DIY 3D Printer Build

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***Abstract*—3D printers are a fascinating technology that have become prominent in the past decade. While there are many different types of 3D printing (FDM, SLA, and SLS), this project is going to focus on Fused Deposition Modeling which is by far the most common type of 3D printing on the hobbyist level. This process uses a continuous filament of thermoplastic material which is melted and deposited in layers to create a 3D object. To gain an in-depth understanding of the workings of this technology, I am going to challenge myself to build my own FDM 3D Printer**

I. Introduction

3D printing, a cornerstone of modern manufacturing, has transformed industries by enabling rapid prototyping, customization, and complex geometries that are otherwise unachievable with traditional methods. Among the various 3D printing technologies, Fused Deposition Modeling (FDM) stands out as one of the most accessible and widely used methods. FDM printers operate by precisely extruding melted filament layer by layer, resulting in durable and versatile parts.

To gain a comprehensive understanding of the mechanics, electronics, and software configurations involved in 3D printing, this project focuses on designing and constructing a DIY FDM 3D printer from scratch. The printer leverages the Cartesian coordinate system—widely used in entry-level and professional printers alike—which provides straightforward movement along the X, Y, and Z axes and simplifies hardware configuration. This hands-on approach enables exploration of the 3D printer's core components, including the frame, motion systems, electronics, firmware configurations, and calibration techniques, while offering flexibility in part selection, customization, and troubleshooting.

The purpose of this paper is to document the building process as well as record all of the research that was involved in this process. Sections detailing the construction of the frame, each axis assembly, and setting up the electronics will outline how each part contributes to the overall structure and functionality, while insights into firmware configurations and calibration will demonstrate how software and hardware work together to achieve precise motion and reliable operation. The paper concludes with a Bill of Materials (BoM), covering all parts sourced, and a discussion of challenges encountered, troubleshooting methods, and potential areas for future enhancements.

Through this project, a deeper technical understanding of FDM printing is achieved, laying a foundation for further more advanced exploration of the 3D printing world. This paper serves as a resource for others looking to undertake a similar project or expand their understanding of 3D printing technology from a DIY perspective.

II. Fused Deposition Modeling

A. Types of 3D printing

There are many different types of 3D printing, each achieving the same means to an end but each with their own strengths and weaknesses. SLA (stereolithography) involves a UV laser used to cure liquid resin, hardening one layer at a time with incredible precision. This type of 3D printing is known for its high-resolution prints. SLS (Selective Laser Sintering) uses a high-powered laser to sinter powdered material one layer at a time which then fuses particles together to form solid, durable objects without need for supports. This method is best for making durable, complex shapes. But this project is going to focus on FDM (Fused Deposition Modeling) 3D printing.

B. The Mechanics of FDM

FDM is by far the most popular 3D printing method due to its affordability, ease of use, and compatibility with a wide range of materials. It works by heating thermoplastic filament, extruding and then depositing it one layer at a time until a three-dimensional object is formed. Filament is fed through a brass nozzle that is heated to 200–250°C that is then precisely extruded onto a build plate that is kept around 60°C in order to keep the bottom layer from fully solidifying and sliding around mid-print.

The nozzle comes in various sizes depending on the desired resolution of the print, typically .02mm to .08mm, .04mm being standard. The smaller the nozzle, the more detail can be achieved. The layer height is also a factor, as layers can be set from 0.1mm to 0.4mm thick, also depending on the resolution but greatly affecting the print time. Fans are also an important aspect of FDM as they help control the cooling rate of the extruded filament, minimizing common issues like stringing and warping.

C. Cartesian Movement System

Every 3D printer has a movement system for how the 3 axes interact in order to achieve the desired result. Each system of movement has its pros and cons. Some movement systems include Delta, CoreXY, and Polar movement systems. For this project I am going to work with the Cartesian movement system.

This is based on the cartesian coordinate system that we all know from middle school math. This is the most commonly used movement system in 3D printing as it is the simplest. In future projects I want to explore other systems of movement but I first want to be proficient with Cartesian.

Cartesian works as follows: The Y-axis is controlled by the build plate which moves forwards and backwards while the X and Z Axes are operated by the nozzle. The nozzle starts at the bottom, directly on top of the build plate, moving rapidly side to side and every layer moving up .1mm to .4mm at a time. Each axis is controlled by a stepper motor. Some 3D printers will have two motors for the Z-axis which will allow the nozzle to correct itself and maintain consistency throughout the print. This is what I will be attempting for this project.

D. The Benefits of FDM

There is a reason FDM is, perhaps, the most widely adopted 3D printing method in the world on both the industrial and hobbyist level. The most prominent reason is cost-effectiveness; FDM printers and materials are the most inexpensive relative to the other 3D printing technologies making it accessible to a broad audience. FDM is also not limited to simply thermoplastics as it can print advanced materials such as nylon and polycarbonate depending on the quality of the printer. FDM printers are perfect for beginners as they offer the most ease of use with relatively little to no clean up afterwards. FDM is perfect for prototyping. I, myself, have designed 3D models with numerous iterations that would not have been possible without the opportunity given to me by my 3D printer. You will find that, in fact, many of the parts used for this project are indeed 3D-printed parts.

III. The Frame

The first step to building a 3D printer is to have a sturdy foundation, or frame, to act as the core of the structure. The shape of the frame itself is fairly straight forward as we simply need one rectangle on the ground to balance the structure and support the x-axis and a vertical rectangle to support the y and z axes [9]. This shape is almost universally used for all Cartesian FDM 3D printers as you can see with Creality, Prusa, or Bambu Lab brand printers. If a printer does not have this shape, and is instead a box shape then it more than likely possesses a CoreXY movement system.

For material, I opted to use aluminum extrusion as it seemed to be a commonly used material for DIY printers due to its sturdiness and convenience that comes with the V-slot system. The V-slot system allows me to use various 3D files found on open-source sites and easily mount them to the aluminum extrusion. Aluminum extrusion is a complete linear rail system, designed with specialized nuts and brackets for this purpose, offering a wide range of applications.

For the frame I used a combination of 2040 and 4040 extrusions. I cut the aluminum extrusion to 400mm in length using a metal cut-off blade with a miter saw. There are better ways to do this; I recommend, simply, a hacksaw as it is far safer. Ensure that all intersections are precisely aligned at 90 degrees, as any deviation can result in inconsistencies in print quality. Additionally, I offset the vertical rectangle by approximately 50mm from the center to allow space for the nozzle assembly, ensuring it is positioned centrally within the structure.

Figure 1. The completed frame for the 3D printer.

IV. Y-Axis

This is where the build gets more involved. After the frame is constructed, the next step is to assemble the y-axis. This is the part of the printer that contains the build plate that will provide forward and backwards movement.

A. 3D printed Parts

Before I built anything I wanted to make sure that I had all of the 3D printed parts that I would need. This includes 4x rod supports [1], 1x Y motor mount, 1x Y belt tensioner and block [2], 1x belt holder [7], and 4x linear bearing [12] which altered to suit my own needs.

B. Purchased Parts

The purchased parts necessary for this part of the build are a build plate with a heating element, 2x linear rods cut to 440mm, stepper motor, timing belt with pulley and idler, hot bed spring and leveling nut set, 4x drylin bearings, 2020 aluminum extrusion with brackets, and an assortment of M3, M4, and M5 screws.

C. Assemble the Build Plate

The first step is to build a structure for the build plate to sit on as seen in figure 2. The build plate is going to need constant calibration to ensure that it is perfectly flat so that the nozzle is the same distance at every point and this will give us a fixed structure that we can adjust the build plate from. I made a simple square with the 2020 aluminum extrusion and drilled holes that lined up with the screw holes of my particular build plate. Before attaching the build plate I made sure to thoroughly clean the bottom of the build plate with 91% isopropyl alcohol

Figure 2. Square structure for the build plate to sit on.

and then sticking the heat element to the build plate. Wiping down the build plate before adhering will provide a much stronger bond. I attached the build plate to the square using the spring and leveling nuts. I ended up using a large washer between the aluminum extrusion and the spring because the spring fit awkwardly with the aluminum extrusion. Then it was a matter of screwing on the adjustment knobs. This will allow me to level the bed on each corner which is important as the print needs to be the perfect distance from the bed throughout the entire build plate.

D. *Mounting the Build Plate to the Frame*

The build plate is going to slide across two linear rods on the y-axis which will mount the build plate to the frame but also provide consistency in the build plate movement which is crucial to a proper 3D print. In order to do this, I printed four linear bearings [12] (which I actually modified slightly from the source in order to put the linear rods as far apart as possible) and mounted them to the square 2020 aluminum extrusion using M5 screws and V-nuts. The linear bearings were designed to perfectly hold drylin bearings which are what will slide across the linear rods. The reason I use drylin bearings instead of ballbearings is because they are completely silent and don't require lubrication which means there won't be any unwanted buildup of anything and therefore require little to no upkeep. At this point I can simply slide the linear rods through the drylin bearings, slide on the four rod supports [1], and mount each one to the frame using more M5 screws and V-nuts. It is important to measure properly and mount each one an equal distance from the sides of the frame in order to have smooth movement. The movement of the build plate should be smooth all the way across and not jam up on the ends.

E. *Installing the Stepper Motor and Belt*

The build plate can now move back and forth, but now it is time to setup a way to move the plate electronically. In order to accomplish this I used a stepper motor with a timing belt as all 3D printers tend to do. First step is to mount the stepper motor to the frame. This was done using a Y-motor mount [2] which I mounted to the back of the frame. Make sure it is mounted so that the rotary part of the motor is in the center of the frame. Then I simply mounted the motor to the motor mount and installed a belt pulley wheel to the motor shaft. Some more advanced 3D printers will use two stepper motors on the Y-axis but in my case I am only using one. Before Installing the timing belt I needed to install the tensioner [2] which mounts to the opposite side of the frame. The tensioner holds another belt pulley wheel and an 20" M3 screw is used on the front of the tensioner to pull the pulley wheel back which provides tension to the timing belt. Now we can install the timing belt making sure it wraps all the way from the motor shaft to the tensioner and back. Ensure that there is plenty of overlap, make it decently tight, and apply a couple of zip ties to hold it together. Now we have a belt that can move but it still does not affect the build plates movement. To solve this, I printed a belt holder [7] that worked in the small space I had to work with and mounted it to the square of the build plate, as shown in figure 3, ensuring that the teeth of the print lined up with the teeth of the build plate in order to avoid any slipping of the belt. Make sure that the zip-tied part of the belt is underneath the build plate to avoid it getting stuck at the pulleys. Now we have a functional y-axis that moves when the stepper motor rotates.

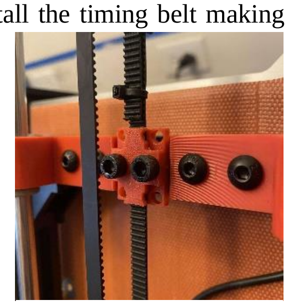

Figure 3. Underside of the Build Plate with Belt Holder

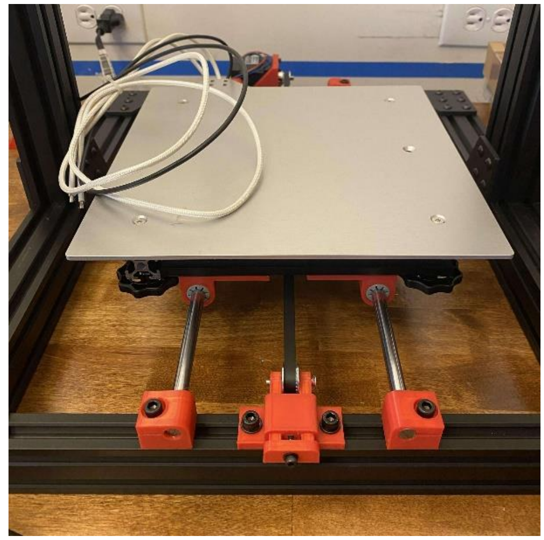

Figure 4. The Completed Y-Axis for the 3D Printer

V. X-Axis

The x-axis has far fewer steps to consider than the y-axis. The stepper motor and timing belt won't be installed until after it is mounted to the z-axis. This part of the printer contains the x-carriage which will hold the print nozzle and provide sideways movement for the 3D printer.

A. *3D printed Parts*

The 3D printed parts for x-axis portion of the project include: 1x x-carriage, 1x fan duct, 1x nozzle mount and clamp [10], 1x x-idler left and right, 1x tensioner [5], and 3x x-carriage bearing mounts [8].

B. *Purchased Parts*

The parts purchased for the x-axis include 2x linear rods, 2x brass nuts for threaded rods, and an assortment of M-screws.

C. *Assemble the X-Carriage*

The x-carriage consists of a series of 3D printed parts that will ultimately hold the nozzle, heatsink, heatsink fan, and part cooling fan. The first step is to assemble the parts that go towards the x-carriage. Take the x-carriage [10] and three x-carriage bearing mounts [8], there are holes in the x-carriage that line up with the bearing mounts. Each will need four M4 screws that are roughly 30mm in length; these can't be too tight or the drylin bearings won't slide smoothly across the linear rods. The drylin bearings will slide right into the bearing mounts. The nozzle mount and clamp can be installed next on the front of the carriage. The clamp fits on the nozzle mount using M3 screws and nuts that fit in the small square holes. The fan duct [10] fits snuggly into the nozzle mount and more M3 screws to hold it in place. Because of the shape of my screws the fan duct couldn't sit flush against the carriage but in the end it was not in the way of the nozzle and it still fulfills its purpose of guiding airflow to the parts so I let it stay crooked. Before beginning the next step, make sure to slide on the linear rods.

D. Installing the Idlers

The next step is to setup the left and right idler parts. The left idler holds the tensioner [5], first install the brass nut that comes with the threaded rods, this should simply require three M2 screws and nuts. The same can be done for the right idler which holds the stepper motor. Slide two drylin bearings into both the left and right idler; two is better than one. For the left idler, screw two M3 screw into the side. This is simply for the tensioner screws to have something solid to push off of. The tensioner just slides into the left idler for now. Finally we can push the left and right idlers onto their corresponding sides of the linear rods. This is all we can do with the x-axis until we install the z-axis.

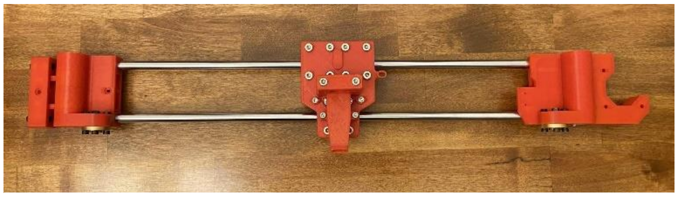

Figure 5. Partially Completed X-Axis

VI. Z-Axis

The z-axis itself has relatively few steps but once that is done the x-axis assembly needs to be completed. Unlike the other axes, this axis will include two stepper motors instead of one. This is one area that will help this printer stand out among the average 3D printer in terms of hardware specifications.

A. 3D printed Parts

The 3D printed parts for this portion of the project include 1x z-motor mount right and left and 1x z-rod holder right and left [2]. Only four 3D printed parts are necessary for this step.

B. Purchased Parts

The parts purchased for this portion of the project are 2x threaded rods that came with the brass nuts used in the previous portion, 2x linear rods, 3x stepper motors, 2x couplers, timing belt with pulley and idler and an assortment of M-screws.

C. Installing the Z-Axis

I began working on the z-axis by installing the left and right z-motor mounts [2]. This is done again by using M5 screw and v-nuts. Make sure the mounts are high enough that the motors still have room to slide into position. Every stepper motor is different so depending on the motor you will need more or less clearance. I used a deck of cards to make sure they were level and a consistent height, adding or removing cards depending on if I needed more or less height. The motors mount with the four M2 screws each. It is important to mention that all of these motors for each axis should be the same exact model. There are so many specifications to consider with stepper motors such as step angle, torque, current rating, voltage rating, phases, wiring configuration, inertia etc. all of which affect how the motor will rotate and vary slightly from model to model. Orient the motor so the wire connection facing an appropriate direction for routing; I opted to face them inwards. The couplers can now be installed on the shafts of the motors. Next I installed the left and right z-rod holders [2]. I wanted them to be as high as possible since this is what will be the limiting factor in terms of print height. Once again, they mount using M5 screws and v-nuts; two on the front and two on the side.

D. Installing the X-Axis Assembly

At this point the x-axis assembly can be mounted to the z-axis. First twist on the threaded rods through the brass nuts on both sides of the x-axis assembly. From here you can slide the linear rods through on both ends. You may need to pull out both sides of the assembly slightly in order to get the linear rods to line up properly. Ensure the threaded rods fall neatly into the couplers and tighten them accordingly. Once the rods are fitted into their slot on the left and right z-motor mount you can tighten the left and right z-rod holders using M3 screws and nuts to ensure the rods won't slide out of place.

E. Finishing the X-Axis

Now it is time to add the finishing touches on the x-axis. Install a stepper motor on the right side of the x-axis assembly. This will only require three screws, although they will need to be much longer this time as the 3D print is very thick here. Install a belt pulley on the shaft of the motor. Make sure it is lined up so that the belt will not constantly rub against the right or left side idler as there is a narrow window to fit the timing belt through. Install an idler on the tensioner as well. As shown in figure 6, wrap the timing belt around a long M3 screw on both sides of the x-carriage and secure it with zip ties. The teeth being against the teeth will help prevent any slipping. I like to add nuts as a spacer to make sure the belt will like up with the openings on the right and left prints, again to prevent any rubbing, but also use nuts to secure the belt to the screw. At this point we have successfully assembled all of our moving parts for the 3D printer.

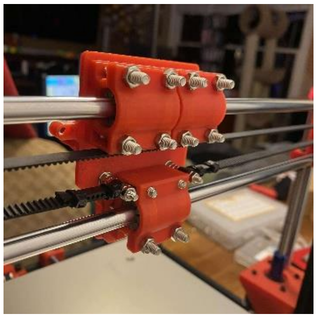

Figure 6. Back of the Completed X-Carriage

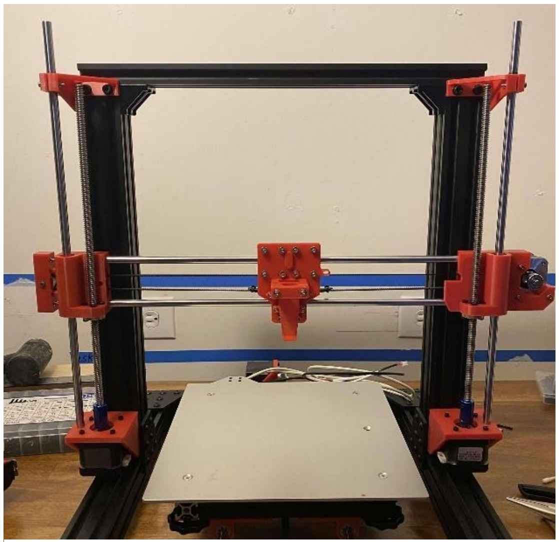

Figure 7. Completed X, Y and Z Axes

VII. Electronics

The final step of the building process for the 3D printer is installing the electronics and wiring them. This is where the project had the most hurdles because I began to have compatibility issues. For example the CNC shield I intended to use, while is meant for all CNC devices including 3D printers, is more meant for engraving machines, or devices without heat elements. I had two options, either buy two MOSFET relays to regulate the nozzle and heat-bed temperatures, or buy an entirely different board that is intended for specifically 3D printers. I opted for the latter as it seemed like the simplest solution.

A. *Nozzle and Extruder*

The first component I installed was the nozzle. The nozzle fits perfectly on the x-carriage assembly with the clamp fitting snuggly around the top of the nozzle heatsink. My particular nozzle came with a 30mm fan and attachment that snaps onto the nozzle heatsink. In the future I may upgrade this fan to a 40mm to provide better cooling. The x-carriage also requires a part cooling fan which I used a blower fan for. This part is held on only by a single M4 screw and it blows down into the fan duct onto the parts. Some printers will include the extruder on the x-carriage but my printer will have the extruder mounted onto the top of the frame.

For the extruder another stepper motor is required in order to extrude and retract the filament. The is crucial as 3D printers will adjust the filament flow rate throughout the print and retract the filament as the nozzle moves to a new location in order to prevent unwanted oozing. I printed a simple stepper motor mount and mounted it to the top frame. The extruder slides onto the stepper motor shaft and is mounted with four 30mm M3 screws. Tubing is fed into the top of the extruder to provide a relief for the filament that is fed through. Tubing is also fed through the bottom and reaches all the way to the nozzle assembly. Make sure this tubing is long enough to comfortable reach the maximum distance that the nozzle assembly will be from the extruder. With proper installation the tubing should not get pulled out by accident.

B. *Power Supply*

The power supply is where electrical hazards start to come into play. It is important that you consult a qualified electrician before proceeding to the next step [9]. Before mounting the power supply there is a small amount of wiring that needs to be done. I purchased a power switch and power plug separately that needed to be connected to the power supply. It came with two jumpers that jump the positive and negative from the plug to the switch. Then positive, negative, and ground are wired to the power supply inputs. In order to supply power to the 3D printer we need to wire 16 AWG on positive and negative output pins. My particular power supply has three output pins for each and it does not matter which one is used. In my case I only had 14 AWG wire available which should work fine as long as it fits. A general rule is that you can go up in AWG but not down as that will lead to a lack of current and could potentially be dangerous. Just make sure the wire is long enough to reach where it needs to go, which is the control board. I found 3D prints meant specifically for this power supply and the installation for those are self-explanatory.

Figure 8. Mounted Power Supply

C. *Limit Switches*

The limit switches required some soldering. I used 22 AWG solid wire and soldered one to the constant pin and another to the normally closed pin. This is not a matter of positive or negative, as a switch simply opens or closes, creating a connection between the two wires which will tell the printer that it has zeroed. I would have preferred stranded wire as that is better for moving parts but this is what I had available. Each axes gets one limit switch. It does not matter which side of the axis they go on since that will get defined later during configuration. Using more 3D prints to mount the limit switches [12], it is simply a matter of finding a convenient location that will allow the axis to reach is full range of movement. The x-axis has a built in mount for those prints, I expanded the holes using a drill and the limit switch mounted snuggly. The most crucial switch is the z-axis as the nozzle needs to not crash into the build plate, but also be a perfect height for printing the first layer.

D. *LCD Screen*

The LCD screen will allow me to control basic functions of the 3D printer without the need for an external computer. I found a simple case for my particular LCD screen that I could print and then subsequently mount somewhere on the printer that would be out of the way but still be close enough to the control board for the wires to reach.

E. *Control Board*

The control board is essentially the heart of the 3D printer; every electrical component on this printer will have wires going to this device and it will control everything. Once again, I found a basic case online for my particular board. The specific board I'm using is a BIGTREETECH SKR mini E3 V2.0 control board. This board comes with four stepper motor drivers with corresponding heat sinks that need to be installed on the board. For the 3D printed case I used a soldering iron to imbed brass threaded inserts into the print in order to securely mount the

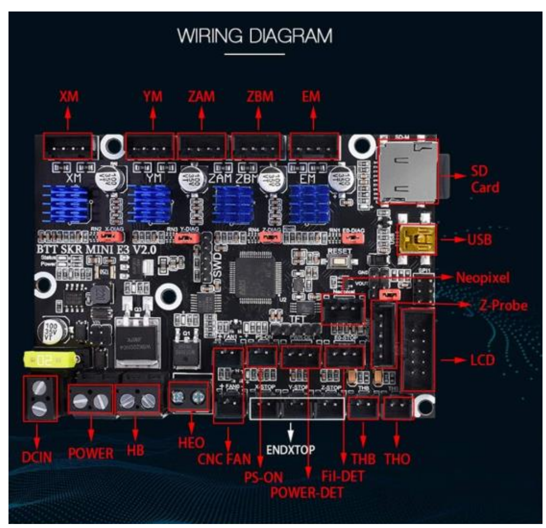

Figure 9. Wiring Diagram for SKR Mini E3 v2.0 Control Board

board. As shown in figure 9, all of the devices plug into the corresponding inputs.

F. Cable Management

When I wire I like to be as neat as possible. This is not very necessary however. The most important times for proper cable management is on the moving parts. In my case I had three instances that I needed to worry about this. Wires coming from the x-carriage, the build plate, and the x-stepper motor and limit switch. I made sure these wires were properly protected with spiral cable wrap. This will help the help the wires as they would be susceptible to wear from the constant movement. Make sure to leave plenty of slack when securing these wires and that they comfortable reach their farthest reaching point. It is also important to make sure that no matter the position, the bundle of wires will not snag on anything as this could possibly be disastrous. Other than that, as long as the wires stay out of the way of the moving parts and do not intrude on the print itself, the wiring is complete. This concludes the physical construction of the 3D printer.

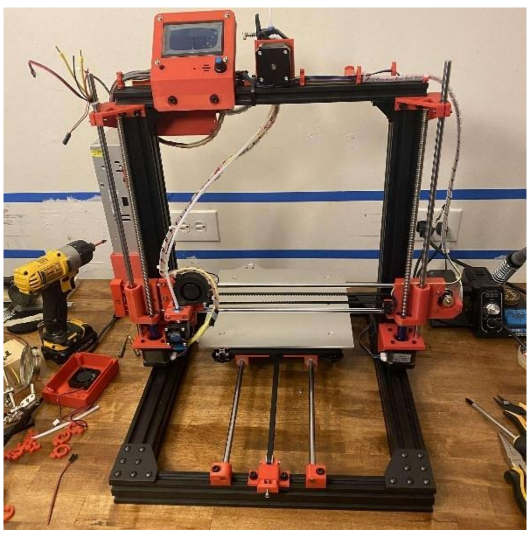

Figure 10. 3D printer Before the New Control Board is Installed

VIII. Slicer Software

3D printers are built to be able to follow and fulfill certain instructions. These instructions come in the form of G-code is what slicer software produces. A slicer is a type of software that turns any 3D file into a set of instructions for 3D printers to execute [3]. 3D files cannot simply be sent to a 3D printer because they are only mesh files, a collection of vertices, edges, and faces. A 3D printer does not know what to do with this. When a mesh file is entered into a slicer software it 'slices' the mesh into layers and, after following preset configuration made by the user, make each layer a path for a 3D printer to follow. The instructions are not merely how a printer should move however, as it specifies factors such as traversal speed, flow rate, fan speeds, print speed, heating temperatures, retraction rate, and more advanced instructions that the average hobbyist does not consider. These instructions are called G-Code and this is what the brain of the 3D printer needs to be programmed to interpret.

IX. Firmware Configurations

Building a 3D printer tends to have a certain level of mysticism around it with the idea that it is incredibly impressive to build one yourself. In truth, it's not as complicated as it seems and anyone can do it. Ten years ago, perhaps, you would've needed to be a genius programmer that could program a printer from scratch to interpret G-Code. Now, there are programs at our disposal that will provide code for us. This is not as simple as just finding an open source and using someone else's code; every DIY 3D printer is unique in terms of its components and layout. The firmware I'll be using for this project is called RepRapFirmware. RepRapFirmware has a built in configuration tool where I can input all of the different variables to consider and it will spit out a unique code that will work for my purposes. This code takes into consideration thing like number of extruders, heated bed, location of limit switches, build volume, direction the stepper motors need to turn to move what direction, filament extrusion, speed capabilities [3] etc. With this, after I have set my unique configuration variables, I create my code.

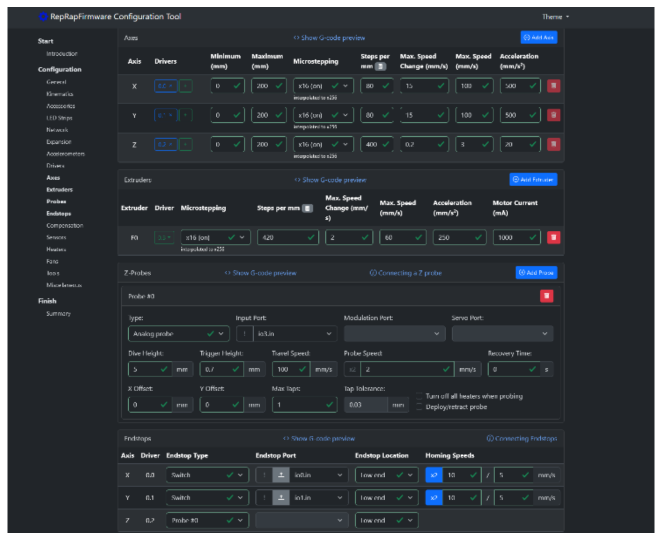

Figure 11. RepRapFirmware Configuration Tool

X. Conclusion

Building a DIY FDM 3D printer has been an invaluable experience, offering deep insights into the mechanics, electronics, and software that drive 3D printing technology. This project not only enhanced my understanding of how individual components work together to achieve precise printing but also allowed me to tackle challenges in design, assembly, and troubleshooting. The hands-on approach has provided a strong foundation for future endeavors in customizing or developing more advanced 3D printers. Overall, this project has been both an educational and rewarding journey into the fascinating world of additive manufacturing.

XI. Bill of Materials

This project was not optimal in terms of how I purchased my materials. Many materials did not end up working for my purposes and I had to return them if I could and replace them. If I were to build 3D printers in the future the expenses would go down significantly as I have learned a lot about the process throughout this project. As it currently stands, simply buying a prebuilt printer would be much more cost effective. All parts were purchased from Amazon as I needed items to arrive as soon as possible. The total cost of everything I ended up using for this project is $724.51. The following is a Bill of Materials of all of the parts that were purchased and used during this project:

ITEM	QUANTITY	UNIT PRICE (USD)	TOTAL PRICE (USD)	SOURCE
2020 ALUMINUM EXTRUSION	1	$36.99	$36.99	Amazon
4040 ALUMINUM EXTRUSION	1	$62.99	$62.99	Amazon
2040 ALUMINUM EXTRUSION	1	$35.99	$35.99	Amazon
2040 ALUMINUM EXTRUSION	1	$18.99	$18.99	Amazon
LM8UU BEARING	2	$14.69	$29.38	Amazon
2020 SERIES CORNER BRACKET SET	1	$22.99	$22.99	Amazon
CNC CONTROLLER KIT	1	$63.99	$63.99	Amazon
GT2 TIMING BELT	1	$14.99	$14.99	Amazon
ALUMINUM BUILD PLATE	1	$59.99	$59.99	Amazon
BED LEVELING SET	1	$7.99	$7.99	Amazon
LINEAR RAILS	1	$28.99	$28.99	Amazon
LINEAR RAILS	1	$11.99	$11.99	Amazon
PLA FILAMENT	1	$17.99	$17.99	Amazon
ALUMINUM EXTRUSION JOINT PLATE CONNECTORS	1	$20.99	$20.99	Amazon
NEMA COUPLERS	1	$6.99	$6.99	Amazon
THREADED RODS	1	$16.49	$16.49	Amazon
24V POWER SUPPLY	1	$20.98	$20.98	Amazon
POWER SOCKET	1	$7.99	$7.99	Amazon
DUAL DRIVE EXTRUDER	1	$13.99	$13.99	Amazon
BLOWER FANS	1	$8.99	$8.99	Amazon
M-SCREW ASSORTMENT BLACK	1	$15.99	$15.99	Amazon
M-SCREW ASSORTMENT SILVER	1	$13.99	$13.99	Amazon

30MM M4 SCREWS	1	$7.89	$7.89	Amazon
LONG M3 SCREW ASSORMENT BLACK	1	$9.99	$9.99	Amazon
COOLING FAN	1	$8.99	$8.99	Amazon
LCD DISPLAY	1	$15.49	$15.49	Amazon
T-SLOT NUTS	1	$8.55	$8.55	Amazon
PARALLEL MODULE	1	$5.59	$5.59	Amazon
BRASS THREADED INSERTS	1	$7.99	$7.99	Amazon
LIMIT SWITCH	1	$8.39	$8.39	Amazon
HOTEND NOZZLE	1	$67.99	$67.99	Amazon
MALE AND FEMALE 22AWG CONNECTORS	1	$8.99	$8.99	Amazon
SKR MINI E3 V2.0	1	$34.99	$34.99	Amazon

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