Sundance Weekly Progress Report

Week 6

27.11.2022

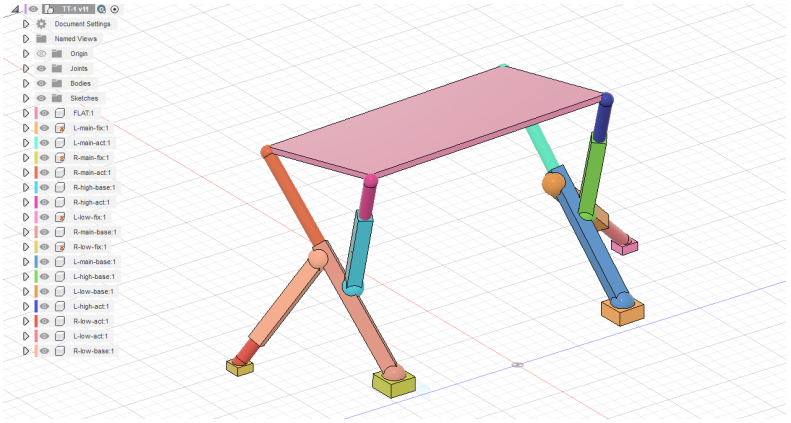
1. Previous Week's Overview

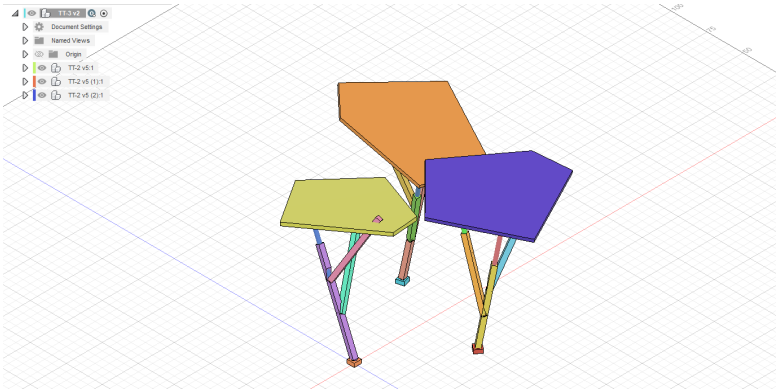
Last week, we experimented on various mechanical structures, and simulated them to explore opportunities for the structural design of the system. We also made general research on the subsystems. Finally, we decided on our main components for the implementation of the subsystems to order the ones we do not already have.

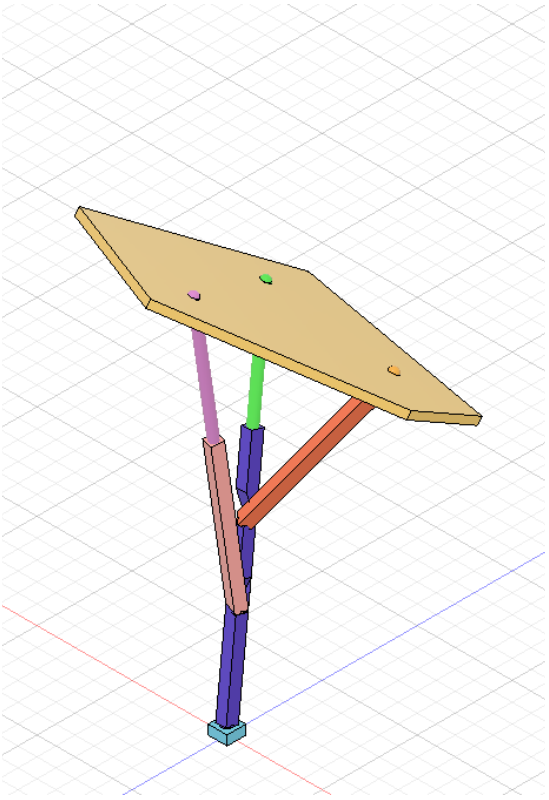
2. This Week's Progress

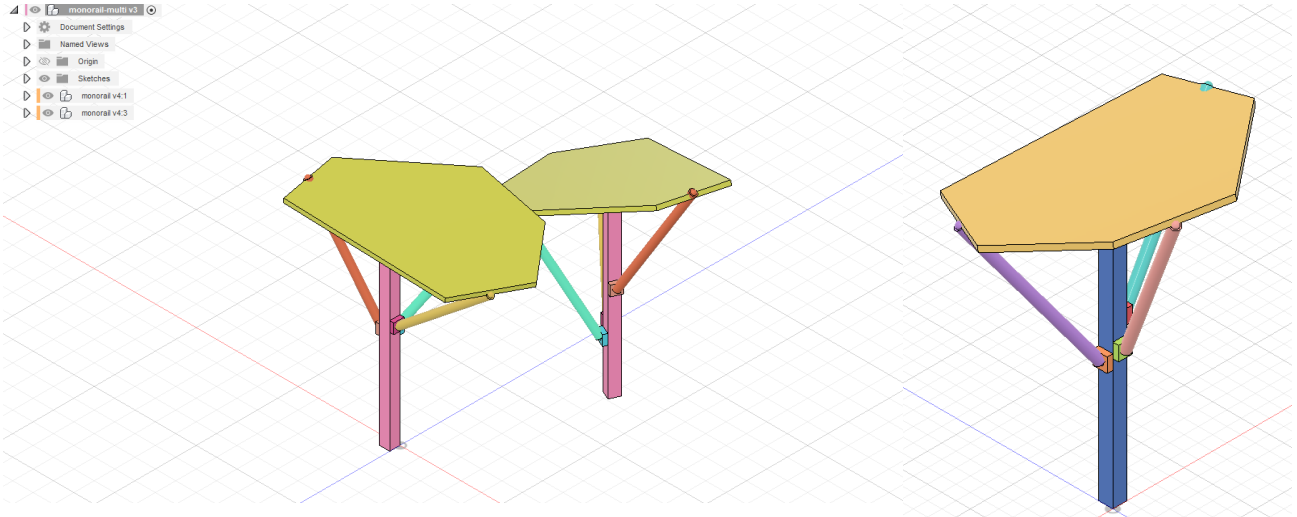
Mechanical Design

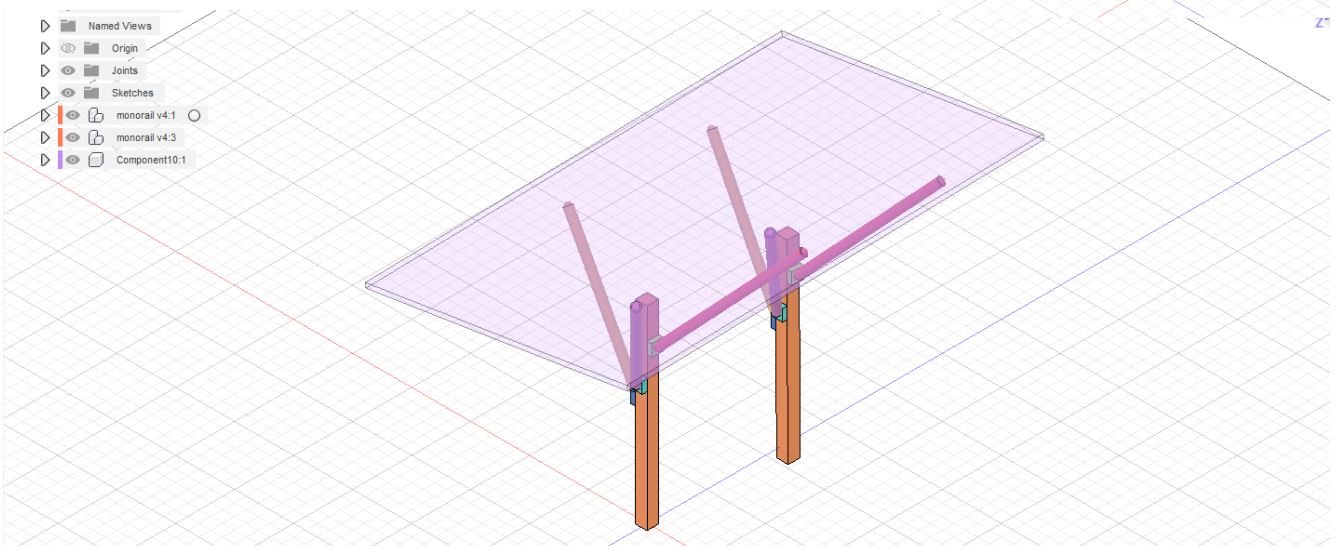
This week, in the mechanical design section, we created different concept mechanisms to translate a plane in space to achieve coverage. The most important observation from last week is that just translation with minimal orientation control is enough. Hence the mechanism search is moved with these observations in mind. Some of the design is more relaxed in terms of movements, and some are more restricted at the start of the next week, we will discuss these explorations thoroughly. Some of the screenshots are below, and a couple more designs on paper will be explored in 3D CAD software.







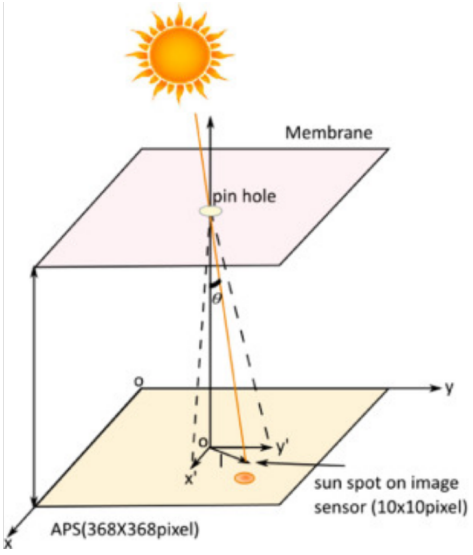


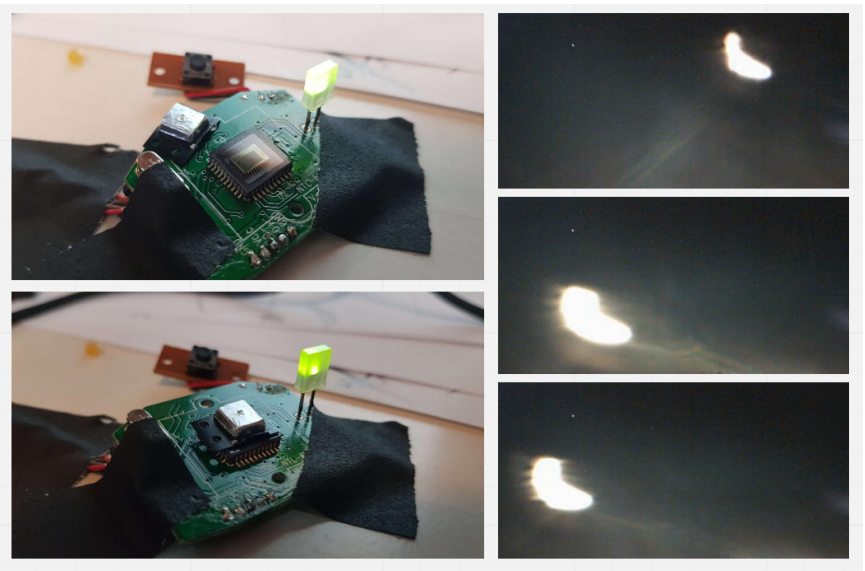


The trend of the design moves into a more single-structure approach rather than the modular, modularisation is idealized to solve the shadow fixation problem. Still, due to restrictions and limitations, we are moving closer to a non-modular canopy.

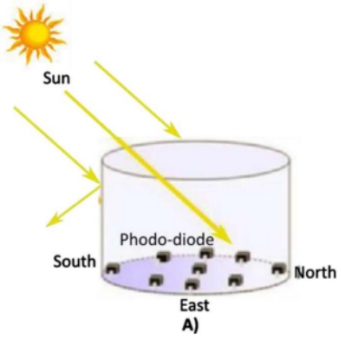
Sun Detection

For sun position detection, we experimented with a 2d pixel array and pinhole approach. An old webcam is disassembled, and a cover with a pinhole is mounted to test the apparatus. The results are promising, and sun detection can be solved in this way in a compact area.

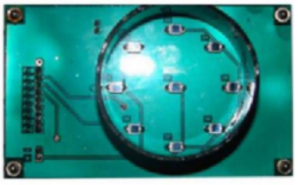




We have also tried different methods.



A)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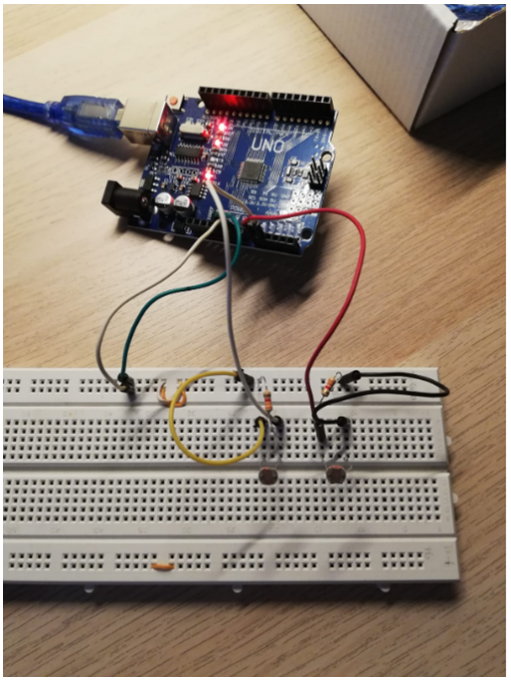
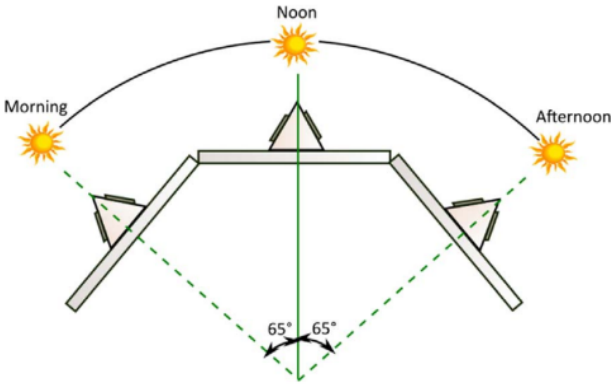
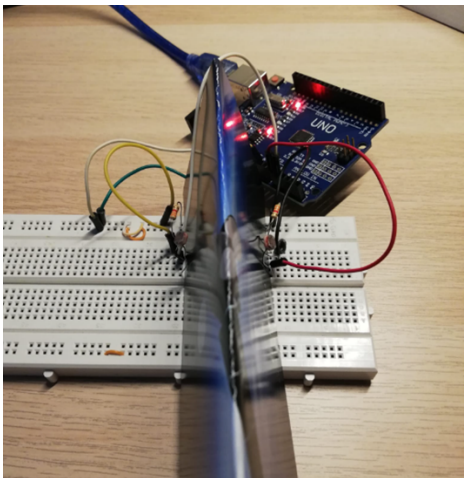


We planned to apply the method seen on the left and constructed the circuit. We realized that when sensors are closer to each other, differences in their resistance is small even though light is applied from right or left. Therefore, detecting the light source's direction becomes impossible. Moreover, when almost even light is applied, differences in the resistances are observed. So, error margin should be defined in the system to eliminate this effect. Moreover, the system is prone to small changes in the orientation.





To experience different sun sensing methods, a simpler version of the method seen on the left is implemented. We have seen that this method is much more efficient. Instead of applying LDR's closer to each other, this system gives more reliable results due to the obstacle between the sensors, which is a shadowmaker.

We have seen from the previous two designs, to obtain more reliable results, the system must be symmetric and orientations of the sensors must be well defined in the design. Small changes in the orientation, changes the result and sensors are not identical in real life. Therefore, we should define error margins to obtain proper operation.

3. Next Week's Plan

Subsystem Implementation
We have two preferred mechanical structures, one of which utilizes a cartesian mechanism and the other one utilizes the monorail mechanism. We will make actuator models for each of them, and try to choose the optimum structure for our system according to our considerations. We will consider ease of implementation of the actuators as well as ease of placing the sensors and the other components of the structure so that the other subsystems are also easier to implement with the chosen structure.

In parallel, we will create inverse kinematics models for the actuators and the whole structure so that we can exactly determine the parameters which will be used during the actuator design. After we create our model, we will try to implement a control algorithm in a simulation program according to a given input.

We will do a broad search on the coverage detection algorithms and design one according to our needs, which is intended to be as simple as possible to reduce computation and complexity of the system. Finally, we will further develop our sun sensing mechanisms to decide which one we will be using.

Test Document
Additionally, we will start writing the test document of the project. This document includes clearly defined test scenarios and procedures of each critical subsystem, which methods will be used to analyze the results of the tests, and empty test tables, which includes spaces for proper measurement that will show the performance of the subsystems and faced errors.