

Hazard Analysis The Nursery Project

Team #, Team Name

Student 1 name

Student 2 name

Student 3 name

Student 4 name

Table 1: Revision History

Date	Developer(s)	Change
Date1	Name(s)	Description of changes
Date2	Name(s)	Description of changes
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1 Introduction

This document is the hazard analysis of the Pot-Pulator. This machine will be built for Sheridan Nurseries, filling trays with pots, preparing them to be populated with soil and seeds, to reduce the manual labour of the workers at the farm. The hazard analysis will consider each part of the Pot-Pulator, including the respective tray and pot droppers, the sensor verification section, and the conveyer belt.

The definition of a hazard used in this document is any issue or property in the Pot-Pulator that will cause a risk to the ideal result of the system. In this system, most hazards will be concerning safety of the workers collecting the trays at the end of the conveyer, and the effectiveness of the verification system.

This document will include the Scope and Purpose of Hazard Analysis, System Boundaries and Components, Failure Mode and Effect Analysis, and Safety & Security Requirements.

2 Scope and Purpose of Hazard Analysis

The scope of this document is to identify the components of the Pot-Pulator that could have harmful consequences to the users or the results and reduce each risk to a level where the overall system will be safe and acceptable.

Hazards will be analyzed based on research of similar systems, and any specific hazards occurring throughout the development process of the machine.

3 System Boundaries and Components

The hazard analysis will be conducted based on the Pot-Pulator, which is restricted to the components below.

1. Conveyer belt
2. Tray allocation
3. Pot dropping
4. Verification system

The hazard analysis will be based on these critical elements of the system. The system boundary includes a conveyer belt moving the system along, tray allocation to place the trays on the conveyer, a pot dropper to place the pots into the trays, and a verification system to confirm the correct placement of the components.

The conveyer belt will be controlled by a sensor based on the other components. At the end of the process, the conveyer belt will bring the completed trays to the end of the line, to be collected by a worker. This will all be accounted for in the hazard analysis.

4 Critical Assumptions

There are no critical assumptions for this system.

5 Failure Mode and Effect Analysis

Component	Failure Mode	Effect of Failure	Cause of failure	Recomended action	SR	Ref
Tray Dispensing	Tray is not dispensed	Machine is unable to continue operation, tray may be damaged	(a) Tray stack software/hardware failure (b) Tray dispenser software/hardware failure (c) Parts failure	(a) Sensor will recognize if tray has not been dispensed, error message will be displayed and operator will be notified. (b) Refer to H1-1a (c) Refer to H1-1a		H1-1
	Trays placed incorrectly on conveyor	Tray is unable to move forward on conveyor, pot dispenser is unable to place pots correctly. May damage pots/trays	Tray dispenser software/hardware failure	Guiding rods will be placed on the conveyor to centre trays into correct position. If trays are unable to move forward, error message will be displayed and operator will be notified.		H1-2

	Trays dispensed are stacked, 2+ trays dispensed at once	Tray storage becomes out of sync with pot storage, may damage pots/trays	(a) Parts failure (b) Trays loaded incorrectly	(a) Sensor will recognize if multiple trays have been dispensed, error message will be displayed and operator will be notified (b) Operator will be trained to properly load trays into machine"	H1-3
	Tray dispenser damages tray	Tray is unable to hold pots and be sent for distribution (will depend on severity of damage to tray)	Quality issue in trays	Operator will be trained to perform 60 second visual check of Pot-pulator, trays, and pots before each refill to note and eliminate trays with any noticeable defects	H1-4
Pot Dispensing	Pots are not dispensed	Tray will be dispensed empty	Software/hardware failure	Sensor post pot dispensing will sense that the tray has not been populated, error message will be displayed and operator will be notified	H2-1

<p>Pots dispensed are not flush with tray openings</p>	<p>Pots will be damaged by Pot-pulator or soil filling machine</p>	<p>(a) Software/hardware failure (b) Quality issue in pots (c) Quality issue in trays</p>	<p>(a) Sensor will recognize that pot is not flush with tray opening, error message will be displayed and operator will be notified (b) Operator will be trained to perform 60 second visual check of Pot-pulator, trays, and pots before each refill to note and eliminate pots with any noticeable defects (c) Refer to H1-4</p>	<p>H2-2</p>
<p>Pots dispensed when tray is not present</p>	<p>Pot storage becomes out of sync with tray storage</p>	<p>Software/hardware failure</p>	<p>Sensor will recognize if pots are dispensed without tray present, error message will be displayed and operator will be notified</p>	<p>H2-3</p>

	Pots dispensed are stacked	Pots will be damaged by Pot-pulator or soil filling machine	<ul style="list-style-type: none"> (a) Parts failure (b) Pots loaded incorrectly 	<ul style="list-style-type: none"> (a) Sensor will recognize if multiple pots have been dispensed, error message will be displayed and operator will be notified (b) Operator will be trained to properly load pots into machine 	H2-4
	Pot dispenser damages pots	Pots are unable to be filled with soil and sent for distribution	Quality issue in pots	Refer to H2-2b	H2-5

Conveyor	Conveyor does not move	Tray is unable to move to soil filling machine, trays may be damaged	(a) Software/hardware failure (b) Parts failure	(a) Sensor will recognize if conveyor is not moving for extended period of time, error message will be displayed and operator will be notified (b) Operator will be trained to perform 60 second visual check of Pot-pulator before pots and trays refill to note any damage to conveyor or belt wear	H3-1
	Conveyor does not stop when it is meant to	Pots are unable to be placed properly in trays, pots and/or trays may be damaged	Software/hardware failure	If tray is in view of pot dispenser, refer to H2-2a. If tray is not in view of pot dispenser, refer to H2-3	H3-2

	Trays slide on conveyor when conveyor is accelerating/decelerating	Pots are unable to be placed properly in trays, trays may be damaged	(a) Software/hardware failure (b) Belt failure	(a) Sensor will recognize if conveyor is accelerating/decelerating at a magnitude greater than specified, error message will be displayed and operator will be notified (b) Refer to H3-1b	H3-3
	Conveyor is unable to reach desired speed	Machine is unable to meet production standards	(a) Software/hardware failure (b) Parts failure	(a) Sensor will recognize if conveyor is not reaching desired speed for extended period of time, error message will be displayed and operator will be notified (b) Refer to H3-1b	H3-4

Verification System	Tray with less than 10 pots passes through verification system	Trays are unable to be sent for distribution, trays are wasted, pot and tray storage will become out of sync	<ul style="list-style-type: none"> (a) Software/hardware failure (b) Verification sensors are obstructed/damaged 	<ul style="list-style-type: none"> (a) Soil machine operator will be inspecting all trays leaving the soil machine. If a tray with less than 10 pots is identified, soil machine operator will be trained to manually stop Pot-pulator (b) Operator will be trained to perform 60 second visual check of Pot-pulator before pots and trays refill to note any obstructions/damage to sensors 	H4-1
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	Verification system does not stop machine process when required to	Trays are unable to be sent for distribution, may cause damage to trays	(a) Software/hardware failure (b) Verification sensors are obstructed/damaged	(a) Refer to H4-1 (b) Refer to H4-2	H4-2
General	Person comes into contact with moving parts of machine	Potential risk of serious injury or death	(a) Operator wearing loose clothing or jewellery (b) Operator places hand in machine during operation	(a) Moving parts will be covered and protected. Operators will complete safety training before operating the Pot-pulator (b) Refer to H5-1a	H5-1
	Person comes into contact with electronics of machine	Potential risk of serious injury or death	Operator makes accidental contact with electrical wiring or electronics of machine	Electrical equipment and electronics will be covered and protected. Operators will complete electrical safety training before operating the Pot-pulator	H5-2

6 Safety and Security Requirements

[Newly discovered requirements. These should also be added to the SRS. (A rationale design process how and why to fake it.) —SS]

7 Roadmap

There were some new non-functional requirements (safety and security) discovered, after performing hazard analysis on the system. The safety and security requirements that will be implemented in the future beyond the timeline of the capstone are SR7, SR10, and SR12. These requirements will be apart of a future implementation due to time-related and financial reasons. The remaining non-functional requirements related to safety and security will be implemented within the timeline the capstone project.