3D Inspection Rover

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**Interface Control Document**

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Interface Control Document

for

3D Inspection Rover

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# Overview

This document provides information about various characteristics of the rover and how the various components will be placed and interact. The main details explored include the physical characteristics, heat dissipation, electrical system, and communications of the rover and its components.

# References and Definitions

## References

Refer to section 2.2 of the Functional System Requirements document.

## Definitions

CCA Circuit Card Assembly

mA Milliamp

mW Milliwatt

MHz Megahertz (1,000,000 Hz)

TBD To Be Determined

TTL Transistor-Transistor Logic

VME VERSA-Module Europe

# Physical Interface

## Weight

**3.1.1 Weight of Rover Body (~60lbs.)**

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Weight lbs. | Number of Items | Total Weight |
| Body | 10 lbs. | 1 | 10 lbs. |
| Wheels | 1 lbs. | 4 | 4 lbs. |
| Battery | 10 lbs. | 3 | 30 lbs. |
| Motors | 1 lbs. | 4 | 4 lbs. |
| Motor Driver | 0.5 lbs. | 1 | 0.5 lbs. |
| Raspberry Pi | 0.5 lbs. | 1 | 0.5 lbs. |
| HC-SR04 Distance Sensor | 0.1 lbs. | 3 | 0.3 lbs. |

Table 1: Weight of Rover Body

**3.1.2. Camera System**

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Weight | Number of Items | Total Weight |
| Mast (Stepper, rod, bracket) | ~10 lbs. | 1 | ~10 lbs. |
| Sony Real Sense | 10 oz | 1 | 10 oz |
| Gimbal | 5.5 oz | 1 | 5.5 oz |
| STP-DRV-4845 Driver | 10.8 oz | 1 | 10.8 oz |
| HS-485HB Servo Motor | 1.59 oz | 2 | 3.18 oz |

Table 2: Weight of Components External to the Rover Body

## Dimensions

### Dimension of Rover Body

The subsystems of the rover will be contained within the body of the rover itself, which is 29.5 inches long, 27.5 inches wide, and 6 inches tall. The motors are 6.5 x 2 inches, the battery unit is 14 ⅛ x 6 inches, and the raspberry pi is 3 x 2.5 inches.

## Mounting Locations

**3.3.1 Rover Operation Setting**

The inspection rover will be deployed in a greenhouse, organized in a set number of aisles and plants. The aisle should be free of obstacles to allow the rover to traverse smoothly. The rover should receive minimal water exposure to preserve the electronics onboard.

**3.3.2 Placement of Units in the Rover Body**

The rover’s body will contain the motors, motor drivers, batteries, and computer system so that the total size of the rover is minimized, and the center of mass can be lowered. Rover size should be minimized for ease of transportation to and from greenhouses and a low center of mass will allow the rover to operate in rough terrain without worry of tipping over.

**3.3.3 Mounting of Camera**

The camera will be mounted above the rover on a gimbal, which would in turn be placed on a screw drive mounted to the center of the rover. This will give the camera an adequate field of view to successfully analyze the plants.

# Thermal Interface

The rover will not produce enough heat to warrant a cooling system to help manage heat, however, the motor drivers and MCU do have built in heat sinks to reduce the change further. The air surrounding the rover will also be cool enough to allow for the heat to dissipate away without harming the rover and its components.

# Electrical Interface

Figure 1: Block Diagram of Subsystem

Diagram

Description automatically generated

## Primary Input Power

2x12 Volt batteries will be used to power the motors.

1x5 volt battery will be used to power the sensors.

## Voltage and Current Levels

**5.2.1 Maximum Values**

|  |  |  |  |
| --- | --- | --- | --- |
| Component | Voltage | Current | Power |
| 12 V Battery | 12 V | 18 Ah | 216 W-h |
| 5 V Battery | 5 V | 6 Ah | 30 W-h |
| HC-SR04 | TBD | TBD | TBD |
| Raspberry Pi 4 B | 5 V | 3 A | 15 W |
| Real Sense | TBD | TBD | TBD |
| Motor | 24 V | 6 A | 144 W |
| Motor Driver | 24 V | 6 A | 144 W |

Table 3: Maximum Power of Each Device

## Signal Interfaces

  The Raspberry Pi will take input signals as well as output signals to and from sensors, camera, and serve as the overall control unit of the rover.

## User Control Interface

There will be a website that the user will be able to interact with to look at data and the location of plants within the greenhouse.

# Communications / Device Interface Protocols

Diagram

Description automatically generated

Figure 2: Peripheral Devices

## Storage and Data Extraction

The Raspberry Pi will store all the data that is collects during its journey through the greenhouse on an SD card. Once the rover has completed the entire greenhouse, the MCU (assuming it has a Wi-Fi connection) will automatically upload all data to a database and website.

## Video Interface

The camera will be connected to the Raspberry Pi to provide the video and image feed.

## Device Peripheral Interface

The rover will use distance sensors and a camera to track the plants and its current position and use this information to navigate to the next plant.