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

Table 1: PCST Evaluation

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	Pot-pulator switch set to on	Normal system operation	Normal system operation	Pass
PCST-03	Pot Dispenser Operation	Sensor reading of status of pot stack	Normal system operation	Normal system operation	Pass
PCST-04	On Switch for Pot Dispenser Error	Pot-pulator switch set to on	Normal system operation	Normal system operation	Pass
PCST-05	Conveyor Operation	Tray placed on conveyor	Normal system operation	Normal system operation	Pass
PCST-06	Conveyor On Button	Pot-pulator switch set to on	Normal system operation	Normal system operation	Pass

3.2 Tray Dispenser Subsystem Testing

Table 2: TDST Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result

TDST-01	Tray Stack Detection	Sensor reads status of tray stack	Signal sent to microprocessor indicating trays are/are not present	Signal detected indicating presence of trays, no signal detected when trays are not present	Pass
TDST-02	Operation from Tray Stack Detection	Sensor reads status of tray stack	Normal system operation	Normal system operation	Pass
TDST-03	Tray from Stack to Conveyor	Stack of trays on tray dropper	One tray from stack is placed onto conveyor, next tray ready to be placed onto conveyor	One tray from stack is placed onto conveyor. Occasionally, two trays will be placed if there are only two remaining in the tray stack	Fail
TDST-04	Verify Tray Status on Conveyor	Sensor reads status of tray on conveyor	Normal system operation	Tray dropper drops additional tray once first tray is no longer underneath tray dropper	Pass

3.3 Pot Dispenser Subsystem Testing

Table 3: PDST Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result

PDST-01	Pot from Stack to Tray	Simulated sensor input, two pot locations of tray directly below pot dispenser	Pot dispenser dispenses two pots into designated pot locations	Pot dispenser dispenses two pots, 70% of cases tested saw pots dispensed into pot locations	Fail
PDST-02	Tray Sensing	Trays placed in front of sensor	Signal sent to microprocessor indicating trays are/are not present	Signal detected indicating presence of trays, no signal detected when trays are not present	Pass
PDST-03	Ability to Dispense 4" Diameter Pots	N/A	N/A	N/A	Pass
PDST-04	Ability to Store/Dispense Multiple Pots	Ten pots, simulated sensor input	Pot dispenser dispenses two pots, reloads from stack, dispenses two pots, etc. until pot storage is empty	Pot dispenser dispenses two pots at a time for 5 cycles until all 10 pots are dispensed	Pass
PDST-05	Pot Storage Detection	N/A	Signal output when no pots are detected in pot storage	Signal output when no pots are detected in pot storage	Pass

3.4 Conveyor Subsystem Testing

Table 4: CST Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
CST-01	Conveyor Ability to Move Trays	Simulated inputs indicating conveyor can start	Constant speed of conveyor motor and belt	Constant speed of conveyor motor and belt	Pass
CST-02	Conveyor Ability to Stop	Simulated signals from pot dispenser indicating tray is beneath pot dispenser	Conveyor motor and belt come to a stop	Conveyor motor and belt come to a stop	Pass
CST-03	Conveyor Belt Friction	Mass of tray, tilt angle of conveyor belt	Maximum acceleration of conveyor belt	Maximum acceleration of conveyor belt	Pass

3.5 Verification Subsystem Testing

Table 5: VST Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result

VST-01	Verify Correct Number of Pots in Tray	Tray filled with pots and tray not filled with pots	Signal sent indicating tray has not been completely filled with pots, no signal sent indicating all pot locations are filled	Signal sent indicating tray has not been completely filled with pots, no signal sent indicating all pot locations are filled	Pass

4 Nonfunctional Requirements Evaluation

4.1 Safety Critical Testing

Table 6: SCT Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
SCT-01	Tray Dispenser Failure	Tray dispenser disconnect	System flags tray dispenser failure	System flags tray dispenser failure	Pass
SCT-02	Pot Dispenser Failure	Pot dispenser disconnect	System flags pot dispenser failure	System flags pot dispenser failure	Pass
SCT-03	Conveyor Failure	Conveyor disconnect	System flags conveyor failure	System flags conveyor failure	Pass
SCT-04	Verification Failure	Verification disconnect	System flags verification failure	System flags verification failure	Pass

4.2 Precision Testing

Table 7: PT Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
PT-01	Tray Dispenser Precision	N/A	N/A	N/A	Pass
PT-02	Pot Dispenser Precision	N/A	N/A	N/A	Pass

4.3 Reliability Testing

Table 8: RT Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
RT-01	Function Under Vibration	N/A	N/A	N/A	Pass

4.4 Expected Physical Environment Testing

Table 9: EPET Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
EPET-01	Function Under Aerial Pollution	N/A	N/A	N/A	Pass

4.5 Speed Requirements Testing

Table 10: SRT Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
SRT-01	Acceleration Displacement of Trays	N/A	N/A	N/A	Pass
SRT-02	Pot Dispensing Rate	Stack of pots	Pots dispensed at desired rate	Pots dispensed at desired rate	Pass
SRT-03	Tray Dispensing Rate	Stack of trays	Trays dispensed at desired rate	Trays dispensed at desired rate	Pass

4.6 Learning Requirements Testing

Table 11: LRT Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
LRT-01	Operational Simplicity	N/A	N/A	N/A	Pass

4.7 Accessibility Testing

Table 12: ART Evaluation

Test Number	Description	Input	Expected Output	Actual Output	Result
ART-01	Audio and Visual Indicators	Trigger signal	Corresponding light, sound, or screen display	Corresponding light, sound, or screen display	Pass

5 Comparison to Existing Implementation

This section will not be appropriate for every project.

6 Unit Testing

7 Changes Due to Testing

The changes due to testing are summarized below:
1. 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 pots being too close to the sensor when travelling down the conveyer, resulting in inaccurate readings.

8 Automated Testing

9 Trace to Requirements

The following table outlines all of the system tests and how they relate to the relevent requirements. The requirements can be referenced in the SRS document.

Table 13: Corresponding Test IDs and Requirements

Test ID	**Supporting Requirements**
TDST-01	TDR3, TDR5
TDST-02	TDR4, TDR5
TDST-03	TDR2
TDST-04	TDR2
PDST-01	PDR2
PDST-02	PDR2
PDST-03	PDR3
PDST-04	PDR4
PDST-05	PDR5, PDR6
PCST-01	TDR1
PCST-02	TDR5, TDR6
PCST-03	TDR7

PCST-04	PDR1
PCST-05	PDR6, PDR7
PCST-06	PDR8
PCST-07	CR1
PCST-08	CR5
PCST-09	CR6
VST-01	VR1
VST-02	VR2
SCT-01	NFR12
SCT-02	NFR12
SCT-03	NFR12
SCT-04	NFR12
PT-01	NFR13
PT-02	NFR14
RT-01	NFR17
EPET-01	NFR20
LRT-01	NFR6
ART-01	NFR7
SRT-01	NFR8
SRT-02	NFR9
SRT-03	NFR10

10 Trace to Modules

11 Code Coverage Metrics

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.