An Understanding of 3-D Printing Methodology

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ABSTRACT: ***During the Industrial revolution industrial machinery, economies of scale, assembly line and factories were synonymous to manufacturing. 3-D printing is a widely utilised technique also known as just an additive manufacturing method to reduce energy and materials to speed innovation. It has been more than 35 years since the development of 3-D printing, presently; individual 3-D printers are accessible in the smaller size and at affordable cost. In USA 3-D printing technology has developed and has being utilised in the automobile industry extensively. 3D printing has grown more and more popular in recent years. The concept of equipment that can print things just like a paper-based inkjet printer has prompted businesses to proclaim 3D printing to be "the very next industrial revolution." Other experts reacted with cynicism and referred to the present limits of technology including to fairly low adoption rates. 3D printing or 'additive manufacturing' as it is known, may become the world's most disruptive technology. Paper will talk about the development of 3-D printing globally, various kinds of techniques known to the experts, its consequences in production and comprehensive functioning of 3-D printing.***

KEYWORDS: 3D Printing, Additive Manufacturing (AM), Computer-Aided Design (CAD), Lithography, Printers.

1. INTRODUCTION

In this day and age, technology is changing in a multitude of different ways, making it difficult to concentrate on just one technology. The nature of production and the means of manufacture have changed dramatically thanks to headway in the additive manufacturing (also known as 3D printing) developments in recent years. Thanks to this technology, engineers have discovered new ways to measure up in the planning stages, how to create more modern, safer, lighter, and cleaner products at lower costs. Even though they're mostly used for fast prototyping, it's interesting to note that rapid product design is only one of the ways 3D printing may be useful. With a new technology coupled with cutting-edge and superior materials, we are experiencing improved creation. While 3D printing has been around for two decades, it was originally conceived by engineer Chuck Hall in 1983. The 3D printing method he developed at the time was called sound system lithography, and it made use of treated material to produce solid parts. This approach is used mostly by manufacturers nowadays. 3D printing has improved the automobile industry with better security, weight, and strength, as well as shorter production times, by allowing designers to make scale models that simulate the actual car structure for aerodynamic testing[1].

High detail models are created using material flow and SLA. 3D printing is often used in manufacturing to create prototypes on a regular basis; this is particularly true when it comes to the side reflection of the vehicle, as well as when used to create precise objects, such as a car guard. 3D printing's most advantageous attribute is its affordability. The increased creativity in the automobile sector is frequently attributed to its cost-saving advantages and the role it plays in helping executives save time. In recent years, the size of printers has grown as quickly as the pace at which they can print, making them a good option for those working with large and medium production runs. In the high-end sector, consumers are very sensitive to price, and 3D printing has a crucial impact. You may customise some components to a particular customer or vehicle. Prior to this, the only thing that was widely used for 3D printing was photo-sensitive gel. In fact, 3D printing is used for many applications and there are different kinds of 3D printing. Using 3D printing technology, one may make a wide variety of objects without having to use a large office, which can manufacture both large and very complex things. A few pieces of the electric model were printed using 3D printing lately [2]. The overview of 3D printing techniques is shown in Figure 1.

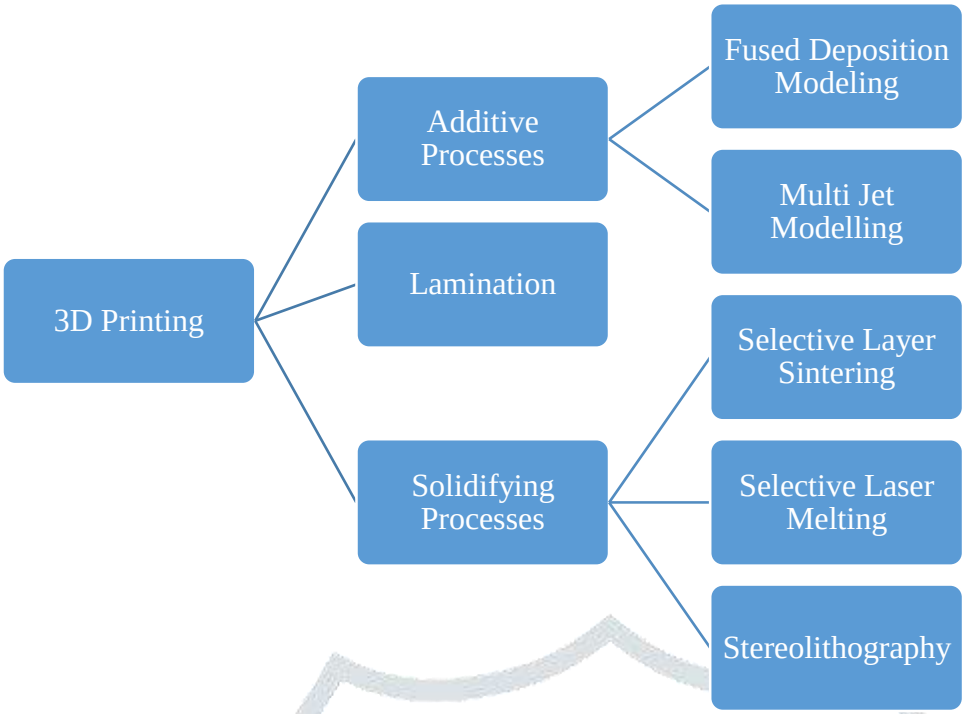

Figure 1: Illustrates the Overview of 3D printing methods.

1.1 3D Printing Modelling:

For those competing in the engineering field, it is a new method of dealing with any problems that arise during the release of a new product. Design, manufacture, and manufacturing stages of a product are thought to benefit from the simultaneous solution of engineering issues in order to overcome the conflicts that arose throughout the creation of a product. There is a significant deal of variation in the performance and operational procedures of rapid prototyping technology (precision, quality, productivity). Product design may be created in a short period and at a cheap cost using minimum equipment in only a few stages[3]. This is the method most businesses choose. The expansion of 3D printing techniques is shown in Figure 2, in terms of the application to commercial and social settings. The next stages are shown in Figure 3, which offers an overview of the previous 3D printing methods:

1.1.1 Model Design: modelling a full part design in a CAD software such as Blender, SketchUp, SolidWorks, etc. and utilising a workflow that works well with that software;

1.1.2 Export to STL: transferring the CAD model to the processing section, which is done in many cases by the CAD programme used to model the part;

1.1.3 Once the model is completed, it is sectioned and assembled;

1.1.4 The physical implementation of the model (building) is influenced by many variables, including:

- the composition and nature of the materials used
- the way the model is supported during execution
- binding an earlier layer to the next one
- After the finishing work (such as airbrush, sanding, hand painting, and acetone) is done, cleaning should take place.

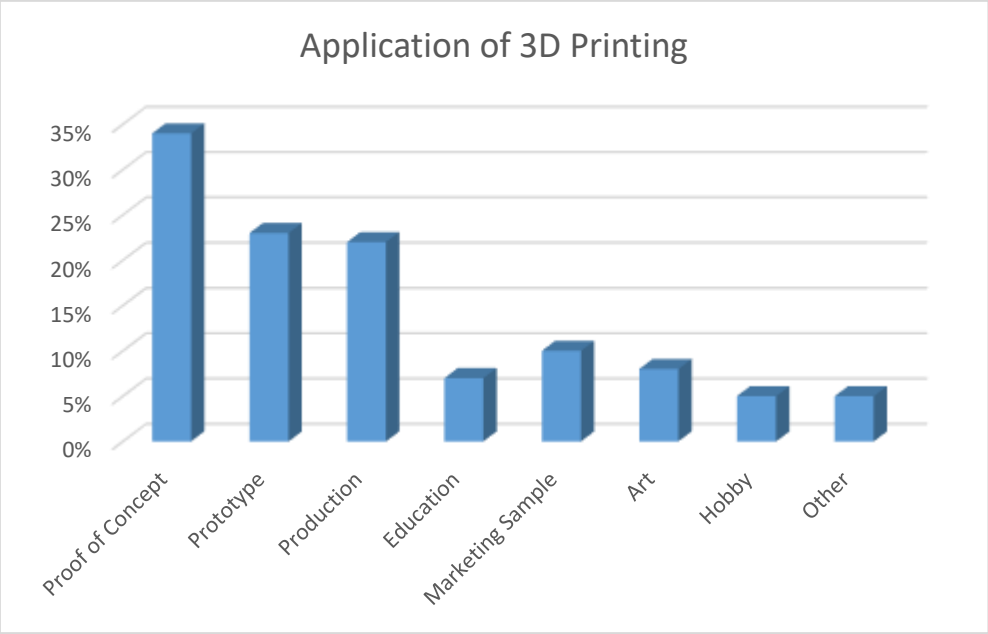

Figure 2: Illustrates the application of 3D Printing.

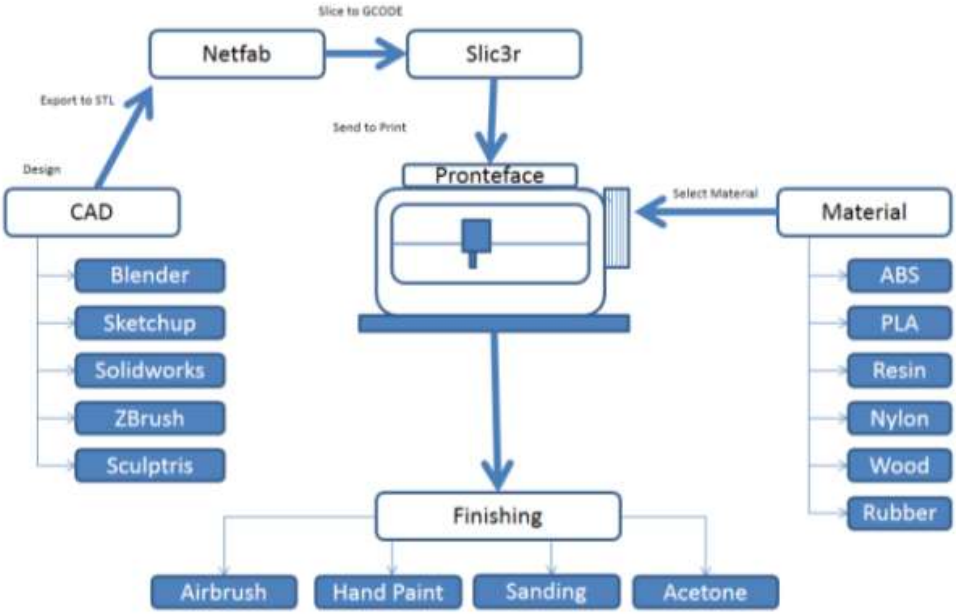

Figure 3: Illustrates the overview of 3D Printing [4].

1.2 3D Printing Batteries:

The energy storage systems in modern portable devices are in high demand, and tiny but strong batteries are in constant demand. With the aim of enhancing the electrochemical performance of batteries, lowering manufacturing cost, and increasing their application, enormous efforts have been invested in researching new electrode materials, electrolytes, cell topologies, and innovative fabrication methods. While 3D printing is altering our environment, it is also improving with each passing day. The technology advances fast, and the basic building blocks of next-generation 3D printed energy structures may be built in almost any form[5].

Until recently, the size and form of commercially accessible batteries have forced manufacturers to build their gadgets around them, limiting the amount of space available in contemporary electronic products. Coin and pouch cells are usually designed in cylindrical or rectangular forms. Therefore, a producer must plan a particular size and form for the battery when creating a product, which may cause the use of space and restrict design choices. The flexibility of the next generation of electronics will be impacted by the increasing difficulty of this issue[6].

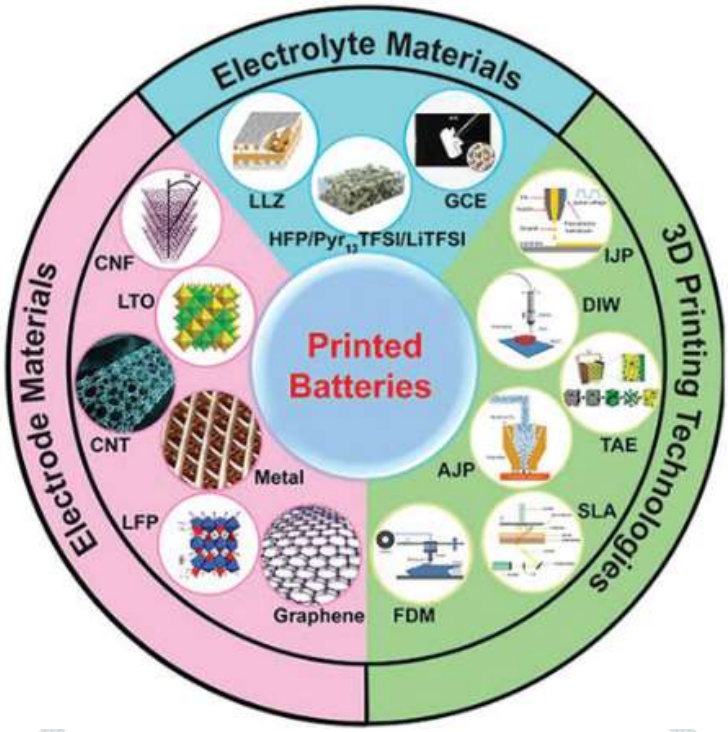

Figure 4: Illustrates the 3D printing technologies, electrolyte and printed electrode materials [NANOWERK].

1.3 3D Printing in Health Care:

3D printing is a kind of additive manufacturing that produces three-dimensional things via the sequential layering of raw materials like metals, polymers, and ceramics. Manufacturers create these things from a digital file, allowing them to make modifications or modify the product as they see fit, using a magnetic resonance imaging (MRI) or computer-aided design (CAD) drawing. The different 3D printing techniques vary in terms of the way in which layers are built up and the kind of materials utilised. There are several types of 3D printers on the market, with varying price points and capabilities. The cheapest are focused on the consumer market and are capable of producing smaller, basic components, while commercial grade printers can create bigger and more sophisticated parts[7].

Nearly one hundred items have been examined by the FDA, all of which are medical equipment, such as orthopaedic implants. Manufacturers would benefit from this strategy, since it provides many benefits for clinical use. A porous knee replacement was produced using 3D printing methods to enable tissue development and integration. One of the best things about 3D printing is that it allows you to print a whole product or component all at once, whereas other manufacturing methods may require that several components be manufactured separately and then screwed or welded together[8].

The use of 3D printing for patient-specific goods is also possible, since it does not depend on moulds or specialist equipment and can quickly be changed. Joint replacements, cranial implants, and dental restorations are among the options. The industry has been introducing this technology, and patients are receiving personalised treatment at the site of care, where point-of-care manufacturing is utilised. Based on a patient's imaging data, this on-demand 3D printing of medical goods is produced. Surgical instruments, prostheses, and anatomical models that are printed at the point of treatment have proven invaluable to surgeons. A decade ago, only three U.S. hospitals had a centralised 3D printing facility, but by 2019, the number had jumped to more than 100. This point-of-care approach may become increasingly prevalent as the technology advances.

In addition to their use in 3D printing, these materials may be useful in other fields of manufacturing. A major effort is being made to use 3D printing to produce medicines that may potentially have novel dosage forms, such as those that could deliver more or less quickly. In 2015, the FDA authorised a 3D-printed medication, a therapy for epilepsy that has a high amount of the active component that rapidly dissolves in water. One day, 3D printing may be used to mix several medicines into one pill, or a polypill. In addition, researchers use bio-printers to build cellular and tissue structures, such as skin graffiti and organs. However, these applications remain in experimental stages[9], [10].

2. DISCUSSION

Photopolymer resin is used in the first class of 3D printers, which creates layers of solidifying material by exposing them to laser or other light. Many 3D printers use liquid tanks to print out object layers for the polymerization of images. Other coatings use a single layer of resin followed by a UV light treatment to strengthen the coating. 3D printers built using various techniques will in the near future be able to mix various photo polymers to produce objects composed of several materials. A second kind of 3D printing or (AM) hardware is made when extremely fine powder is used to bond successive layers together. Using a heat source like a laser, it is possible to fuse together granules or powder particles with adhesive by jetting it onto the powder. They also melt when they are placed on a construction sheet. In addition to having a material melt and mix when they are put on a build layer, the other advances have a powdered substance. The other three-dimensional printing techniques are now widely utilised in a range of materials, with different levels of powder adherence. These include a wide range of materials, including nylon, cobalt, bio-plastic, wax, ceramics, stainless steel, titanium, and bronze.

Some 3D printers extrude semi-liquid or molten material via the print head nozzle. Most scenarios use molten thermoplastics. Some 3D printers utilise melted metal or chocolate/cake icing to create gastronomic masterpieces. A few 3D printers use extrusion, which is the process of pushing semi-liquid or molten material through the print head nozzle. Thermoplastics are the preferred choice for most applications. Some 3D printers utilise molten metal or chocolate/cake icing to create culinary items. Imagine being able to create a detailed replica of a car. It will first slice whole slabs of wood from the interior to the exterior to gradually create the shape of a vehicle. It is no longer a mystery to teach a robot arm to carve the shape of a piece of wood and it is not a rocket science anymore to cut wood into form. But 3D printing systems do not use any of these technologies; it is just like our conventional ink jet printer. FDM, an additive manufacturing technique, is utilised in which a plastic-based substance is constantly deposited and used to print layer by layer. The 3D CAD model is converted into a 2D layer by layer to create a 3D model. Instead of utilising ink, the printer deposits layers of plastic or powder, which are then fused together using glue to create the desired shape.

A 2014 Local Motors electric vehicle prototype was initially created using 3D printing in only 44 hours, assisted by a carbon filler mix known as strati. Thermoplastic strati are printed through additive manufacturing using a machine. This machine is entirely recyclable and may be reused, hacked, and put to use in the manufacture of a new car. Once the vehicle's whole framework is 3D printed, additional components, such as the engine, gearbox, drive train, batteries, suspension, and so on, are assembled manually. Local Motors is supplied with components by small non-OEM corporations. This kind of organisation is well served by 3D printing's ability to produce accurate cross-sectional plans. 3D printing isn't restricted to cars; it is used for a variety of other forms of transport.

3D printing is also being used by the massive American car manufacturer Ford for producing components. German auto manufacturing company BMW use 3D printing and showing to create handy tools for assembling cars. The sound system lithography and laser sintering are two of the many technologies used by GM. Chrysler uses 3D imaging to make all sorts of wide-ranging side-view mirrors. The use of prototyping has been quite successful in 3D printing, but large producers have also made significant advances in this technology by developing 3D printing productions, machine figures, and other forms of creative and innovative materials.

3D printing technology streamlines the creation of templates, research, prototyping, and production, making each process more efficient. Printable prototypes are made possible via the use of technology, and the initial step of the creation of automotive components is the modelling of these components in 3D. In order to make advantage of this feature, editors and applications that monitor hardware are necessary. A few basic programmes like Netfabb, Dreamcatcher, Stratasys, Solid Works, Solid Edge, and Creo are implemented.

3. CONCLUSION

3-D printing is the newest technology that will provide possible new options for the development of vehicles and vehicle manufacturing. Automobile production will be enhanced by a new level of confidence and competence in 3-D printing in the mass manufacturing sector, which will improve material use and mass reduction. You may improve the primary product life cycle and practical efficiency, such as dependability, cost, and manufacturability, with the use of additive manufacturing, which is a kind of tool and technique of design. As opposed to the methods that were previously used, 3-D printing is simpler. To become completely mainstream, 3-D printing must be able to match traditional manufacturing's mass production capacity, because companies need to churn out large volumes to meet consumers' needs consistently. There are those who say that hybrid systems that combine current technology with the newest will be created in recent times, but 3D

printing is considered to be a question of the future. A sand model for an automotive design may be made via 3-D printing, which simplifies traditional measurements. Since the introduction of 3D printers, both traditional techniques and fusion have been well known. Mass-produced parts for DDM metal production are not as easily manufactured using 3D printers. A reason is that DDM's metal components are not used by OEMs, who are customers. 3-D printers can't create their output fast according to present 3-D technology, therefore it's ideal to use one to construct a prototype of a design; nevertheless, it's not well-suited for mass production. New software and powerful processors, however, are enabling 3-D technology to be developed more swiftly.

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