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" DESIGN AND FABRICATION OF 3D PRINTER "

Girish Kumbhar[1], Virendra waghmare[2], Sudeep Kevete[3]

Department of Mechanical Engineering,

Smt. Kashibai Navale College of Engineering, Savitribai Phule Pune University, Pune, Maharashtra, INDIA.

ABSTRACT

The introduction of 3D printing has completely changed the manufacturing industry since it uses additive manufacturing to build three-dimensional products layer by layer. Due to its capacity for producing quick prototypes, highly customized products, and complicated designs with minimal waste, 3D printers are gaining popularity. An overview of the low-cost design and fabrication of a DIY 3D printer is given in this article. A 3D model is first downloaded in.stl format from the website thing verse, adjusted, and thoroughly prepared/checked in blender. Next, it is opened in slicer software, scaled to the required size, adjusted on the heat bed, and converted to Gcode format for printing. A 3D printer of the fused deposition modelling (FDM) variety is constructed from the ground up to model objects by depositing heated filament onto a heated plate layer by layer. In this article, we examine the possibilities of customization brought about by 3D printing, such as the potential to make personalized products and iterate on designs more quickly. It also examines how the consistency and quality of printed products are impacted by the material qualities of the 3D printing materials. It emphasizes the economics of 3D printing for low-volume, low-cost, and especially home-made level uses.

Keywords - 3D modeling software, STL file format Slicing software, G-code, Print bed, Nozzle, Filament.

1. INTRODUCTION

David E. H. Jones introduced the idea of 3D printing in 1974, marking the invention of the technology. Chuck Hall of the 3D System Corporation submitted his own patent in 1984. The method of creating three-dimensional items from digital files is known as 3D printing. In this method, the entire thing is created by printing layers of a certain material on top of one another. This procedure, which involves producing an object layer by layer, is also known as additive manufacturing.The most cutting-edge three-dimensional manufacturing and scanning technology in the world is high precision industrial 3D printing.

A rapidly expanding additive manufacturing technique known as 3D printing builds objects from digital model files using powder materials like metal or plastic.

A new high-end manufacturing technique that is widely employed in manufacturing and other industries is 3D printing. This technology has subtly altered the manufacturing sector's trend during the past few years.

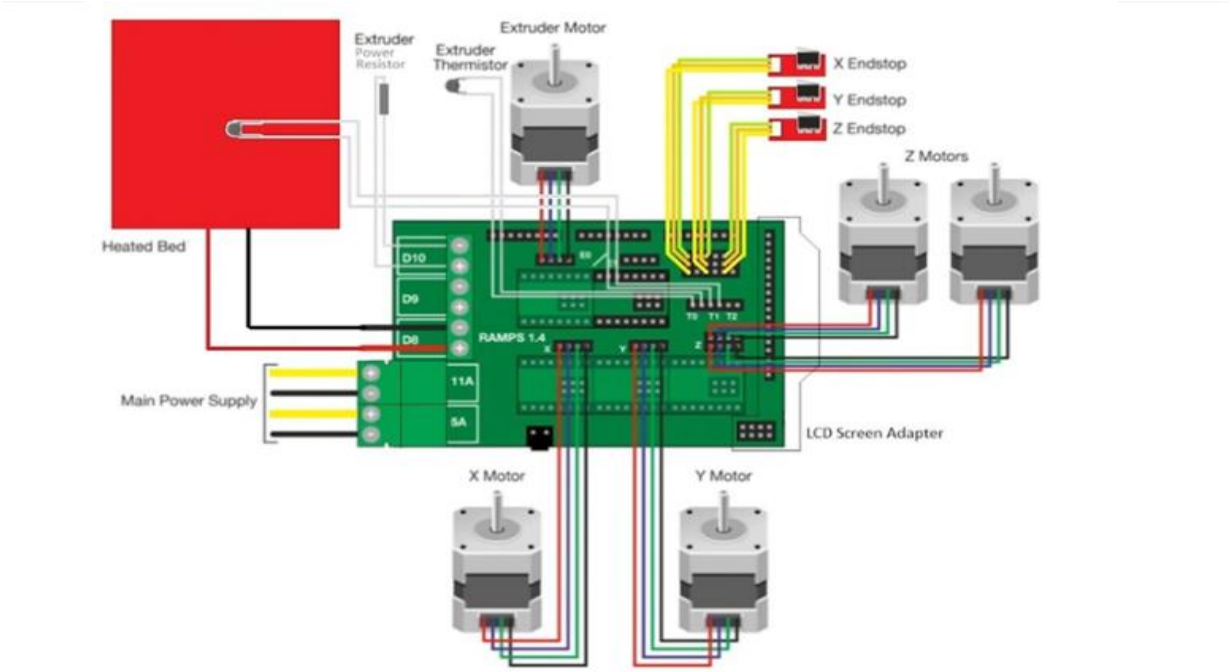
1.2 Problem Statement:

3D printer curbs, certain problem statement which are as follows Quality Manufacturing at low cost, Speed and lead time, Risk Mitigation, Design Flexibility, Material and Sustainability, Micro 3D printing, Precision, Repeatability, Resolution

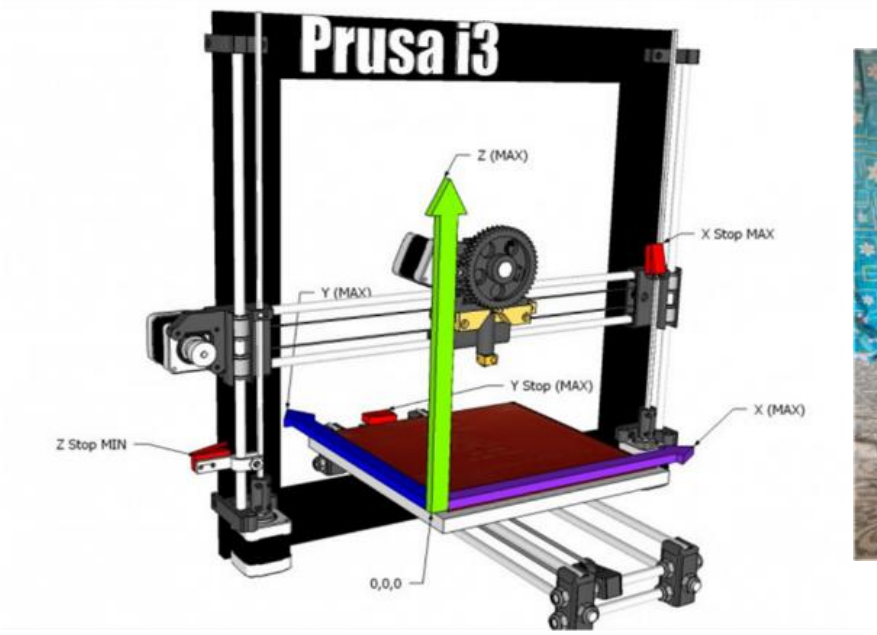
2. METHODOLOGY

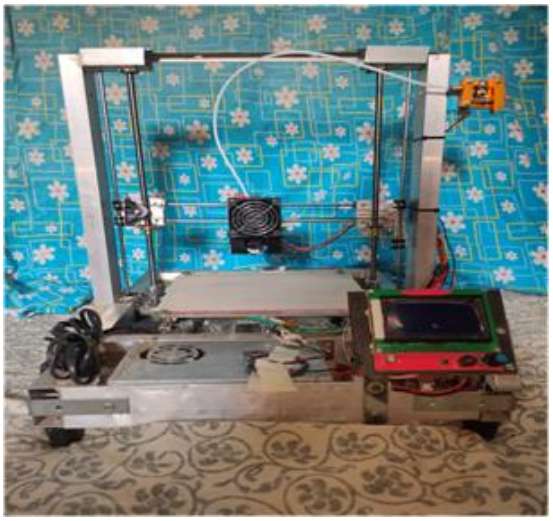
1) . Design and Analysis

Circuit Diagram:



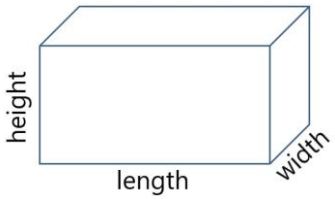
Simulation Diagram:





B) CALCULATIONS:

By considering this object our whole project dimensions are:



570 mm length, 400 mm width, 480 mm height.

1. Lead Screw Material: 304 Stainless Steel.

2. Length: 350mm.

3. Diameter: 8mm.

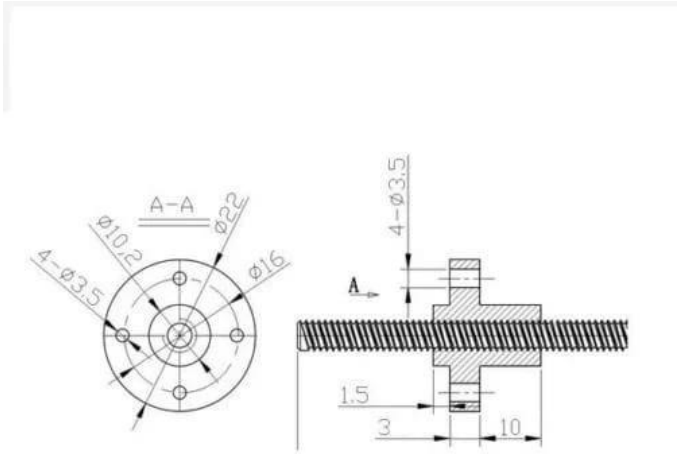
4. 4 Start Lead Screw

5. Brass Nut Size: 10 x 13 x 22 mm.

6. Mainly use for Stepping motor driving guide rail.

7. T shape design, made of high-quality stainless-steel material.

(5mm Smooth rod aluminum 350mm length)



- Each of the partial rotations is called a "step", with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

On x axis 40.50 steps per mm

On y axis 80.00 steps per mm

On z axis 405.50 steps per mm

On E axis 94.44steps per mm (extruder)

Couplers Details:

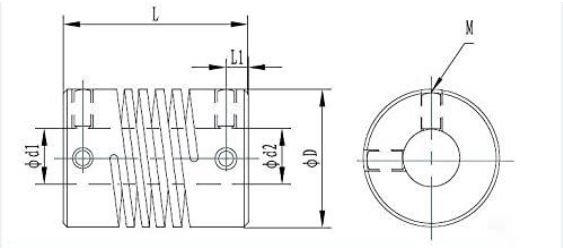
Type: Flexible Shaft Coupling (In 3d printer connect Stepper motor shaft to lead screw)

• Material: Aluminum

• Size: 5mm x 8mm (Ød1 x Ød2)

• Outside Diameter: 19mm (ØD)

Length: 25mm (L)



Features:

1. Corrosion resistance and High Durability

2. One piece construction with long- lasting performance

3. Torsional stiffness: Zero backlash

4. Low moment of inertia offering constant velocity

Linear bearing

1. Color: silver

2. Model: LM6UU

3. Shaft ID: 6mm

4. Outer Diameter: 12mm

5. size: 19 x 12 (LxW) mm.

6. Outer Casing: Chromium Steel

7. Ball Circuits: 4

Filament:

• Filament Diameter - 1.75mm

• Temperature of first layer of filament - 230°C

• Temperature of other layers of filament - 228°C

• Temp of bed - 0°C

2) Raw Material Procurement

COMPONENTS USED

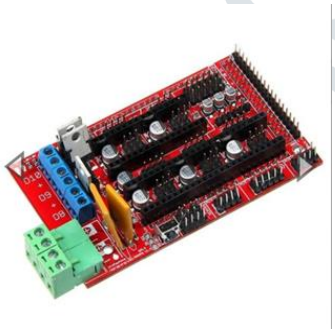
A) AURDINO MEGA 2560:

- The Arduino MEGA 2560 is designed for projects that require more I/O lines, more sketch memory and more RAM. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities maintaining the simplicity and effectiveness of the Arduino platform.

- The Arduino Mega 2560 is programmed using the Arduino Software (IDE)

- The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

B) **RAMPS 1.4 SHIELD:**



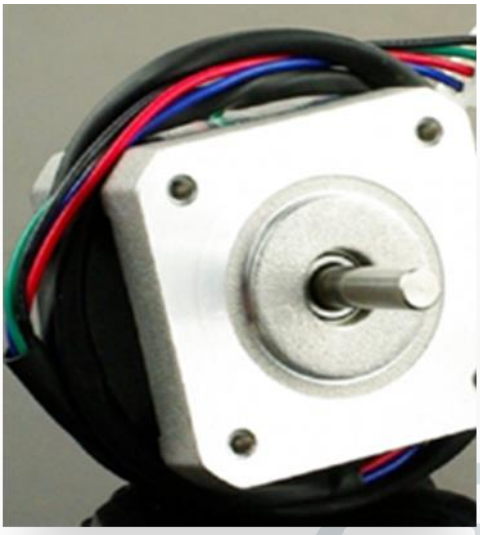
- RepRap Arduino Mega Pololu Shield, known affectionately as RAMPS, is the brain for most of the 3D printers. It is designed to fit the entire electronics needed for a RepRap in one small package for low cost.

- RAMPS 1.4 (RepRap Arduino Mega Palolo Shield) is the most popular 3D printer controller used today. Interfacing with an Arduino MEGA2560, it expands the Arduino platform to provide all the necessary features for a 3D Printer.
- This board is mainly a 12V board and can be modified to work at 24V.

C) A4988 DRIVERS:

- The A4988 is a complete micro stepping motor driver with built-in translator for easy operation. It is designed to operate bipolar stepper motors in full-, half-, quarter-, eighth-, and sixteenth-step modes, with an output drive capacity of up to 35 V and ±2 A
- The A4988 is a micro stepping driver for controlling bipolar stepper motors which has built-in translator for easy operation. This means that we can control the stepper motor with just 2 pins from our controller, or one for controlling the rotation direction and the other for controlling the steps.

D) NEMA 17 STEPPER MOTOR:



Stepper motors are an important part of 3D printers. They are used in a variety of applications depending on the type of printer. For example, stepper motors are used to move the extruder or the build platform alone the x, y, and z axis. The extruder assembly also has a stepper motor used to pull the filament into the extruder.

- Stepper motors are unique in that they can move to a known interval and then hold that position. Because they are a good motor to move an object to a repeatable position, they are often used in robotics and in printers.
- Stepper motors come in a variety of sizes. The most popular sizes used in 3D printers are the NEMA 14, NEMA 17, NEMA 23, and NEMA 24.

E) END STOP:

- End stop ensure that a machine, through one of various methods, keeps on object on an axis. (In the case of a 3D printer, the object could be the print head, for example.) This stops the object from derailing or jamming at the end of that axis.
- A metrical line ending at a grammatical boundary or break such as a dash or closing parenthesis or with punctuation such as a colon, a semicolon, or a period. A line is considered end-stopped, too, if it contains a complete phrase.

F) E3D HOT END:

The hot end can be described as the component of an FDM 3D printer that heats, melts and extrudes the material layer by layer through a nozzle. The whole structure of the hot end helps to maintain a consistent and accurate temperature as well as providing an optimized thermal dissipation.

- The E3D-v6 as sold is limited in temperature by the thermistor to 295*C but can go higher (tested up to 420*C) with a thermocouple upgrade.

G) MK8 EXTRUDER:

- This Part is very important in 3D Printer. The extruder is used for the pushes the plastic filament inside the hot end nozzle.
- There are number of small components in the extruder. see the above image

H) LIST OF OTHER COMPONENTS:

- 2 pieces 8mm Threaded rod: - 1000Rs
- 1.5-inch ALUMINIUM CHANNEL (Estimated price 350Rs for 2pcs (6pcs used)
- 8mm and 6mm LINEAR BEARINGS
- estimated price.
- 8mm and 5mm smooth rod: - Estimated price 350rs
- 12v20amp POWER SUPPLY: - Estimated price 800rs
- GT2 pully and 2m belt

3) Testing of Raw Material

4) Assembly & Fabrication

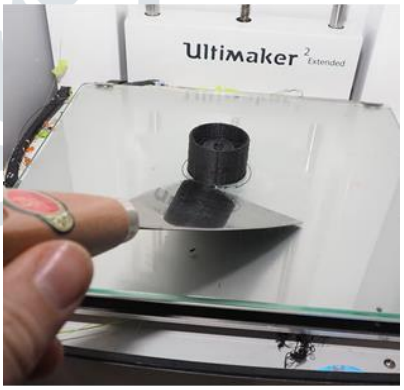
5) Coding & Resources

- Xloader : It is used for upload the Hex file into Arduino.
- Slicer : In this 3d diagram that is drawn or downloaded from internet can be sliced and that diagram file is converted into g-code file from .stl file.
- AutoCAD / Solid works / Blender: We mainly have this software as backup to adjust 3d diagrams scale, or to make any changes of needed in 3d diagram.

6) Testing & Calibration

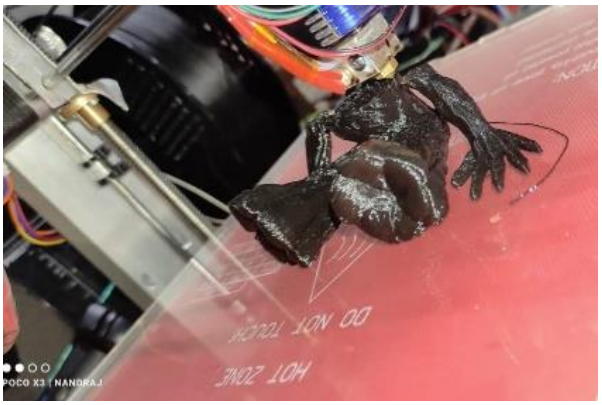
7) Errors & Correction:

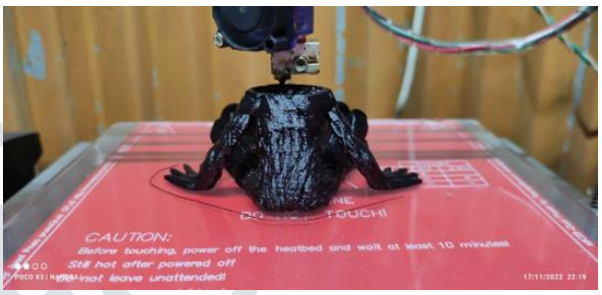
➢ CORRECTIONS IN: Print is Stuck to Print Bed



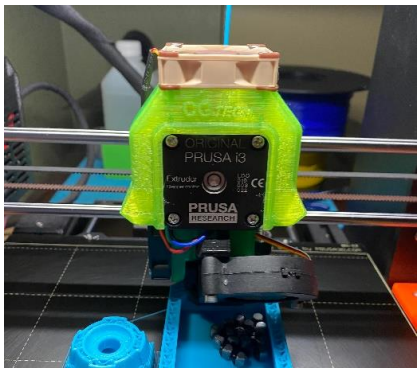
- Try a little patience.
- Use a palette knife.
- Give the print platform a clean
- Stick it in the oven.
- Don’t use cheap filament Make some holes.

4. RESULTS & DISCUSSION



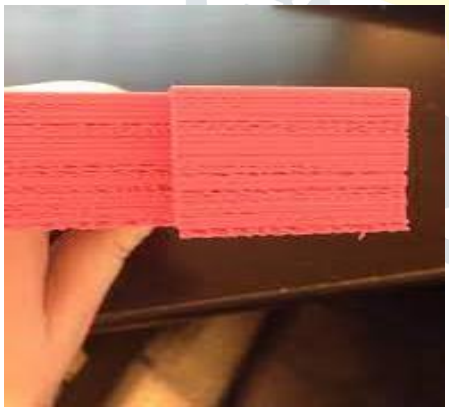


➢ CORRECTIONS IN: Extruder Stepper Motor Overheating



- The main solution is to turn off the printer.
- Let the machine rest for some time, and then you can start it again.
- You can add an extra cooling fan for the motor.
- Make sure your extruder is not getting an excess load to pull the filament, So, it has a smooth filament path.

➢ CORRECTIONS IN: Some Layers are Missing.



- Check over the mechanics and make sure everything is tight.
- Double-check the printer's construction and alignment.
- Listen out for worn bearings and bent rods.
- Add a little oil to keep things running smooth.

5. CONCLUSION

It is widely assumed that 3D printing will be a transformative force in manufacturing, whether positive or negative. Despite fears of fraud, Many companies, including as those in automotive and aerospace industry, are already employing the technology to regularly build sophisticated components. The traditional manufacturing industry will have significant hurdles in adapting to these developments. However, the chances for science and engineering are certainly vast, and the creative possibilities in product design and printing material formulation are virtually limitless.

As a result, we designed and built a low-cost 3D printer with an Arduino board as its brain.We used our own ideas to create a frame and assemble parts. Because we know that FDM type 3D printers have less accuracy, i.e. the printed product has less finishing than other types of printing devices, we tried to make it precise by increasing the layer height, nozzle diameter, and travel speed. Conversely, decreasing the value of the same parameters increases the machining time.Specifically, in this project, we attempted to lower the cost of developing and producing a 3D printer, and we were successful up to a degree.

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