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THE SUMMARY OF 3D PRINTING TECHNOLOGY: TECHNIQUE, MATERIAL, APPLICATIONS AND ADVANTAGES

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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's. There are many Different processes available in 3D printing technology such as (1) EBM (electron beam machining), (2) DLP (digital light processing), (3) FDM (fused deposition method), (4) LOM (laminated object manufacturing), (5) SLS (selective laser sintering), etc.This is a research paper on 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, become a notable topic in technological aspects.In this project, 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 has been using 4 axis mechanisms where 3 axes are x-y-z and the fourth axis is an extruder.The process used by us is FDM technology, in which different materials like PLA (polylactic acid), ABS (acrylonitrile butadiene styrene), HIPS (high impact polystyrene), etc are used.

Keywords- 3D Printing, Fused deposition molding (FDM), Additive Manufacturing Technology (AM), Portable Machine, Engineering and Technology.

I. INTRODUCTION

A 3D printing is an additive manufacturing technology where 3D objects are printed by using CAD (computer aided design) software like FUSION360, solid Works, CATIA, etc. This 3D prototype objects and parts are created by the addition of multiple layers of material.It can also 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 as construction, 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 like 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). The sales o f 3D printing machines has been grown widely and their price has been dropped gradually, after the start of the 21 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 describes the simple fact that the technologies all share the common theme of sequential- layer material addition or 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 primary decade during which metal endues parts such as engine brackets and large nuts would be grown (either before or rather than machining) in job production rather than legally being machined from bar stock or plate.

II. 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)

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3. EBM (electron beam machining)
4. LOM (laminated object manufacturing) DLP (digital light processing),etc

There are different methods of 3D printing, but the foremost widely used is Fused Deposition Modelling (FDM) method. Here we are using FDM technology for our project.FDM printers use a thermoplastic filament, which is heated to its melting point and extruded layer by layer, to create a 3D 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.

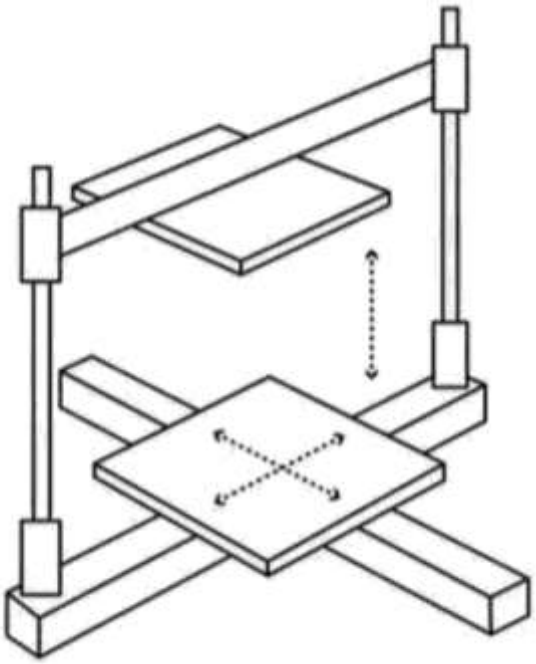

Figure 1.1: - Cartesian configuration.

III. MATERIAL USED

The materials used for 3D printing are as diverse as because the Products that result from the process. As such, 3D printing is flexible enough to permit manufacturers to work out the form, texture and strength of a product. Best of all, these qualities can be achieved with far fewer steps than what's typically required in traditional means of production. Moreover, these products can be made with various types of 3D printing materials.

Plastic is most commonly used material. It is one of the most divers material used for 3D printed toys and household products. Plastic products are mostly manufactured by FDM printers, in which thermoplastic filament is melted and molded into a shape, layer by layer. Polylactic acid (PLA) is a common thermoplastic polymer derived from natural sources like corn starch or sugar cane in contrast to many other thermoplastics which are produced from non-renewable sources such as petroleum. From automotive to food packaging, a variety of industries are using PLA to produce 3D printed products.

Advantages of PLA:

1]Low printing tempreture: PLA is a comapartively low tempreture thermoplastic. Ideal printing tempreture of PLA starts from around

180°C

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2] **Ease of use:** PLA is one of the handiest filament used for 3D printing.
3] **Variety of color and blending options:** PLA comes with wide range of colors and blends. It can also be mixed with wood, carbon and even metal.
4] **Easy post-processing:** PLA prints can be easily sanded, polished and painted, allowing for an improved surface finish with less effort. The PLA parts also be drilled, grilled and glued.
5] **Biodegradable:** The most important aspect of using PLA is that, it is environment friendly. It is non-toxic and also requires less energy and emits fewer greenhouse gases during the process.

Some key points of PLA:

- PLA melting point: 150-160°C
- PLA printing temperature: 180-230°C
- Heated print bed: optional
- Cooling: part cooling fan is necessary
- Enclosure: not necessary
- Filament storage: airtight container

IV. APPLICATIONS

EDUCATION: The advantages of 3D printing for education are that it helps better prepare students for his or her future by allowing students to make prototypes without the necessity for expensive tooling. Students study 3D printing applications by designing and producing models they will actuallyhold.
APPAREL: 3D printing has spread into the world of clothing with fashion designers experimenting with 3D printed shoes, dresses, and fashionable accessories.
CONSTRUCTION: With the assistance of 3D printers, we are ready to build civil models like prototype of building or plan structures. So that the purchasers can easily visualized the models.
DENTAL: With the assistance of 3D printers, we are ready to print jaws it are often a prototype or it are often a jaw bone which may be transplanted as per the need.
MEDICAL: Medical uses for 3D printing, both actual and potential, can be organized into several broad categories, including tissue and organ fabrication; creation of customized prosthetics, implants, and anatomical models; and pharmaceutical research regarding drug dosage forms, delivery and discovery.
DOMESTIC USE: The domestic market of the 3D printing was mainly practiced by hobbyists and enthusiasts and was very little used for many of the practical household applications which are inapplicable.

IN PRINTED CIRCUIT BOARDS (PCB):
We can develop a prototype of a printed circuit boards (PCB) the core of any electronic device and other electronic parts.

V. ADVANTAGES

SPEED: Rapid Prototyping is one of the biggest advantage of 3D printing technology. Rapid Prototyping is basically the ability to design, manufacture, and test a customized part in as little time as possible.
COST: For small scale production and applications, 3D printing is the most cost- effective manufacturing process.

FLEXIBILITY: Any 3D printer can create almost anything that fits within its build volume.

ACCESSIBILITY: 3D printing system are much more accessible and can be used by a much wider range of people than traditional manufacturing setups.
SUSTAINABILITY: With 3D printing, fewer parts need off shoring for manufacturing. This causes environmental impact because
fewer things are being shipped across the globe and there is no need to operate and maintain an energy consuming factory.

VI. CONCLUSION

Generally it is accepted that the 3D printing will becoming 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 up set 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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