

Low Cost 3D Printing for Rapid Prototyping and its Application

Abhishek Admuthe¹, Akshay sharma², Vishal Chavan³, Pratik Gaikwad⁴, Prof. S. S. Jadhav⁵, Prof. U. V. Kodande⁶, Dr. S. S. Suryawamshi⁷

^{1,2, 3, 4}(Student, Mechanical Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Sangli)
^{5, 6, 7}(Lecturer, Mechanical Engineering, Padmabhooshan Vasantraodada Patil Institute of Technology, Budhgaon, Sangli)

Abstract:

3D printing is an added substance producing procedure in which 3D articles are printed with the assistance of CAD (PC supported plan) programming. Various cycles are accessible in 3D printing innovation, for example, (1) FDM (combined testimony method),(2) SLS(selective laser sintering) (3) EBM (electron bar machining),(4) LOM(laminated object manufacturing),(5) DLP (advanced light processing),etc.

In this paper, we have zeroed in on the plan and manufacture of a versatile 3D printer of bed volume (150 x 180 x 200 mm³) which can be built financially. We are utilizing 4 pivot instruments where 3 tomahawks are x-y-z and the fourth hub is an extruder.

The cycle embraced by us is FDM innovation, in which diverse the materials like PLA (polylactic corrosive), ABS (acrylonitrile butadiene styrene), HIPS (high effect polystyrene), and so forth By warming any of the fiber material to its liquefying point and it is saved layer by layer. Blend of numerous layers of such kind will give us a last 3D model.

Keywords —3D-Printing, 3Dprinters, stereo lithography (STL), additive Manufacturing, material used in 3d printing.

I. INTRODUCTION

Quick Prototyping (RP) has gotten one of the quickest developing new advances. Models are Building in only a couple hours, from a CAD document in which the calculation of the model is characterized in 3D. It gives the fashioner probability of confirming the states of the item, approve in the event that it finds a way into the gathering with the ideal capacities. It chops down the necessary chance to plan an item. It has been utilized in Mechanical plan, aviation clinical application, expressions, and design and it is an expected instrument for the mechanical field.

Added substance producing measures are utilized to make actual models from three-dimensional (3D) Computer helped plan (CAD) models.

Combined statement demonstrating (FDM) is an added substance manufacture Process that forms an item from flimsy layers of expelled fibers of a semi-liquefied thermoplastic. The parts Mechanical properties rely chiefly upon variable factors, for example, the material's saving direction, the Filament's stream rate, the raster's division, and the expulsion temperatures.

3D printing (3DP) is turning into an innovative work centre in numerous fields including biomedicine and science as it can rapidly and precisely manufacture any ideal 3D model of any size. As one of the quick prototyping (RP) advancements for straightforwardly computerized fabricating that gives capacities to making a wide scope of item calculations in an expansive assortment of materials. The creation in miniature

and nano level may change the exhibition of biomaterials and gadgets contrasted and the conventional advancements

3D Printing is a quickly developing field in different controls of which not many are Mechanical, Medical, and Civil, Electrical and so forth It is a piece of Rapid prototyping Methods which utilizes the idea of added substance producing.

The idea of Additive assembling was used in the improvement of 3D printing which is the statement of fluid material layer by layer to get the last segment as per given plan.

In the present assembling industry 3D printing is a vital part as a result of its straightforwardness and dependability to create perplexing and exact components.3D printing has broken numerous obstructions of which one of its execution in space segments like its utilization in the blemishes wanderer. This paper comprises of not many uses of 3D imprinting in different applications.

II. METHODOLOGY

The following flow chart shows the methodology used by us in construction of 3D printer. The first step is to select one of the additive manufacturing process among many process explained in chapter 2. Then an appropriate mechanism is selected for X, Y and Z axis movements, considering various factors such as cost of fabrication, simplicity of design, synchronization, accuracy etc. Once the mechanism is selected the next step is integration of electronics and software then the machine is designed and fabricated. The last step is, synchronization of mechanical, electrical and software elements of the machine. The once-over of 3D printing advancements and techniques continues creating as 3D printing is persistently developing. The 3D printing industry keeps updating its equipment and the materials and methodologies to make dissent or parts. Dependent upon various components, for instance, spending plan, framework or limit, picking the

fitting 3D printing measure and furthermore the right material is basic.

III. DESIGN AND FABRICATION

The FDM innovation is spotless, easy to utilize and it is naturally steady. Complex shapes and many-sided parts can be printed. FDM is at the actual section of the market as it essentially utilized by people. FDM is a moderate 3D printing measure contrasted with other 3D printing innovations.

FDM begins with an item methodology which shapes a STL document (stereo lithography record design), deductively cutting and arranging the model for the structure technique. In the occasion that required, support designs may be made. The machine may distribute various materials to achieve different targets. The model or part is made by expelling little measure of thermoplastic material to the ideal shape layers as the material sets instantly after ejection from the spout. A plastic fiber or metal wire is relaxed up from a circle and supplies material to an expulsion spout which can kill the stream on and. There is generally a worm drive that drives the fiber into the spout at a controlled rate. The spout is warmed to relax the material. The thermoplastics are warmed past their glass change temperature and are then saved by a removal head. The spout can be moved in both even and vertical orientation by a mathematically controlled segment. The spout takes an instrument path constrained by a PC helped creating (CAM) programming group, and the part is created from the last, one layer out of nowhere. Stepper motors or servo motors are ordinarily used to move the removal head. The framework used is regularly a X-Y-Z rectilinear layout, though other mechanical plans have been used. Notwithstanding the way that as a printing development FDM is particularly versatile, and it is good for overseeing little shades by the assistance of cutting down layers.

The design of the model has to be done in software where the actual model with the required dimensions is developed so that it can be used to print the model. To develop and fabricate the model there are many process and parameters involved mainly design of the model. The design process started by keeping the print volume as a basic design parameter. As the objective of the project is the construction of economical and sizable 3D Printer, a print volume of 200 x 180 x 150 mm³ is selected. The 3 – Dimensional motion is achieved by synchronization of movements in X, Y and Z directions. Hence mechanism of our 3D Printer is Z plus core XY. This mechanism uses 4 stepper motors, two for Y-axis movement (to and fro movement), one for Z-axis movement (Vertical movement) and one for Extruder filament. This mechanism uses the single motor to control lead screws to which the print bed is connected to the movement in Z – direction. The lead screws are driven by the motor which in turn moves the bed in the vertical direction. Two motors have been used here because the print volume is large, there will be a disruption in the movement if only a single motor is used. The conceptual design has been initially visualized in Sketch-upsoftware..

IV. UTILITY OF 3D PRINTING

3D printing has significant applications in fields of mechanical designing and Aerospace Industry. This has made Research and Development in these Industries alongside its utilization in manufacture.3D printing has the additional benefit of simplifying the cycle to make any segment as it has just three sections for its yield, which are DESIGN, ANALYSIS, PRINTING of the last segment utilizing the 3D printer.

3D printing has numerous utilities in assembling industry not many of which to be investigated are 1) Mass Customization of items.

2) On Demand Component creation.

(1) Mass Customization of items: Mass customization is particular from the technique of conveying however many item variations as would be prudent. All the more explicitly, it

concerns conveying the ideal item - on a mass scale - after the declaration of necessities occurred [4].

Large scale manufacturing is quite possibly the most utilized strategies to make to stay aware of the developing requests in today industry. This has made 3D printing one of the harbingers in the large scale manufacturing industry. The quest for balance between the item's cost and the level of its variation to singular clients is a perpetual situation for makers. From one perspective, large scale manufacturing implies low expenses. Then again, a superior transformation of the item's attributes and its capacities to the purchaser's requirements implies the chance of getting a greater cost. That is the reason, for instance, an extravagant item which is generally described by a serious level of variation to necessities and a satisfactory cost can't be a mass item. Mass customization should accommodate these limits; in particular make it conceivable to give the client item serious level of transformation and a value equivalent to a mass item [5].

By utilizing this thought we can get an agreement what 3D printing as an assembling asset for mass customization will have regarding that of the idea of large scale manufacturing by Henry portage which whenever executed appropriately makes a whole unique market situation. Later on, we ought to anticipate a further turn of events and dispersion of mass customization in ensuing exchange. This will be encouraged not just by factors which have so far brought about its creation and development. On account of creation, an expanding job will be played by completely robotized frameworks with ever more prominent adaptability.

The 3D printing innovation is by all accounts extremely encouraging in this viewpoint. Then again, with respect to the distinguishing proof of the client's necessities, IT frameworks gathering data from various dispersed sources and afterward investigating them and looking for designs in the conduct of specific clients will assume an expanding part. The above shows the

need of altered large scale manufacturing industry which just 3D printing can give.

(2) On Demand Component Production :

On Demand Component Production is the way toward making the segment without even a moment's pause contingent upon the client needs determinations and prerequisites. This should be possible either by utilizing the segment straightforwardly to the application or utilizing the part as we make design for use in projecting either in Metal projecting or embellishment.

Segment in direct application where the 3D printed part is straightforwardly utilized as part in the hardware. Late advances in 3D printing have made it conceivable to make segments which are exact and to make them in direct use in the pieces of working of hardware.

With more than 2,500 FDM parts, the Kaveri fly motor model might be the most mind boggling fast model gathering at any point made. It took GTRE just 30 days to create every one of these segments from ABS plastic utilizing Two FDM-based Fortus (prior FDM TITAN) machines. It required an additional 10 days to amass the motor. The absolute expense to deliver the FDM get together was about \$20,000[6].

This features the most recent pattern where the 3D Printing was utilized in a pragmatic application. Albeit a large number can be made for use in day by day life 3D printing has a disservice over infusion projecting where the steady is time albeit this can be helpful in situation where customization is one of the key effects points of the innovative work.

Segment in direct application where the 3D printed part is made as an example and used to create the cast where it very well may be utilized as a standard projecting or venture projecting relying upon the need: In this situation the segment printed and afterward it is utilized as the example this has shown different benefits over traditional projecting techniques, this was done tentatively by VinayPramod et.al in 2015 in their investigation Feasibility Study on 3D Printed Patterns in projecting [7].

This test has demonstrated that projecting made utilizing 3D projecting examples utilizing PLA

material and was contrasted and a customary wooden example the two of them were researched under a Scanning Electron Microscope with Magnifications of 250 and 1000; in spite of the fact that the two of them have comparable surface completion the 3D printed design based projecting has displayed a superior completion over the wooden example based projecting. Venture Castings (IC) is utilized for making metallic parts which are troublesome or complex to make utilizing customary strategies.

In an examination done by Sivadasan M et.al on subject of Use of combined testimony displaying measure in venture accuracy projecting - a practical fast tooling they have closed the accompanying which show cases the utility of 3D printing as speculation projecting alternative. The investigation investigated the immaterialness of FDM and example value of ABS in IC. The outcomes demonstrate that consuming ABS create non-Sticky, free and fragile insignificant build-up around 1.5% and is can be helped by appropriate cycle varieties - post cleaning of the shells [8].

This examination was finished by 3D printing and utilizing ABS (Acrylonitrile Butadiene Styrene) as the example it is first tried for its value, kind of debris and burnout, Test of warm disintegration, Test for reproductions of accuracy examples and testing projecting through IC course in spite of the fact that there is debris build-up it tends to be decreased cleaning of the shells subsequent to projecting.

V. CONCLUSION

The outcome of this project was to build a portable 3D Printer which has been successfully completed. The design of the frame is made robust and compact using aluminium sections. The material selection of the various elements is economical. Using a single motor for vertical movement along with a proximity sensor makes bed levelling easy and the bed movement is monitored with resolution in microns. The drawback in few of the 3D Printer which uses bed movement in Y axis has distortion of the printed layer at high rates of

REFERENCES

- [1] A. Ramya and SaileelaVanapalli, 3d Printing Technologies In Various Applications. International Journal of Mechanical Engineering and Technology, 7(3), 2016, pp. 396–409. <http://www.iaeme.com/currentissue.asp?JType=IJMET&VType=7&IType=3>
- [2] C.W. Hull, Apparatus for Production of Three-dimensional Objects byStereolithography, in, Google Patents,1986.
- [3] Dr.Rajashekhar Patil, Deepak D, DharshanGowda S, Krishna Kashyap C S, Mohammed Murtaza, Prashanth S N, Harsha N and Bharath V G, Economical 3d – Printer by Adopting FDM Technique, International Journal of Mechanical Engineering and Technology, 8(4), 2017, pp. 442-447.
- [4] Hideo Kodama, "Automatic method for fabricating a three-dimensional plastic model with photo-hardeningpolymer,"ReviewofScientificInstruments,Vol.52,No.II,pp1770-1773,November 1981
- [5] Hideo Kodama, "A Scheme for Three-Dimensional Display by Automatic Fabrication of Three- Dimensional Model," IEICE TRANSACTIONS on Electronics (Japanese Edition), vol.J64-C, No.4, , April 1981
- [6] Amon, C. H.; Beuth, J. L.; Weiss, L. E.; Merz, R.; Prinz, F. B. (1998). "Shape Deposition Manufacturing With Microcasting: Processing, Thermal and Mechanical Issues" (PDF). Journal of Manufacturing Science and Engineering 120(3).
- [7] Freedman, David H. "Layer By Layer." Technology Review 115.1 (2012):50—53. Academic Search Premier. Web. 26 July2013.
- [8] Jason King Book Review: 3D Printing — The Next Industrial Revolution, 3D PrintingDirect Digital Manufacturing Pioneers, Headquarters, 27th April 2014.Replicator World, June2013