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3D PRINTER

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Abstract: *3D printing is a kind of direct manufacturing technology and is called rapid prototyping, based on digital model files which can make almost any shape of 3D entities. There is no doubt that 3D printing will bring a revolutionary impact on manufacturing. The aim is to create a state-of-art machine controlled by a computer and capable of producing a 3D solid representation of a CAD model in plastic form through an extruder. Fused Deposition Modeling (FDM) used here is an additive manufacturing technology for printing 3D objects layer by layer. The main purpose of the research is to develop a low-cost 3D printer using easily available materials and layer by layer methods for fabrication which can be used to print objects confined within 300 x 300 x 300 (in mm) printing area.*

Keywords: *Fused Deposition Modeling, Arduino Mega, 3D Printer, Prototype, CAD software, Filaments.*

I. Introduction

Nowadays 3D printers vary in order to differences of types are developed rapidly used in industrial design. In the manufacturing area a latest technology has proven to be very trustable and is called rapid prototyping. This technology has been continuously improved and has slowly risen up into a useful tool for many fields like product development, researchers, manufacturing and scientists. 3D printing is the process of creating an object with material step by step printing to add layer in three dimension formations. The major difference between traditional manufacturing and 3D printing is that the 3d printer involves additive and rapid approach but most of the traditional manufacturing processes involve subtractive, forging, molding, cutting, gluing, welding and foremost assembling the parts. At the commencement 3D printing was mostly seen as a tool to shape and make it to the artistic or different designs, but in last couple of years this technology is reaching to a point where mechanical components and some required part can be printed.

It completely standardized the industrial manufacturing, also change our entire way of life in the future as 3D printer makes possible to finish model in a single process. Printing is useful stuff that helps people in day to day life[1]. For consumer level additive manufacturing, mainly two main techniques to 3D printing objects: Stereo lithography and Fused Deposition modeling. Both processes add material layer by layer, to make an object's[2].Stereo lithography(SLA) uses a Ultra-Violet light source to particular cure resin while Fused Deposition Modeling (FDM) extrudes semi-liquid plastic in a required layout to create objects. The fastest growth of this FDM technology has allowed great revolutions and 3D printing (mainly Fused Deposition Modeling or FDM technique) cheap cost for manufacturing.

II. Concept of 3D Printing

3D printing has been changing the manufacturing and prototyping industries since the late 1980's, but it wasn't until 2009 that "desktop" 3D printers were readily available to the public. A desktop 3D printer is industry jargon for a smaller, less expensive 3D printer that a typical consumer can buy. Bowyer's team called their first printer as Darwin (released in March 2007) and the next as Mendel (released in 2009). Since 2010, 3D printer technology has shown explosive growth with the help of the open source and DIY communities. It was superseded by the Maker Bot Thing-O-Matic in 2010. These were mostly made of laser cut wooden parts with some 3D-printed parts (plus, of course, motors and electronics). Eventually, Maker Bot became one of the earlier commercial consumer printer companies and was purchased by Stratasys in 2013 [3]. The Fused Deposition Manufacturing Technology is the mostly available and comparably less expensive. 3D Printing Technology development should help people to do their work more easily and make them comfortable. 3D

printing starts by making a virtual design of the object you want to create. The virtual design is used as a template of the physical object to be created. That virtual design can be made using a 3D modeling program such as CAD (Computer Aided Design) to create a design from scratch. Alternatively a 3D scanner can be used for an existing object. So scanner makes a 3D digital copy of an object and puts it into a 3D modeling program. The model is then sliced into hundreds or thousands of horizontal layers in preparation for printing [4].

III. Design of The Proposed System

The business products, around 300 mm (length), 300 mm (width) and 300mm (height) building structure will be equitable working space for the 3D prototyping machine which will be built in this project. Thus developing a 3D printer with 300 x 300 x 300 mm, the frame will have to reach an overall 900 mm to 1000 mm length and width of 900 mm to 1000 mm height considering the toleration from others factors (HBP and moving axis area). Thus, from the approximate machine size, it is possible to predict that the structure will be strong and stable enough since the base is wide and the height is stable for the structure design. Since the frame design, XYZ motion drivers are needed to put in consideration throughout the design[5]. The fully supported rail is chosen as the XY axes supporting railing system. As on the Z-axis, rod rail is suitable for vertical structures due to it is simplify installation and high efficiency during Z-axis movement**.**

IV. Hardware Assembly

4.1. Extruder Heater

The extruder heater block consist of an aluminum mounting block and a 40W heating element where it is rated at 12V.The power dissipated by this heating element is controlled by varying the duty cycle of the PWM applied by the microcontroller [6]. When a 12VDC is applied to this heating element, the control system for this system used MOSFET to control the power delivered. The IRF540 MOSFET will be used together with a 4N25S optical isolator to provide a gate voltage of 12V to the MOSFET whenever a trigger signal is received from the microcontroller.

Fig. 4.1 Extruder

4.2. Extruder Mounting And Positioning

The extruder is mounted on two pieces of Aluminum rod (X axis). Since the 3D printer uses fused deposition method (FDM) technology, the material is melted and forced out to form the model layer by layer, thus no external forces is introduced that may cause bending on the Z axis structures machine. Hence, the two aluminum rods are sufficient to support the extruder during the prototyping process. The tip of the nozzle is required to be kept at least 0.8mm from the heat Bed. This is to ensure the melted plastic is able to stick on the surface of the heated bed platform.

4.3. Heated Bed Platform

The heated bed platform is designed using a simple printed circuit board. The copper surface produces heat as current flow through the PCB. However, the problem occurs when the melted PLA does not adhere to the copper surface. Finally, an acrylic is used for the testing. The melted PLA is able to stick firmly on the surface of the acrylic.

4.4 Stepper Motor

As shown in figure 4.4 A stepper motor is a type of DC motor that works in discrete steps. It is a synchronous brushless motor where a full rotation is divided into a number of steps.

Fig.4.4 Stepper Motor NEMA17

The two main components of a stepper motor are the rotor and the stator. The rotor is the rotating shaft and the stator consists of electromagnets that form the stationary part of the motor. When a discrete DC voltage is applied, the stepper motor rotates in a particular angle called the step angle; thus a stepper motor is manufactured with steps per revolution of 12, 24, 72, 144, 180 and 200, with a corresponding step angle of 30, 15, 5, 2.5, 2 and 1.8. It can be operated with or without a feedback control.

4.5. Safety Consideration

A safety enclosure has been constructed to cover the 3D printer machine in order to keep the user safer from heating elements during the prototyping process. This is to make sure that users do not interrupt the machine when it is in the printing process which could harm the users. The recommended bed temperature for PLA is 70°C, it is still relatively safe to touch the platform. However, the nozzle which is maintained at a temperature of more than 200°C is unsafe for the user to touch it. Hence, it is suitable to build a safety enclosure in order to support safety prototyping procedure.

V. Software Used

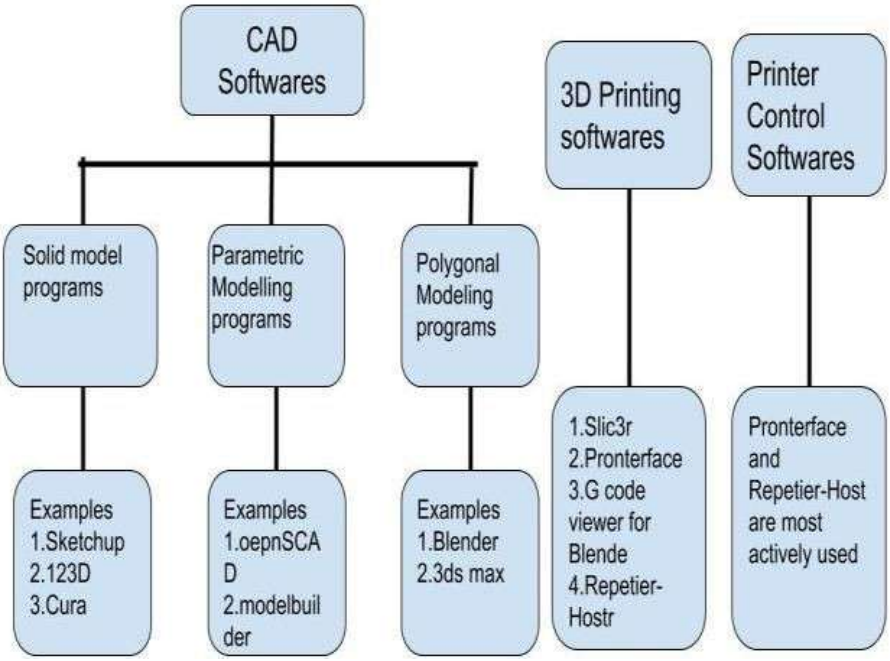

Fig. 5.1 Software used in Process of 3D Printing

VI. Proposed Methodology

3D printer uses series of commands called G-code. Fig. 6.1 shows the interfacing between hardware and software.

G-code flow's one command at a time to printer from a source computer through USB port also printer can read through SD card. The firmware interprets the G-code at a time and shifts it to the printer for further execution. Status of the information (example: temperature) return to the user's computer through the USB. In our case interpretation of G-code is done on the host computer and controls are sent to the printer. The prepared

file is thus uploaded in the 3D printer, which will see the printer creating the object layer by layer. Here, every slice (2D image) is read by the printer and proceeds to create the object layer by layer and the resulting object has no sign of layering visible, but a 3 dimensional structure.

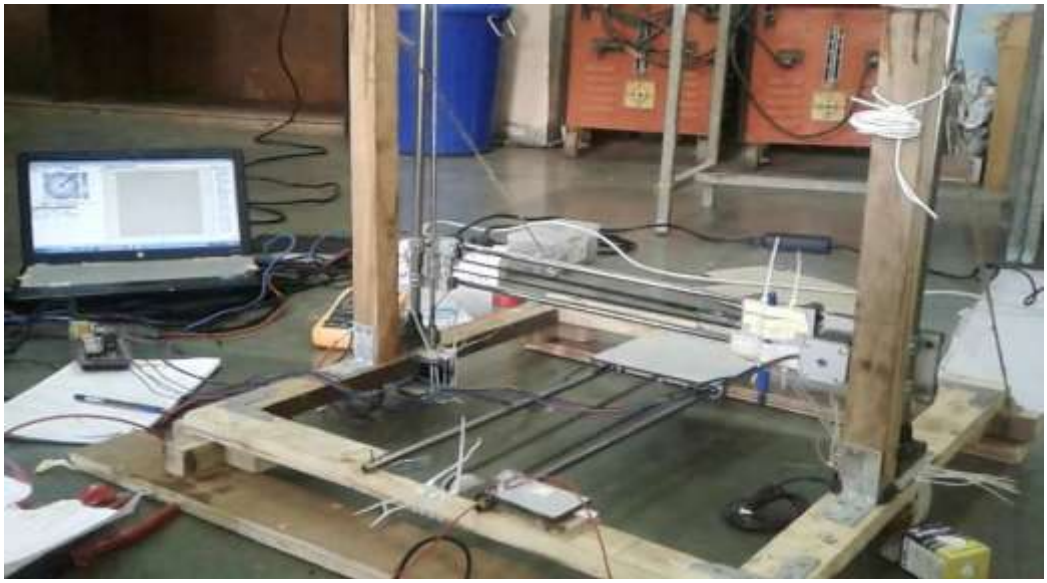

Fig. 6.1 3D Printer

VII. Material Used for 3DPrinter

7.1 Material : PLA (Poly-lactic Acid)
7.2 Extruded temperature: 170 ˚C to 220˚C.
7.3 Formation : Biodegradable Plastic made from corn or potatoes(Produced from plants tarch)
7.4 Prons: Bio-plastic- good environmental properties.
7.5 Cons: Low heat resistance.

VIII. Advantages

8.1 Less waste Production
8.2 Plastic reuse
8.3 Unlimited shapes and geometry
8.4 User friendly
8.5 Customization
8.6 Provides employment

IX. Application

9.1 Manufacturing
9.2. Packaging
9.3. Consumer products
9.4. Bio medical field
9.5. Architectural models
9.6. Educationally.

X. Future Scope and Conclusion

We can add the IoT concept with 3D modeling such as we can see real time printing the object with the help of raspberry Pi and camera Interface with 3D scanner to make digital file of the object to be printed[7]. Thus, 3D printer has such wide range of advantages and applications, where we can explore and examine the virtual reality objects that can be created by us. This proposed concept of 3D printing technology is such that it has low cost of ownership. One can conclude that 3D printing technology is revolutionary and resellers because it is a very exciting technology that has tremendous potential and a variety of technologies in one place and considering their financial gains and social impact.

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