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Automation of Production Line

Introduction

Neocon International is a company locates in Dartmouth, Halifax which manufactures plastic cargo liners (mats) used on vehicles . The existing production line is fully manual and not efficient due to social distancing constraint under the COVID-19 pandemic.

Cargo Liner

The purpose of this project is to automate the production lines in Neocon International. The manufacturing process consists of four steps: thermoforming, trimming, Velcro promoting and packaging. Omron TM-12 collaborative robots (cobots) and LD-90 mobile robots (AGVs) are applied to transport semi-products and perform repeated tasks. Intel Machine Vision system will be loaded on the cobots to assist the work.

Team 03 had delivered a model of improved production line, which will be implemented by Neocon in the near future.

Design Process

The design process mainly consists of following steps:

- Plant visit
  - Identifying the product (cargo liner)
  - Analyzing existing production line
  - On-site time study
- Idea generation
  - Brainstorming
  - Information gathering (requesting quotes from Omron and Intel)
  - Concept analyzing (pros & cons, feasibility)
  - Main direction selection
- Design refinement and iteration
  - Workstation arrangement
  - Production line time study (estimation)
  - Production line economic study (estimation)
  - 3D model building (Solidworks)

Cobot

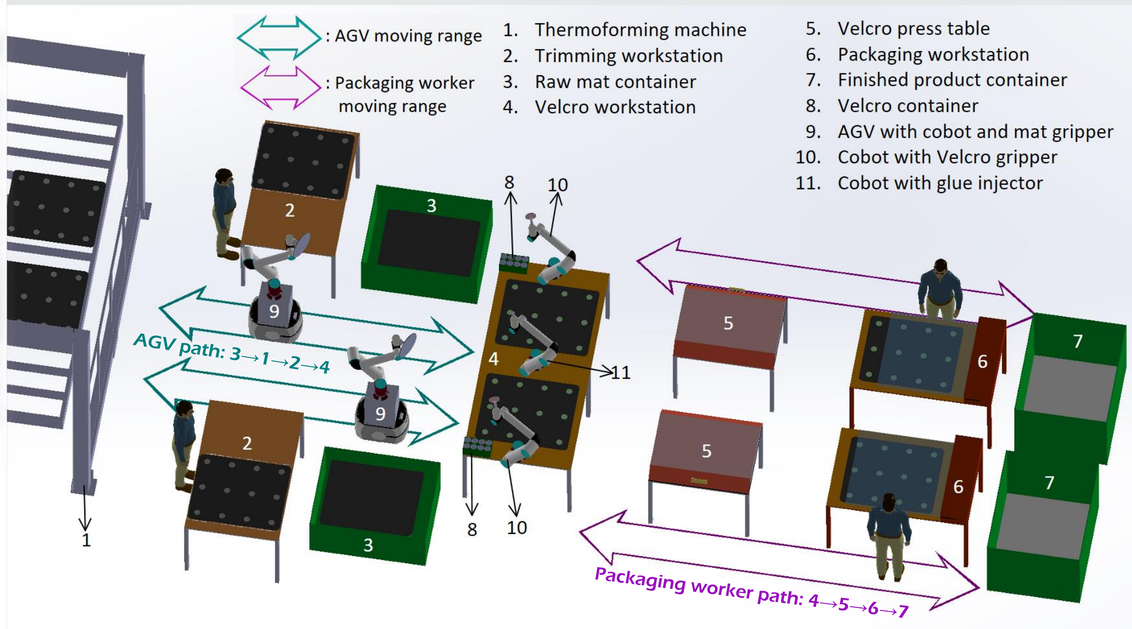
Mobile Robot (AGV)

Details of Design

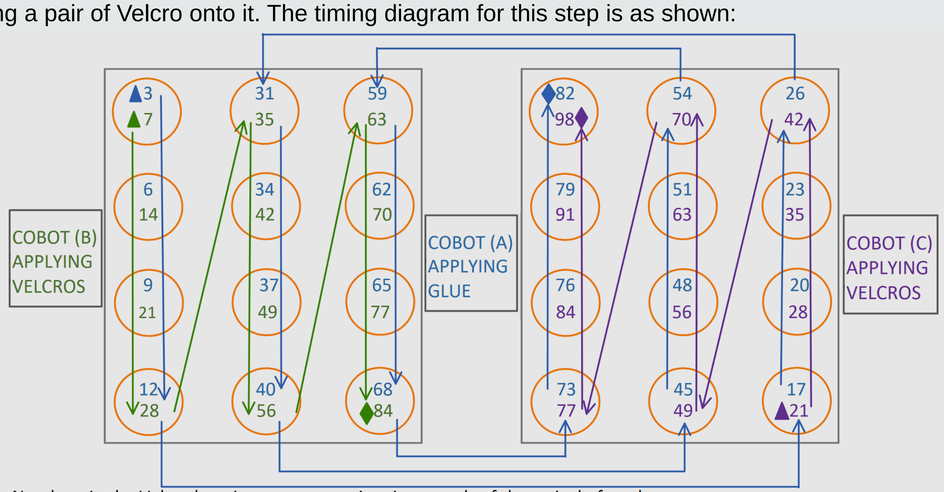
This design utilizes 2 mobile robots to transfer mats and 3 cobots to replace 2 workers to apply Velcro for each 2 production lines, while 4 simultaneously-proceeding processes remarkably improves efficiency.

Process 1 involves a mobile robot loading raw mat to thermoforming machine and placing trimmed mat accurately onto Velcro workstation. Process 2 involves the main production line (manual trimming, automated Velcro applying, manual Velcro press and manual packaging). Process 3 involves the automatic thermoforming machine (existing). These 3 processes are synchronized.

Process 4 involves every one separate worker combining every piece of Velcro top and Velcro base for the demands of every 3 production lines (not shown in the picture).



The Velcro applying process for each Velcro position on the mat involves 2 steps: adding glue, then putting a pair of Velcro onto it. The timing diagram for this step is as shown:



- Numbers in the Velcro locations represent time in seconds of the arrival of a robot.
- ▲ represents the start point, and ◆represents the end point of a route.
- Arrowed lines represent the order of Velcro locations that the robots arrive. The actual trajectories of movement may differ.

Conclusion and Recommendations

- This project has achieved its goal of automating the production line by using the mobile robots and the cobots to reduce the number of workers needed on each production line and increases the efficiency. The improvements can be summarized by:
  - The number of workers was reduced by 22%
  - The Cost per Piece was reduced from $2 to $1.5 per mat (25% cost reduction)
  - The cost of the new design will be recovered in approximately 4 to 6 years
  - The rate of production was improved, from 145 seconds per mat to 140 seconds per mat.
  - The unstable trimming time caused by human working habits was highly accommodated.

Future Recommendations:

The Packaging step could be entirely automated if a packaging machine of the appropriate size was found in the market or designed to fit the measurements of the product (125 cm x 105 cm). The automation of the packaging step can significantly reduce labor and increase the efficiency.

(example packaging machine)

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