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3D PRINTER: A REVIEW

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Abstract --- this is a review paper on 3D printing In which we will be going to study about various techniques, process and general principle involved in 3d printers, there type and what are the various materials required to build a 3d printer. We are also going to get deep into the history of 3d printer as well and going to discuss their Applications. In this review paper their will be a bunch of knowledge provided through which we all will come to know about the advancement in printers.

Keywords -- 3D printer, additive manufacturing

I. INTRODUCTION

In today's scenario as we are seeing and observing that the technology is emerging and giving us more and more awesome results and through these emerging technology we are able to manufacture the unpredictable and out of imaginary structures and various prototype as well.Currently we are living in the 21 century in which the technology has raised enough to break the records and to give the drawbacks a face to face answer. Now considering the 3d world we have been evolved enough to handle the virtual reality which can be more than a 3d but the basics idea will be a strong base for all the evolution of dimensional world one of the main and most advanced technique followed in 3d modeling and structure(prototype) is 3d printer which follows method of additive manufacturing. Additive manufacturing is a process of making a 3d model in reality by implementing lots of layers as soon as the previous layer is machined of a particular material from which it has to be made of, 3d printers are used to manufacture the 3d model made of metal, plastic, carbon fiber, conductive carbomorph (carbon black plus plastic) etc.

Nowadays the 3d printers are widely used in manufacturing Industries in today's world the technology is giving us more and more accurate and precise results in which this technology is also one f the medium to rove the above statement.The emerging technology in any field of engineering is not only aims to save their time but also concerned with the perfection. In 1984 the first 3d printer was designed and opening ceremony was done by charls W. hull Whereas the first 3d printer was invented by stratasys.

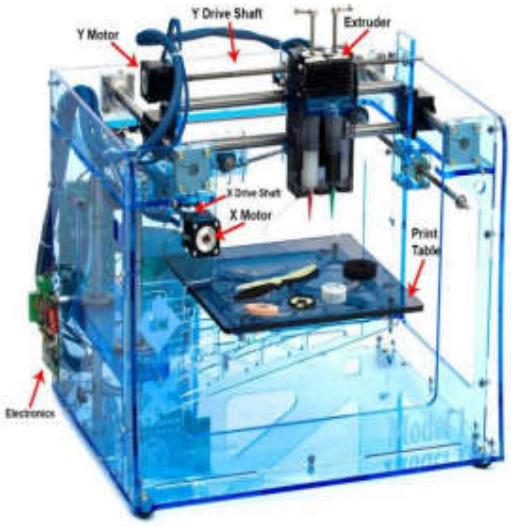

Fig 1 3D printer (Gokhare et al., 2017)

II. ADDITIVE MANUFACTURING

When their was a concept of 3d printer the most common question arises in the mind of the

engineers which were “how will the complex shaped object will printed in 3d modeling using a 3d printer” to resolve this issue their has to be a solution to make this machine more efficient and advanced version and finally the method has been developed which was more time efficient and having the capabilities of manufacture complex shapes which was **additive manufacturing(AM)** which includes fusion deposition modeling, limited object manufacturing in 1991 and selective laser sintering(SLS) in 1992.

There were various tools used in the 3d printing machine general tool like a sharp cutter with programmed motors and other equipment. 3d printers are generally used to make a prototype of and object in a small scale on which testing can be done nowadays various solar operated 3d printers are launching which is considered to be most efficient 3d printer. As the the concept of AM came into market it became the most feasible method within no time and was used by almost every manufacturing industries one of which was general motors.

In today's scenario some top best 3d printing machines are as follows

1. markforged metal x

2. WAAM

3. HP jet fusion 500/300

4. Startasys J750/735

Etc…

These are some of the advanced 3d printing machine used in today's emerging industries. In earlier the 3d printers were used to be most costly due to heavy use in materials to build and working were generally not that much effective and since the fact that the machine is invented newly so the cost were not that much affordable. As per the gradually rise in the technology some confinements were mad and lots of things are made compact and more efficient the size is been reduced to portable etc.. Advancement were made which ultimately reduces the cost of the AM operated machine.

The 3d printer comes in variant regarding their size it can be as big as a room and as small as an cartoon box

III. GENERAL PRINCIPLES

A. Modeling

To start with the printing of the prototype some steps are to be followed firstly the **modeling** which includes the **CAD** model in the software is made and analysis the model in the software it self. The computer here plays an important role to virtually observe the CAD model designed which then cut the model in various thin layers or cross section to feed the data to the printer as an input it generally prepare the blueprint animation to the actuator of the printer to feed.

B. printing

In printing part the file is firstly converted to .STL extension which is then processed thorough one of the software called “slicer”. the software slicer is used to convert 3D model into a series of thin layer and generates a G-code which is the input to the actuators of the printer it reads the G-code provided by the slicer and work accordingly every 3d model has its own G-code which makes easier for the user and printer to recognize each and every model respectively. Slicer comes with different types like slic3r, KISSlicer and cura.

When the machine reads or scan the G-code the printer starts putting the layer by layer which can be of liquid, metal plastic, dry powder or sheet material. One of the ability of the 3d printer is that it can manufacture any shape which will be accurate from top to bottom.

The thickness and the XY resolution is analyses by one of the instrument used is called micrometer generally the thickness of the sheet or layer used is 100micrometer or 0.1mm it has the capability to print on the thinnest sheet unto 16 micrometer additive manufacturing is way faster, more flexible, and more affordable when printing in smaller quantities. The printing process can take lots of time even a day will be insufficient depends upon the size and shape of

the prototype but the method of AM can be used to reduce the efforts and time of manufacturing.

C. Finishing

this is the final step involved in the completion of the printing process sometime the manufactured product is directly implemented for used but some of the issues arises in some highly complex and resolution prototype is over sizing which needs to be get in the required shape this is done manually in some case by eliminating the unwanted material but nowadays as the technology is emerging the finishing is done by the machine itself after the completion of the printing part by just scanning the object through laser sensors. One of the machine used in finishing of the printed object is "**accucraft iD-20**"

IV. METHODS FOR PRINTING.

A. Stereolithography

This method is one of the oldest method used in the 3d printing since it is being used till now, like others this method is firstly required to convert the file extension to the printer understandable form which is standard tessellation language(STL) which when processed through printing machine it converts liquid plastic to solid object.

In this generally a UV rays is used to strike over a photopolymer resin. The photopolymer resin is a UV rays sensitive which when comes in contact produces a solid object the UV rays are focused to the photopolymer resin layer as pre-programmed by the computer after the first layer is finished the machine lowers the layer and the slider contain that resin re coats a new layer of resin t resume the manufacturing. This method can also be used in the inverted manner just by focusing the UV rays bottom to the resin.

Nowadays the 3d printing is used in medical fields specially the process of AM in which steriolithography method is used, in this firstly various scan is being preformed like MRI, CT etc. Then the scanned data is converted o the printer understandable language and then the printing is preformed by using polymer resin to make some specific parts of an human being. Most interesting part of this method is that it is commonly used to make a prototype as well so it can produce a prototype with high accuracy of any complex shape.

B. Fusion deposition modeling

The method of FDM is generally used to manufacture an-isotropic materials which mans those materials whose properties are not identical in all directions like wood and composites this methods is nowadays are highly used in plastic modeling which uses acrylnitrile butadiene styrene plastic to model which is also known as ABS plastic modeling. This method also uses rapid prototyping process for modeling and nowadays some carbon fibers and some thermoplastics are also in use of modeling through FDM. This method provide low cost product and minimal wastage and ease of material change. To increase the efficiency and precision of the printing their is a possibility to add some of the reinforced material into plastic material to form a thermoplastic matrix carbon fiber reinforced plastic (CFRP) which can be used directly in applications like aerospace, automotive and wind energy.

The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing(CAM). In this type of modeling the liquid plastic is injected to the nozzle thorough a very thin pipe line which is stored in a reservoir then according to the input of software the nozzle attached to the movable hinges which is capable of moving in X and Y direction where as the surface upon which the model is being resting is capable of moving down one by one as the first layer is finished then similarly the liquid ABS plastic continues to eject out from a nozzle and a layer by layer starts forming and after a day or after an hour depends upon the size, shape and level of complexities the final product is formed which is then polished and grinned to give a surface finish finally it is polished with an alcohol or an ether to give a shiny look

C. Selective laser sintering

In today's world the 3d printers have also acquired their position in medical fields which is quiet interesting and helpful to living ones the method which is being use din medical field is selective laser sintering. It generally uses the powder based material system in tissue engineering and to study their mechanical and biological impact on the environment, this method has successful achieved a goal of formation and improving the bio compatibility and bio activity of the product and their mechanical properties as well this type of AM approach is simple and adaptable to almost every printing conditions and uses wide range of powder to produce porous ceramics, polymers and metal based tissues. These method is used to produce a regeneration in bones in fabrication tissues using powder based AM techniques.

In this printing method CO_2 and ND:YAG laser system is used to scan the layers of the powdered material and to create a 3d model, there are generally three categories of binding mechanism of SLS these are:

1. solid sate sintering

2. Liquid phase assisted sintering

3. Full melting

There are some factors which effects the fabricated part like lase energy density, layer thickness, part bed temperature, hatch distance etc… the article range used in this case is from 10 to 150 micrometer, one of the main and interesting function of this printing method is that if there is a requirement of more denser material or the fabricated part it is just need to be decrease in the speed of scanning due to which there will be a longer time for the laser beam to interact with the powder and hence there will be more energy transfer from laser t the material (powder) and vice verse thus increasing the energy transfer will lead to the melting of the binder which can distort the internal structure and hence the shape may get deformed which will not be beneficial for the industries.

V. PROPERTIES OF 3D PRINTING MATERIALS

PLASTICS:-

A. Polyamide properties

Typically known as nylon it is basically very strong and light its flexibility depends on the thickness of the material, can say that thicker the wall less will be the flexibility which implies that we can even bend the material. It also holds the capability to manufacture most delicate and complex parts as well. It produces porous surface which can be made smooth enough with the polishing process

B. ABS properties

This can be used as a filament in FDM and FFF 3d printers primarily, it is known to have lightness and impact strength among all these it can resist the heat up to 200^0C it is bio-compatible

C. Polyactic acid

This is one of the material properties of all which uses a special type of raw material which is **cornstarch,** this food material is little bit less durable and since it has a major limitations and disadvantage so it is most likely to be used in manufacturing decorative products

D. Alumide

This type of material exhibits the property of hardness and is solid generally since it is the combination or composition of polyamide 12 and aluminum which is hard and can break under a massive load since there is a consistency of aluminum so it provides the final product a shiny or metallic look.

RESINS:-

A. Polyjet resin

Resins are normally colorless unless and unit the color is added to it so the product formed is somewhat translucent or opaque in look, this is a type of stereolithography based on photopolymerization since they are opaque and

having a precise finish so they are used in ornamental works and prototyping.

B.elestomeric polyurethane

Since the word elestromer has been introduced it is clear that it exhibits elastic properties, however it is considered to be the most high preformance polyurethane elestromers it has a tear resistance to some extent. It does not require mold to create the part and is highly time efficient among all the material such as FDM. It contains a very smooth and polish able material

CONCLUSION

It have been a great journey of 3d printers from earlier century to today's scenario and in future the 3d printers will be the largest leading and growing fields of manufacturing hopefully. As we are concern with the emerging technology and as per the analysis of rate of technology growth we all can hope that the future construction and manufacturing part could be easily modified through these 3d printers. One can conclude that as per the day by day increase in the 3d printing technology will influence the human life and society. 3d printers have changed the mode of construction and reduces the human efforts.

3d printers, a device which uses a 3d modeled design in the form of a file on the software converts to a real life 3d model with a wide verity of manufacturing techniques and processes which blows the mind of the leading technology it could give a great challenge to the emerging technology. This type of technology is making once life easier by providing them more precise results which has a great outcome in which there is a long and satisfactory journey from an imagination from a human mind to a real life 3d scaled model and ultimately to a large scale structure. In future aspect hope fully the advanced 3d printing technology will fulfill the needs of various industries and will take them to higher post and one day they will lead the market.

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