NanoPack

A PACKING MACHINE FOR NANOVIEW BIOSCIENCES

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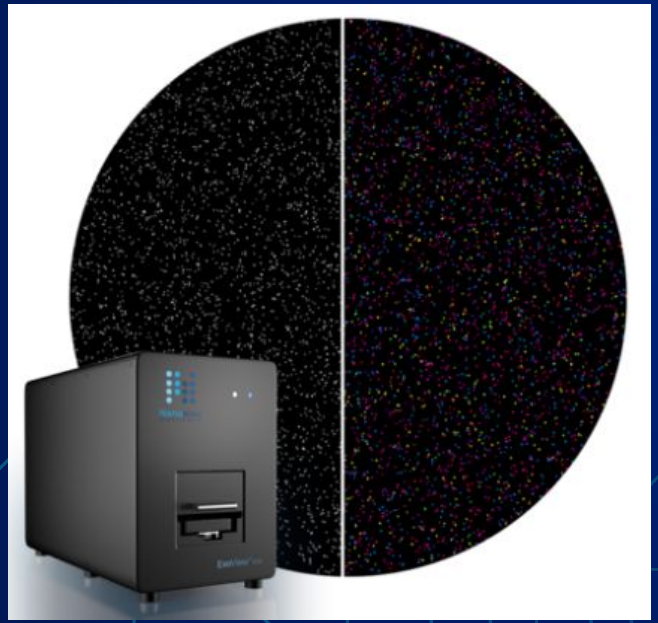
Product Design Review

NanoView BIOSCIENCES



Our client, NanoView Biosciences, is a biotechnology company which makes machines capable of detecting markers on exosomes and other biological systems

They are a startup company based in Brighton, and their President is a former BU professor, David Freedman

Problem Statement

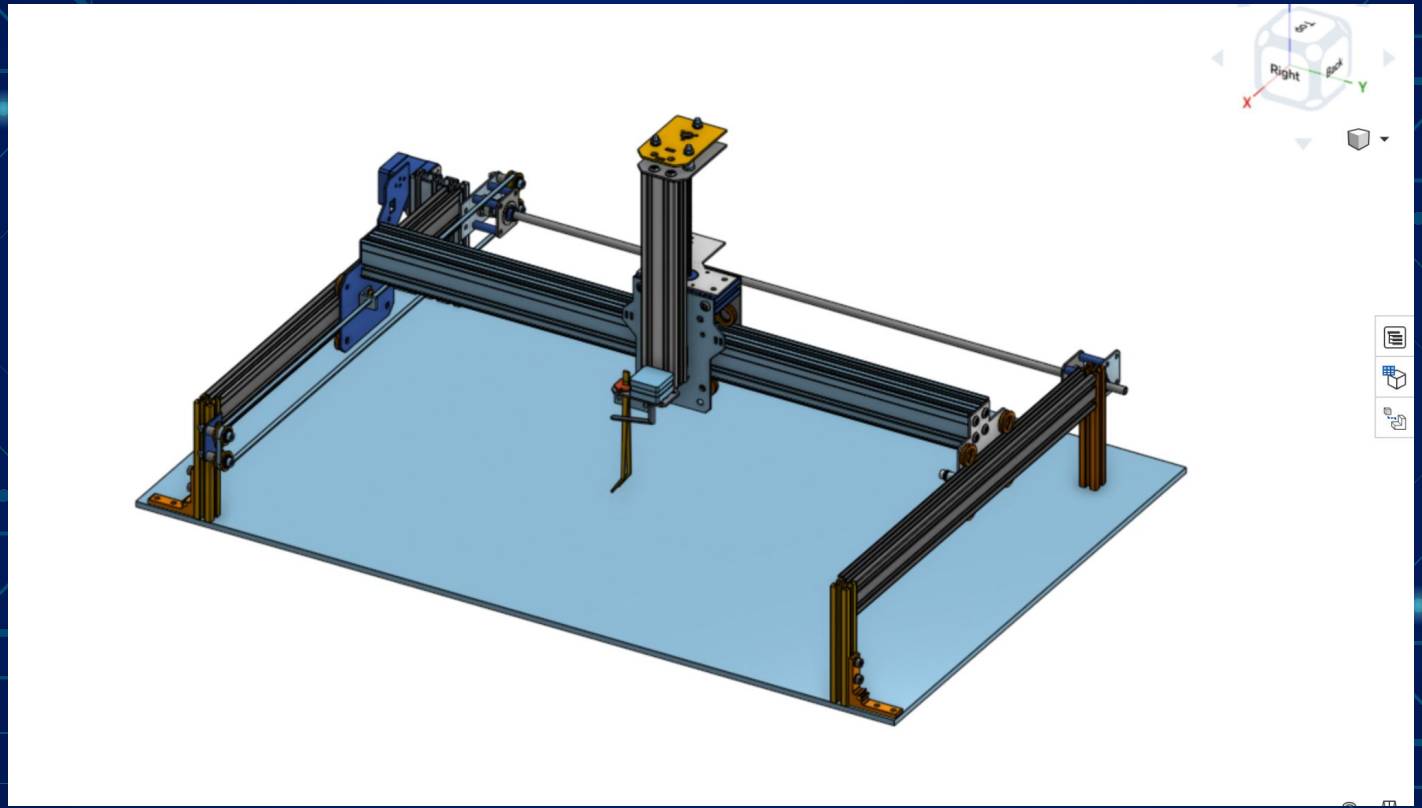
- NanoView currently uses a person with tweezers when they transfer silicon chips from their lab container, “the traveler” into user cases, “clamshells”
- Our job is to automate the process of transferring the chips from the traveler to clamshell
- This will speed up the process, prevent human error, and reduce risk of contamination

Deliverables

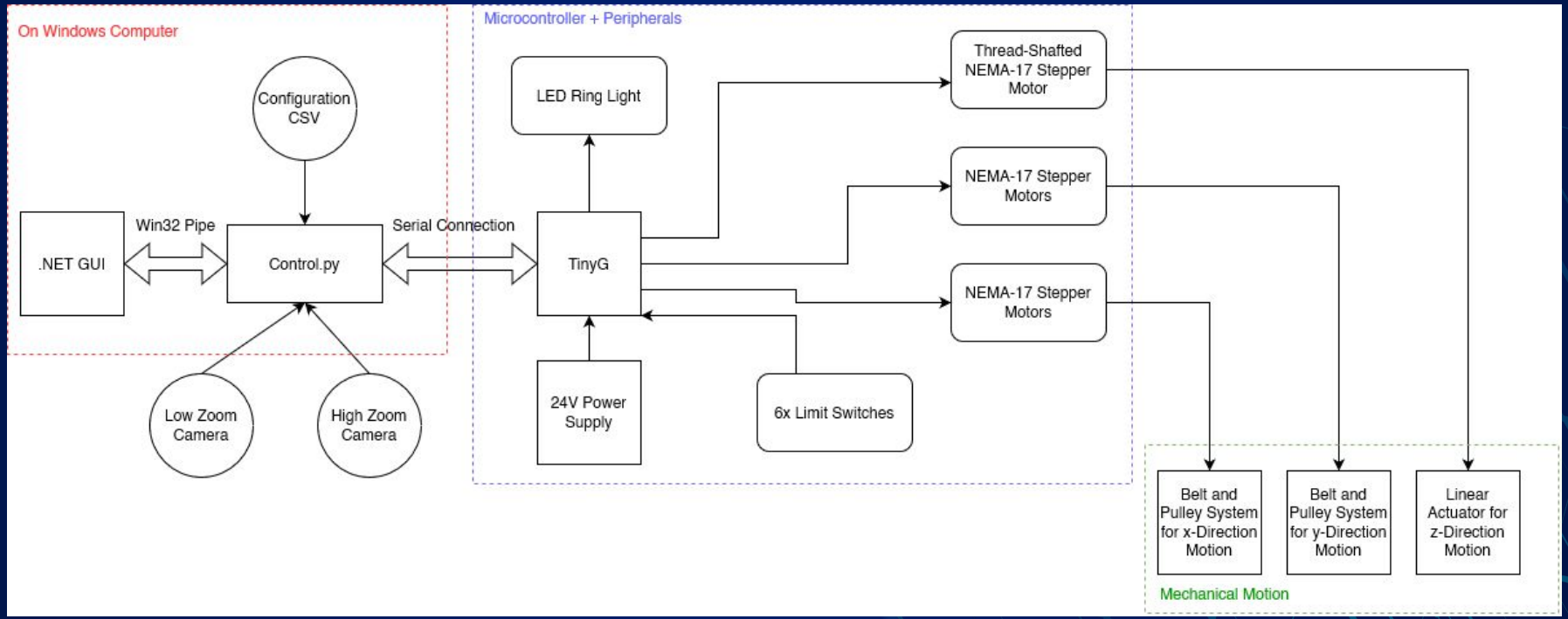
We will deliver a product meeting the following requirements:

1. Comprised of packing machine and accompanying software package
2. 10x increase in packing speed
3. Same level of care as a human
4. Check chip ID as chips are packaged
5. Integrate into existing manufacturing pipeline
6. No damage to chips during packing
7. Fit inside the manufacturing facility

Visualization

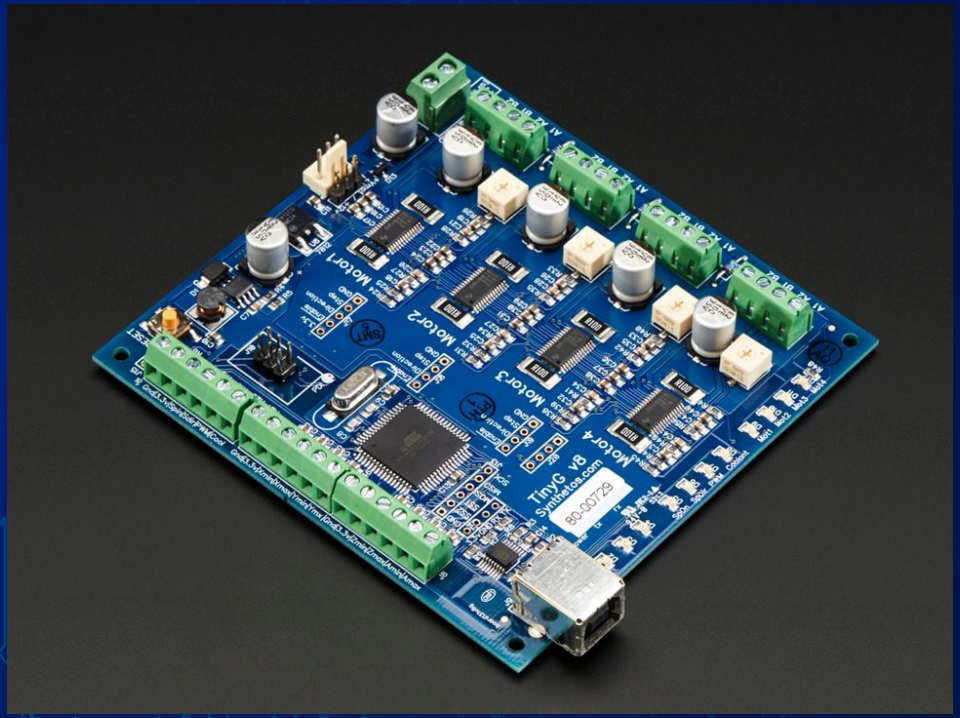


System Block Diagram

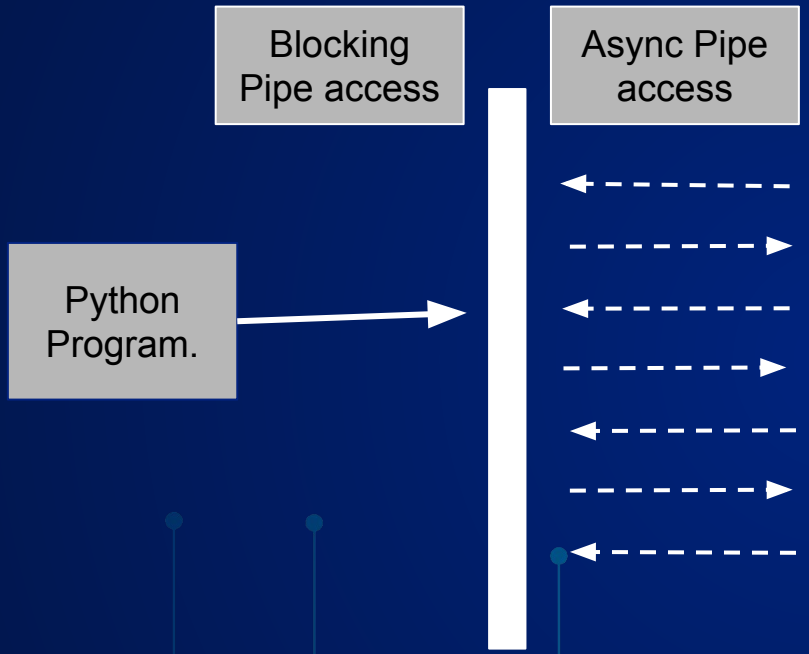


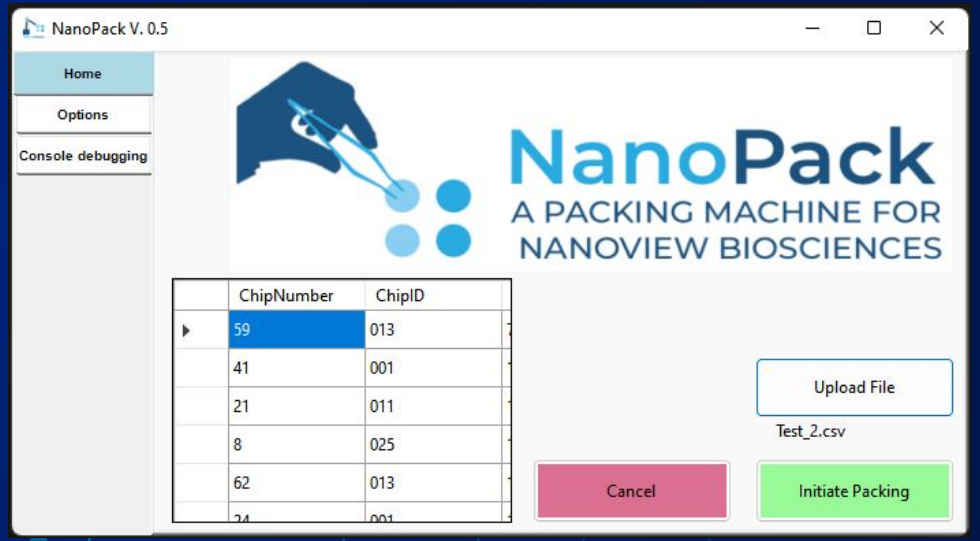
Technical Design - TinyG Microcontroller

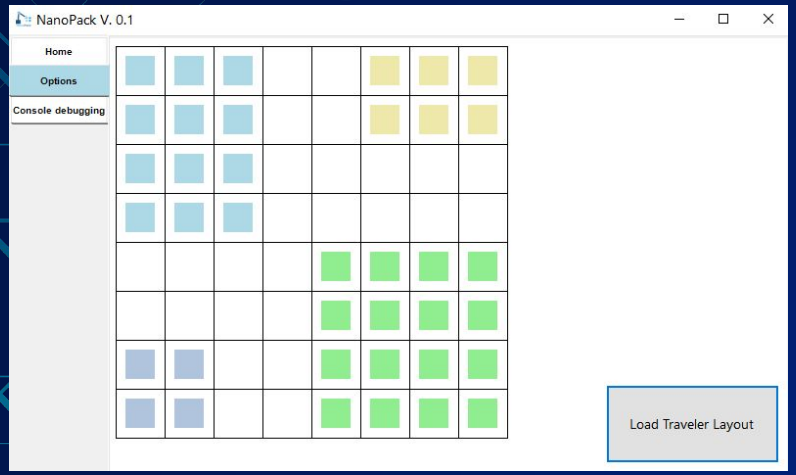
- Serial G-code → stepper motor
- Communicate via Python and pySerial
- Serial port detected automatically with the VID of the board
- TinyG motor and communication protocols are configurable via serial
- G-code commands to move the machine are sent JSON format
    - e.g. {'gc', 'G0 X 1'} to perform a G0 movement on the X-axis



Technical Design - GUI

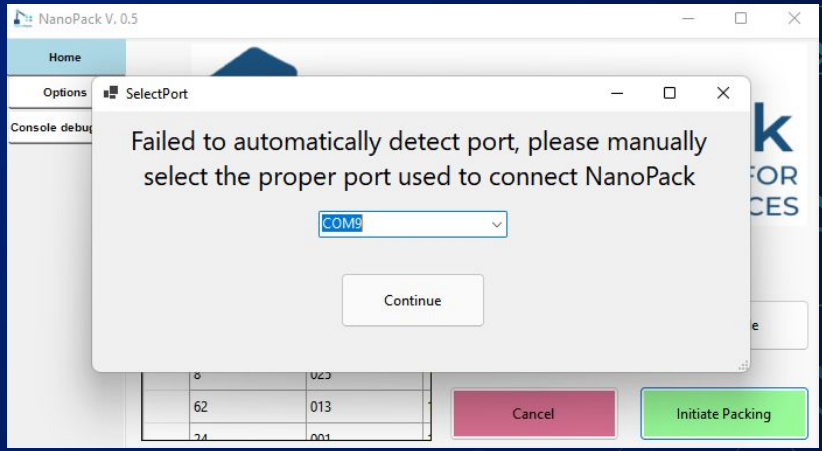




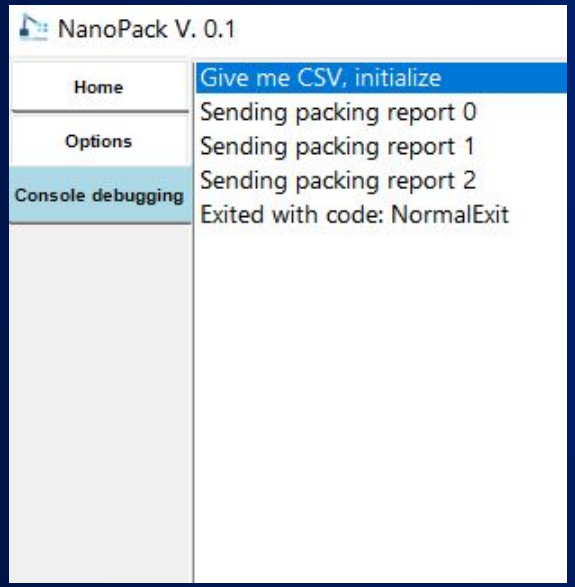


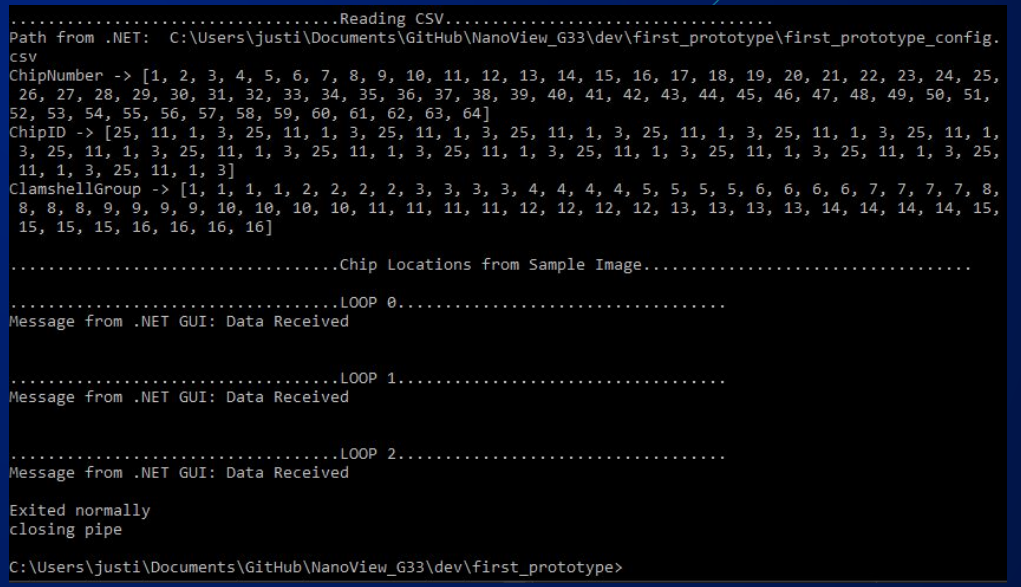
Traveler Visualization

Port Selection



Example of inter-process communication



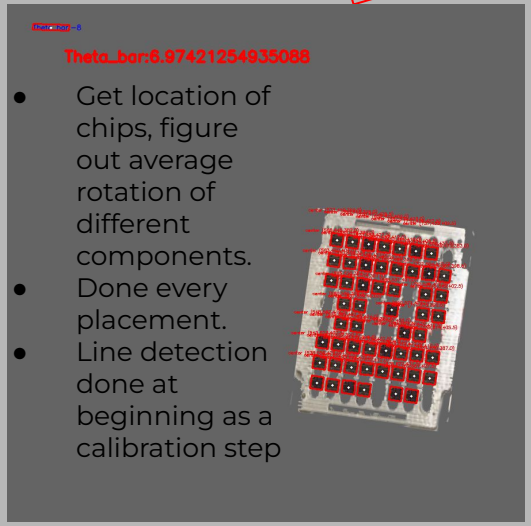


Technical Design - ML

Text Scanning

- Use a CNN to classify images into number categories.
- Verify against csv before starting chip placement
- Only done at the beginning of the processes.
- Generated noise on top of existing image set to create a larger training.

Object Recognition

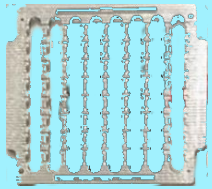


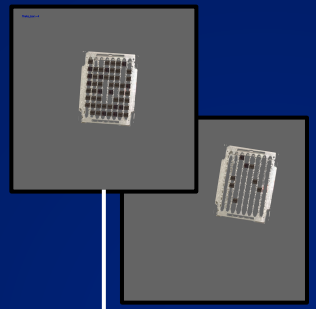
- Get location of chips, figure out average rotation of different components.
- Done every placement.
- Line detection done at beginning as a calibration step

Technical Design - ML

Object Recognition

Assets





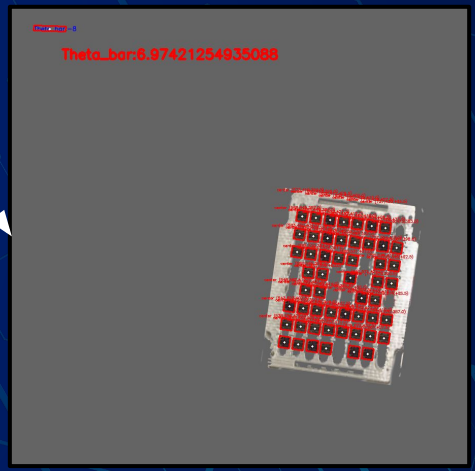
PreProcess

Contour Detection

Object Classification by area

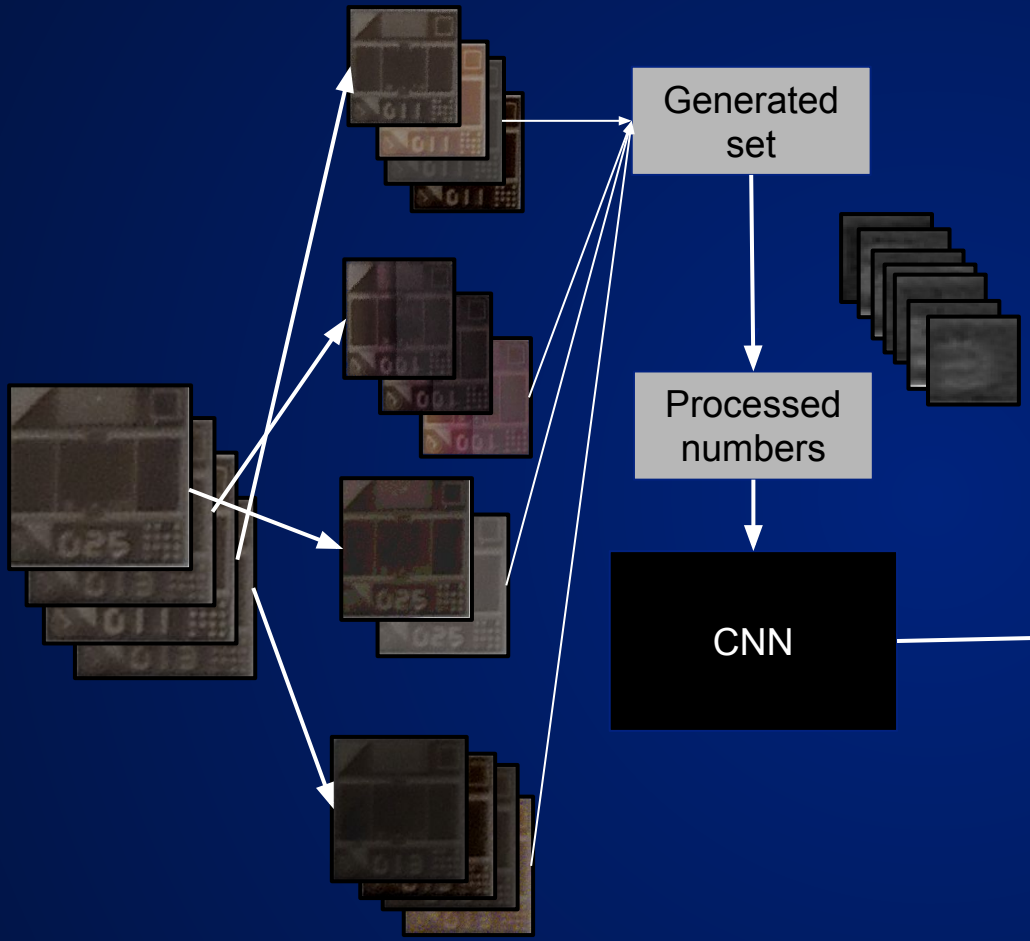
Bounding rectangles

Angle Detection & Averaging



Technical Design - ML

Text Scanning



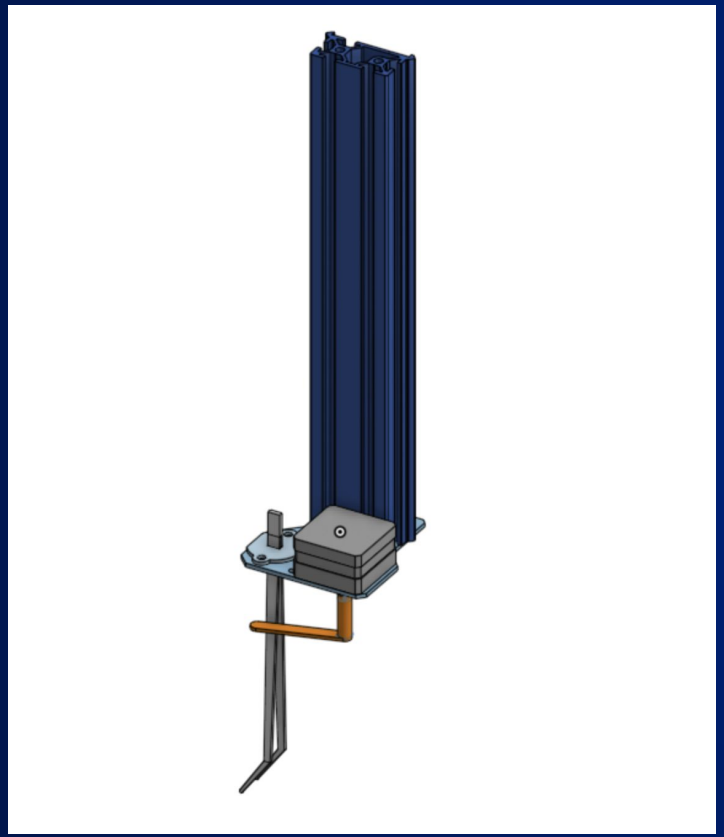
Generated set

Processed numbers

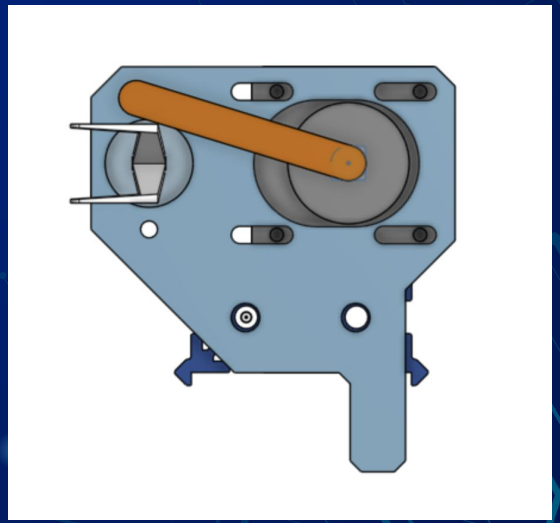
CNN

Classification:
[0,2,5]
[0,1,1]
[0,1,1]
[5,1,3]

Technical Design - Mechanical



- Modified design from LitePlacer robot
- Custom tweezer actuator designed to pick up chips
- Added 3D printed mount for tweezers + stepper arm to pinch tweezers



Schedule (Gantt Chart)