

ECO 3D PRINTS

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ABSTRACT

This paper explores an innovative approach to sustainable 3D printing using filament derived from waste plastics. Traditional 3D printing materials often contribute to protecting the environment, but this solution solves this problem by repurposing discarded plastic into a versatile and eco-friendly fiber. This process involves collecting and processing various types of plastic waste, such as bottles and packaging materials, and turning them into consistent and durable printing material. This method not only reduces the impact of plastic pollution on the environment, but also promotes a circular economy. The compatibility of the filament with standard 3D printers makes it possible to create various objects while solving the global challenge of plastic waste. This research contributes to the development of environmentally friendly manufacturing processes and supports a more sustainable future for additive manufacturing technologies.

Keywords - Eco-friendly - Recycled plastic - 3D printer - Sustainability - Circular economy.

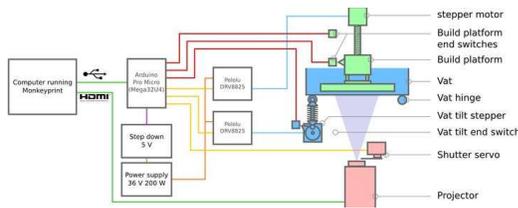
I. INTRODUCTION

The evolution of 3D printing, also known as additive manufacturing, has changed the landscape of manufacturing by making it possible to create three-dimensional objects from digital models. This

revolutionary process involves adding layers of structural material to build an object, as opposed to subtractive methods that involve removing material. While plastics have traditionally been the primary material for 3D printing, recent innovations have expanded into alternative materials such as various metals and organics such as carbon derivatives. The beginning of 3D printing dates back to 1984, when Charles Hull, a pioneer in stereolithography, designed the first 3D printer at 3D Systems Corp. His contributions include the development of the STL file format, which is still widely used in 3D printing today. Technology was rapidly advancing to allow objects to be created layer by layer, and Hull's commercial rapid prototyping revolutionized the manufacturing environment. In the area of sustainability, an emerging aspect of 3D printing involves the use of recycled plastic fibers as the primary construction material. This environmentally friendly approach solves the global problem of plastic waste by converting discarded materials into high-quality print media. As technology advances, these eco-friendly 3D printers contribute to circular economy principles, reducing reliance on virgin plastics and enabling users to actively participate in recycling initiatives.

II. EXISTING METHODOLOGY

Fused Deposition Modelling (FDM) continues to be at the forefront of 3D printing technology, impacting various industries with its robust capabilities. Originating from Stratasys in the late 1980s, FDM has gained wide acceptance due to its straightforwardness and adaptability. This method involves feeding thermoplastic filament through a heated nozzle where the material is melted. The molten material is then carefully applied layer by layer, a process that culminates in the creation of complex three-dimensional objects. The beginning of each project relies on a CAD (computer-aided design) model, carefully cut into thin cross-sectional layers. The 3D printer interprets these cuts and organizes the precise movements of the nozzle so that each layer is created sequentially. As these layers cool and solidify, they fuse together seamlessly to create a cohesive and durable final product.



Block Diagram of Existing System

The appeal of FDM lies not only in its methodical layering process, but also in its adaptability to different materials such as ABS, PLA and PETG, offering versatility across a spectrum of applications. Known for its cost-effectiveness and user-friendly interface, FDM has transcended the boundaries of professional applications, making it equally accessible to hobbyists. The impact of FDM extends across various sectors, with applications ranging from prototyping and product development to direct production of final parts. Its widespread adoption underscores its effectiveness in translating digital designs into tangible, functional objects,

making Fused Deposition Modelling a cornerstone of additive manufacturing.

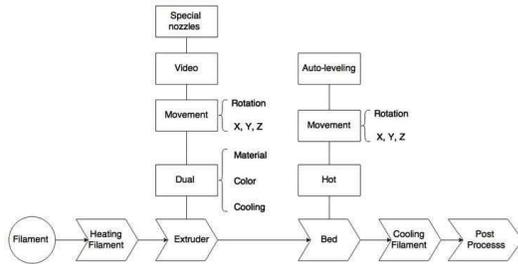
III. PROPOSED METHODOLOGY

The proposed methodology for a 3D printer using filaments made from waste plastics, specifically from recycled bottles and similar materials, involves a multi-step process to ensure efficiency and quality in the production of eco-friendly filaments. The initial phase involves the collection and sorting of various sources of plastic waste, with an emphasis on materials with suitable properties for 3D printing, such as PET bottles. The collected plastics then go through a thorough cleaning and crushing process to remove impurities and achieve a consistent particle size.



The crushed plastic is then subjected to a melting and extrusion stage, where it is heated to a melting temperature and then extruded into a fibre shape. Additives or stiffeners may be added during this stage to improve the properties of the material. Quality control measures such as diameter monitoring and tensile strength testing ensure that the filament produced meets the required standards for 3D printing. The resulting recycled filament

can then be wound and packaged for use in compatible 3D printers.



Block Diagram of Proposed System

The printer's motion system includes X, Y, and Z axes, allowing complex and precise construction of objects. The rotation options further expand the design possibilities and allow the creation of complex geometries. Dual material support provides versatility, accommodating recycled plastic fibre for sustainable printing. The colour mixing function enhances the aesthetic appeal and allows for vivid and customized prints.



This methodology not only solves the environmental challenge of plastic waste, but also supports a closed-loop system by converting discarded plastics into valuable printing resources. Collaborations with waste management systems, recycling facilities and technological advances in extrusion processes are key components of this proposed methodology, which promotes a sustainable approach to filament production for wider adoption of environmentally responsible 3D printing practices.

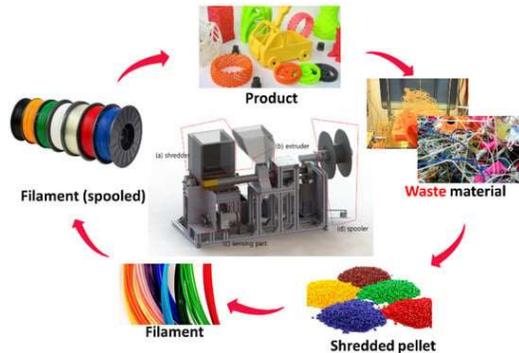
Recycled Filament:

Creating 3D printer filament from waste plastic, involves a painstaking process aimed at turning discarded materials into a high-quality printing

resource. The methodology typically begins with the collection and sorting of plastic waste, with an emphasis on PET-based materials due to their desirable properties for 3D printing. After collection, the plastic undergoes thorough cleaning to remove contaminants and impurities. After cleaning, the plastic is crushed into smaller pieces to facilitate subsequent processing steps.

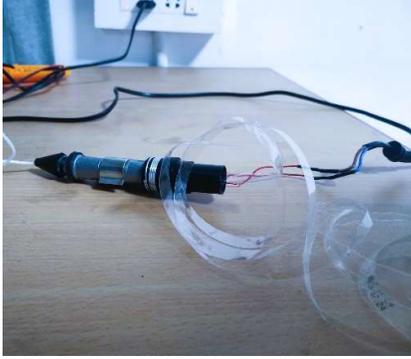
The crushed plastic is then fed into a hot extruder designed to melt the plastic at its specific melting point. The molten plastic is extruded through a nozzle to form a continuous filament. During this stage, additives or reinforcing agents may be added to improve the mechanical properties of the fiber or to address specific application requirements. The extrusion process is carefully controlled to ensure consistent diameter and quality throughout the fibre length.

After extrusion, the recycled fibre goes through a series of quality checks to meet industry standards.



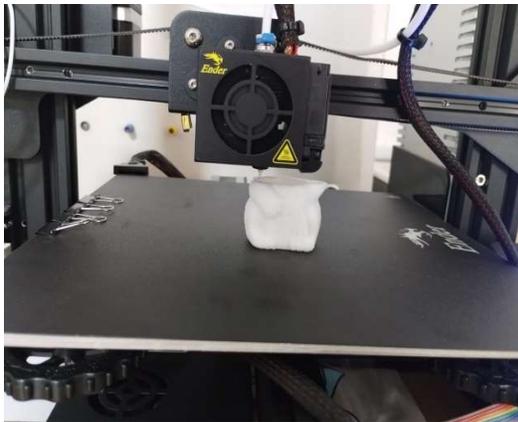
Monitoring the diameter is a critical step as it ensures filament uniformity and prevents problems such as nozzle clogging during 3D printing. Tensile strength testing evaluates the mechanical properties of the fibre and ensures that it has the required durability for printing applications. Other checks may include colour consistency, flexibility, and resistance to deformation.

The quality control process is essential to ensure that filament made from waste plastic meets the necessary specifications for reliable 3D printing. By following strict quality control measures, manufacturers can provide users with sustainable and reliable print material, contributing to the wider adoption of green additive manufacturing practices.



V. RESULT AND DISCUSSION

The use of waste plastics, specifically PET bottles, in the production of 3D printer filament through a careful melting and recycling process results in a sustainable and high-quality printing resource. By turning discarded plastics into a versatile fibre, this ecological approach solves environmental problems while supporting the principles of a circular economy. The process involves the collection, cleaning and crushing of plastic waste, followed by a controlled melting and extrusion phase that ensures a uniform fibre diameter and brings potential improvements. Quality controls, including diameter monitoring and tensile strength testing, are key to guaranteeing the reliability of recycled filament for 3D printing applications.



This innovative method not only mitigates plastic pollution, but also provides a viable alternative to traditional filament production methods, reducing reliance on virgin plastics. The adoption of such sustainable practices is in line with the growing demand for environmentally conscious manufacturing and promotes a more responsible and efficient approach to additive manufacturing. The result is a positive step towards a circular and ecological 3D printing ecosystem where waste is transformed into valuable resources to create complex and functional objects.

VI. CONCLUSION

This product can be said that the use of 3D printers with filaments originating from waste plastics represents a transformational leap towards sustainable production. This environmentally conscious approach not only addresses the escalating environmental concerns associated with plastic waste, but also pioneers a circular economy model. By recycling discarded plastic materials into high-quality filaments, these printers make a significant contribution to mitigating pollution and reducing the demand for virgin plastics. The synthesis of cutting-edge technology with environmental responsibility exemplifies the seamless integration of waste-derived fibres, demonstrating the potential for innovative solutions to global challenges. Moreover, the adoption of such 3D printing technologies promotes a paradigm shift in the way we perceive and engage with manufacturing processes. It enables individuals and industries to actively participate in recycling initiatives while creating functional and complex objects. As the demand for sustainable practices continues to grow, 3D printers using waste plastic fibers are emerging as

a beacon of responsible manufacturing, offering a tangible and scalable solution for a greener future. Embracing these advances not only revolutionizes the field of additive manufacturing, but also promotes a holistic approach to environmental stewardship and resource conservation.

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