DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING

Team 13
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Department of Mechanical Engineering

Material Handling

Introduction

Description of the Project:
Scope: To design, fabricate, and test a design or system that can transport ABS plastic from the pallets to the thermoforming machine by a single user. By reducing the handling of material to one user this would free one worker to improve the efficiency of the work done in the process.

Requirements
- Design a system to transform large sheets of ABS plastic sheets onto the thermoforming machine
- Maximum dimension of ABS sheets: 96" × 139“
- Minimum dimension of ABS sheets: 77" × 96“
- Must be operated by a single person
- Must be able to reduce the handling time by at least 30 seconds

Who is the Client?

The main contact when dealing with the aspects of the project is Brenton Teed.
Mr. Teed works as an engineer for Malley Industries. They deal with fabricating partitions, wall liners, and ceiling kits for vehicles. Malley Industries is located in New Brunswick, Dieppe.

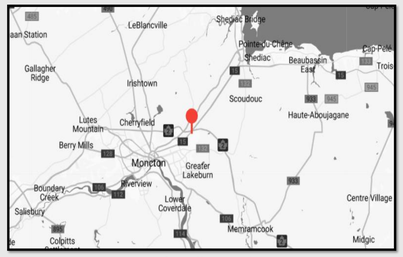

Figure 1: Location of Malley Industries
Image source: https://www.malleyindustries.com/contact-us

Design Process

The design team went through the following process to end up with a final solution for the client.

Understanding the Problem
- Who does this affect
- What is the current process/ concept is done currently

Meet with the Client
- Discuss the requirements and restraints of the project
- Understand what the client wants
- Budget

Brainstorm Concept Ideas
- Any idea was considered
- Ideas were created without requirements in mind
- Ideas were evaluated through a criteria table and the best three were chosen
- Determine the best concept and start to work on it
- Start with rough numbers to begin

First Iteration
- The first simulation of the robotic arm was created.
- A review of what could be improved was done.
- The first iteration was shown to the client to gather feedback.
- The team compiled a list of improvements and updated the model.
- Iterations were done until satisfied with the final design.

Details of Design

Robotic Arm:
FANUC R-2000iC/125L
Specifications:

Axes	6
Maximum Payload	125 kg
Reach	3100 mm
Robot Mass	1115 kg
Mounting	Floor

The R-2000iC/125L was chosen for this system as it has the required reach, payload, and axes needed to move the ABS sheets. Also, with the ability to teach the robot automatically move the sheets it removes the physical labor factor.

Figure 2: FANUC R-2000iC/125L

Suction Cup Brand:
piGrip FX
Specifications:

Number of Cups	12
Radius of Each Cup	1.24'' / 1.65''
Material	Thermoplastic Rubber
Pressure	21 in. Hg

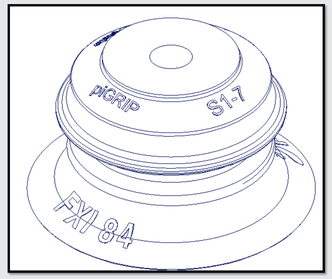

Figure 3: Suction Cup

The specified suction cup uses a flexible lip (FX) which is used for textured surfaced material and provides a very tight seal. The folds seen in Figure 2 are bellows which are used to allow the cup to attach at different angles as well as providing extra lifting force.

First Iteration

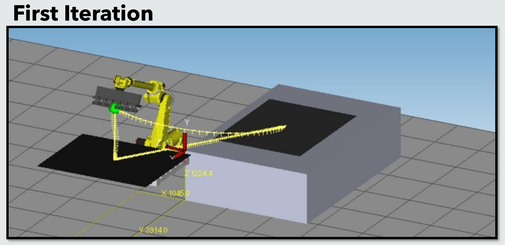

Figure 4: Overall View of the First Iteration

The main focus of the first iteration design of the system was to test the functionality of the robotic arm to lift the ABS sheets with the maximum mass and dimensions and place them on the thermoforming machine.

Second Iteration

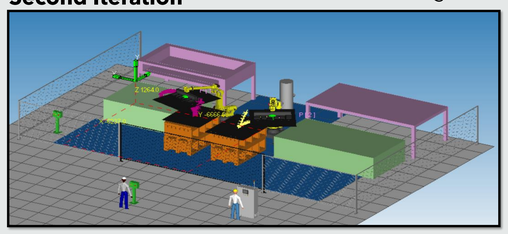

Figure 5: Overall View of the Second Iteration

The main purpose of the second iteration was to find the optimum way to place two robotic arms within Malley's workplace considering the position of the air tank, thermoforming machines, cooling fans, and stacks of plastics. Also, the robots' speed was adjusted to satisfy the client's need regarding the cycle time. Figure 6 shows the work envelope including the tool.

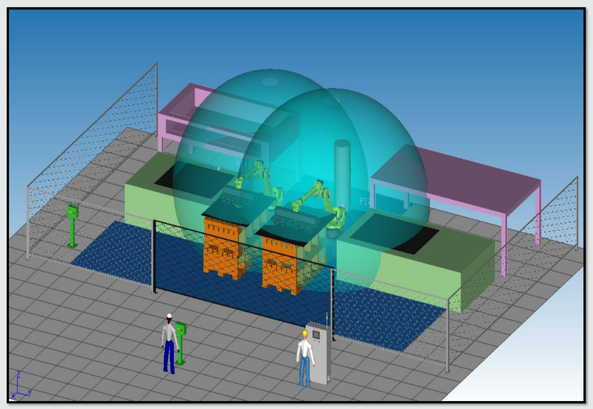

Figure 6: Work Envelope of the Second Iteration

Speed Vs. Loading Time Graph:
The relationship between the speed and the cycle time is not linear.

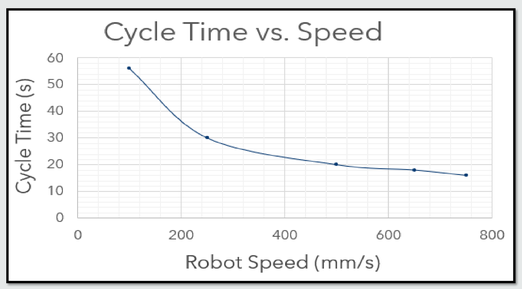

Figure 7: Cycle Time vs. Speed Graph

Conclusion and Recommendations

Final Iteration

The result of the design solution was finished after reviewing the team's first iteration and deciding what could be added or changed to improve the design. The focus during this final iteration was the aspect of safety as this was a top priority of the client. The following points are what was added/changed to produce the final design solution for this year's Capstone project.

- Closed in work site
- Emergency stop switch on outside and inside of work area
- Tactile floor sensors
- Rearrangement of thermo forming machines
- Cycle time analysis

Recommendations

The team's recommendations for the client and the potential of any teams that may work on the project are the following:

- The client should program the teaching pendant in order to save on an installation fee.
- The speed the robot should operate at the team recommends 500 mm/s for a total cycle time of 20 seconds.
- The PiGRIP FX suction cup should be used as this cup provides extra lifting force and is able to attach at slightly different angles.

References

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