FUTURE25: Stem-Kit Assembly Line Optimization

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Background and Introduction

FutureMakers is a company located in Hampden, Baltimore, that produces STEM learning kits for elementary-aged classrooms. These kits range from battery-powered cars to straw structures. Each kit requires a number of small parts that need to be counted and sorted, which creates slow, reptetitive, and meticulous work for FutureMaker employees.

STEM Kit Examples: Battery Powered Car and Straw Structure

Currently, FutureMakers has employees manually collect pieces and compare them to a packing list. This is error-prone, slow, and difficult work. FM wants to empower workers to spend more time on work that they find fulfilling.

Problem Definitions

1. Reduce the time required to count bundles of parts
   a. Help team prep for growth
2. Completely eliminate part undercount in bundles
   a. Prevent any potential ruined experiences
3. Allow for operators of any intellectual ability
   a. Encourage inclusivity

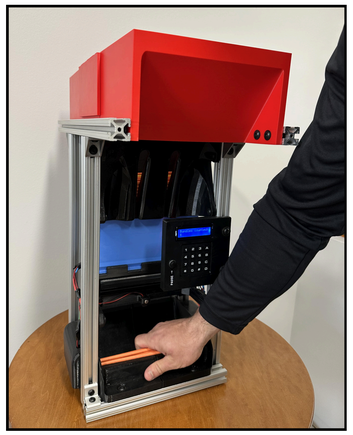
Additional Considerations

1. Account for future product additions or modifications
2. Allow for replacement parts to be manufactured in-house post-project

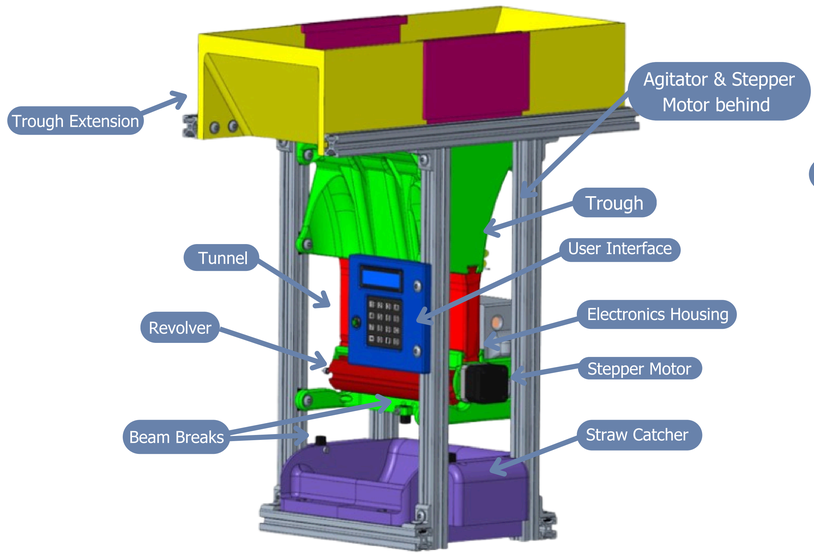
Project 1: Straw Counter

Solution Brief:
We created and delivered 4 examples of a device designed to count straws into various bundle sizes.

Operation:
Up to 1250 straws are loaded into a trough and then dispensed via gravity and agitation through a funnel. They are then dispensed via magazine from a tunnel. The straws are dispensed from the revolver mechanism and are counted both mechanically, by rotation, and visually, via a beam break system. The user interacts with the system via a keypad and LCD.



Straw Counter in Action

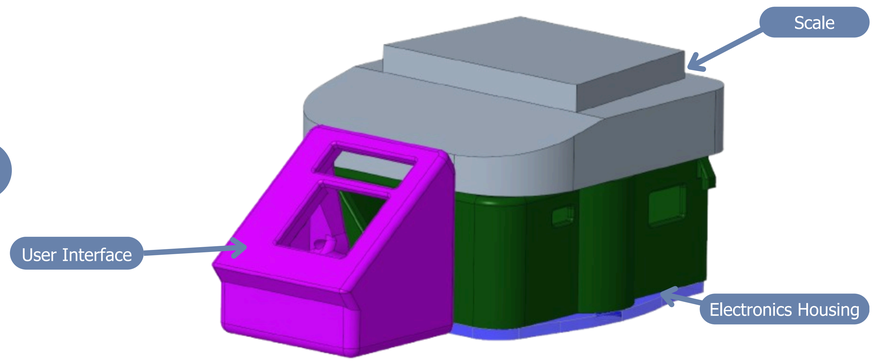


Testing and Validation:
1. Reduce time
   a. We compared counting times with the machine versus without and found roughly 60% time savings per bundle.
2. Eliminate undercount
   a. Tested 5000 straws in bundles of 12 with no undercount.
3. Allow any operators
   a. Tested operation with 15 different subjects with no prior instruction. No reported difficulties.

Project 2: Prec. Parts Counter

Solution Brief:
We created and delivered 12 smart scales to assist in weight counting of various small parts.

Operation:
The operator loads the scale with material. The operator then inputs the part type, number per bundle and number of bundles using a keypad and LCD user interface.
The Arduino computes a weight that, when met, drives the probability of undercount to 1/10,000 and overcount to no mroe than 10% using the input parameters and pre-measured statistical values for each part. The LCD provides feedback to the operator so they meet this goal weight, ensuring part count is within target standards.



Testing and Validation:
1. Eliminate uncertainty
   a. Allowed for accurate, continuous tracking of bundles completed with assurance of no undercount
2. Eliminate undercount
   a. Tested 5000 parts of 10 part varietes with bundle sizes of 1-30 with no undercount
3. Easy Operability
   a. Tested operation with 15 different subjects with no prior instruction. No reported difficulties.

Acknowledgements

Matt Barinholtz, Lucas Salazar, FutureMakers
Rich Bauernschub, JHU WSE - Mohamed Alwady, Consultant
Chris Gunther, JHU WSE - Stephen Belkoff, JHU WSE