

# Sundance Weekly Progress Report

Week 8

11.12.2022

The Sundance logo, featuring the word "sundance" in a lowercase, sans-serif font, centered within a dark, irregular, cloud-like shape.

## 1. Previous Week's Overview

Last week, we continued to work on two subsystems: actuator control system and coverage detection algorithm. We evaluated some possible mechanical designs and decided to use a monorail actuator system. Moreover, we discussed possible coverage detection algorithms and divided this subsystem into submodules, which are preprocessing and the main processing algorithm.

## 2. This Week's Progress

### ***Preparing Test Documents***

This week, we spent significant time discussing our test procedures. We have already chosen our critical subsystems as actuation and coverage detection subsystems. We decided on how we wanted to implement the coverage detection algorithm by defining the inputs, outputs, and standard objectives of the system. Also, we thought about the test cases in which the detection algorithms could possibly fail. Our algorithm will mostly be based on edge and corner detection using one or multiple cameras. This approach can be sensitive to light intensity and color changes in the environment, as well as the intensity of the source with respect to the other secondary (weaker) light sources in the environment. Hence, our tests will focus on determining the weaknesses and statistical success rate of our algorithm in different conditions. This will be done by using computer generated random and special images, which include many simple and complex shadow patterns, as test cases. Then, our algorithm will be executed for many test cases and a statistical analysis of its success will be investigated.

For the actuator subsystem, we plan to measure its performance by conducting speed measurements, force measurements, and positional accuracy tests. The actuator will be controlled by a closed-loop PID controller. We will vertically load our actuators using gravity on a test setup which will be fixed on a table. Finally, the sun sensing subsystem test procedure is rather straightforward. We will use a camera inside a small box with a pinhole for the sun detection subsystem. It will be tested by fixing our light source on different positions and rotating our sensor to test it in the whole three dimensional space.

Considering all of the subsystems as well as our general system requirements, we prepared the first drafts of our test documents for all the subsystems and the whole system. We tried to include as many details as possible, but the documents will be updated as we progress on subsystem implementation. Before the module test demo day our test documents for the critical subsystems will be finalized.

### ***Bill of Materials for Critical Components***

Since we have one or two weeks for the module demo day, we gathered critical components the list is given below.

- 3D printer filament
- 30×30 mm , 20×20 mm Aluminium Extrusions
- DC motor with Gear and Encoder included (Namiki 22CL-35001PG 80:1)
- Stepper motor and driver ( NEMA17 )
- Various  $\mu$ controllers (arduino, stm32f103, pico etc)
- Raspberry Pi 3B+ with camera
- Lead Screw 400mm x 8mm (in transit)
- GT2 Timing Belt

### 3. Next Week's Plan

Next week, we will finalize our actuator design in terms of a solid model with detail and ready to be produced. Around wednesday it is planned to be in production and the assembly with the initial construction of the test setup is to be made in the weekend.

In parallel to the mechanical system production the coverage detection subsystem is also to be worked on. By the end of Tuesday, we plan to have our first tests on our coverage detection implementation, which will be the simplest case: The case in which only the shadow of the canopy is present. Later on, in the next two days, we will also add the functionality to reject other irregular shadow patterns and handle the shadow occlusions. Finally, we will generate lots of test data and try to analyze them statistically to measure its performance in different conditions and we will get ready for the module test demo.