DESIGN AND FABRICATION OF 3D PRINTER WITH 2 AXIS MOVING BED (4 DEGREE OF FREEDOM)

Md.Aman

(Assistant professor)
dept. of mechanical engineering
united college of engineering and research naini prayagraj

Prayagraj, India

imaman786@gmail.com

Aditya Srivastav
dept. of mechanical engineering
united college of engineering and research naini prayagraj

Prayagraj, India

adityamaa889@gmail.com

Mohit
dept. of mechanical engineering
united college of engineering and research naini prayagraj

Prayagraj, India

parmilamohit2016@gmail.com

Ajay Patel
dept. of mechanical engineering
united college of engineering and research naini prayagraj

Prayagraj, India

ajaypatelas8764@gmail.com

Hemlata Mishra
dept. of mechanical engineering
united college of engineering and research naini prayagraj

Prayagraj, India

hemlatamishra0001@gamil.com

Abstract

3D printing is an additive manufacturing technique in which 3D objects are printed with the help of CAD (computer-aided design) software. For additive manufacturing various processes are used such as-(a) SLS (selective laser sintering), (b) EBM (electron beam machining), (c) LOM (laminated object manufacturing), (d) DLP (digital light processing), (e) FDM (fused deposition method), etc. In this paper, we have focused on the design and fabrication of 3D printer with 3 Axis moving bed (4 degree of freedom). The 4degree of freedom are- the bed moving in 3 axes are x-y-z which are first 3 degree of freedom and the fourth degree of freedom, the bed is rotating along xy- axis. The process used in our 3D printer is FDM technology (Fused Deposition Method). There are different types of materials PLA (polylactic acid), ABS (acrylonitrile butadiene

styrene), HIPS (high impact polystyrene), etc used in this process. By heating any of the filament material to its melting point and it is deposited layer by layer. Combination of many layers of such type will give us a final 3D model and which can be constructed economically.

Keywords—*3D Printing, Filament, Nozzle, Fused Deposition Method (FDM), Additive Manufacturing.*

I. INTRODUCTION

This manufacturing method gives a quick and inexpensive (low cost) alternative for creating prototypes and working models. Some materials which are used in the development of 3D objects are- polylactic acid (PLA), Acrylonitrile Butadiene Styrene (ABS), High impact polystyrene (HIP) etc. Recently some new alternative materials have been developed like Metals and its types of composition and organic matter like carbon and its derivatives. At that time 3D printing technique is used widely in many industries like Automobile, Aerospace, Education, and medical fields also due to its accuracy and efficient production of objects. those objects which are printed by 3D printer will be high strength, good finishing, light weight and rapid prototyping of the object can be done. The prototypes is computerized 3D model and converting that in an advance document into a physical objects this 3D printing technique used that time in worldwide due to its approach to decrease costs spare time and producing better items.

2 DIFFERENT PROCESSES OF 3D PRINTING: -There are various processes available in 3D printing technology to create a 3D object. These processes may be selected based on the use of material, the purpose of design, the complexity of the object and application of the object. The processes are as follows: -

2.1 **Fused Deposition Modelling (FDM)-** It is an extrusion-based additive manufacturing processes, where the parts are produced by layer-by-layer technique as other AM system. The other name of FDM is FFF (Fused Filament Fabrication). Fused deposition modelling depends on the standard STL data file for input and is capable of using multiple build materials in a build/support relationship

2.2 **Selective Laser Sintering (SLS):** Selective laser melting process is a laser based additive manufacturing technology. Intricate component can be created directly out of powder metal on the basis of solid work / CAD file. It is also very intricate structure for dental and human implants.

2.3**. Laminated Object Manufacturing:** In LOM process the adhesive coated layers material is rolled on a building platform. Which are glued together by the heated rolls then it cut layer by layer by the help of laser in the desert shape. After that the appropriate object is produced. which is a final object

3. MECHANISM:

Design of object: In this additive manufacturing technology first, we create dimensional model by the help of some software's (crew, AutoCAD, solid work) where the all required test perform on actual model. After that we converted that into STL file and transfer to the printer and the printer convert into G-code and start to printing the physical object.

Design of printer:

Dimensional motion is achieved in this printer by the help of a stepper motor by the helpof6steppermotors.2 for vertical (z axis) up and down motion and 3 is bed moment in x axis, y axis and xy- plane bed rotation, and 1 for extruding the material.

X axis Movement:

Figure shows the rendered CAD model of the mechanism of Lateral movement. It consists of the carriage, cylindrical rods, pulleys, timing belt and hot bed arranged as shown.

For the x-axis movement we used one stepper motor and timing belt which is connected to the hot bed carriage provided to and fro motion to bed and carriage is also connect two cylindrical rods for sliding.

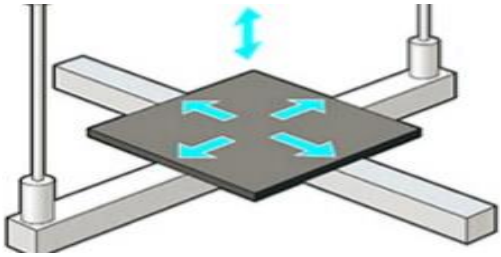

Fig:1-X-axis Movement

Y–axis Movement

Figure shows the rendered CAD model of the mechanism for Y-axis movement. It consists of Carriage, Cylindrical Rods, Pulleys and Timing Belt arranged as shown.

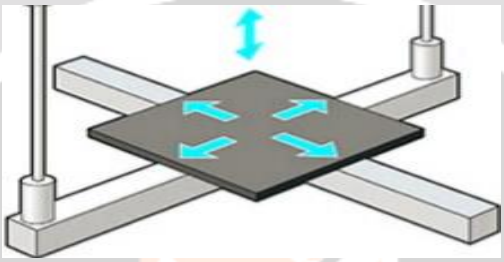

Fig:2- Y-axis Movement

For y axis movement we also use one stepper motor with timing belt which is connected at right angles to x axis connected belt with two sliding cylindrical rods for performing the bed in and out motion in y axis to the hot bed carriage.

Z-axis Movement:

Figure shows the rendered CAD model of the mechanism of vertical movement. It consists of
led screws, shaft coupler, flange nut and carriage bed arranged as shown in the image.

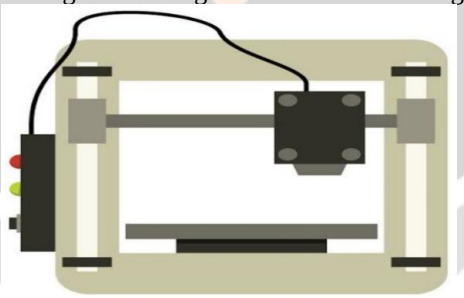

Fig:3- Z-axis Movement

In z axis movement nozzle will move which is connected two stepper motors with the help of two screw cylindrical rod and connect to the nozzle carriage that is responsible for up and down motion in vertical.

Rotation in XY-plane: the mechanism of xy-plane rotation it consists Printing bed (Hot bed), shaft, stepper motor, connecting gear are arranged. By the help of diagram, we understand the mechanism of xy-plan rotation it consists to the one stepper motor which is connected above to the carriage bed and rotate the hot bed in xy- plane.

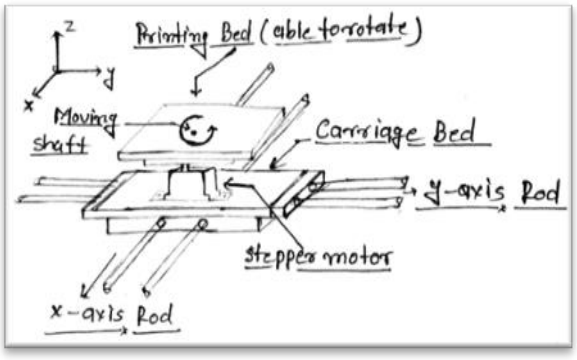

Fig:4- XY Plane Movement

Build Volume	150L x 180W x 200H
Method	Fused Deposition Modeling
Layer Resolution Height	50 microns
Number of Extruders	One
Machine Size	380mm(L) x 550mm(W) x 610mm(H)
Machine Weight	8Kg
Power Supply	DC 12V, 5amp
Power Consumption	250v, 50-60Hz, 5amp, 600W
Connectivity	USB, SD
Filament Diameter	1.75mm
Nozzle Diameter	0.3 mm
Filament Material	PLA, ABS, Thermoplastics
Print File Type	G-code, STL, Obj

Table1 Machine Specifications

CONCLUSION

The result of this paper is to make a 3D printer with two axis moving bed (4 degree of freedom) which done successfully by this-

1. We able to reduce deposit material movement with the nozzle in x axis or y axis. Because we give only vertical movement (z axis) to the nozzle carriage.
2. We increase the possibility to fixing the hot bed axis in xy-plane (at any angle). The design of the frame is made robust and compact using aluminum section. The material section of the different element is economical.

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REFERENCES

[1] A. Ramya and Sai Leela Vanapalli, 3d Printing Technologies in Various Applications. International Journal of Mechanical Engineering and Technology, 7(3), 2016, pp. 396–409. http://www.iaeme.com/currentissue.asp?JType=IJMET&VType=7&IType=3.

[2] Jacobs, P.F., Rapid Prototyping & Manufacturing, Fundamentals of Stereolithography, Society of Manufacturing Engineers, 1992, Chapter 1: 11–18

[3] Dr. Rajashekar Patil, Deepak D, Dharshan Gowda S, Krishna Kashyap C S, Mohammed Murtaza, Prashanth S N, Harsha N and Bharath V G, Economical 3d – Printer by Adopting FDM Technique, International Journal of Mechanical Engineering and Technology, 8 (4), 2017, pp. 442-447

[4] Helena N Chia, Benjamin M Wu (2015), Recent advances in 3D printing of biomaterials, Journal of Biological Engineering, pp. 1–14

[5] Kaufui V. Wong and Aldo Hernandez (2012), A Review of Additive Manufacturing, International Scholarly Research Network, pp 1–10

[6] T. Prabhu. Modern Rapid 3D Printer - A Design Review. International Journal of Mechanical Engineering and Technology, 7(3), 2016, pp. 29–37

[7] file:///C:/Users/HP/Downloads/D-R-516-Banding-and-Clogged-Nozzles.pdf