International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 04 | April - 2023 Impact Factor: 7.185 ISSN: 2582-3930

DESIGN AND DEVELOPMENT OF 3D PRINTER

Sarvajna Bhat[1], Madni Faruquee[2], Shweta Patil[3], Sudarshan Patil[4] , Asst Prof. Shilpa Katre[5] , Dr. Pradnya Maturkar[6]

[1,2,3,4] ***Students*** *Department of Electronic and Telecommunication Engineering, St. John College of Engineering and Management, Palghar (E) 401402*

[5]***Asst Prof. Shilpa Katre*** *Department of Electronic and Telecommunication Engineering, St. John College of Engineering and Management, Palghar (E) 401402*

[6] ***Asst Prof. Dr. Pradnya Maturkar*** *Department of Electronics Engineering, YCCE ,Nagpur.*

Abstract - The 3D printing process is becoming more and more popular these days due to its advantages over traditional processes. A 3D printer is a machine that creates objects from plastic, nylon and many other materials. 3D printers are now portable and very expensive. By analyzing this problem, we are trying to design a 3D printer. Compared with other 3D printers, the cost of this printer is much lower. Make a low-cost 3D printer with a price 15% lower than the market. The generation of 3D printing is mainly based on additive manufacturing. This generation has the power to transform economic sectors by generating products in the shortest possible time. Previously, it would have taken days, months, or even years to generate the same product. The research on these printers and their software aims to make the printers much cheaper than the printers currently on the market. In 3D printer technology, three-dimensional objects are created by depositing successive layers of material. In this project, we focus on the design and development of a 3D printer that can be built economically. We use firmware and a 3-axis mechanism where 3 axes are x-y-z with an extruder.

***Key Words*:** *RepRap (Arduino MEGA) board, G- code Marlin.*

I. INTRODUCTION

WHAT IS A 3D PRINTER?
These machines are used to convert 3D designs that a person can create using a computer into real objects.
To achieve this, we use liquid plastic (or other material) instead of the ink we are used to, which solidifies after printing and makes the object. 3D printing, or additive manufacturing, is the process of creating three-dimensional strong items from virtual files. The introduction of 3D published gadgets is executed the use of additive approaches. In additive approaches, objects are created by means of depositing successive layers of rely till the item is created. The 3-d printer lets you create complicated shapes the use of much less cloth than other manufacturing strategies.
The focal point of this assignment is on the fused deposition modelling (FDM) production method. The motive for using FDM from all the many Additive production tactics is because of its extensive variety of applications and adoption by way of many individuals and industries in lots of special sectors. Fused deposition modelling (FDM), additionally called the cloth extrusion additive manufacturing technique, utilizes polymers as the uncooked cloth (filament). The filament is generally heated after which extruded via the nozzle of the 3D printer gadget. In 3-Dimensional (3D) printing, 3D items are formed the usage of a 3D photo document. It is a process of making an item via putting layers of fabric one on pinnacle of some other [1].
The paper is organized as given; section II shows history and literature survey; section III discuss regarding system development; section IV highlights various firmware and software used; section V outlines the conclusion and output of project ; section VI states the Future scope of the project.

II. LITRETURE SURVEY

It started with the improvement of additive production techniques and their substances inside the Nineteen Eighties. In 1986, Chuck Hull invented a way referred to as stereolithography, which uses Ultraviolet (UV) lasers to remedy photopolymers [1]. Selective laser sintering and direct metal laser sintering was developed inside the 1980s, those are steel sintering strategies. Later in 1990 FDM (Fused Deposition Modelling) technique evolved. In 1995, Massachusetts Institute of technology (MIT) evolved a 3D printing (3DP) technique referred to as manner of inkjet deposition of liquid binder on powder [1]

III. SYSTEM DEVELOPMENT

Various elements of a 3D printer.

A. Frame: It is a key element of the printer because it ensures the rigidity of the machine. Made of steel, sheet metal or aluminum, it must withstand the various constraints imposed by the various elements of the machine. Therefore, its design is essential not to limit the precision and speed during the printing process.

B. Printer head: It is most important for the printer. By moving in different directions, it is this part that will create the 3D object. The plastic filament enters at the top in solid form and exits at the bottom in liquid form after heating. It consists of the following parts:

i. An extruder which can control the melting of the filament flow. At this point, you will have a jog wheel and a stepper motor. The latter defines the speed at which the filament is pushed through, as a means of controlling the flow.

ii. The hot end, which does the actual printing. It consists of a nozzle which deposits layers of material on the printing surface.

iii. The extruder and warm stop are probable the maximum vital parts of a 3D printer. Many humans confer with these elements together as an "extruder"; however, each element performs a very important feature. The filament is fed into the extruder between the force gear and the bearings. As the motor spins, the force equipment spins, forcing the filament into the new stop. The recent stop is a heated chamber that melts the filament as it is pressured through the extruder. The molten filament is then pushed via a small nozzle at the bottom of the recent tip. The filamentary plastic that comes out of the nozzle is put together strand through strand, layer via layer, to form the whole version.

C. The print bed: Mainly consists of an aluminum base with a heating element, on which there is a removable pressure surface. The printing surface can be glass, metal or fibre composite. Usually, the surface can be heated. Although not mandatory, it ensures better adhesion of the first layers of melted filament, depending on the material to be printed. Although more and more printers have built-in bed level sensors, you will also find adjustments to set the bed at right angles to the movement of the printhead.

D. The 3 axes on printer: The position of the print head is defined by its coordinates along the X, Y and Z axes:

i. The X axis defines the movement in width (ouı and back). The print head usually slides on two rails for guidance. It is driven by a stepper motor and has a limit switch that sets the 0 position.

ii. The Y axis sets the depth movement (left and right). It is very common for the print bed to slide back and forth on two rails. It is driven by a stepper motor and has a limit switch that sets the 0 position.

iii. The Z axis sets the pitch movement (up and down). The movement still moves up and down on two axes, but using a ball screw connected to a stepper motor. For this axis the limit switch can be set manually or 0 can be set using the probe sensor on the base plate. This allows us to set the height between the print head and the print surface.

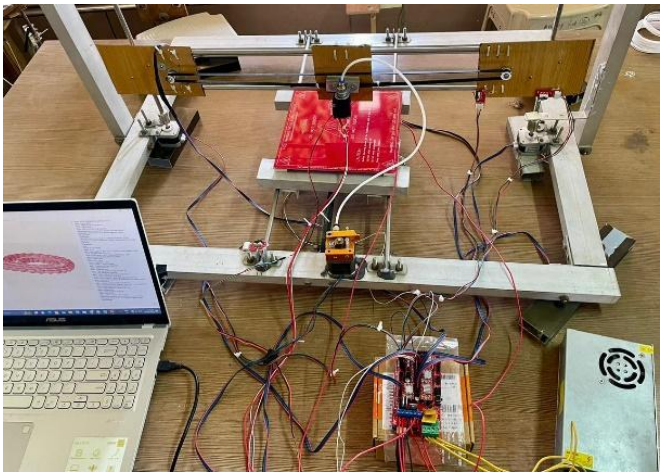

Fig -1: Overview

E. The electronics board: The board is responsible for coordinating all the activities on the printer such as:

i. Reading and interpreting the computer code instructions it receives.

ii. Calculating the trajectory of the print head

iii. Driving the various stepper motors of the printer axes.

iv. Modulation of the heating elements in the print head and control of the print bed.

F. The power supply: No power means no printing. It does the same thing as the power supplies you find in a desktop computer. This is the power supply that provides all the power the printer needs to operate.

G. Filament: There are many types of filaments, some of which are intended for technical applications. Some of the most common materials include: PLA (or Polylactic Acid): This is one of the best-selling plastics due to its ease of use and affordability. It is primarily derived from corn-starch and is generally considered safe for food contact and industrially compostable. It is available in a variety of colors for industrial, medical and decorative applications.

IV. FIRMWARE AND SOFTWARE

Firmware is permanent software in read simplest memory (ROM) in the form of non-risky memory utilized in a computer program to offer manipulate of a hardware tool. It can provide a preferred operating environment for the device to extra complex software, permitting the hardware to run on the working device (OS) and run multiple devices to complete all monitoring and manage features. This firmware is used for diverse functions together with client devices, laptop peripherals, and so forth. The electronics of the three-D printer are controlled by using a processor, which includes an Intel processor and an Arduino primarily based microcontroller utilized by 3-D printers. Those processors were utilized in computer systems to run the authentic software. Firmware is the complete software program that runs the 3-d printer, the firmware part of it is the nearest component to real programming. In a 3D printer, software performs a crucial position in sending statistics from one place to any other. With out software program, we cannot produce virtual gadgets to be reduce and revealed. This software is a platform where any three-D version can be created with any 3-D software program.

LIST OF FIRMWARE

A. Arduino IDE

By using IDE, we can easily write code and upload it on board. We recommend it for users with weak or no internet connection. The software can be used with any Arduino development board. The Arduino is an open-source electronic platform grounded on clean to use tackle and software program. Arduino forums are suitable to read an input and turn it into lights an LED, or something displayed on line. You may manage the board via giving commands to the board by using transferring a hard and fast of instructions to the microcontroller of the board.

B. MARLIN

Marlin is an open-source firmware in which any of RepRap circle of relatives can mirror in fast prototyping and its miles popularly known as a 3D printer. It turned into received by means of Grbl and Sprinter and it have become open source for all 3D printers. Marlin is used for respected 3D printers like last, Marlin runs in 8-bit microcontrollers the chips are at the center of open-source reference platform for marlin Arduino Mega2560 with RAMPS 1.4.

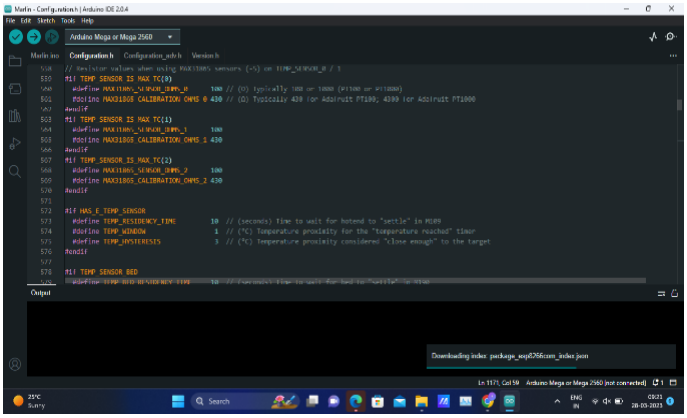

Fig -2: Marlin

C. PRONTERFACE

Pronterface is a smooth graphical client interface that lets in you to expose and manipulate your printer from a USB-related laptop. With it you may without detention flow into stepper buses, manipulate mattress and snoot temperatures, boat G- regulation instructions without detention via a terminal or press window, and masses lesser. Originally designed to control the end-to-end 3D printing workflow, including slicing (using Slic3r), Pronterface tends to fulfil a simpler role today. Yet, despite other software options, including various “G-code senders”, providing much of the same functionality, Pronterface has several distinct advantages.

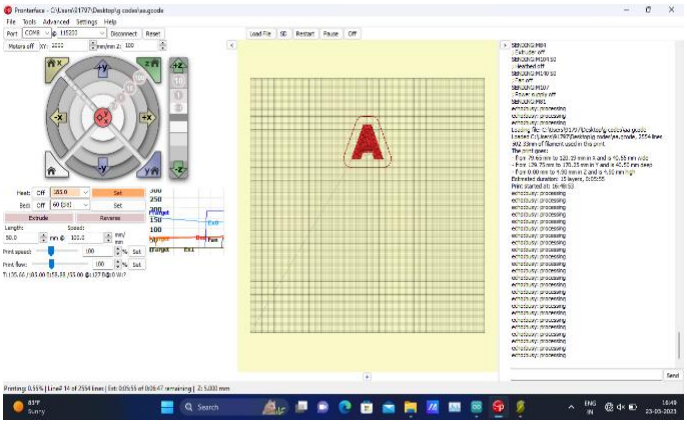

Fig -3: Pronterface interface

D. Slic3r

The main function of a slicing software is to process files in STL format. It stores visual images of 3D models. The set of instructions to convert a 3D model into a 3D printer is called a slice. It literally "slices" the 3D model into thin layers and further determines how each layer should be printed (toolpath) for the shortest time, best strength, etc. get. Slicing software takes a 3D model, usually an STL file, and converts it to g-code which sends instructions to the printer.

V. CONCLUSIONS

The result of this project was the construction of a 3D printer that was successfully completed. With the help of aluminum profiles, the frame design is solid and compact. The material is selected from various elements in an economical manner. It is clear that 3D printing has many benefits. Many distinctive industries are starting to combine 3D printing into their processes with the goal of leveraging the use of era in distinct methods. It's a technology that has evolved appreciably in current years, and it will retain to evolve as it maintains to refine what it gives. Thinking about all the benefits of 3D printing, it is clear that its simplest a depend of time before it soon turns into a more capable era than traditional methods. The ability to print complex shapes and parts without any shape assembly is what makes 3D printing so particular. Small and complicated shapes may be created in a brief time and at very low cost. The opportunity of developing and generating gadgets of different shapes without unique tooling gives agencies greater manufacturing flexibility and facilitates to reduce fees. The advantage of 3D printing is that it enhances innovation and is ideal for on-call for customization wishes. It allows companies to layout and create products like by no means before.

Fig -4: Result

VI. FUTURE SCOPE

Although the printing of body corridor organs is under trial stage and is not available for medical practices. But with growing technology and development in biomaterials available for similar operations, it’s not insolvable to prognosticate that similar 3D published corridor or organs will be crucial players in the healthcare sector. The developments in this sector make this field presto, cost effective, stoner-friendly, flexible and affect acquainted. The author envisages an exponential rise in prototyping conditioning using 3D printing technology looking into the versatility of the technology and its rigidity to colorful types of material.

REFERENCES

1. Lalit Kumar, Qamar Tanveer, Vineet Kumar, Mohd. Javaid, “Developing low cost 3D printer, ” Journal of Applied Sciences and Engineering Research, Vol. 5, Issue 6, 2016.
2. J.M. Sosa, S. Len, J.M.Cerezo, A.Vega, Reuse of 3D printers for laboratory training, Department of Electronics Engineering and Automation/ Institute for Applied Microelectronics University of Las Palmas de Gran Canaria Las Palmas de Gran Canaria, Spain,, 2016.
3. Pratik S Kamble, Suchitra A Khoje, Jyoti A Lele."Recent Developments in 3D Printing Technologies: Review", 2018 Second International Conference on Intelligent Computing and Control Systems (ICICCS),2018
4. Shyh-Kuang Uenga, Lu-Kang Chenb, Szu-Yao Jenc, A preview system for 3D printing, Proceedings of the 2017 IEEE International Confer- ence on Applied System Innovation, 2017.