2024S1-2238: 3D Printer part removal using Sensitive Robots and Intelligent Grippers (Smart Manufacturing)
ENG/FIT4701 Project Proposal

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Project type: Consultancy

1 Introduction

In the realm of Engineering education at Monash University, a significant number of 3D printed components are currently integrated to support project completion and task fulfilment. Despite the existing non-automated farm setups in Makerspaces and Innovation Hubs showcasing the capability for large-scale 3D part production, there remains substantial room for efficiency enhancement. The independent operation of each printer necessitates students to dedicate a considerable amount of time to locate available printers, queue for printing access, and await the completion of their parts, often without the ability to monitor the printing progress.

These challenges served as a catalyst for the development of an automated 3D printing farm system dubbed "Matrix." The Matrix system will incorporate a H-gantry structure positioned at the forefront of a frame housing eight Prusa XL 3D printers, each to be equipped with a mechanism for the automatic removal of printer bed sheets. Control of all printers, gantry system motors, and the sheet removal device will be facilitated through a user-friendly touchscreen interface. This configuration enables real-time monitoring of each printer's progress within the frame and the remote assignment of new printing tasks utilising the advanced features of the Prusa XL printers.

In scenarios where an object is completed or a replacement is required, the system will orchestrate the movement of a removal device within the vertical plane defined by the gantry structure. Through the extension of the removal device, printed parts and sheets will be seamlessly extracted, with a new sheet promptly replacing the previous one. This meticulous process will ensure the uninterrupted and efficient operation of all printers within the system. With its intricate design and scalability potential, the Matrix system will represent a significant advancement in 3D printing technology. The current project focus revolves around the construction of the automated system, laying the foundation for its integration into the educational landscape at Monash University.

2 Aims and Objectives

2.1 Aims

Overall Aim:

To design and develop an advanced gantry system that automates key processes within a 3D printing farm, significantly enhancing operational efficiency, specifically targeting improvements in material handling and maintenance protocols.

Supporting Aims:

- To engineer a gantry system capable of interfacing with multiple 3D printers, automating tasks such as the transfer of print materials, removal of finished products, the execution of maintenance protocols, and providing real-time updates and maintenance alerts to users.
- To establish a comprehensive suite of automated functions within the gantry system, including the transfer of materials, removal of finished products, and execution of essential maintenance tasks, thereby demonstrating practical applications in a Smart Manufacturing environment.
- To iteratively engineer and refine tools and end-effectors for the gantry system, ensuring optimal performance in material handling and maintenance operations.

2.2 Objectives

Phase 1:

Design and Development:

- To design a H-gantry system with an x-y setup that enables the tool head to navigate the entire operating area, focusing on the integration of transmission structures for vertical movement (YZ axis).
- To evaluate and determine the gantry system's optimal movement patterns and speeds, ensuring efficient operation while minimising the risk of disrupting ongoing print jobs.
- To construct a panel removal device that can safely and effectively detach printed parts from the print bed, incorporating solutions like robotic arms and gripping tools optimised for 3D printers.
- To develop a modular and scalable design for the gantry system, allowing for easy integration into different sizes and configurations of 3D printing farms, and enabling future upgrades and expansions.

Phase 2:

Control System Integration:

- To program a PLC (Programmable Logic Controller) that interfaces with the lab's server, ensuring the gantry system can receive precise instructions on operational tasks, thereby meeting functional requirements.
- To develop a Human-Machine Interface (HMI) that allows manual control of the gantry system, enhancing usability and providing a backup control mechanism.

Safety and Efficiency Enhancements:

- To implement safety features including electromagnet locks for operational drawers, barriers to ensure no person is near the gantry during operation, and LEDs for operational visibility and safety alerts.
- To integrate force detection technologies to prevent collisions and ensure the safety of both the system and the operators.

Operational Protocols and Automation:

- To ensure the gantry system can operate within predefined speeds for efficient material transfer, accurately monitor its position, and attach tools necessary for maintenance tasks.
- To design the system with the capability to be showcased as part of a digital twin lab, demonstrating its functionality and integration within a smart manufacturing environment.

Budget and Performance Optimization:

- To adhere to financial constraints ensuring the gantry system is cost-effective.

- To evaluate and refine the system's performance through testing and iteration, ensuring it meets the high-level requirements for efficiency, safety, and integration capabilities.

Phase 3:

Testing and Evaluation Objectives:

- Simulate various operational scenarios to test the responsiveness and effectiveness of the gantry system in real-world manufacturing conditions.
- Evaluate the system's performance, identifying areas for improvement and refinement to meet predefined efficiency and reliability metrics.
- Document the integration process, challenges encountered, and solutions developed, providing a comprehensive case study on the gantry system's impact on operational efficiency and automation capabilities.

Feedback and Iteration Objectives:

- Collect feedback from system users and analyse system performance data to identify opportunities for further enhancements.
- Apply iterative improvements to the gantry system, focusing on increased automation, efficiency, and user-friendliness

3 State of the Fields

3.1 3D Printing with Manufacturing and Education

3D printing, representative of additive manufacturing, is propelling the manufacturing industry into the next era. Additive manufacturing stands in stark contrast to traditional manufacturing methods by its ability to fabricate complex, tailor-made products more swiftly and at reduced costs [1].The future potential of AM is discussed in the context of its expanding role in modern manufacturing and the development of new applications in multiple fields[2].3D printing technologies employ a diverse array of materials, including polymers, metals, and ceramics, each serving distinct industrial requirements effectively. The application spectrum of these materials in 3D printing is vast, spanning from medical implementations such as prosthetic devices and heart valve scaffolds to industrial uses in the automotive and aerospace sectors, highlighting the versatility and adaptability of 3D printing methods in contemporary manufacturing processes [3].

For current engineering students at Monash University, utilizing 3D printing to fabricate prototypes and complete projects has become an essential aspect of their educational experience. The application of 3D-printed models substantially improves the visualization and comprehension of engineering principles, thereby enhancing learning outcomes in fields such as manufacturing, maintenance, logistics, and operations [4]. In a similar vein, the farm actively enhances both educational and research pursuits by enabling students to apply theoretical knowledge practically. Through its ongoing expansion, which includes the acquisition of more high-performance machines, the farm has significantly boosted its capacity. This growth has empowered students to produce detailed models and components, further melding hands-on practice with their academic studies [5]. Consequently, the initiative to develop an automated system that augments the efficiency with which engineering students access the necessary parts is both necessary and meaningful.

3.3 Existing Complete Machine Reference

Prusa AFS

The best reference system currently available is Prusa AFS. This system can achieve most of the functionalities required, with a very high level of integration and completeness. However, the problem with this system is that it has chosen smaller, more basic printers to fit more units into a reasonable overall volume, which goes against the original intent of controlling eight PRUSA XLs and has potential issues [6]. It is impractical to purchase this system directly due to the high cost.

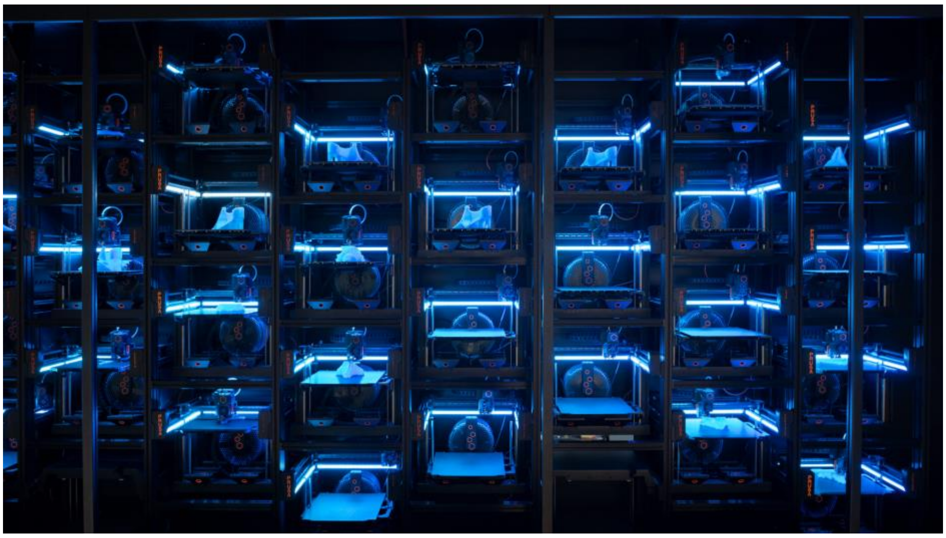

Figure 1 - Prusa AFS

Mosaic Manufacturing

Mosaic Manufacturing also has a similar system called Array, which can achieve efficient batch printing. However, this solution supports its own printers and control systems and lacks expandability [7].

Figure 2 - Mosaic Array

Robot-based Automation 3D Printer Farm

Another complete system is the Robot-based Automation 3D Printer Farm, created by Ali Aburaia [8]. This system has a large robotic arm set up above the entire frame to replace the printer sheet and can be monitored and managed through a terminal. However, due to space constraints, the frame in the Lab that holds the printers is almost touching the ceiling, making it impossible to accommodate a mechanical arm on top, so this plan was also abandoned.

Figure 3 - Robot-based Automation 3D Printer Farm

3.4 Vertical Gantry System

CoreXY

The initial consideration was for a CoreXY structure. CoreXY is a technology widely used in desktop 3D printers for rapid and precise operations. The key to this structure lies in its belt layout and movement method. In this configuration, two stepper motors are typically fixed on the printer's frame, rather than attached to the moving print head. These motors control the movement of the device through a series of complex belt configurations. The belts are intertwined and fixed in a specific manner to ensure that the print head can move precisely along the X and Y axes, independent of the print bed [9]. However, this structure can only be horizontally oriented because the objects are pulled in a crisscrossing manner by the two belts. When this structure is positioned vertically, the forces pulling the device up and down are different. Since the movement of the two motors simultaneously affects the device, this can pose a risk of instability for the structure.

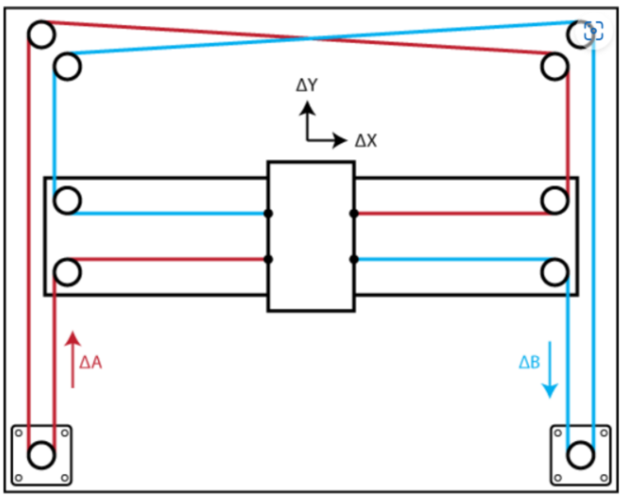

Figure 4 - CoreXY Theory

H-Gantry

During the background investigation, two types of H-gantry structures were identified. Since no formal names were found for distinction, they are temporarily named non-fixed H-gantry and fixed H-gantry.

Non-fixed H-gantry

The non-fixed H-gantry system has a motor on each of the three bars of this H-shaped structure, with two horizontal bars controlling the device's horizontal movement via belts. The vertical bar's motor controls the device's vertical movement [10]. This mechanism is very simple and straightforward, making it easy to build. However, since our design requirements specifically stated that motors must be fixed in place to ensure safety and stability, this system with non-fixed motors was not adopted.

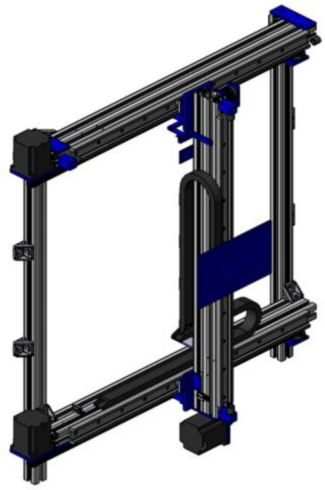

Figure 5 - A non-fixed H-gantry Product

Fixed H-gantry

The fixed H-gantry was ultimately considered suitable for this project. The H-gantry described in the document operates using a unique parallel drive configuration with a single belt. This setup involves two stationary motors that remain fixed. At the same time, their rotational movement is converted into linear motion along two axes—X and Y—via a series of pulleys and a timing belt. The system is designed as an "H", where the belt is routed around eight pulleys: two on each end of the parallel tracks and four on a moving bridge, which spans the two tracks [11][12]. Because the device's vertical movement is controlled by only one motor, its vertical motion stability is greatly enhanced.

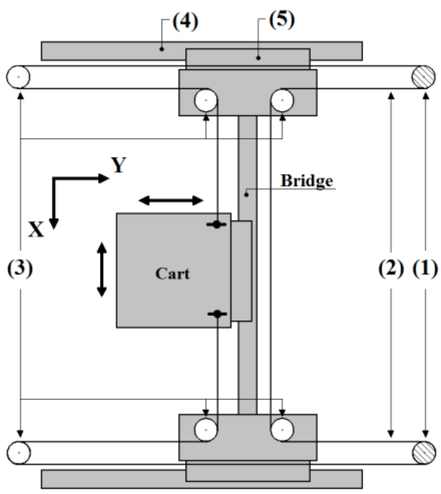

Figure 6 - Fixed H-gantry Theory

3.5 Removing the Print Sheet

Part Removal Only

For desktop printers, a more primitive method involves tilting the printer so that when printing is complete, the sheet is bent to loosen the connection between the printed part and the sheet. Then, using the weight of the part itself, it can slide off or be pushed off the platform by controlling the print head, achieving the goal of collection [13]. However, tilting the printer itself can affect the quality of the printing. Additionally, since it is set within a frame, there is a risk of the tilted printer slipping.

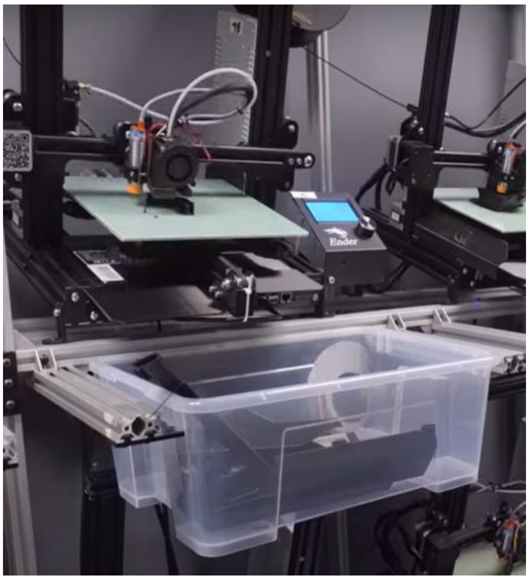

Figure 7 - Primitive Method of Automated Part Removal

Robotic Arm Removal

The robotic arms are equipped with end-effectors designed to interact with the 3D printer and the printed objects. They operate by identifying and reaching into the printer to detach completed parts from the print bed. This is achieved through a combination of mechanical movements and possibly the use of tools or suction-based devices on the end-effectors. The system likely integrates sensors and computer vision to accurately identify the location and orientation of the parts, ensuring precise and gentle handling to avoid damage [14]. The Innovation Lab has a Kuka mobile robotic arm that can perform related operations, but driving the robotic arm to perform tasks greatly increases the system's workspace and risks, affecting the lab's activity space, and is not an ideal choice.

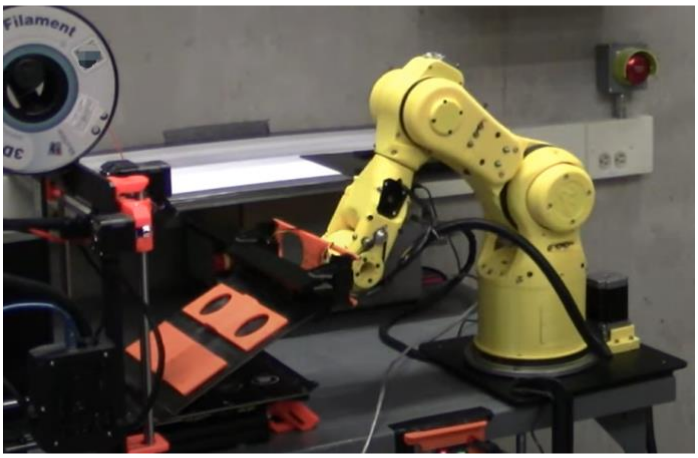

Figure 8 - Part Removal with Robotic Arm

Removal Device

Therefore, a removal device fixed to the gantry system is ideal. In PRUSA, such a device exists, but it is unclear how this device operates. This is the team's next target after setting up the H-gantry.

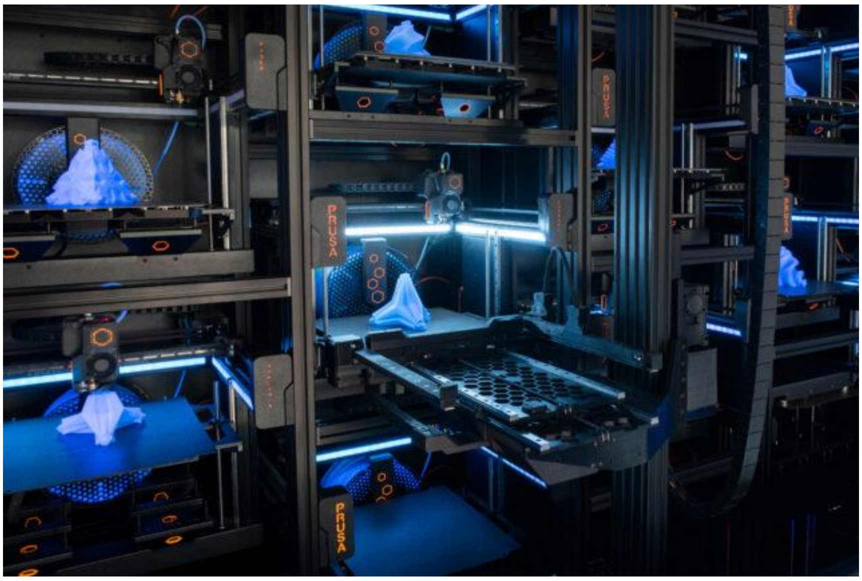

Figure 9 - Prusa AFS's Part Removal Device

4 Requirements, Specifications and Approach

4.1 Requirements

Table 1 - High-level Requirements

Requirement ID	Requirement Description
[H.001]	The system shall be able to move to the centre of all printer beds
[H.002]	The system shall be safe for people to be in the lab while operational
[H.003]	The system must be able to be showcased as part of the digital twin lab.

Table 2 - Financial Requirements

Requirement ID	Requirement Description
[C.001]	The gantry must cost no more than $400 for additional materials

Table 3 - Functional Requirements

Requirement ID	Requirement Description
[F.001]	The system must be able to operate at speeds moving between a printer and drop-off point at a minimum of 2 minutes
[F.002]	The gantry must be accurately able to monitor position
[F.003]	The gantry must be able to have tools attached to it
[F.004]	The gantry must be able to receive instructions from the lab's OPC UA server
[F.005]	The system must be able to be controlled manually by a user

Table 4 - Non-Functional Requirements

Requirement ID	Requirement Description
[N.001]	The solution must use motors provided by the stakeholder

Table 5 - Safety Requirements

Requirement ID	Requirement Description
[S.001]	All drawers must be closed while the gantry is operational
[S.002]	No person is allowed near the gantry while operational
[S.003]	The gantry must stop if excess force is used
[S.004]	The gantry must be able to be stopped manually from anywhere within its area of operation

4.2 Design Specification & Approach

Current Matrix Setup

Figure 10 - Current Matrix Setup

Proposed project structure

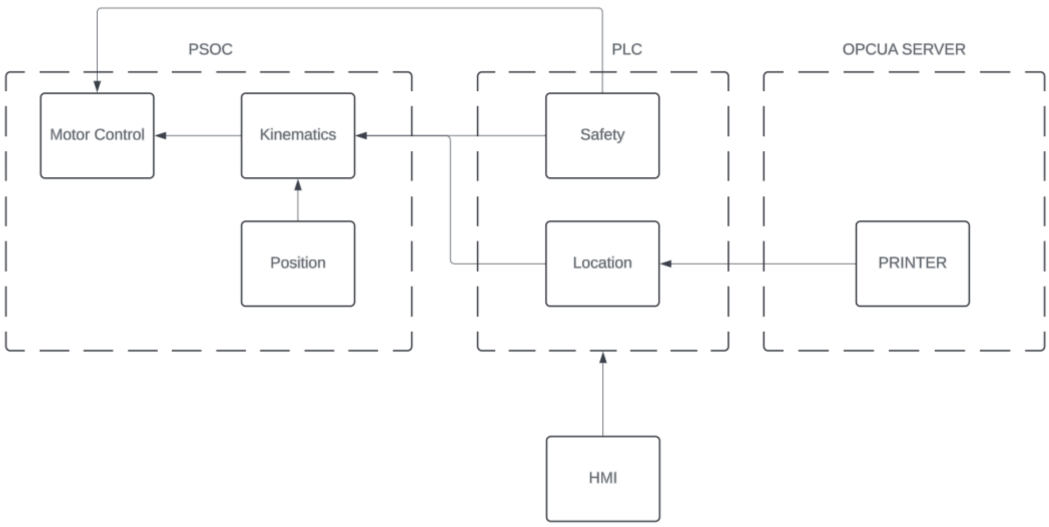

Figure 11 - Proposed Project Structure

Proposed Wiring Diagram

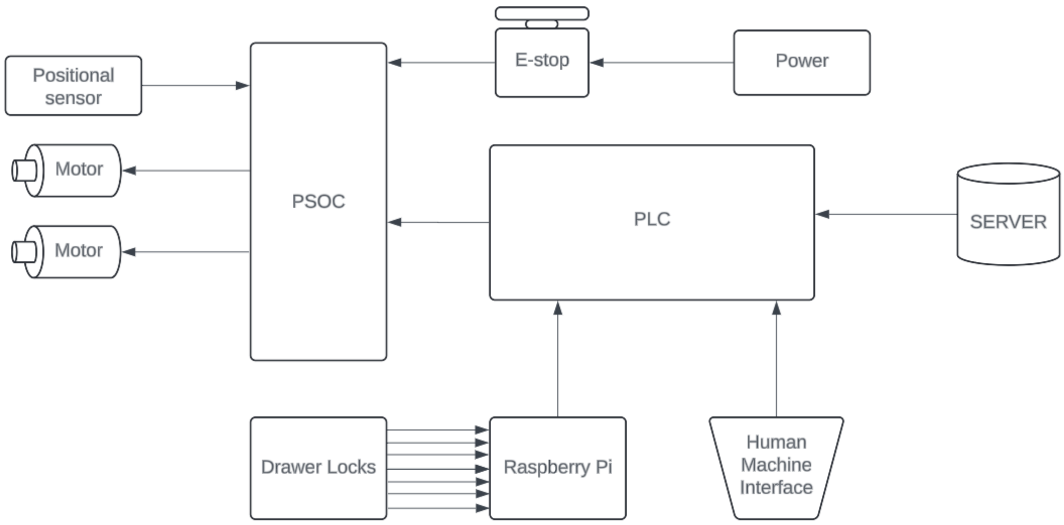

Figure 12 - Proposed Wiring Diagram

H – Gantry setup [H.001] [H.002] [H.003]

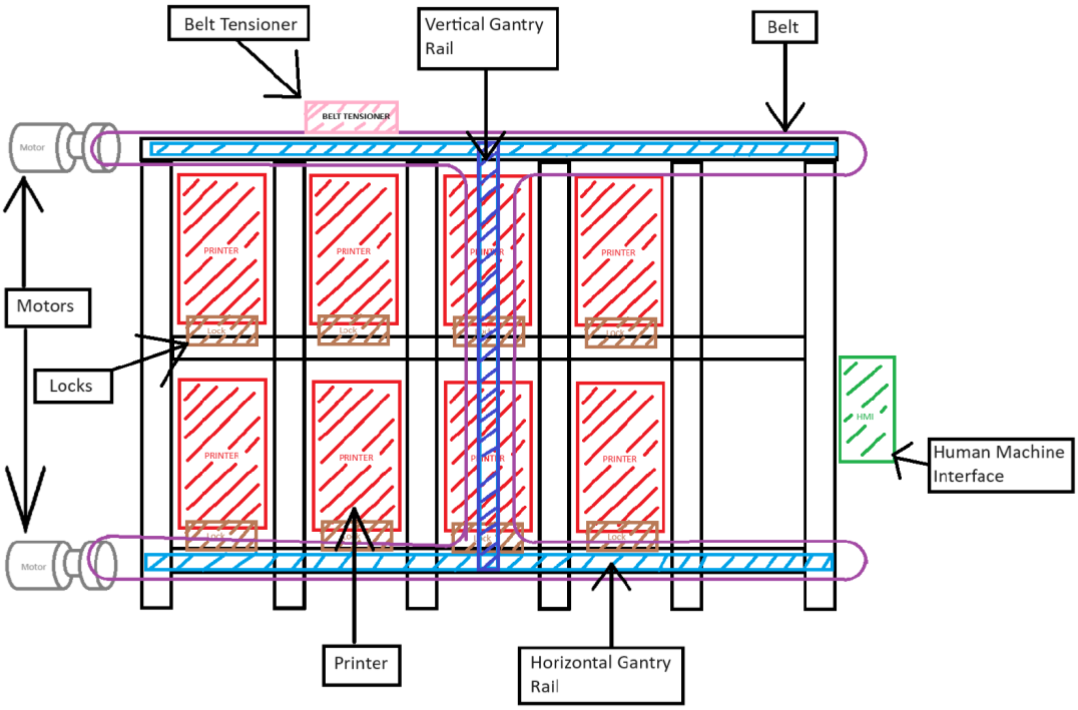

Figure 13 - H-gantry Diagram

The proposed set up for the gantry is an H-gantry featuring 2 motors. This allows the motors to move the tool head anywhere in the gantry area, satisfying [H.001].

Figure 14 - Provided Stepper Motors

The stepper motors shown above will be used as they have a high amount of torque and high accuracy, allowing the gantry head to move at the required speeds [F.001]. The power to the motors will be limited to reduce speed to a safe level to satisfy requirement [H.002].

PLC [F.004]

Figure 15 - Provided PLC with Safety Module

The proposed project structure utilises a PLC integrated with the OPC UA server. Communication with a pre-existing server is critical for the stakeholder. A PLC will allow for communication between the gantry system and the server, with the server giving instructions on which printer to access. This will fulfil [F.004]. Moreover, the system is using the provided safety module, as seen in figure 6 to ensure that the safety features perform at a high level, fulfilling [H.002].

PSOC - Motor Control, Kinematics [H.001]

To move the gantry between positions and fulfil [H.001], the system must be able to calculate and control how the motors must move. This is all being handled by the PSOC. The PSOC has benefits over alternate solutions such as a Raspberry Pi due to PSOCs allowing a hardware-based implementation. This provides more accuracy in control over the provided stepper motors. Moreover, it is a lower-cost solution compared to alternatives.

HMI [F.005] [H.003]

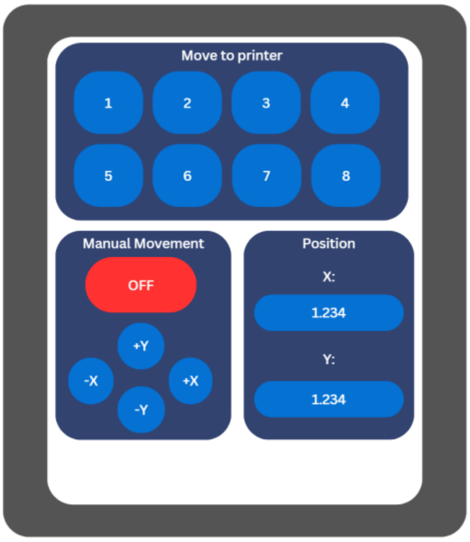

Figure 16 - Proposed Human Machine Interface (HMI) Design

Figure 17 - Provided Human Machine Interface (HMI) Display

To fulfil functional requirement 5, a Human machine interface (HMI) will be added. The HMI will be connected to the PLC. The HMI will have the ability to manually input positions as well as desired printers, as well as jog the gantry head to move in the x and y direction. The proposed design is featured in figure 7. This will fulfil the requirement [F.005]. Moreover, by manually controlling the system, it will be able to be showcased as part of the digital twin labs, fulfilling requirements [H.003].

Locks [S.001]

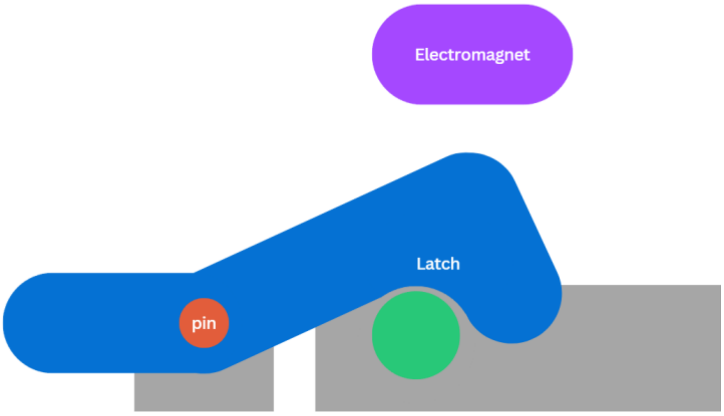

Figure 18 - Proposed Tray Lock

The locking system is designed to fulfil requirements [S.001]. To avoid collisions with the gantry, the drawers must not be able to move out while the gantry is moving. The proposed locking mechanism involves using a latch and an electromagnet that will prevent the drawers from being removed while the gantry is moving. By activating the electromagnet, the latch can be opened, and the drawers removed. This system was chosen over a manual latch as by using electrical components, the locks can be tracked, and it is simple to ensure the gantry is not moving. Moreover, this system was chosen over other designs to ensure that in an electrical failure, the drawers remain locked.

Barrier [S.002]

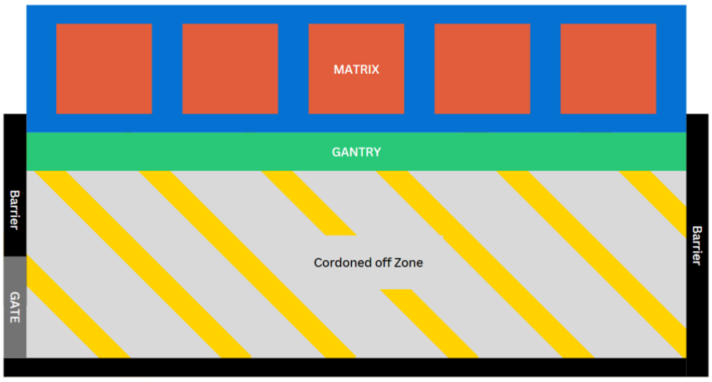

Figure 19 - Proposed Barrier Layout Viewed from above

A physical barrier will be placed around the gantry to isolate it from the rest of the lab. While the gantry is in operation, no one will be allowed to enter the area, thereby fulfilling requirement [S.002]. Training will be included with the induction of the lab, and signs detailing entry requirements will be placed near the gate.

LEDs [S.002] [H.003]

LEDs will be added to alert people in the lab of the gantry's operation. As part of the administrative control measures, everyone in the lab can be alerted by a series of LEDs that will warn them not to enter the operational zone of the gantry.

Force detection. [F.005]

A force metre will be attached to the belts to determine whether the gantry has collided with an object. By measuring a spike in the force applied by the motors we will be able to tell if a collision has occurred and cut power to the motors. This was chosen over alternative methods such as using a laser along the vertical beam due to its simplicity and accuracy.

Emergency Stop buttons [H.002] [S.004]

Figure 20 - Provided Emergency Stop Buttons

The emergency stop buttons provided, as seen in figure 11, will be placed around the matrix to be able to stop the machine running at any time. The emergency stop buttons will be placed within the cordoned off zone, and on the matrix at multiple locations so that an emergency stop button is always accessible [S.004]. Upon hitting the button, the gantry will stop moving.

5 Scope, Project Plan & Timeline

5.1 Project Scope

The project scope includes the following:

- The design and construction of a gantry system, including specifying points where the gantry needs to move, determining the necessity and placement of position sensors, and considering kinematic aspects related to the movement of the gantry.
- Develop a robust mounting system for the motors to ensure stability and efficiency.
- Assess and ensure the stability of the entire system for safe and reliable operation.
- Identify and define the maximum operational limits for the system, including performing calculations for force and torque to determine operational limits, and establishing appropriate belt tension limits for optimal performance.
- Evaluate the need for integrating draw sensors and locks to prevent incidents and ensure operational safety.
- Plan and implement an efficient power distribution system to meet the operational requirements.
- Implement a comprehensive safety system, including emergency stop mechanisms, proper cable management and standard operating procedures.
- Design and integrate a user-friendly human-machine interface for intuitive control, connecting the system to the Programmable Logic Controller (PLC) for seamless integration.
- Develop a method for communication with the server or lab through the PLC for data exchange and control interface.
- Design a modular interface for tools to be used for interacting with the 3D printers.

Details that are out of the scope:

- Installing a camera system for monitoring individual printers.
- Storage of completed parts once removed from the printer.
- Develop tools for print removal, bed cleaning and other applications.

5.2 Project Plan & Timeline

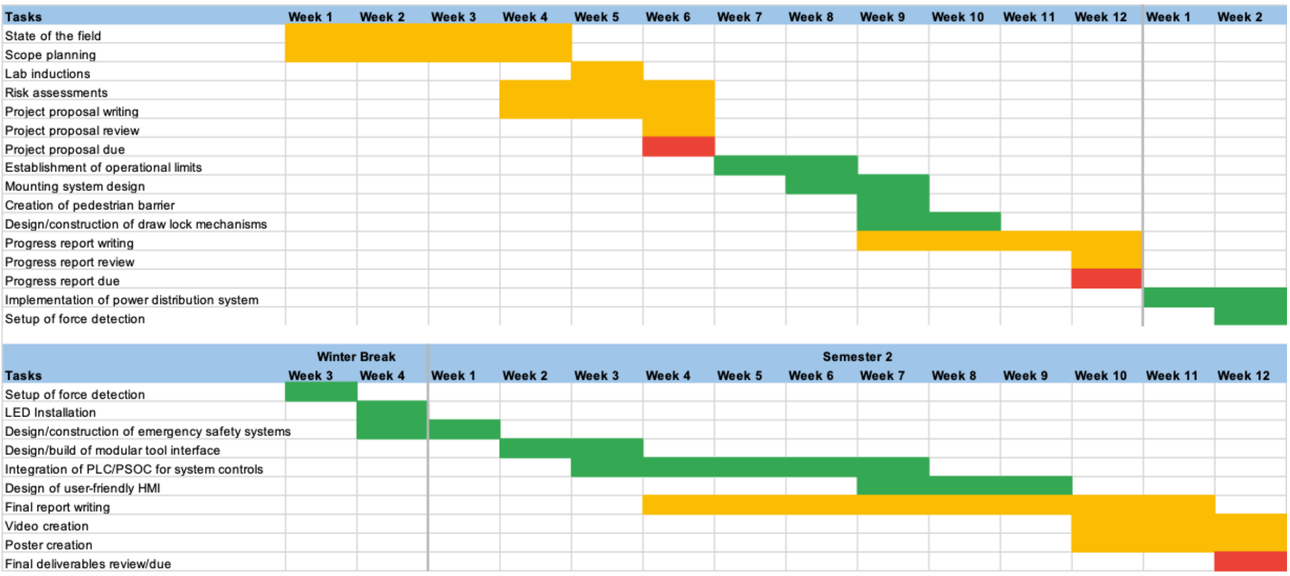

Figure 21 - Timeline Gantt Chart

Project Plan:

- **Establishment of operational limits:** Conducting force and torque calculations and determining belt tension limits. This task is estimated to require approximately 2 weeks to finalise.
- **Mounting system design:** Designing and constructing a mounting system for motors, belts, and aluminium t-slots. This task involves decision-making, design creation, and system assembly, expected to take around 2 weeks.
- **Creation of pedestrian barrier:** Installing a pedestrian barrier is essential for safety and is projected to be completed in less than 1 week.
- **Design/construction of draw lock mechanisms:** The intricate task of designing draw lock mechanisms necessitates careful planning and is estimated to take approximately 2 weeks.
- **Implementation of power distribution system:** Establishing a power distribution system for overall functionality is scheduled to be completed within 2 weeks.
- **Setup of force detection:** Implementing force detection mechanisms for monitoring system performance is expected to take about 2 weeks.
- **LED Installation:** Installing LEDs for visual indicators is estimated to take around 1 week.
- **Design/construction of emergency safety systems:** Designing and implementing emergency safety systems to ensure user well-being is a task projected to take approximately 2 weeks.
- **Design/build of modular tool interface:** Developing a versatile and user-friendly interface for various tools is expected to require around 2 weeks.
- **Integration of PLC/PSOC for system controls:** Integrating PLC/PSOC for system controls is a significant task demanding careful integration and testing, estimated to take about 5 weeks.
- **Design of user-friendly HMI:** Designing a user-friendly HMI for operational ease is projected to take approximately 3 weeks to complete.

5.3 Work Breakdown

Table 6 - Roles and Responsibilities

Team Member	Roles and Responsibilities
William Tadgell	PLC ● Power distribution system ● Integration of PLC for system controls ● Design of HMI
Zain Bin Saqib Khan	Mechanical structures ● Mounting system ● Draw lock mechanisms ● LED installation
Xiaohang Zhou	Tool changer ● Operational limits ● Modular tool interface
Michael Gilboa	Safety ● Pedestrian barrier ● Force detection ● Emergency safety systems

Team Contract: can be found in Appendix B.

6 Risk Management Plan

Consequence and Likelihood	Insignificant	Minor	Serious	Disastrous	Catastrophic
Rare	L	L	L	L	M
Unlikely	L	L	M	M	S
Possible	L	M	M	S	H
Likely	L	M	S	H	E
Almost Certain	M	S	H	E	E

Figure 22 - Risk Assessment Matrix

L=Low Risk, M=Medium Risk, S=Substantial Risk, H=High Risk, E=Extreme Risk

Table 7 - Non-OHS Project Risks

Project Risk	Risk	Likelihood	Consequence	Risk level	Mitigation	Residual Risk
Delayed delivery of components	Delayed construction of gantry	Unlikely	Minor	L	Create a list of all components needed for the project and order them in advance.	Components are still not available. There will be a need for an alternative design option.
Completion time exceeds the deadline	Deliverables cannot be completed	Unlikely	Serious	M	Maintain timeline and project plan with regular updates.	Completion takes longer than accounted for. Need to reconsider the technicalities of certain deliverables.
Failure of the automated system	Malfunction of the system	Unlikely	Serious	M	Regular maintenance and inspection of electrical and mechanical components.	Automated systems fail. Will require investigation into cause of error and relevant repairs

Occupational Health and Safety (OHS) risks: can be found in Appendix A.

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8 Appendices

8.1 Appendix A: Project Risk Assessment

NUMBER	RISK DESCRIPTION	TREND	CURRENT	RESIDUAL
57764	ENG4701_CL_2024_(S1)_3D Printer part removal using Sensitive Robots and Intelligent Grippers (Smart Manufacturing)		Low	Not Assessed

RISK TYPE
1. Activity or Task Based Risk Assessment

DOCUMENTS REFERENCED

RISK OWNER	RISK IDENTIFIED ON	LAST REVIEWED ON	NEXT SCHEDULED REVIEW
MICHAEL SAM GILBOA	30/03/2024		

RISK FACTOR(S)	EXISTING CONTROL(S)	PROPOSED CONTROL(S)	OWNER	DUE DATE
Risk of electric shock due to the high voltage involved in powering the motors and other electrical components.	**Control:** All electrical points marked and no wires left exposed to human contact.			

Fire hazard due to electrical malfunctions or overheating of components.	**Control:** Regular maintenance and inspection of electrical components to prevent malfunctions.	
Risk of entanglement or crush injuries from moving parts such as the gantry and motors.	**Control:** Clear warning signs in relevant locations, and physical barriers for pedestrians.	
Tripping on cables/wires or other equipment on the floor	**Control:** Cable management to minimise loose cables and the chance of tripping.	
Lifting of gantry and other components.	**Control:** Multiple persons lifting larger or heavy objects. **Control Effectiveness:** **Control:** Protective Gloves **Control Effectiveness:**	
Long hours assembling the system.	**Control:** Frequent breaks. Assembly spread out over multiple days if required. Many people assisting to divide the load. **Control Effectiveness:**	
Using hand tools and basic power tools (e.g. power drills).		

	Control: Use safety glasses and/or protective gloves where applicable. Closed shoes are required at all times. **Control Effectiveness:** **Control:** One person assembling in each area at once. **Control Effectiveness:**	
Assembly of upper gantry may require a step or ladder. This introduces a risk of falling.	**Control:** Spotter and supporter required for use of ladder and steps. **Control Effectiveness:**	
Centre of mass and stability of the system.	**Control:** Worst case centre of mass analysis determined suitable layout and design. **Control Effectiveness:** **Control:** The system is to be bolted to the ground under BPDs advice. **Control Effectiveness:**	

8.2 Appendix B: Team Contract

Team Contract

Team Name: 2024S1-2238: 3D Printer part removal using Sensitive Robots and Intelligent Grippers (Smart Manufacturing)

Team Member Names:

William Tadgell		Zain Bin Saqib Khan
Xiaohang Zhou		Michael Gilboa

1. Document Purpose
The purpose of this team contract is to outline the standard operating practices and team norms of the above named team and individually listed members for the remaining duration of the team lifespan. The guidelines outlined in this document are agreed to by all team members as indicated by their signature at the end of the contract. Any amendments to the contract must be discussed and agreed to by all signing members. Failure to abide by the outlined standard operating practices of this contract could harm the team's overall functioning and result in penalising action as detailed in the contract.

2. Rules and Regulations
The team agrees to the following guidelines regarding general procedures, practices, and behaviours that are deemed acceptable.

A. Expectations

i. Project Expectations

- The goal of the project is to complete the gantry to a high standard, aiming to meet all the requirements
- Aiming for 70+ grade
- Deadlines will be decided based on unit requirements and are set during team meetings and are agreed upon by all members of the team
- Team will split work equally based on robust discussion of time required and difficulty to complete each task, therefore distributing tasks to members accordingly
- If inequality has occurred, the team will compensate by balancing the remainder of the work differently to equalise total effort from each team member

ii. Member Expectations

- Each member is expected to put in a standard of work that results is grades 70+ according to the provided rubric, as well as put in the effort required of the grade
- Each member is expected to contribute 10-12 hours per week towards the project
- Members are all expected to adhere to academic integrity, and should any individual be found in violation, the whole team must address the issue and replace any content in violation of academic integrity

B. Communication

i. *Communication Medium*

- The team will be mostly contacted via Whatsapp group.

ii. *Communication Timelines*

- Team members are expected to respond between 9-6 on weekdays and weekends
- Expected response times are within 24-hours during standard hours. This is expected to be 12 hours within a week of a major project deadline.

iii. *Communication Code of Conduct*

- Members are expected to communicate in a respectful and professional manner as dictated by Monash Uni's code of conduct

C. Team Meetings

i. *Scheduling*

- Weekly meeting on Tuesdays, time to be determined each week based on team and supervisor availability

ii. *Involvement*

- All members will be asked for their involvement and opinions in team discussions and decisions
- Team members are expected to be prepared to share their progress in team meetings and provide feedback on other members work

iii. *Attendance & Notice*

- Attendance is expected at all team meetings
- If a team member cannot attend, they must give the rest of the team notice in advance, and must read over the completed meeting minutes in their own time
- Preferable amount of notice for absence is 24 hours, excluding scenarios with unexpected circumstances

D. Team Conflict & Decision Making

i. *Conflict Code of Conduct*

- When two or more members experience conflict, other members will be involved in order to resolve the dispute. If the dispute is unable to be resolved then the supervisor must be involved.

ii. *Decision-Making*

- Major decisions are discussed during meetings and are agreed upon by all members of the team.
- Sub-projects decisions are decided upon by all sub-team leads based on input from all sub-project members
- When multiple members cannot reach an agreement the discussion will continue until a reasonable timeframe, after which the team will decide on a majority vote.

E. Stress Management

i. *Monitoring & Assistance*

- Team members should reach out to each other when they are experiencing stress or burnout
- All members should attempt to accommodate fellow team members who are struggling, and provide assistance where necessary

F. Contract Code of Conduct

i. Contract Breaches

- All warnings of contract violations will be recorded and given to the team supervisor.
- A major breach of contract will result in 3 strikes while a minor breach will result in a single strike. Once 3 strikes are reached, a full team meeting will be organised to discuss the violation and where to proceed.

ii. Penalties

- Penalties should be discussed with the team supervisor and any other relevant staff

3. Declaration

By signing below, team members acknowledge and agree to be bound by the guidelines outlined above.

William Tadgell	06/04/2024
Team Member Signature	Date
Zain Bin Saqib Khan	09/04/2024
Team Member Signature	Date
Xiaohang Zhou	09/04/2024
Team Member Signature	Date
Michael Gilboa	06/04/2024
Team Member Signature	Date