Automated High-Throughput Acquisition of Roots

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Customer Background

Salk Institute for Biological Studies is a non-profit and biomedicine research institute in San Diego, California. Salk is currently analyzing petri dishes filled with plant roots in different conditions and temperatures. Research that is important in uncovering biological principles, crop productivity and sustainability.
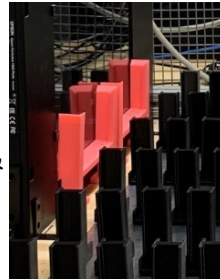
Problem Statement / Scope of Work

Salk needs an automated system that will pick up the petri dishes and scan them. This process will save money and time.
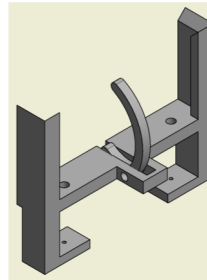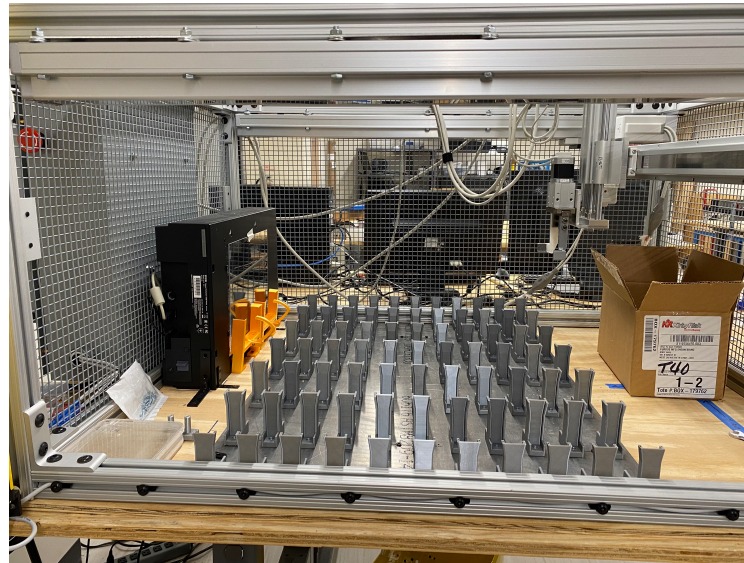
Experimentation and Concepts

Weakness:
- Loose tolerance on plate& scanner
- Tight tolerance on sides

Strengths:
- Cradle springs back in position
- Perfect tolerance for plates
- Easy assemble

FMEA

Requirements

Rep. #	Requirement	Description	Test to Verify
1	Automatically save image in directory with name/date	The Save file must save as the desired settings set by the user	Input a save file directory and name and save the scan
	Rational and Reference	The user needs to be able to find the scans in a simple matter.	
11	HMI	Must display system status	Demonstration by running process
	Rational and Reference	For the operator to know what step in the process is being completed	
18	Plates Per Shelf	At least 48 plates can be loaded under the gantry at one time	Measure plate density to ensure that at least 48 plates can be scanned without human interference
	Rational and Reference	Standard requirement by Salk	
19	Environment Temperature	System must be able to operate in an environment that ranges from 4-38 deg C	Verify that each component selected can operate in the required temperature range.
	Rational and Reference	Temperature requirement for roots to be in optimal condition	
24	Emergency Stop	Safety protocol: A light curtain stops the process when an object is inside of its range (either 30.48 cm or 43.18 cm depending on shelf height).	The light curtain is mounted to the shelf in the lab where the gantry resides. It is verified that if someone breaks the plane of the light curtain by putting their hand into the field that the gantry stops its process.
	Rational and Reference	An emergency protocol which stops the process if someone enters the operating zone	

Final Design

Testing

Test ID	Req. Matrix	Test Name	Specifications & Test Method	Test Description	Outcome
1	4	Calibration	Manual movements	Look at the code and ensure the gripper arm moves back to its home position at the start of operation	Calibration works and operates correctly
4	8	Plate Scan Position`	Visual inspection	When plate has made it to the scanner, does the plate lean up against the scanner for a good scan	Scan is readable and clear
8	18	Plate Number	Count	Plates must be able to fit in the gantry	System scans 48 plates
10	24	E-Stop	Manual movements	Light curtain must be able to stop the machine once tripped	E-stop must be activated
11	28	Size	Measure	Gantry system must fit within specifications by measuring	Gantry dimensions fit within requirements