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Evaluation of FDM Kobra Neo 3D Printer

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Abstract

Additive manufacturing, or 3D printing, revolutionizes traditional manufacturing by layering materials to create 3D objects, impacting sectors like healthcare and aerospace. It explores diverse techniques, materials, and technologies, with effects on customization, cost, and sustainability. Variables such as layer height, print speed, temperature, and infill density affect print quality, with support structures necessary for overhangs. Research on filament behavior with the Kobra Neo 3D printer aims to optimize printing parameters for superior outcomes and application versatility.

Keywords: 3D Printing, Fluid Depositing Modelling, Kobra Neo

1. Introduction

3D printing, also known as additive manufacturing, fabricates three-dimensional objects by layering cross sections sequentially, akin to printing ink on paper. This process involves solidifying or binding liquid or powder at desired spots in each horizontal cross section. It iteratively repeats layering until the entire object is formed vertically. Often used for rapid prototyping, it can also create final products. Applications span from plastic figurines to metal machine parts and surgical implants. The technology, initially patented as 3DP in 1993, has evolved with computer-aided design (CAD) driving various processes. Technologies like stereolithography and fused deposition modeling (FDM) pioneered layer-by-layer creation. Inventions like selective laser sintering (SLS) in the 1990s and 2000s further expanded capabilities by fusing powdered materials for robust prototypes.

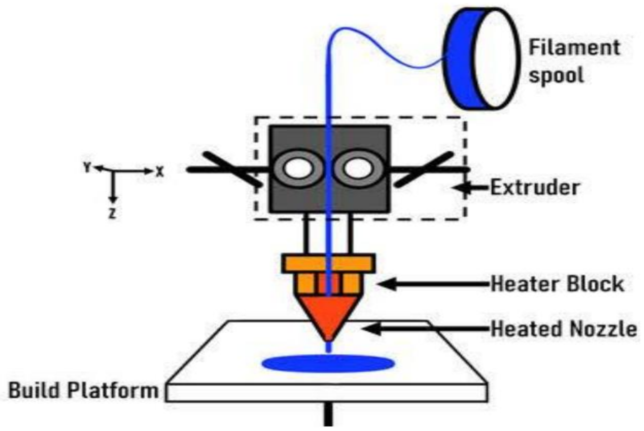

Fig-1.1: FDM 3D Printer

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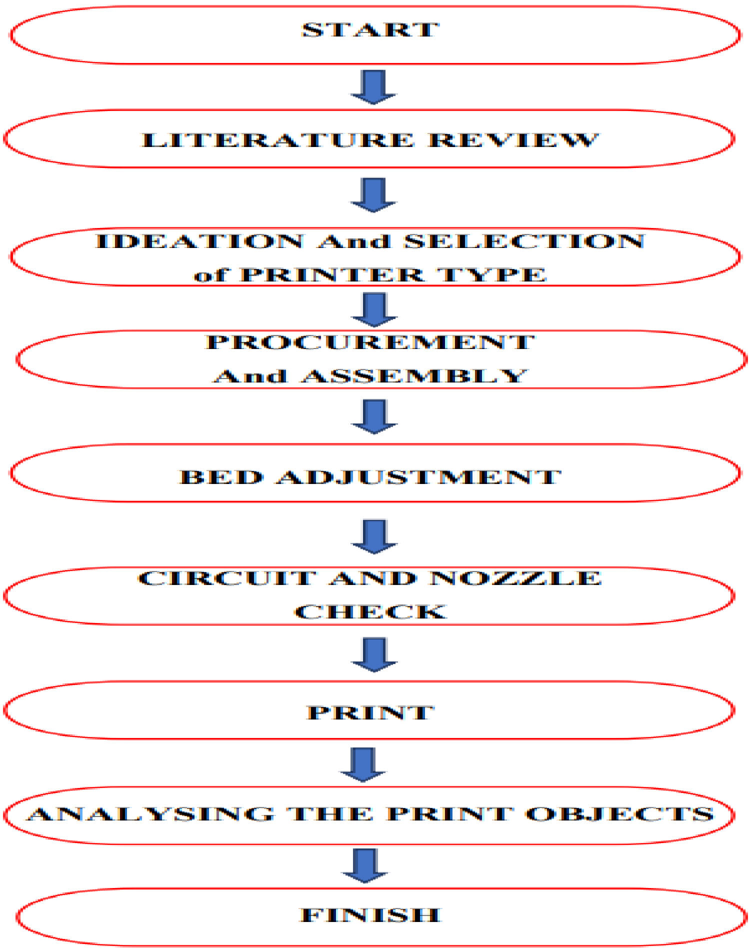
Affordable desktop printers led to widespread adoption among hobbyists and small businesses. The 2010s saw expanded material choices and precision, with industrial printers capable of intricate designs. Medical applications flourished, including prosthetics and implants. Today, ongoing research into materials and processes continues to drive 3D printing's evolution, promising revolutionary changes across industries, particularly in medicine. Additive manufacturing, or 3D printing, constructs objects layer by layer from digital models, utilizing technologies like FDM, SLA, and SLS, with materials ranging from plastics to metals, offering diverse applications in prototyping and custom manufacturing.

2. Methodology



2.1. Major Parts of 3D Printer

2.1.1. Extruder

Extruders are a crucial component in 3D printers. In simple terms, the extruder is the tool that holds the filament in place and controls the amount that is fed into a Hot end. One key point is to highlight that hot end are not the same as an extruder, but rather they are attached to it, and they are the main location that is tasked with the melting process. Extruders come with a stepper motor that allows for the filament to be fed through. Additionally, some form of gearing and hobbed shaft to hold the filament in place, a fan in some cases, a heat sink for better temperature regulation and finally the hot end.

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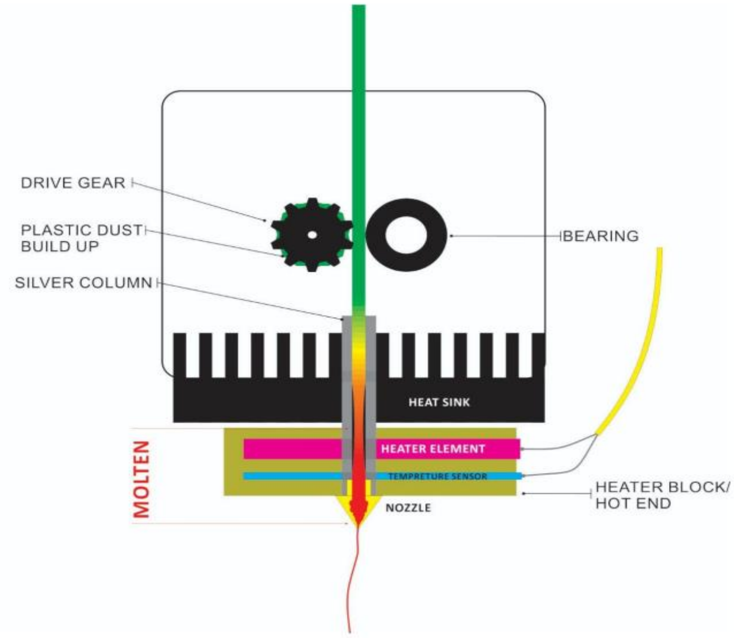

Fig-2.1.1: Extruder

Extruders in 3D printing come in dual or single setups, with dual extruders enabling printing with support materials for complex designs. These systems can be independent, allowing printing with multiple materials in a single object. There are two types: Direct Extruders, where the motor and hot end are directly attached, and Bowden, which employs a separation tube. Extruders offer precise material control, crucial for layer-by-layer construction and support structure creation. They enable multi-material printing and feature adaptive temperature control for optimal print quality. Additionally, they facilitate filament retraction, easy maintenance, and compatibility with various printer models. Overall, extruders are vital components influencing the quality, complexity, and versatility of 3D prints.

2.1.2. Print Bed

The print bed in 3D printing serves as the foundation for objects during the printing process, crucial for ensuring accurate and well-formed prints. Calibration is essential, particularly for the first layer, which sets the stage for the entire print. Adequate adhesion between the object and the bed, facilitated by materials like aluminium or glass, is vital to prevent issues like warping.

Fig-2.1.2: Print Bed

Heated print beds help maintain uniform temperature distribution, reducing warping and improving overall print quality. Additionally, they offer advantages such as versatility, compatibility with various materials, and ease of removal. These features contribute to efficient and successful 3D printing outcomes, enhancing adhesion, reducing warping, and broadening the range of printable materials and applications.

2.1.3. Hot Ends

A hot end in 3D printing functions as the component responsible for melting filament and extruding it through a nozzle. Typically consisting of a feed tube, heatsink, thermal barrier tube with a heat-break, heat-block, and nozzle, the hot end ensures precise temperature control to prevent issues like filament clogging or under-extrusion. The thermal barrier tube, particularly the heat-break section, creates a controlled temperature transition to prevent premature filament melting before reaching the heat block, a process known as heat creep. This meticulous design ensures optimal filament melting conditions for consistent extrusion and high-quality prints.

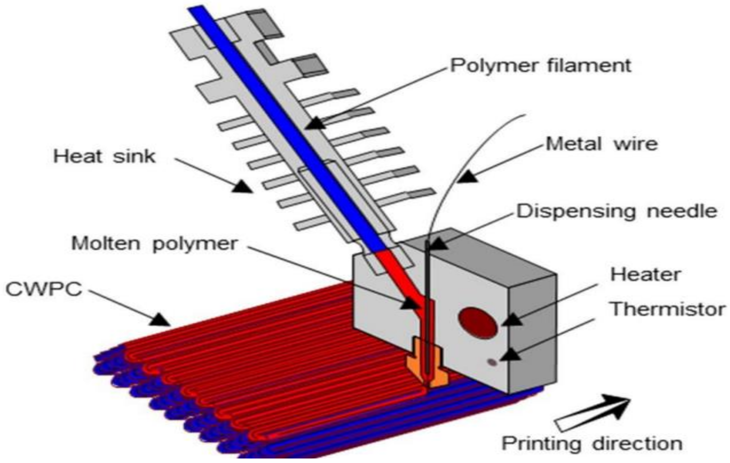

Fig-2.1.3: Hot ends

Advantages of a reliable hot end include its compatibility with various filament materials, precise temperature control, and versatility in handling different temperature requirements. Interchangeable nozzles allow for customization of layer resolutions and print speeds, while consistent extrusion ensures uniform print quality. Advanced hot end designs support high-speed printing and intricate details, making them suitable for diverse applications. Additionally, easy maintenance features and compatibility with multiple printer models offer users flexibility and convenience in achieving successful 3D prints across a wide range of materials and applications.

3. Modelling

3.1. Sim Slot.

SolidWorks proves instrumental in the meticulous modelling of the SIM slot. Leveraging features like sketches and extrusions, the 3D representation captures precise dimensions and mechanisms for SIM card insertion and removal. Virtual simulations within SolidWorks assess the integration within the drone's structure, allowing for iterative adjustments before manufacturing. Material properties are simulated to ensure selected materials meet criteria for durability and compatibility. This modelling phase in SolidWorks is essential for refining the SIM slot design, laying the groundwork for subsequent manufacturing processes.

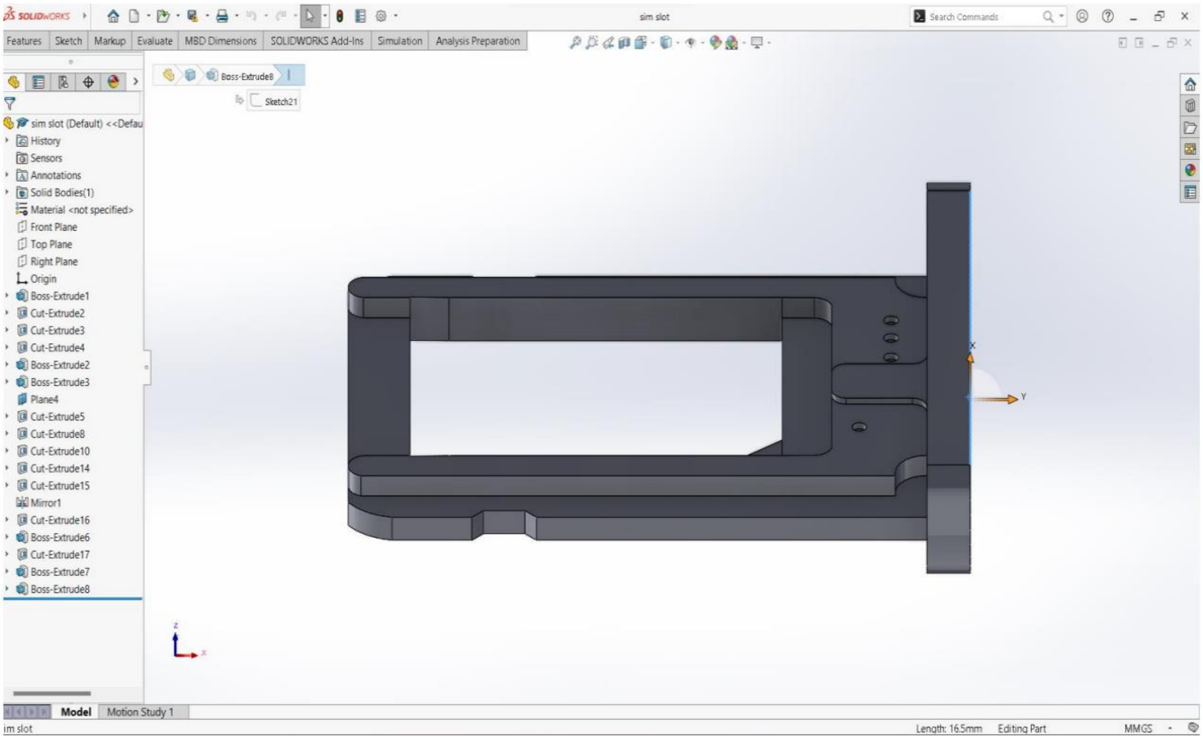

Fig-3.1: Design of Sim slot

3.2. Drone Propeller

In SolidWorks modelling, the propeller undergoes a comprehensive design process, considering aerodynamics, blade geometry, and hub structure. Techniques like lofts and sweeps achieve precise digital models. Dynamic simulations assess performance across various conditions, aiding optimization. Integration into the drone system validates aerodynamic efficiency. Features like revolves ensure manufacturability aligns with production constraints. SolidWorks facilitates iterative design refinement before real-world implementation.

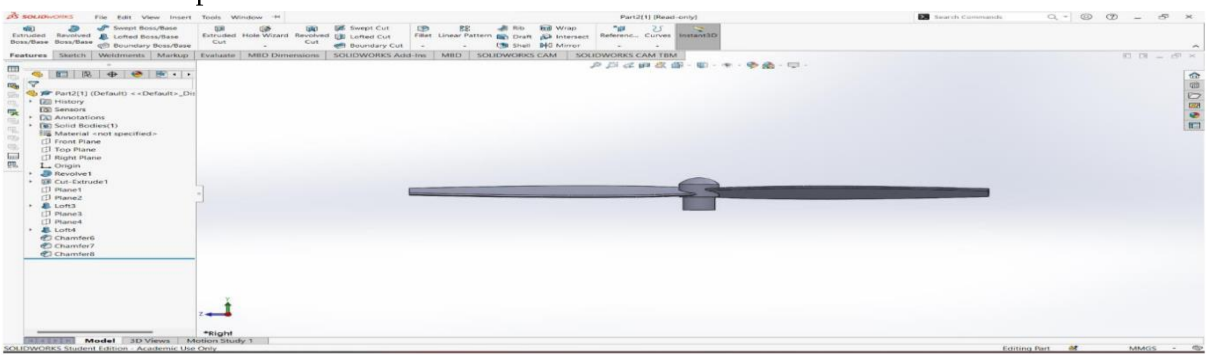

Fig-3.2: Design of Drone propeller

4. Result and Discussion

4.1.Result

In this study, we systematically utilized PLA material in our 3D printing setup to analyse the effects of FDM technology. Rheological testing of PLA showed decreased shear viscosity with increasing shear rates. To ensure stable printing within FDM's shear rate range, we carefully adjusted printing temperatures between 170°C and 210°C. Operating the machines at 50% speed was a key method to optimize printing and understand material properties. Notably, PLA demonstrated high rigidity and hardness for improved wear resistance, alongside a low glass transition temperature, essential for successful 3D printing.

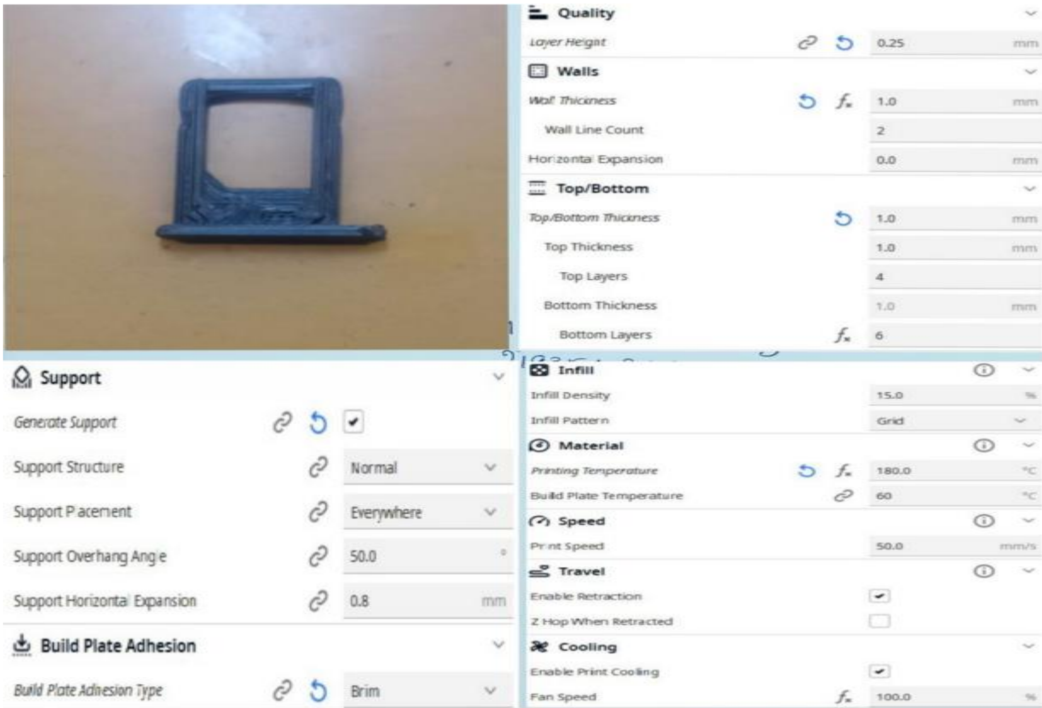

Fig-4.1.1: Slicing configuration of Sim Slot

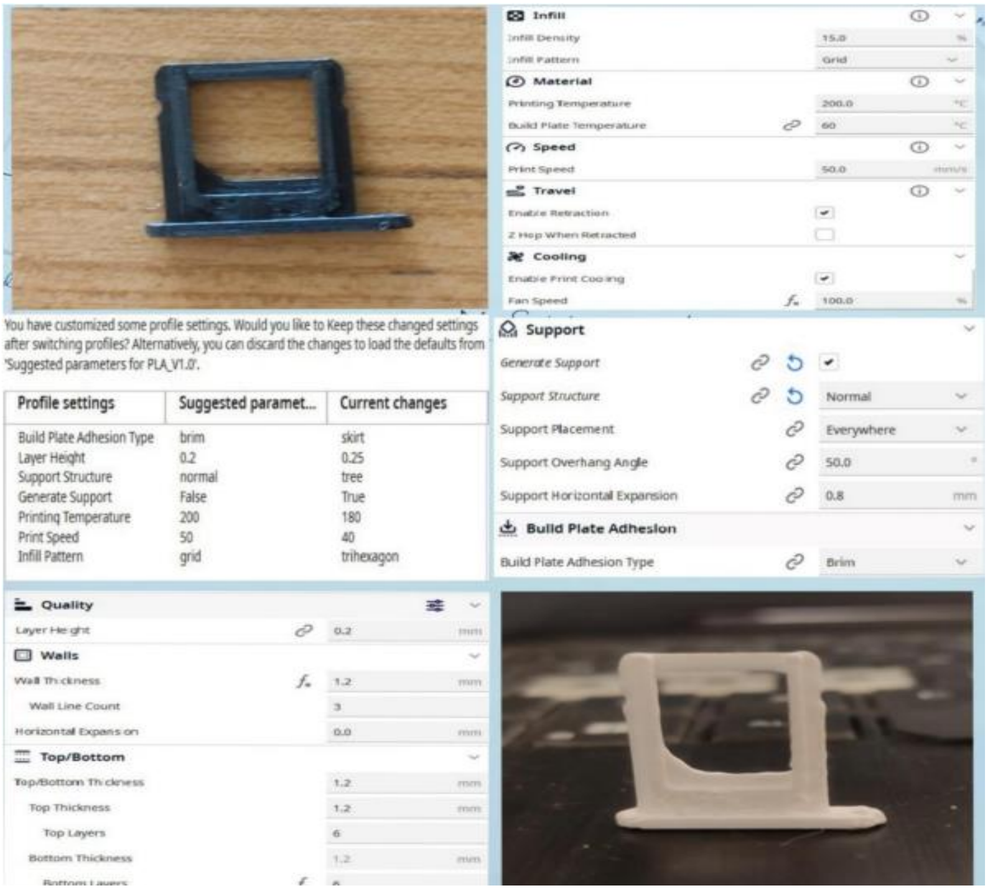

Fig- 4.1.2: Sim Slot With changed Slicing Configuration

In this figure (4.2) the speed of the machine is decreased to 50% to get a good surface finish. The surface finish is neat compared to fig (4.1).

Fig- 4.1.3: Side and Top Views of Propeller

In producing the propeller, the speed of the machine is maintained 50% as well, which gave a good finish.

4.2. DISCUSSION

Fused Deposition Modelling (FDM) is a versatile and accessible 3D printing technology ideal for prototyping and low-volume production. Despite limitations in surface finish and speed, ongoing technological advancements are addressing these challenges, cementing FDM's role in additive manufacturing. When choosing a 3D printing method, it's crucial to assess the project's needs and desired product traits.

5. Conclusion

In conclusion, the design and manufacturing of the drone propeller and SIM slot were successfully executed using the Kobra Neo FDM printer. Despite being unrelated objects, both demonstrated simplicity in production and achieved commendable finishing, especially considering the cost-effectiveness of the low-priced printing machine. This outcome underscores the efficiency of the design process and the capabilities of the Kobra Neo FDM printer, providing a cost-effective solution for producing high-quality components. The printer's ability to work with a melting point of up to 260 degrees further enhances its versatility, making it suitable for a range of applications where precision and durability are essential. The synergy between design precision and the printer's capabilities, coupled with its high melting point capacity, contributes to a favourable outcome, highlighting the potential for streamlined and cost-efficient production in diverse applications.

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