Heliostat Control Tracking

Samuel Dixon
Jordan George
Erica Quist

INTERFACE CONTROL DOCUMENT

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Interface Control Document
for
Heliostat Control Tracking

Prepared by: Erica, Jordan, Samuel

Erica, Jordan, Samuel 11/16/2022

Author Date

Approved by:

Jordan George 11/16/2022

Project Leader Date

Dr. Kalafatis 11/16/2022

Dr. Kalafatis Date

Dalton Cyr 10/13/2022

T/A Date

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A	9/30/2022	Erica Quist, Samuel Dixon, Jordan George		Draft Release
B	10/13/2022	Samuel Dixon		Removed highlighting and made revisions based on draft feedback

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1. Overview

The Interface and Control Document (ICD) will explore in-depth detail regarding the subsystem information described in the Concept of Operations (ConOps) and Functional System Requirements (FSR) respective documents. This will involve detailing the specific descriptions of the hardware and software being used in this project and how they interface with each other. Lastly, the ICD will give information regarding the characteristics of protocols being used for design.

2. References and Definitions

2.1. References

IEEE Standard 802.11
Standard for WIFI Networks

Android Studio API Online Reference

The other Reference Documents are located in Section 2.2 of the Functional System Requirements document.

2.2. Definitions

API	Application Programmable Interface
DNI	Direct Normal Irradiance
g	Grams
GUI	Graphical User Interface
in	Inches
lbs	Pounds
mA	Milliamp
mW	Milliwatt
V	Voltage
Baud Rate	

3. Physical Interface

3.1. Weight

3.1.1. Weight of PCB Shield and ESP-32 System

Component	Weight
ESP-32 PCB System	13 g
L298n Motor Driver	26 g

Table 1: Weight of PCB Shield and ESP-32

3.1.2. Weight of Battery

Component	Weight
Battery	4.6 lbs

Table 2: Weight of the battery

3.2. Dimensions

3.2.1. Dimension of PCB Shield and ESP-32 System

Component	Dimensions
ESP-32 System	4.00 in x 2.10 in
L298n Motor Driver	1.69 in x 1.69 in x 1.02 in

Table 3: Dimensions of PCB Shield and ESP-32

3.2.2. Dimension of Frame

Component	Length	Width	Height
Frame	48 in	48 in	60 in

Table 4: Dimensions of the frame

3.2.3. Dimension of Mirror

Component	Length	Width	Height
Planar Mirror	12 in	12 in	0.16 in

Table 5: Dimensions of the planar mirrors

3.2.4. Dimension of Battery

Component	Length	Width	Height
Battery	5.94 in	2.56 in	3.70 in

Table 6: Dimensions of the battery

3.3. Mounting Locations

3.3.1. Mounting of Sensors

There will be two magnetometers mounted on the system frame. Also, a photodiode will be mounted to a target that will be used to measure how much of the sun's energy the Heliostat Control Tracking system outputs.

3.3.2. Mounting of Mirrors

The planar mirrors will be mounted onto the frame in a 3x3 array since there will be nine mirrors in this system. Support rails, epoxy, and fasteners will be used to complete this mounting task. The frame will have rotational and tilt capabilities to allow the mirror array to be angled for optimal output of solar energy.

3.3.3. Mounting of ESP-32 Control Unit

The ESP-32 Control Unit will be within a metal box that is mounted on one of the sides of the frame. Most of the circuitry, circuit boards, and wires will be located in this box.

4. Electrical Interface

4.1. Primary Input Power

Component	Max Voltage	Max Current
Battery	12 V	7 A

Table 7: Max Voltage and Current Values for the battery

4.2. Max Voltage and Current Values

Component	Max Voltage	Max Current
ESP-32 Wroom	3.6 V	260 mA
Magnetometer Sensor	12 V	40 mA
L298n Motor Driver	35 V	2 A

Table 8: Max Voltage and Current Values for PCB Shield and ESP-32

4.3. Signal Interfaces

4.3.1. Rotation & Tilt Sensors

A triple axis magnetometer will be used to get the rotation and tilt of the mirror array. This magnetometer will be connected to the ESP-32 mega which will communicate with the Android app to display this data.

4.3.2. Luminosity Sensor

To measure the output of the system, a photodiode will be attached to a target. This target will be set up to receive the outputted solar energy from the planar mirrors. The ESP-32 also will be responsible for relaying the data from this sensor to the Android app to visualize the data. This data will be useful to find the most optimal angle of the mirror array for the highest output.

4.4. User Control Interface

The user control interface is an android application that will provide the user with data visualization and system analytics through bluetooth communication of the ESP-32 and wireless connection to the internet. The bluetooth communication will service instantaneous data received from the ESP-32 and the wireless communication will service historical data accumulated over time.

5. Communications / Device Interface Protocols

5.1. Wireless Communications (WiFi)

In order for the android device to store the sensor data received through bluetooth communication from the microcontroller, it must connect to the internet and upload the data to the particular web server. The device will adhere to the Wireless Communication Protocol as specified in the IEEE Standard 802.11.

5.2. Device Peripheral Interface

The respective TX and RX pins of the microcontroller will be sending and receiving serial data to and from the smartphone though the ESP-32 rover microcontroller. This data received on the pins will be adhering to serial communication protocol, specifically UART. The data being shared between the two devices is asynchronous, meaning the devices do not have their own clocks defining when information is sent or received. Therefore, it is important that these devices adhere to the protocol specifications and agree on a common data sharing rate, which is commonly known as the baud rate.