Sundance Weekly Progress Report Week 4 (Spring)	sundance
04.04.2023	

1. Previous Week's Overview

Previous week, we tested the image processing algorithm with different camera positions. We investigated "haar-like features for rapid object detection" techniques for pole detection in case it becomes necessary, and we tested template matching as an object detection technique. On the communication side, we tried writing codes for both UART and USB serial communication on STM32F4 controllers but debugging was required due to some errors.

2. This Week's Progress

Image Processing

This week we were focused on revising our main code for image processing. For this subject we focused on image background estimation/extraction methods which we did not have time to work on previously. The results were inadequate for the video feed we used for the general methods used in this application.
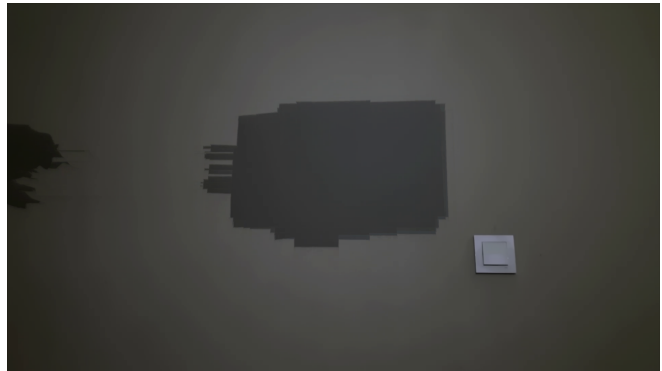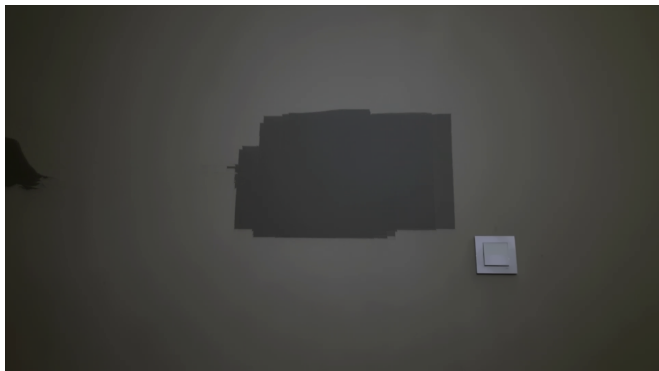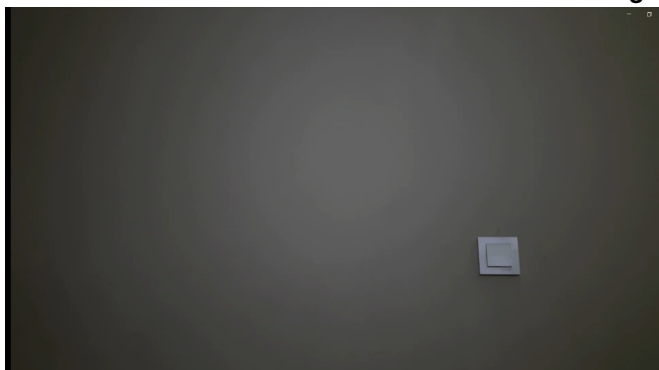

Figure. Results

Figure. Expected result

Communication

Since Raspberry Pi had limited UART pins, and we also wanted to experiment with USB serial

protocol, we tried USB serial communication this week. Since USB-C ports of the STM32F controllers will also be used for powering the boards, we can directly use the USB interface without additional pins. Furthermore, if we manage to send .hex files from Raspberry to STM32F controllers and program them over the USB port, it will make the debugging much less cumbersome when we assemble the system together; which will increase the testing processes. Hence, we plan to use USB communication between the devices.

A star-like topology will be used where the Raspberry Pi is the host (master device) and all the STM32F devices are connected to it as communication devices. Step by step, this week we set up the communication environment by writing codes both for STM32F401 (in STM32Cube IDE) and for Raspberry (in Python). The communication is successfully configured as both devices successfully received string messages from each other, and took actions according to the messages.
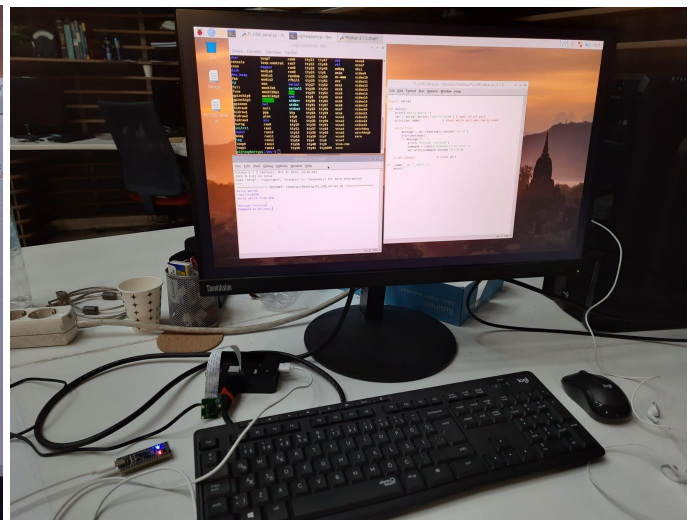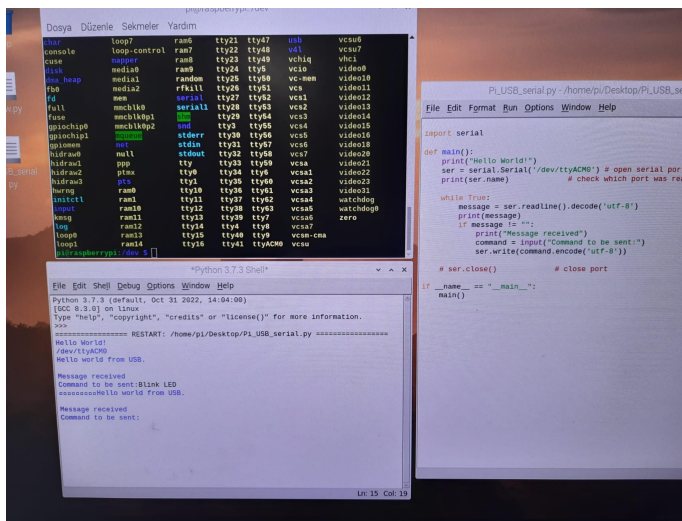
Mechanical Design Parameters

The mechanical structure parameters such as the size of the poles and the limbs are determined this week. The final dimensions are found out to be promising in terms of the applicability. A basic model capturing the exact dimensions is constructed on fusion to check the range without analytically calculating the IK/FK. Results are as expected with a single limitation that is the lower poles are about 21cm from the nearest pole, requirement restricts it to 50 cm however the longer solutions limit the range of movement of the shadow which means that it would hang to another limit that is 45 degrees of the sun approach angle.
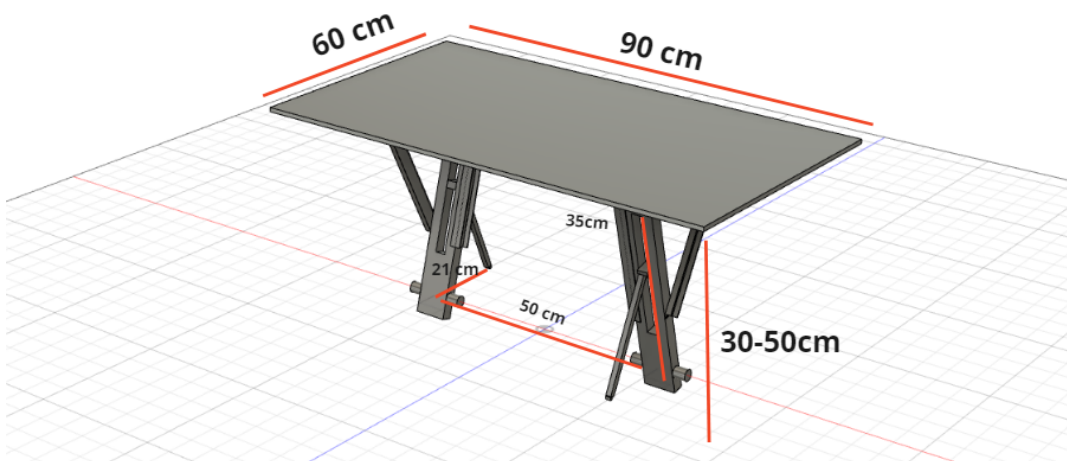
Motor Selection
We also tried our new step motors within our required torque and speed range, but we observed that they cannot withstand that much power and hence their thermal performance is poor. Even though it had advantages in our mechanical system, we decided not to use them and use the other DC motors we had for the final design.

3. Next Week's Plan

Image Processing
We will try to implement the background extraction by correcting the algorithm we worked on this week. Later, we will try to detect the errors by conducting case studies with our algorithm and try to find solutions to each of them.

Communication and Automated Flashing over USB
As explained in this week's work, we plan to automate the code downloading process to the STM32F4's over the USB, which will ease the cumbersome debugging process during system integration. We will first try to communicate with multiple devices simultaneously this week. Then, we will work on this automated flashing task.

CDRR Template
Since we only have two weeks left, we want to produce a template for the CDRR of our project this week. The template will not be extremely detailed, but it will specify what needs to be written or prepared for every section/subsection of the report.