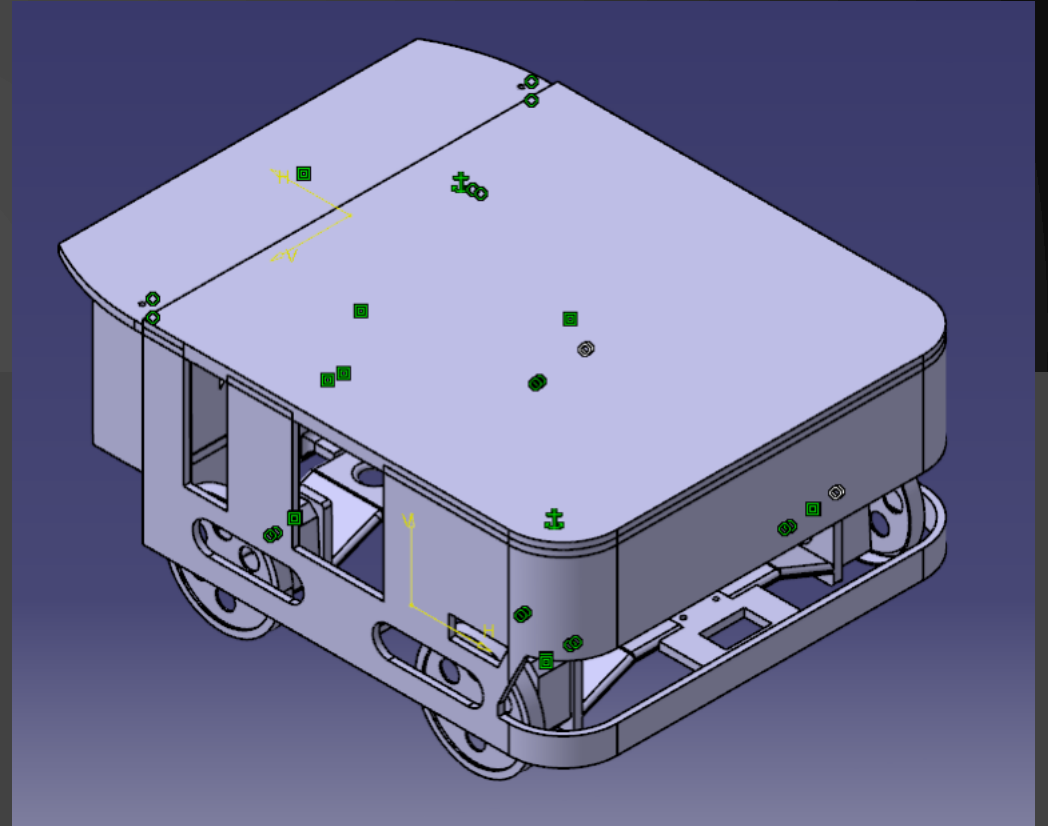


# PROGRAM

- The Arduino Uno stores the commands to actuate the motors.
- USB serial communication between controllers
- The Pixycam CMUCAM5 tracks multiple color coded boxes/shelves.
- Laser TOF sensor for distance
- Encoder and limit switches control movement of linear motion system.
  - Forklift limit switch detects if the box is on the forks.
  - Upper limit switch stops box from being lifted too high.
  - Encoder allows choosing different shelf heights
- IMU for precise turns and trajectories

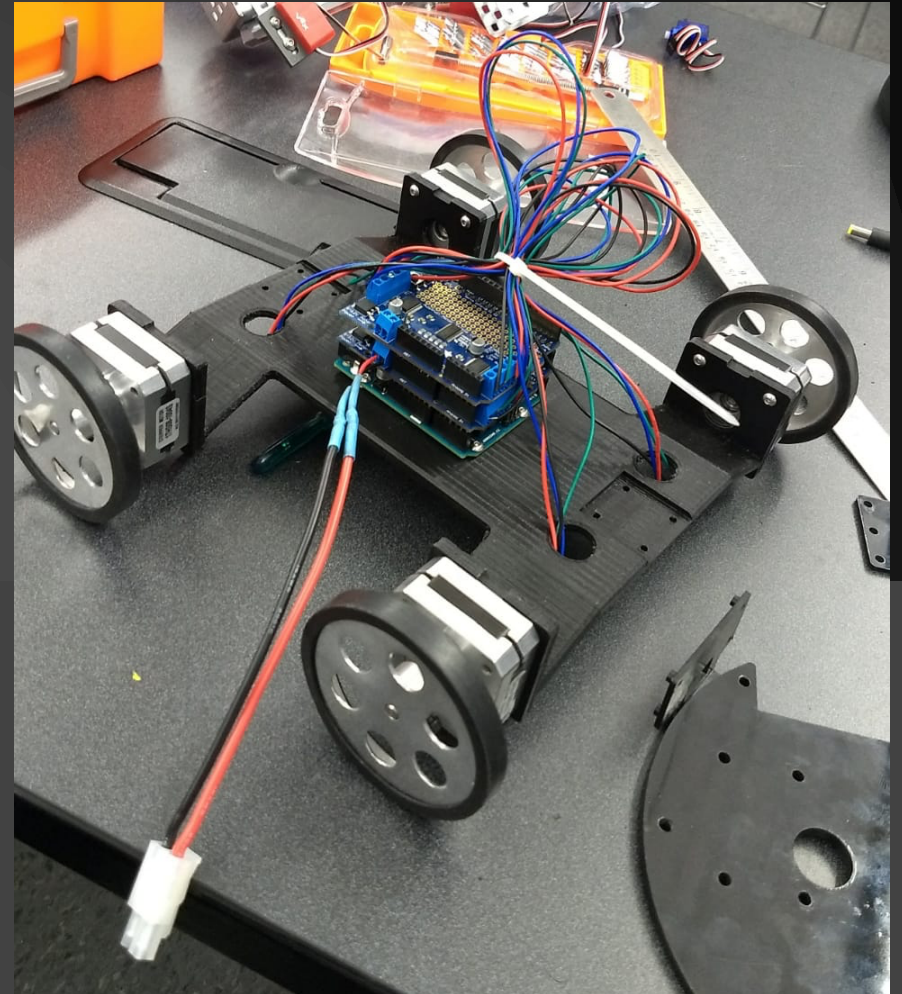
# FUTURE PLANS

- Create a larger sized model
  - Enclosed casing around robot to protect electronics.
- Get higher torque motors
- Resolve integration issues.



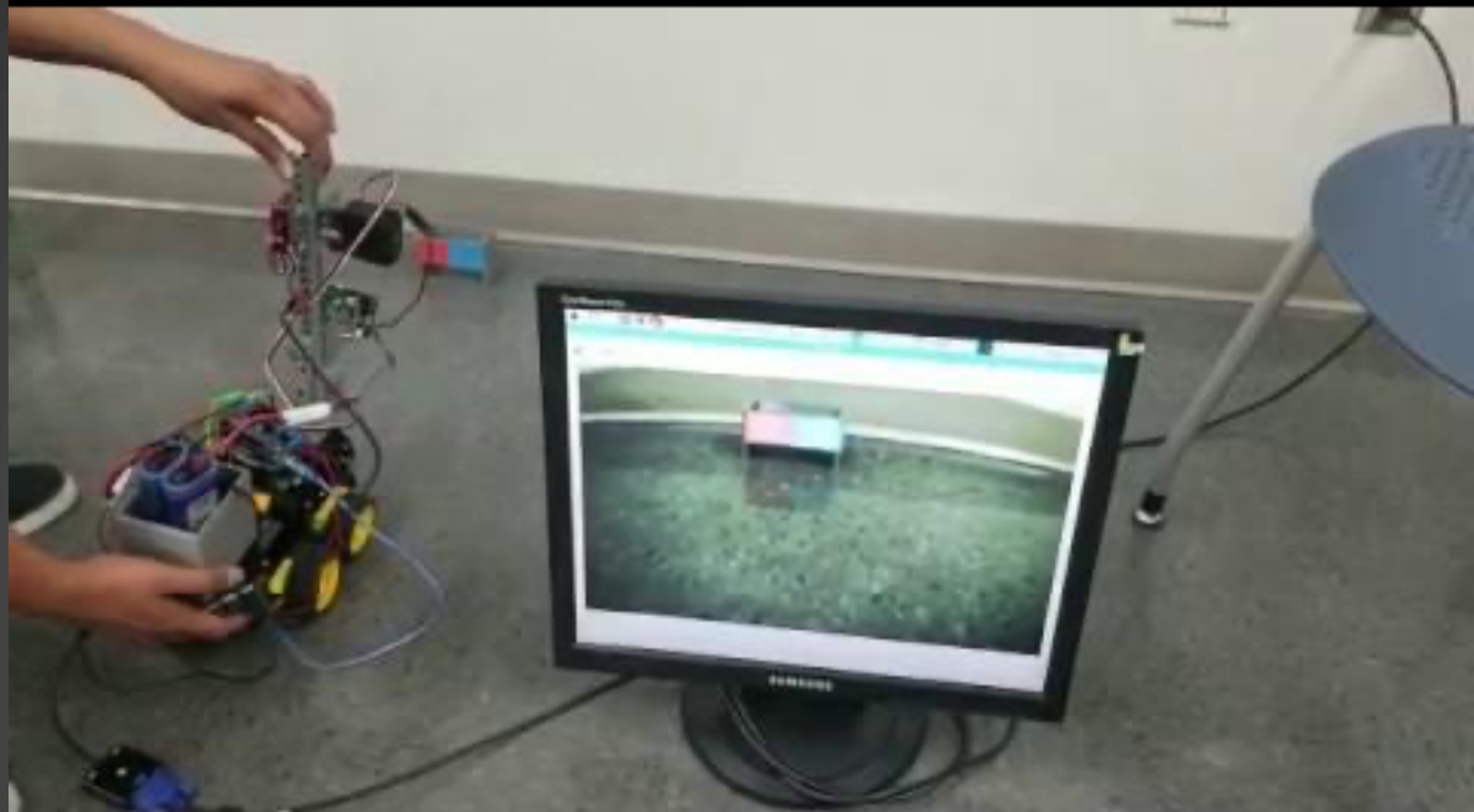
# Problems Encountered

- Individual components worked great but full scale integration was glitchy
- Too much overhead, ran out of processing power and PI froze
- C++, Python 2, and Python 3 PI libraries - Had to pass data between all 3
- Precision steering was problematic because of the forklift weight
  - Tried many combinations of stepper motor, dc motors, and control systems
  - Need much higher torque to steer in small increments
  - Caused several complete mechanical redesigns





VIDEO PROOF  
(Full demo very  
soon)





**THANK  
YOU!**

