Fused Deposition Method based Object Prototyping with Portable 3D Printer

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Abstract

3D printing is an additive manufacturing technology where 3D objects are printed with the help of CAD (computer-aided design) software. There are different processes available in 3D printing technology such as EBM (electron beam machining),DLP (digital light processing),FDM (fused deposition method), LOM (laminated object manufacturing), SLS (selective laser sintering), etc.

This research paper highlights 3D printing and the reason to make prototypes of an objects in a manufacturing industries with the help of various materials used in 3D printing and their properties which become a notable topic in technological aspects.

In this paper, we have focused on the design and fabrication of a portable 3D printer of bed volume (220 x 220 x 250 mm) which can be constructed economically. We are using 4 axis mechanisms where 3 axis are x-y-z and the fourth axis is an extruder.

The process adopted by us is FDM technology, during which different materials like PLA (polylactic acid), ABS (acrylonitrile butadiene styrene), HIPS (high impact polystyrene), etc are used.

Keywords-3D Printing, Additive Manufacturing Technology (AM), Portable Machine, Fused Deposition Method, Engineering and Technology.

I. INTRODUCTION

A 3D printing is an additive manufacturing technique during which 3D objects are printed with the help of CAD (computer aided design) software like FUSION360, solid works, CATIA, etc. This 3D prototype objects andparts are made by the addition of multiple layers of material.

It can also be called as rapid prototyping of an object. It is a mechanized method in which 3D prototype objects are quickly generated as per the required size by the machine connected to a computer containing model files of any object. The main reason to use 3D printer is for 90% of material utilization, increase product life, lighter and stronger. 3D printing is efficiently utilized in various fields such asconstruction, aerospace, medical automobile, and in manufacturing of many households' products.

Now, rapid prototyping of any object has a wide range of Applications in various fields of human activity: engineering, research, medical industry, military, construction, architecture, fashion, education, the computer industry and many others. The plastic extrusion technology most widely associated with the term "3D printing" was invented in 1990 by Stratus's by name fused deposition modeling (FDM). There has been an outsized growth within the sales of 3D printing machines and their price has been dropped gradually, after the start of the 21st century. By the early 2010s, the terms additive manufacturing (AM) and 3D printing evolved senses in which they were alternate umbrella terms for AM technologies, one being used officially by industrial AM end use part producers, AM machine manufacturers, and global technical standards organizations, and the other used in popular vernacular by consumer - maker communities and the media. Both terms reflect the straightforwardincontrovertible fact that the technologies all share the common theme of sequential-layer material addition/joining throughout a 3D work envelope under automated control.

The other terms which has been used as AM synonyms included rapid manufacturing,desktop manufacturing and agile tooling on-demand manufacturing. In the 2010s were the first decade in which metal end use parts such as engine brackets

and large nuts would be grown (either before or instead of machining) in job production instead of obligatory being machined from bar stock or plate.

II. LITERATURE REVIWE

The use of rapid prototyping in the joining of fractured historical silver object

This paper aims to present a proposal for the restoration of a silver crown by means of fitting pieces produced by the process of 3D modelling and rapid prototyping. It also analyses the benefits of this procedure in restoration of objects weakened by corrosive processes.

Design/methodology/approach

Elemental chemical analysis was carried out in the alloy used in the manufacture of the crown and the constructive and corrosive processes present were studied. Three fitting pieces were modelled and prototyped in wax casting by the stereo lithography apparatus system aiming to restore the part and protect the original metal against impacts and external tensions which could speed up some deterioration processes.

Heat distribution in material during fused deposition modelling

The paper aims to investigate the problem of heat distribution in FDM 3D printing. The temperature distribution of the material is important because of the occurrence of shrinkage and crystallization phenomena that affect the dimensional accuracy and strength of the material.

Design/methodology/approach

The study uses a thermoplastic material (polylactide) and a test stand equipped with a 3D printer adapted to perform thermographic observations. The main source of heat in the study was a molten laminate material and a hot-end head.

III. REASONS TO MAKE PROTOTYPE

Before understanding the benefits of prototyping, you would like to obviously define what this process is. The prototype is an early sample release of product or a model built to test a concept or process of a model product. The prototype is an important draft design which precedes the development of the original design of a product. It is intended not only to show the structure of the future object, but also the products, the interrelation of its main pages. Prototyping is a process where it designed to significantly reduce the time to develop an object, due to the focus of the designer on the main functional and marketing factors. It is a term utilized in a spread of contexts, including semantics, design, electronics, and software programing. Prototype serves to provide the specifications for a real, working system rather than a theoretical one.

IV. 3D PRINTING IN PROTOTYPE OBJECTS

The 3D printing has become increasingly democratized in the past few years. The press releases daily updates highlighting the brilliance of the emerging technology, but what can 3D Printing do exactly? Is it possible to use it not just for prototypes but also for production?

The innovation of 3D printing targets two things one is to reduce time to get the first version of a product and emancipate many constraints that are not possible with traditional production methods. For example, with the help of 3D printing, it is possible to print complex geometric shapes and interlocking parts that require no assembly. It is also possible to produce single prototype objects, in small quantities, at a very low cost and the fastest delivery. This technology also helps in the reduction of production-related to material losses.

3D Printing can produce different objects without creating specific tooling or maybe using several tools. This is how the 3D Printing helps increasing flexibility in the production flow and helps reducing the industrial expenses. Since there's no need to build a dedicated production line, it helps also to significantly save time: The 3D Printing enables us to innovate faster andmechanize faster. Since 3D printing makes a replica of the 3D files one by one, so that economies of scale can't be realized when the same file is produced several times: this is clearly different from the series manufacturing methods that aims to produce millions of units of the same objects. On the contrary, 3D Printing is the perfect method for on-demand requirement and theneeds of customization. There are tons of other good reasons to choose 3D Printing instead of other manufacturing methods.

IV. TECHNOLOGY USED

There are different processes available in 3D printing technology, they are as follows:

1. FDM (fused deposition method)
2. SLS (selective laser sintering)
3. EBM (electron beam machining)
4. LOM (laminated object manufacturing)
5. DLP (digital light processing), etc.

There are different methods of 3D printing, but the most widely used is a process known as Fused Deposition Modelling (FDM). Here we are using FDM technology for our project.

FDM printers use a thermoplastic filament, which is heated to its melting point and extruded, layers by layers, to create a three dimensional object.

In FDM technology different materials like PLA (polylactic acid), ABS (acrylonitrile butadiene styrene), HIPS (high impact polystyrene), etc are used to 3D print.

Cartesian configuration: - Cartesian 3D printers are pretty much named after the coordinate system the X Y and Z axis which is used to determine where and how to move in three dimensions and the Cartesian 3D printers which have a heated bed which moves only in the Z axis. The extruder sits on the X-axis and Y-axis, where it can move in three directions on a gantry.

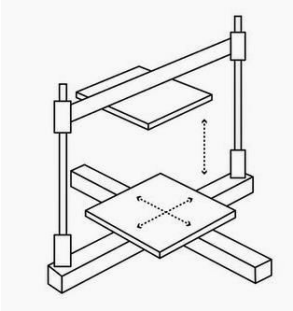

Figure 1.1: - Cartesian configuration.

V. CONCLUSION

Generally it is accepted that the 3D printing will become a revolutionary force in manufacturing field, where positive or negative despite concerns over counterfeiting, many of the companies are already using the 3D printing technology. 3D printer spreading broadly in an assortment of utilizations, from the basic residential use to entangled mechanical applications with the diminishing expense and expanding productivity in market. A few specialists contend that these printers will be the drive of a coming upset that will change the entire essence of the industry and that it will be a fundamental piece of each home as per the abatement in cost.

Usage of PLA tends to develop the social responsibility of the printer as PLA being bio degradable helps to reduce environment waste related to 3D printing process, this makes the 3D printing is eco-friendly.

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