

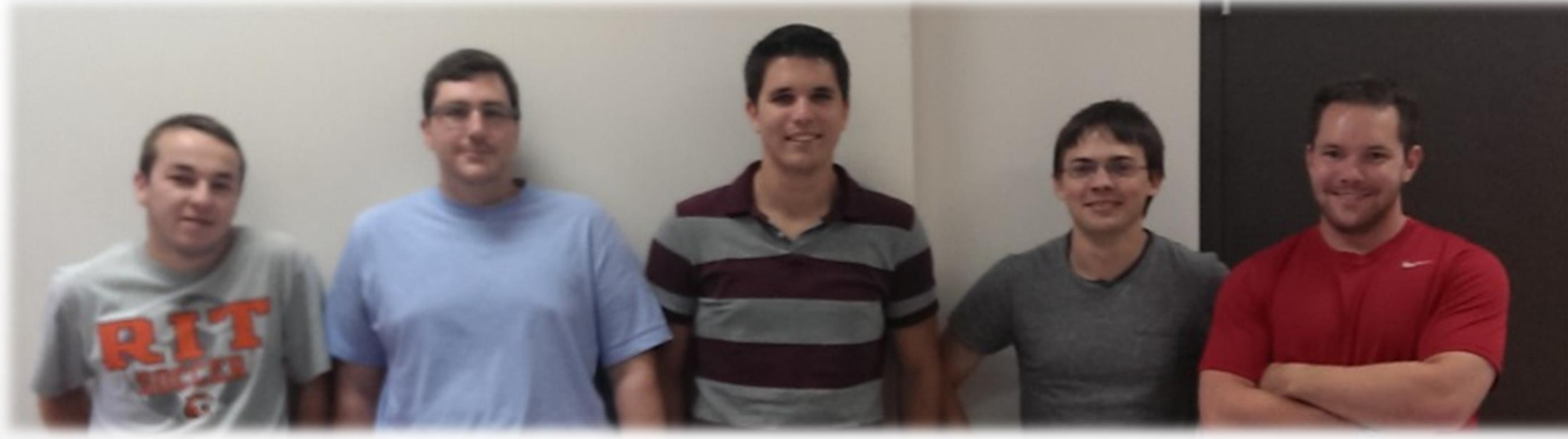
# P14551: Multi-Process 3-D Printer

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## Customer

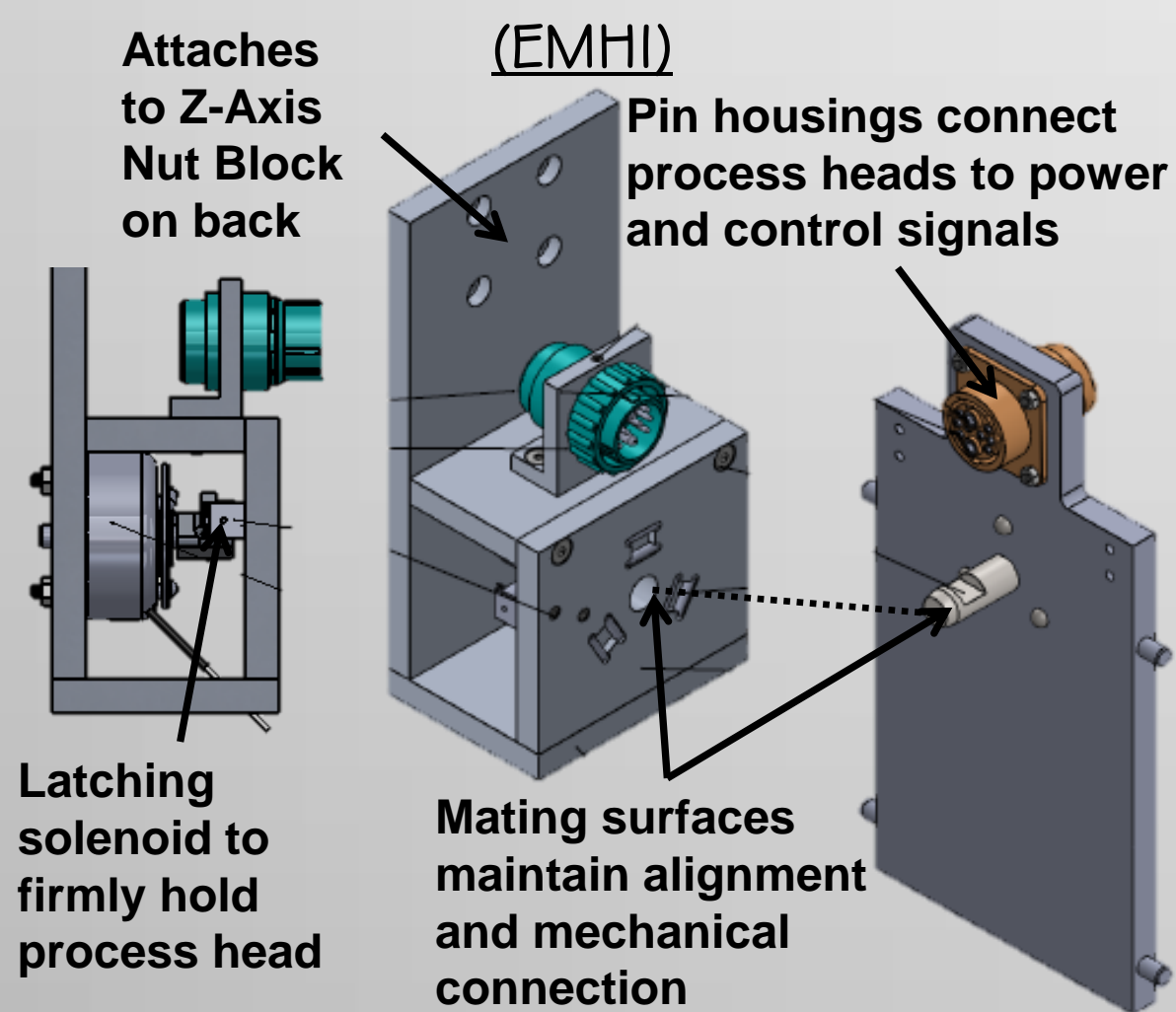
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## Objective

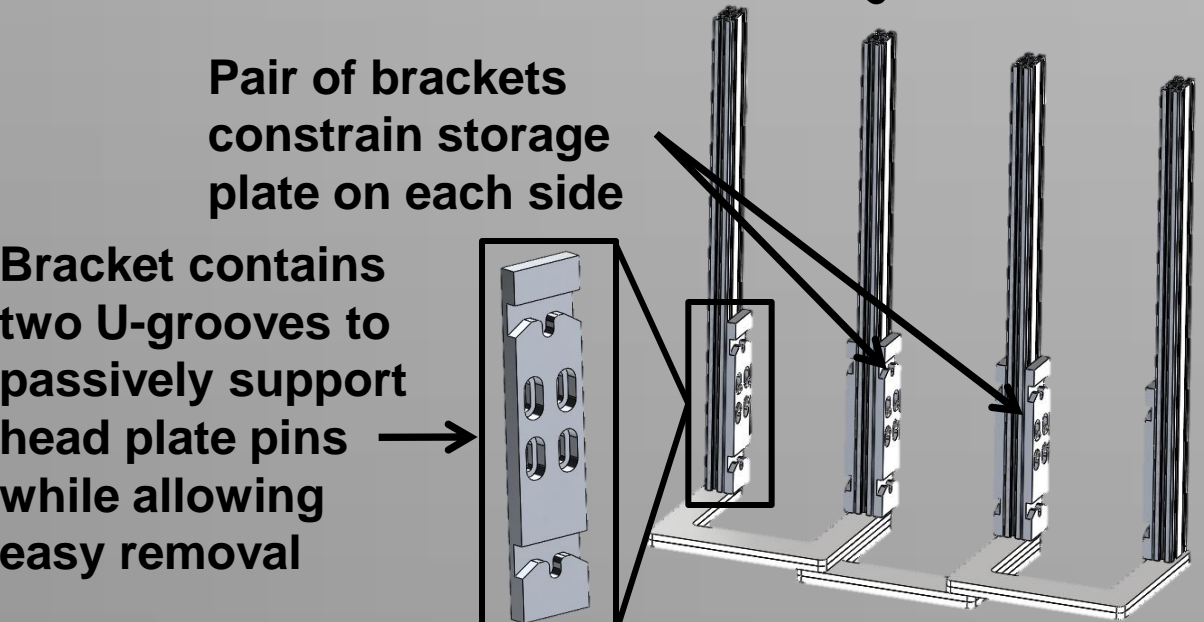
To develop a 3D printing system capable of executing both additive and subtractive processes through the design and implementation of a unique process head interface system while simultaneously minimizing system cost to appeal to the hobbyist market.

## Electrical/Mechanical Head Interface (EMHI)



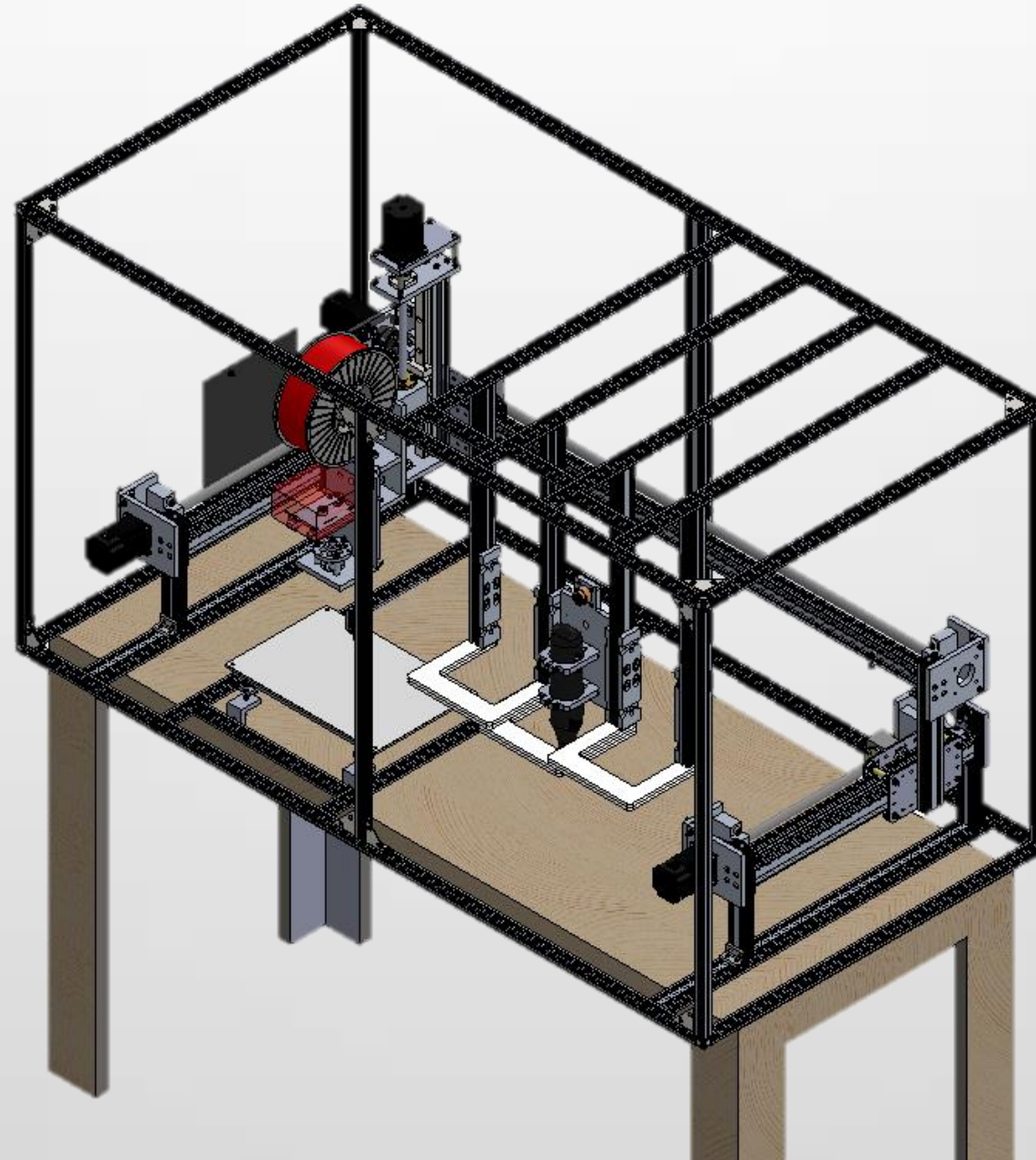
- Interface between the motion system and process heads that allows the system to utilize any arbitrary process head that has been appropriately configured.
- Mechanical Connection: A set of three pairs of axially aligned dowel-bearing mates with a centered dowel pin
- Electrical Connection; A commercially available pin housing with 2 power and 8 data pins

## Process Head Storage

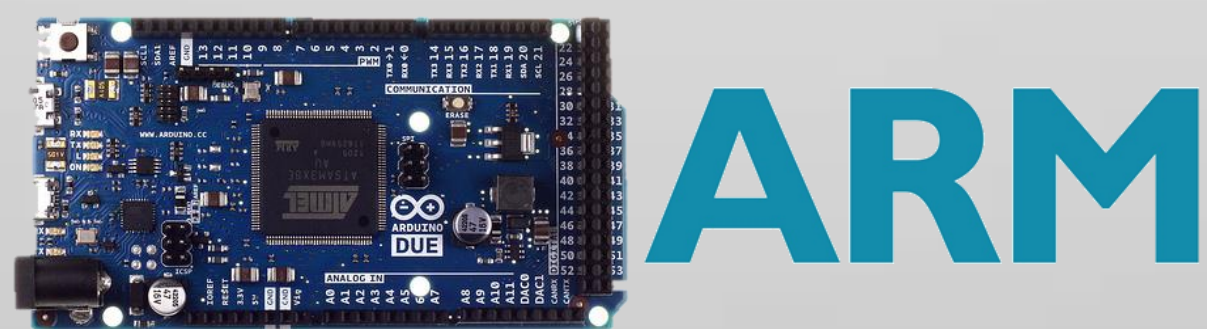


Designed to maximize simplicity, this subsystem is located in front of one of the access doors to easily allow an operator to mount or remove process heads while providing a stable passive storage solution

## Overall System

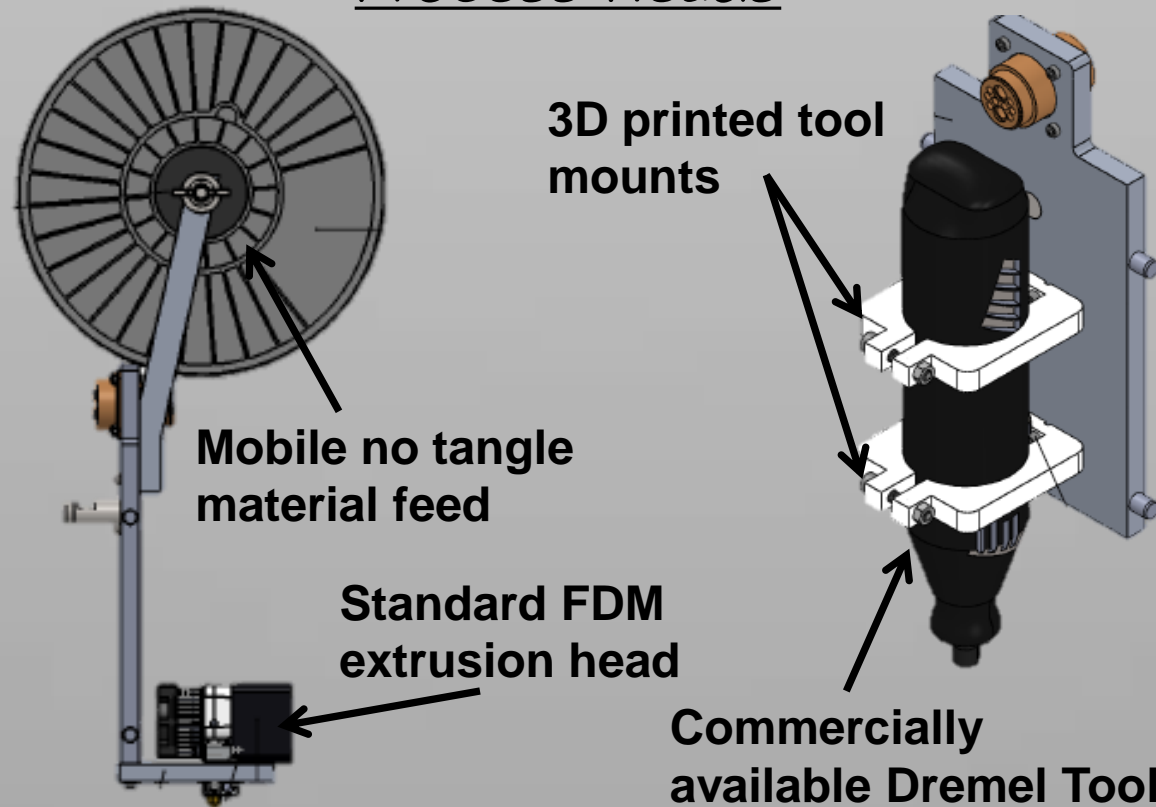


## System Control



- The Arduino Due with ARM Cortex-M3 CPU utilized for entire system control
- Firmware development based on modification of Repetier's open source 3D printer software
- Arduino accepts G-code commands from Repetier Host interactive GUI.

## Process Heads

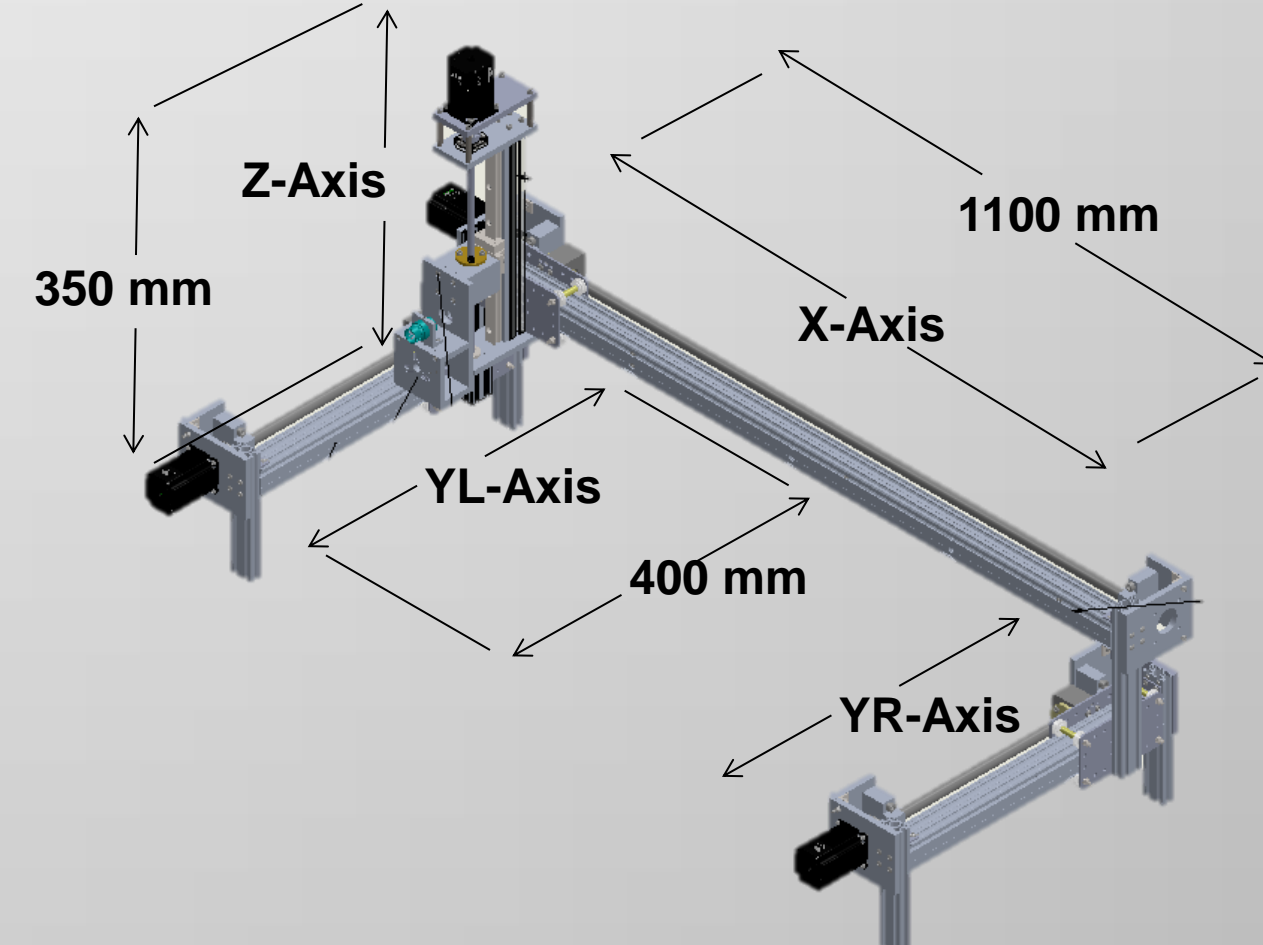


- Two representative process heads were implemented:
  - One additive and one subtractive
- FDM extruder and Dremel Tool
- System designed to store up to three process heads at one time

## System Constraints

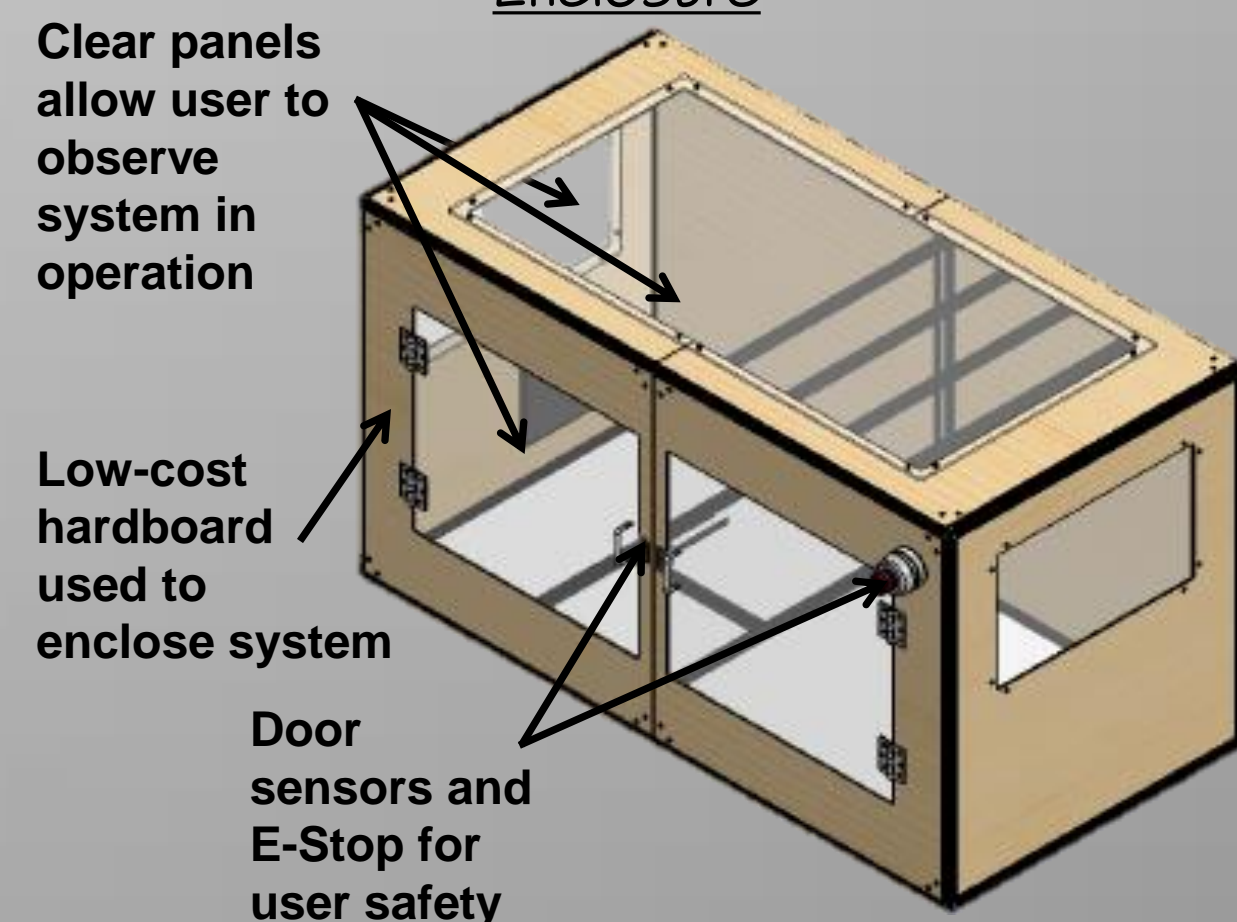
- Open source mechanical design
- Cost under \$5000 to produce
- Reuse existing materials when possible
- Fit on a standard lab bench
- Utilize open source or low cost software
- Implement an automated process head storage and retrieval cycle

## Motion System



- XY axes use MakerRail extruded aluminum for linear constraint
- Z axis utilizes a 5DOF constrained precision linear rail
- NEMA 23 stepper motors with integrated controllers and encoders used on each of the drive axes

## Enclosure



- Exterior made of hardboard due to strength, low cost, and surface finish
- Frame made from extruded aluminum
- Doors and windows made of Polycarbonate sheeting
- Overall design focused on providing easy access and panel removal