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A Study on 3D Printing and its Various Application

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ABSTRACT: ***One of the most important technological developments in additive manufacturing that has been adopted and accepted as a component of the contemporary industry is 3D printing. It offers several advantages over traditional approaches, with time being one of the most important. Typically, in additive manufacturing processes, the element is produced using the principles of rapid prototyping of the material, as well as layer-by-layer deposition, which is accomplished by transferring the information to the machine's software. Which uses Stereo Lithography (STL) file. Format created by modeling software (CAD). These days, the use of 3D printing in mechanical engineering is particularly beneficial for research and invention of a variety of components, from simple, everyday use structures to complicated ones. Simple, dependable, or precise are a few advantages that 3D printing provides for components employed in aerospace applications, making it one of the most well-liked ways to make concepts-only parts. 3D printing is becoming the most widely used additive manufacturing technology across all industries, not only engineering. The main objective of this paper is to learn more about 3D printing and its application.***

KEYWORDS: ***3D Printing, Prototyping, Technology, Software.***

1. INTRODUCTION

Rapid prototyping, often known as additive manufacturing processes, is a new technology that has shown to be highly promising in the manufacturing sector. This technology has seen significant advancements and has become an effective tool for numerous industries, including research, manufacturing, design, engineering, and science. The 3D printer was created through the collaboration of various fields, including design, electronics, manufacturing, materials, as well as business. The technique of 3D printing involves building up layers of material to make an item in three dimensions. Traditional manufacturing techniques typically employ a subtractive approach, which requires a mix of grinding, forging, bending, molding, welding, cutting, gluing, or assembling [1], [2]. In contrast, 3D printing uses an additive approach. Initially, 3D printing was primarily used to shape objects and create unique patterns. However, in recent years, this technology has advanced to the point that mechanical parts or certain other necessities may also be produced. As 3D printers make it possible to finish a model in a single procedure, it will fundamentally alter not just the industrial/manufacturing field but also our whole way of life in the future.

Since its inception in the late 1970s, additive manufacturing, often known as 3D printing, has advanced significantly. Although quick prototyping was the original purpose of 3D printing, the field has expanded to include a variety of technologies. The number of businesses utilizing 3D printing has rapidly increased during the course of the technology's development. Industry-specific variations exist in the applications while using cases, but in general they comprise tooling help, functional and aesthetic prototypes, or even end-use components. Companies are starting to look for ways to use 3D printing to develop new business models or possibilities as the technology's potential uses grow [3].

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In this paper people will examine the present condition of 3D printing in a number of different businesses, as well as how the technique is being applied in other fields. Humans hope that this tutorial will offer you a thorough grasp of how 3D printing is being utilized to promote innovation or company expansion via the use of real-world examples.

A handful of the many disciplines where 3D printing is being used include medical, mechanical, civil, or electrical. It is a technique for rapid prototyping that makes use of manufacturing processes. The evolution of 3D printing, which involves the layer by layer depositing of liquid material to produce the final element in accordance with a given design, made use of the design and manufacturing principle. Due to its ease of use and dependability in producing extremely complicated and exact components, 3D printing plays a significant role in today's manufacturing business. One barrier that 3D printing has breached is the usage of space-related components, such as the use during the mars rover. This paper includes a few examples of 3D printing in use for diverse purposes [4].

One of the newest technologies with the quickest growth is rapid prototyping (RP). From a CAD file in which the model's shape is established in three dimensions, prototypes may be built in a matter of hours. It provides the designer with the opportunity to confirm the product's forms and determine if it fits into to the assemblage with the necessary functionalities. It reduces the amount of time needed to create a product. It is a prospective tool for the mechanical profession and has been utilized in mechanical systems, aerospace medicinal applications, the arts, and other architecture [5].

Physical models are created utilizing additive manufacturing processes employing three-dimensional (3D) computer-aided design (CAD) models. Fused deposition modeling (FDM) is an additive manufacturing technique that builds products from tiny layers of extruded filaments made of a semi-melted thermoplastic. The orientation of the material throughout deposition, the filament's flow velocity, the distance between raster’s, and the extrusion temperatures are some of the variables that have the most effects on mechanical properties. These parameters control the part's microstructure (where the scale of the extruded fibers is approximately 0.1 mm) and have an impact on the fiber-to-fiber bonding. Because of the FDM material's unique properties, the designer may modify the part's meso and macro structures while modifying its mechanical performance.

2. LITERATURE REVIEW

Buchi Bhanu Prakash studied about 3D printing, which has emerged as a noteworthy topic in today's inventive dialogue. The author examine additive manufacturing, sometimes known as 3D printing, in this paper. In the beginning, we shall define this phrase and explain why it is so important. People will go a little further into the past. When that happens, we should look at the 3D printing process and the materials used to create 3D printed products. They could also recognize the advantages and drawbacks of 3D printing. They have to pay attention to the many apps that are now available. Finally, this innovation's potential for the future is demonstrated [6].

Gebhardt, Andreaset al studied about three dimensional printing and its application. As more well-known publications promote the use of 3D printing to make models and sculptures, even private users are becoming more aware of this technology. Sadly, they mainly provide a poor image of how this new technology will influence our daily life. This is typically the result of a

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highly technical perspective based on erroneous examples. This paper focuses on how the Maslow hierarchy of needs has arranged people's needs. This emphasizes how 3D printing is already having an effect on a variety of aspects of life and is about to revolutionize most of them [7].

Kaninik Baradi studied about construction of structural members using 3d printing. The groundbreaking technology of 3D printing has the potential to completely change the way that building is carried out globally and in India. The methods for 3D printing are described in this study along with how sensitively the procedure reacts to the material being molded. There are not many examples of uses for 3D printing. The benefits, constraints, and scope of the research in the Indian setting are also discussed in the study [8].

Medhavi Kamran and Abhishek Saxena studied about with its enhanced method of creating components layer by layer employing additive methodology and new trends, 3D printing has completely replaced the whole manufacturing operation in the world of emerging technology. In the current paper, a thorough comparison between it and traditional manufacturing methods for producing complex things and components for thousands of various applications has been made. The incredibly adaptable and quick processes of 3D printing speed up innovation, lower energy use, use less material, and shorten supply chains. The feed system, process details, supporting materials, software utilized in 3D printers, and some current advancements in 3d printing are also covered in this study [9].

Jabbar Qasim Al-Maliki studied about Technologies of 3D printing. A digital file may be used to create three-dimensional solid things via additive manufacturing, often known as 3D printing. Utilizing additive methods, 3D printed objects are produced. In an additive process, an item is made by adding layers of material one after another until the full product is made. Each of these layers might be thought of as a horizontally cross-section of the final item that has been finely cut [10].

3. DISCUSSION

Design visualization, prototyping/CAD, architecture, metal casting, education, GIS, healthcare, or entertainment/retail are a few examples of applications. Rebuilding bones or parts of the body in forensic pathology, recreating old and irreplaceable items in archaeology, trying to reconstruct fossils in paleontology, and repairing severely damaged evidence recovered from crime scenes are further uses.

3.1. Engineering, analysis, or planning applications:

3.1.1. Scaling:

By scaling the original CAD model, rapid prototyping technology make it simple to reduce (or increase) the size of a model. The designer may easily scale the CAD model to account for desired holding capacities in the case of designs with varied holding capacity and examine the renderings on the CAD program.

3.1.2. Fit and Form:

Sizes, volumes, or shapes must be taken into account from an aesthetic and utilitarian perspective. It's crucial to consider a part's surroundings and how it fits into a design. The model would be used to assess how well it meets the demands of both form and function.

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Appliances, consumer electronics, the aerospace industry, and the automobile industry all employ form and fit models.

3.1.3. Flow analysis:

If manufactured using conventional manufacturing methods, designs of elements that impact or are impacted by air or fluids flow cannot be changed simply. A computational model may be used to retain the original 3D design data, as well as it could be used to realize any changes to object data depending on certain testing. Products made in the aerospace, biomedical, automotive, as well as shipbuilding sectors all require flow analysis.

3.1.4. Pre-Production Parts:

Pilot manufacturing runs of ten or even more parts are typical in situations where commercial production would be introduced once the prototype of the system has been evaluated and validated. The pilot-production components are used to validate the design or requirements of the tooling. Several rapid prototyping techniques can quickly manufacture pilot created a process, which helps to reduce process development time and quicken the time it takes to get a product to market.

3.2. Applications in manufacturing and tooling:

Soft Tooling Direct: In this procedure, the mold tool is immediately produced using quick prototyping equipment. Such machinery is appropriate for liquid metal sand casting, a procedure in which the mold is taken apart after just one cast.

3.2.1. Direct Hard Tooling:

In recent times, study has focused heavily on the direct hard tooling generated by rapid prototyping techniques. Fast turnaround times to develop very complex-shaped mold equipment for high volume manufacturing are benefits of hard tooling generated by rapid prototyping techniques. Modification to generic designs may often be implemented quickly, often nearly instantly. Rapid prototyping-based indirect hard machining techniques are beneficial in a variety of ways. Except for minor variations in binder system formulas or system types, and most of these processes continue to be fundamentally identical in nature. The Rapid Section Presents the results is one example of a process (RSP). Casting metallic materials and steel powder in a binder solution is one indirect approach for making hard tooling for plastic injection molding.

3.3. Applications in the Aerospace Sector:

Design Validation of an Airline Electrical Generator:

Sundstrand Aerospace produces inline Electrical generators make the decision to test the feasibility of their integrated drive generator concept for a big airliner. Sundstrand put the pieces together and verified their fit, shape, clearances, limit function, or interferences with the housing as well as the numerous sub-assemblies. Following the first examination, a number of problematic areas were identified, fixed, or sometimes new models were created.

3.4. Applications in the Automobile Industry:

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While many vehicle components may be changed, many are difficult to replace. Automotive elements that must be cast into metal if broken or malfunctioning are crucial in terms of the mobility in these zones since they hinder movement unless replaced. These demands might well be managed and expanded using just 3D printing technology, which is utilized for things like 3D castings, prosthetics, etc. for medical purposes, metal casting usage for parts, as well as many other uses in this industry.

4. CONCLUSION

One of the aspects of additive manufacturing that is growing the fastest is 3D printing. Regardless of their intended use, 3D printing is being used in a wide range of disciplines since it can be customized to meet the requirements of each individual sector. Applications for 3D printing include the civil, electrical, and medicinal fields. Shortened lead times and quick prototyping are both made possible by 3D printing. The importance of 3D printing in many mechanical engineering applications was highlighted in this paper. For parts used in aerospace applications, 3D printing offers benefits including simplicity, dependability, and accuracy, making it one of the most popular ways to create concept-only parts. Not just in engineering but across all sectors, 3D printing is quickly becoming the most popular additive manufacturing method. This paper's main goal is to provide additional information on 3D printing and its uses.

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