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Fabrication of Prototype using Additive Manufacturing

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ABSTRACT

Our objective is to fabricate a prototype utilizing additive manufacturing, which is just 3D printing in digital form. A prototype is described as the transformation of a concept into a physical form. As a result, clay and wood are used to construct the prototype. Fabrication takes a long time because of the production procedures, which are time-consuming and incorrect when compared to the design. Digital additive manufacturing is used to eliminate this.There are several alternatives in digital additive manufacturing, such as selecting materials such as ABS, PLA, Carbon fiber, and others, which allows for greater versatility in selecting materials for construction. To begin, use design tools to develop a 3D design. The design is subsequently transformed into layers using slicer software, which divides the design into layers without causing any design disruption. The sliced design is then saved on an SD card and fed into a 3D printer.

Fabrication using standard manufacturing methods takes a long time and requires a lot of people. Fabrication will be completed in a matter of hours utilizing digital additive manufacturing, and the created product will be as accurate as possible.

KEYWORDS: Additive manufacturing, digital additive manufacturing, 3D printer, pla, abs

1. INTRODUCTION

3D printing is a type of additive manufacturing technique. It's 'additive' in the sense that it doesn't need a block of material or a mold to make physical objects; instead, it stacks and fuses layers of material. It's usually quick, has cheap fixed setup costs, and can produce more complicated geometries than 'conventional' technologies, with an ever-growing variety of materials. It's widely utilized in the engineering field, especially for prototyping and designing lightweight geometries.'3D printing is commonly associated with maker culture, hobbyists and amateurs,desktop printers, accessible printing technologies like FDM, and low-cost materials such as ABS and PLA (we'll explain all those acronyms below). This is largely attributable to the democratization of 3D printing through affordable desktop machines that sprung from the RepRap movement, like the original MakerBot andUltimaker, which also led to the explosion of 3D printing in 2009.3D printing methods are also referred to as "rapid prototyping." This may be traced back to the beginnings of 3D printing when the technology was initially introduced. When 3D printing techniques were initially developed in the 1980s, they were known as rapid prototyping technologies because the technology could only be used for prototypes, not production items. Other manufacturing methods (such as CNC machining) have gotten cheaper and more accessible for prototyping in recent years, while 3D printing has evolved into an excellent solution for many types of production parts. While some people still use the term "rapid prototyping" to refer to 3D printing, it is increasingly being used to apply to all types of very fast prototyping. By depositing and fusing 2D layers of material, additive manufacturing creates 3D objects. This approach is perfect for prototyping because it requires essentially little setup time or costs. Parts can be created quickly and then discarded. One of the main advantages of 3D printing is that parts may be made in practically any geometry. One of the most significant drawbacks of 3D printing is that most parts are inherently anisotropic or not entirely dense, which means they lack the material and mechanical qualities of parts produced using subtractive or formative methods. Different prints of the same part are prone to subtle variances due to changes in cooling or curing conditions, which limits consistency and repeatability. Automakers employ 3D printing in the automotive sector to evaluate shape and fit, experiment with aesthetic finishes, and ensure that all parts perform and interact as intended. It also allows for quick turnaround of jigs, fixtures, and grips, as well as the creation of bellows, the engineering of intricate ducting, and the rapid production of sophisticated, lightweight mounting brackets.Prototyping is made much easier using 3D printing. In the prototype, speed is essential, and 3D printers' ability to go from CAD to print with almost no setup expenses means they can create parts quickly and have excellent unit economics for single-part and small batches. Speed and cost are essential factors when printing manufacturing parts, but design freedom and ease of modification are the most widely used features. Topology optimized structures with a high strength-to-weight ratio are utilized for high-performance parts in aerospace and automotive, and previously assembled components can be merged into a single part. Customization is crucial in healthcare; most hearing aids manufactured in the United States are nearly entirely made using 3D printing.Low-run injection molds can be 3D printed instead of machined from stiff, heat-resistant polymers, making them significantly cheaper and faster to manufacture.

2. LITERATURE REVIEW

Accordingto [1]Many rapid prototyping (RP) and rapid manufacturing (RM) systems work in a stop-start fashion. This happens because objects are constructed layer by layer, and each new layer must be prepared and/or moved into place before being processed. As a result, layer delivery efficiency has a significant impact on the overall build pace of many RP systems.

As per [2] existing system,When examining Digital Additive Manufacturing technologies as a whole, a number of generic traits that are distinct from traditional model-making processes through machining can be discovered.

As per [3]AM refers to a group of manufacturing processes that create 3D components by layering materials on top of one other. A polymer, concrete, metal, or even a hybrid could be used.

The paper [4] represents about Additive manufacturing is revolutionising the way businesses develop and build things all around the world. It can save a significant amount of time and money when used appropriately. Companies claim that additive manufacturing has helped them save weeks, if not months, of design, development, and production time while improving product quality and range. Getting a product to market weeks or months ahead of the competition might spell the difference between success and failure. Companies who opt to use additive technology have a better chance of competing.

In this paper[5]Direct 3D procedures do not necessitate the completion of the lower section of a product before moving on to the upper component. This allows for even more shape creation freedom but also places a significant burden on the manufacturing equipment's programming. Therefore, technologies like "Fused Deposition Manufacturing," "Shape Melting Technology," and others that can theoretically be used as direct 3D approaches are used in a 2D layer mode in practice.

This considerably simplifies the CAM software: less CPU power is required, and machine programming is faster and easier.

In 3D procedures, there are two types of processes: those that create an entire 3D surface at once (surface by surface manufacturing) and those that produce the object point by point in a continuous or discrete fashion.

3. MATERIALS AND METHODOLOGY

The large choice of materials available in FDM (both desktop and industrial) is one of the technology's primary advantages. Commodity thermoplastics like PLA and ABS, engineering thermoplastics like PA, TPU, and PETG, and high-performance thermoplastics like PEEK and PEI are all included..

The most frequent material used in desktop FDM printers is PLA filament. PLA printing is simple to do and produces pieces with finer details. ABS is typically used when greater strength, ductility, and heat stability are required. ABS, on the other hand, is more prone to warping, especially if you're using a machine without a heated chamber.

The mechanical qualities and precision of your part, as well as its cost, will be affected by printing in different materials. In the table below, we compare the most prevalent FDM materials.

Material charachterstics

The characteristics of the ABS material is having good strength and good temperature resistance thus more suscepatable to wrapping

The characteristics of the PLA is having excellent visual quality and easy to print with less impact strength

The characteristics of nylon (PA) is having high strength with excellent wear and chemical resistance

The characterstic of TPU is having flexibility and diificulty to print

Methodology

In Additive manufacturing there are various types of methods used for fabrication or for rapid prototyping

In this paper the method used is FDM (Fused Deposition Modeling)

An FDM 3D printer operates by depositing melted filament material layer by layer on a build platform until the part is complete. FDM works by converting digital design files into physical dimensions by uploading them to the machine. Polymers like as ABS, PLA, PETG, and PEI are used in FDM, and the machine feeds them as threads through a heated nozzle.

To operate an FDM machine, you first load a spool of this thermoplastic filament into the printer. Once the nozzle hits the desired temperature, the printer feeds the filament through an extrusion head and nozzle.

This extrusion head is connected to a three-axis system that allows it to move in all three dimensions. The printer extrudes small strands of molten material and places them layer by layer along a design path. The material cools and solidifies after being placed. In some circumstances, fans can be attached to the extrusion head to speed upcooling.

Multiple passes are required to fill an area, akin to filling in a shape with a marker. The build platform falls when the printer completes a layer, and the machine moves on to the next layer. The extrusion head moves up in various machine configurations. This process continues until the part is complete.

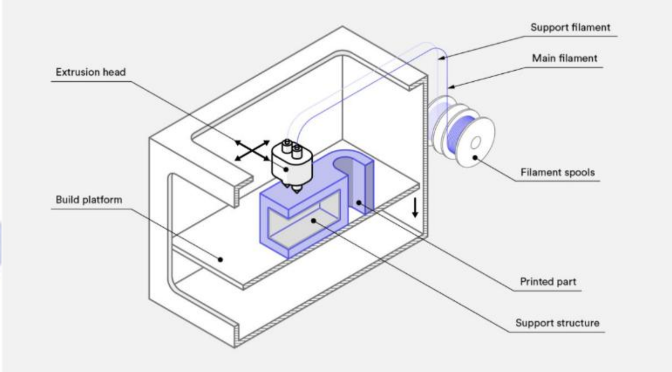

Figure 1 layout of the FDM 3D printer

Figure 2 parts of the FDM 3D printer

Figure 3 display unit of the FDM printer

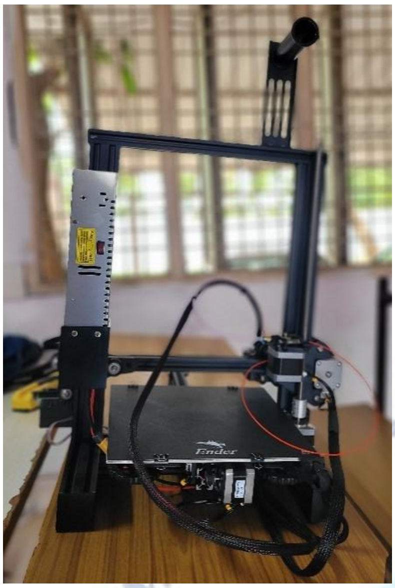

Figure 4FDM printing machine

4. RESULTS

In this section, the 3D design which is given to FDM 3D printer fabricates the design within certain time which may be dependent of the design.As of now we have given the 3D design of a van and a front wing of a formula one car and a logo of our college which we are studying.

The results came quite surprisingly the fabricated 3D designs are as accurate as the original one, i.e, the design parameters does not change while being fabricated and when it comes to detailing its matches upto the design which was given as input for reference.

5

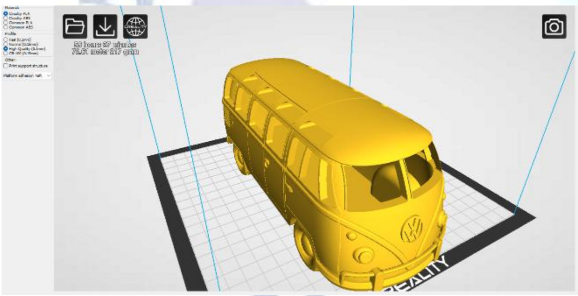

Figure 5 3D Design of van

Figure 6 Fabricated van

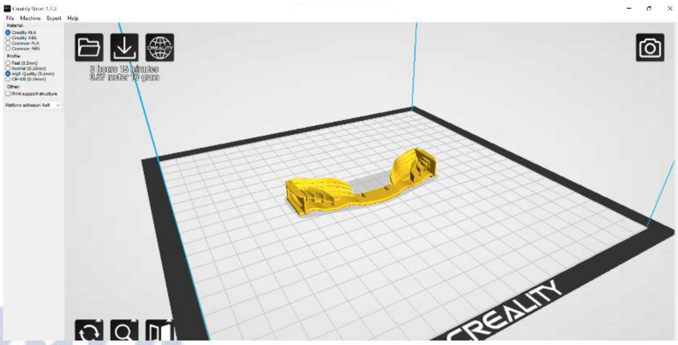

Figure 7 3D design of Front wing

Figure 8 Fabricated Front wing

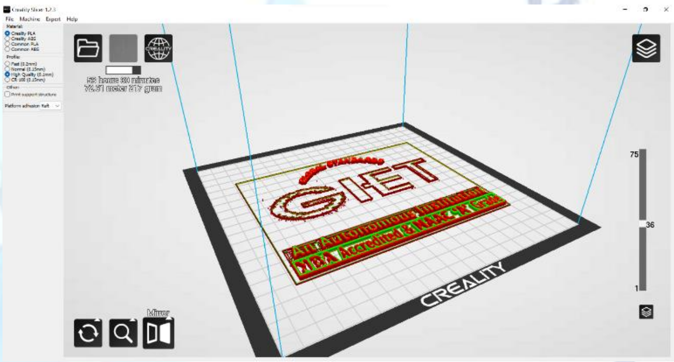

Figure 9 Design of Logo

Figure 10 Fabricaated logo

5. CONCLUSION

In this paper, we suggest using the Additive manufacturing techniques which are useful for rapid manufacturing and rapid prototyping with design parameters and detailing.the prototype can be finished with in hours of time and the detailing of the prototype os as good as design which cannot be acquired by traditional manufacturing.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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