
Design and Fabrication of Hybrid 3D Printing Machine

K. Prudhvi¹, Dr. B. Satyanarayana²

¹Research scholar, Department of mechanical engineering, VNRVJIET, Bachupally, Hyderabad, Telangana, India

²Professor, Department of mechanical engineering, VNRVJIET, Bachupally, Hyderabad, Telangana, India

Abstract:

The hindrance of the additive Manufacturing procedure is low correctness Furthermore poor surface complete while those hindrance of the subtractive manufacturing procedure is that's only the tip of the iceberg wastage about material. Should succeed the issues in subtractive and additive manufacturing courses hybrid manufacturing procedure is acquainted. Hybrid manufacturing is you quit offering on that one that uses profits of both, additive and subtractive techniques. Usually, different machines are used to do these procedures. A couple organizations are manufacturing single machine known as hybrid machine with procedure both additive Furthermore subtractive manufacturing for constrained administration Furthermore might not make as for every those client necessities Also Additionally not cosset powerful. Therefore, in this work, an endeavor need been constructed with outline What's more manufacture An altered hybrid 3D printer with less cosset contrasted with economically accessible printers without bargaining a great part on the caliber of the result processed.

Keywords:

Hybrid Manufacturing, 3D Printer, Additive Manufacturing, Subtractive Manufacturing, Polylactic acid (PLA), Acrylonitrile Butadiene Styrene (ABS), Tensile.

1. INTRODUCTION

Previously, today's manufacturing industry, Different manufacturing operations bring been broadly utilized for transforming results to huge numbers modern parts. These techniques are by and large distinguished Similarly as subtractive manufacturing, additive manufacturing, and transformative procedures for example, such that forming, joining What's more separating operations, Case in point welding and sawing. However, these manufacturing techniques have their intrinsic drawbacks which can't a chance to be wiped out. On other words, because of their innovative unrest constraints, they are not constantly practical to the generation for Different parts As far as geometry, extent What's more quality and so on.

3D printing may be otherwise called desktop creation or additive manufacturing; it may be a prototyping transform the place by a true article is made starting with a 3D outline. Those advanced 3D-model will be spared in STL configuration. STL record will be opened in the backed programming the place the 3D demonstrated plan will a chance to be cut will produce G-codes that machine might perused Furthermore produce required way to a print. Those 3D printer afterward prints those outline layer by layer Furthermore structures a genuine object. 3Dprinting will be An quick Creating and expense profit investigation manifestation for fast prototyping.

Advanced machine instruments need aid regulated Eventually Tom's perusing an electronic numerical control (CNC). For this reason, manufacturing courses to example, drilling, turning, and milling, will be likewise alluded will Likewise CNC machining atthose machine devices will be controlled by An CNC. That fundamental errand of the CNC will be on control the relative movement of the device around and the fill in bit. All these instruments remove unwanted material will assembling an part with those fancied geometry.

This paper may be around joining additive substance Also subtractive procedures to structure a hybrid methodology for that An model need been created which will be talked about further in this paper.

2. DESIGN AND FABRICATION

So as with enhance intensity On present day mass number industry, results must make planned and made for the accompanying two objectives that need aid regularly Previously, opposition:

) Decreasing time and cost

) Improving quality and flexibility

Dependable Furthermore prudent creation about metallic parts with confounded geometries will be about respectable premium to the aerospace, medical, automotive, tooling, What's more customer results commercial enterprises. On an exertion should abbreviate those time-to-manufacture, decline those manufacturing transform chain, Also reduced handling expenses from claiming items generated Eventually Tom's perusing these industries, exploration need centered on the joining of numerous unit manufacturing procedures under person machine. The end objective may be to decrease processing space, time, and Furthermore labor prerequisites. Coordinated circuit frameworks are progressively continuously distinguished concerning illustration an intends to meet these objectives. A significant number factor would accelerate the push at coordinated circuit frameworks. These incorporate the require for decreased supplies and methodology cost, shorter transforming times, lessened review time, and decreased taking care of. On the different hand, coordinated frameworks require a larger amount about amalgamation over can an solitary methodology. Therefore, improvement of coordinated forms will by and large be that's only the tip of the iceberg complex over that about distinctive unit manufacturing courses yet all the it Might furnish simplified, low expense manufacturing.

An 2D model need been drafted with a distinctive parts such as control box, manufacture plate, extruder setup, and so forth throughout this way, observing and stock arrangement of all instrumentation may be enha. And every last one of robust demonstrated parts would amassed in CATIA. The drafting for the individual's Different parts also collected robust 3d model will be demonstrated on figure 1 and figure 2. Numerous progressions bring been settled on of the last model. Acrylic sheet from claiming 8mm thickness may be utilized to creation for separate parts similarly as it is Shabby What's more effectively accessible material. Laser cutting methodology need been utilized for cutting singular parts starting with acrylic sheet. Parts bring been amassed by screws Also paste. Gantry rods have been utilized to supporting Furthermore development for axes. A separate lead screw need been utilized for those development for Z hub. NEMA 17 stepper motors are utilized for the minute for X Also Y hub NEMA 24 stepper engine is utilized to Z hub lead screw minute. Extruder what's more CNC penetrating machine are mounted along Z hub. Arduino control board need been used to control those machine. Circlet associations would demonstrate in the figure 3. The created mixture 3d printer model modal is indicated in the figure 4 (a) Furthermore (b). Extruder meets expectations for fused deposition modeling (FDM). FDM meets expectations looking into a "additive" guideline by establishing down material over layers; An plastic fiber alternately metal wire may be loosened up starting with An loop What's more supplies material to prepare An a feature. An PCB penetrating engine of dc 12V need been provided Likewise those and only mixture procedure. Specification of drilling motor is given in the table 1.

Table 1 Specifications of drill

Specification of drill motor	
Power	3-12 V DC
Diameter	2.8CM
Length	5.2CM
Weight	65g
Rated wattage	20W
Rated torque	600G.CM
Brass chuck hole diameter	2.3mm
Chuck capacity	0.8-1.5mm
Chuck outside diameter	8mm

Table 2 3D printer specifications

3D printer specifications	
Printer dimensions	Height :760mm Width:515mm Length:470mm
Weight	35kgs
Maximum build volume	200mm x 150mm x 150mm
Extruder	Single extrusion
Filament diameter	2 mm
Filaments	PLA (Bio-degradable),ABS
Extruder temperature	Up to 250°C
Layer thickness	0.20 mm
Software	Repetier host V1.6.2
Hybrid capability	Yes (removable drill)

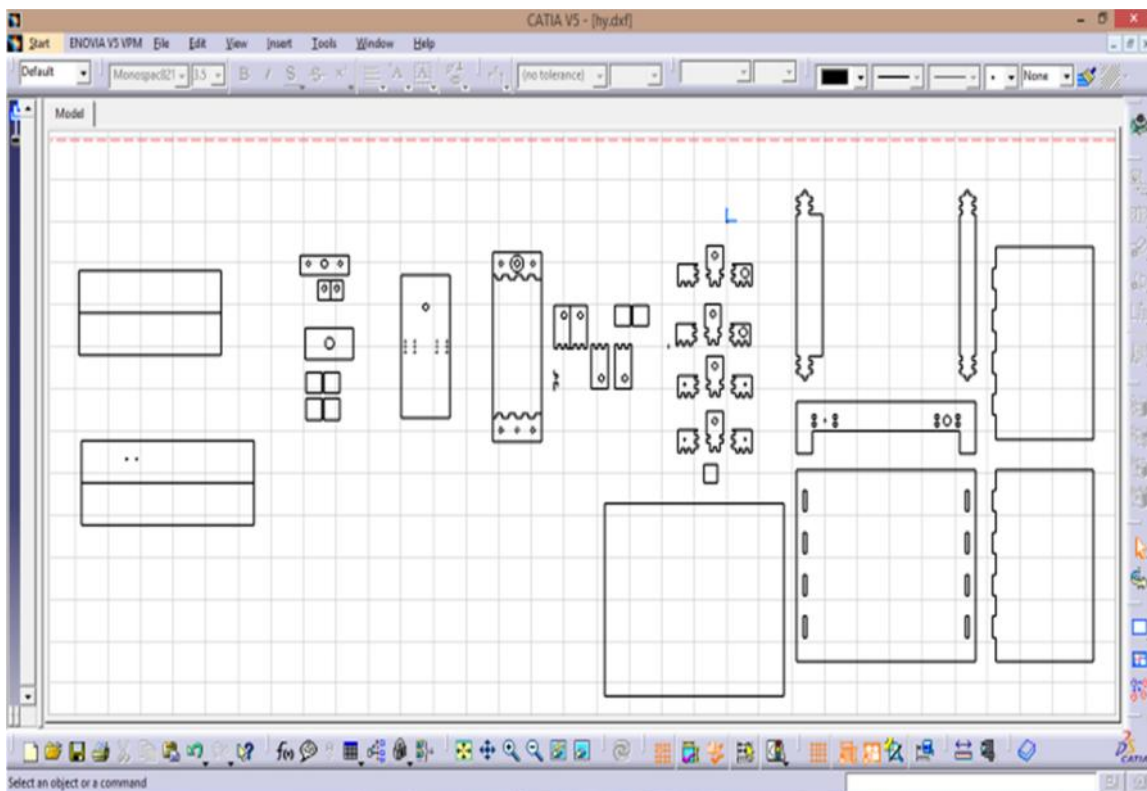


Fig:1 2D Drafting of individual parts

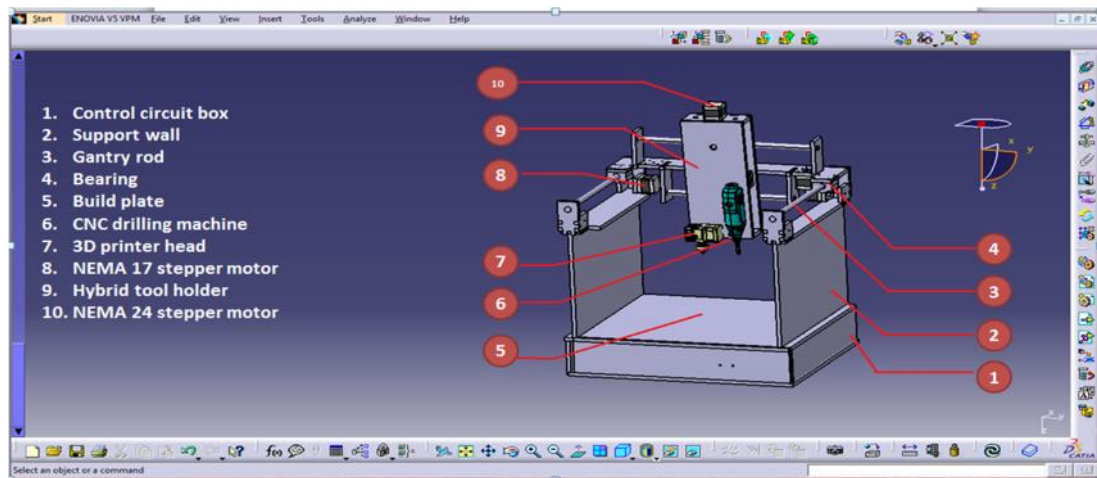


Fig:2 3D model of printer

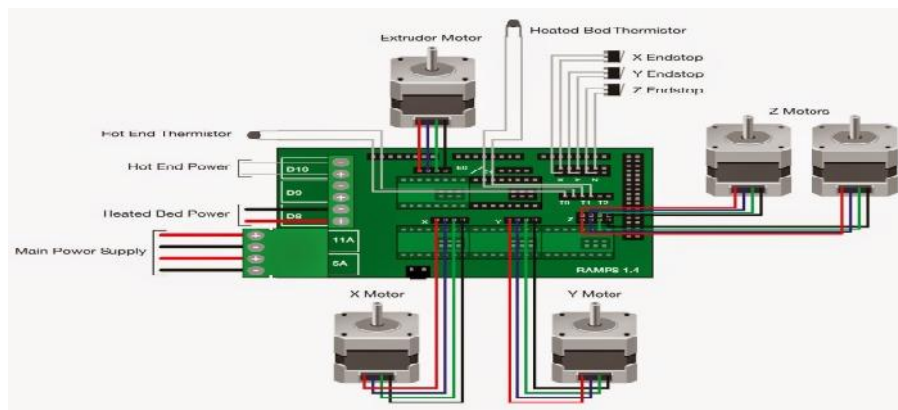
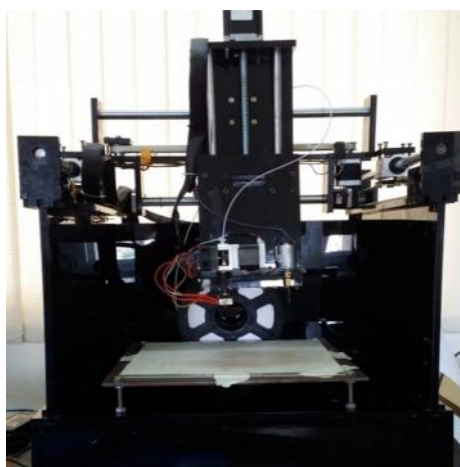
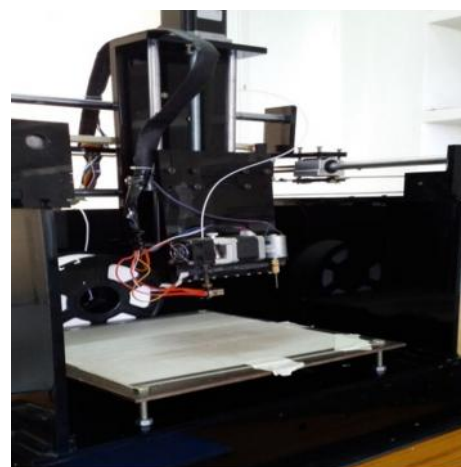


Fig:3Arduino control board



(a)



(b)

Fig: 4 The fabricated hybrid 3D printer

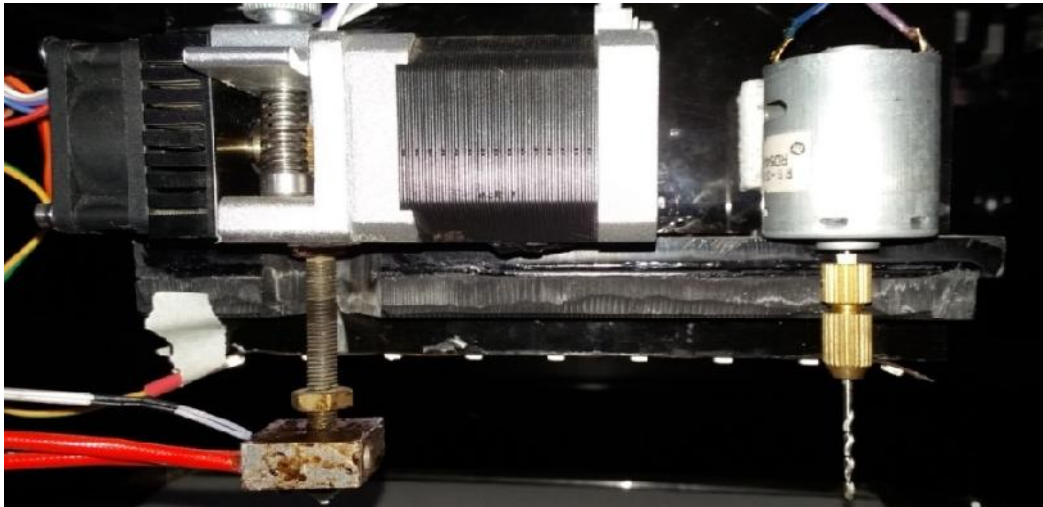


Fig: 5 Hybrid tool head

3. RESULTS AND DISCUSSION

The fabricated 3D printed will support all freely available open source software. Whereas for this hybrid 3D printer REPETIER HOST software has been used this is capable of both 3D printing and CNC drilling. The software will slice the input design and code will be generated. But for CNC drilling a manual G code has to be generated. The outlook of the software window was as shown in the figure 6.

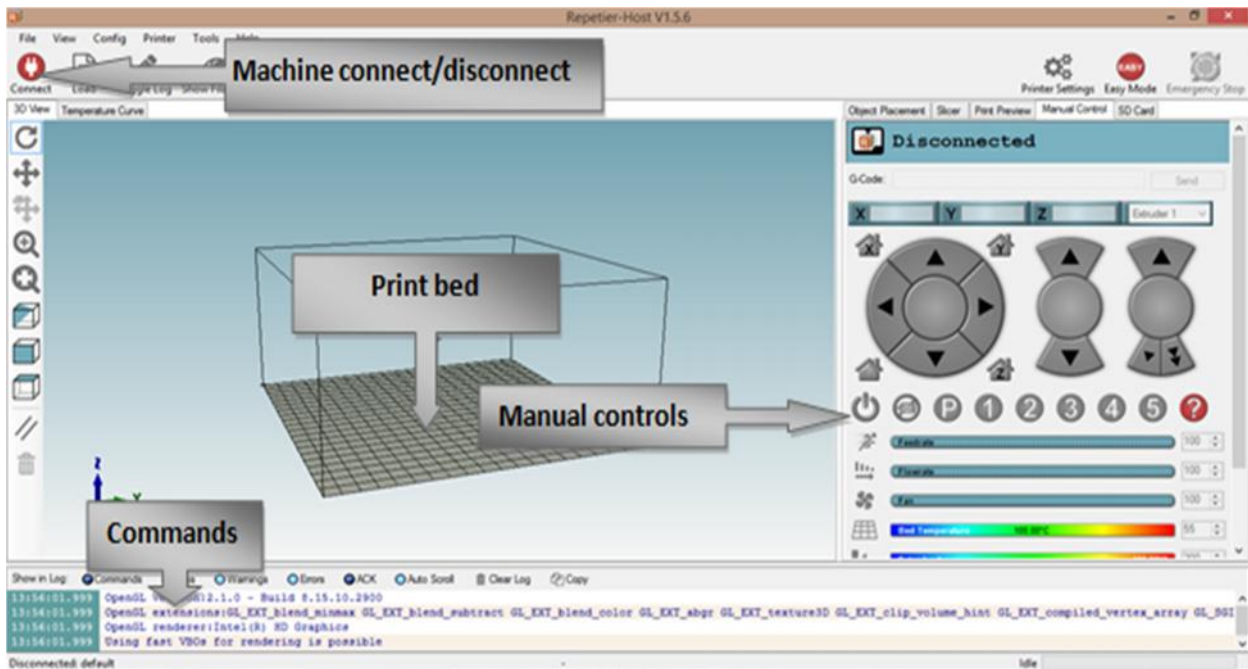


Fig: 6 Outlook of Repetier host

A sample structure has been designed in modeling software's like CATIA, solid works, AutoCAD etc. and the file should be saved as stl. format. It is a format which the REPETIER host can read and it will convert the design structure into G codes which the machine can understand and perform the operation accordingly.

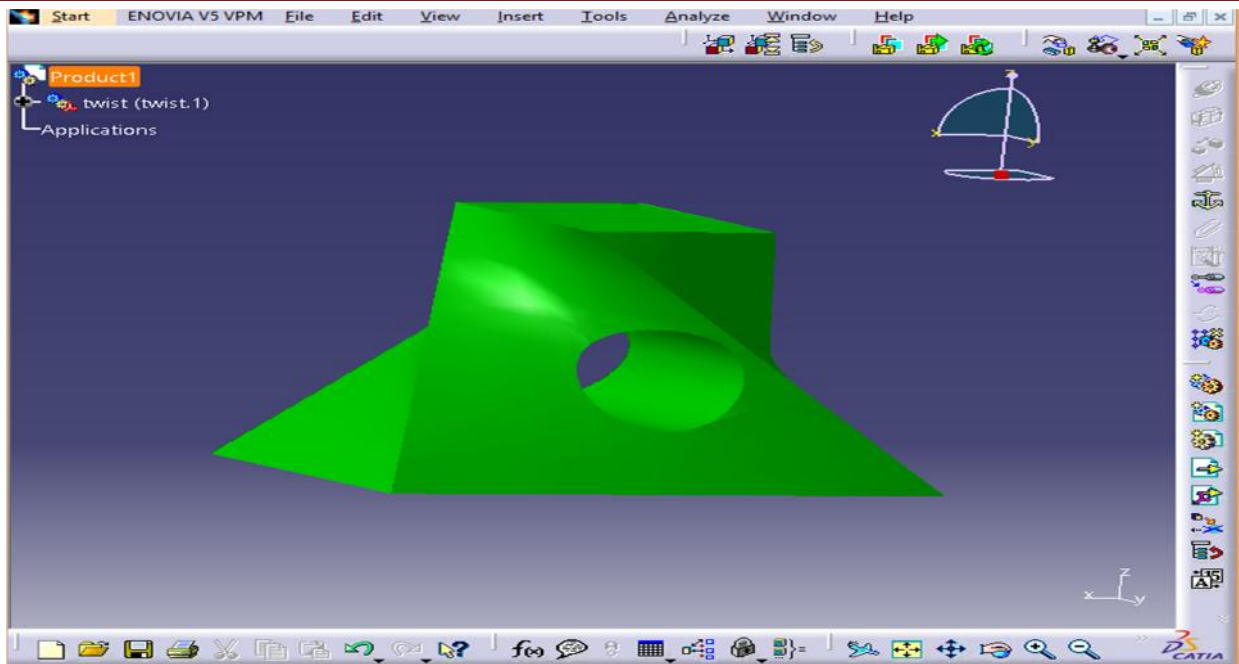


Fig: 7 3D modeled part in CATIA V5

A sample design has been modeled in CATIA V5 as shown in the figure7 and it will be saved in stl. format .

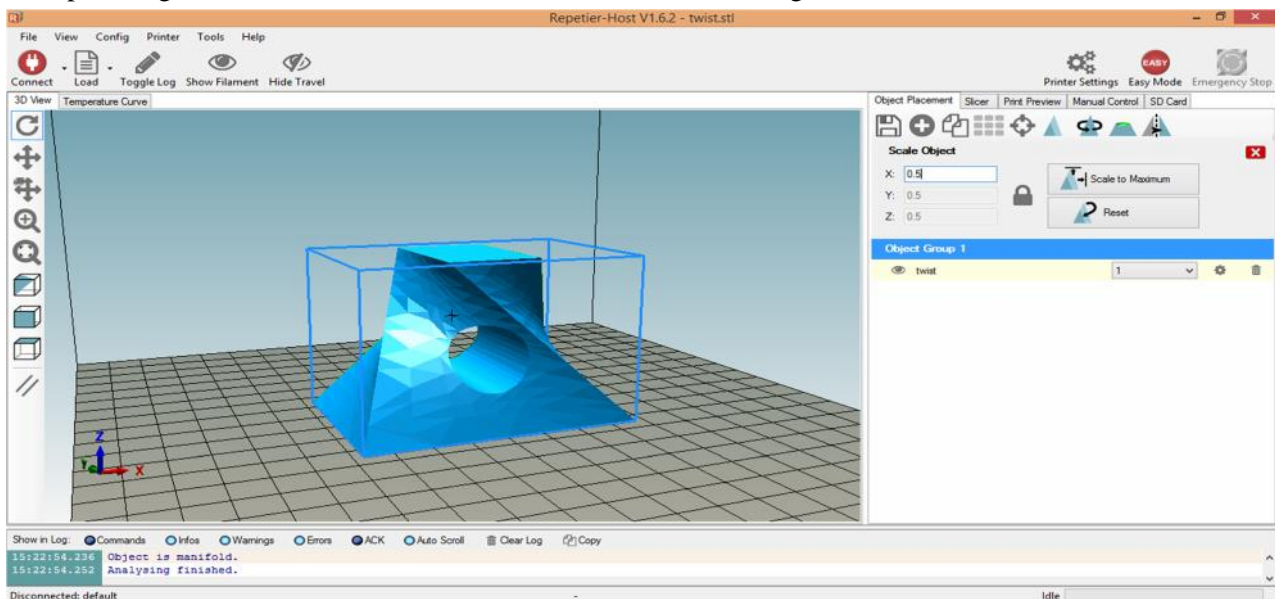


Fig: 8 placement of the 3D modeled part

The stl.file is opened in REPETIER Host software the outlook of software window is shown in the figure 8. This software the model can be moved, resized, scaled to required measurements. After the placement of the sample it will be sliced in slice3r which is available in the same software. Slicing the object will results the generation of G code and it will also give the estimated time for printing.The printing will be started after all the process has been done.

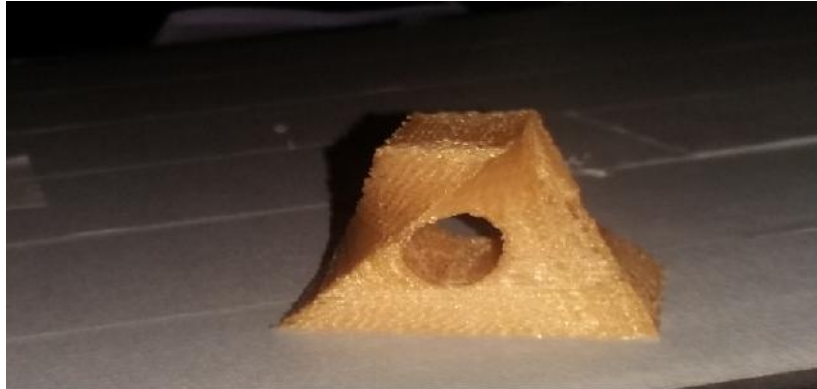


Fig: 9 3D printed part

The machine is equipped with both addition (3D printer) and subtraction (drill machine) tools. For drilling operation a manual G-code should be written according to the requirements.

Some sample components have been printed and visually inspected for correctness. Sample printed parts are shown in the figure 10.



Fig: 10 sample 3D printed parts

4. CONCLUSION

- The designed Hybrid 3D printer was successfully fabricated with low cost and high efficiency compared to commercially available 3D printers.
- Drilling operations were also been performed as a part of hybrid manufacturing.

5. FUTURE SCOPE OF WORK

- Further modifications and tweaks are planned to be made in the future to make the 3D printer more robust.

REFERENCES

1. GuhaManogharan, Richard Wysk, Ola harrysson, “AIMS-a metal additive –Hybrid manufacturing system: System Architecture and attributes” North American Manufacturing Research volume 1, 2015, pages 273-286.
2. Marcel Müller and ElmarWings, A Research Article on “An Architecture for Hybrid Manufacturing Combining 3D printing and CNC machining” Institutf`urMaschinen und Anlagenbau, Constantiaplatz 4, 26723 Emden, Germany, 5 July 2016.
3. Miss Prachi More, “3D printer making digital real” ISSN: 2277-9655
4. R.J.Friel ,R.A.Harris , “ A hybrid production process for novel functional products” CIRP 6(2013) 35-40.
5. Dusan N Sormaz Ohio University, USA“product design and planning for additive and hybrid manufacturing” December 08-10,2014 .

-
6. Zhu Z, Dhokia V, Nassehi A and Newman ST. “A review of hybrid manufacturing process –state of the art and future perspectives” International journal of computer integrated manufacturing 2013; 26(7): 596-615.
 7. Akula, S. & Karunakaran, K.P. (2006). Hybrid Adaptive Layer Manufacturing: An Intelligent Art of Direct Metal Rapid Tooling Process. Robotics and Computer-Integrated Manufacturing, Vol. 22, No. 2, pp. 113-123.
 8. Van-Thao Le, Henri Paris, Guillaume Mandil Using additive and subtractive manufacturing technologies in a new remanufacturing strategy to produce new parts from End-of-Life parts 28 August 2015.
 9. Jacquelyn K. S. Nagel and Frank W. Liou “Hybrid Manufacturing System design and development” www.intechopen.com.
 10. <http://nodasystech.com/design/reprap-wiring-diagram.php>
 11. <https://www.cipet.gov.in/centres/olc-cipet-hyderabad/introduction.php>