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The Use of Artificial Intelligence in the Nail Industry: from Trend Forecasting to Process Automation

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Abstract

This article examines the potential and specific applications of artificial intelligence (AI) tools in the nail industry, focusing on trend forecasting and process automation. The relevance of this topic arises from the growing imbalance in the industry: clients increasingly demand personalized services and fast service delivery, while salons struggle with a shortage of skilled professionals and outdated demand forecasting methods. The purpose of this study is to systematize scholarly and expert perspectives on the integration of AI to address these challenges, identifying key technological and ethical concerns. The main contradiction lies in the tension between the economic efficiency of automation (e.g., reducing service time) and the risks of service dehumanization (potential loss of customer loyalty due to diminished emotional interaction). The findings suggest that AI-driven solutions—such as robotics and predictive trend analytics—can significantly transform and enhance the industry. However, successful implementation requires hybrid models in which algorithms complement rather than replace human professionals. The study also includes an analysis of specific case studies (Umia, Clockwork) that highlight the synergy between intelligent systems and the "creative core" of beauty services. Special attention is given to the challenges associated with AI integration. The insights presented will be valuable to beauty salon owners, developers of beauty technologies, and researchers investigating AI's impact on niche service sectors.

Keywords: automation; artificial intelligence; nail industry; personalization; trend forecasting; robotics; digitalization.

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1. Introduction

The modern nail industry faces numerous and significant challenges driven by the dynamics of fashion trends, increasing client expectations for personalized services, and the need for operational process optimization. In 2023, the nail salon market was valued at $8.4 billion, with an expected average annual growth rate of 5% from 2024 to 2032 [9]. This sector is rapidly evolving due to a combination of factors, including growing demand for self-care, increased awareness of hygiene, the popularity of nail art among Generation Z, and rising disposable income paired with fast-paced lifestyles. Many salons are significantly expanding their range of services.

Traditional demand forecasting methods, which rely on subjective trend analysis, often lead to imbalances between supply and consumer preferences. Manual resource management, limited customization options, and high dependence on human factors pose risks to the profitability and competitiveness of salons. The integration of artificial intelligence (AI) presents a solution to these challenges by transforming the industry through predictive analytics, automation, and adaptive services. For this reason, this study aims to explore AI's functional applications.

2. Materials and Methods

In contemporary academic sources and review publications on AI applications in the nail industry, researchers focus on several key areas. Market analysts [1, 6, 9] emphasize economic prospects, such as the growth of robotic system markets and the identification of "premium personalization" and "express services" segments as demand drivers. Studies within the technological domain [3, 4, 11] highlight AI functionalities, including computer vision algorithms for 3D nail plate scanning, generative networks for unique design creation, and IoT integration for inventory management. For instance, K. Gasenko [4] describes a case study on AI platform integration, which reduced client service time by automating design selection.

Research focused on customer-oriented approaches [2, 8, 10] reveals a paradox in technology perception: despite increased service speed, many clients remain skeptical about the safety of robotic systems [10]. S.M.C. Loureiro [8] introduces the concept of "similarity avoidance," explaining the demand for AI-driven customization, where algorithms analyze clothing styles through photos to enhance conversion rates. Meanwhile, P. Dr. P. Alexandra-Lucia [2] emphasizes that customer satisfaction correlates more with a technician's "emotional engagement" than with technological advancement, raising concerns about fully replacing human professionals with robots.

The educational aspect is explored in N. Hidayah's work [5], which examines AI-powered nail art tutorials as a tool for skill standardization. Unlike traditional courses, algorithmically structured video tutorials reduce training time. However, E. De. J. Lopes [7] argues that while automation techniques such as time measurement streamline processes, they fail to address creativity, which remains a human prerogative.

While some researchers highlight AI's economic efficiency, others point to the risks of service dehumanization, fueling ongoing debates within academic and professional circles. Issues such as intellectual property rights for AI-generated designs and the impact of automation on employment remain underexplored. Most studies rely on

B2C segment surveys, often overlooking the unique challenges of small salons.

The author has conducted a predominantly applied selection of literature, guided by an interdisciplinary scope and the relevance of the sources under review. The focus is placed on works that reflect current trends in the development of artificial intelligence, its application in the service sector, and, in particular, within the beauty industry. The theoretical foundation comprises both fundamental studies on machine learning and neural networks, as well as analytical materials in the fields of marketing, digital transformation of small businesses, and customer experience. The selection of sources was driven by practical relevance and scientific novelty, enabling the author to construct arguments at the intersection of technology, economics, and entrepreneurship. There is a clear intention to rely on recent publications, including English-language studies, which demonstrates an effort to integrate the analysis into the global academic discourse.

The limitations of the study stem from its applied focus and relatively narrow industry specificity—the analysis is primarily centered on the manicure business, which complicates the extrapolation of findings to other segments of the beauty industry. In addition, the author relies on a limited amount of empirical data and primarily draws upon theoretical and review-based sources.

The methodology for this study includes quantitative analysis of market data (based on statistical information), case studies of technology startups, comparative and content analysis, and systematization.

3. Results and Discussion

The growing focus on a healthy lifestyle remains a key driver of the nail salon industry's expansion. A major challenge, however, is the rapid obsolescence of designs [2, 5]. Machine learning algorithms, particularly recurrent neural networks (RNNs) and transformers, analyze vast datasets from social media, search queries (Google Trends), and e-commerce platforms (sales of nail polishes and stencils). These models identify semantic patterns in discussions about new manicure styles, enabling predictions of rising trends, such as geometric prints or "glass" nude coatings, several months before peak demand.

Computer vision, trained on datasets containing millions of nail images, classifies styles based on geometry, color schemes, and complexity of execution. This allows salons to adjust pricing lists and train technicians in advance, mitigating the risk of missed revenue opportunities. Unlike expert assessments, AI eliminates cognitive biases, ensuring objective forecasting.

It is important to emphasize that artificial intelligence is transforming fashion analysis by replacing intuitive hypotheses with precise quantitative methods. Clustering algorithms, for instance, group visual elements from millions of social media posts to identify microtrends, ranging from metallic-effect "cat-eye" designs to pastel gradient styles. These models take into account not only images but also context, including hashtags, brand mentions, and even the locations where certain styles are gaining popularity.

Platforms utilize convolutional neural networks to deconstruct nail designs into fundamental components such as shapes, textures, and color combinations. This approach helps forecast which elements will be in demand in

the upcoming season. Figure 1 systematizes the capabilities of artificial intelligence in trend forecasting.

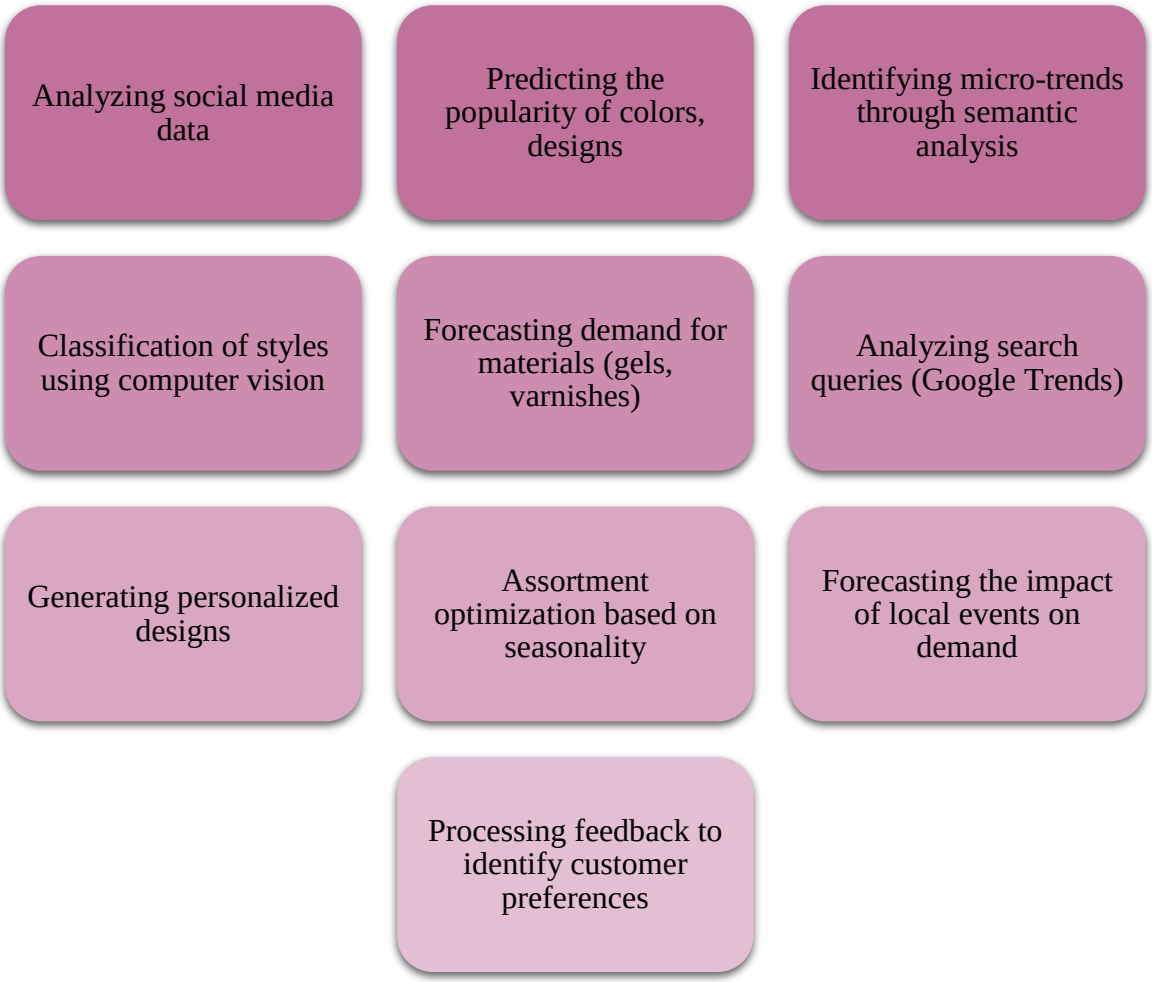

Figure 1: The functionality of artificial intelligence in forecasting trends in the manicure business (compiled by the author based on [2, 4-7, 10])

Manual nail processing is a labor-intensive procedure where even minor errors significantly affect the final result. AI-powered robotic systems are already being tested in pilot projects, where real-time adjustments to manipulator movements are made based on clients' anatomical features.

According to a study by Oxford Economics, up to 20 million jobs worldwide in healthcare, manufacturing, retail, and logistics could be replaced by automated technologies [1]. Robots are becoming increasingly proficient in performing complex physical tasks, including those previously considered challenging, such as nail care. Figure 2 presents key directions in the use of robotics in the nail industry.

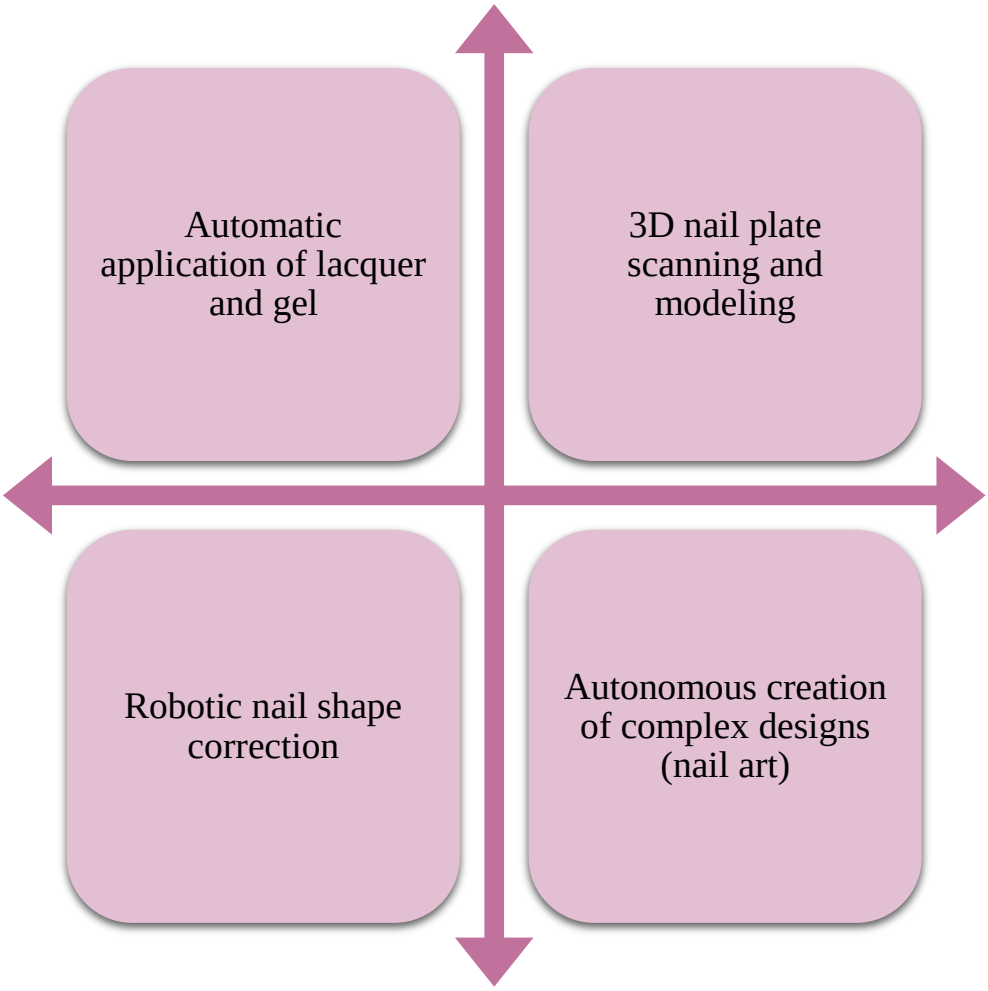

Figure 2: Key directions of robotics in the manicure business using artificial intelligence tools (compiled by the author based on [1, 5, 6, 8])

Processing appointment bookings through chatbots reduces the workload on administrators. Models trained in recognition automatically suggest available slots, provide consultations on procedures, and send visit reminders. Implementing such solutions in chain salons decreases booking time.

Let us consider a hypothetical example. Suppose that a traditional manual client registration and request processing by an administrator takes approximately 5 minutes, whereas an AI-powered chatbot completes the same operation in just 30 seconds. With an average of 50 appointments per day, the time saved amounts to around 225 minutes—or nearly 4 hours. On a monthly scale, this translates to over 80 hours, equivalent to the full working time of one employee. Thus, even the basic implementation of an AI-based tool can significantly reduce operational costs and accelerate customer service.

Initial data:

Manual registration time — 5 minutes per client

AI-assisted registration time — 0.5 minutes (30 seconds)

Number of appointments per day — 50 clients

1. Time saved per client:

5 minutes − 0.5 minutes = 4.5 minutes

2. Total time saved per day:

4.5 minutes × 50 clients = 225 minutes

Another key effect is the personalization of services, shifting from a mass-market approach to an individualized experience. Clients expect unique solutions, which are difficult to achieve through manual design selection. Generative adversarial networks (GANs) create personalized sketches by combining user preferences, such as favorite colors and clothing style, with current trends. Applications analyze client hand photos, simulate a virtual manicure based on nail shape and skin tone, and offer numerous options with quick response times.

Recommendation systems, similar to those used by Netflix, increase the average transaction value. For instance, if a client frequently selects minimalist patterns, the algorithm suggests complementary options like thermochromic coatings or stamping. AI's adaptability reduces the likelihood of service refusals during consultations.

Attention should now be directed to optimizing management in logistics, inventory, and pricing.

Disproportion between material procurement and actual demand is a common cause of financial losses. Time series forecasting methods (ARIMA, Prophet) predict the need for gels, polishes, and decorative elements, minimizing excess inventory. In salons with dynamic pricing, AI adjusts service costs in real-time, considering factors such as seasonality, occupancy rates, and competition.

Logistics disruptions are a major challenge for salons. AI solutions, particularly predictive models based on graph neural networks, incorporate not only historical sales data but also external factors:

- Weather conditions (humidity affects demand for gel polishes);
- Local events (wedding season increases requests for French manicures);
- Competitor activity.

These systems employ ensemble learning methods (Random Forest, Gradient Boosting) to predict material consumption with maximum accuracy. Integration with IoT sensors in warehouses enables automatic stock replenishment when critical levels are reached, minimizing downtime.

Sentiment analysis of customer reviews helps identify hidden issues. Even when ratings are high, negative comments about long procedure durations serve as a basis for revising staff schedules.

Despite numerous positive effects, several challenges associated with AI implementation in this industry remain,

as outlined in Table 1.

Table 1: Systematization of problematic aspects of the use of artificial intelligence in the manicure business (compiled by the author based on [2, 4-8, 10])

Aspect	**Description**
Technological limitations	Difficulties in accurately scanning nails, considering curvature, texture, and skin tone. Limited AI adaptability to individual anatomical features (e.g., ingrown nails, damage).
Data quality	Insufficient diversity in training datasets (rare nail shapes or complex designs). Risk of model overfitting on narrow datasets, reducing forecast accuracy.
Customer barriers	Consumer skepticism toward automated services (concerns about safety and quality). Limited willingness to pay a premium for technology if results do not surpass manual work.
Economic and operational challenges	High costs of AI implementation and maintenance for small salons. Need for regular software and equipment updates to maintain competitiveness.
Ethical and social aspects	Potential job displacement for nail technicians. Intellectual property concerns over AI-generated designs.
Regulatory issues	Lack of safety standards for robotic manicure devices. Challenges in certifying AI solutions across different countries.

Among the notable case studies, the experience of the Canadian startup Umia stands out. This company has developed a fully automated AI-driven manicure studio that addresses both client concerns—time, cost, and nail health—and industry challenges such as physical strain on technicians and limited profitability. It offers a platform for monetizing designs, increasing efficiency, and fostering creative growth in the nail art industry. Umia enables artists to earn royalties on their designs, similar to models in the music or photography industries, while automation significantly reduces the time required to apply intricate patterns. The results are instantly visible upon completion, with no compromises in quality or nail health [11].

Another case involves a partnership between the international wellness company XWell and the startup Clockwork, which is introducing AI-powered autonomous manicure stations in U.S. airports through the XpresSpa network. The technology combines 3D nail plate scanning with precision polish application algorithms. Functioning similarly to a 3D printer, the robotic system creates a flawless finish in just ten minutes. Clients select a shade, insert a polish cartridge, receive on-screen instructions, and then the robotic arm applies the polish in fine lines from the edge to the center [3].

4. Conclusion

In the current landscape, AI adoption in the nail industry is transitioning from an experimental phase to large-scale implementation. These technologies not only solve operational challenges but also establish a new standard for the customer experience, where predictability is seamlessly integrated with creativity.

Beyond the evident advantages outlined in this article, AI minimizes human error. Algorithms are trained on synthetic defects, such as uneven edges and air bubbles in gel polish, enabling them to detect and correct these issues in real applications. Personalization has reached a new level, as transformer architectures like BERT analyze client visit histories, predicting not only preferred colors but also the optimal booking times, such as evening slots for busy professionals.

However, success hinges on data quality and the willingness of businesses to reassess established processes. The author suggests that further research should focus on the ethical implications of automation, particularly job displacement and digital inequality among small salons.

Thus, AI is evolving beyond a mere tool to become a "strategic partner," redefining the standards of speed, precision, and creativity in the nail industry.

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