Review on the 3D Printing Applications

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***ABSTRACT:** 3D printing, also known as additive manufacturing, has been called the next big thing, with the potential to be as widely used as the cellular phone industry. 3D printers convert a digital blueprint into a real three-dimensional item. Plastic, metal, nylon, and over a hundred more materials are used in the printing process, which is done layer by layer (additive manufacturing). Manufacturing, industrial design, jewelry, footwear, architecture, engineering and construction, automotive, aerospace, dentistry and medical industries, education, geographic information systems, civil engineering, and many more fields have found 3D printing to be beneficial. In every area of application, it has shown to be a quick and cost-effective solution. 3D printing's uses are growing all the time, and it's proving to be a really interesting technology to keep an eye on. We will look at how it works as well as present and prospective uses of 3D printing in this article.*

***KEYWORDS:** Aeronautics, Automobile, 3D Printing, Manufacturing, Industry.*

1. INTRODUCTION

3D printing may create real objects by gradually adding material to a geometrical representation. This 3D method has become more popular in recent years. In 1980, Charles Hull became the first person to commercialize 3D printing. 3D printing is now mostly used to produce man-made things[1]. 3D printed cornea, PGA rocket engine, steel bridge in Amsterdam, heart pump, jewelry collections, PGA rocket engine, steel bridge in Amsterdam, and other products related to the aviation and culinary sectors 3D printing (3D) is a three-dimensional item production method that employs a layer-by-layer approach. Structures created directly from a CAD drawing 3D printing is a cutting-edge technology that has established itself as a technical stage that is both versatile and adaptable[2]. It opens up new possibilities for companies looking to boost their productivity. Graphene-based materials, thermoplastics, and ceramics Materials and metal are presently among the materials that can be created using 3D printing technology. 3D printing is a three-dimensional item creation method. Technology has the power to change industries and industrial processes. Acceptance of 3D Printing Manufacturing will be accelerated while costs are reduced thanks to technology. Consumer demand is also rising at the same time. will have more control over production Consumers have more influence over the final product and may make specific demands[3].

It was custom-made for them. Meanwhile, 3D printing technology facilities will become more closely linked. allowing for a more flexible and responsive manufacturing process as well as improved quality control Furthermore, by using 3D printing technology, the need for global shipping is reduced. This is because when manufacturing facilities are located closer to the ultimate destination, all distribution may be handled locally. This was achieved via the use of fleet monitoring technology, which saves both energy and time. Finally, 3D printing technology has the potential to be helpful. Logistics should be reorganized in the business. The logistics departments of businesses may manage the whole process and provide extra alternatives. Complete and end-to-end services are available. Globally, 3D printing is currently widely used[4]. It is becoming increasingly usual to use 3D printing for mass manufacturing. Agriculture, healthcare, autos, and aerospace industries all use open source designs for modification and production.

However, there are a number of disadvantages to utilizing 3D printing in manufacturing. Industry 3D printing, for example, reduces the need for manufacturing manpower[5]. This will have a major effect on economies that rely largely on low-wage labor. Additionally, 3D printing technology may be used to manufacture a range of things, including blades and weapons. as well as items that may be dangerous As a consequence, 3D printing should only be used by a limited number of people in order to prevent terrorists from exploiting it. Weapons are smuggled into the nation unnoticed by criminals as well. Those that get a blueprint, on the other hand, will be able to construct their own structures. Fake products are easy to get by. This is due to the fact that 3D printing technology is simple to use; all you have to do is draw and set the settings. 3D objects may be created using data that has been machine-printed.

To conclude, in recent years, 3D printing has grown in popularity as a flexible and powerful tool. manufacturing sector that is advanced This method is extensively used in a number of countries, including the United States. Manufacturing business As a consequence, this article covers the many types of 3D printing technology, as well as its benefits and drawbacks. The materials used in production utilizing 3D printing technology. In the 1980s, the first 3D printers were used to draw a design immersed in a liquid polymer by a computer. Thanks to the laser, the drawn pattern solidified into a layer, and that's how you made a plastic item. Since then, additive manufacturing has advanced to the point that material extrusion is now utilized. An item is created using this technique by pushing materials via a mechanical head, similar to how inkjet printers extrude ink onto paper.

Surprisingly, the cost of purchasing 3D printers has decreased as technology has advanced. Domestic use of 3D printers is on the increase, with prices ranging from a few hundred dollars to several thousand dollars. However, one significant disadvantage is that printing 3D things requires specialized knowledge. In reality, both the digital file and the final printing need the expertise of a skilled individual. Commercial use of 3D printers is also on the rise, particularly in industries like automotive and aerospace engineering. In the automotive and aerospace industries, for example, spare parts are manufactured, resulting in increased economies of scale. The advent of 3D printers has been dubbed the second Industrial Revolution by some experts because it is altering how the production line in industry operates. From Bionics to Prosthetics to Digital Dentistry, 3D printing has shown to be very useful in the medical sector. Inevitably, this will have a beneficial impact on and change all aspects of medicine .The majority of the work is still in the experimental stage, but experts believe that the incorporation of 3D printing as a tool will transform medicine in the future[2].

1.1 Applications of 3D Printing:

- *Aeronautics and spaceflight:*

3D printing technology allows for unrivaled component and production design flexibility. In the aerospace sector, 3D printing technology offers the ability to produce lightweight components with better and complicated shapes, lowering energy and resource requirements. At the same time, 3D printing technology may save fuel by reducing the amount of material needed to manufacture aeronautical components. In addition, 3D printing has been extensively used to manufacture spare parts for certain aircraft components, such as engines. The engine's component is readily damaged and must be replaced on a regular basis. As a result, 3D printing technology is a viable option for procuring such replacement components. Nickel-based alloys are favored in the aerospace sector owing to their tensile characteristics, oxidation/corrosion resistance, and damage tolerance.

- *Automobile manufacturing:*

3D printing technology has revolutionized our industry's ability to design, develop, and produce new products. In the automobile sector, 3D printing has created a phenomenon by allowing for lighter and more complicated structures in a shorter amount of time. Local Motor, for example, produced the world's first 3D-printed electric vehicle in 2014. Local Motors has expanded the spectrum of applications of 3D printing technology beyond automobiles by producing the OLLI, a 3D-printed bus. OLLI is a 3D printed bus that is autonomous, electric, recyclable, and very smart. Furthermore, Ford is a pioneer in the use of 3D printing technology, using it to create prototypes and engine components. BMW also makes hand-tools for automotive testing and assembly using 3D printing technology. Meanwhile, AUDI teamed up with SLM Solution Group AG to manufacture replacement parts and prototypes in 2017. As a result, utilizing 3D printing technology in the automobile sector allows companies to experiment with different options and prioritize them early in the development process, resulting in an optimal and successful vehicle design. At the same time, 3D printing technology may help to minimize material waste and consumption. Furthermore, 3D printing technology may decrease costs and time, allowing for rapid testing of new ideas[6].

- *Food manufacturing:*

Not only does 3D printing offer possibilities for the aerospace sector, but it also opens doors for the food industry. There is a rising need for the creation of tailored food for specific dietary requirements, such as athletes, children, pregnant women, patients, and others, who require a varied quantity of nutrients by eliminating superfluous components and increasing the presence of beneficial ingredients[7]. However, the creation of personalized meals requires a lot of attention to detail and creativity, which is where 3D-food printing comes in[8]. Food layer manufacturing, often known as 3D-food printing, is a method of fabricating

food by layering consecutive layers generated directly from computer-aided design data[9]. Specific materials may be combined and processed into different complex structures and shapes utilizing 3D printing technology [59]. Sugar, chocolate, pureed foods, and flat foods like spaghetti, pizza, and crackers may all be utilized to make new foods with intricate and fascinating shapes and patterns. 3D printing is a low-cost, high-energy-efficiency food manufacturing technique that is also ecologically friendly and has excellent quality control[10]. Because it provides a new method for food modification and can adapt to individual tastes and requirements, 3D-food printing may be healthful and beneficial to humans. It might be feasible to create diets that impose themselves without the requirement for exercise if food preparation and contents could be automatically changed to the consumer's knowledge[3].

- *Medical and healthcare industries:*

Printing 3D skin, medication and pharmaceutical research, bone and cartilage, replacement tissues , organ , printing for cancer research , and finally models for visualization, education, and communication may all be done using 3D printing technology. The following are some of the benefits of 3D printing technology for biomedical products:

- With 3D printing technology, the natural structure of the skin may be replicated at a cheaper cost. Pharmaceutical, cosmetic, and chemical goods may all be tested using 3D printed skin. As a result, using animal skin to test goods is no longer required. As a consequence, employing a skin copy will assist the researcher in obtaining accurate results.
- Printing drugs using 3D printing technology may improve efficiency, accuracy of dropping size and dose, high repeatability, and the ability to create dosage forms with complicated drug-release patterns.
- Cartilage and bone may be printed using 3D printing technology to fill bony gaps in the cartilage or bone produced by trauma or illness. This therapy differs from auto-grafts and allografts in that it focuses on in vivo bone generation, maintenance, and improvement of function.
- 3D printing technology may also be utilized to replace, repair, maintain, or enhance tissue function. The 3D-printed replacement tissues feature an interconnected pore network, are biocompatible, have suitable surface chemistry, and have excellent mechanical characteristics.
- Similar organ failure caused by crucial issues such as illness, accidents, and birth abnormalities may also be printed using 3D printing technology.
- 3D printing can be used to create highly controlled cancer tissue models, which has the potential to speed up cancer research. Patients may obtain more dependable and precise data by utilizing 3D printing technology.
- Neurosurgeons may utilize 3D printed models in the learning process to assist them practice surgical procedures. Because the 3D model is a simulation of a genuine patient's pathological state, it may enhance accuracy, save time for the trainer while conducting clinical procedures, and offer chances for hands-on training for surgeons.

- *Industry of architecture, construction, and building:*

3D printing technology is an ecologically friendly derivative that provides limitless geometric complexity realization possibilities. 3D printing technology may be utilized to manufacture whole buildings or generate construction components in the construction sector. The rise of Building Information Modelling (BIM) will make 3D printing technology more accessible. Building Information Modelling (BIM) is a digital representation of functional and physical properties that may be used to exchange information and knowledge about 3D structures. It may serve as a trustworthy source of information for making decisions throughout the building's life cycle, from conception to destruction. This cutting-edge, collaborative technology will enable more efficient design, construction, and maintenance of the built environment. Companies may use 3D printing technology to design and construct the visual of a building in a short amount of time and at a low cost, as well as prevent delays and assist identify trouble areas. Simultaneously, construction engineers and their clients may communicate more effectively and clearly thanks to 3D printing technology. A customer's expectations are mostly based on a concept, and 3D printing makes it easy to manifest that notion beyond the outmoded technique of paper and pencil. Apis Cor Printed House in Russia and Canal House in Amsterdam are two examples of 3D printed buildings.

- *Fabric and the Fashion Industry:*

3D printed shoes, jewelry, consumer items, and apparel are emerging into the market as 3D printing technology penetrates the retail sector. Although the mix of fashion and 3D printing may not seem to be the most logical match, it is rapidly becoming a global reality. Big businesses like Nike, New Balance, and Adidas, for example, are working to create mass manufacturing of 3D printed shoes. 3D printed shoes are now available for athletes, custom-made shoes, and sneakers . Furthermore, 3D printing technology may expand fashion design's creative potential. Indeed, it enables the creation of forms without the need of molds. In the fashion business, 3D printing technology may be used to design and manufacture mesh-based clothing as well as print decorations for conventional textiles. Furthermore, 3D printing technology is not only used in the fashion sector, but it can also be used to manufacture leather products and accessories. For example, jewels, watches, and accessories. The aim of utilizing 3D printing technology to create fashion goods, according to merchants and designers, is not to replicate existing products, but to enhance product design by providing consumers with customised and unique products. The benefits of developing a product utilizing 3D printing technology include on-demand bespoke fit and style. Meanwhile, by using 3D printing technology, the supply chain costs may be reduced. Finally, 3D printing technology allows for the rapid creation and delivery of small quantities of goods.

- *Electric and Electronic Industries:*

Manufacturers are beginning to see 3D printing's promise fulfilled in all kinds of fascinating ways as it becomes more accessible to sciences, technology, and industrial sectors. Different 3D printing methods are now widely utilized for structural electronic devices such as active electronic materials, electrodes, and devices with mass customisation and adaptive design by inserting conductors into 3D printed components. The Fused Deposition method was utilized in the fabrication of the 3D electrode. Modeling of 3D printing techniques enables mass production of electrode materials at a cheap cost and in a short amount of time. The design and surface area of the 3D electrode may be readily modified to fit a specific application, unlike conventional electrodes such as aluminum, copper, and carbon electrodes. Furthermore, since the 3D electrode printing technique is completely automated and precise, it was able to finish the printing procedure for eight electrodes in only 30 minutes. Furthermore, active electronic components are any electronic devices or components that are capable of amplifying and regulating electric flow charges. Active gadgets also include those that have the ability to produce electricity. Silicon-controlled rectifiers, transistors, diodes, operational amplifiers, light-emitting diodes (LEDs), batteries, and other active electronic components are examples. Due to their extensive functions, these components often require more complicated manufacturing methods than passive components. The benefits of 3D printing technology for product processing and electronics are many. The efficiency of electronic systems may be implemented in Industry Revolution 4.0 with multi-material printing technology, allowing more creative designs to be produced in only one procedure. To solve today's society's environmental pollutions, the creation of a green electronic device with cheap manufacturing costs, excellent safety, high reliability, and fast production is urgently needed.

2. DISCUSSION

The panorama of 3D printing in the industrial sector is explored in depth in this study. At the moment, 3D printing technology is gaining traction in the manufacturing industry, and it provides many advantages to individuals, businesses, and governments. As a result, more data is required to make progress on methods to improve the use of 3D printing technology. More knowledge on 3D printing technology will aid companies and governments in upgrading and improving the technology's infrastructure. As a result, the purpose of this article is to provide an overview of the many kinds of 3D printing technologies, as well as the materials used in 3D printing technology in the manufacturing sector and the applications of 3D printing technology. In the future, researchers may investigate the many types of 3D printing machines as well as the appropriate materials for each kind of machine. In the case of mandibular contour osteoplasty, 3D printing plays an important role. The anatomical features of the mandible are shown in the accurate 3D printing model, particularly the position of the inferior alveolar canal and the thickness of the lateral cortex of the mandible. Before the surgical procedures, accurate diagnoses, preoperative planning, simulated operations, and surgical templates may be created. Furthermore, the surgical template provides a precise method of translating the preoperative plan to the actual procedure. With the use of 3D printing, surgeons may quickly conduct osteotomies and accomplish precise skeletal construct restoration. Overcorrection/undercorrection, inferior alveolar nerve damage, and facial

asymmetry are all undesirable outcomes that may be prevented. So the additional time and money (about $250) invested on the 3D printing model were well worth it.

3. CONCLUSION

3D printing provides a fast, easy, and reasonably inexpensive technique. As it is, a broad variety of materials and technologies with different features and arameters are accessible (the scope of the following article is extremely restricted, consisting solely of a selection of typical popular technologies). This allows a prospective researcher to choose the technology that best suits his needs while still meeting the criteria of the experiment. Models with thin walls and robust exteriors have been successfully produced. 3D printing holes with a high length-to-diameter ratio, as well as extremely tiny items, is feasible (like measurement holes of 0.4mm diameter). However, not all of the 3D printing methods on display provide flawless outcomes. The technique and material used have a direct impact on the quality. Some 3D printed models are only appropriate for a narrow temperature range. If not, they may soften, deflect, distort, and so on.

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