Team 11: Koops Training Machine

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Problem Statement and Background:

This machine will train new hires and interns at Koops in controls and project engineering. The goal is to enable them to get familiar with and train on frequently used automation equipment in their first week. It covers PLC and robot programming, Servo and Variable Frequency drives, machine vision, safety integration, sensors, and part tracking. The machine will be set in a 'broken' state, where it will be the trainees' job to return it to working order.

Key Specifications:

- The machine must be modular and small enough to fit through a door of width 31.5" and height 80"
- Operate on a 120V 20A Circuit
- Include sensors, drives, camera, robot, and machine motion components commonly found on Koops equipment
- Set up / tear down the machine within an hour
- Must develop training documentation for machine

Notable Challenges:

Timeline:

The group had to manage differences in project and supplier timelines for the reception of components.

Modularity:

The design was focused on the machine being easy to move and operates on minimal power and air consumption.

Footprint:

Many aspects of the machine were designed with size in mind, leading to clever applications of machine motion components.

Design Philosophy:

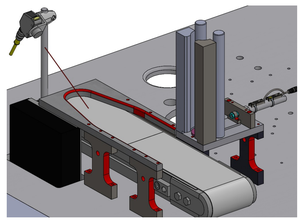
The function of the machine was driven by the components that were required by our sponsor, which challenged the group to essentially design the end-product backwards of how it would normally be done.

What the Stations do:

The goal of the machine is to sort chips of assorted color and material. While all chips have a plastic coating, some have metal cores, and some have stickers while others don't. This allows for the machine to highlight different functionalities of automation equipment in a familiar and digestible application that will get new hires and interns familiar with Koops processes in their first week.

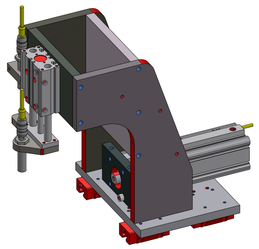
De-Stacker:

The chip de-stacker station pushes unsorted chips onto a conveyor to be picked and placed onto the dial table by the robot.



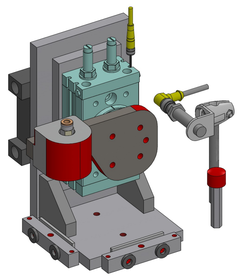
Height Check:

The height check station utilizes a laser sensor to measure to the top of the chip. The height measured must fall within the set limits to ensure only a single chip is in the nest at a time.



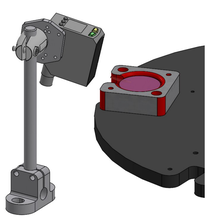
Material Check Shuttle:

The material check station utilizes an inductive proximity sensor to detect whether the chip in the nest has a metal core or is completely plastic.



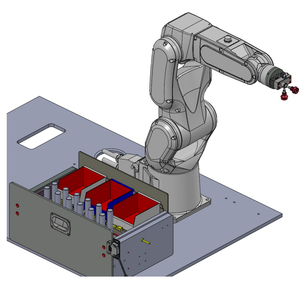
Sticker Check / Chip Flipper:

The sticker check station utilizes a Cognex IS2000 camera to determine if a chip in the nest has a Koops logo sticker. A rotary cylinder is used to flip the chip over to reveal the back face in the case of the sticker not being detected in the chips first orientation.



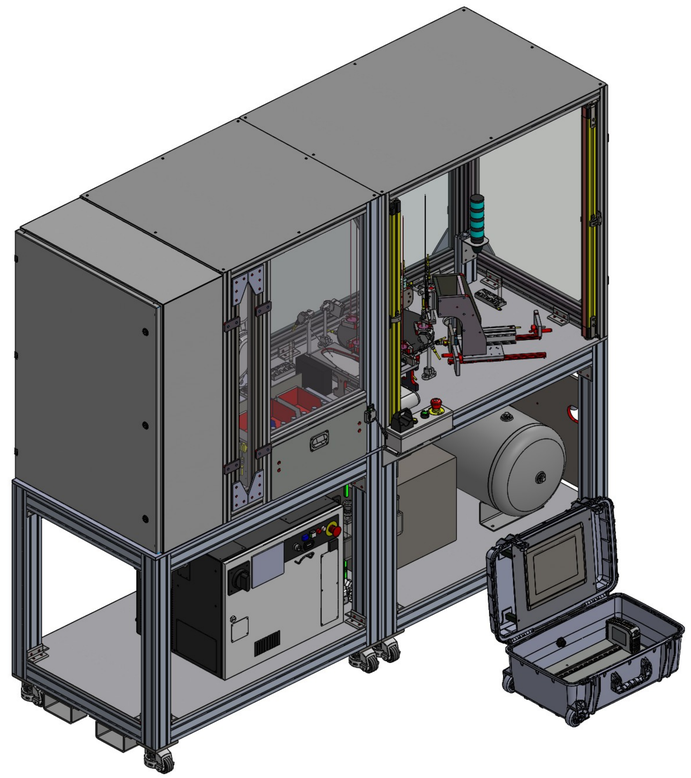
Color Check:

The color check station utilizes a color sensor that provides information on the red, green, and blue values of a chip as analog readouts. With these values, the color of the chip can be determined for sorting purposes.



Robot / Sorting Drawer:

A Fanuc LR-Mate robot picks and places chips from each machine position using vacuum cups on the EOAT. Chips that make it around the dial table are sorted into drawers based on tracked information from each station. The five front stacks hold "good" parts that pass all check, while the three back bins hold "reject" parts that fail one or more tests.



Current and Future Use Cases:

Current:

The machine will be used strictly for training new hires and interns.

Future:

The machine can be easily modified as time goes on. As Koops changes standard components, sensors and cylinders can be easily swapped out. Additionally, the machine might be used for more advanced training purposes, technical interviews, and demonstration purposes.

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