UMassAmherst
The Commonwealth's Flagship Campus

Cumulative Design Review:

Intelligent Screw Organizer - ISO

Team 20
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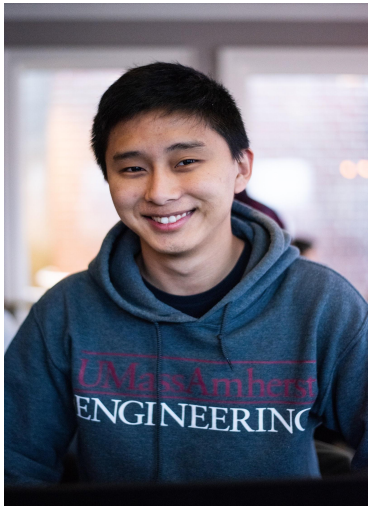
Advisor: Professor Eslami

ISO Team:



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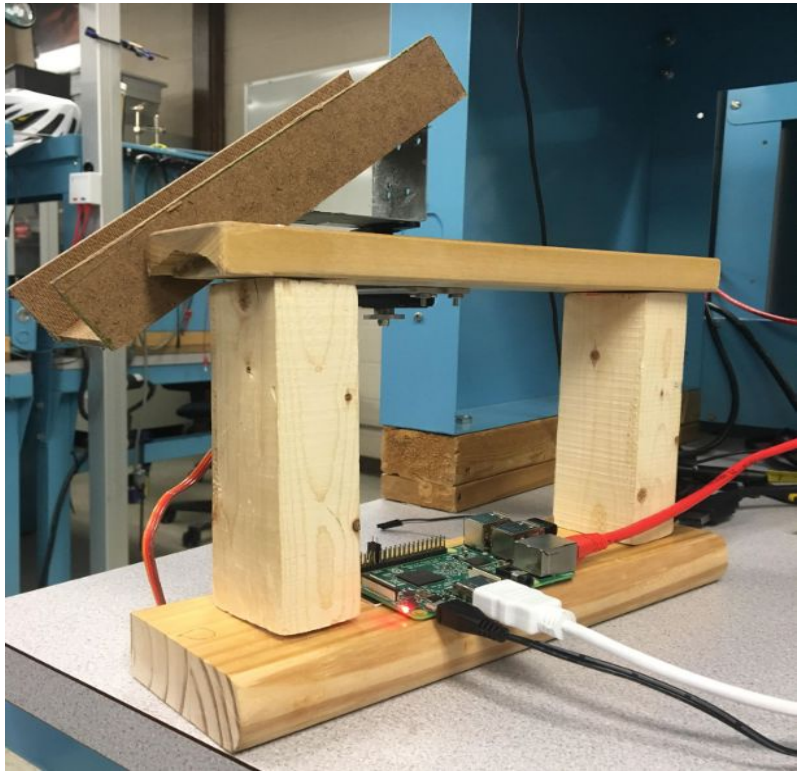
Outline

1. Problem Statement
2. System Review
3. CDR Accomplishments
4. FPR Deliverables
5. Demo
6. Questions



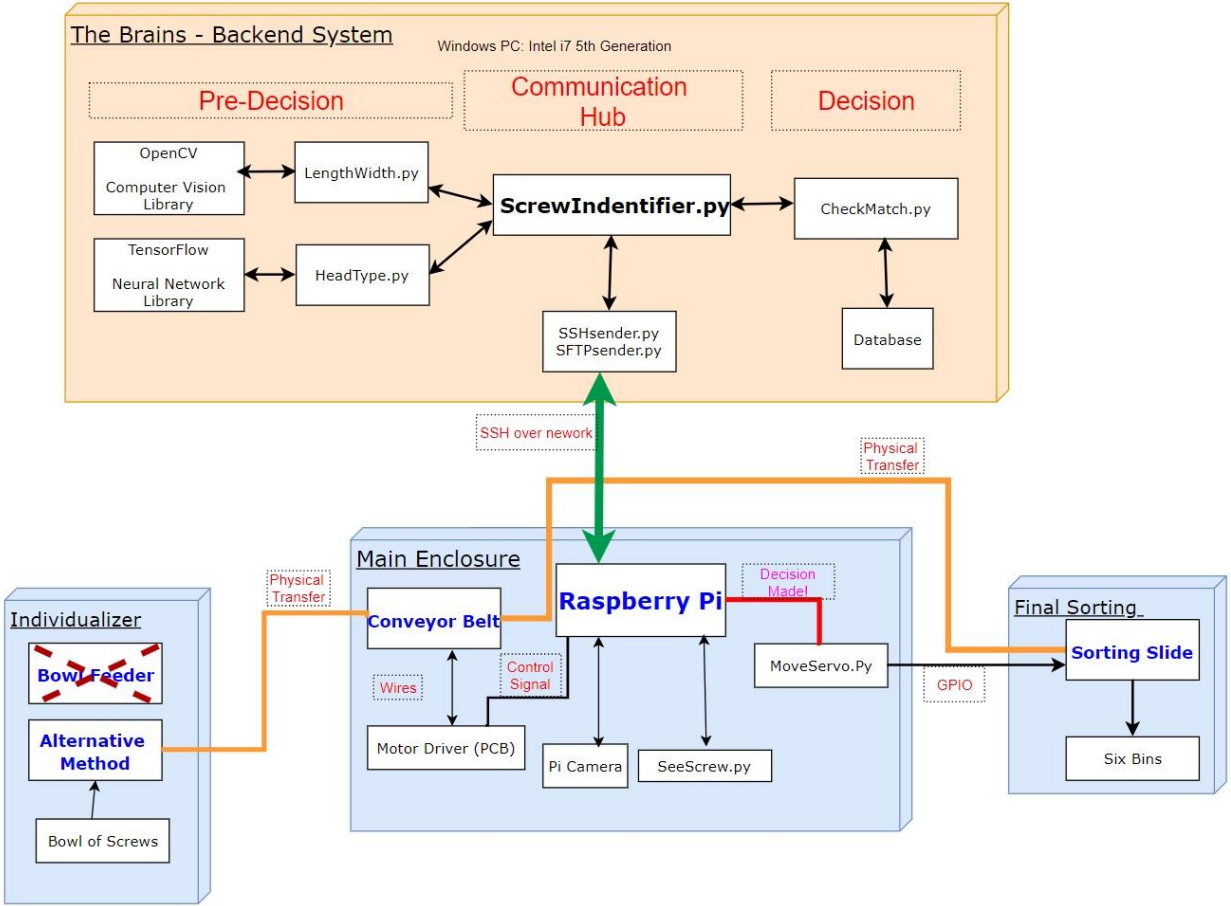
The Problem

- Many people and machines shops have loose screws laying around and do not want to invest the time and effort in sorting them. They also don’t want to spend the money in an industrial sorting machine

- Throwing them out would be a waste of materials and only contribute to the growing trash problem our planet has.

We have a quick and low-cost solution for the problem: ISO

Block Diagram



Backend Brains - Summary

Intel i7 running extensive Python code controls entire system

- Communicates with Raspberry Pi over SSH and SFTP
- Orients image then determines screw height and width
- Checks database to see if there is a match
- Sends command (over SSH channel) to move sorting slider into proper position

Backend Brains - Pseudo Code

Via SFTP, receive screw image from Raspberry Pi

Rotate and fill image to align screw in vertical orientation

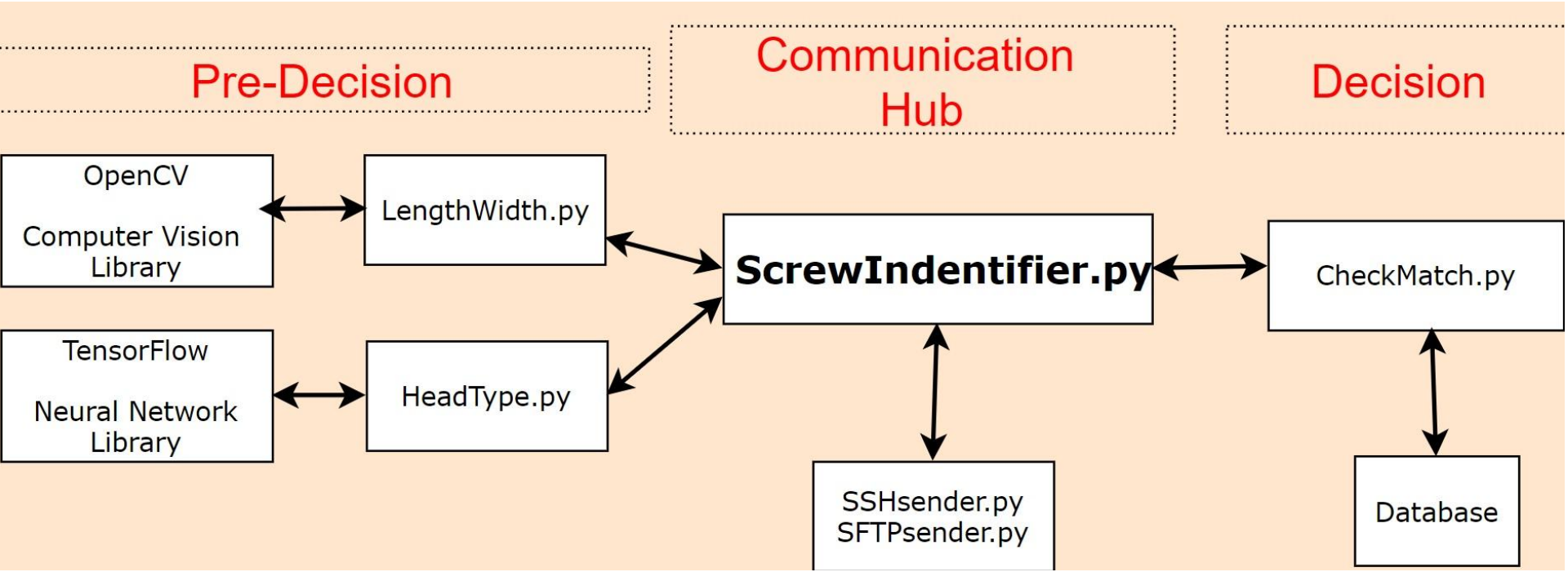
Complete Gaussian Blur, Grayscale, Canny Algorithm to image

Using pixel manipulations and custom algorithms, computes length and width of screw

TO DO: Add TensorFlow model that classifies head type to add additional reference criteria

Make decision based on data and move servo

Backend Brains - The Code

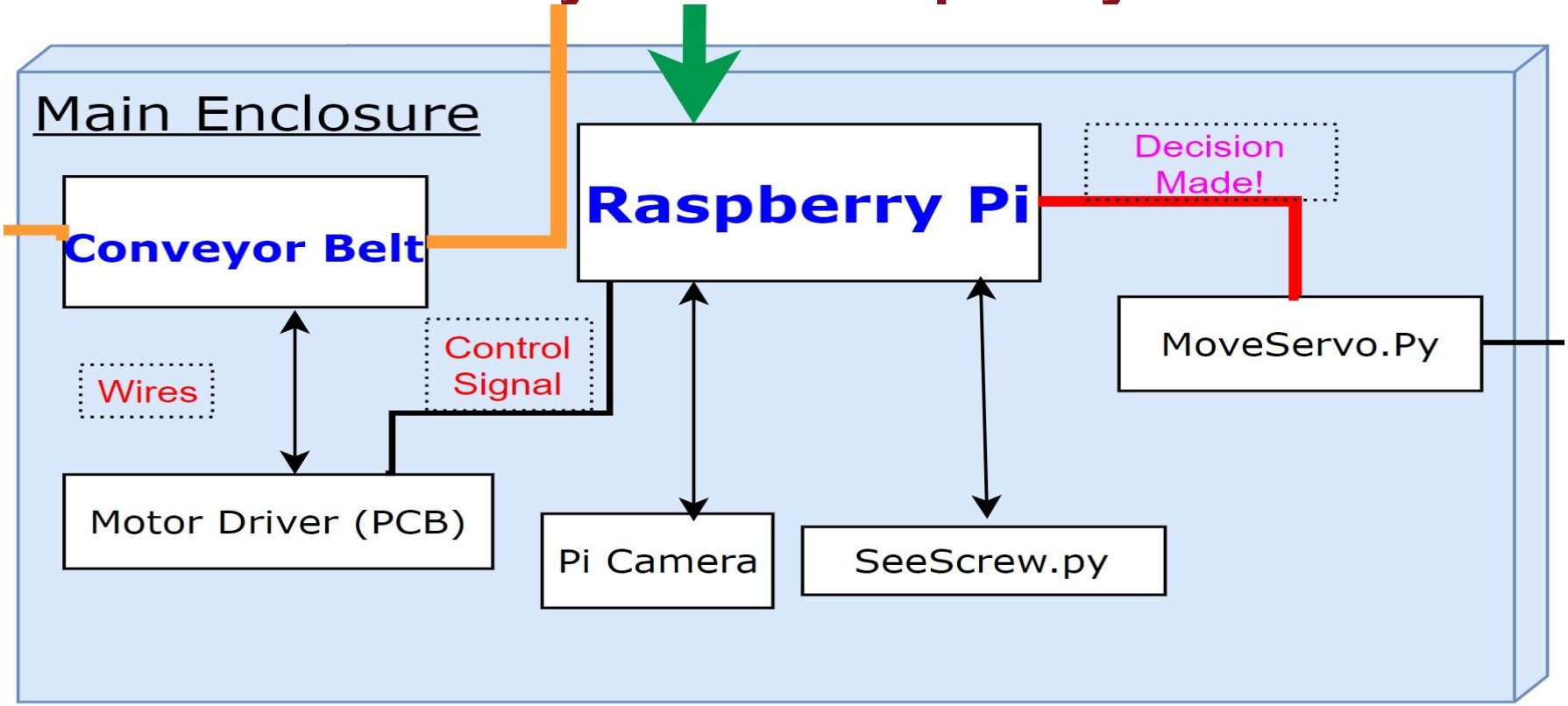


Enclosure - Conveyor and Raspberry Pi

- Conveyor System (controlled by motor driver PCB - To Do)
  - Feeds screws into enclosure system
  - Powered by driver which is controlled by Pi command

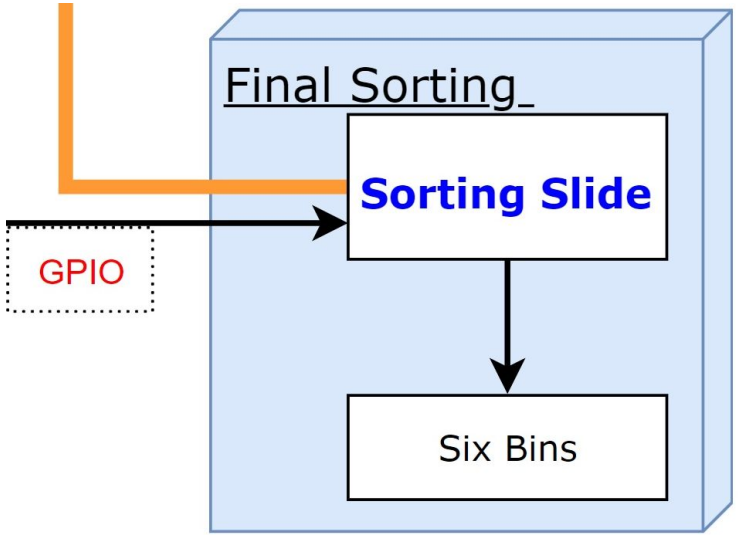
- Raspberry Pi
  - Turns on via SSH command from PC
  - On program inception, turns on conveyor belt via control signal and runs continuous ScrewDetection.py script
  - On detections, send image to PC via SFTP
  - Receive servo position detection decision via SSH and make the move

Enclosure - Conveyor and Raspberry Pi



Sorting Mechanism

- Conveyor belt feeds into mouth of slide sorter
- Raspberry Pi sends commands via GPIO pins to servomotor
- 6 different bins will hold screws (5 being similar screws with 1 being miscellaneous)



Proposed CDR Deliverables

- Automatic Conveyor system
  - Take single screw and setup under camera
  - Able to pass screw to final sorting placement

- Integrate Backend Communication
  - Tell the sorting mechanism which bin to place current screw
  - Receive data from camera in real time

- Build individualizer mechanism
  - Separate out a single screw and setup under camera
  - Build individualizer system and enclosure for mount

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Individualizer Dilemma

If we had the budget of a medium-sized business, an automatic bowl feeder would be feasible. However:

- Custom bowl feeder would cost thousands ($$$$$)
- Would be an engineering feat in and of itself
- **We have been focusing mainly on the CSE problems**

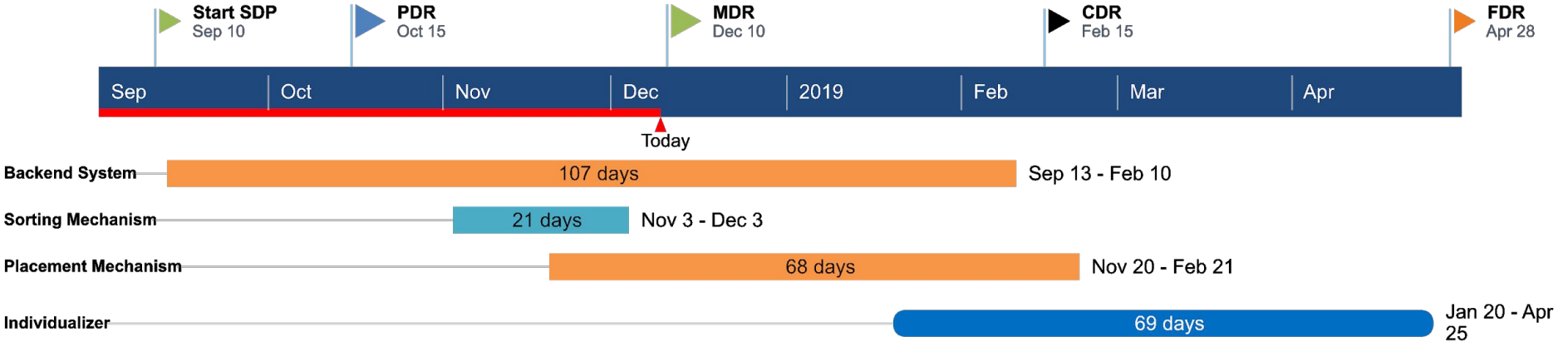
Nonetheless we will be researching and pursuing alternatives:

- Conical funnel at mouth of conveyor belt that singles screws
- Servo-controlled incline screw head holding system
- Hand fed

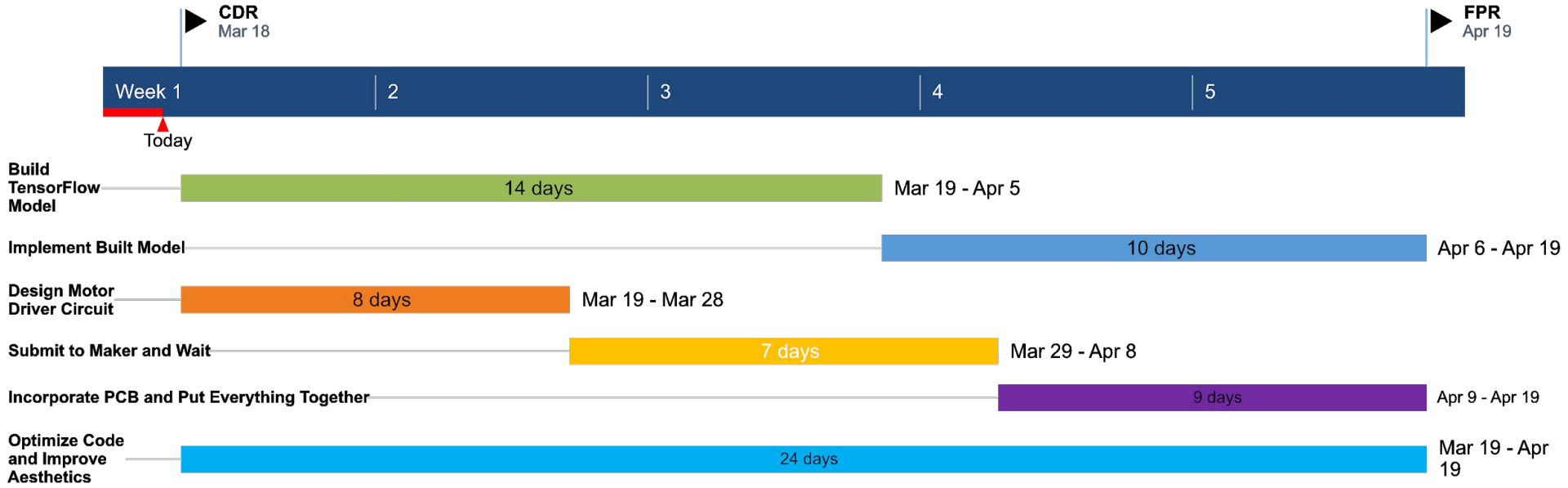
FPR Deliverables

- **Motor Driver PCB** - Jordon B
  - Conveyor Belt gear motor needs a variable speed driver and power supply.
- **TensorFlow Model Creation** - Jordan G
  - Implement machine learning model for head type detection
  - Incorporate head decision into current detection algorithm
- **Optimize Software Suite** - Andrew M.
  - Get detection code to work as flawlessly as possible
- **Aesthetic Improvements** - Rajesh S.
  - Upgrade enclosure structure and add professional touch
- **Final Prototype Completion** - All Members
  - Have final ISO system completed and working by FPR

Gantt Chart Status at MDR



Current Gantt Chart




DEMO

Thank you

Questions?