Robotic Sorting System

Pace Dominy

Joseph Miller

Lam Tran

**Interface Control Document**

REVISION – Draft

25 January 2018

Interface Control Document

for

Robotic Sorting System

Prepared by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Author Date

Approved by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Project Leader Date

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

John Lusher II, P.E. Date

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

T/A Date

**Change Record**

| **Rev.** | **Date** | **Originator** | **Approvals** | **Description** |
| --- | --- | --- | --- | --- |
| **-** | 10/3/2022 | Robotic Sorting System |  | Draft Release |

**Table of Contents**

[**No table of figures entries found.**](#_heading=h.ru8kqc8vhhen) **[5](#_heading=h.ru8kqc8vhhen)**

1. [**Overview**](#_heading=h.snohc17m7ev8) **[5](#_heading=h.snohc17m7ev8)**
2. [**References and Definitions**](#_heading=h.9mhoathqdkun) **[6](#_heading=h.9mhoathqdkun)**

2.1 [References](#_heading=h.5ohvcajgcnbs) [6](#_heading=h.5ohvcajgcnbs)

2.2 [Definitions](#_heading=h.7z44f9x2fcew) [6](#_heading=h.7z44f9x2fcew)

1. [**Physical Interface**](#_heading=h.tyjcwt) **7**

3.1 [Weight](#_heading=h.gxgbit2d7gox) [7](#_heading=h.gxgbit2d7gox)

3.2 [Dimensions](#_heading=h.agp4k1fedvr7) [7](#_heading=h.agp4k1fedvr7)

3.2.1 [Dimension of subsystem name](#_heading=h.jyd36bnk98ct) [7](#_heading=h.jyd36bnk98ct)

3.3 [Mounting Locations](#_heading=h.hg9bqbg640h0) [7](#_heading=h.hg9bqbg640h0)

1. [**Thermal Interface**](#_heading=h.dq93tflazn0q) **[8](#_heading=h.dq93tflazn0q)**
2. [**Electrical Interface**](#_heading=h.l2s0444mpd62) **[9](#_heading=h.l2s0444mpd62)**

5.1 [Primary Input Power](#_heading=h.kj7w7ucmfgoa) [9](#_heading=h.kj7w7ucmfgoa)

5.2 [Polarity Reversal](#_heading=h.uq6i233bmo9h) [9](#_heading=h.uq6i233bmo9h)

5.3 [Signal Interfaces](#_heading=h.nmsyag5i91lo) [9](#_heading=h.nmsyag5i91lo)

5.4 [Video Interfaces](#_heading=h.shvjy03g94j8) [9](#_heading=h.shvjy03g94j8)

5.5 [User Control Interface](#_heading=h.neucg5tz6n5a) [9](#_heading=h.neucg5tz6n5a)

1. [**Communications / Device Interface Protocols**](#_heading=h.onad6hcbzx13) **[10](#_heading=h.onad6hcbzx13)**

6.1 [Wireless Communications (WiFi)](#_heading=h.iow5uf5q6iwh) [10](#_heading=h.iow5uf5q6iwh)

6.2 [Host Device](#_heading=h.eo183iubrn8d) [10](#_heading=h.eo183iubrn8d)

6.3 [Video Interface](#_heading=h.lt11hylxnuhq) [10](#_heading=h.lt11hylxnuhq)

6.4 [Device Peripheral Interface](#_heading=h.mjsp5lrsdu7n) 10

**List of Tables**

No table of figures entries found.

**List of Figures**

No table of figures entries found.

# 

# Overview

This document will provide details on the interfaces of the Robotic Sorting System. There are 4 types of interfaces: physical, thermal, electrical, and communications/devices. Each interface is explained in great detail. The Robotic Sorting System is for the small farmers to quickly validate and sort their fruits by quality standards. This system includes a conveyor belt, two robotic levers/guiding rails, sensors, and an Android application. A Raspberry Pi receives data from the sensors which it uses to control the conveyor belt, control the robotic levers, and provide updates of the system status to the Android application.

# References and Definitions

Provide any references (i.e., standards documents) and definitions. Examples are shown below.

## References

| **Document Number** | **Revision/Release Date** | **Document Title** |
| --- | --- | --- |
| ANSI/NFPA 70 | 2023 | National Electrical Code |
| Bluetooth SIG 5.0 | 06 December 2016 | Bluetooth Core Specification v5.0 |
|  | June 2019 | Raspberry Pi 4 Module B Datasheet |

## 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

* + 1. **Weight of Conveyor Belt System**

The conveyor belt system will weigh no more than 100 lbs in order for the system to be moved without any large machinery.

* + 1. **Weight of Robotic Lever System**

The Robotic Lever system will weigh no more than 20 lbs and will be attached to the frame of the conveyor belt system so as to not interfere with the conveyor belt. The robotic lever arms will be light enough to be supported by the guiding belt as well as to not add unnecessary weight to the overall system. Likewise, the supports will be just light enough to support the guiding arms and guiding belt.

| **Part** | **Weight** |
| --- | --- |
| Lever Arms/Guiding Rails | >8 lbs |
| Guiding Belt | >1 lb |
| Guiding Belt Motor | >1 lb |
| Supports | >10 lbs |

* + 1. **Weight of Printed Circuit Board**

The printed circuit board will weigh less than one pound.

* + 1. **Weight of Sensors**

## Dimensions

### Dimensions of Phone Application

The phone application shall take up no more than 30 MB of space. This will ensure that the system requirements are relaxed, enabling as many Android devices as possible to run the application.

* + 1. **Dimensions of Robotic Lever Arms**

The Lever Arms/Guiding Rails will be approximately 1 ft long in order to reach either end of the belt as well as to prevent from having to make the conveyor belt too long to compensate for longer guiding arms.

* + 1. **Dimensions of Conveyor Belt System**

The conveyor belt will be approximately 2 ft in width while the overall conveyor belt system will be max 2 ft 6 in in width. The conveyor belt will be around 2 ft tall and the length of the conveyor belt will be 6 ft long max.

* + 1. **Dimensions of Power System**

The PCB will be no bigger than 40 . The wiring to and from the PCB will take up as little space as possible and be neatly routed.

* + 1. **Dimensions of Sensors**

## 

## Mounting Locations

* + 1. **Raspberry Pi**

The Raspberry Pi is mounted on the side of the conveyor belt within a protective container.

* + 1. **Lever Arms/Guiding Rails**

The lever arm is mounted on the side of the conveyor belt. One end of the Lever Arm is fixed to the side of the conveyor belt, while the other end is connected to a linear actuator.

* + 1. **Motors**

The motors are mounted at the end of the conveyor belt and the end of the guiding belt.

* + 1. **Camera**

The camera is mounted on the side of the conveyor belt. The camera is also adjusted to point at the conveyor belt.

* + 1. **Weight Sensor**

The weight sensor is mounted on the ends of the conveyor belt and under the receptacles.

# Thermal Interface

* 1. **Raspberry Pi**

The Raspberry Pi will have an attached heatsink. It does not require a cold wall.

# Electrical Interface

## Primary Input Power

Primary input power will be 120 VAC with a current of 15 A. This input is standard in the US and equates to 1800 Watts.

## Signal Interfaces

## Bluetooth Interface

The Android app will connect to the Robotic Sorting System via the Bluetooth 5.0 interface on the Raspberry Pi’s Broadcom BCM2711 processor.

## Picture Interface

* + 1. **Raspberry Pi Camera**

Raspberry Pi camera will be connected to the Raspberry Pi camera port via a ribbon cable.

## User Control Interface

The user will interact with all system functions, including belt control, sorting configuration, and weight readouts, through the provided Android application on an Android smartphone or tablet. The system will also push error messages to the Android app based on the presence of a failure condition as described in paragraph 3.2.5 of the project Functional System Requirements document.

# Communications / Device Interface Protocols

## Wireless Communications (Bluetooth)

The Bluetooth connection between the Android device and the Raspberry Pi used in the Robotic Sorting Machine shall be established and used under the Bluetooth Core Protocol, version 5.0.

## Host Device

i.e., USB 3.0

## Raspberry Pi Input/Output

Raspberry Pi will take input power from the PCB and output controller signals from the GPIO pins back to the PCB, specifically to the motor controllers. Raspberry Pi will also take input from the Raspberry Pi camera.

## Image Interface

Reference Robotic Sorting System ICD Section 5.4.1