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DESIGN AND PRINTING OF HELICAL GEAR WITH RESIN 3D PRINTING MACHINE

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Abstract - Stereolithography 3D printing (SLA) has evolved into a leading additive manufacturing technology, revolutionizing various industries with its precision and versatility. This paper provides a comprehensive overview of the advances and challenges in SLA 3D printing technology. This overview begins with an overview of the principles of SLA printing, including the photopolymerization process and the role of digital slicing software in creating printable 3D models. Next, recent advances in materials such as photopolymer resins have improved mechanical, biocompatibility, and functional properties, expanding the applications of his SLA printing in areas such as aerospace, healthcare, and consumer products. This section explains.

Additionally, this review addresses improvements to hardware components such as light sources, build platforms, and optical systems, resulting in increased print speed, resolution, and reliability. Additionally, the impact of advances in post-processing techniques such as UV curing, rinsing, and surface finishing on the final print quality will be investigated.

***Key Words*:** Stereolithography, photopolymerization, 3D printing, hardware, UV curing, rinsing.

1. INTRODUCTION

3D printing, also known as additive manufacturing, dates back to the 1980s. This concept originates from Charles Hull, who first invented his 3D printing technology, stereolithography, in 1983. This process uses ultraviolet light to solidify a thin layer of liquid resin to create a three-dimensional object.

TYPES OF 3D PRINTING MACHINES:

- Fused Deposition Modelling (FDM)
- Stereolithography (SLA)
- Selective Laser Sintering (SLS)
- Digital Light Processing (DLP)
- Binder Jetting. Material Jetting
- Multi Jet Fusion (MJF)
- Electron Beam Melting (EBM)
- Direct Metal Laser Sintering (DMLS)
- Laminated Object Manufacturing (LOM)

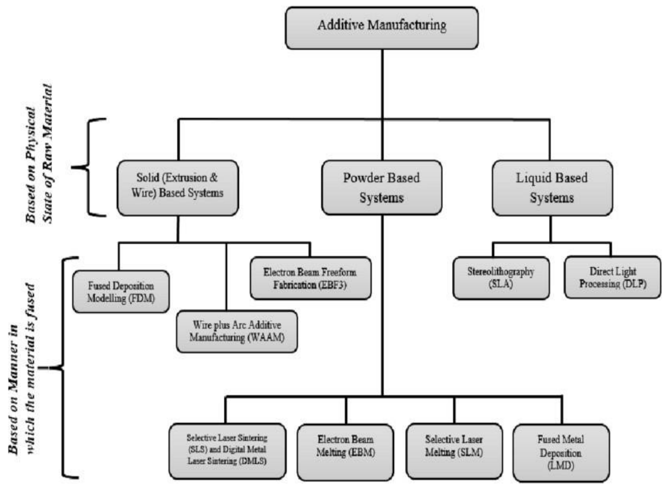

Fig 1: Manufacturing Classification

SPECIFICATION:

Printing Parameter

System: EL3D-3.0.2

Operation: 3.5 Inch Touch Screen

Slicer Software: Voxel dance Tango

Connectivity: USB

Hardware Specification

Dimension: 24.6cm (L)*23cm(W)*45.3cm(H)

Build Volume: 13.28cm (L)*7.47cm(W)*15cm(H)

Weight: 6.8KG

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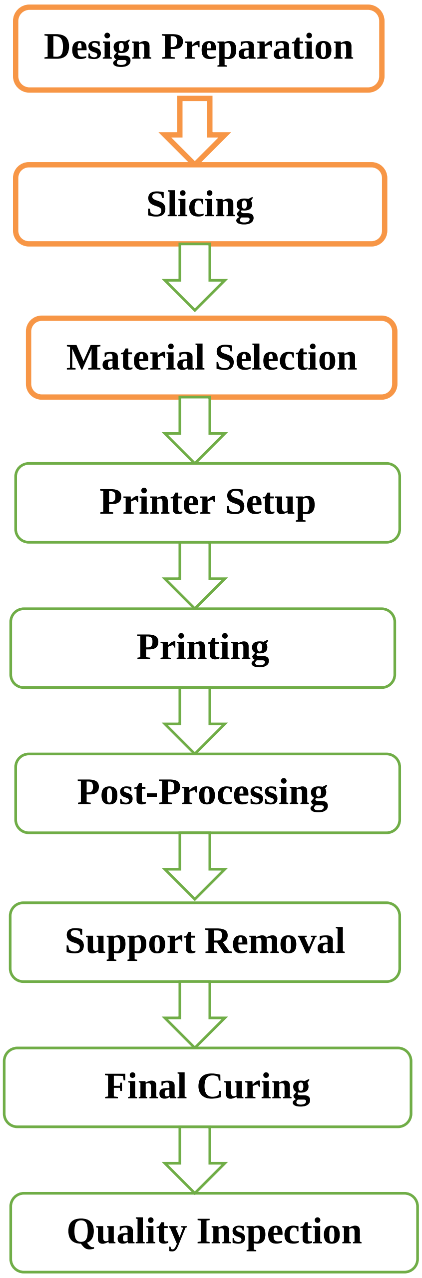
2. METHODOLOGY:



Material Selection:

• **Standard Resin:** A general purpose resin suitable for a variety of applications including miniatures, figurines, and decorative items. One example is Any Cubic Colored UV resin, which is an affordable option that offers reliable quality.

• **Water-washable resins:** These resins are easy to clean because they can be washed with water instead of alcohol. ELEGOO water-washable 3D printer resin is popular due to its printability and durability.

• **ABS-like resin:** For projects that require a more durable and stronger material, ABS-like resin is a good choice. It is impact and heat resistant, making it suitable for more robust applications.

• **Flexible Resins:** When elasticity is required, flexible resins are similar to rubber and can be bent and stretched without breaking. Ideal for parts that require impact and breakage resistance.

• **Engineering resins:** These are designed for industrial applications and may include materials that are hard and heat resistant when cured, such as ceramics, or transparent, hard materials such as polycarbonate 3.

•**8K resin:** For ultra-high resolution prints, his 8K resins, such as Phrozen Aqua 8K resin, offer excellent detail and are ideal for complex models.

DESIGN AND FABRICATION:

DESIGN OF A HELICAL GEAR

1. Click **New**.

2. Click **Part, OK**.

3. Click **Front Plane** and click on **Sketch**.

3. Click **Circle** and sketch a circle center at origin. Click **Smart Dimension**, click sketched circle and set it diameter to **1.0in**.

4. You just completed your sketch, let's build feature from it. Click **Features>Extruded Boss/Base.**

5. Click on front face and click **Normal To**.

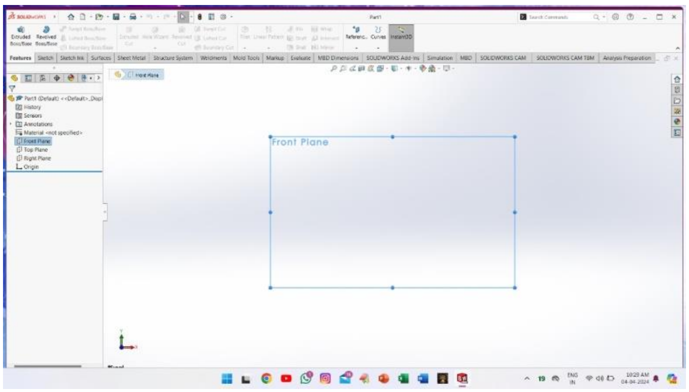


Fig 2: Front Panel

6. Click Front, then click Sketch.

7. Click Centerline and sketch a vertical centerline.

8. Click Line to sketch the outline of the gear teeth.

9. Click Smart Dimension and create a dimension sketch as shown below.

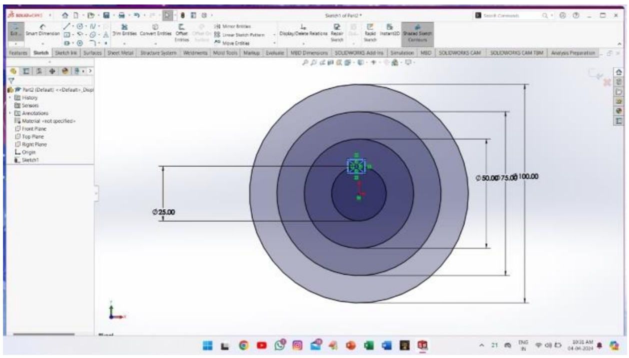


Fig 3: Dimensions of helical gear

10. Click Finish Sketch and change the view to Isometric.

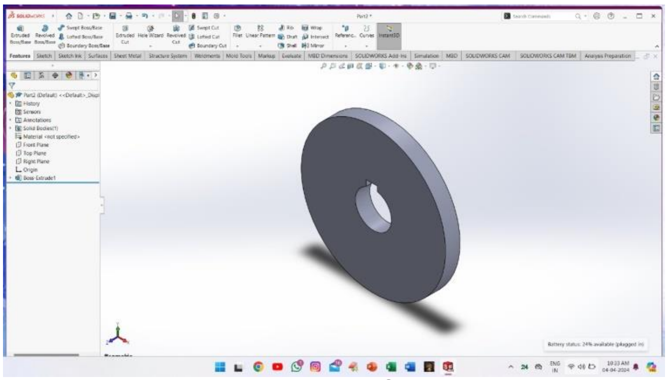


Fig 4: Isometric view of helical gear

11. Click the mouse scroll button to rotate the part to the back. Click on the back and select "Normal To". Click this surface again and click Sketch.

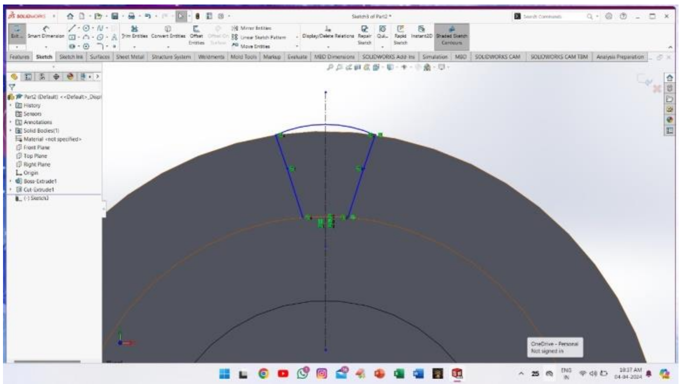


Fig 5: Swept cut of helical gear

12. Transfer the final sketch to this surface. Hold down the CTRL key, click all the sketch lines

, and click Convert Element. Now we need to remove all relationships between this sketch and other sketches. Click View/Remove Relationships, then click Remove All.

13. Click and drag to select all sketch lines. Click Rotate Element, click the Center of rotation box, and click Origin (Center). In the parameter options, enter 10 degrees of rotation.

14. Click Finish Sketch and change the view to Isometric.

15. Click Features > Loft Booth/Base to open the parts tree and double-click Sketch 2 and Sketch 3 to add loft features. Make sure the two green dots are on the same edge as the other sketch. If not, drag to move it.

16.Click on Loft 1 (gear tooth) and then click on the circle pattern.

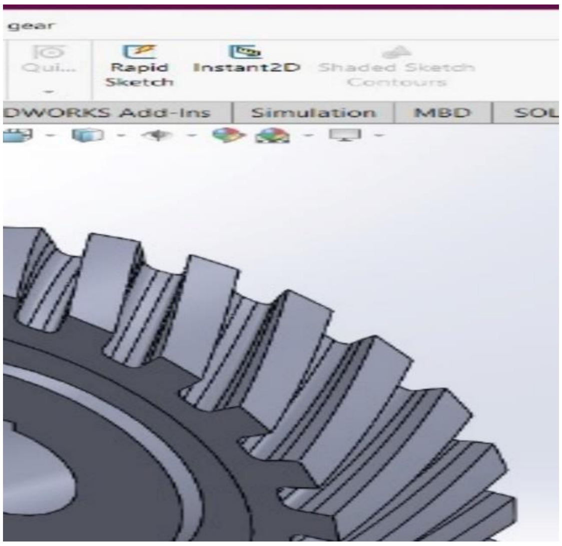


Fig 6: Top view of helical gear

17.Click the cylindrical surface as the axis of rotation (or click View > Temporary Axis and select the temporary axis as the axis of rotation).

18. Click Front Surface and select Normal Direction.

19. Click the front face and select Sketch.

20. Sketch a circle and sketch the center of the circle at the origin. Click Smart Dimension and dimension the sketch as a 0.40 inch circle.

21. Click Features > Extruded Cut and set Direction to Through All.

22. Click on the front and select "Sketch".

23. Click Rectangle and sketch a rectangle as you sketch. Click "Smart Dimension" and dimension the rectangle as shown below.

24. Click Feature > Extrude Cut and set Direction to All Through. That's it!

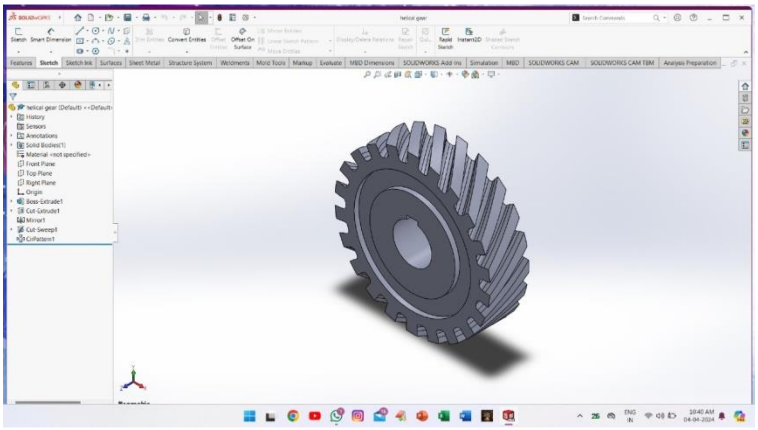


Fig 7: Design of helical gear

3. RESULT AND DISCUSSION:

3D printing of SLA helical gears allows the production of gears with precise tooth profiles and smooth surfaces, making them suitable for a variety of applications where precision and performance are important. This method allows the creation of custom gear designs with complex helix angles and tooth shapes that are difficult or impossible to achieve with traditional manufacturing methods. Additionally, SLA printing enables rapid and cost-effective production of prototypes and small-batch gears, facilitating rapid iteration and adaptation. Overall, a high quality and functional spur gear is created that meets the specific requirements of the intended application.

4. CONCLUSION:

Known for its high resolution and precision, SLA 3D printing is ideal for complex designs and detailed prototypes. However, it can be more time-consuming and expensive than other methods. Overall, this is a valuable tool for industries such as automotive, aerospace, and medical where precision is important.

SLA (stereolithography) 3D printing offers intricate detail and high resolution, making it ideal for creating complex and precise objects. Its ability to create smooth surfaces and minute shapes is unmatched by many other 3D printing processes. However, this may not be the fastest or most cost-effective option for mass production. Despite SLA's limitations, it remains a valuable tool for prototyping, jewelry making, and manufacturing high-quality parts where precision is paramount.

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