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DEVELOPMENT OF FUSED DEPOSITION MODELING (FDM) PRINTER

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ABSTRACT

Now a day's additive manufacturing is widely used for the synthesis of a product. As fused deposition modeling is one of type of additive manufacturing process. It is easy handle and gives freedom to print various type of material. The main drawback is it takes more time for printing.

In this project we are trying to reduce the timing of the printing. We are going to have some changes in programming and some necessary mechanical changes according to program of fused deposition modeling printer.

1. INTRODUCTION

In recent years, global markets have led to a fundamental change in product development. Today it is very important to guide a product from concept to market quickly and inexpensively. Rapid prototyping (RP) is a method to make these prototypes much quicker and also more cost-effective. Rapid prototyping was introduced in late 1980's. Rapid Prototyping can be defined as a group of techniques used to quickly fabricate a physical working model / component layer by layer (additive deposition) of a part or assembly using 3D CAD data. RP is the next frontier for researchers, publishers & users of advance technologies. This Paper will show how FDM technology that leads RP has not only proven to be cost effective but also evolved as unique unavoidable need for many applications and research studies.

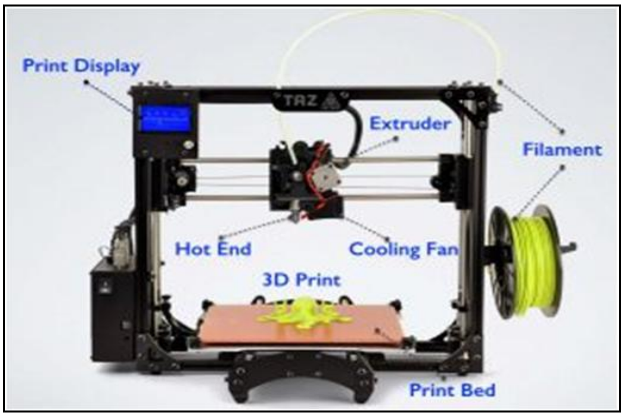
In the FDM hardware, the FDM head moves in two horizontal axes across a foundation and deposits a layer of material for each slice. The material filament is pulled into the FDM head by the drive wheels. It is heated inside the liquefier in the FDM head so it comes out in a semi-liquid state. The successive layers fuse together and solidify to build up an accurate, three-dimensional model of the design. A crucial feature of the FDM process is its potential to fabricate parts with locally controlled properties like mechanical properties, density and porosity. It is even becoming possible to manufacture functional parts in addition to prototypes. In order to fully evolve the FDM into a manufacturing tool, a number of improvements are essential. The functional parts require the process improvements for greater dimensional control and better tolerances, improvements in surface finish, the variety of polymers available for use should increase and the mechanical properties of the prototyped parts should be enhanced to maintain their integrity during working. To improve this promising technology, recent years have seen a substantial amount of research in the area of FDM manufacturing process planning. Research work has included the consideration of processing parameters and their optimization and mechanical properties. Some studies have been conducted to determine the optimum parameters of FDM, and performance criteria often used include build time, strength, toughness and surface integrity of the prototypes, normally for injection moulding and tooling applications. Strength of parts made by FDM suffers from anisotropy and adhesive strength between layers (or across filaments) is appreciably less than the strength of continuous filaments - longitudinal strength [1].

One limit of using FDM for preparing prototypes of plastic parts is that these parts are typically thin walled and with the width of extruded fiber (0,511 mm) it is almost impossible to create walls thinner than 1 mm or these walls are very brittle (e.g. snap fit). Another issue with FDM prototypes is surface quality which is dependent on layer thickness (typically 0,254 mm) and build angle. However, in a number of cases, proper choice of orientation of the part (build direction) in the FDM. It is very difficult to evaluate the prototype interior structure. However, there is a very convenient method which allows scanning exterior shape, prototype dimensions as well as interior structure of prototypes. Computer tomography (CT) is the fusion of metrology and tomography. METROTOM is a well thought-out design with its 3D computed tomography with microfocus X-ray tubes and detectors. CT allows you to measure the interior of a work piece: all recorded data can be applied to all areas of quality assurance and be evaluated. CT technology allows non-destructive testing of damage and porosity analysis, material inspection, defect checks, etc. Abilities of this technology offer an excellent tool for evaluation of FDM prototypes structure. Therefore, this paper provides the results of experimental determination and analysis of the structure of some simple shapes fabricated using the FDM process in regard to different temperatures of the printing head, the envelope temperatures as well as location of parts built on the platform.

Many different materials can be used for 3D printing, such as ABS plastic, PLA, polyamide(nylon), glass filled polyamide, stereo lithography materials (epoxy resins), silver, titanium, steel, wax, photopolymers and polycarbonate.

Nozzle is a major part of construction machinery in 3D printer, It consists of extrusion mechanism, stepping motor, heating module and so on, mainly used for the completion of the transfer of printing materials, heating, cooling, temperature detection and other functions. The responsibility of extrusion mechanism is transfer the material to the spray head, and the stepping motor is the power component of the extrusion mechanism [1]. In order to ensure the smooth running of the extrusion mechanism, we need a good speed control method of the stepper motor start, stop, acceleration and deceleration process as far as possible to avoid the occurrence of shock, loss of step, shock or super phenomenon. Therefore, stepper motor acceleration and deceleration control is one of the difficulties problems. T shaped algorithm is easy to implement. The movement direction of 3D printer nozzle extrusion mechanism has always been the same, but in the middle of two times same direction T shape acceleration and deceleration motion in a straight line, slowed down, stop, and next acceleration will impact on the equipment

II COMPLETE DESIGN AND FABRICATION OF 3D PRINTER

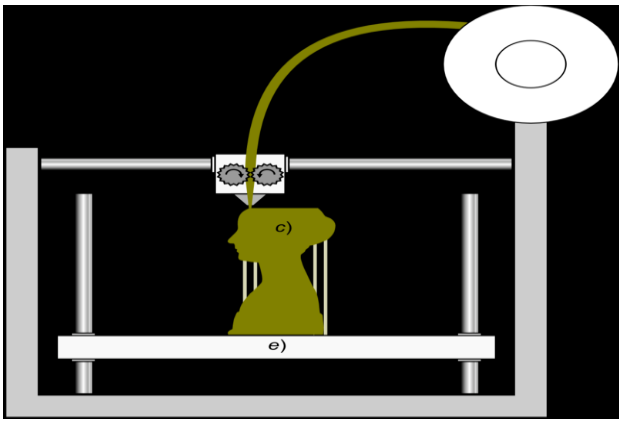


III POSITIONING SYSTEM

Inkjet 3D printing requires positioning a print head in three dimensions relative to a build platform: two planar dimensions are required to produce a single layer, and an additional dimension is required to reposition the system to fabricate successive layers. Generating three independent degrees of positioning movement requires a minimum of three degrees of actuation. The X-axis and Y-axis are arranged in a series configuration to move the printer's carriage in a plane. In particular, the Y-axis carries the X-axis, which actuates the carriage, as shown in Figure. Both axes use a timing belt drive for actuation and ride on linear ball bearings. High-torque stepper motors actuate the X- and Y-axis belt drives directly providing more than 2000 DPI in resolution.

In contrast to the X- and Y-axes, the Z-axis only needs to make infrequent small movements. A lead screw driver provides exactly the required combination of features for this task. Three independent screw drives are used to control the Z-axis allowing the platform to tile for leveling and calibration. Each linear screw driver is controlled by a stepper motor with resolution of 32000 DPI. Justin 2013 [L an] describes the details of the positioning system design.

IV SCHEMATIC REPRESENTATION OF THE 3D PRINTING TECHNIQUE FUSED FILAMENT FABRICATION



Process:-

a) A filament of plastic material is fed through a heated moving head

b) That melts and extrudes it depositing it, layer after layer, in the desired shape

c) A moving platform

e) Lowers after each layer is deposited. For this kind of technology additional vertical support structures

d) Are needed to sustain overhanging parts

V PART DESIGN IN SOLID-WORKS

There are various steps involved in the process of printing of a part or model using a 3D Printer. Here all the steps involved in the printing process in our 3D Printer are explained in detail. The first and foremost step in the process of 3d Printing is to design the part or model to be Printed in any of the 3D Modeling Software's such as Pro-E , Catia , Solid works…etc

While most 3D printing software can handle more than one object being printed at a time, sequential printing is a little different. The problem with printing multiple parts at once is that if one of the parts fails to print properly, then all of the other parts must be discarded as well. Sequential printing still prints multiple parts on the bed; however the parts are printed one at a time. This allows the printer to successfully complete part a before moving onto part B. Since the extruder has the potential of crashing into the already printed parts, the user must specify a clearance distance in order to avoid any interference. While this process does take longer, it will save the user from having to discard a whole bed of parts in the case of an error.

VI CONCLUSIONS

The intention behind this research was to develop a low cost 3D Printer by using materials which are easily available and cost effective. We have been successful in reducing the cost to a considerable extent i.e. about 10-15 %. The parts made in 3D design software are successfully imported in the printing software and the product obtained has the same dimension given during the design stage of the product i.e. an accuracy close to 100%.We were able to successfully fabricate the 3D printer according to its virtual design proposed at reduced cost.

VII ADVANTAGES

1. Good variety of materials available
2. Easy material change
3. Low maintenance cost
4. Quick production of thin parts
5. No need of supervision
6. No toxic materials
7. Compact size and low temperature operation

VIII FUTURE SCOPE

It is predicted by some additive manufacturing advocates that this technological development will change the nature of commerce, because end users will be able to do much of their own manufacturing rather than engaging in trade to buy products from other people and corporations. 3D printers capable of outputting in color and multiple materials already exist and will continue to improve to a point where functional products will be able to be output. With effects on energy use, waste reduction, customization, product availability, medicine, art, construction and sciences, 3D printing will change the manufacturing world as we know it

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