USING FDM 3D PRINTING TECHNOLOGY TO CREATE A LAMP WITH CUSTOM DESIGN

Utilización de la tecnología de impresión 3D FDM para crear una lámpara con diseño personalizado

Chebotarova Iryna[1], Astakhova Anna[1]
[1] Department of Media Systems and Technologies, Kharkiv National University of Radio Electronics
Iryna.chebotarova@nure.ua; anna.astakhova@nure.ua

Abstract

In this work, the process of creating a custom-designed lamp using Fused Deposition Modeling (FDM) 3D printing technology is presented. The project includes the preparation of a vector illustration, conversion to 3D model, slicing, multicolor printing, and final assembly with LED integration. Free and accessible tools such as Tinkercad and online lithophane generators are used, and various filaments and printer settings are tested to achieve optimal quality. The study demonstrates the effectiveness of FDM for producing functional and aesthetic home decor items in a cost-efficient and creative way.

Keywords: 3D printing, fused deposition modeling, custom lamp design, PLA filament.

Introduction

Today, several 3D printing technologies are available, each possessing unique characteristics and fields of application (Gibson et al., 2021). Among the most widely used are Stereolithography (SLA), Selective Laser Sintering (SLS), and Fused Deposition Modeling (FDM) (see Fig. 1).

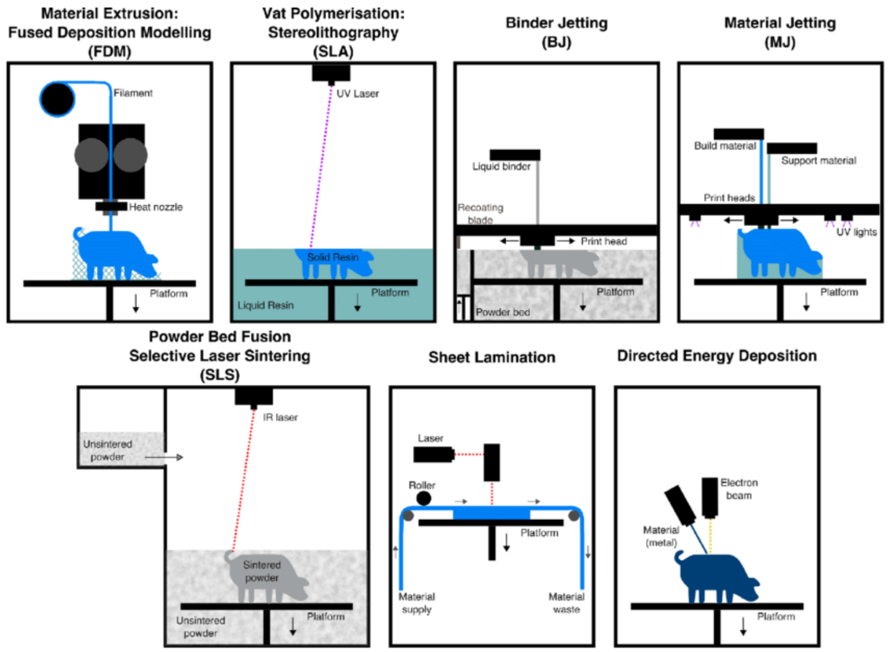

Figure 1. Schematic examples of the principles of 3D printing technologies.
Source: "An Overview of 3D Printing in Forensic Science: The Tangible Third-Dimension", Journal of Forensic Sciences, 2020, https://www.researchgate.net/publication/341364845_An_Overview_of_3D_Printing_in_Forensic_Science_The_Tangible_Third-Dimension.

Stereolithography is a resin-based process that uses a UV laser to selectively cure liquid photopolymer resin in a vat, solidifying it layer by layer to form high-resolution, finely detailed objects. This technology is known for its smooth surface finish and precision, making it ideal for dental models, jewelry, and prototypes requiring tight tolerances, though it involves additional post-processing steps such as cleaning and UV curing. Selective Laser Sintering employs a high-powered laser to sinter fine thermoplastic powder, typically nylon, into solid structures without the need for support materials, as the unsintered powder surrounding the object serves as a natural scaffold. SLS enables the production of strong, functional parts with complex geometries, often used in industrial and engineering applications, but requires specialized equipment, environmental controls, and extensive post-processing.

FDM was chosen specifically due to its cost-effectiveness and ease of use. Fused Deposition Modeling operates by feeding a thermoplastic filament —such as PLA, ABS, or PETG— into a heated extruder, where it is melted and deposited in successive layers onto a build platform (Kam et al., 2023). As the material cools and hardens, it gradually forms the final three-dimensional object. While FDM offers lower resolution and mechanical strength compared to SLA and SLS, it remains the most accessible method for rapid prototyping and functional prints, especially for hobbyists and small-scale manufacturing. The article discusses various technologies for developing audiobooks for blind people and considers the features of text recognition technology in creating audiobooks.

The process of creating a lamp using FDM

Everything begins with an idea —what exactly you want to create. In this case, it is a lamp with a custom design. The first step involves preparing an image. It could be anything, even a photo, but an illustration was preferred for this instance. So, it is demonstrated here how to prepare one for 3D printing.

To achieve the highest possible quality, it is important to use a vector illustration. One has already been created in Adobe Illustrator and has been divided into multiple layers: background, text, and decorative elements. Each layer is saved as a separate SVG file, and the entire illustration is additionally exported as a regular JPG file.

Next, it is necessary to transform our vector illustration into a 3D model. For this task, Tinkercad software is used because it is user-friendly, free, and does not require a powerful computer (Tinkercad, 2025). But while Tinkercad has limited functionality compared to more advanced software, it is ideal for our specific purpose. Of course, for more complex and detailed projects, Fusion 360 would certainly be preferable.

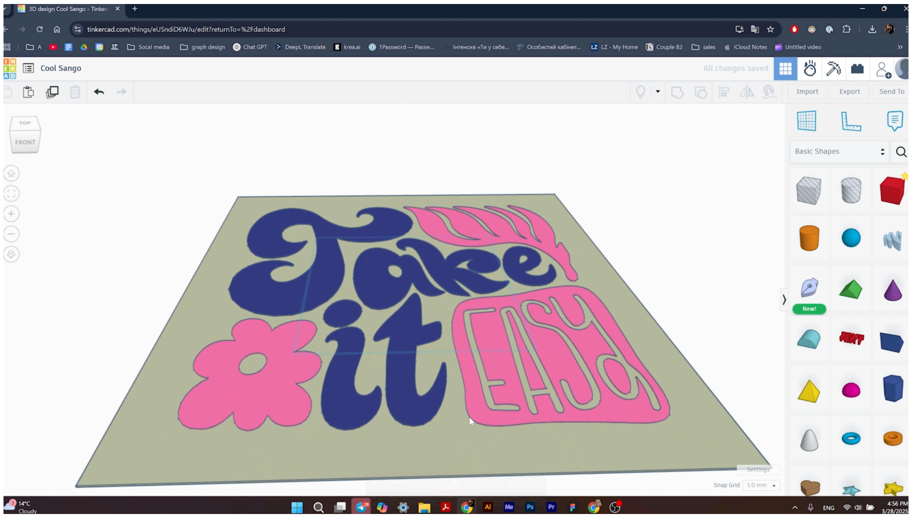

Figure 2. The final result of the project.
Source: Own elaboration.

So, in Tinkercad, I create a new project and import each SVG element. The image aligns perfectly after importing it. Then, I set the background thickness to 1 mm to allow sufficient light transmission. I elevate all the other elements to the background height and set their thickness to 0.5 mm. Finally, I export the completed model in OBJ format (see Fig. 2).

For the base of the lamp, I also have my own lifehack. I open Maker World, navigate to the Maker Lab section, and select Make My Lithophane. Originally, this service was designed to generate lamps specifically from photographs, but I have opted to use an illustration instead and manually adjusted it for improved quality in the final product. After creating a new project, we are offered several options —I select multicolor printing with an LED strip and upload our JPG illustration. I slightly enlarge the dimensions and then download the completed project, choosing settings compatible with my specific printer model and nozzle size (see Fig. 3).

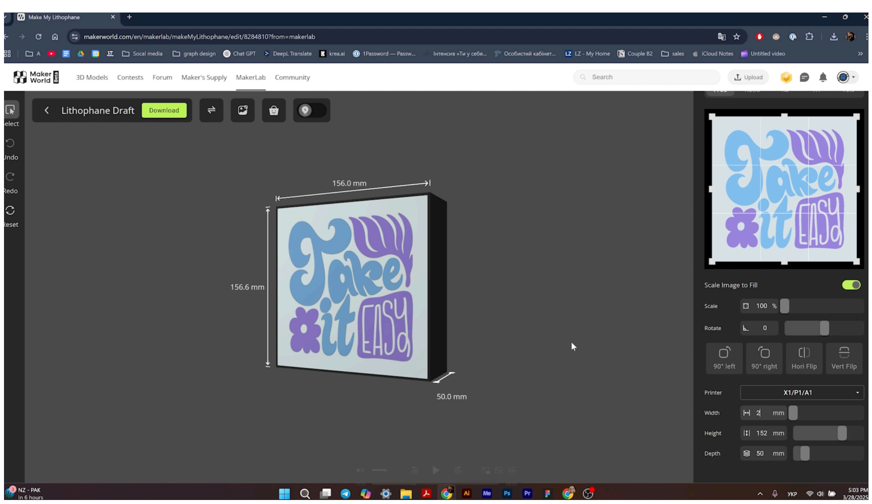

Figure 3. The final result of the project.
Source: Own elaboration.

At this stage, I will physically prepare the printer before continuing with model preparation. First, it is necessary to decide on the filament type to be used. Generally, there are many different types of plastic filaments available:

- PLA or PLA+ is the most affordable, easiest, and safest plastic for printing, but it is less durable and not resistant to high temperatures or water, offering only moderate strength.
- PETG is stronger and water-resistant but requires more careful handling during printing.
- ABS is very strong but toxic, making it unsuitable for printing in spaces without proper ventilation.

These are the main filament types, although many others exist, such as soft, rubber-like, ultra-light, or dedicated support filament. For this lamp, standard PLA is perfect. I use PLA filaments from eSUN and Bambu Lab, as they offer an optimal balance of price and quality (Bambu Lab, 2025). Next, I determine specific colors: black for the lamp base, white for the background, and blue and purple for the illustration itself. Since the illustration is multicolored, I use the Automatic Material System for my Bambu Lab X1C printer, loading any additional required colors into it.

Then, I choose the Plate. Several different Plates are available for various tasks (see Fig. 4), but my primary criterion is a smooth finish without texture. The Bambu Lab Cool Plate Super track is ideal for this purpose. I remove the default Plate that is currently installed, take the Cool Plate, clean it with alcohol, and carefully place it back on the printer.

Figure 4. The final result of the project.
Source: Own elaboration.

I continue preparing the model in a slicer —a specialized software that converts three-dimensional digital models (such as STL or OBJ files) into sets of two-dimensional layers, generating G-code. This code contains instructions that control the movement of the printhead, speed, temperature, layer thickness, and other parameters critical to printing. While numerous slicers exist, I use Bambu Lab's slicer since my printer is a Bambu Lab model. First, I open the lamp base file in the slicer and import the illustration model as well. Comparing them, we can clearly see that my custom-created illustration is of significantly higher quality, so I replace the automatically generated image with the one I prepared earlier. Next, I proceed directly to configuring the print settings. Initially, I select my printer —Bambu Lab X1C with a 0.4 mm nozzle. Then I select the Plate that I will be using and update the model's colors according to my previously chosen filaments. Additionally, I always increase the nozzle temperature for the first layer, ensuring a more stable and high-quality foundation. After setting these parameters, I click "Slice" and review the results. The software provides various statistical insights that help predict the print outcome. I activate the Travel view, which visualizes the path the printhead will take during printing. Here, itis apparent that the path is overloaded, which could result in unpleasant stringing, requiring additional post-processing. To optimize the printhead movement, I enable the option Avoid Crossing Walls, setting the threshold to 300. I also activate Ironing, ensuring the top layers become exceptionally smooth. All other settings remain at their default values. Now the model is ready for printing —I'll start with the lamp base (see Fig. 5).

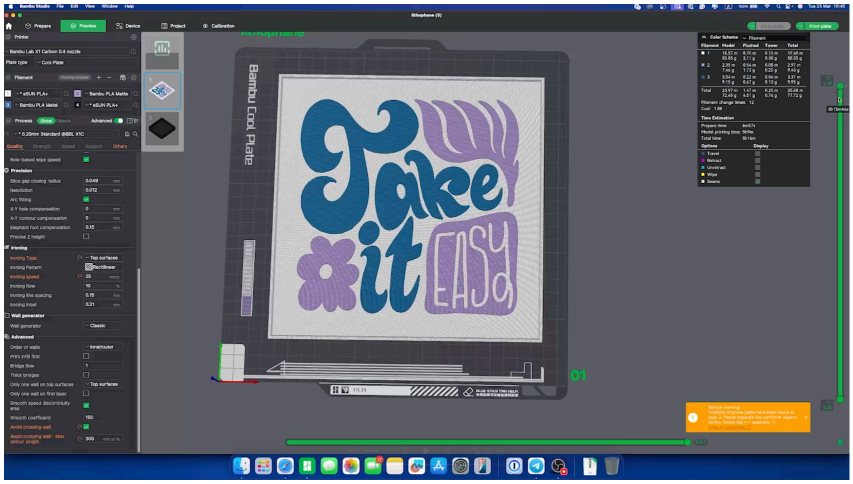

Figure 5. The final result of the project.
Source: Own elaboration.

While the lamp base is printing, I have time to buy an LED strip. Of course, I could order the specialized branded LED strip from the official Bambu Lab website, but it is quite expensive and requires waiting for delivery. In reality, its specifications are not different from the LED strips available at IKEA, so that is where I will go to pick one up. I am choosing the simplest and most affordable option, although IKEA also offers multicolored LED strips that can be controlled via smartphone.

By this time, the lamp base has finished printing and is ready to be removed. Carefully, I take out the Plate and gently bend it to detach the printed part. If necessary, I can assist this process using a specialized blade. Afterward, I reinstall the Plate onto the printer and begin printing the illustration. Approximately five hours later, once the illustration is completed, I repeat the same steps to carefully detach it from the Plate.

At this stage, post-processing would typically begin. Usually, I use a small gas torch along with sandpaper of varying grit levels to refine the printed surfaces. However, the print turned out so perfectly smooth this time that additional post-processing is unnecessary. So, I immediately proceed with assembling the lamp (see Fig. 6): attaching the LED strip to the base and carefully fitting the printed illustration into the designated grooves. The lamp is now fully assembled and ready to use.

Figure 6. The final result of the project.
Source: Own elaboration.

Conclusion

The project presented in this paper illustrates the practical and creative potential of Fused Deposition Modeling (FDM) technology for the development of customized home decor items (see Fig. 7), particularly functional and visually appealing lighting solutions. Through the example of a custom-designed lamp, the study highlights each stage of the process —from conceptual illustration and 3D modeling to material selection, slicing, and final assembly—demonstrating that accessible, low-cost tools and materials can produce professional-quality results (Chebotarova & Astakhova, 2023).

The use of vector graphics and modular layering allowed for detailed and accurate 3D model preparation, while the integration of freely available software such as Tinkercad and online lithophane generators streamlined the design-to-print workflow. Furthermore, the selection of suitable filaments, slicing optimizations such as travel path minimization and surface ironing, and the precise use of multicolor printing contribute to the high-quality output with minimal post-processing.

This case also demonstrates the growing capabilities of modern desktop FDM printers, particularly those equipped with automated material handling systems and compatible with advanced slicing software. The project's success —with a total time investment of approximately 12 hours and a cost of around €15— underscores the viability of using consumer-grade FDM technology not only for prototyping but for creating functional, finished products suitable for everyday use.

Beyond the technical aspects, this work emphasizes the empowerment of individual creators and small-scale designers, enabling them to bring personal, customizable design visions to life without relying on industrial manufacturing processes. In particular, the application of such technologies in interior design opens new pathways for sustainable, on-demand production tailored to specific aesthetic and spatial requirements.

As additive manufacturing technologies continue to evolve, future studies may explore integrating smart functionalities, sustainable materials, or collaborative design platforms to further expand the possibilities of custom home decor items (Ngo *et al.,* 2018). This project serves as a foundational example of how accessible digital fabrication can bridge the gap between artistic creativity and technical execution in practical, real-world applications.

Figure 7. The final result of the project.
Source: own elaboration

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