Tech Expo, Spring 2026– Team 49

Injection Molding Machine Control System

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PURDUE UNIVERSITY
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Problem Statement

Create an electrical control system for a non-functioning injection molding machine. The control system must operate various functions including injection, clamping, heating, and part ejection. In addition to the operation, there must be an emergency stop circuit that completely cuts all power to the machine in the case of machine runaway or pressing of the manual E-Stop button.

Customer Background

The Purdue Polytechnic Institute Kokomo campus offers various Engineering Technology degrees, with an emphasis on electrical and mechanical applications. It is committed to dedicated and flexible learning while preparing students for industry and beyond.

Requirements

Operational:

- Injection plunger movement
- Mold clamping
- Part ejection
- Band heater temperature control
- Coolant pump activation
- Pellet feed solenoid opening

Safety:

- A dedicated E-Stop must cut all machine power in the event of machine runaway or operator activation
- All operation must run off 120 VAC wall power

UI Requirements:

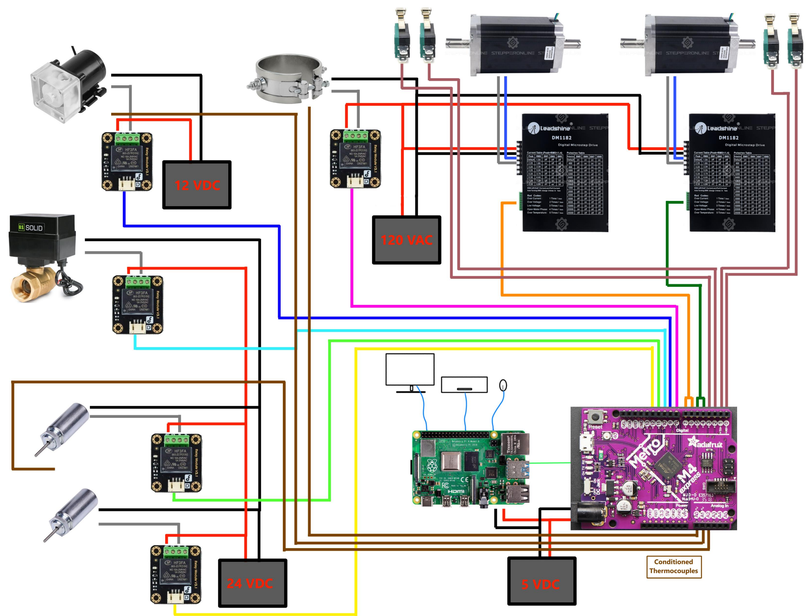
- Clean and organized
- Display cycle time, band heater temperature, and part count

Experimentation and Concepts

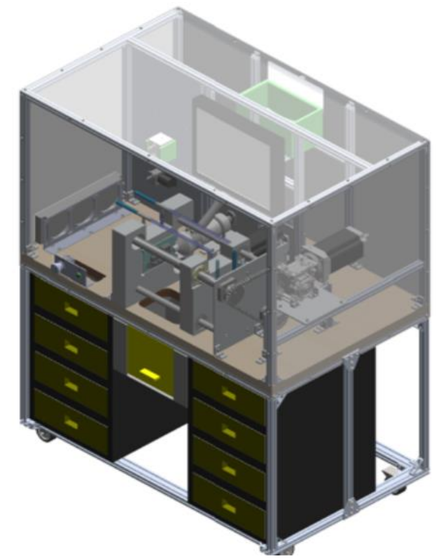
The final design for the control system considered many different concepts:

- A centralized system was chosen over a distributed control system.
- A centralized system allowed for the use of one control device to run the entire system instead of less powerful devices working together.
- This led to easier communication, timing, and needing fewer devices to run.
- It was decided to use two main devices: a Raspberry PI & an Adafruit Metro.
- The Adafruit Metro handles controlling the injection and mold position motors, controlling the band heater for melting, controlling plastic delivery to the melting chamber, part ejection solenoids, and more
- The Raspberry PI 4 handles the GUI, which handles process variables, like band heater temp, plastic volume, and more. It also updates the user on the progress of the molding process in real time.

Final Design



Testing and Results



Req #	Test Name	Test Description	Test Results
1	Continuity	Confirm continuity between all points noted by schematic.	All p2p tests were 0.2 ohms or less.
2	Motors	Stepper motors run with no issues and proper acceleration.	Injection motor good. Clamp motor failing and thumps.
3	Band Heater	Band heater heats to 130 C with 120 V applied.	Band heater reached 150 C.
4	Safety Circuit	All parts of the safety circuit cut power to the machine when pressed or broken.	Safety circuit works as expected.
5	Temperature Control	At the board level, simulating the thermistor results in turning the band heat on or off.	Band heater turns on and off at appropriate signal levels.
6	Program Status	Neo Pixel LED changes colors according to machine state.	Neo Pixel changes colors appropriately.