Verification and Validation Report: The Nursery Project

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1 Revision History

Date	Version	Notes
2023-03-08	1.0	Initial Revision

2 Symbols, Abbreviations and Acronyms

symbol	description
ART	Accessibility Requirements Test
CR	Conveyor Functional Requirement
CST	Conveyor Subsystem Test
EPET	Expected Physical Environment Test
LCD	Liquid-Crystal Display
LED	Light Emitting Diode
LRT	Learning Requirements Test
MG	Module Guide
MIS	Management Information Systems
NFR	Non-Functional Requirement
PDST	Pot Dispenser Subsystem Test
PDR	Pot Dispensing Functional Requirement
PCST	Pot-pulator Complete System Testing
PT	Precision Test
RT	Reliability Test
SCT	Safety Critical Test
SRS	Software Requirements Specification
SRT	Speed Requirements Test
TDST	Tray Dispenser Subsystem Test
TDR	Tray Dispensing Functional Requirement
VST	Verification Subsystem Test
VR	Verification Functional Requirement

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3 Functional Requirements Evaluation

3.1 Pot-pulator Complete System Testing

Test Number	Description	Input	Expected Output	Actual Output	Result
PCST-01	Tray Dispenser Operation	Sensor reading of status of tray stack	Normal system operation	Normal system operation	Pass
PCST-02	On Switch for Tray Dispenser Error				

Table 1: PCST Evaluation

This section will not be appropriate for every project.

6 Unit Testing

6.1 Hardware Testing

The following section includes testing that was performed on critical hardware components of the system. These tests were performed for the purpose of verifying and understanding the behaviour of each hardware component.

1. HT-01: **AC Motor Control**

   Test Description: The conveyor operates using an AC motor. In order to control it, a potentiometer and mechanical relay were used. The

potentiometer controls the motor speed, and the relay controls on/off rotation of the motor.

Input: Signal from Arduino to periodically switch the relay. Potentiometer position varies.

Expected Output: Conveyor starts and stops based on the switching of relay. The speed of conveyor slows and speeds up in accordance to the potentiometer.

Test Result: PASS

2. HT-02: **Stepper Motor Control**
   Test Description: Many subsystems of the Pot-pulator uses stepper motors (ie. tray dispenser,pot dropper). Stepper drivers were wired and tested with step sizes that were offered by the drivers purchased.

   Input: Signals from Arduino to turn the motor 1 full revolution in full, half, quarter, eighth, and sixteenth stepping modes.

   Expected Output: 1 full revolution

   Test Result: PASS

3. HT-03: **Ultrasonic Range Finder Control**
   Test Description: These sensors are used to meaure distances within the system for complete operation. Measurements were observed and verfied with a physical measuring tool (ie. ruler, tape measure)

   Input: Object placed in front of the sensor.

   Expected Output: Distance measured and displayed in the serial monitor (console).

   Test Result: PASS

7 Changes Due to Testing

7.1 Tray Dispenser Subsystem

7.2 Pot Dispenser Subsystem

7.3 Conveyor Subsystem

7.4 Verification Subsystem

The bases of the verification mounts were recently expanded away from the conveyer by approximately 5 cm on either side, to address issues with the performance of the ultrasonic sensor along the conveyer belt system. The limitations were identified in the sensor's ability to accurately read values when the trays being measured were too close to the sensor as they moved down the conveyer belt.

The minimum distance that an ultrasonic sensor can measure accurately depends on its design and specifications. In general, most ultrasonic sensors have a minimum range of around 2-3 cm, but this can vary depending on factors such as the sensor's frequency, beam width, and sensitivity. In this application, a 5 cm range worked best. When the first design was implemented, the ultrasonic sensors were mounted directly above the edges of the conveyer belt, resulting in the pots becoming almost directly flush to the sensors when moving down the conveyer belt. In this case, the sensor was not able to effectively detect objects at very close range due to limitations in its design or sensitivity.

To overcome this limitation, the base of the verification mounts was expanded, therefore increasing the distance between the sensor and the trays being measured. This improved the accuracy and reliability of the measurements being collected to ensure that the data generated by the system was of the highest quality possible.

Appendix — Reflection

The information in this section will be used to evaluate the team members on the graduate attribute of Lifelong Learning. Please answer the following questions:

1.

2.