DESIGN AND DEVELOPMENT OF AN EXTRUSION-BASED 2.5D/3D PRINTER FOR ELECTRONIC PACKAGING

2.5/3D SYRINGE EXTRUSION PRINTER

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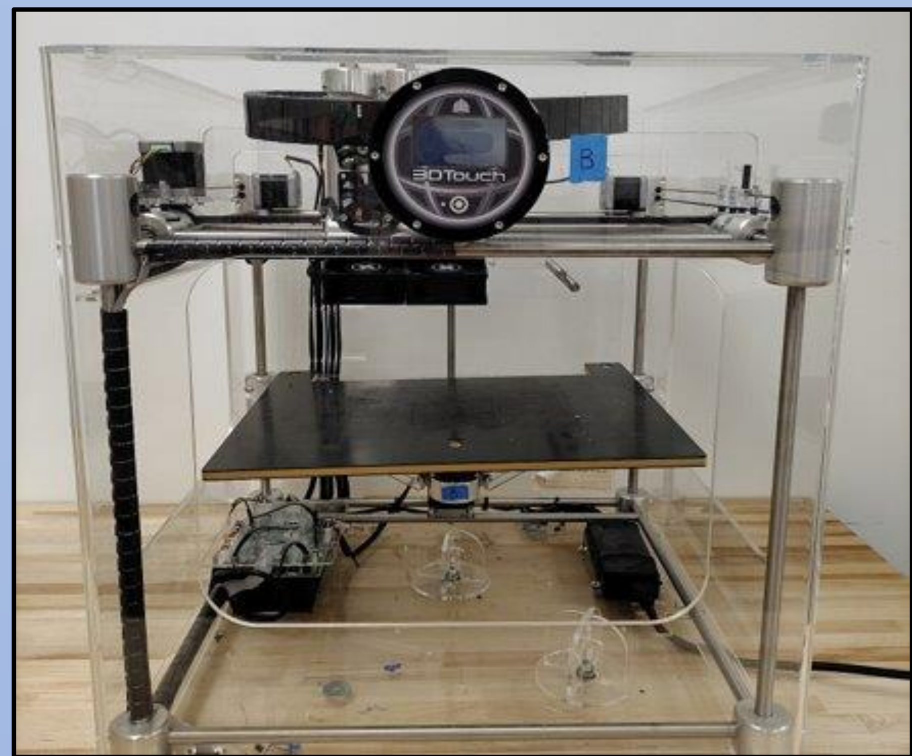
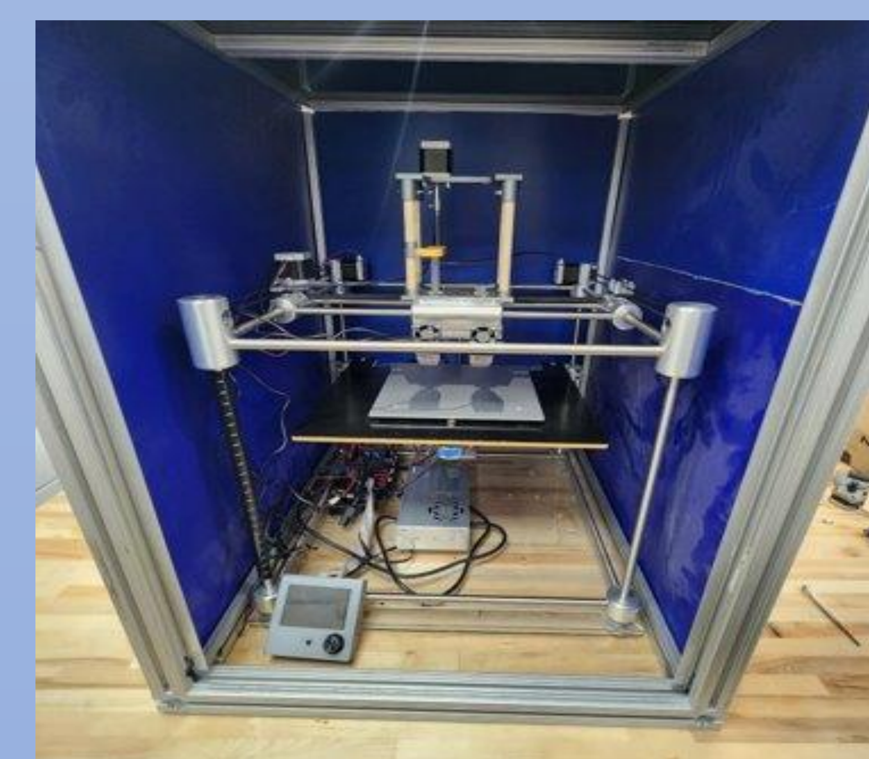




Project Overview:

The overall driving force of the project was to take out the original extrusion heads that melted thermal plastic materials and replace them with a syringe that would extrude resin and paste-like materials such as silicone. The materials that will be used in the syringe need to also be cured using a laser. For that reason, we integrated the use of a 500mW blue laser that will cure the resin or paste-like material as it is being distributed on the substrate. Major changes involved designing a new carriage for the syringes, adding curing lasers, wiring and adding electrical components, programming, building a safety enclosure, and integrating everything we could from the old 3D printer. We also had to purchase a new control board because the old one had out-of-data software that wouldn't work with our new design. We opted to buy the new Octopus V1.1 control board from BIGTREETECH which gives the printer a faster processing speed and the ability to print using a .stl file format, unlike the old control board. We upgraded the old bed to a heated bed to decrease warpage in our parts. It also has the capability to print wirelessly if you hook it up to a Raspberry Pi.

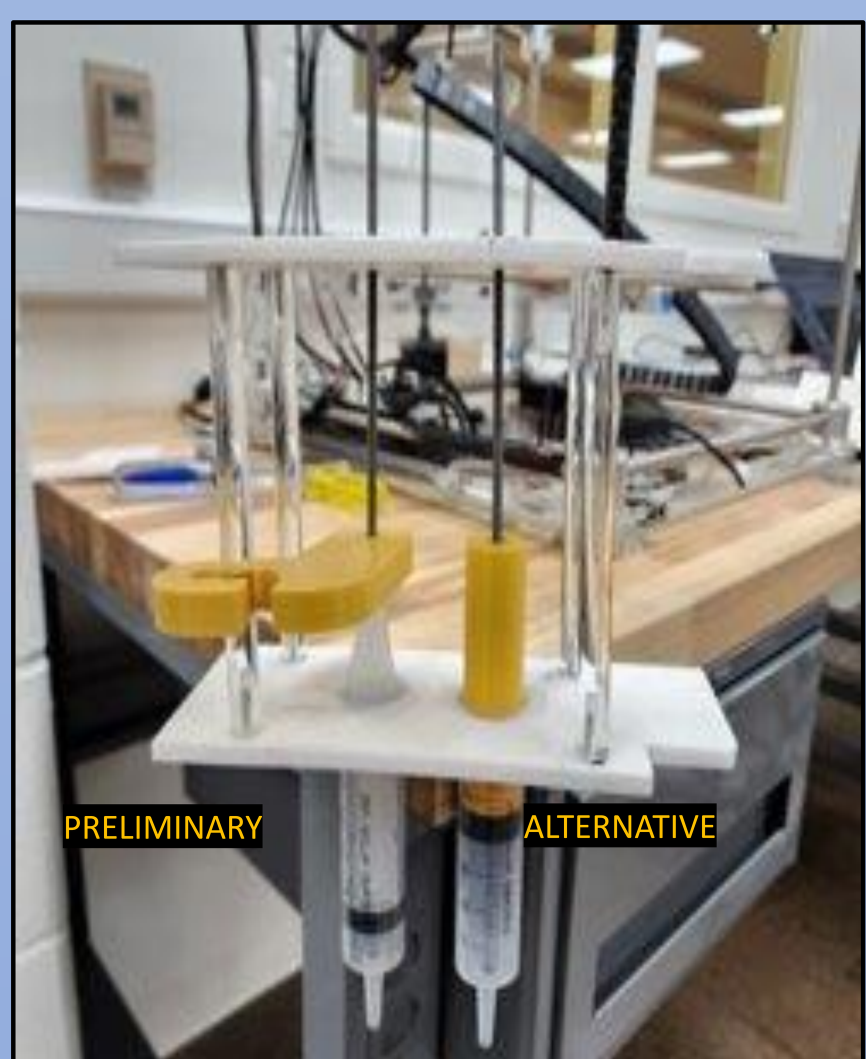
The improvements made to create this printer will make it faster and easier to use. The biggest outcome will be the ability to swap materials quickly at any time. The syringes used are cheap and easily available which means you can have many syringes on hand filled with various materials. There is also a heater for the syringe if the consistency of the material you are using needs to be warmed up to flow freely through the nozzle. The syringes use standard extrusion tips which allow you to swap them out to change sizes.

Extrusion Based Printing:

This is a method of printing that involves depositing material layer by layer onto a print bed through a nozzle from a print head or similar apparatus to create a 3-dimensional object. This is commonly known as Fused Deposition Modeling (FDM) and these printers are widely available and frequently utilized for producing a variety of prototypes, models, and even functioning parts. This 3D printer utilizes a syringe mechanism instead of a traditional filament-fed extruder. Syringe-based extrusion has the ability to print using a wider range of materials hence it can do semi-solid extrusion of materials with different viscosities. Extrusion-based printer prices vary widely on several factors but entry-level printers can start at around $200 to $500, Mid-range printers can be between $500 and $2,000 and professional or industrial-grade extrusion printers can be anywhere between $2,000 to $10,000

- DELIVERABLES
  - FABRICATE FEATURES AS SMALL AS 1 X 1 X 0.5 MM
  - HEATED BED--------
  - HEATED EXTRUDER--------
  - UV LASER SINTERING OPTION
  - TYPE OF PROGRAMMING
  - ENCLOSURE

PRINTER HEAD DESIGNS



Pros

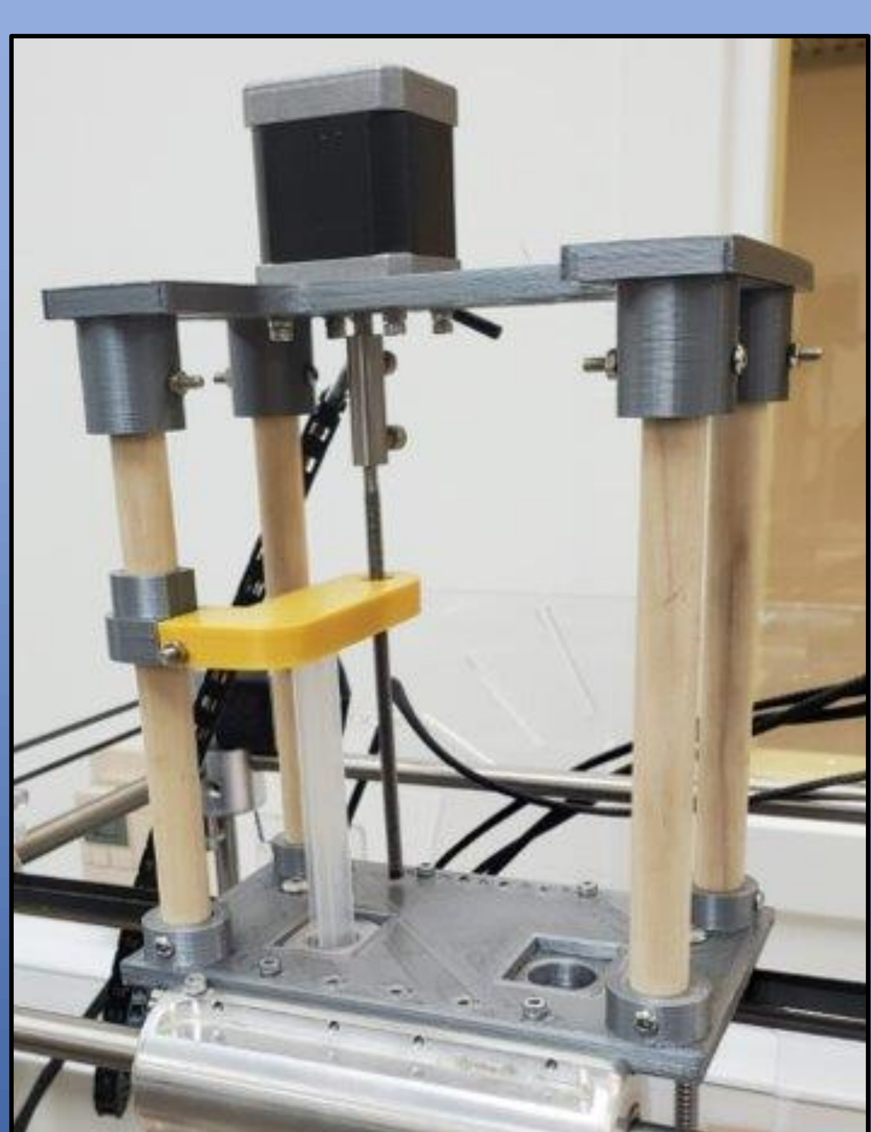
Preliminary Design
- Prevents unwanted rotational movement
- Compatible with different syringes

Alternative
- Direct transmission of motion

Cons

Preliminary Design
- Creates more friction
- The plunger stays down when done with the print

Alternative
- Fits one syringe type
- The rotational friction would be a concern



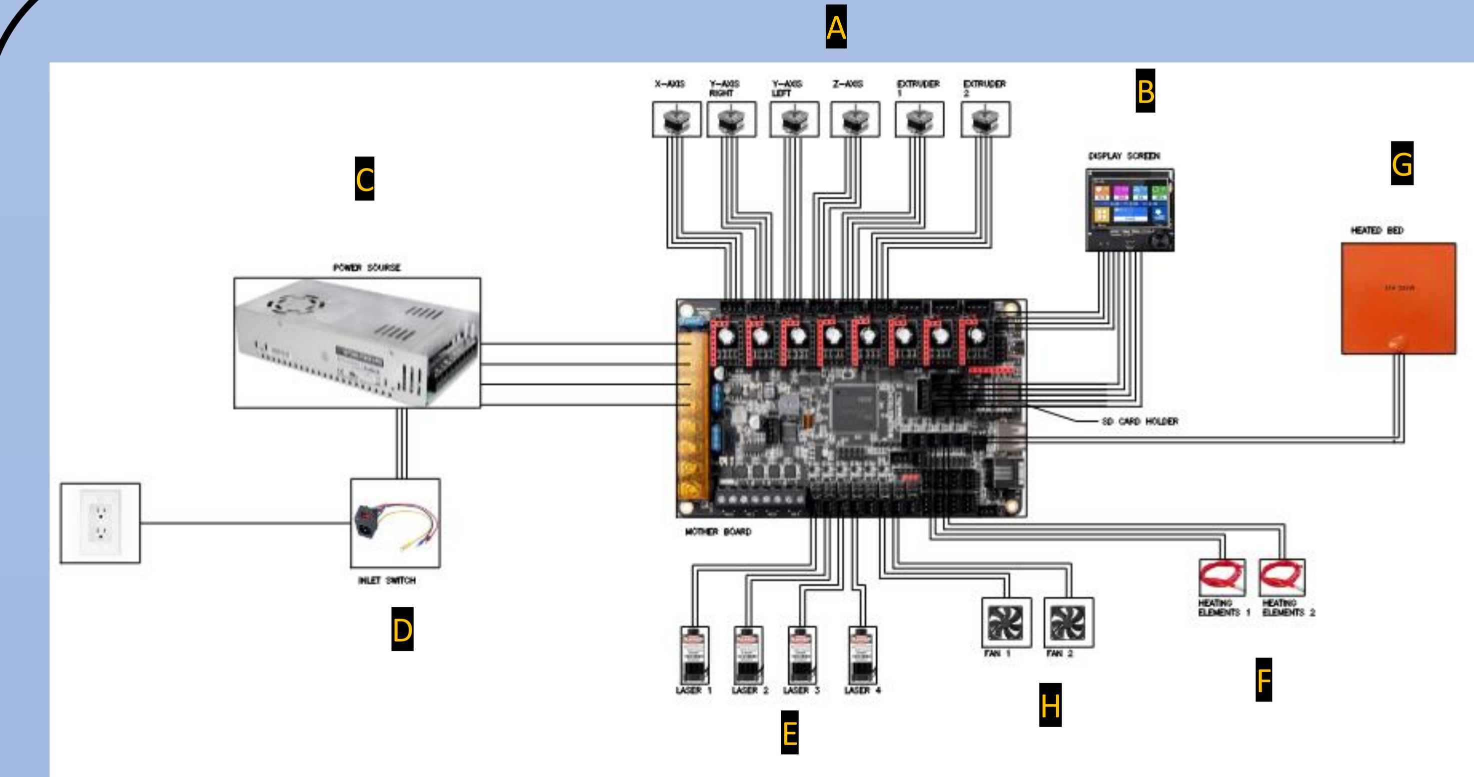
Pros

- Two-piece pusher plate quickly
- Easier assembly/ disassembly
- Low cost
- Vastly improved alignment

Cons

- Increased fabrication time
- Requires more support material

Wiring Diagram of Control Board



A- Stepper Motors

We will be recycling the stepper motors from the old printer and leaving the setup for all axes the same. For the syringe extrusion, we will be using the stepper motors that once powered the old extrusion feeding mechanisms.

B- Display Screen

This LCD screen is made by BIGTREE TECH. We incorporated it into our design to help easily control the components of the 3D printer.

C- Power Source

We are using a 24V Power source made by Chengliang Power Supply to provide power to the motherboard, which enables the printer to run all electrical components.

D- Power Switch

We added a 15 Amp rocker power switch made by BIQU to provide an easy on/off for the power running to the power supply. This switch also allows us to use a standard wall plug to provide power to the power supply itself.

E- Laser

For curing the resin as it is being distributed, we used a blue 500mW laser manufactured by Sovol. This laser has been proven to effectively cure resin in similar printing applications such as this one.

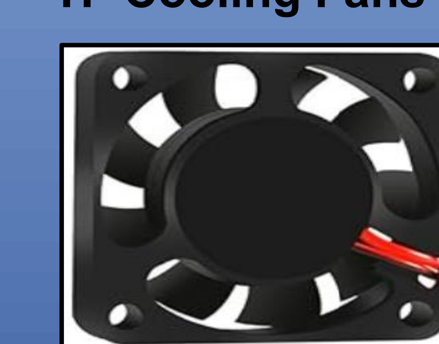
F- Heating Elements

For using a paste like material such as silicone we added Creality 24V 40W Heater Cartridges. This will allow the materials to achieve a better consistency to flow through the syringe at a better rate without changing any programming.

G- Heated Bed

We are using the heated be from Creality to decrease the chances of warping with our builds. This will be easily controlled by the LCD screen.

H- Cooling Fans



The cooling fans will be recycled from the old 3D printer and used to keep the motherboard from overheating.