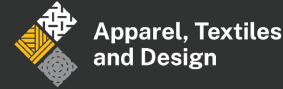


# Digital Threads: Crafting Sustainable Fashion with 3D Printing & Virtual Garments

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Apparel, Textiles & Design



## INTRODUCTION

The fashion industry annually disposes of 92 million tons of textiles in landfills and is ranked third in the world for emissions (Climate Trade, 2023). The industry has a projected increase of 50% in global emissions by 2030 (Igini, 2023). Sustainable practices must be explored and implemented to reduce waste and use resources more responsibly. Over-production has resulted in unwanted products that are disposed of before being worn. 3D printing offers a way of producing fantastical digital designs using new approaches to construction as well as the ability to print on demand. This research developed a sustainable method of producing wearable attachments using a combination of cut-and-sew techniques and 3D printing. The attachment was designed in Nomad and 3ds Max and virtually prototyped in Browzwear until fit and shape attributes were refined adequately for a physical prototype. The digital file, which can be used in virtual applications such as Instagram and can be 3D printed when there is a demand for a physical product.

## DESIGN PROBLEM

Responding to the growing demand for environmentally friendly practices in design and manufacturing, this research developed a sustainable method of producing garment attachments on-demand, leveraging new technologies. By merging the digital and physical space, a consumer has the opportunity to choose a digital version of a garment with low-to-no physical waste for use in digital space or to fabricate that same digital garment in the physical world for use in real world settings. Due to the apparel industry's environmental impacts, sustainable practices must be explored and implemented to reduce waste and use resources more responsibly.



Model wearing fully digital wearable.



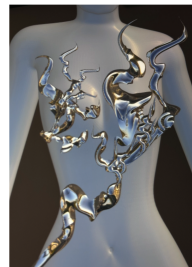
Model wearing 3D printed physical wearable.

## METHODS

This project used four phases—research, digital modeling, physical modeling, and production of the final product. During the first phase, I selected and tested 4 filaments for 3D printing, examining their sources, recyclability, strength, and flexibility while also researching sustainable fabrics and threads. In the second phase, I designed the digital garment using Browzwear for pattern making along with 3ds Max and Nomad for 3D modeling accessories. In the third phase, I created multiple small-scale test prints using a Neptune 3 Max 3D printer and I created a physical prototype, assembling sewn pieces with 3D printed components, along with Cromo Fácil to achieve a metal-like finish. Finally, I produced a physical wearable garment with 3D printed parts and a digital version of the same garment.

## DATA

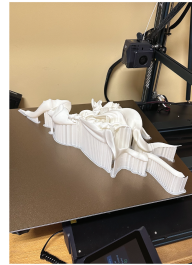
I created seven small-scale prototype 3D prints and two full-scale prototype prints. Three virtual prototypes were created for the garment before moving into physical prototypes. Two physical garment prototypes were created before the final garment was constructed. Three test prints were used to develop the application of Cromo Fácil varying surface smoothing techniques. Early results were posted to Instagram to obtain general feedback.



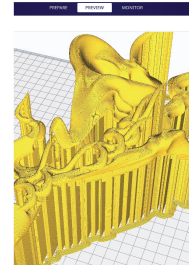
3D Modeling prototype on nomad and 3ds max.



Digital base garment prototype in Browzwear.



Attachment on the 3D printer in PLA filament. Buildplate dimensions are 420 x 420 x 500 mm



3D model in the slicing software with supports visible.



Croma Fácil on the test prints.



Physical base garment prototype.

## RESULTS



Final physical garment



Final virtual garment

## DISCUSSION

The results of this research indicates this is a possible method of producing futuristic designs for both virtual and physical use. Feedback obtained through Instagram indicates interest in these types of wearable shapes and location on body.

The main **limitation** of this study was the inability to test sustainable filament and fabric combinations due to the high cost of these materials. It is possible that sustainable filament and fabrics will behave differently than the materials I used in this study.

This research is a pilot project, and I intend to build upon it by exploring the printing of larger pieces in sections and conducting a more thorough investigation of sustainable filaments and fabrics. For **future research**, I plan to experiment with additional attachment designs and attachment mechanisms.

## ACKNOWLEDGEMENTS

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