DESIGN AND IMPLEMENTATION OF ARDUINO BASED 3D PRINTING USING FDM TECHNIQUE

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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 and printed one after the other by laying down the material (Additive Manufacturing). The print materials can be plastic, nylon, metal and many more, we can find its application in the field of aerospace, automation industries, manufacture and architectural engineering, construction of design industries, dental & medical fields and many more. The application in many of these fields is very rapid and also 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.

Keywords: *3D Printing, FDM Technique, Rapid Prototyping and Auto Bed Levelling.*

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1. INTRODUCTION

In recent years the 3-Dimensional Printing has become one of the rapid technological trend in today's world. The growth is so rapid that it can also be called as the "Era of 3D Printer". This is one of the technology which is said to be affected and can be considered as the boon to the human history than compared to any other fields. In this revolutionary method, the inkjet technology separate printing the parts and each part will be glued to make 3D model. This was very tedious task and time consuming with minimum accuracy. So to overcome this problem the 3d printer with SLA technology was invented. In the year 1984 Charles Hull was the first person to invent to 3d printing using SLA (Stereolithographic 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 is also called as "Rapid Prototyping" because it is the mechanism where the blueprint of the image is designed and developed in the computer. This digital code is translated into the solid visible pattern. The design can either be developed in CAD program or can be scanned using the 3D scanner.

1.1 Statement of the Problem

The increasing demand in the area of developing a model at a faster rate, the industries requires increasing the production rate towards the huge demand by consumers for end product. The technology must be cost effective and easy accessible by the consumers. Prototyping is time consuming from product cycle up to development life cycle and also very expensive.so the main concern is towards the maintenance of time where each end user or the organization requires to reduce the time it takes to build the product.

1.2 Scope of the study

The 3d printing technology has become one of the most important research study in this new era. The production and its areas of concentration are uncountable because it helps the production industry and rapid prototyping industries to reduce the amount of time involved in the product and also the cost. Hence for this purpose. Our research has been scaled down to the applications and as well as the importance and benefits of 3d printing to rapid prototyping.

2. LITERATURE SURVEY

The paper provides the information about the systematic reviews in this 3D printing field based on the academic research publication and also providing the overview of the efforts taken in research development. The 3D printing has number of processes and different technologies offering capabilities to develop the parts and the products with different materials. Mainly these technology and processes depends on the production methods that is carried out like Additive manufacturing which has layer by layer process or subtraction method or casting/molding processes. Day by day applications of the 3D printing is increasing penetrating deeper into the marketing, industrial, maker and customer sector. [1]

The paper presents the detailed information about the advanced and common material used to build the products using fused deposition modelling techniques for rapid prototyping. In rapid prototyping techniques, the state of materials initially can be solid, liquid or even powder state. Considering the solid forms, it can be wires, pellets or laminates. Metal, resins, ceramics, wax, nylon, paper are the current materials of Fused deposition modelling techniques are ABS, PLA, polycarbonate, polyamide, polyethylene and

polypropylene. Some advanced materials for the special purpose application in FDM are PZT, aluminum oxide, stainless steel, silicon nitrate and hydro ox apatite. [2]

3. FDM PRINTING METHODOLOGY

Software Requirement Specification:

- Computer Aided Design -Unigraphics, Pro-E
- Slic-3r
- Repetier Host

Firmware Requirement Specification:

- Arduino IDE
- Marlin Firmware

Hardware Requirement Specification (Electronics):

- Arduino Mega 2560
- Ramps 1.4
- Nema 17 Stepper Motor
- A4988 Stepper Motor Driver
- MK-2B Heat Bed
- Hot End Extruder
- Printing material

The initial step is creating a model in the computer which serves as a blueprint for 3D model. The CAD software for creating and designing the object can be like AutoCAD, CAM, CAE, 3DS Max etc. After designing the object, the object file is required to be modified. if the object file contains the curve parts then those curved parts cannot be directly given to print by the printer. Such curve parts of the object file can be converted to the STL file format. The conversion to STL file format removes the entire curve by linear shapes.

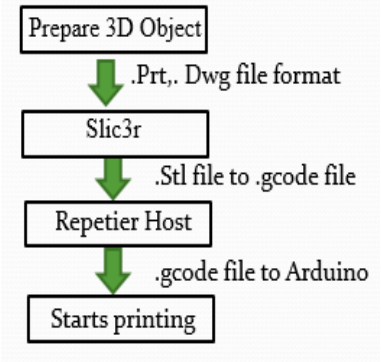

Fig 1: Flow Chart for software process

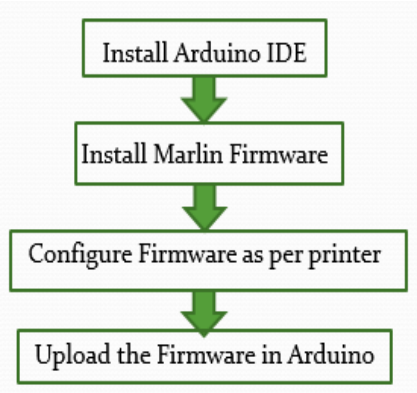

Fig 2: Flow chart for firmware process

Thus STL file is then sliced layer by layer. the thickness of printing object depends on the resolution of the 3D printer. The sliced file is then processed and it generates the control signals accordingly along x, y, z axis which is processed by the controller that drives the extruder motor feeding the material layer by layer thus completing the designed object.

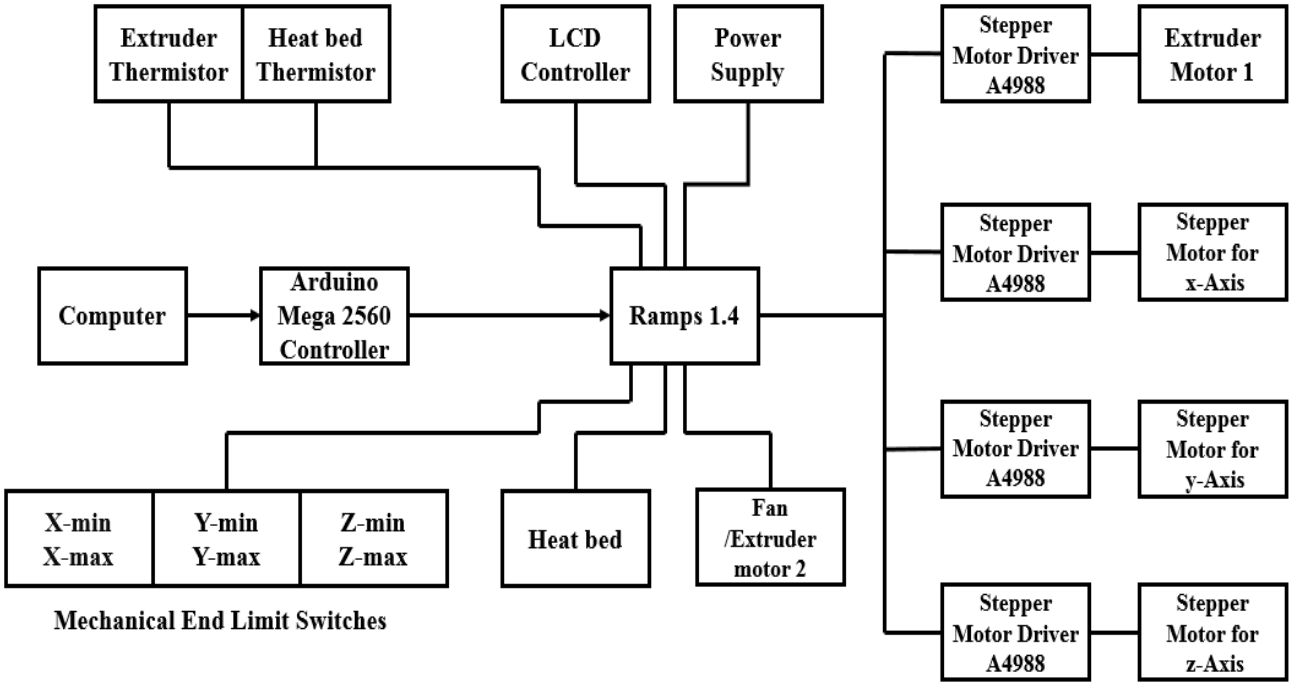

Fig 3: Block diagram of 3D printer

3.1 Auto Bed Levelling

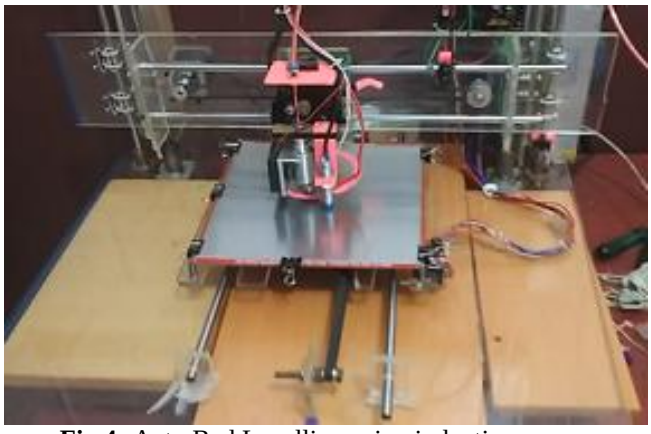

Fig 4: Auto Bed Levelling using inductive sensor

Sometimes levelling the bed manually requires constant concentration and good vision which is tedious and time consuming. Thus implementing the automated bed levelling enhances the print. Running the auto bed levelling method before printing gives less related issues on unevenness of print bed. Issues like nozzle jamming and wrapping problem.The entire configuration involves placing an inductive proximity sensor instead of mechanical switches in the z-axis. Before the actual printing the software instructs to measure 3 points on the bed and after completing it turns on the auto bed levelling in order to calculate the evenness of the bed. This feature traces out the unevenness of the bed. It might be tilted at one end of the bed thus while printing it lowers the axis to make the printing parts constant with the tilt bed and always corrects the unevenness of the bed. It does not alter anything in the print file it just does the correction in z axis for uneven bed surface during printing. G1 Z1is the code that raises the extruder to be 1mm above. The marlin firmware needs to be updated by configuring some start codes.
G29; it enables auto bed levelling

G92 E0; Zero the extruder length

G28 X0 Y0; move X/Y to the end stop minimum

G28 Z0; move z to end stop minimum.

M107; start with fan off.

4. RESULTS

Fig 5: 3D Printed Owl Model

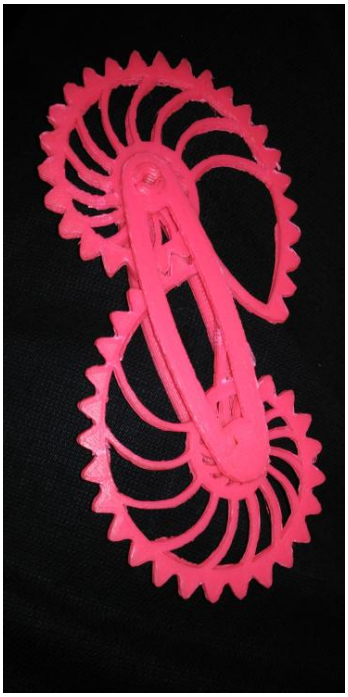

Fig 6- 3D Printed Mechanical Gear

4. CONCLUSIONS

3D Printing technology could revolutionize and re-shape the world. It will provide companies and individuals fast and easy manufacturing in any size or 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 levelling enhances the quality of the print with less human interruption.

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BIOGRAPHIES

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