

Thesis Project Portfolio

Real-Time Color Palette Generation: Enhancing Design Efficiency

(Technical Report)

Facilitating Sustainability in the Fashion Industry with Machine Learning

(STS Research Paper)

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Executive Summary

The intersection of technology and design is reshaping the fashion industry, presenting a unique opportunity to not only enhance creativity and streamline production, but also address critical sustainability issues. For my capstone project, “Real-Time Color Palette Generation: Enhancing Design Efficiency,” I discuss the machine learning tool I built to streamline the digital design workflow by automating the extraction of dominant colors from reference images. By reducing the time to manually select and apply colors, designers can focus more on creativity rather than menial tasks. Alongside this, my STS research paper, “Facilitating Sustainability in the Fashion Industry with Machine Learning,” explores whether machine learning is effectively mitigating or enforcing unsustainable practices within the fashion industry. The research aims to understand if and how these tools contribute to sustainability goals by analyzing and reflecting on their current uses in the industry. These projects intersect by highlighting the significant influence of machine learning on the fashion industry as a whole, emphasizing both the potential benefits as well as the critical need for a responsible, sustainable implementation. Together, they stress the importance of developing technology with the goal of improving sustainability and creativity, rather than merely maximizing productivity or profits.

My capstone project addresses inefficiencies within the digital design process, specifically the manual and often subjective selection of color palettes. It is common for designers to use reference images as inspiration for a theme or palette, but selecting the most prevalent, impactful colors and subsequently matching them to the company’s existing palette can be a challenging, tedious task. Thus, utilizing the k -means clustering algorithm, I integrated a Python-based plugin with a widely used digital design software, enabling designers to instantly extract and apply the most dominant colors from reference images to design components. This

method significantly reduced the manual effort involved, improving both consistency and efficiency in the design workflow.

Through numerous positive qualitative feedback reports, this project demonstrated overall enhanced workflow efficiency by removing the manual labor from color selection. Designers had greater freedom to experiment creatively due to the automated generation of palettes and the flexibility to apply colors randomly or via existing color blocking patterns. Future improvements may include refining the speed of the extraction algorithm and incorporating adaptive color adjustments for further customization. The integration of this tool into existing software not only streamlined the design process but emphasized the importance of balancing technical efficiency with creative flexibility.

On the other hand, my STS research paper investigates the role of machine learning in addressing sustainability challenges that have been exacerbated by the fashion industry's reliance on "fast fashion" models, which promote waste and environmental degradation. Employing the analytical framework of technological momentum, I examine how machine learning tools are supporting and/or harming societal sustainability goals using case studies and industry analyses.

My research reveals that machine learning technologies can significantly enhance sustainability by optimizing supply chain processes, forecasting demand, and facilitating eco-friendly material selection. However, it also risks reinforcing unsustainable consumption through hyper-personalized marketing. I conclude that machine learning's impact on sustainability largely depends on whether its development prioritizes sustainable innovation or profit-driven consumption. Truly effective implementation will thus require collaboration from companies, careful governance, and informed consumers to serve its sustainable purpose.