Technoeconomics. 2025, Vol. 4, No. 1 (12). Pp. 52–63.
Техноэкономика. 2025, Том 4, № 1 (12). С. 52–63.

Scientific article
UDC 330.47
DOI: https://doi.org/10.57809/2025.4.1.12.6

MVP WEB SERVICE FOR A COSMETOLOGY COMPANY WITH ARTIFICIAL INTELLIGENCE ELEMENTS

Artyom Krasnoshchekov[1], Rostislav Shepel[2] ✉

[1] Peter the Great St. Petersburg Polytechnic University, St. Petersburg, Russia;
[2] University of Nottingham, Nottingham, UK

✉ efyrs5@nottingham.ac.uk

Abstract. This article focuses on the development of an MVP web service for a cosmetic company utilizing internet search technologies, web scraping, and generative artificial intelligence models. The increasing demand for personalized cosmetic products highlights the relevance of this study, which aims to optimize product selection and analysis processes. The research introduces a web service designed to analyze cosmetic products and provide personalized recommendations. The IT architecture, comprising two microservices, was developed and tested on real data. The results demonstrated a recognition accuracy of 99.45% for the company's products and 92.45% for products from other brands. The overall success rate for data processing reached 92.97%. The proposed solution proves to be effective for creating digital products with minimal development costs and offers potential for further functionality expansion.

Keywords: MVP web service, cosmetic industry, artificial intelligence, OCR, personalized recommendations, generative AI, LLM, microservices architecture, parsing

Citation: Krasnoshchekov A., Shepel R. MVP Web Service for a Cosmetology Company with Artificial Intelligence Elements. Technoeconomics. 2025. 4. 1 (12). 52–63. DOI: https://doi.org/10.57809/2025.4.1.12.6

Научная статья
УДК 330.47
DOI: https://doi.org/10.57809/2025.4.1.12.6

MVP ВЕБ-СЕРВИС ДЛЯ КОСМЕТОЛОГИЧЕСКОЙ КОМПАНИИ С ЭЛЕМЕНТАМИ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

Артём Краснощеков[1], Ростислав Шепель[2] ✉

[1] Санкт-Петербургский политехнический университет Петра Великого, Санкт-Петербург, Россия;

[2] Ноттингемский университет, Ноттингем, Великобритания

✉ efyrs5@nottingham.ac.uk

Аннотация. Данная статья посвящена разработке MVP веб-сервиса для косметологической компании с использованием технологий поиска в Интернете, парсинга и генеративного искусственного интеллекта. Актуальность исследования обусловлена растущим спросом на персонализированные косметические продукты и необходимостью оптимизации процессов выбора и анализа. В данной работе исследуется веб-сервис для анализа косметических продуктов и предоставления персонализированных рекомендаций. В ходе исследования разработана IT-архитектура, включающая два микросервиса, и проведено тестирование на реальных данных. Результаты показали точность распознавания продуктов компании на уровне 99,45% и других брендов — 92,45%. Общая успешность обработки данных составила 92,97%. В заключение, предложенное решение показало свою эффективность для создания цифровых продуктов с минимальными затратами и возможностью дальнейшего расширения функционала.

Ключевые слова: MVP веб-сервис, косметическая индустрия, искусственный интеллект, OCR, персонализированные рекомендации, генеративный ИИ, LLM, микросервисная архитектура, парсинг

Для цитирования: Краснощеков А., Шепель Р. MVP веб-сервис для косметологической компании с элементами искусственного интеллекта // Техноэкономика. 2025. Т. 4, № 1 (12). С. 52–63. DOI: https://doi.org/10.57809/2025.4.1.12.6

Introduction

The cosmetics industry is currently showing steady growth. According to Fortune Business Insights, the cosmetics market was valued at $374.18 billion in 2023, and it is projected to increase up to $758.05 billion by 2032. The rapid development of the industry is driving the demand for personalized products, which presents new challenges related to safety and consumer awareness. Modern customers are increasingly facing difficulties in selecting cosmetic products due to a lack of information about ingredient composition and compatibility, which can lead to adverse reactions and a decrease in trust in brands.

To address these issues, companies in the cosmetics sector are increasingly using digital technologies to optimize processes related to analysis, personalization, and recommendation delivery. However, the high cost of developing and integrating such solutions remains a significant barrier for startups and small businesses. In a competitive market, cosmetic companies must quickly adapt to the changing environment and implement pilot projects to strengthen their positions and maintain market share in the digital landscape.

In this context, the creation of minimally viable products (MVPs) using ready-made tools and technologies that can be tailored to the company's specific needs is particularly relevant.

Such solutions allow for quick testing of key metrics and the collection of user feedback, which is essential for further product improvement and reducing risks during implementation. The aim of this research is to develop an MVP product for a cosmetic company that enables the analysis of cosmetic products, provides personalized recommendations to users, and allows the company to make its presence known in the digital cosmetics market with minimal development costs. The following tasks are set to achieve this goal:

1. Analyze existing digital technologies applicable in the field of cosmetology;
2. Develop an IT architecture tailored for the MVP product;
3. Formulate recommendations for improving user experience and further product development.

Materials and Methods

To achieve the goal and objectives of the research, a methodology was developed, which includes the analysis of digital technologies used in cosmetology, the design, and testing of the IT architecture of the MVP product. The overall sequence of actions within the methodology is presented in the following stages:

1. Technology Analysis.

The study examined advanced digital technologies such as artificial intelligence (AI), machine learning (ML), optical character recognition (OCR), augmented reality (AR), biometrics, and intelligent assistants and their application in the cosmetics industry.

Artificial Intelligence: AI is a branch of computer science focused on creating systems capable of learning and adapting to perform tasks typically associated with human intelligence, such as pattern recognition, natural language processing, and decision-making (Russell, Norvig, 2016; Skatova, 2024). In cosmetology, AI is used to analyze customer preferences and automate product selection, enabling personalized recommendations.

Machine Learning: ML is a subset of AI in which algorithms are trained on large datasets to improve accuracy and task performance (Goodfellow, Bengio, Courville, 2016). In the cosmetics industry, ML is used for skin condition diagnosis and to create models that analyze user data, allowing for precise cosmetic product recommendations.

Optical Character Recognition (OCR): OCR is a technology that converts text from images into a digital format for subsequent analysis and processing (Smith, 2007; Wu, 2023). In cosmetics, OCR helps scan product ingredient lists on packaging, ensuring transparency of information for consumers.

Augmented Reality (AR): AR is a technology that overlays digital elements onto real-world objects on a device's screen, enabling users to interact with virtual objects in real-time (Azuma, 1997). In cosmetics, AR is used for virtual makeup try-ons, enhancing the customer experience and reducing the likelihood of returns.

Biometrics: This technology involves the automatic recognition and analysis of physical characteristics, such as skin structure and fingerprints, for identification and service personalization (Jain, 2004; Raj, 2021; Kazakevich, 2023). In cosmetics, biometric technologies assist in selecting products tailored to a client's skin condition and characteristics, improving the accuracy and effectiveness of recommendations.

Intelligent Agents: AI-powered systems, such as large language models (LLMs), interact with users through text or voice interfaces, providing personalized information and recommendations. In cosmetics, intelligent agents offer consultations, cosmetic product recommendations, and 24/7 support, improving service quality and customer satisfaction.

2. IT Architecture Development.

Based on the analysis, an IT framework was proposed, including two microservices. Key

technologies include SerpAPI, Google Search, OCR for text recognition and source retrieval, parsing for content extraction from websites, and GPT-4 for analysis and conclusions.

3. Modeling and Testing.

To validate the functionality of the proposed IT architecture, a prototype of the MVP product was created and tested using automated tests, which evaluated the accuracy of product recognition and the quality of the recommendations provided.

4. Literature Review.

A review of scientific literature was conducted, focusing on the application of modern technologies and highlighting their significance. For example, the use of machine learning for diagnosing skin diseases has shown impressive results. Research demonstrates that ML-based algorithms, such as Convolutional Neural Networks (CNN), can classify skin diseases with accuracy comparable to dermatologists and identify hidden correlations in data, enabling more accurate and personalized diagnoses (Chan, 2020; Yoo, 2024).

Another significant achievement is the integration of artificial intelligence and extended reality (XR) for creating interactive skincare recommendations. One study describes a system that analyzes skin images and provides personalized recommendations based on identified features, such as acne and pigmentation. Using XR, users can not only see the analysis results but also visualize the potential effects of using the products, making the selection process more informed and engaging (Rajegowda, 2024).

These achievements represent only a small portion of the research highlighting the potential and relevance of modern technologies in the field of cosmetology.

Results and Discussion

As a result of the analysis of modern technologies and IT solutions, a proposal was made for a cosmetic company considering its resources and limitations. The company's IT framework, presented in the diagram (Figure 1), provides the basic infrastructure sufficient for integration with external systems and the deployment of the new product.

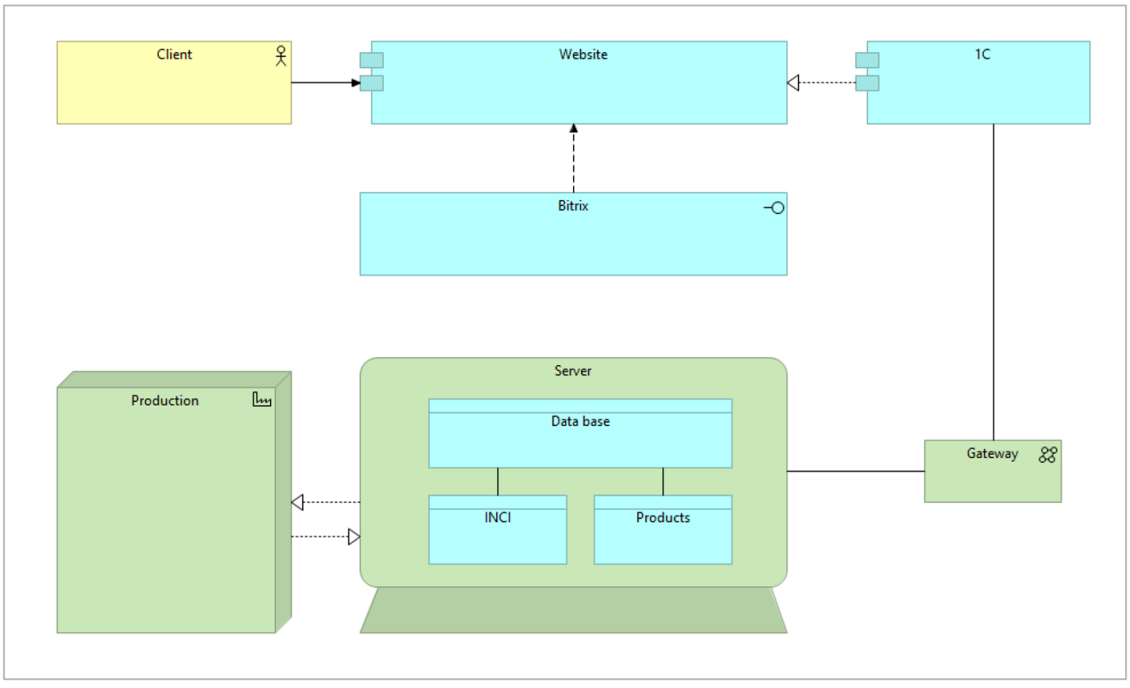


Fig. 1. IT Architecture of the Company.

Based on the experience of large companies, a web service has been developed that allows users to upload an image of a cosmetic product, specify its intended use, and receive an analysis of its composition. The service also provides usage recommendations, selects alternatives, and suggests complementary products from the company's range. User scenarios are illustrated in the Use Case diagram (Figure 2).

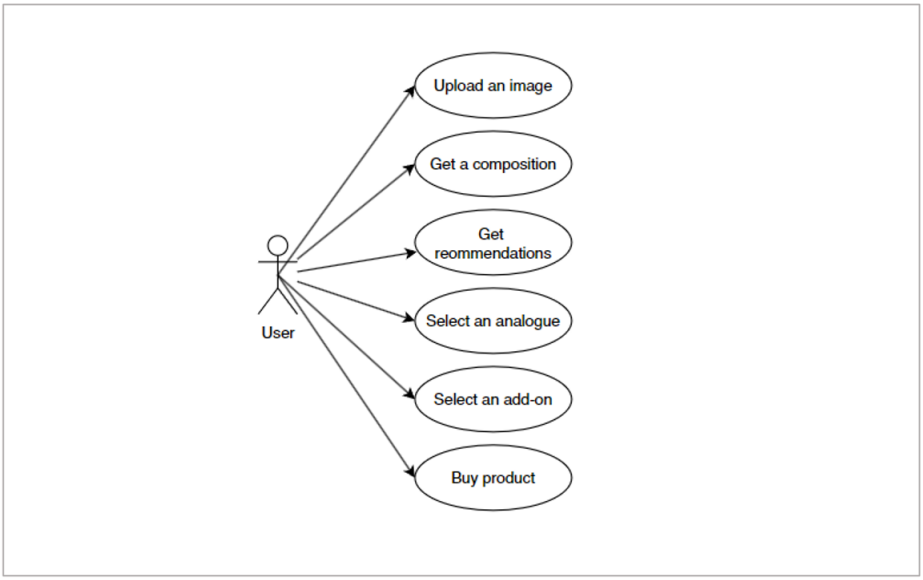


Fig. 2. Use Case Diagram.

The core of the web service consists of internet search technologies, parsing, and generative artificial intelligence models. Since the company has a database of its own products and ingredients (INCI), integration with new technologies allows the use of verified data to provide accurate recommendations.

On the backend, it is proposed to develop two microservices: the first handles the company's data, including algorithms for analyzing product compositions and providing recommendations, while the second is responsible for recognizing products from images, collecting data from external websites via parsing, and using a generative model to transform unstructured data into a formatted output for the user. This interaction between components allows for efficient processing of user queries, ensuring a response time of 5 to 15 seconds (Figure 3).

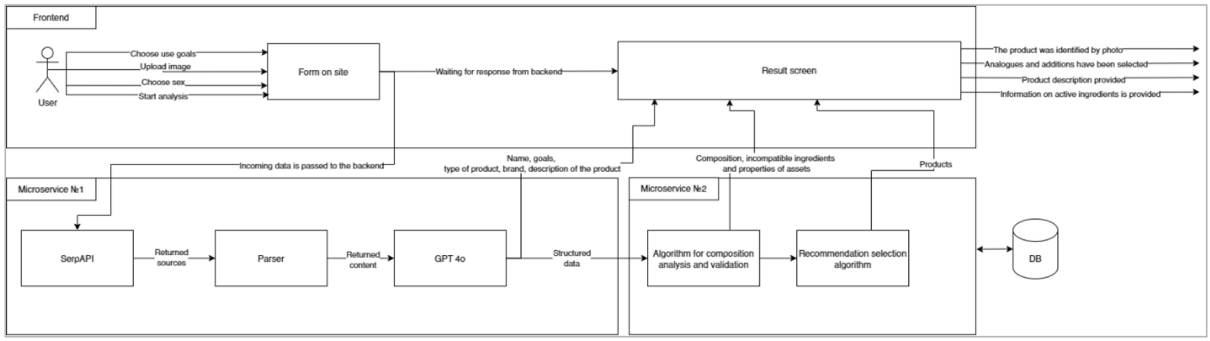
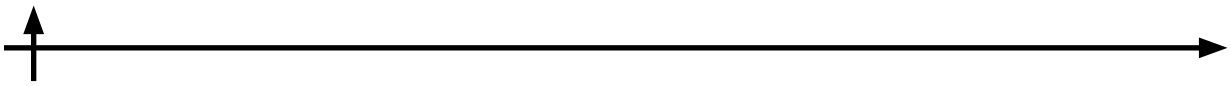


Fig. 3. Solution Architecture.



The internet search is performed using SerpAPI (Google Search API), which, when a photo is uploaded, queries the global network and returns relevant sources. Additionally, OCR technology is used to recognize text on the image, improving the accuracy of the search. Parsing technology is applied to extract content from the most relevant websites, which is then analyzed by the GPT-4 model. The output data includes the cosmetic product name, brand, product type, composition, true purpose of the product, and its description. Prompt testing helped improve the accuracy of the output.

The testing results showed that the solution architecture is flexible and easily adaptable to changes, minimizing development and deployment costs. The testing was conducted on two datasets. The first dataset consisted of images from websites: 73 products from the company and 95 products from other cosmetic brands. The second dataset consisted of 84 real photos from company users and 96 real photos from other brands. Additionally, a link to the original image on Google Drive was provided.

Table 1. Example of products from dataset

91	Protein Silk Scrub Ayurvedic	La Sultane de Saba
92	Midnight Blue Calming Cream	Dear, klairs
95	Sensibio Gel moussant cleansing gel	Bioderma
96	Mugwort Calming Soothing Gel	Round Lab
98	Нуяйас Tonique Purifiant cleansing toner	URIAGE
99	Enzyme powder enzyme powder	Skin Helpers
102	Niacinamide 10% Zinc 1%	The Ordinary
103	HYDRO GEL Reviving	PROFKA
105	Ultra-moisturizing tonic	Sendo
109	Future Solution Lx Extra Rich Cleansing Foam E	Shiseido

As a result of testing and iterative improvements, the following outcome was achieved on real product photos, which serves as a litmus test in this case. The results are divided into two parts: the quality of recognizing the full product name (recognize service) and the quality of obtaining the other required data – composition, product description, and intended use (describe service). The results are based on 5-10 runs across the entire dataset. For the company's real photos, an accuracy of 99.45% was achieved. The results are presented in Table 2.

The accuracy on photos of cosmetic products from other brands was 92.45%. The results are presented in Table 3.

Table 2. Results report of recognize service. Products of company

Iteration	Accuracy, %	Number correct/total	Average accuracy over 10 iterations, %	Total number of unique errors
1	98.63	72/73	99.45	4
2	100.00	73/73		
3	98.63	72/73		
4	98.63	72/73		
5	98.63	72/73		
6	100.00	73/73		
7	100.00	73/73		
8	100.00	73/73		
9	100.00	73/73		
10	100.00	73/73		

Table 3. Results report of recognize service. Products of other brands

Iteration	Accuracy,%	Number correct/total	Average accuracy over 5 runs, %
1	93.68	89/95	92,46
2	92.63	88/95	
3	90.62	87/96	
4	92.63	88/95	
5	92.71	89/95	

The histogram below shows the incorrect product name detections, distributed by brand.

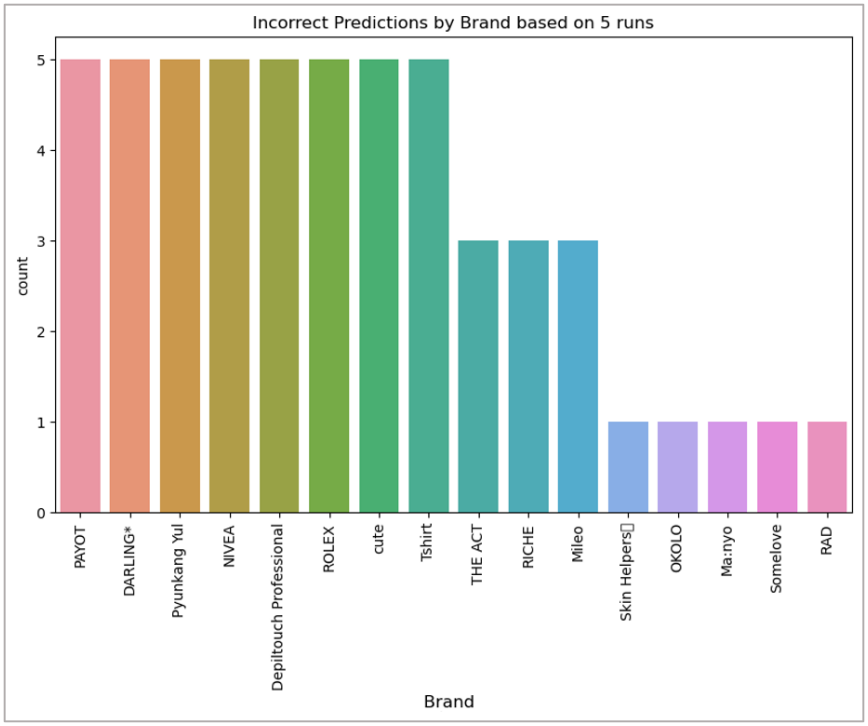


Fig. 4. Incorrect predictions by Brand.

For the identification of other product attributes from other brands, the following results were obtained. On average, for 95.63% of the products, all data were successfully retrieved, except for the composition. The average percentage of failure to retrieve the composition was 8.12%. Therefore, the overall average accuracy of obtaining product data was 87.51%. The results are presented in Table 4.

Table 4. Results report of describe service. Products of other brands

Iteration	Success Describe API, %	No composition, %	Elements total	Average Describe API Success Rate, %	Average percentage no composition, %
1	94.79	7.29	96	95.63	8.12
2	96.88	8.33			
3	95.83	6.25			
4	93.75	10.42			
5	96.88%	8.33%			

The overall success rate (End-to-end) was 92.97%. This value reflects the total success in identifying and obtaining all product data. The results are presented in Tables 5 and 6.

Table 5. Results report of end-to-end tests

Iteration	Success Recognition (describe) API, %	Success Describe API, %	Success rate (end-to-end), %
1	98.96	90.53	89.58
2	98.96	95.79	94.79
3	98.96	94.74	93.75
4	98.96	94.74	93.75

Table 6. Results report of all main parameters

№	Parameter	Average value, %
1	Success Recognition (describe) API, %	98.96
2	Success Describe API, %	93.95
3	Success rate (end-to-end), %	92.97

The launch of the solution allowed the company to enter the digital product market, providing users with a personalized experience without the need to create custom solutions and with minimal development costs. The achieved recognition accuracy and data retrieval results from the internet about the product are sufficiently high for the proposed solution architecture and within the MVP framework.

In the future, it is suggested to expand the service's functionality by adding the ability to upload and analyze multiple products simultaneously for comparison and improved diagnostics. It is also recommended to integrate an intelligent agent that could provide consultations, manage objections, and answer user queries. After testing all metrics and receiving positive feedback from users, further product upgrades using more advanced technologies to improve analysis quality and accuracy may be considered.

Conclusion

During the research, an IT architecture for a minimally viable product (MVP) web service in a cosmetic company was proposed and tested. The application of internet search technologies, parsing, and generative artificial intelligence models enabled the creation of functionality for analyzing cosmetic products with minimal costs and resources, providing high accuracy and fast processing of user queries. The developed solution demonstrated its effectiveness. The accuracy results and data retrieval for the products showed high performance, confirming the viability of the chosen technologies for the MVP.

The goal of the research, which was to develop an MVP product for personalized cosmetic product analysis, was achieved. The completion of the research tasks led to the following results:

1. The analysis of existing technologies in the cosmetics industry justified the choice of suitable tools for solving MVP tasks. Technologies such as AI, ML, OCR, and AR were studied and adapted, showing high potential for integration into cosmetic services.

2. The development and testing of the IT architecture concluded with the successful creation of a prototype, which included the interaction of microservices and the integration of external APIs for processing and analyzing cosmetic product data. Testing results confirmed the stability of the architecture and the processing speed of user queries, averaging between 5 and 15 seconds, which met the MVP requirements.

3. Recommendations for improving the user experience and further product development were formed. Based on the collected data and testing results, recommendations were developed to improve the service, aimed at enhancing usability and personalizing recommendations.

Despite the achieved results, several aspects were beyond the scope of the current research. The MVP product did not yet support simultaneous analysis of multiple products, which could limit the functionality of the service. Additionally, an intelligent agent has not been implemented yet, which could interact with users, provide consultations, and handle objections. These areas open up opportunities for future developments and improvements.

Potential directions for further research include:

1. Adding the ability to analyze multiple cosmetic products simultaneously for more accurate compatibility diagnostics.

2. Developing and integrating an intelligent agent to improve user interaction and enhance service automation.

3. Expanding the database to include more ingredients and products, which would improve the accuracy of recommendations and broaden the service's application.

These improvements and development directions will help create a comprehensive platform for automating services and enhancing customer satisfaction in the cosmetics industry.

REFERENCES

Azuma R. 1997. A Survey of Augmented Reality. Presence: Teleoperators and Virtual Environments 6(4), 355–385. doi:10.1162/pres.1997.6.4.355

Chan S., Reddy V., Myers B. 2020. Machine Learning in Dermatology: Current Applications, Opportunities, and Limitations. Journal of the American Academy of Dermatology, 10 (3), 365-386. doi:10.1007/s13555-020-00372-0

Goodfellow I., Bengio Y., Courville A. 2016. Deep Learning. MIT Press, 801.

Jain A., Ross A., Prabhakar S. 2004. An Introduction to Biometric Recognition. IEEE Transactions on Circuits and Systems for Video Technology 14(1), 4–20. doi:10.1109/TCSVT.2003.818349

Kazakevich B. 2023. Agile approach to accelerate product development using an MVP framework. Australian Journal of Multi-Disciplinary Engineering, 1-12. doi:10.1080/14488388.2023.2266164

Raj V. 2021. Performance and complexity comparison of service oriented architecture and microservices architecture. International Journal of Communication Networks and Distributed Systems 27 (1), 100. doi:10.1504/ijcnds.2021.116463

Rajegowda G., Spyridis Y., Villarini B. 2024. An AI-Assisted Skincare Routine Recommendation System in XR. ArXiv preprint. Smart Innovation, Systems and Technologies AI Technologies and Virtual Reality, 381-395. doi:10.48550/arXiv.2403.13466

Russell S., Norvig P. 2016. Artificial Intelligence: A Modern Approach. Pearson Education, 116.

Skatova M. 2024. Assessment of requirements of regulatory documents on the use of artificial intelligence in higher education. Technoeconomics 3, 2 (9), 22–33. DOI: https://doi.org/10.57809/2024.3.2.9.2

Smith R. 2007. An Overview of the Tesseract OCR Engine. Document Analysis and Recognition, ICDAR, 2, 629–633. doi:10.1109/ICDAR.2007.4376991

Wu L. 2023. Agile Design and AI Integration: Revolutionizing MVP Development for Superior Product Design. International Journal of Education and Humanities 9 (1), 226-230. doi:10.54097/ijeh.v9i1.9417

Yoo Ha. 2024. The Effect of Co-evolution of AI-Based Customized Cosmetics Preparation on Customized Cosmetic Preparation Managers and Potential Demand Values. Journal of the Korean Society of Cosmetology 30 (1), 25-34. doi:10.52660/jksc.2024.30.1.25

Yoo Ha. 2024. The Effects of Opinions on AI-based Customized Cosmetic Preparation Managers on Potential Demand Values and Development Directions. Journal of the Korean Society of Cosmetology 30 (2), 323-333. doi:10.52660/jksc.2024.30.2.323

Estee Lauder smart chatbot. URL: https://habr.com/ru/news/810849/ (accessed: 01.02.2025).

How the SkinVision algorithm works. URL: https://www.skinvision.com/articles/how-does-skinvisions-algorithm-detect-skin-cancer/ (accessed: 20.02.2025).

LLM agents. URL: https://towardsdatascience.com/intro-to-llm-agents-with-langchain-when-rag-is-not-enough-7d8c08145834/ (accessed: 08.02.2025).

L'Oreal Paris “Make Up Genius” app. URL: https://www.loreal.com/ru-ru/russia/press-release/group/mobile-app-make-up-genius-of-loreal-paris/ (accessed: 26.02.2025).

Neutrogena Skin360 Scanner. URL: https://www.designboom.com/technology/neutrogena-skin-scanner-skin360-01-06-2018/ (accessed: 22.02.2025).

OCR in Yuka. URL: https://www.wired.com/story/yuka-app/ (accessed: 10.02.2025).

Review of Sephora's Visual Artist app. URL: https://www.businessinsider.com/sephora-visual-artist-app-feature-teaches-how-to-apply-makeup-using-ai-photos-2017-3/ (accessed: 24.02.2025).

Scale of the cosmetics market (report). URL: https://www.fortunebusinessinsights.com/cosmetics-market-102614/ (accessed: 10.02.2025).

СПИСОК ИСТОЧНИКОВ

Azuma R. 1997. A Survey of Augmented Reality. Presence: Teleoperators and Virtual Environments 6(4), 355–385. doi:10.1162/pres.1997.6.4.355

Chan S., Reddy V., Myers B. 2020. Machine Learning in Dermatology: Current Applications, Opportunities, and Limitations. Journal of the American Academy of Dermatology, 10 (3), 365-386. doi:10.1007/s13555-020-00372-0

Goodfellow I., Bengio Y., Courville A. 2016. Deep Learning. MIT Press, 801.

Jain A., Ross A., Prabhakar S. 2004. An Introduction to Biometric Recognition. IEEE Transactions on Circuits and Systems for Video Technology 14(1), 4–20. doi:10.1109/TCSVT.2003.818349

Kazakevich B. 2023. Agile approach to accelerate product development using an MVP framework. Australian Journal of Multi-Disciplinary Engineering, 1-12. doi:10.1080/14488388.2023.2266164

Raj V. 2021. Performance and complexity comparison of service oriented architecture and microservices architecture. International Journal of Communication Networks and Distributed Systems 27 (1), 100. doi:10.1504/ijcnds.2021.116463

Rajegowda G., Spyridis Y., Villarini B. 2024. An AI-Assisted Skincare Routine Recommendation System in XR. ArXiv preprint. Smart Innovation, Systems and Technologies AI Technologies and Virtual Reality, 381-395. doi:10.48550/arXiv.2403.13466

Russell S., Norvig P. 2016. Artificial Intelligence: A Modern Approach. Pearson Education, 116.

Skatova M. 2024. Assessment of requirements of regulatory documents on the use of artificial intelligence in higher education. Technoeconomics 3, 2 (9), 22–33. DOI: https://doi.org/10.57809/2024.3.2.9.2

Smith R. 2007. An Overview of the Tesseract OCR Engine. Document Analysis and Recognition, ICDAR, 2, 629–633. doi:10.1109/ICDAR.2007.4376991

Wu L. 2023. Agile Design and AI Integration: Revolutionizing MVP Development for Superior Product Design. International Journal of Education and Humanities 9 (1), 226-230. doi:10.54097/ijeh.v9i1.9417

Yoo Ha. 2024. The Effect of Co-evolution of AI-Based Customized Cosmetics Preparation on Customized Cosmetic Preparation Managers and Potential Demand Values. Journal of the Korean Society of Cosmetology 30 (1), 25-34. doi:10.52660/jksc.2024.30.1.25

Yoo Ha. 2024. The Effects of Opinions on AI-based Customized Cosmetic Preparation Managers on Potential Demand Values and Development Directions. Journal of the Korean Society of Cosmetology 30 (2), 323-333. doi:10.52660/jksc.2024.30.2.323

Умный чат-бот Estйe Lauder. URL: https://habr.com/ru/news/810849/ (дата обращения: 01.02.2025).

Как работает алгоритм SkinVision. URL: https://www.skinvision.com/articles/how-does-skinvisions-algorithm-detect-skin-cancer/ (дата обращения: 20.02.2025).

LLM agents. URL: https://towardsdatascience.com/intro-to-llm-agents-with-langchain-when-rag-is-not-enough-7d8c08145834/ (дата обращения: 08.02.2025).

Приложение “Make Up Genius” от L’Oreal Paris. URL: https://www.loreal.com/ru-ru/russia/press-release/group/mobile-app-make-up-genius-of-loreal-paris/ (дата обращения: 26.02.2025).

Сканер Neutrogena Skin360. URL: https://www.designboom.com/technology/neutrogena-skin-scanner-skin360-01-06-2018/ (дата обращения: 22.02.2025).

OCR в Yuka. URL: https://www.wired.com/story/yuka-app/ (дата обращения: 10.02.2025).

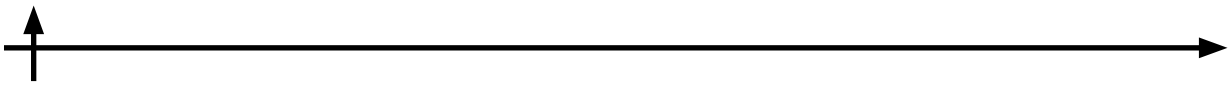
Обзор приложения Sephora “Visual Artist”. URL: https://www.businessinsider.com/sephora-visual-artist-app-feature-teaches-how-to-apply-makeup-using-ai-photos-2017-3/ (дата обращения: 24.02.2025).

Масштабы косметического рынка (отчет). URL: https://www.fortunebusinessinsights.com/cosmetics-market-102614/ (дата обращения: 10.02.2025).

INFORMATION ABOUT AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

KRASNOSHCHEKOV Artyom S. – student.
E-mail: artyomkrasn@mail.ru
КРАСНОЩЕКОВ Артём Сергеевич – студент.
E-mail: artyomkrasn@mail.ru

SHEPEL Rostislav A. – master of Science.
E-mail: efyrs5@nottingham.ac.uk
ШЕПЕЛЬ Ростислав Андреевич – магистр.
E-mail: efyrs5@nottingham.ac.uk
ORCID: https://orcid.org/0009-0004-2447-112X



Статья поступила в редакцию 03.03.2025; одобрена после рецензирования 05.03.2025; принята к публикации 10.03.2025.

The article was submitted 03.03.2025; approved after reviewing 05.03.2025; accepted for publication 10.03.2025.