

ENCODER-BASED CUT TO LENGTH DEMONSTRATION

EXPO

engineering ▲ design



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TEAM 360 DESIGNS

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Sponsored by Encoder Products Company

OBJECTIVE

- I Design an attractive, interactive display that educates trade show goers on EPC's products.
- I Demonstrate programmable encoder functionality.
- I Demonstrate linear encoder functionality.
- I Demonstrate an industry application ("cut to length")



VALUE PROPOSITION

- I Allows EPC to demonstrate their products capabilities to new clients and employees
- I Creates an attractive display to compete with other tables at trade shows
- I Makes encoders interesting for nontechnical buyers
- I Provides a user-friendly interface for both experts and novices
- I Clarifies how encoders work

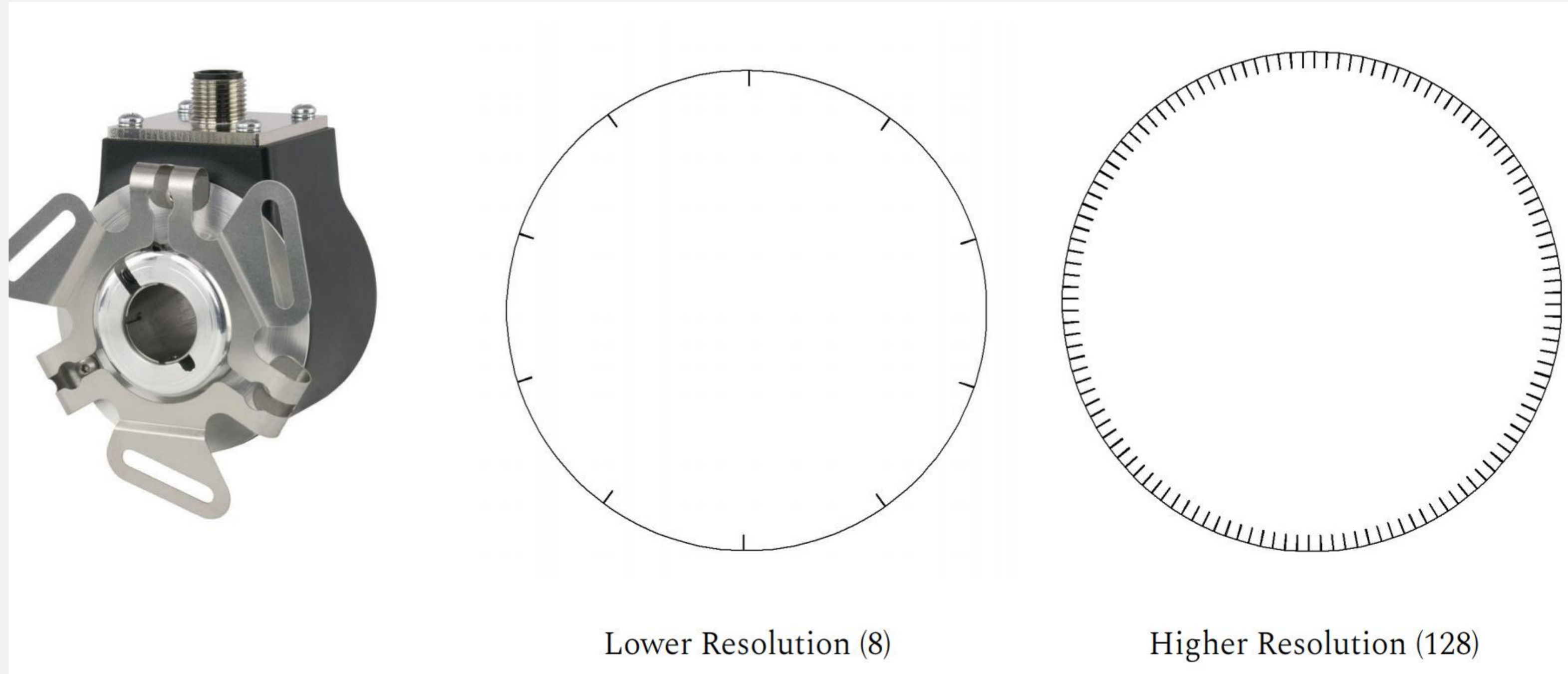
BACKGROUND

WHAT IS AN ENCODER?

Encoders are used to measure the number of ticks in a revolution. This can be translated to being very precise measurements of distance, velocity, and acceleration. They are useful in many design and manufacturing applications such as:

- I Conveyor belt operations
- I Heavy Machinery
- I Food and Beverage industries

EPC has encoders that can change their resolution. The 58TP can be programmed to have a resolution from 1 to 65,536



PRODUCT REQUIREMENTS



<i>General Description</i>	<i>Measure</i>	<i>Target</i>
HMI Integration	visualize variables, supply inputs, back end programming	motion control works as designed; user interface is self evident for people to use.
Operation time	staff	8 hours per day, enough to run continuously for the duration of a trade show
Easy set-up	Set up time and staff	Less than 15 minutes by 2 people
Engages audience	Attractive, interesting, user friendly	Finished (painted/anodized, no wires showing), logos applied

USER EXPERIENCE



ENGINEERING MODE

- I Success is much harder to achieve.
Smaller window for “success”
- I Manually change resolution of encoder
to achieve goal
- I Nothing will be preprogrammed
- I Calculator provided for math

CITIZEN MODE

- I Larger window for “success”
- I There will be different preprogrammed
resolutions to choose from on PLC
interface
- I Distances will be a whole numbers
- I Predetermined tables will be provided
for math

**Both Engineer and Citizen mode will have conversions
for distance per revolution of the stepper motor**

USER EXPERIENCE

SUCCESS ROUTINES

I One of three random success routines occur upon reaching desired distance

1. Flashing lights from an LED strip
2. Celebration music from speaker and screen will show “Congratulations!”
3. Motor will automatically dispense candy from a candy dispenser



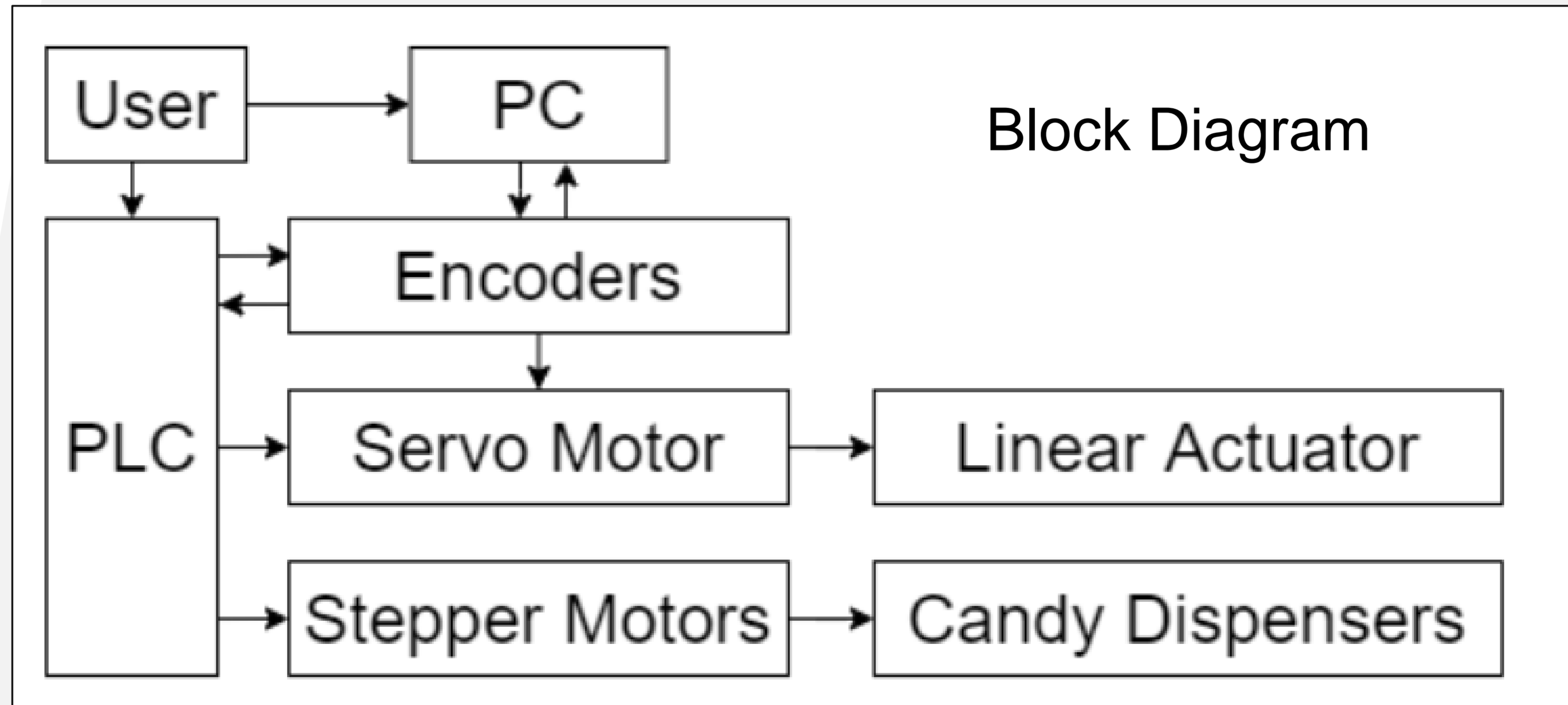
FAILURE ROUTINE

I If failure occurs, a sound will go off and the linear actuator will return back to the starting position

I PLC will say “try again”

I User will be informed how far off they were. Multiple attempts can be made to achieve success

CONCEPTUAL DESIGN



MANUFACTURING PROCESS



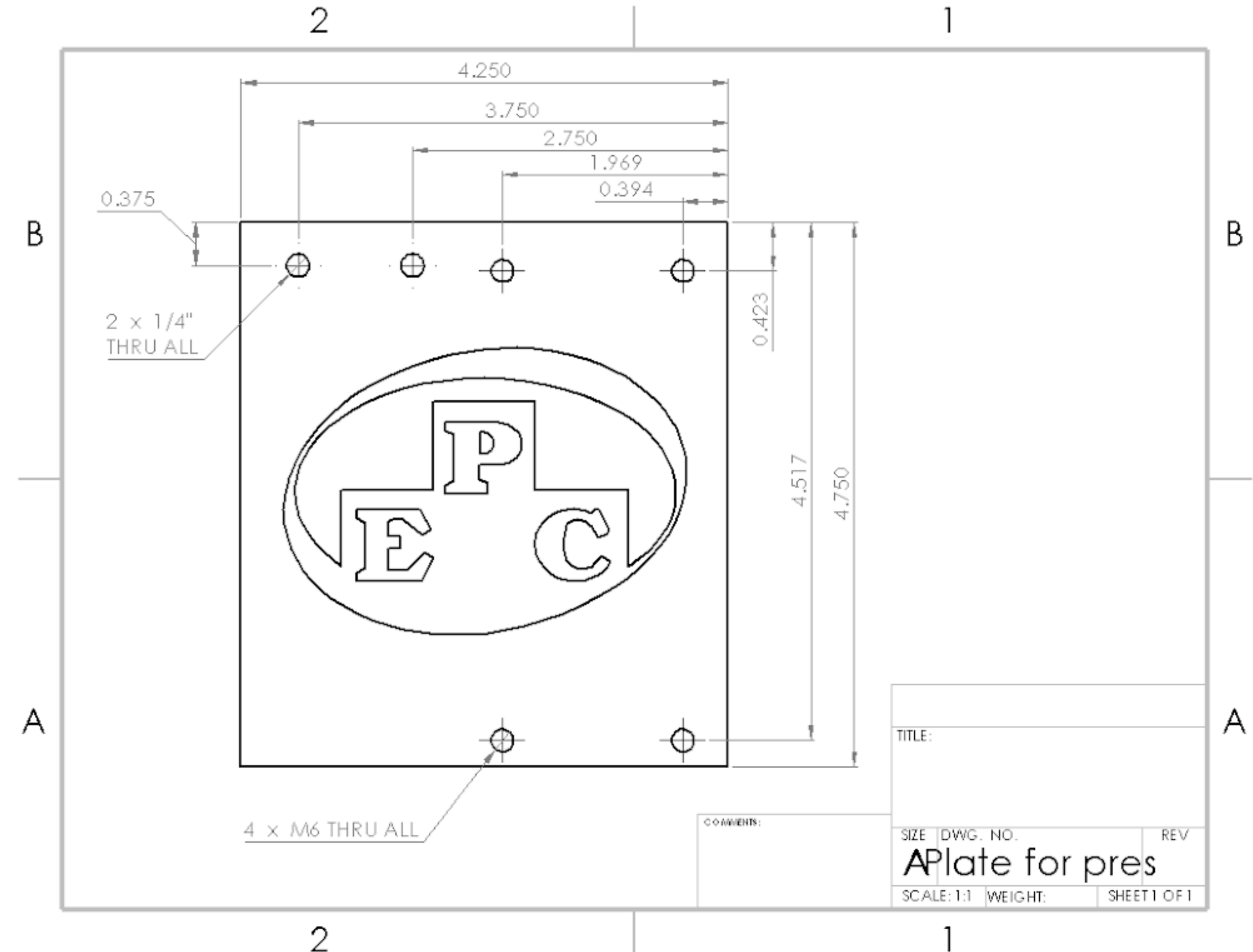
I Most parts were purchased from Amazon or other vendor sites in order to maintain a high degree of quality.

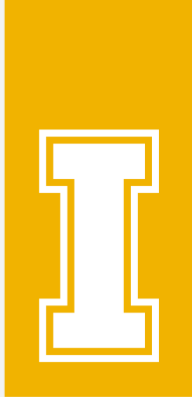
Purchased Parts

- I** Linear actuator
- I** Food dispenser
- I** Stepper motor

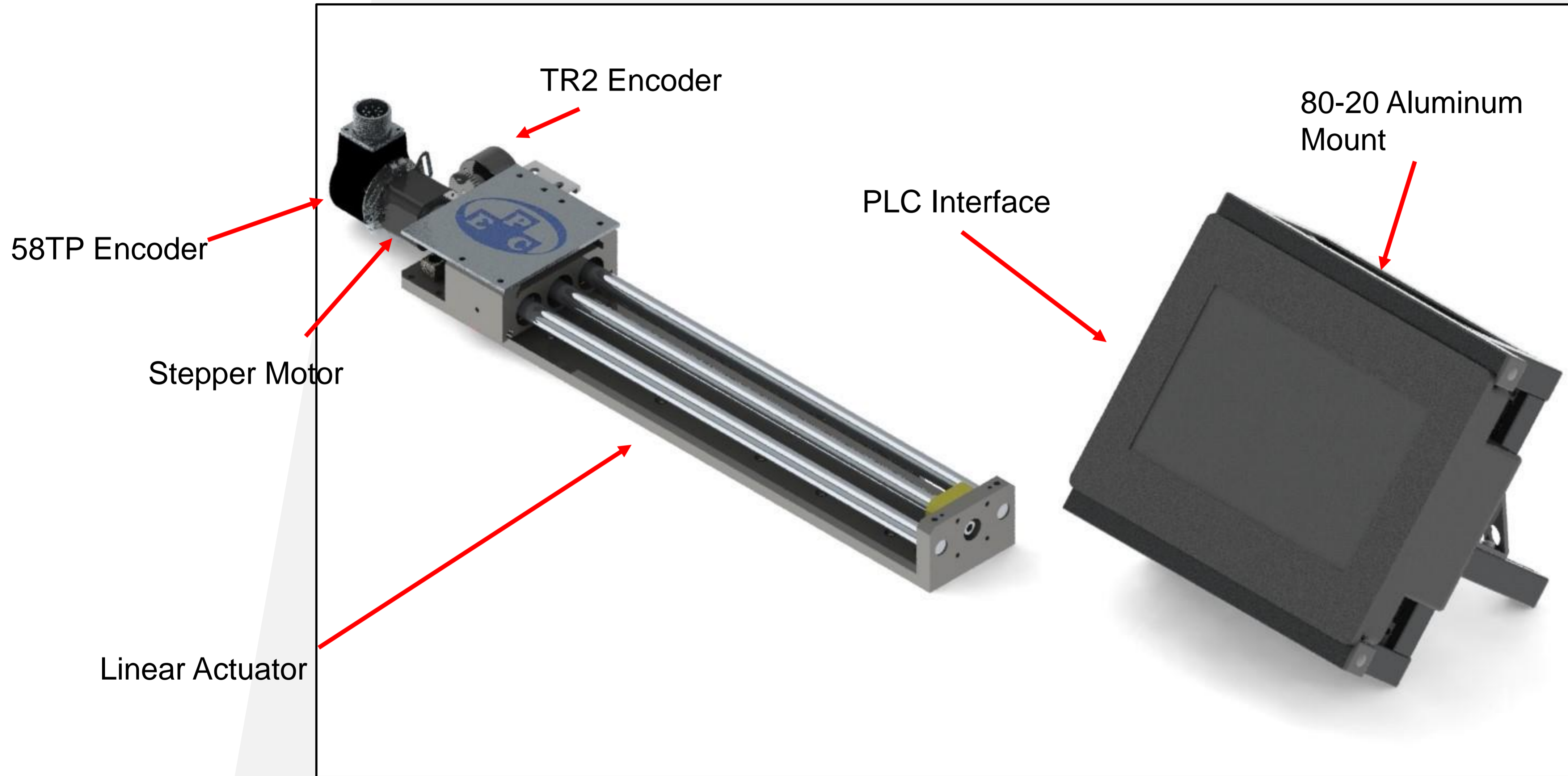
Fabricated Parts

- I** Custom fabricated plate with EPC logo
- I** Custom Fabricated 80-20 Aluminum mount to hold PLC

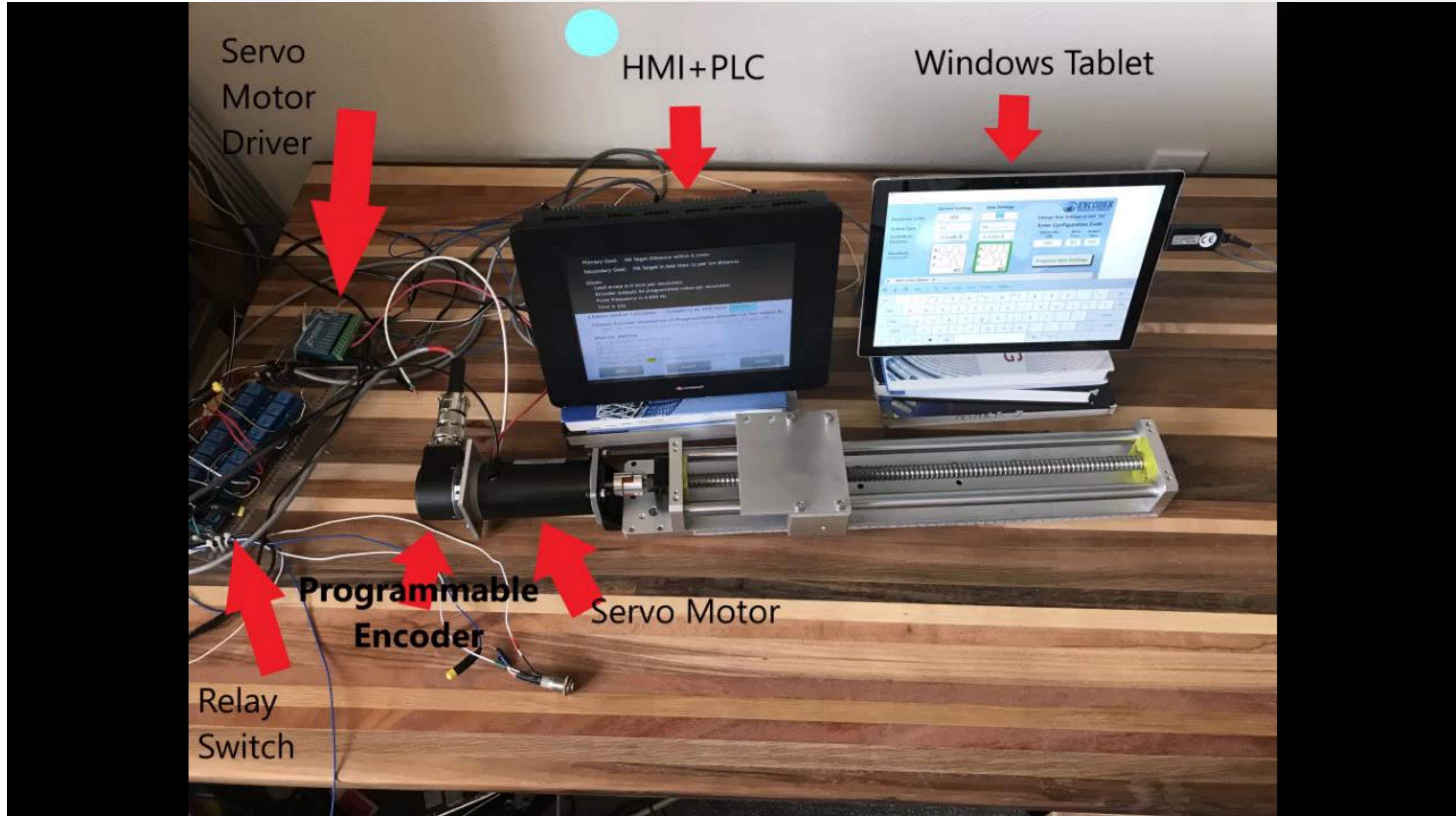




FINAL DESIGN



FINAL PROTOTYPE



DESIGN VALIDATION EXAMPLE(S)



Can the PLC read the Linear encoder?	02/10/20	1/28/20	The PLC can read the encoder	P
Can the PLC run the stepper motor?		01/28/20	The PLC can run the stepper.	P
Can the PLC rotate the stepper motor a given number of rotations?	02/10/20	2/19/20	it can run a given number of rotations	P
Can the PLC run the servo motor?	02/14/20	2/23/20	the PLC runs the stepper	P
Can the PLC rotate the servo motor a given number of rotations?	02/21	2/23/20	it can run a given number of rotations	P

Mark

RECOMMENDATIONS/NEXT STEPS

- I Purchase 80/20 components from drawing package and assemble the Unitronics HMI/PLC frame
- I Get familiarized with the code and ladder logic of the PLC
- I Install motor for candy dispenser to run success routine
- I Complete failure/exception coding
- I Validate TR2 24V compatibility

PROJECT LEARNING



Tanner

- I Compiling external part numbers to create BOM for purchasing
- I Working with clients while demand/ideas morph and circumstances change
- I Understanding the importance of interdisciplinary work in an engineering project

Mark

- I Designing a switch for high speed data transfer requires shielding to prevent “crosstalk”
- I High speed outputs are not short circuit protected
- I Servo drivers low voltage input impedances are not all equal

Jake

- I Web design and presenting our project in a highly professional manner
- I Working with clients and adapting our design to meet their needs
- I Adapting the project and work to meet with changing external environment that were beyond our control