



THE FUTURE OF ARTIFICIAL INTELLIGENCE BASED SOFTWARE IN TEXTILE PRINTING

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ABSTRACT: Artificial intelligence (AI) is reshaping the future of textile printing by transforming the way software is used in design, production and quality control. In this paper it will be explored how AI-driven tools are enabling smarter workflows through automated color management, pattern generation, defect detection and predictive maintenance. By integrating machine learning and data-driven decision-making, these solutions offer increased efficiency, reduced waste and greater personalization in textile production. The presented literature overview will also highlight emerging trends, practical applications and the broader implications of AI adoption for both industry and education. It will be highlighted the importance of future AI adoption in textile printing processes. As sustainability and digitalization become central goals, AI-based software is set to play a key role in the next generation of textile printing technology.

Keywords: Artificial intelligence, textile printing, software, design.

BUDUĆNOST SOFTVERA ZASNOVANOG NA VEŠTAČKOJ INTELIGENCIJI U ŠTAMPI TEKSTILA

APSTRAKT: Veštačka inteligencija (AI) oblikuje budućnost štampe tekstila transformišući način na koji se softver koristi u dizajnu, proizvodnji i kontroli kvaliteta. U ovom radu biće istraženo kako alati zasnovani na AI omogućavaju pametnije tokove rada kroz automatsko upravljanje bojama, generisanje šara, detekciju grešaka i prediktivno održavanje. Integracijom mašinskog učenja i donošenja odluka zasnovanog na podacima, ova rešenja nude povećanu efikasnost, smanjeni otpad i veću personalizaciju u proizvodnji tekstila. Prikazani pregled literature takođe će osvetliti nove trendove, praktične primene i šire implikacije usvajanja veštačke inteligencije za industriju i obrazovanje. Biće naglašena



važnost budućeg usvajanja AI tehnologija u procesima štampe tekstila. Kako održivost i digitalizacija postaju ključni ciljevi, softver zasnovan na veštačkoj inteligenciji imaće centralnu ulogu u sledećoj generaciji tehnologije štampe tekstila.

Ključne reči: *Veštačka inteligencija, štampa na tekstu, softveri, dizajn.*

1. INTRODUCTION

The printing process in textile manufacturing can be defined as the localized application of colorants to selected areas of a substrate, typically a textile fabric. In addition to printing, dyeing is also commonly employed in industrial textile processing. The fundamental distinction between these two methods lies in the distribution of color: while dyeing involves the uniform coloration of the entire surface, printing selectively applies colorants to predetermined regions, enabling the creation of complex patterns, multicolor designs, and intricate motifs.

Although printing is nowadays largely associated with paper, the earliest applications of this technique were developed for textile decoration. Historical evidence indicates that textile printing predates paper printing by several centuries. The oldest surviving printed textiles—China’s three-color silk prints—are dated to approximately 220 BCE. In contrast, the earliest known dyed cotton samples, discovered in the Indus Valley, are believed to originate from around 3000 BCE [1].

Among contemporary textile printing technologies, screen printing and digital printing are the most prevalent. The comparison between these two techniques remains a subject of ongoing academic and industrial interest, particularly during the current transitional period in which each holds distinct advantages depending on the application context [2].

Screen printing, a conventional technique, involves the creation of stencils (screens), mechanical spreading of ink, and precise alignment during printing. It is widely regarded for its ability to produce vibrant, durable prints with sharp edges and deep color penetration. This method becomes economically favorable for high-volume production runs, as the unit cost decreases significantly with increased quantity.

Digital printing, in contrast, eliminates the need for physical screens and associated setup processes. It relies on computer-controlled printers that apply ink directly onto the substrate, offering greater flexibility, faster turnaround times, and cost-effectiveness for short-run or customized production. However, limitations in color fidelity—particularly in CMYK reproduction—and print durability can still pose challenges when compared to screen printing.

An important development in both screen and digital textile printing is the increasing integration of artificial intelligence (AI). AI-driven technologies are enhancing various stages of the printing workflow, including automated color management, defect detection, pattern generation, and predictive maintenance. The adoption of AI contributes to improved efficiency, reduced waste, and enhanced quality control, marking a significant evolution in textile printing processes [3].



2. THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE PRINTING INDUSTRY

Artificial intelligence (AI) encompasses technologies that enable machines—such as computers or robots—to perform tasks traditionally requiring human cognitive abilities. These include learning, reasoning, perception, language processing, and the ability to draw conclusions from past experiences [4, 5]. In the printing industry, AI-based solutions are increasingly integrated across all stages of production—from prepress and printing to quality control and customer interaction—offering enhanced print quality, cost-effectiveness, and operational efficiency.

Predominantly, AI applications within the graphic arts and printing sectors are rooted in machine learning and computer vision technologies, particularly in the domains of image processing and machine vision [4]. These advancements have facilitated the transformation of traditional workflows, introducing automation, precision, and adaptability across the value chain.

In the domain of design, AI tools assist in automated design generation, image enhancement, and the creation of customized graphics, enabling designers to streamline and elevate creative processes. In prepress operations, AI enables automated proofreading, color correction, file optimization, and trapping, significantly reducing the manual workload and improving throughput.

During the printing phase, AI supports predictive maintenance, quality assurance, ink usage optimization, and workflow automation, all of which contribute to enhanced reliability and cost control. In sales and customer engagement, AI solutions—such as chatbots, virtual assistants, automated quote generation, and follow-up systems—improve response times and client satisfaction [6].

Manufacturers of advanced digital printing systems, particularly those developed for commercial, high-speed, and large-format printing, are increasingly incorporating AI in conjunction with cloud-based and automation technologies. These integrations aim to improve print accuracy, color fidelity, operational efficiency, and profitability [7]. AI-powered features are capable of automatically configuring print settings based on file content, enhancing image resolution, and simplifying preflight checks. Additionally, AI facilitates ink usage prediction and inventory optimization, thus reducing waste and ensuring continuous production.

Job preparation is also automated through AI, and when coupled with cloud connectivity, it enables remote management and on-demand production, thereby minimizing manual interventions. This allows operators with varying skill levels to efficiently handle diverse print tasks [7, 8].

One of the most significant advantages of AI in the printing industry is its capacity to automate repetitive and labor-intensive operations. AI systems can manage tasks such as font recognition, color correction, and image scaling, freeing human resources to focus on more strategic and creative roles.

Furthermore, AI-enhanced software can perform real-time color analysis and adjustments to maintain consistent and optimal output quality. Error detection and correction during the printing process are also facilitated by AI, as the systems can autonomously halt or adjust



production to minimize defects. This automated quality control significantly reduces material waste and lowers production costs.

Moreover, AI contributes to the integration of print media with digital technologies. For instance, printed codes or images can be scanned by users to trigger augmented reality (AR) experiences via smartphones or tablets, enriching user interaction and enhancing the communicative potential of printed materials [6, 8, 9].

In the field of graphic design, AI integration within software tools supports creatives in producing visually optimized, market-relevant content—particularly in areas such as packaging design—by promoting both functional performance and environmental sustainability [8].

Additionally, the incorporation of AI into 3D printing processes is facilitating the creation of more complex and efficient printed models. This not only accelerates the design and production phases but also makes 3D printing technologies more accessible to a wider range of users [8].

3. TEXTILE PRINTING SOFTWARE

In recent years, the textile industry has experienced significant growth in the adoption of digital textile printing technologies. Central to these advancements is the increasing reliance on software solutions that facilitate both the design and production stages. While general-purpose graphic design applications such as Adobe Illustrator and CorelDraw remain widely utilized, textile printing presents unique requirements that necessitate specialized functionalities. Among these are the need for precise pattern repetition, which ensures seamless garment assembly, and meticulous color management to guarantee accurate reproduction across devices and materials [10].

Textile-specific software solutions have emerged to address these demands, integrating features tailored to the intricacies of textile production. Programs such as NedGraphics 2025 offer a comprehensive suite of tools for digital textile printing, including AI-assisted pattern generation, colorway creation, and high-resolution print simulation. The software supports seamless integration with color management systems and digital printing hardware, streamlining workflows for both designers and manufacturers. Additionally, NedGraphics includes plug-ins for Adobe Photoshop and Illustrator, developed by Aquario Design (now operating under the NedGraphics for Adobe brand), enhancing functionalities like pattern repetition and color handling. The latest version introduces improvements such as a tile-based layout for design comparison, a new Colour Reduction Window, and support for the Unified 3D Material (U3M) format, which facilitates realistic 3D simulations of textile behavior [11].

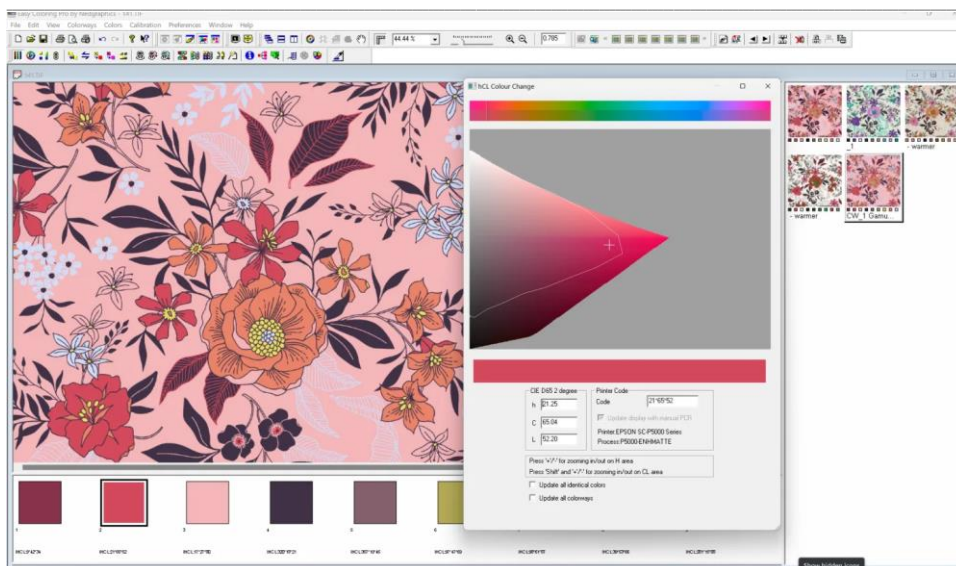


Figure 1: NedGraphics

Optitex serves as a robust 2D and 3D CAD solution designed for apparel and textile production. It enables users to create precise digital patterns and simulate garment behavior in a virtual environment. By supporting the integration of print placement within the virtual prototyping workflow, Optitex reduces the need for physical samples and supports more sustainable production practices [12].

AVA CAD/CAM is another industry-standard software package aimed at textile and surface design professionals. It offers advanced tools for color separations, pattern repeat creation, and print simulation. Known for its sophisticated color management capabilities, AVA supports various output technologies, including inkjet and rotary screen printing. The most recent version, AVA v5.9, features a redesigned user interface, automation tools, enhanced text functionality, and expanded color file compatibility, including support for Adobe Swatch Exchange and ICC 4.3 profiles. Its integration with PrintFactory ensures compatibility with a broad range of textile printers [13].

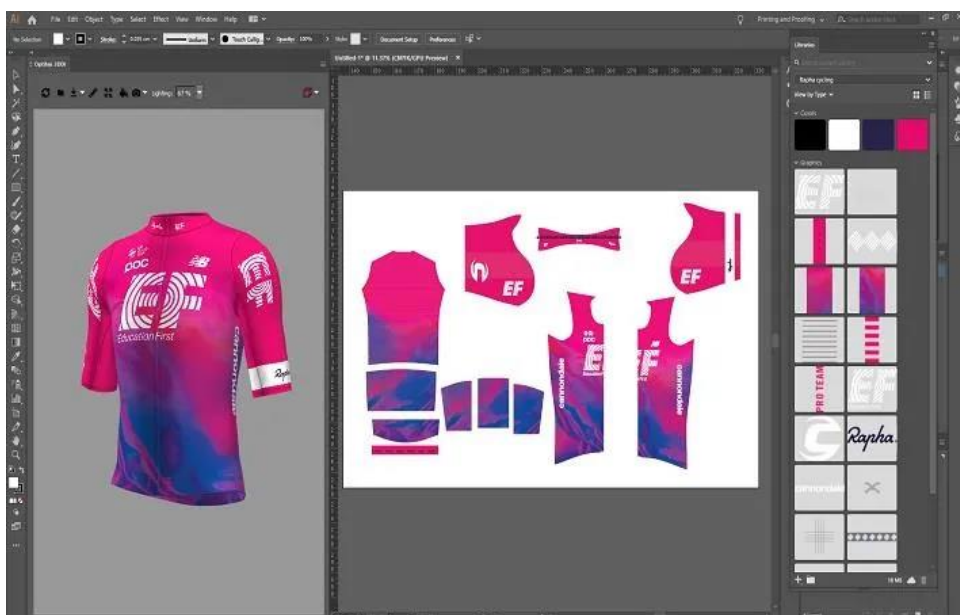


Figure 2: Optitex

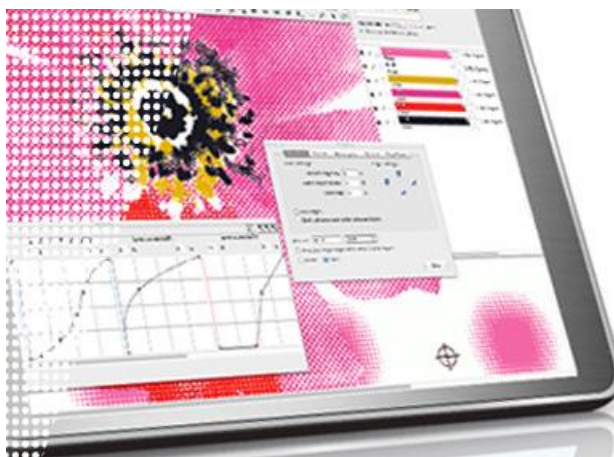


Figure 3: AVA

The Pointcarre software suite, developed by the French-American company of the same name, encompasses modules for digital printing, weaving, and knitting. It includes a color engine capable of simulating both rotary and digital printing outputs, ensuring accurate color sampling and consistency.

The latest innovation, 'Design Maker,' introduces a generative AI tool developed specifically for textile design. Unlike generic image-generation tools, Design Maker is optimized for creating repetitive patterns and integrates with Pointcarre's Jacquard Maker and ColorSep modules.

With support for multiple formats and customization options, this AI-powered functionality enhances the creative workflow while ensuring technical precision. Pointcarre remains committed to simplifying textile design processes, enabling designers to focus on creativity and color development [14].



Figure 4: Pointcarre

InEdit is a specialized software platform for digital textile printing, particularly known for its strong capabilities in print job and color data management. Designed for compatibility with industrial and large-format printers, InEdit includes features such as ICC profiling, step-and-repeat patterning, and support for variable data printing. It is most recognized for the NeoStampa RIP, a widely adopted solution for digital printing. Additionally, InEdit provides design tools such as NeoTextil, a plug-in for Adobe Photoshop that includes modules for pattern repetition (nT Step and Repeat), automated color separation (nT Masquerade), color variant creation (nT Colorations), and photorealistic simulation (nT Virtual Vision) [15].

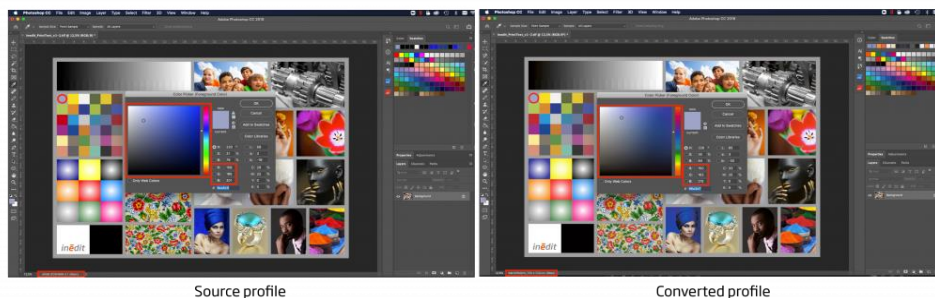


Figure 5: InEdit

The digital textile printing market is supported by a diverse range of mature software solutions, each offering unique strengths. The choice of software often depends on specific workflow needs, design preferences, and compatibility with supply chain partners. As textile printing continues to evolve, particularly with the integration of artificial intelligence and 3D visualization technologies, these platforms will play an increasingly critical role in enhancing efficiency, creativity, and production sustainability.

4. CONCLUSION

The integration of artificial intelligence into textile printing software marks a transformative shift in the design and production processes of the textile industry. AI-driven solutions are increasingly influencing key aspects of digital textile workflows, including automated color management, pattern generation, defect detection, and predictive maintenance. These technologies offer not only improvements in operational efficiency and production speed but also significant advancements in customization, accuracy, and sustainability.

Specialized software packages such as NedGraphics, Optitex, AVA CAD/CAM, Pointcarre, and InEdit demonstrate how AI capabilities are being effectively embedded into commercial design and manufacturing environments. These platforms support intelligent automation, enhance visualization through 3D simulation, and promote environmentally conscious practices by reducing material waste and minimizing the need for physical sampling.

As textile manufacturing continues to shift toward digitalization and sustainable production models, the role of AI-based software is expected to expand further. Future developments will likely focus on deeper integration with smart manufacturing systems, real-time data analytics, and generative design tools that support creative exploration while ensuring production feasibility.

Ultimately, the adoption of AI in textile printing represents more than a technological upgrade—it signals a paradigm shift in how textiles are conceived, produced, and consumed. Embracing these innovations will be essential for companies aiming to remain competitive in an increasingly digital and sustainable global market.



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