

PERSONAL DESIGN, THE NEW FASHION TREND WITH APPLICATIONS OF INNOVATIVE TECHNOLOGIES

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ABSTRACT. The development of 3D technology has brought opportunities and challenges to the shoe industry, as people's living standards have improved due to economic development, and people have increasing requirements for shoe design. They have become more critical, active and informed. They pursue customized products/services and like to be involved in the design process. Additive manufacturing technologies enable this customization of products and new business models should embrace these trends to differentiate themselves and gain competitive advantage. The application of 3D technology is widespread in various fields, including footwear production. From a physical model, it is possible to create a digital model using 3D scanning technology for redesign purposes. The use of 3D printing technology can enable faster modeling of footwear products, enrich the shape of footwear and meet the aesthetic needs of footwear designers. Therefore, the article studies and analyzes the top technologies in fashion, 3D shoe printing technology.

KEY WORDS: fashion, innovative technologies, 3D printing

PERSONAL DESIGN, NOUL TREND ÎN MODĂ CU APLICAȚII DE TEHNOLOGII INOVATIVE

REZUMAT. Dezvoltarea tehnologiei 3D a adus oportunități și provocări pentru industria încălțăminte, deoarece standardele de viață ale oamenilor s-au îmbunătățit datorită dezvoltării economice, iar oamenii au cerințe tot mai mari pentru designul încălțăminte. Au devenit mai critici, activi și informați. Ei urmăresc produse/servicii personalizate și le place să fie implicați în procesul de proiectare. Tehnologiile de fabricație aditivă permit această personalizare a produselor și noile modele de afaceri ar trebui să îmbrățișeze aceste tendințe pentru a se diferenția și a obține avantaje competitive. Aplicarea tehnologiei 3D este larg răspândită în diferite domenii, inclusiv în producția de încălțăminte. Dintr-un model fizic, este posibil să se creeze un model digital folosind tehnologia de scanare 3D în scopuri de reproiectare. Utilizarea tehnologiei de imprimare 3D poate permite modelarea mai rapidă a produselor de încălțăminte, îmbogăți forma încălțăminte și poate satisface nevoile estetice ale designerilor de încălțăminte. Prin urmare, articolul studiază și analizează tehnologiile de top în modă, tehnologia de imprimare 3D a încălțăminte.

CUVINTE CHEIE: modă, tehnologii inovative, imprimare 3D

PERSONAL DESIGN, LA NOUVELLE TENDANCE DE LA MODE AVEC DES APPLICATIONS DE TECHNOLOGIES INNOVANTES

RÉSUMÉ. Le développement de la technologie 3D a apporté des opportunités et des défis à l'industrie de la chaussure, car le niveau de vie des gens s'est amélioré en raison du développement économique et les gens ont des exigences croissantes en matière de conception de chaussures. Ils sont devenus plus critiques, actifs et informés. Ils recherchent des produits/services personnalisés et aiment être impliqués dans le processus de conception. Les technologies de fabrication additive permettent cette personnalisation des produits et les nouveaux modèles commerciaux doivent adopter ces tendances pour se différencier et acquérir un avantage concurrentiel. L'application de la technologie 3D est répandue dans divers domaines, y compris la production de chaussures. A partir d'un modèle physique, il est possible de créer un modèle numérique en utilisant la technologie de numérisation 3D à des fins de reconception. L'utilisation de la technologie d'impression 3D peut permettre une modélisation plus rapide des produits chaussants, enrichir la forme des chaussures et répondre aux besoins esthétiques des créateurs de chaussures. Par conséquent, l'article étudie et analyse les plus nouvelles technologies de la mode, la technologie d'impression 3D de chaussures.

MOTS CLÉS : mode, technologies innovantes, impression 3D

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INTRODUCTION

Fashion and technology go very well together. And this is just the beginning, because high tech will continue to transform what we wear, in many ways, in the years to come. 3D printing technology is still in its early stages, but it has already made its way into the world of fashion.

In the future we will see more and more shoes with a unique design. Product development activity and innovation are important components of the design process. Following the stages of the design process, after the new product concept has been defined, it is necessary to diversify (develop) this product idea. Diversification techniques (product development) aim to obtain a sufficient number of models within the same family (concept), models to be subjected to an analysis aimed at defining the optimal variants, both for the consumer and for the producer.

Technology has progressed enormously in the last 20 years and as a result of this progress, 3D printers are no longer used only for creating prototypes, but even for finished products.

3D printers allow designers to produce a prototype in a very short time. Consequently, the prototype can be tested and remodeled quickly. Designers can obtain, with the help of 3D printers, shoe components with extremely complex shapes. Today, the technology is present in most of the research laboratories owned by the institutions concerned with the development of fashion design.

Fashion design does not only express a new idea in the creation of a product, but also an identification of it with the person who wears it. This is how the notion of personal design appears, which we will encounter more and more often in the coming years.

Everything will become a cultural communication through the message of the product idea, a technological communication

through the technical sketch of the product, a commercial communication through the collection catalogue and an advertising one through the fashion illustration.

As one of the largest industries in the world, expected to rake in up to \$3.3 trillion by 2030 [1], it is surprising to learn that the way fashion works today has not changed that much in the last twenty years. However, growing concerns about pollution, as well as the need to satisfy today's hyper-connected consumers, have given way to new technologies. We live in the "age of technology".

People want instant access to the latest trends as soon as new shoe designs hit the catwalks, thanks to social media. Also, younger generations looking to stand out from the crowd are looking for products that can be tailored to their specific needs and preferences. In addition, "mass produced" or "fast fashion" footwear seems to be losing its appeal.

Many designers must embrace the latest technologies to push the boundaries of manufacturing, marketing and wearability as customers' real lives become more intertwined with the digital world.

TOP TECHNOLOGICAL PROGRESS IN FASHION

Artificial Intelligence

In recent years, shoe companies have used artificial intelligence to improve their customers' shopping experience, analyze data, increase sales, forecast trends and provide inventory data. Chatbots and touch screens are used in stores to improve the customer experience through personalized product suggestions. Real-time inventory tracking has become essential for businesses as it saves time and ensures efficient warehouse management and operations. In addition, if we combine inventory tracking with powerful predictive tools, companies could have a significant competitive advantage. Instead of

significant competitive advantage. Instead of relying solely on traditional ways of forecasting trends—which require observation and data collection from fashion designers and trend spotters—companies can have instant access to data that allows them to plan the right styles and quantities in a timely manner.

British fashion company STITCH FIX has an automated wardrobe planning tool that, using analytics, records its customers' purchases and enters them into a virtual wardrobe [2]. The platform allows women to create looks from their wardrobe and even choose from over 10,000 stores. Also, the TRUEFIT customization platform uses an online matching engine that helps users find a

proper fit with brands and new styles on the market [3]. Another interesting example is the INTELLIGENCE NODE, which allows users to track trends in real time [4]. Customers can enter specific keywords, user browsing patterns, price limits, and more. Intelligence Node's AI-based search platform allows users to find exact or closest matches to the desired product. Fashion trend forecasting relied solely on past trends to predict the future. New technologies like HEURITECH are defining audience panels on social networks [5]. To predict future trends, it applies image recognition technology from social media to access shapes, prints, colors and material characteristics (Fig. 1).



Figure 1. Image recognition technology that predicts style trends. Source: Heuritech

Google also implemented a similar experiment in partnership with German fashion brand ZALANDO. The neural network understands style preferences, colors and textures. After that, the algorithm was used to create models based on users' style

preferences (Fig. 2). There is also a collaborative project between IBM and the Fashion Institute of Technology, known as "Reimagine Retail", which uses IBM's high-tech AI tools to indicate real-time trends in the fashion industry in shapes, colors, etc.

Shoes

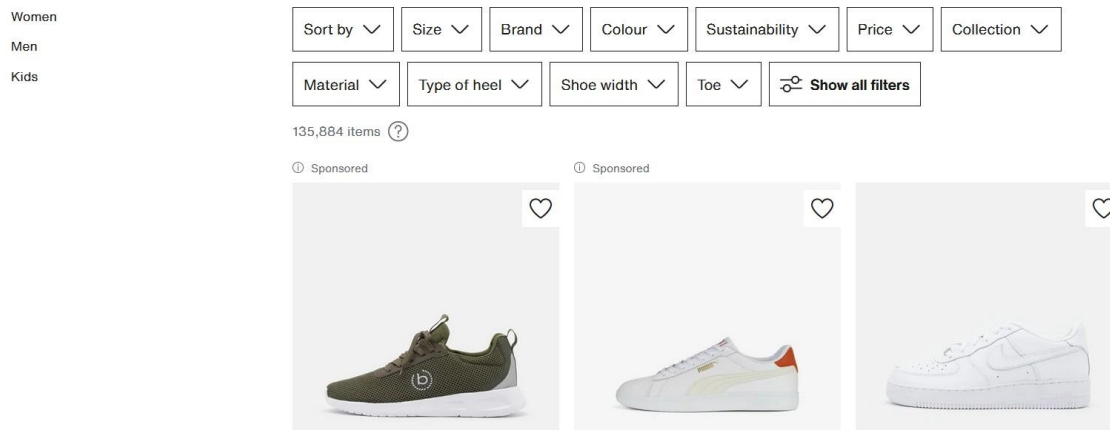


Figure 2. ZALANDO Algorithm, source: Zalando

These technologies highlight how AI is the bulwark of future developments in the fashion industry, shaping everything from trend forecasting to how consumers can actually view and buy products.

New Materials

New materials are undoubtedly the future of fashion, another way for designers to distinguish themselves. All the facts point to the idea that ecological leather is not a very sustainable option [6]. Startups like MODERN MEADOW are fighting this by creating lab-grown leather without harming animals [7]. Also, companies like BOLT THREADS and ENTOGENETICS are innovating very strong spider silk [8].

The latest applications of printed objects that change colors include a system created by MIT researchers called ColorFab 3D. This technology prints 3D objects with “photochromic inks” that change color when exposed to certain wavelengths of UV light. [9] One of their first items produced was the ring that can be programmed in a number of customizable colors.

Google fans could soon be wearing clothing made by the digital tech giant. Project Jacquard [10], from Google’s ATAP (Advanced Technology and Projects) lab, is a collection of conductive threads for weaving touch-

sensitive textiles such as clothing, tablecloths, carpets, or anything else made of fabric. The team behind Project Jacquard also makes it possible to change color with Ebb. It is a technology that changes the color of the fabric. The color can be programmed to change our mood or decor. Ebb materials could even help us perform many activities we currently do on our phones using color signals. For example, when we receive a call, the color of the cuff changes. This highlights how new materials will literally reshape the clothing and footwear we wear.

Internet of Things (IoT)

IoT describes a network of objects – “things” – that are embedded in technology to enable the exchange and connection of data over the Internet. This is one of the most exciting emerging technology trends in the fashion market. Year after year, everyday fashion continues to improve to reflect the realities of our everyday lives. From a great emphasis on comfort to the use of new materials, the fashion industry has had to keep up in adapting to the demands of contemporary life. This has been seen most clearly in advances in wearable technology and wearable gadgets. These have come to influence the way we interact with the environment, with others, with our bodies,

giving the word “comfort” a whole new meaning.

As our “real” lives become more and more blended with a virtual existence, many designers have experimented and pushed the boundaries of what wearability means. The Internet of Things (IoT) enables data sharing, inventory management, security, increased efficiency and productivity. Some of the most exciting IoT innovations are related to health. For example, the NADI X yoga pants (Fig. 3) have built-in sensors to correct users’ posture through vibrations while they perform yoga

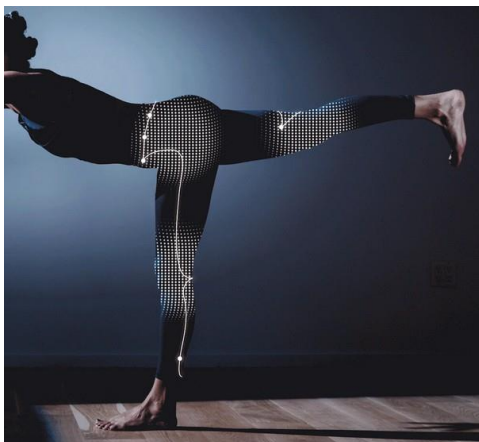


Figure 3. NADI X Yoga pants.
Source: Zalando

Virtual and Augmented Reality (VR and AR)

A widespread use of VR allows customers to try on clothes virtually. This provides greater accuracy due to custom measurement functionality and also uses augmented reality technology. It also means customers may be more likely to buy products they feel like trying. Some companies are making the most of AR and VR technology. One user of AR/VR technology is EFI Optitex, which has greatly improved the costly and time-consuming process of finding a suitable fit. They showed how to take the essential components of a design, such as sketches and technical models, which can then be turned into simulated 3D renderings. Other new 3D rendering technologies include CLO. The tool allows companies to edit models and make changes instantly.

exercises [11]. HEXOSKIN, for example, tracks heart rate and temperature. They also make socks that count steps, measure calories, etc. Nike has released a pair of lace-up sneakers (Fig. 4) that can adapt to the unique shape of the wearer’s foot and can be controlled via a smartphone. The needs of the foot change at any moment, depending on the sport, its duration and the specific movements. When users wear the IoT shoes, it appears that a customized system senses the foot tension and the shoe adjusts [12].



Figure 4. Nike customizable shoes

3D Printing

Additive manufacturing technologies, also known as 3D printing or rapid prototyping, have had a rapid development in the last decade, being considered technologies of the future. With their help, you can create different products with a complex geometric shape, different conceptual models or functional prototypes that can be tested, checked and revised repeatedly before sending the new product into production. Since the advent of 3D printers, many companies, both large and small, have looked at the possibilities they offer for on-demand production [13]. This will create new avenues for customization, durability and creativity. Thus, many fashion companies have adopted 3D printing

technology in their collections in 2022, from accessories to finished products. Even though it takes more time to create, less waste results. On-demand garment printing reduces material waste by approximately 35% [14].

One of the pioneers of 3D printing in the fashion industry is Iris Van Herpen. The Dutch designer has an extensive body of 3D printing work dating back to 2010. One of her most notable pieces is the “Crystallization” top, which was 3D printed from white polyamide. Van Herpen is perhaps the only designer who has presented at the prestigious Haute Couture fashion weeks in Paris, using sophisticated technologies for her garments and presentations.

3D printing also takes fashion to a new level of conceptual art. Anouk Wipprecht’s incredible Spider dress has mechanical arms that move based on the proximity of other people. This 3D printed dress combines cutting edge scientific technology and haute couture fashion, demonstrating the versatility of this new technology. Digital knitting has also made great strides in the world of 3D printing and offers a wealth of customization possibilities. For example, manufacturers like Shima Seiki can turn cones of yarn into a seamless garment in less than an hour.

The Advantages of 3D Printing

In footwear production, the traditional technological process is mainly: designing, modeling, cutting, sewing and soling. The whole production process takes a long time and is very complicated. The combination of 3D design technology and 3D printing technology can quickly achieve the initial mold production and check the result, thereby reducing the time and improving the competitiveness of footwear enterprises in the fierce market competition [15, 16, 17]. The use of software and 3D technology to obtain the shoe allows the creation and modification of its shape in accordance with the design requirements. 3D printing

technology is needed to faster and better integrate fashion elements [18, 19].

The main advantages are:

- reducing the costs of planning, designing, making and putting a new product on the market by checking the design and functionality at an early stage, respectively, by eliminating some preliminary stages belonging to the series production process, allowing at the same time to make the required changes much faster and at lesser costs;
- optimizing the design, the possibility of customization, obtaining objects with a high degree of complexity;
- decreasing the time of launching the new product on the market (from a few weeks/months to a few hours or days);
- promoting the principle of sustainability – because the products can be made to order, depending on the needs, without consuming excess resources, the materials used are generally easy to recycle, they are ecological and compatible with the environment [20].

3D PRINTED SHOES

3D printing can be used in any field, and fashion is no exception. It is possible to create 3D printed shoes, original designs, insoles, soles, heels, etc., make rapid prototypes and try new manufacturing processes. Everything is possible thanks to 3D printing technology.

Designers and 3D Printing

3D printing allows designers to create clothing. But its usefulness in fashion technology does not stop there, as it is also possible to create shoes. For example, Zoe Jia-Yu Dai, a shoe designer from Taiwan, created “Breaking the 3D Mould” (Fig. 5), a collection of shoes with 3D printed parts [21]. This technology allows designers to go further with designing structures. It is a way to change the

manufacturing process. It is easier to create organic structures with additive

manufacturing than with a traditional process.



Figure 5. "Breaking the 3D Mould"

It is obviously a good way to create prototypes. Some designers only focus on shoe design. The "Melissa" shoes are an excellent example of the possibilities offered by 3D printing technology when it comes to design [22]. The "Melissa" shoes are among the most amazing examples of what 3D printing can do for style and design (Fig. 6-8). This Brazilian footwear company produces shoes using injection molding and 3D printing.

They are made of a patented plastic called Melflex. The production process is quite green and tends towards a cradle-to-cradle model, as the remaining material is used to create new shoes. The design and production process of "Melissa" models requires experimentation. The brand works with architects and designers to propose a futuristic and unique shoe design.



Figure 6. Designer Andreia Chaves created the "Invisible shoes"



Figure 7. The Brazilian duo Campana Brothers designed a mini-collection



Figure 8. Swedish designer Naim Josefi created these shoes that fit perfectly. The buyer's foot is scanned in the store and the shoes are made on demand.

3D Printed Shoes – Attempting a New Manufacturing Process and New Materials

Rethinking Production

As in other sectors, 3D printing can be used to develop new manufacturing processes. It can provide more possibilities and opportunities to any company. For example, Feetz is an American startup that makes shoes to order, easy to wear and with an appealing style. In addition, Feetz is committed to protecting the environment. They developed their own 3D printer, using a fused filament manufacturing technique and their own 3D printing material – a proprietary polymer. They wanted to rethink the entire manufacturing process, to make it more sustainable. Feetz uses recycled and recyclable materials, is water-free and has

reduced its carbon footprint by 60%. In addition, there is no material waste, because with 3D printing you only use the amount you need [23]. The use of 3D printing in their manufacturing process shows that it is possible to change the way the footwear industry affects the environment.

High Performance Materials for 3D Printing

New high-performance materials are now available on the market and are specially adapted to the creation of footwear parts such as midsoles. The perfect example is thermoplastic polyurethane (TPU). Objects printed with thermoplastic polyurethane offer advanced properties, which is perfect for obtaining durable, strong and flexible parts (Fig. 9).



Figure 9. 3D-printed TPU soles [23]

CONCLUSIONS

3D printing can be used in any field, and fashion is no exception. It is possible to create 3D printed shoes, original designs, insoles, soles, heels, etc., make rapid prototypes and try new manufacturing processes. Everything is possible thanks to 3D printing technology.

3D printing takes fashion to a new level of conceptual art. Designers will continue to work with 3D printing because it allows the creation of incredible designs with a lot of freedom. The footwear industry is more connected to 3D printing than we might think. All these examples show that there are different ways to create shoes. You can push the boundaries of design or change manufacturing methods by finding an environmentally friendly way to produce, or even get shoes or insoles custom-made for more comfort.

Fashion innovation is critical to commercial value and longevity. It is central to how we shape the industry. Fashion innovation can help replace existing materials with sustainable alternatives. Innovation in fashion will enable us to function and interact in a digital world. The only way forward is to innovate, develop and adapt fashion.

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