PURDUE UNIVERSITY | School of Industrial Engineering

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Amazon: Reducing Scrap on SLAM Machines

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TEAM 01

Introduction

One of the main sources of scrap for Amazon is package kickoffs on the Scan Label Apply Manifest (SLAM) machines – costing the company an estimated $92.4 million yearly. Each package in Amazon is given a sp00 label, which contains information about the package's order such as how it is meant to travel through Amazon's network. SLAM machines scan sp00s, create shipping labels, print them, and apply them on the packages. Currently, U.S. facilities have a camera array setup that allows for scanning sp00s on the top and sides of packages. However, the system is unable to read the underside of packages or envelopes. Unread sp00 labels account for 30-50% of overall SLAM kickoffs. The goal of this project is to modify the current SLAM machine setup to allow for scanning the underside of packages, in turn reducing package kickoffs and overall scrap.

Fig. 1 Example of a sp00 label

Fig. 2 SLAM (Packages shown are not actual customer orders)

System Evaluation

The team's proposed solution involves the addition of new cameras beneath the SLAM belts. The team will use Cognex DM303 cameras since they are already in use at Amazon sites. The current setup of the SLAM machine has minimal gaps in the belts that sp00s on the underside can be scanned through. The most logical gap in the belts is after the scale portion of the SLAM, as it provides the greatest area for mounting additional cameras and light arrays. The mounting position of the camera will affect the field of view, which will in turn affect the success rate of sp00 scanning. The new camera must be integrated into the existing camera array in order to communicate with the programmable logic controller (PLC). In the graphic shown, packages move from right to left. The gap of interest (fig. 3, highlighted in green) was measured at 0.47in. The belt width was found to be 23in.

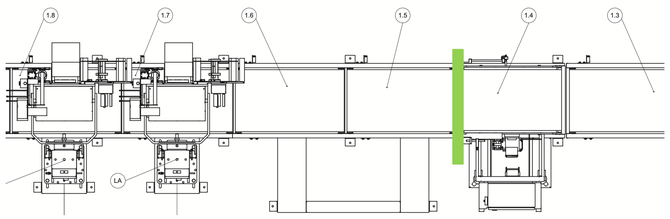

Fig. 3 Aerial view of SLAM machine

Testing & Design

Testing was performed on a SLAM line at the IND1 Amazon Fulfillment Center in Whitestown, Indiana. Mounting positions and triggering conditions were tested using DataMan software until an optimal set was found for consistent scanning of sp00 labels on packages. The following are the optimal conditions:

Dual Camera System: Implementing two additional cameras	Lateral Position of the Cameras: 4.5in and 13.5in from right side of the belt	Top of cameras: 10in off the ground
Delay start: 745ms	Delay end: 1000ms	Light brightness: 15%

Figure 4 displays the placement of the new cameras, highlighted in red, within the existing structure of the SLAM machines.

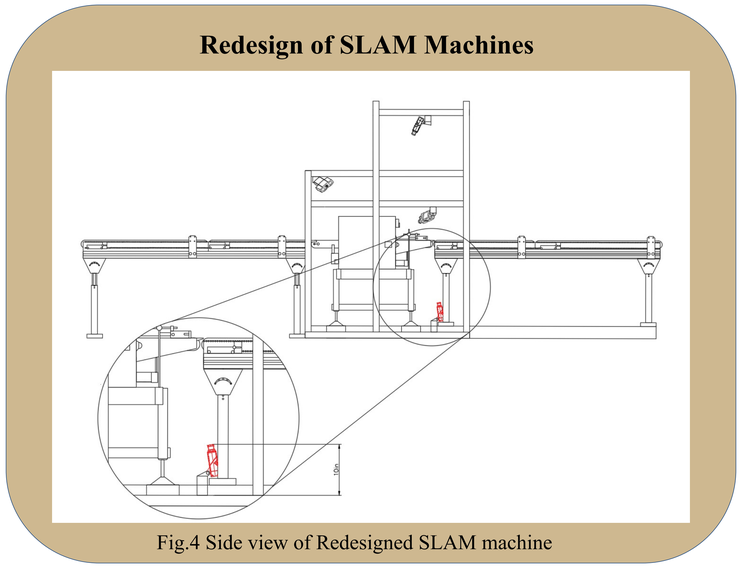

Fig.4 Side view of Redesigned SLAM machine

Results

The optimal conditions found through testing yielded a solution that will greatly improve the ability of the SLAM machine to scan the underside of packages. During the testing process, several designs were developed. The optimal single camera setup allows for consistent scanning of bottom-facing sp00s at a rate of >90%. Based on research done on the SLAM behavior, the dual camera setup is theorized to have a success rate of >95%. If implemented network-wide, this would lead to an annual cost reduction of $43.9 million.

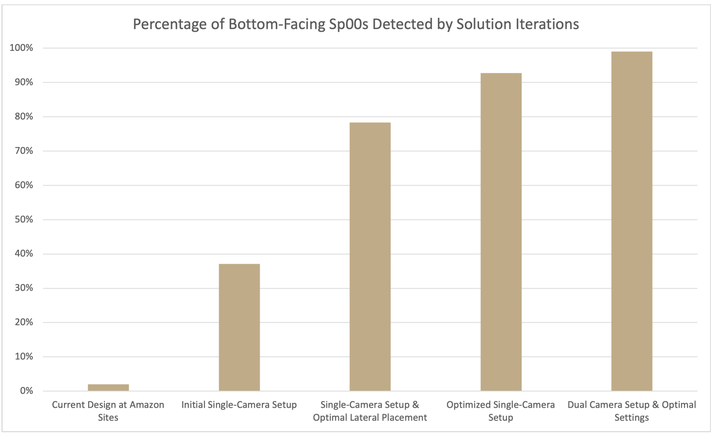

Fig. 5 Success rate of solution iterations

Implementation

The designed two-camera system will be mounted below the conveyor belt, scanning sp00 labels through the shown gap (fig. 3). The triggering conditions of the cameras will be configured as shown in the testing section. Furthermore, the finger guard currently in place over the mentioned gap will be replaced with fence guarding. This will widen the gap from 0.47in to 1.34in for the camera to scan through. This setup for one SLAM machine will cost $4,962.38 in total; $4,702.38 and $260 for the cameras and the fencing respectively. Additionally, to run this new setup, some changes will have to be added to the Programmable Logic Controller (PLC). The logic rung shown in fig. 6 allows the SLAM machines to process the data gathered by the new cameras.

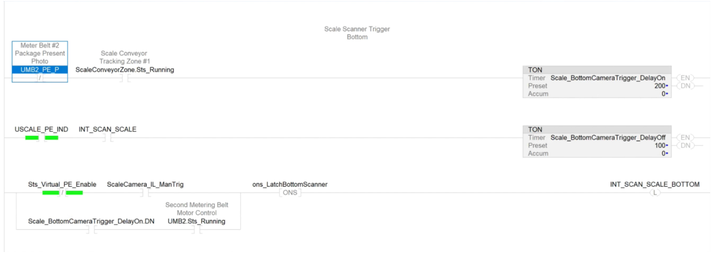

Fig. 6 Proposed PLC changes to enhance solution performance.

Takeaways

This project has been very beneficial to Amazon and the team alike. It was great to work with an industry partner in order to solve a real-world problem. The experience that was gained throughout the semester will be valuable to each of the team members throughout their careers. The team is proud to present a solution to Amazon that will potentially save them millions of dollars in the years to come.