

## Project Scope

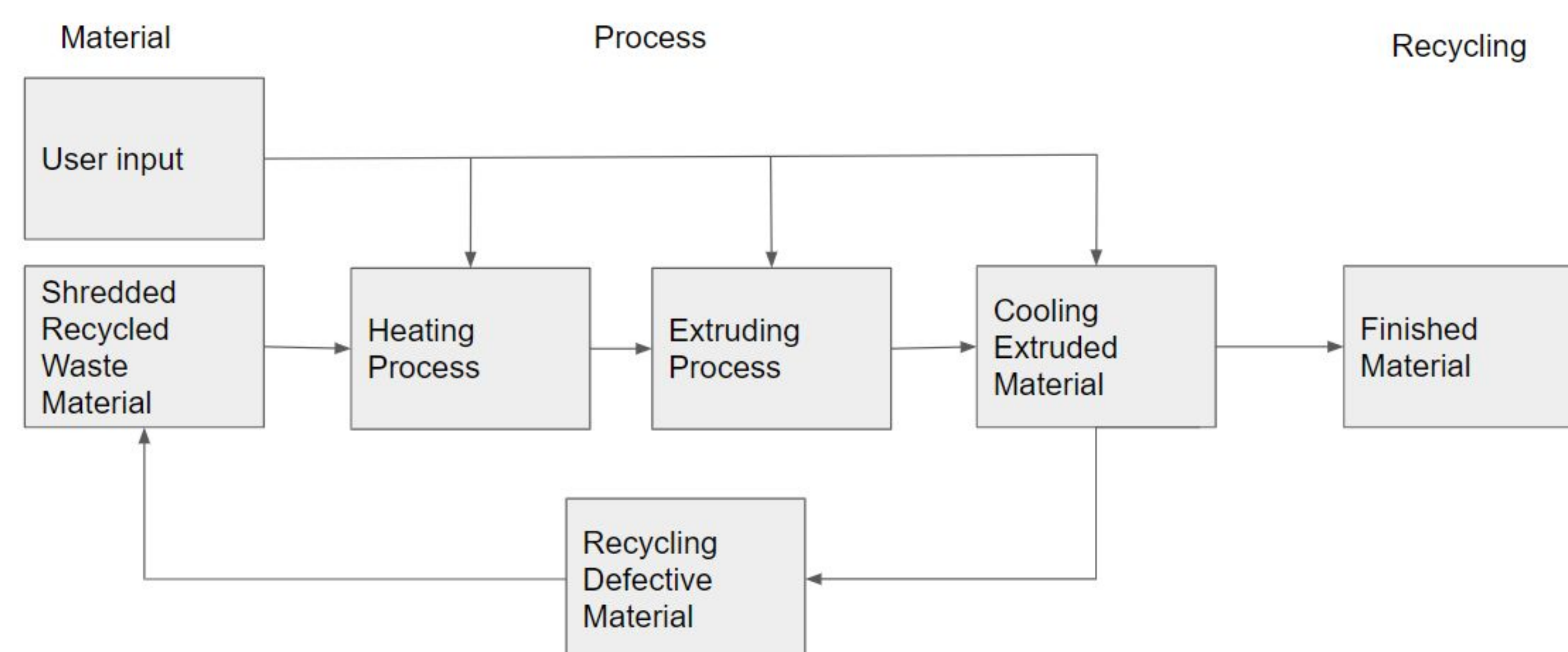
**Background:** As the up and coming rapid prototyping process, 3D printing has become popular among companies and universities alike. As UMBC uses 3D printing in its design classes and laboratory work, there's plenty of failed prints waiting to be discarded or recycled.

**Task:** Manufacture a machine that can accept shredded plastic and turn it into extruded plastic filament. The filament would need to be one continuous strand with a consistent thickness and roundness.

## System Requirements

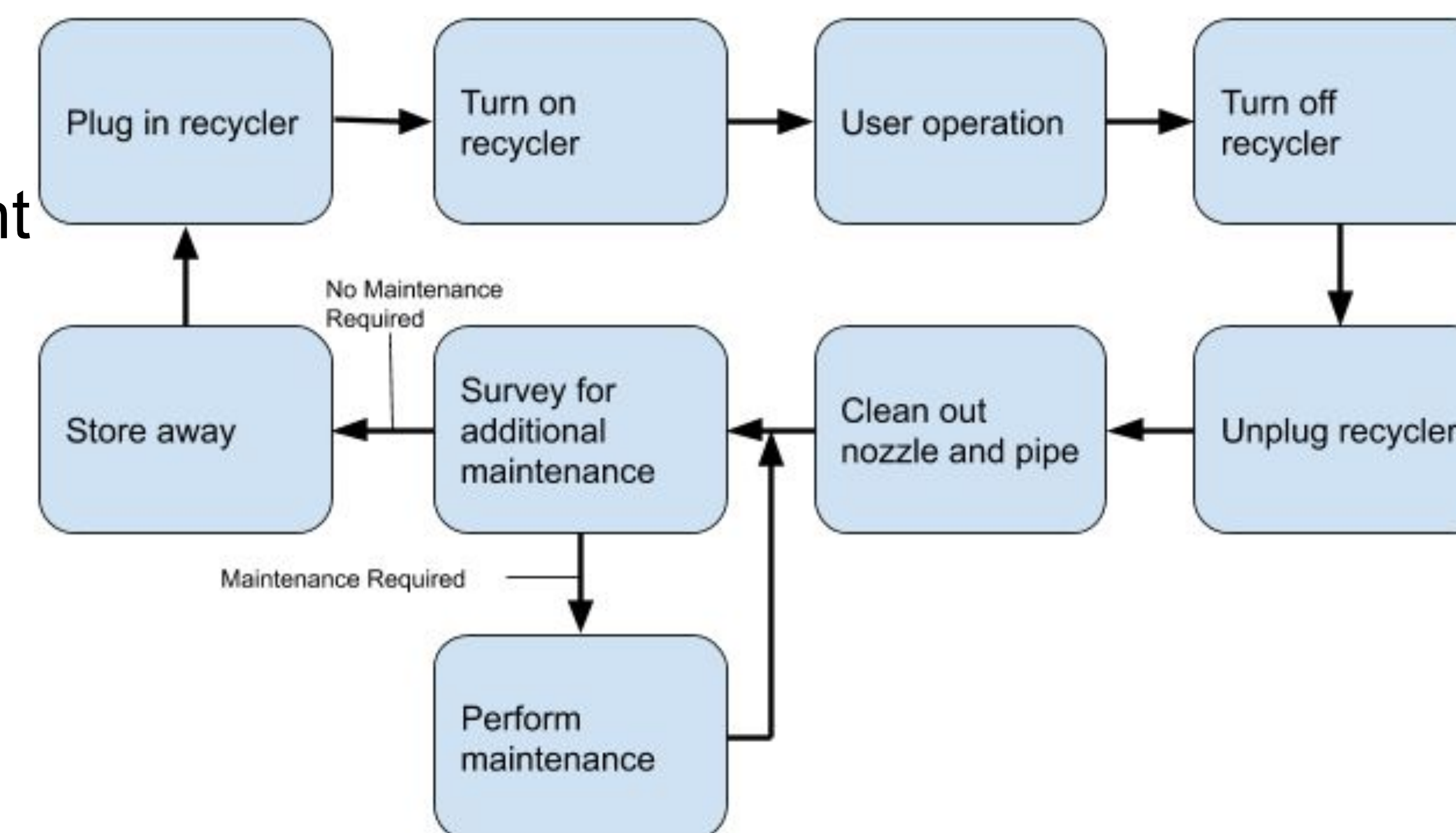
Extruded filament shall be a continuous strand. The filament shall also maintain a constant diameter of  $1.75 \pm 0.1$  mm. Industry standard 1.75mm filament has a tolerance of  $\pm 0.05$  mm, but that is for industrial scale operations in professional companies. Extruded filament shall have a roundness of  $>90\%$ .

**Figure 1:** Functional Block Diagram

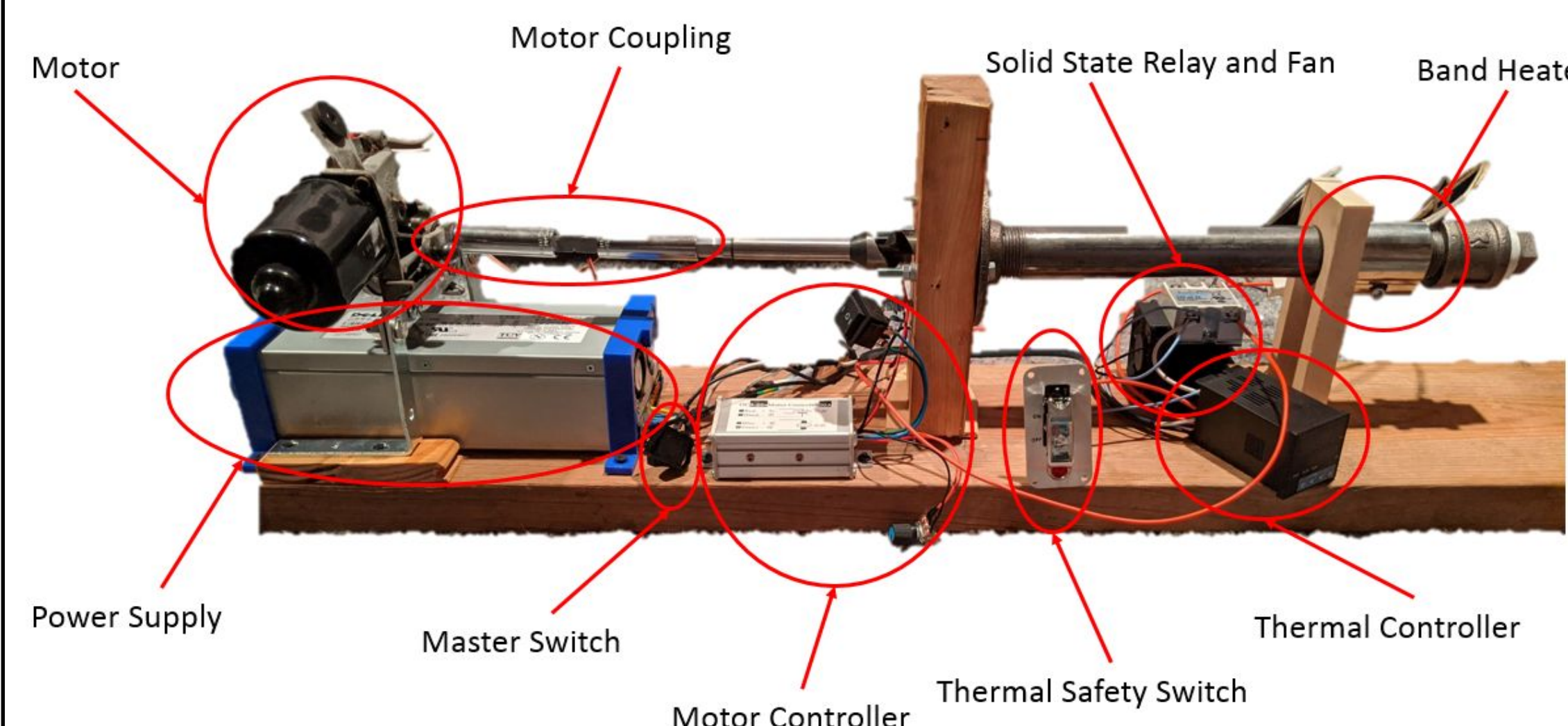


## Mission Scenario

**Figure 2:** The diagram to the right shows the mission scenario diagram that the user will follow when operating the machine.

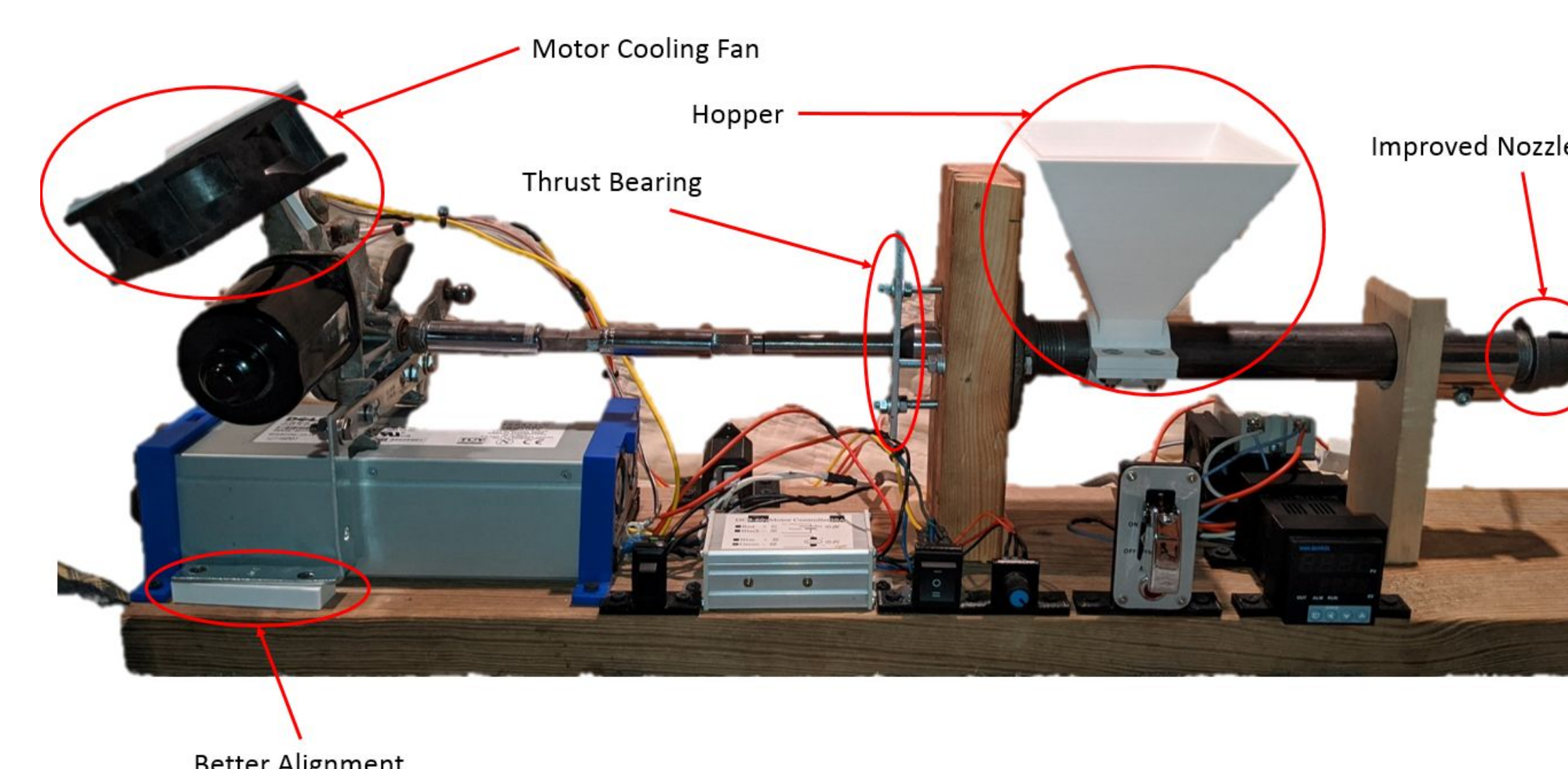


## Prototypes

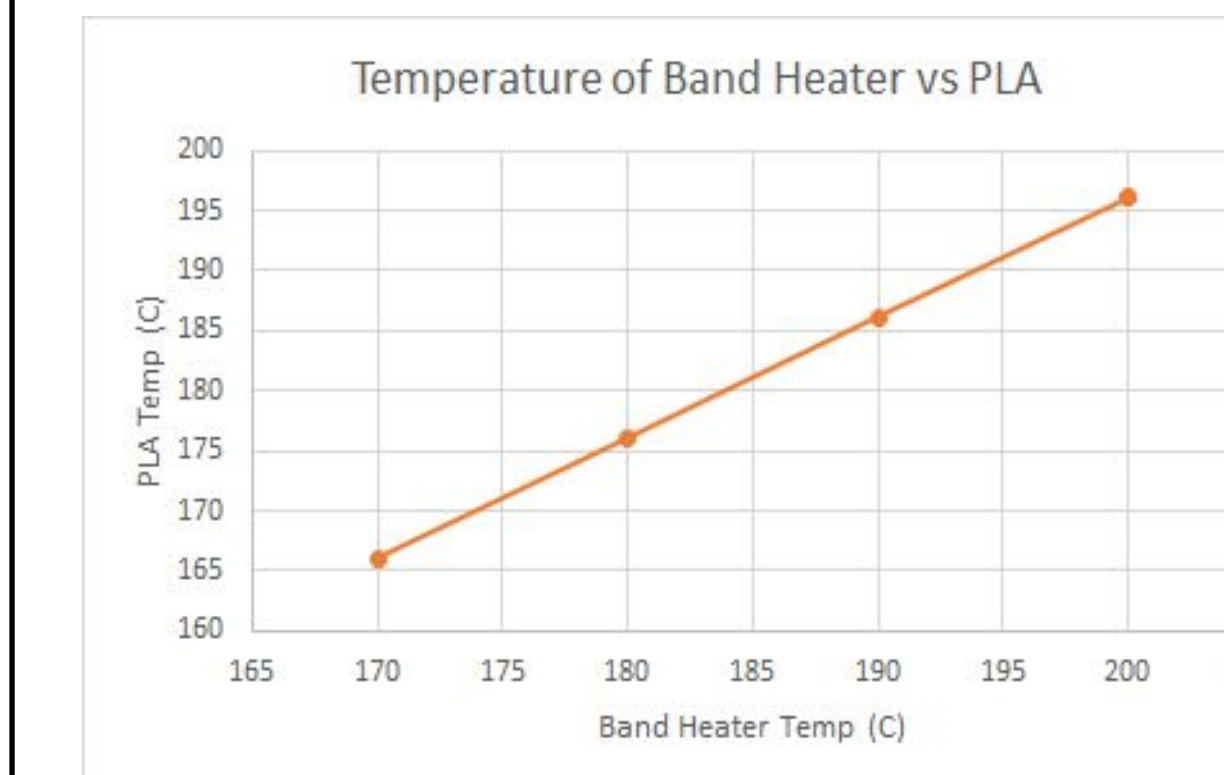


**Figure 3:** The prototype to the left was the first functional prototype that was constructed. It allowed testing of all critical systems.

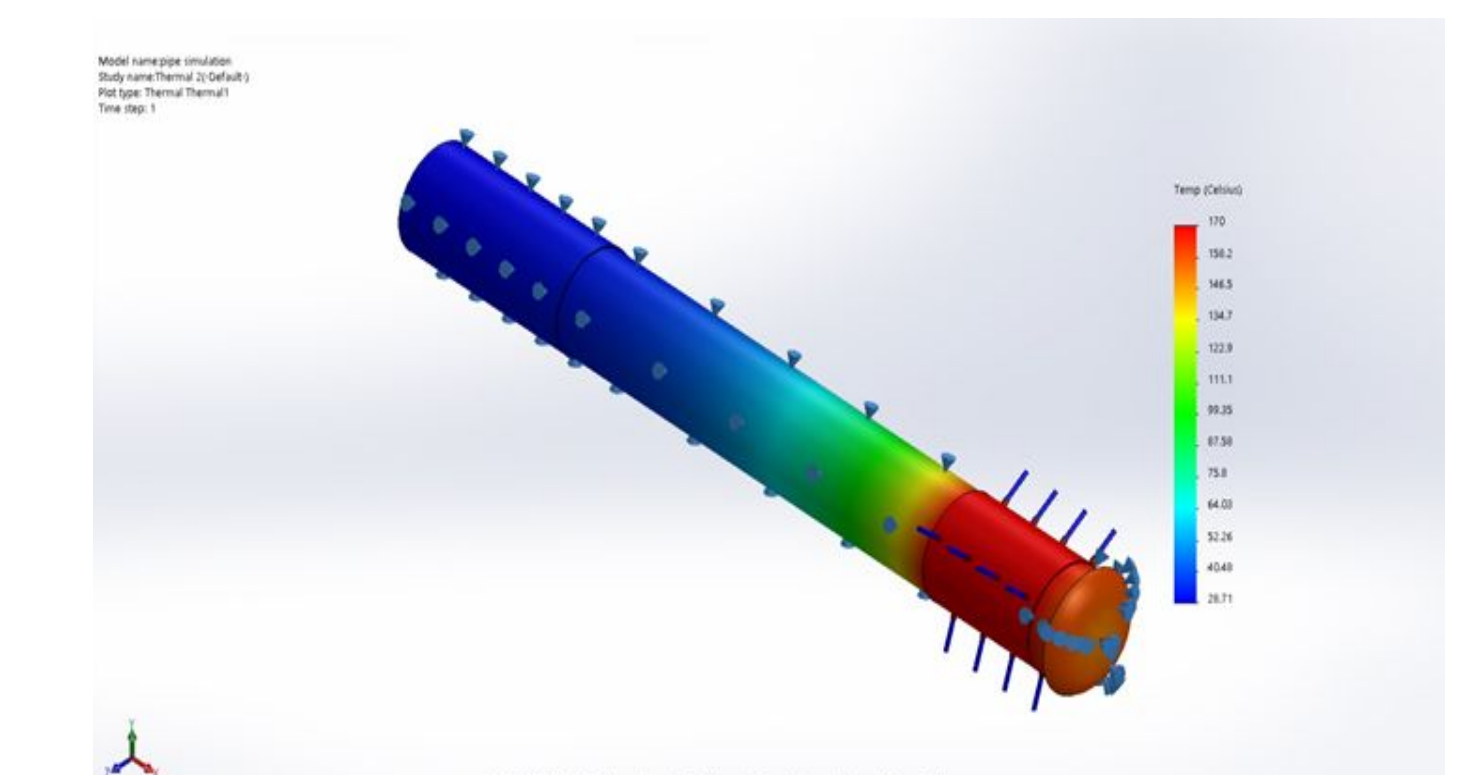
**Figure 4:** The prototype to the right was the next prototype iteration. With this prototype, the recycled filament was successfully extruded.



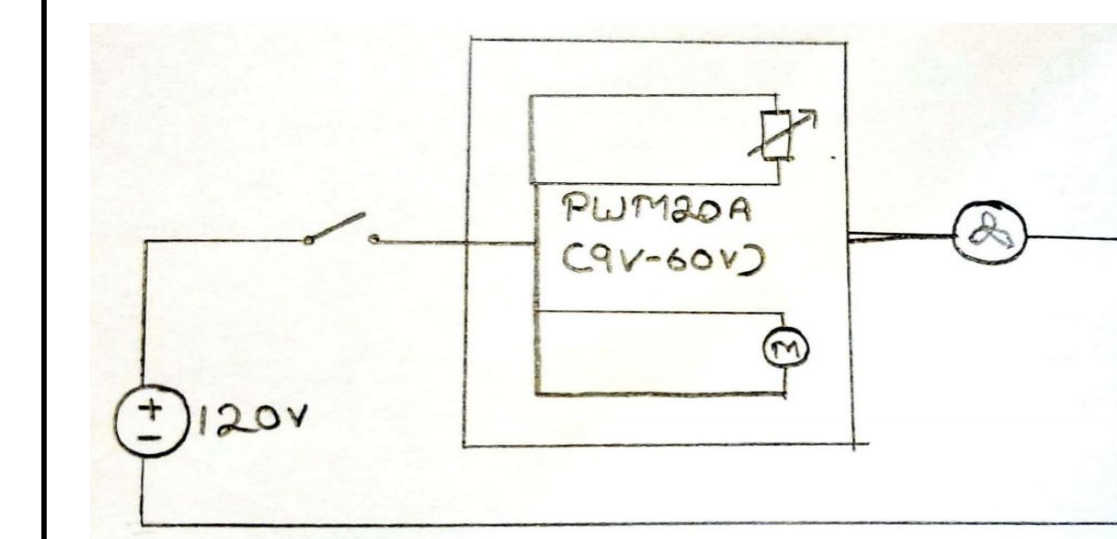
## Design and Development



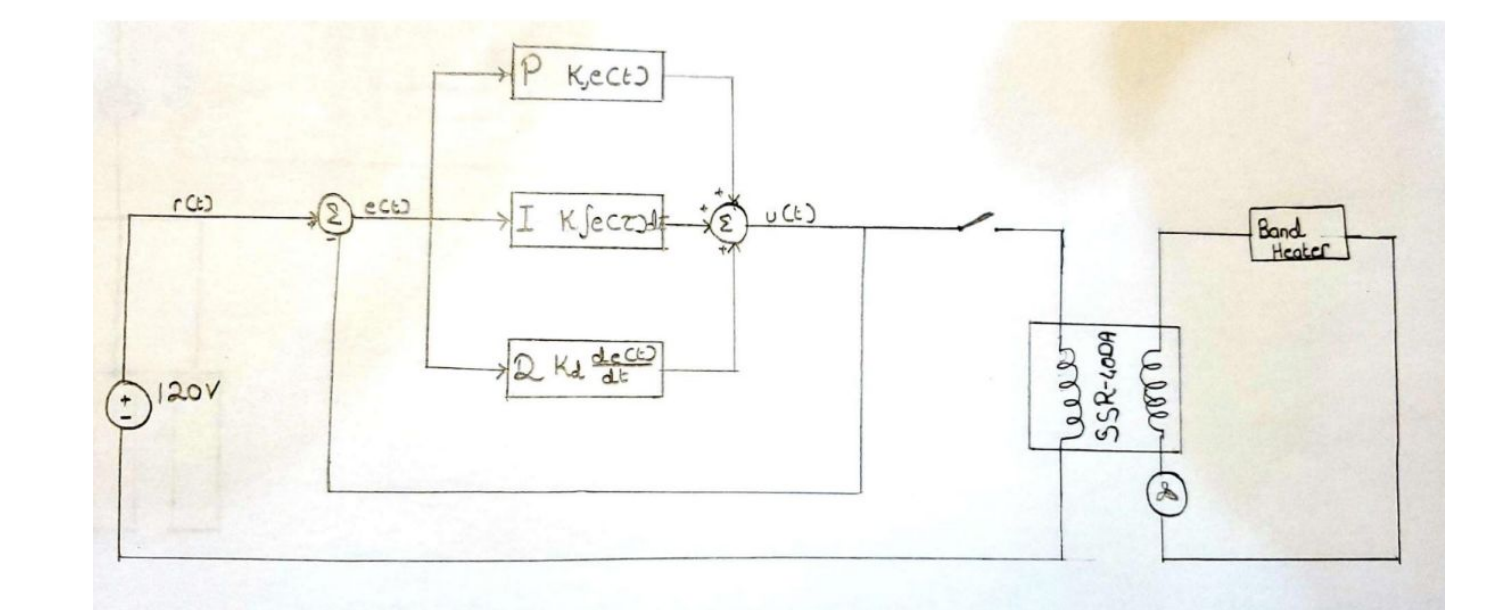
**Figure 5:** Linear Slope found using Fourier's Law. There's a  $4^{\circ}\text{C}$  difference between the band heater and PLA



**Figure 6:** Simulation of the band heaters effect on the pipe. 25% of the pipe is hot enough to melt the PLA when the band heater is at its max temperature ( $170^{\circ}\text{C}$ ).



**Figure 7A:** First part of circuit consisting a motor controller, motor, and a fan



**Figure 7B:** Second part of the circuit consisting of the PID controller, Solid state relay, fan, and a band heater

## Future Work

- More powerful band heater
- Correct nozzle size
- Improve consistency
  - Optimize flow rate
  - Angle machine