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Uses of 3D Bio-printing in the environmental sustainability

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Abstract:

The integration of the 3D printing in the environmental sustainability which offers the significant potential to address the environmental changes.3D printing enables the mankind to produce the products with the minimal production of waste products. 3D printing support the sustainability innovation through the developmental of new eco-friendly materials such as biodegradable polymers, organic waste and composite derived from the renewable resources, unicellular organisms such as algae, fungi, papers, food byproducts etc. This study had helped to explore the diversified applications and beneficiary of 3D printing in advancing the environmental sustainability, provide insight view with regard to the waste reduction, and creating the sustainable products from the eco-friendly raw materials.

Key words: *Environmental sustainability, recycling, biodegradable, eco-friendly.*

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1. Introduction

3D printing is also termed as additive manufacturing which means it is a process of developing three dimensional objects by constructing them layer by layer from a digital design. 3d digital model is often created using CAD (Computer Aided Design). As the world is arising with the new challenges such as resources depletion, waste generation, and climatic change, and different type of hazardous pollution here where 3D printing come to the rescue and address the issue and aid in overcoming the issues. 3D printing enables the use of recycled materials such as biodegradable plastics, waste products and organic materials like algae or fungi that can be reformed into the new products. This technique further more supports the concepts of a circular economy by enabling the recycling of materials back into the production process, reducing the need for new materials and lowering the environmental footprint. In order to sustain our environmental resources recycle principle play a vital role in it and 3D printing also follow the same principle in many scenario hence it is taking a wider scope in the environmental sustainability.

Reviews of related literature

Gebler, M., Uiterkamp, A.J.S. & Visser C. (2014). Conducted a study on **"A global sustainability perspective on 3D printing technologies"**. This study aimed to present a comphrensive and global sustainability assessment of 3D printing and it is mainly focused on core specific aspects of sustainability using descriptive method or describing technology-specific gains in costs, energy and CO2 emission.

Mohd Sheraib ,Abid Haleem and Sanjay Kumar (2021). Published a research paper on **"Impact of 3D printing on the environment. A literature based study".** This paper compare the environmental impacts of conventional subtractive manufacturing with 3D printing technologies in producing parts through life cycle analysis. This comparison is helps to develop a model to determine the overall environmental impact that includes energy consumption, wastage, and utilizing auxiliary resources.

Malte Gebler, Anton JM Schoot, Cindy Visser (2014) conducted a study on **"A global sustainability perspective on 3D printing technology".** This study aimed to present a comprehensive and global sustainability assessment of 3D Printing and it is mainly formed on care specific aspects of sustainability descriptive method or describing technology-specific gains in costs, energy and Co2 emissions.

Objectives of this study

1. To enhance environmental sustainability through waste management.
2. To promote the environmental sustainability through waste management.
3. To encourage eco-friendly environment in the country.
4. To create the eco-friendly environment in the country.

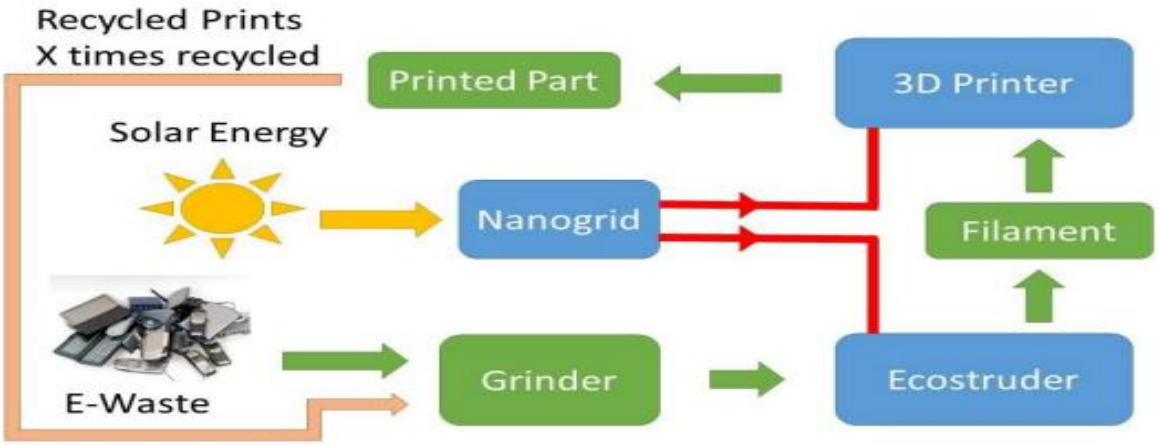
Research Method

This study is based on Literature review, survey cum descriptive method by studying previous works about 3D printing and its environmental impacts.

3D printing

Three-dimensional (3D) printing is a method of producing three-dimensional objects by joining materials layer-by-layer under the direction of a computer. The development of computer-aided 3D modeling technology supported the emergence of 3D printing in the 1980s. This technology allows for more customizable products, complex structures, and lightweight design. It also offers the advantages of speed, flexibility, sustainability, risk reduction and accessibility.

Eco-friendly 3D printing using an ecostruder, recycled E-waste and solar power.



https://www.morgen-filament.de/eco-friendly-3d-printing-using-an-ecostruder-recycled-e-waste-and-solar-power/

These plastics included the outer casing from devices such as old computers, laptop docking stations and desktop telephones. They cleaned the plastic if needed and then broke it down into fragments and fed it into a hand operated granulation device, which was composed of a series of geared, interlocking teeth that could be rotated using a lever arm. The plastic underwent several phases of repeated grinding, after which it was put through a mesh sieve.The researchers then created their own melt extrusion device, which they named the Ecostruder. The system uses a single screw system and is powered by an internally geared DC motor.

Sustainability of 3D printing:

1. **Minimal Waste :**It produces only the necessary product and it produces very minimal secondary products
2. **Less Energy :** This technique uses minimal energy for the production of the product and it uses the layer-by layer approach for the production of the product

Others of making 3D printing more sustainable

1. Use bio-based powders instead of petroleum based materials
2. Use recyclable metals materials like copper and stainless steel

Applications of 3D printing in environmental sustainability are as follows:

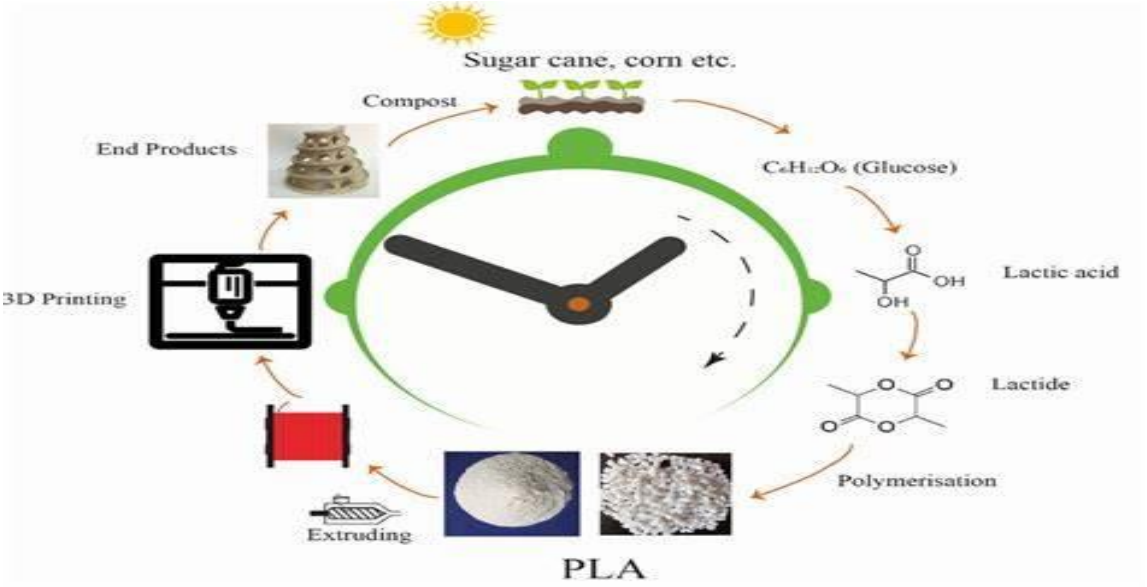
1. **Reduction of waste and material:** When comparing to traditional method of manufacturing 3D printing manufacturing offers a great benefit in terms of waste production.
2. **Regional production of goods:** A traditional method of manufacturing leads to the global dependency and impact on the regional economy and environment might be in terms of transport expenses and packaging process. Where packaging process demands the use of plastic which is harmful for the environment whereas 3D printing able to produce the goods directly within the

community without relying on the external sources and reduce the CO2 emissions through transportation process.

3. **Recycling of the plastic materials:** The 3D technology is useful in recycling and up cycling the used materials by combining waste product with the 3Dprinted work pieces or 3Dscratch pieces to create new aesthetic materials.

https://pureadvantage.org/recycling-3d-printing/

4. **Eco-friendly materials:** For the 3D printing process toxic materials are not used and not recommended too, instead they use the recycled materials and bio-degradable materials. Example: corn starch, sugarcane, wheat waste etc. PLA(Polylatic acid) is made from raw materials of corn.



https://ar.inspiredpencil.com/pictures-2023/polylactic-acid-3d-printing

2. Conclusion:

3D bio-printing showcases a transformative opportunity for advancing environmental sustainability. By enabling the use of recycled and the biodegradable materials, reducing the production of waste. It provides the eco-friendly alternatives to the chemically based environment. 3D bio-printing has the ability to significantly reduce the environmental impact of various industries. Meanwhile there is a various hurdles in enforcing this technology in a effective manner and the hurdles are high cost and lack

of knowledge regarding the 3D bioprinting, but still these technology can offers a promising contribution towards a sustainable environment and efficient resource utilization. Making it is a key contributor to global environmental conservation and sustainability efforts.

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