A Study on Design of an Adaptive System for Stabilization of A 3D Printer Using 3D Pen & GCODE Language

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ABSTRACT: 3 dimensional printing is a technique to make a 3 dimensional object in which layers of material are made using computer control to melt the material and make the object hence it is also known as additive manufacturing technique and is reverse of the Reductive manufacturing technique in which we start from the block of a material and remove the part which is not needed. The objective of our project is to make a 3D printer which is cheaper than the 3D printer already available in the market. The main way this can be achieved is by using old electronic parts for example:- Stepper motors from the used printers. This also involves making the body of the 3D printer using the available material..

KEYWORDS: 3D, Printer, Arduino,3D pen, Stepper motor, RAMPS 1.4, motor driver.

I. INTRODUCTION

3 Dimensional printing is a technique to make a 3 dimensional object in which layers of material are made using computer control to melt the material and make the object hence it is also known as additive manufacturing technique and is reverse of the Reductive manufacturing technique in which we start from the block of a material and remove the part which is not needed.The object made using 3D printing can be of any shape or geometry and are much simpler and faster to make as compared to the other techniques. This technique also helps to use the material in the controlled manner and avoid wastage.

II. RELATED WORK

Technology there is a plastic filament or a metal wire which is unwound from a coil and supplying material to an extrusion nozzle which can turn the flow on and off. The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing software. The object is produced by extruding melted material to form layers as the material hardens immediately after extrusion from the nozzle. This technology is most widely used with two plastic filament material types: ABS (Acrylonitrile Butadiene styrene) and PLA (Polyactic acid).

In our 3D model maker we are using Material Extrusion Method. The most commonly used technology in this process is Fused Deposition Modeling (FDM).In FDM technology there is a plastic filament or a metal wirEwhich is unwound from a coil and supplying material to an extrusion nozzle which can turn the flow on and off. The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing software.

There are 7 methods to do 3D printing such as:

A. Vat Photo polymerisation

B. Material Jetting

C. Binder Jetting

D. Material Extrusion

E. Power Bed Fusion

F. Sheet Lamination
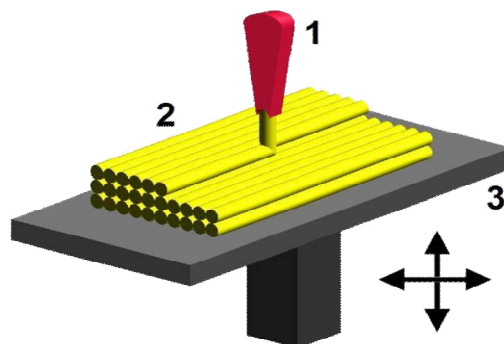
III. PROPOSED ALGORITHM

The Electronics board controls the printing process. Here in Electronics board the microcontroller we are using is ARDUINO MEGA 2560 and a RAMP 1.4. ARDINO MEGA 2560 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. RAMP 1.4 mainly designed for the purpose of using stepper driven board.

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I. FEATURES

1. Standard interfaces (as that of extruder)   .

2. MOSFET are applied to the heater/ fan and thermistor circuit.

3. Support 5 stepper drive board

4. All the MOSFET can be controlled by PWM

5. Use the interface of servo motor to adjust the level of printing platform automatically

6.LEDcan indicate the status of the heater (the open and close of MOS).

7. Stepper motor for X,Y,Z axis in parallel.

The Arduino board has several functions:

1. Process code instructions.

2.Control the four stepper motor controllers

3.Control the temperature of the hot end and monitor the hot end

4. Monitor the end stops (End stops are used for homing the three axis.

The Arduino board is connected to the PC using a USB to serial converter. The Arduino used with the RAMPS has a converter built in. The RAMPS board is a shield board that needs to be connected to an Arduino MEGA 2560 board.

 The RAMPS has some additional features:

• One extra heater

• Optional SD card reader

There are 4 stepper motors we are using:

- One to control the X-axis

- One to control the Y-axis

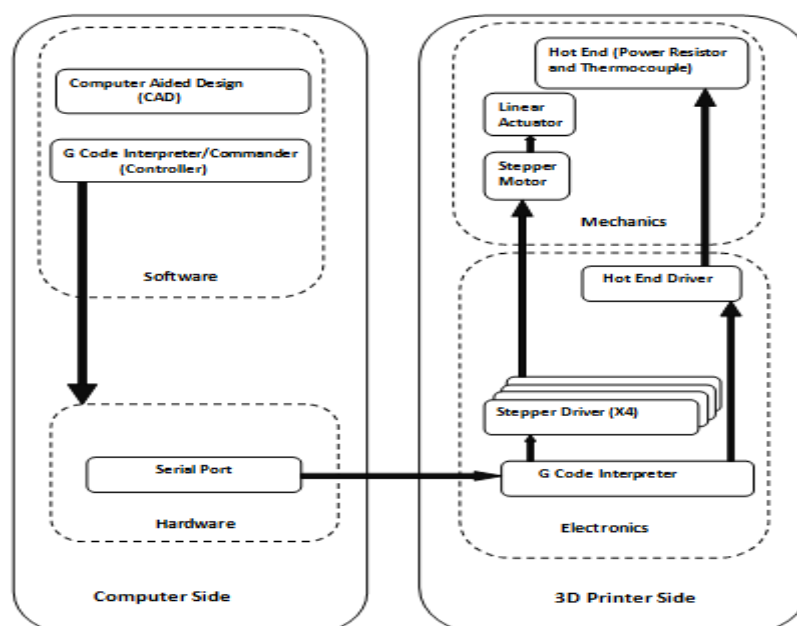- One to control the Z-axis

6.1 Block Diagram of 3D PRINTER

Fig. 6.1 Block diagram of 3D Printer

This above block diagram describes the basic working of the product. As shown in above blockDiagram Firstly a 3D object is designed using a CAD Tool and then is converted in such a fileformat specifically a G –Code using software's like that is understandable by the electronics that mainly includes the Microntroller.

I will be using MakerCam.com to create a test image for our machine. You are free to use 3D printing software such as Slic3r, but the code will have to be heavily edited in order to make it work for our machine. In MakerCam, you can create a test image by following these steps:

Insert a new basic image by going to "Insert" and selecting a shape.

Using the Arrow tool (from top left toolbar), select your entire image.

Move it to the bottom left corner of the grid.

You can pan around the grid by selecting the Hand tool from the toolbar. Use it to drag the image back to the center of the screen.

From the upper right corner of the page, change the measurements to cm.

Using the scale option from "Edit > Scaled Selected", scale the object down and move it so that it fits within the single square that is in the corner of the grid (use the picture to the left as reference).

With the image still selected, go to "Cam > Follow Path Operations" and use these values as a test basis:

1. The "target depth" will be the height of your object. I used -1.

2. "Safety Height" and "Stock Surface" are set to 0.

3. "Step Down" will be the height each layer of filament will be. For starters, I set mine to 0.2, but if you want thinner layering, you can make it lower.

4. "Feed Rate" is the speed at which the print goes. Setting it to 50 worked will with my 3D pen at it's lowest extrusion speed.

5. The "Plunge Rate" is the speed at which the nozzle moves up and down. This doesn't really matter, but I set mine to 50.

Then go to "Cam > Calculate Selected" to calculate the path.

Lastly, go to "Cam > Export G-code" to save the G-Code of your image.

Before we can run this Gcode through GRBL Controller, we need to make a few edits to ensure that it works with our 3D printer. So open up the file that you saved from makercam.com in a text editor such as Notepad. You should see a bunch of different lines of letters and numbers. These are the G-Code coordinates that are sent to the machine that tells it what to do. We want to add "M3" and "M5" commands to tell the filament extruder when to extrude and when to stop extruding. Here's what you need to do:

- Below "G17" is the first "M3" command. Since this starts the extruder way too early (at the beginning of the script), we want to move it until after the nozzle has moved to its starting position, which is immediate after the first "F50" (feedrate 50) command on the next line.

- Throughout the rest of the code, everytime you see an "F50" command, place an "M3" command immediately after it on the next line.

- Next, look for the first Z0 command. Z0, moves the nozzle to 0mm, which we do not want. That would push it down to the base platform and ruin our print. Instead of moving the Z axis at this point, we want to just stop the extrusion motor. So everytime you see a Z0 command, delete it and replace it with an M5 command.

- At the very end of the script, after the final M5 command, we want to move the Z axis so that it is above our final print. Since I set my print height to be -1, I'm going to set the final Z axis height to be -2 (G0 Z-2)

- After setting the final Z height, a helpful thing to do would be to move the X and Y axis back to their original starting positions. So right below the Z axis movement, put "G0 X0 Y0" to move them.

Save your code and then your ready to print

IV. CONCLUSION

It is concluded from this paper that it is possible to build a low cost 3D Model Maker with relatively same performance than the existing technologies.The microcontroller (MEGA 2560 and RAMP 1.4) was the key to enabling the project to come together, meaning that with the functions specified and programmed into it, the 3D Model Maker is able to accomplish the specified goal.

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