Team 76: Tool that translates printed text to braille

Electrical & Computer Engineering

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Introduction to the team

- **Abraham Han**
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- **Blas Alejandro Calatayud Cerezo**
  (Senior, Electrical Engineering)

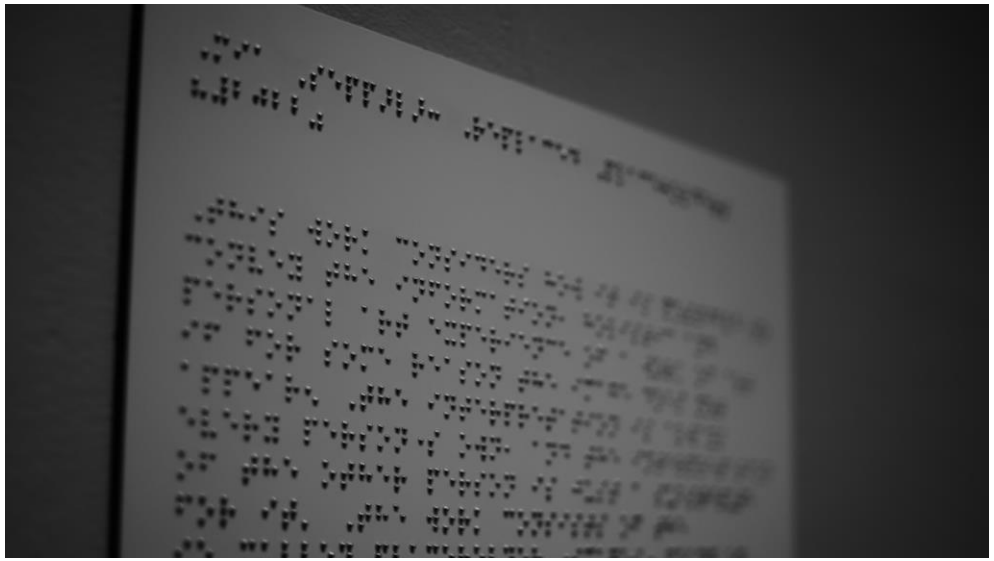
In the United States, 24%* of the visually impaired live below the poverty line...

*In 2020, according to data from the U.S. Census Bureau

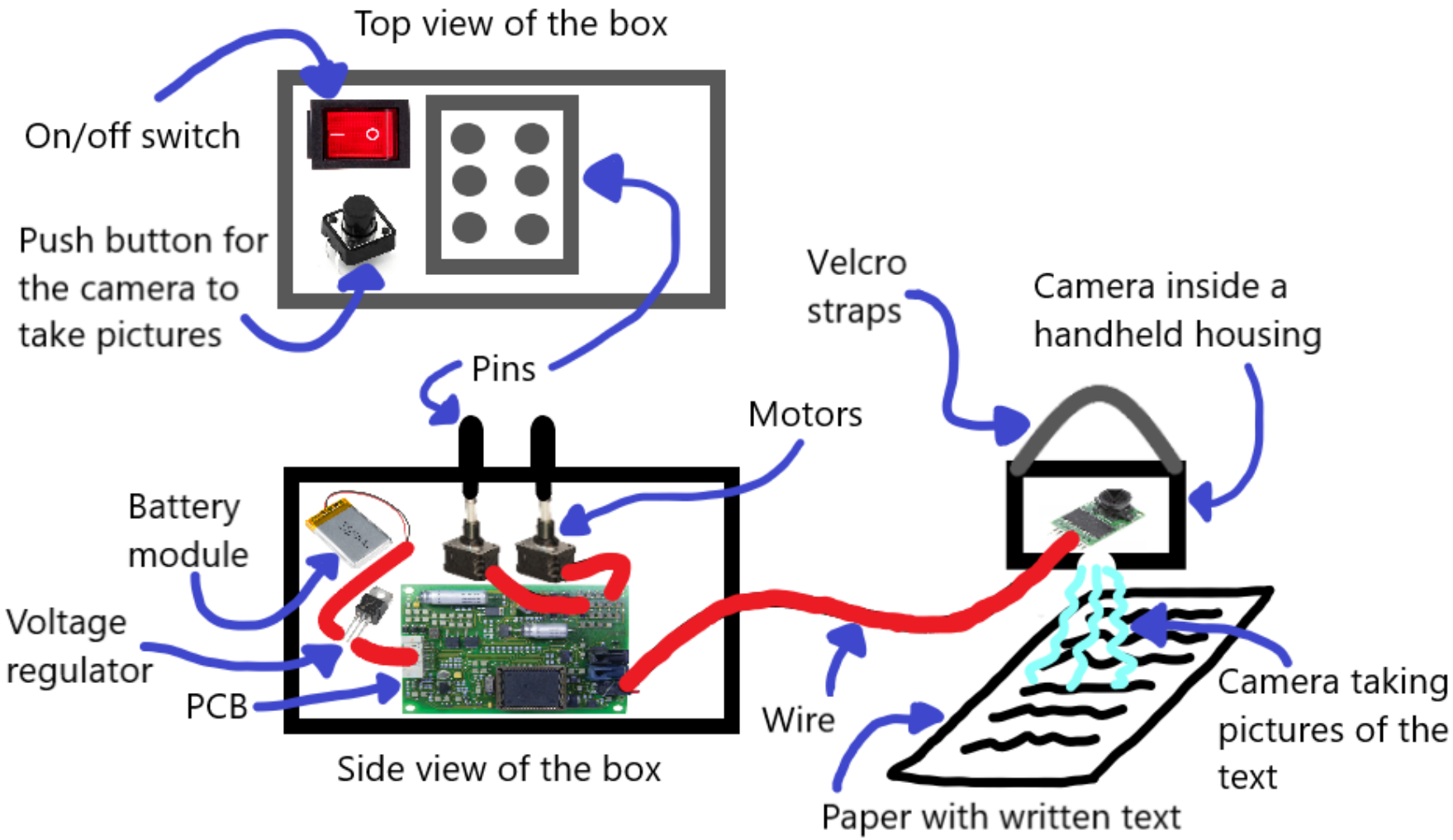
How can we aid the blind in navigating a world designed for the abled?

Objective

A device that converts physical text in the real world into physical braille

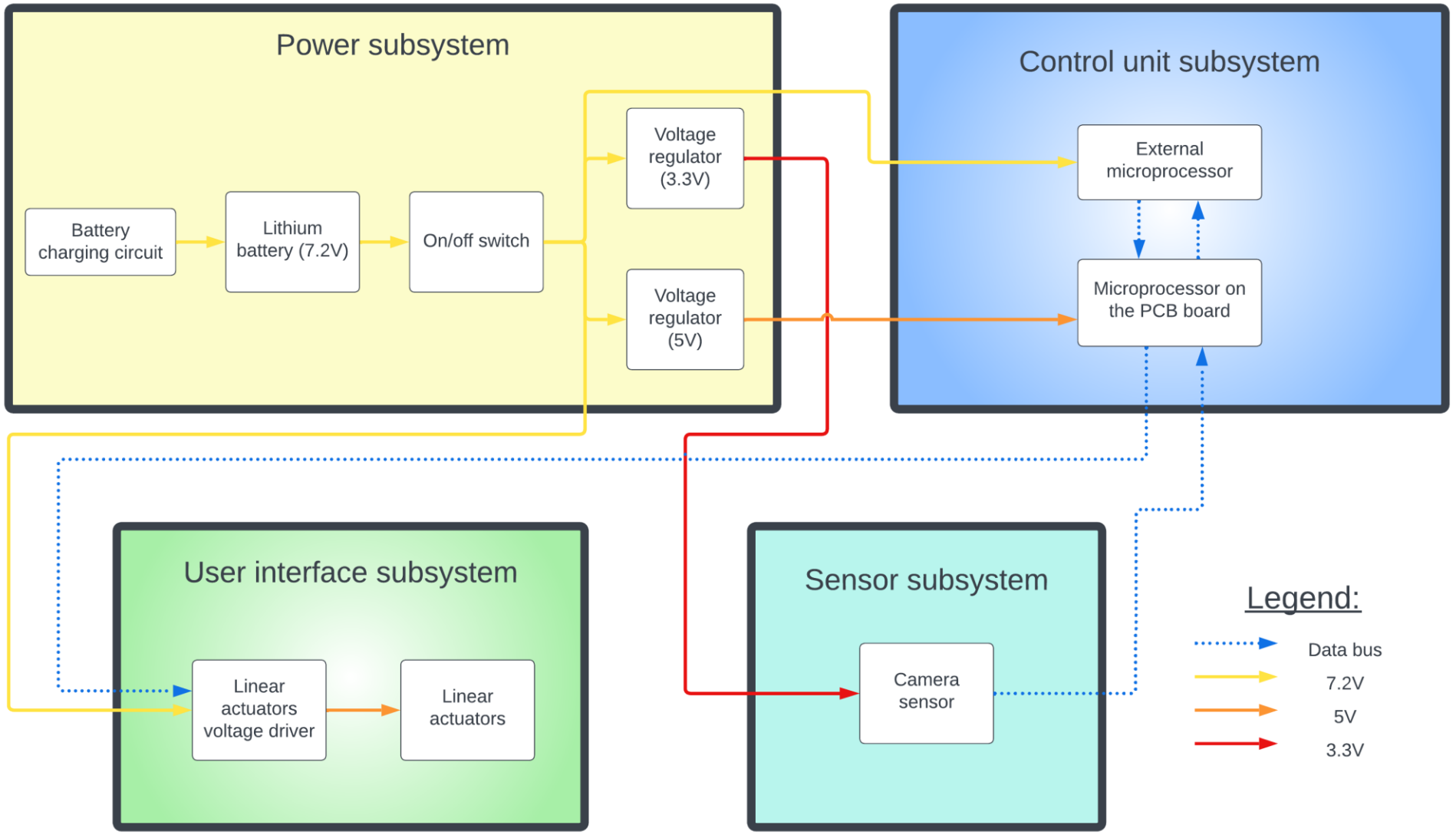


Original design

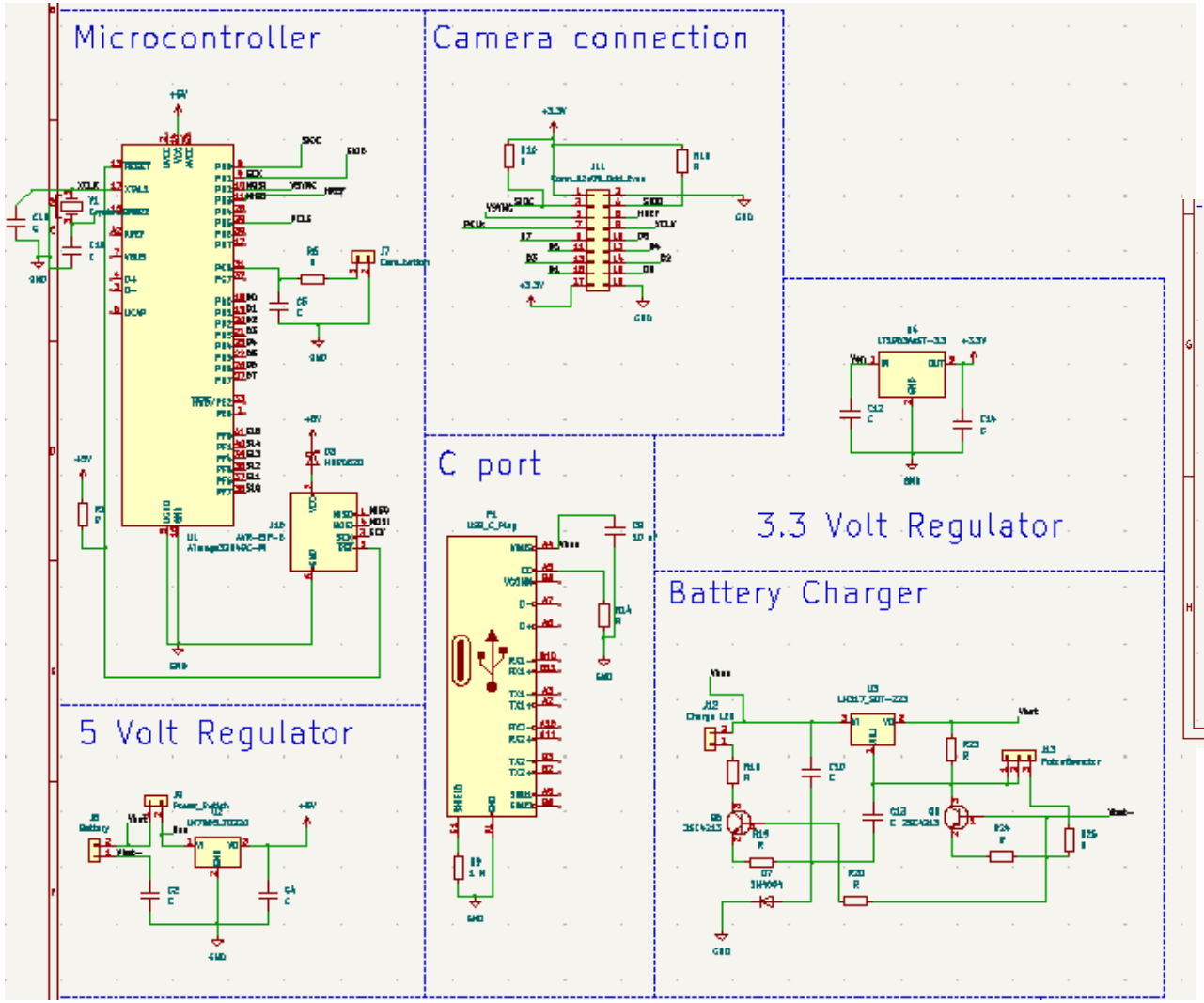


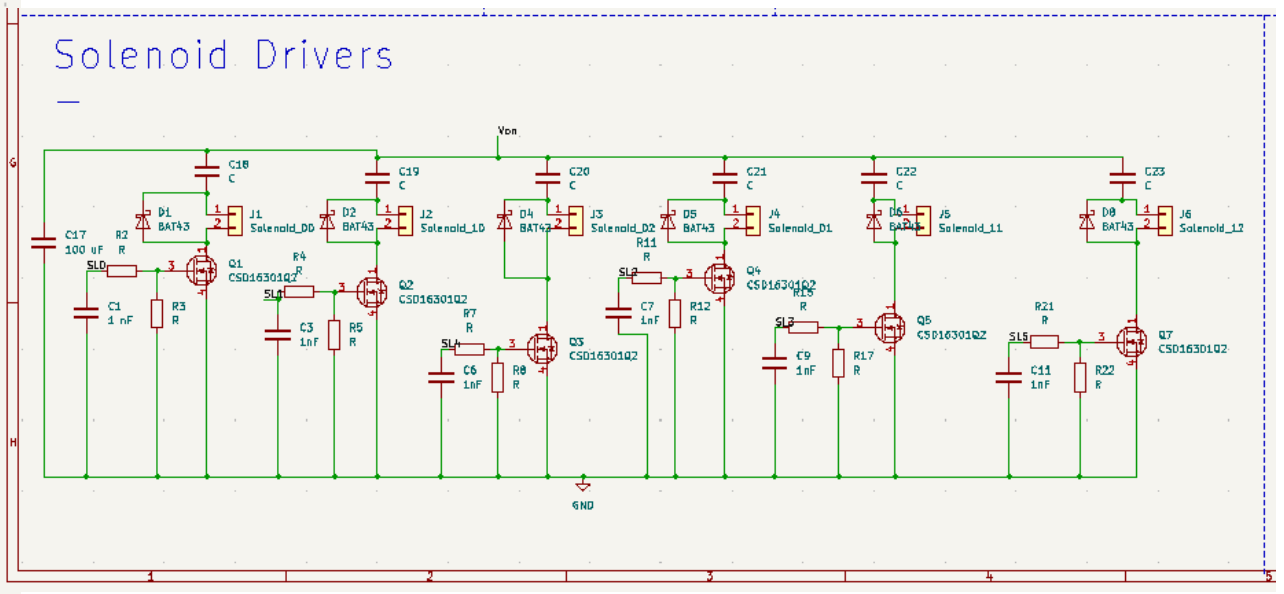
Final design

Block Diagram



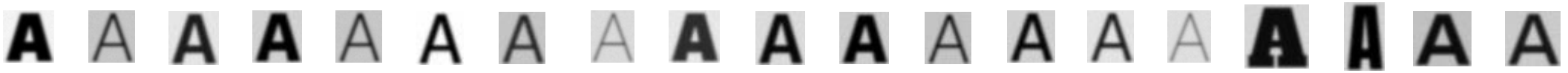
PCB design


Microcontroller
Camera connection
C port
3.3 Volt Regulator
Battery Charger
5 Volt Regulator


Solenoid Drivers

Software

Testing Methods…



Raising the accuracy...

1. Grayscale (+3%)
2. Noise Removal (+5%)
3. Thresholding (+14%)
    - Simple binary threshold
    - Ostu's Binarization

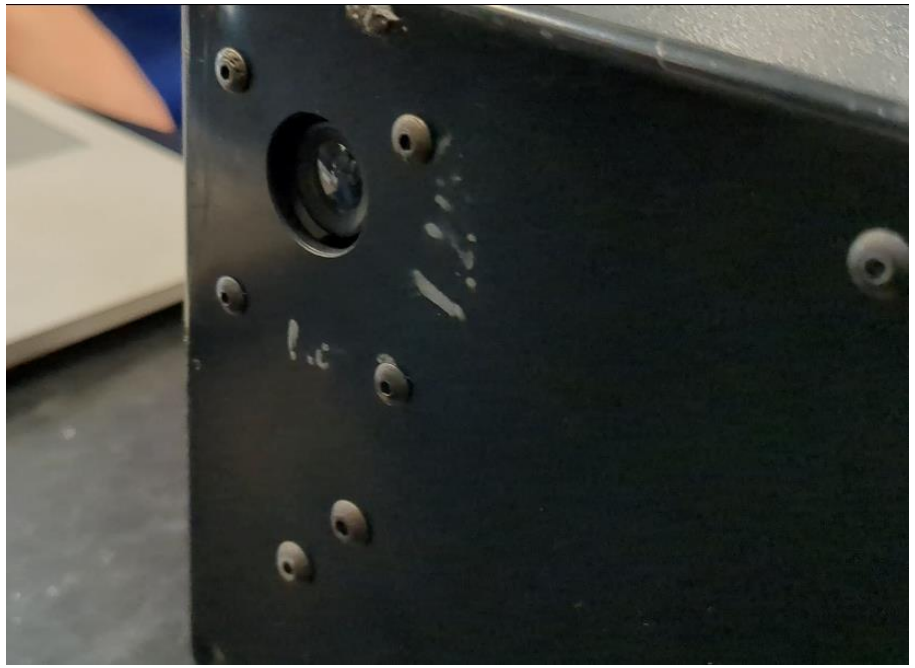
Functional requirements and test results

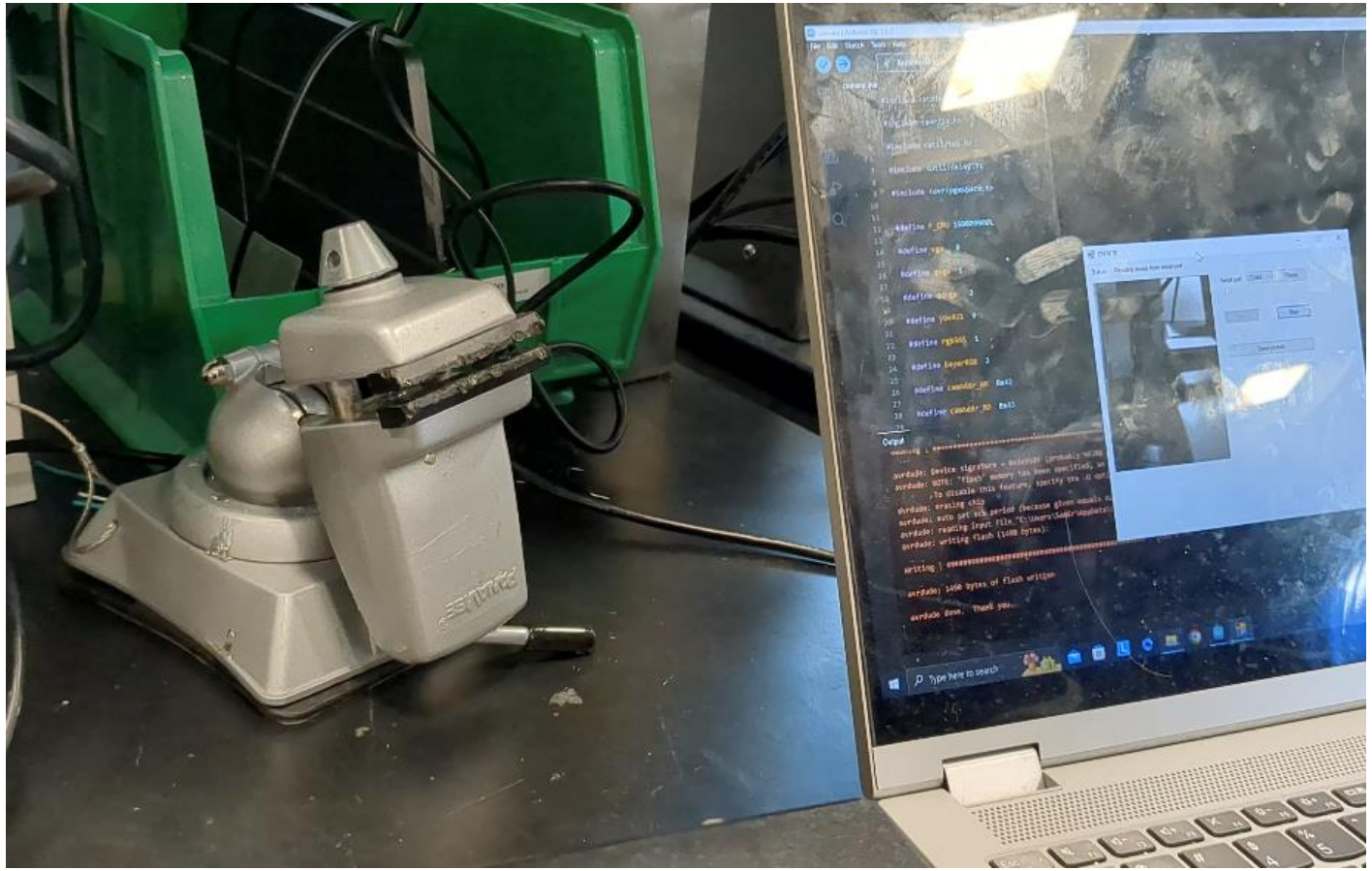
- **Sensor subsystem:**

The camera must be able to take at least a 480p resolution photo and send the data to the control unit system.

Functional test results

- **Sensor subsystem**



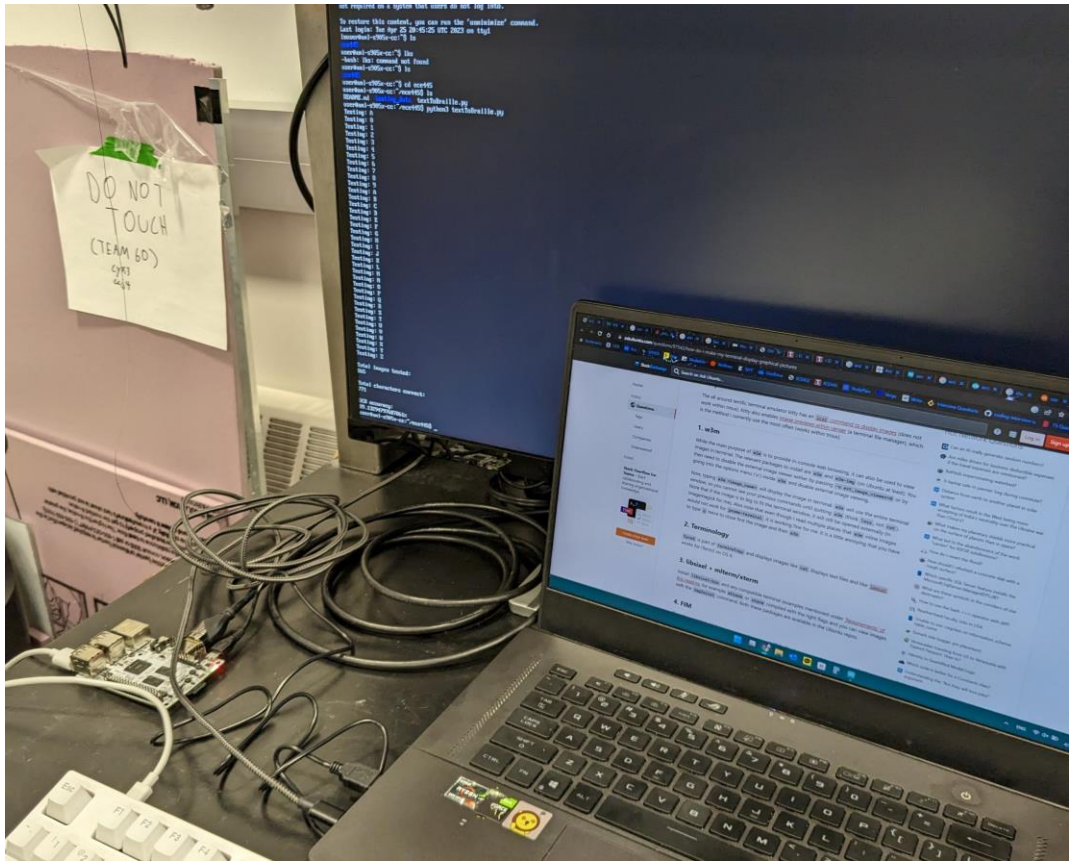


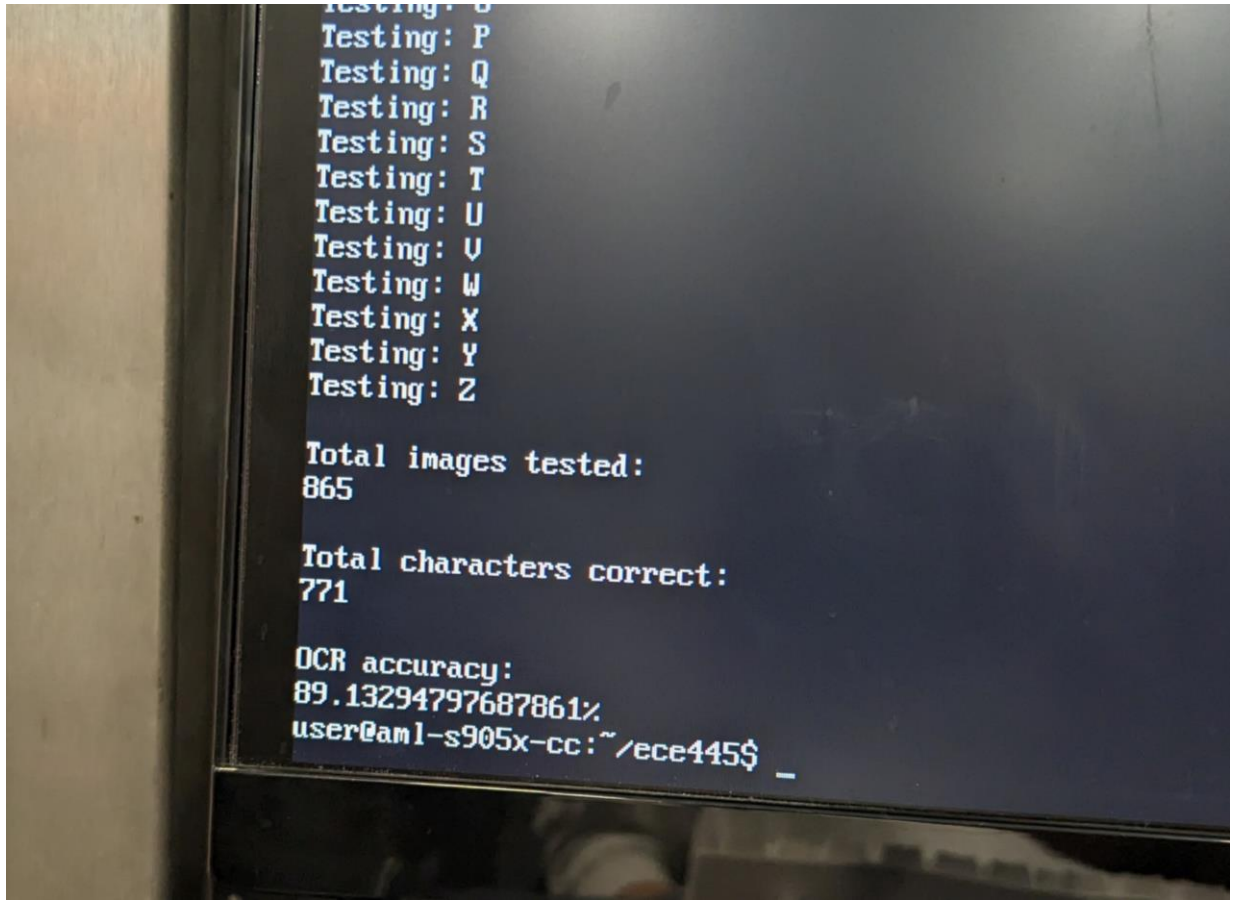
- **Control unit subsystem:**

The ML algorithm on the microprocessor must be able to analyze image data and convert to character texts with 90% accuracy rate.

Functional test results

- **Control unit subsystem**





- **Power management subsystem:**

1) The voltage regulator will limit the voltage to the correct value for each system component.

2) The power management subsystem will be able to safely charge the battery.

Functional test results

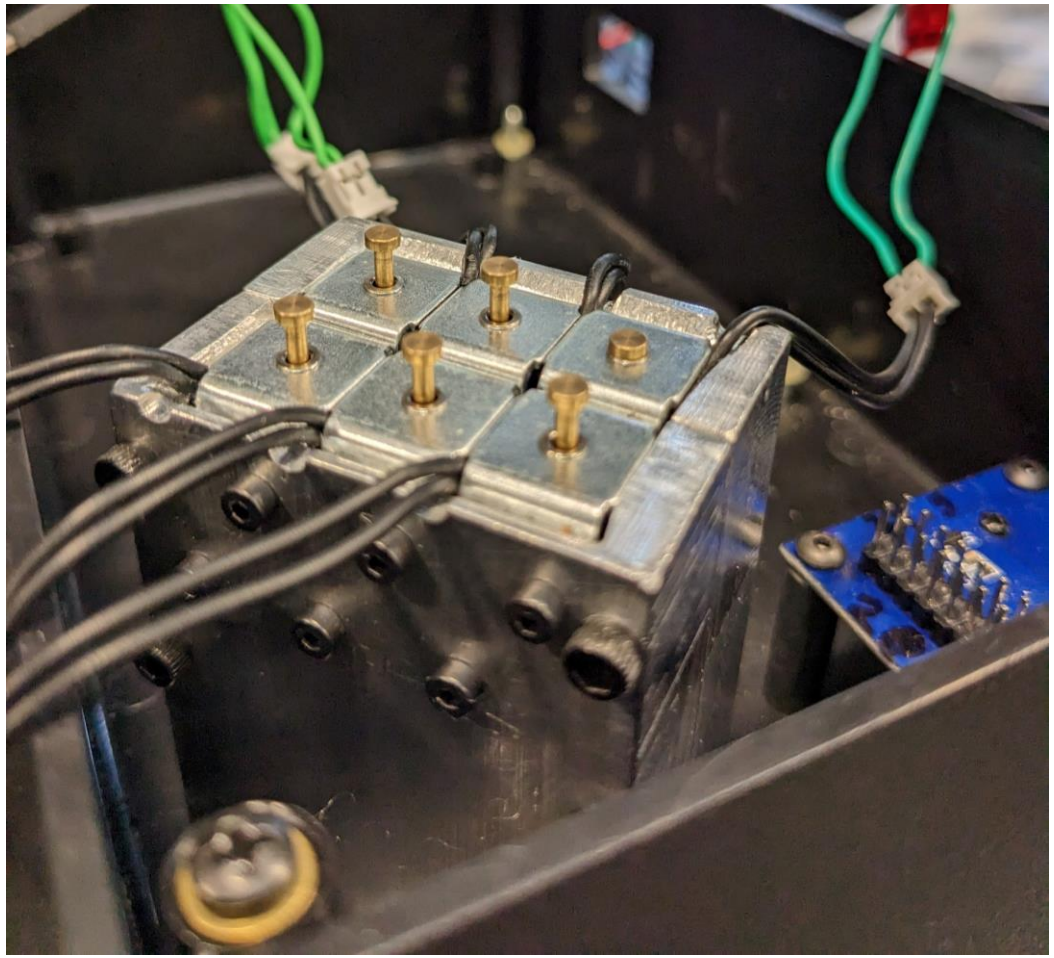
- **Power subsystem**

- **User interface subsystem:**

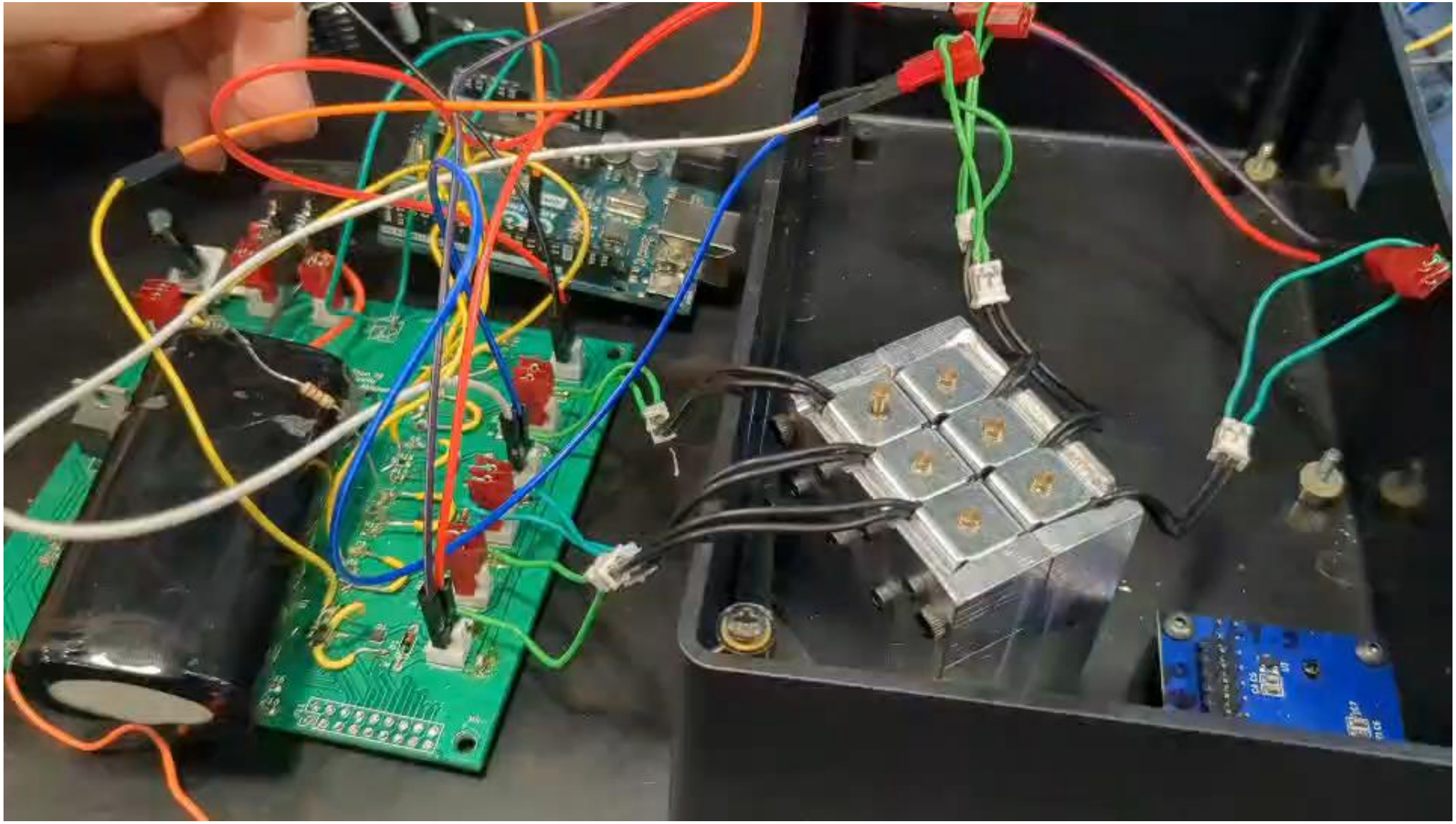
The Motors must be able to lift the pins 0.35±0.1 cm high and to lower them in less than 1 second when forming the braille characters.

Functional test results

- **User interface subsystem**



Video on the user interface subsystem



Successes and challenges

- **Successes:**
  - **Subsystem Implementations**

- **Challenges:**
  - **System Integration**

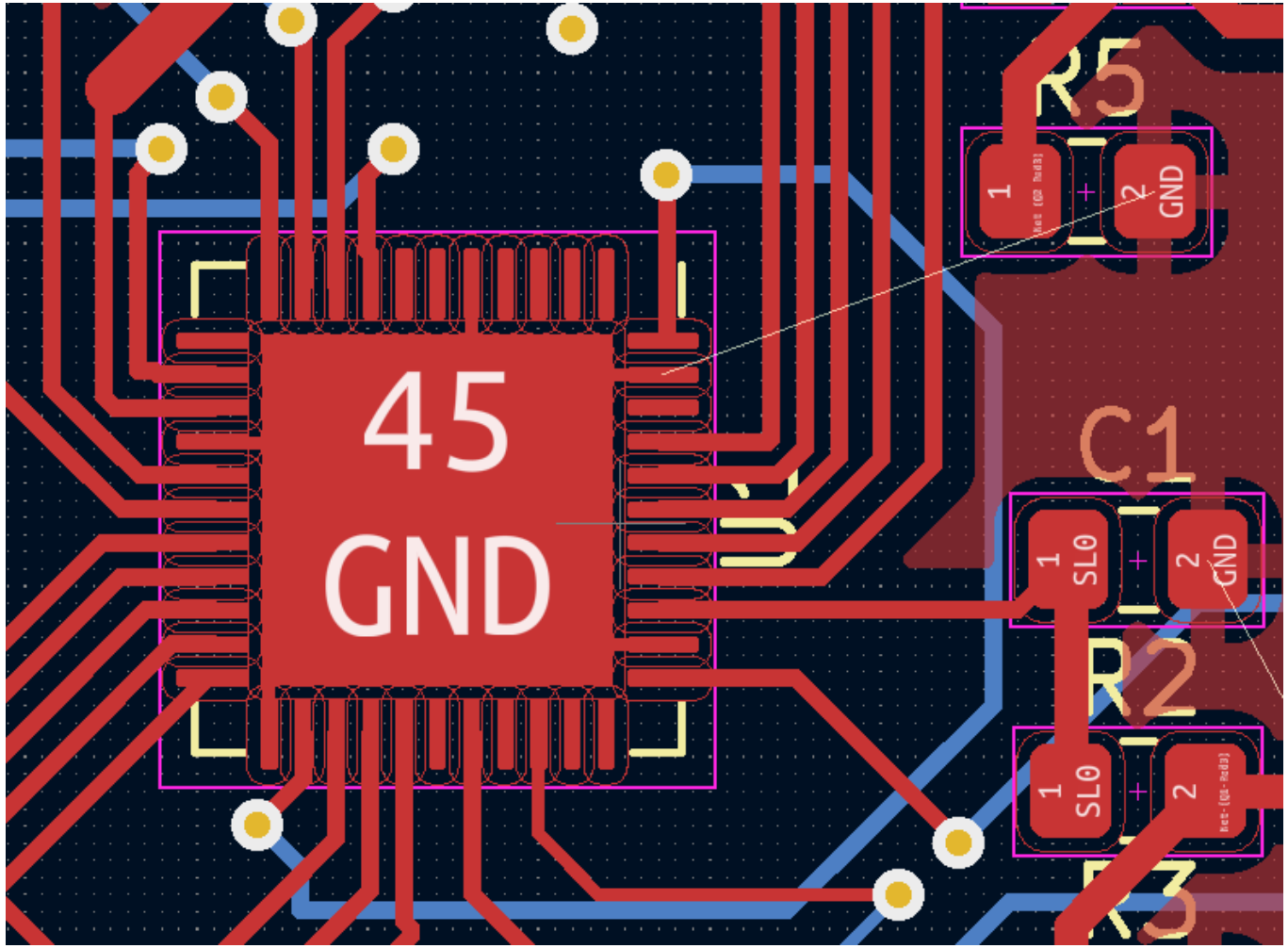
Failed verifications

Our integration of the project failed mostly due to the inability to program the Atmega32u4 microcontroller on the PCB.

We believe this is due errors we had with the PCB grounding plane.

While debugging we found that in the final design for the PCB we didn't make the via connections for separated grounding planes.

We were able to connect most of the grounding areas by soldering wires to pre-existing connection.



Conclusions from the project

- System Integration is HARD
  - All our subsystems worked independently
  - However, we were not able to integrate all of them into one final product
  - Testing PCB designs and components are crucial

Recommendations for future work

PCB fixes:

One change that we be made upon a redesign is fixing up the PCB. Fixing the grounding plane connections and some cases in which we chose the wrong footprint.

Better camera sensor or scanner:

With how we coded the Arduino for testing, our current camera has a very slow framerate, with a low resolution.

Q & A

Any questions, comments or concerns?

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