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3-Axial CNC Router to 3D Printer

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ABSTRACT

Additive manufacturing is also known as 3D printing. 3D printing is achieved by translating the digital code into visible solid 3D model. Successive layers are printed one after the other by laying down the material this is called as Additive Manufacturing. The printing materials can be plastic, nylon, metal and many more; we can find its application in the field of aerospace, medical field, automation industries, manufacture and architectural engineering, and many more. The application in many of these fields is very enormously growing and also it is cost effective. The use of 3D printing is beneficial to the industries like medical, aerospace, manufacturing, automation and also consumer products in wider range. Thus providing the exciting technology to look forward for this paper seeking to explore the working procedure of 3D printing and its applications in today's world and also for the future.

I.INTRODUCTION

In recent years the 3-Dimensional Printing has become one of the rapid technological trends in today's world. The growth is so rapid that it can also be called as the "Era of 3D Printer" [1]. This is one of the technologies which is said to be affected and can be considered as the boom to the human history than compared to any other fields. In this revolutionary method, the inkjet technology separate printing the parts was done and each successive part will be glued layer by layer to make the 3D model.

This was very tedious and difficult task and also it was time consuming with minimum accuracy. So to overcome this problem, the 3D Printer was invented. In the year 1984 Charles Hull was the first person to invent the 3D printing using SLA (Stereo lithographic apparatus) method. It is the additive manufacturing where the material is added layer by layer as per the design. The physical 3D model is developed by translating the digital code into the visible code pattern.

The SLA printing method is also called as "Rapid Prototyping" because it is the mechanism where the blueprint of the object is designed and developed in the computer [2]. This Digital code or G-code is translated into the solid visible pattern. This design can either be developed in CAD software or can be scanned using 3D scanner

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II.SYSTEM WORKING

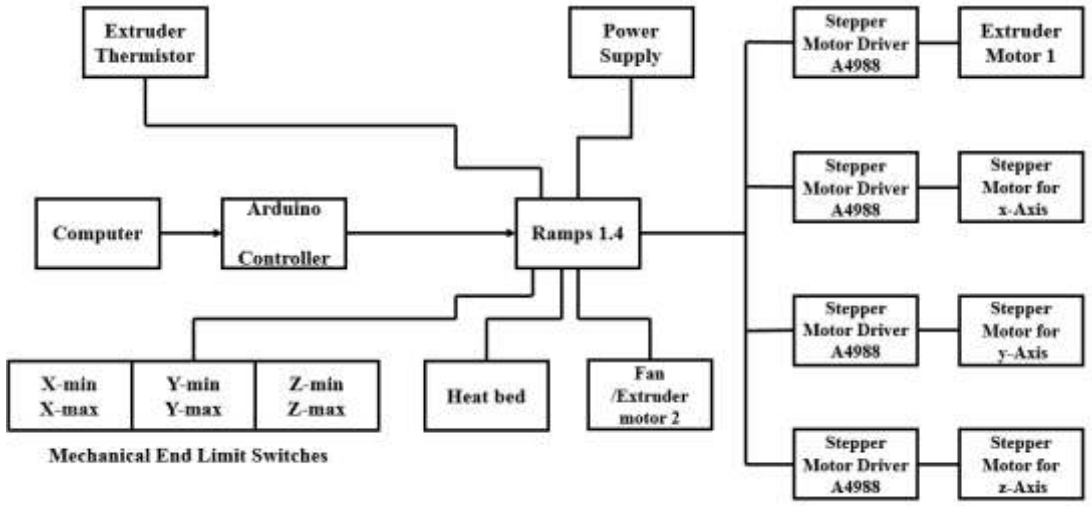

Fig. 1 Block Diagram of 3D Printer

The first step is to design a 3D objet (which is to be printed) on computer using CAD, Slice-3r software or any other software. Then install the Arduino Mega (AtMega 328) controller this will send G-code file to run the Ramp 1.4 using A4988 stepper motor driver. The G-code is a file having the step sizes of the X-direction, Y-direction and Z-directions.

The combination of Ramp 1.4 and A4988 is used to drive Stepper motor which drives the stepper motor in X, Y, and Z directions using the G-code file.

Secondly, the Extruder will start printing the objet using the G-code file. In this the Extruder uses FDM (Fused Deposition Modeling) in which the material is melted or softened to produce the layer. The hotbed is actually going to melt the filament [3]. The Extruder works on 12V and it consist of cooling fan, E3D Hotend, A Nozzle of 0.4 diameter.

The software used for FDM printing methodology are listed below and the procedure is illustrated in below Fig. 2

1. Computer Aided Design-Unigraphics, Pro-E
2. Slic-3r
3. Repeater Host

The Firmware Requirement are listed below and the procedure is interpreted in below Fig. 3

1. Arduino IDE
2. Marlin Firmware

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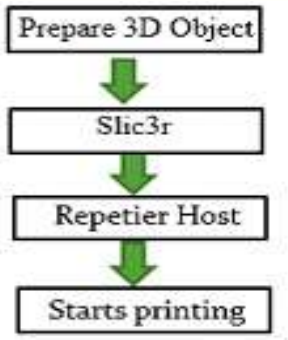

Fig. 2 Flow Chart for software process

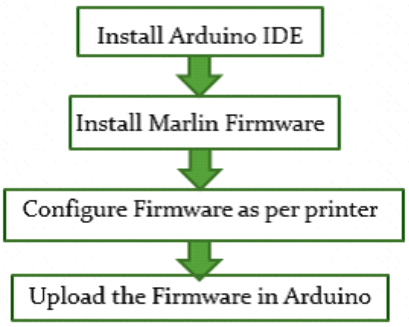

Fig. 3 Flow chart for firmware process

III.HARDWARE DESCRIPTION

1. MK8 Extruder

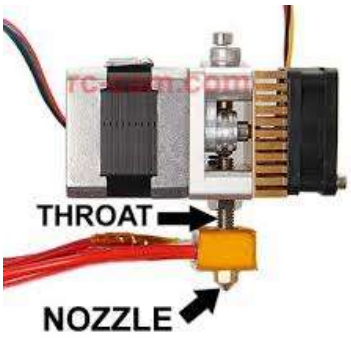

Fig. 4 Hardware Structure of MK8 Extruder

Extruder works on12V(optional 24), it consist of cooling fan, a 304 Stainless Steel Cartage heater, a nozzle with input diameter of 1.75mm(with ±0.1 tolerance), 100k NTC Thermistor, E3D Hotend.

The heater heats the filament like PLA, ABS, Nylon, Metal, etc. at the temperature of 200 to 300 degree Celsius and comes out from the nozzle with output diameter of 0.4mm. The flow rate of nozzle is about 24 cc/h [4].

2. Ramps 1.4

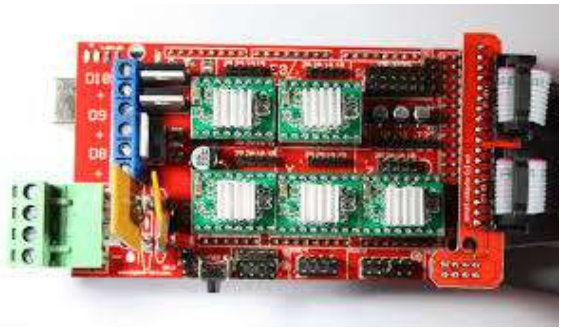

Fig. 5 Ramp 1.4 as Arduino Shield to Drive the Nema 17 Stepper Motor

Ramps 1.4 is also called as 3D Printer CNC Shield Expansion Board, its main purpose is to drive the stepper motors using driver module in X-direction, Y-direction, Z-direction and the Extruder. It only works when it is connected to mother board (Arduino) and A4988. The combination of Ramps 1.4+AtMega 328+A4988 is becoming a mainstream of 3D printer control board.

3.Nema 17Stepper Motor

Fig. 6 Hardware Structure of Stepper Motor

Nema 17 Stepper motor is the motor of choice for 3D printers, Desktop CNC, etc. The rotation angle of motor is proportional to the input pulse. The motor has full torque at stand still (if the windings are energized). It has precise position and repeat ability with accuracy of 3-5% of a step and this error is non-cumulative from one step to the next. The life of motor is simply dependent on the life of the bearing because it does not have contact brushes.

IV.RESULT

3D Printer completes a model in a single process. It reduces the time to print and it also reduces the cost of printing as the filament materials are cheaper and easily available in the market. This innovative technology reduces the company's time, manpower and the money.

Fig. 7 Final Hardware Structure of 3D Printer

IV.CONCLUSION

3D Printing technology could revolutionize and re-shape the world. It will provide companies and individuals fast and easy manufacturing in any size, shape and scale limited only by their imagination. 3D printing, on the other hand, can enable fast, reliable, and repeatable means of producing tailor-made products which can still be made inexpensively due to automation of processes and distribution of manufacturing needs. Auto bed leveling enhances the quality of the print with less human interruption.

V.FUTURE ASPECTS

The biggest future scope of 3D Printer is in the medical field, it can be used to create the replacement organ and event to directly repair the human body in situation. This is known as "Bioprinting" and is an area with rapid development.

3D Printers may also be used to make future buildings. Demonstrating the potential, over in China an amazing company called "WinSun Decoration Design Engineering" has already 3D printed a number of houses. Produced using a vast material Extruder 3D Printer, these include a 1,100 square meter mansion and a few storey apartment block.

VI.ACKNOWLEDGEMENTS

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