

# XAI: Using Smart Photobooth for Explaining History of Art

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## ABSTRACT

The rise of Artificial Intelligence has led to advancements in daily life, including applications in industries, telemedicine, farming, and smart cities. It is necessary to have human-AI synergies to guarantee user engagement and provide interactive expert knowledge, despite AI's success in "less technical" fields. In this article, the possible synergies between humans and AI to explain the development of art history and artistic style transfer are discussed. This study is part of the "Smart Photobooth" project that is able to automatically transform a user's picture into a well-known artistic style as an interactive approach to introduce the fundamentals of the history of art to the common people and provide them with a concise explanation of the various art painting styles. This study investigates human-AI synergies by combining the explanation produced by an explainable AI mechanism with a human expert's insights to provide reasons for school students and a larger audience.

## CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

## KEYWORDS

User-Centred Design, User Experience

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## 1 INTRODUCTION

The emergence of AI has led to enormous changes in the last decade, including applications in farming, industries, and medicine. This trend has recently expanded into diverse fields such as cultural heritage and digital history. In fact, making cultural heritage more accessible and more engaging by bringing it closer to more audiences is considered to be one of the main contributions of the latest generation of AI systems [5]. Though the importance of AI in other domains has increased and run successfully, human-AI collaborations are still in the early stages of development, and further research work is needed in this field, especially in understudied fields such as AI and art. The "Smart Photobooth" is a project designed to share information on the history of art and artistic styles. Also, to share the most recent machine learning processes and their applications in art development and categorization. It is a fun and engaging smart machine that allows users to engage with AI and study the training methodology of intelligent machines. It entices people of various genders, ages, and backgrounds to study more and explore computational methodologies. Upon entering the photo booth, the user may snap a self-portrait and then choose a style to apply to the picture. Professional artists select a collection of artistic styles, and it may be a well-known artistic style (for example, cubism and impressionism). The style conversion is achieved using Neural Style Transfer (NST) [9]. It uses Generative Adversarial Networks (GAN) [9] to transfer the pictures. The NST technique is trained with two training datasets that reflect end-user

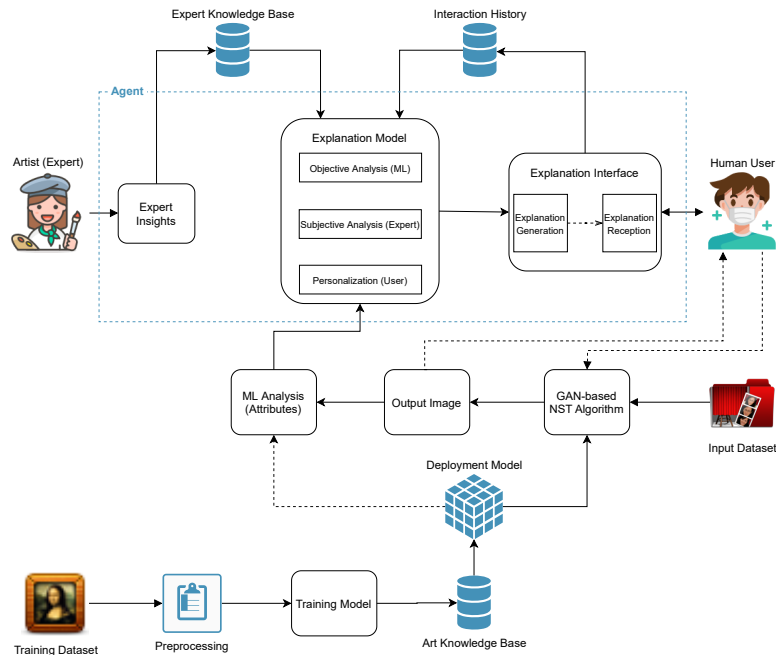


Figure 1: Explainable Human-Agent Architecture for Art

portraits and artistic styles. After the user receives their converted image, firsthand, they receive a short tutorial that briefly explains the artistic style and its place in the history of art, depending on familiar paintings from the style. On the other hand, an AI explanation is provided, underlining the style characteristics present in the converted user portrait. The explanation is determined by the explainable AI (XAI) technique [5].

## 2 ARCHITECTURE

The Smart Photobooth is a playful and interactive smart "machine" where users can experiment with AI and learn about the process of training smart machines. The Smart Photobooth combines AI and Art. The scenario of the Smart Photobooth is the following: when the user enters the booth, they can take a portrait of themselves and then select a style to transform their image, based on several available styles selected by professional artists (e.g., impressionism, cubism, etc.). The style transfer is conducted using an NST mechanism [9]. Once the user obtains the output (i.e., their portrait pictured in the chosen style), they also obtain a multi-media presentation explaining both (i) the basic principles of the chosen style, its historical context, main contributors, and most famous paintings, and (ii) an illustration of how the style influenced the visual features of the output image.

Figure 1 depicts our proposed architecture to explain the history of art to human users by agents. The bottom side presents the machine learning model, including the GAN-based NST Algorithm. The top side of the architecture presents the agent model responsible for explainability. The two-way arrow between the Explanation Interface and Human User highlights an interaction where the feedback from the user is used to update the Explanation Model. In addition, the Smart Photobooth gives high

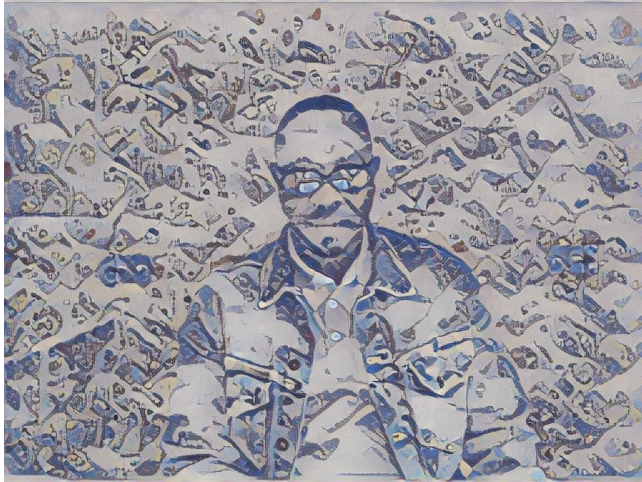
importance to the data privacy of the users and complies with GDPR (General Data Protection Regulation). The original picture of the user that was taken is deleted. Only the artistic pictures are stored anonymously and securely. Figure 2 presents the output of the Smart Photobooth.

## 3 CHALLENGES AND FUTURE WORKS

In AI and Art dissemination, the usage of XAI is in its infancy, with the majority of the pioneering work accomplished at the conceptual level [5]. The work aims to implement and evaluate XAI-based art dissemination in a practical situation. The architecture explained above merges end-user input, the artist's expertise, and the outcome of the highly sophisticated machine learning techniques. The agent is responsible for integrating this diverse data and making it accessible and comprehensible to various parties.

The Photobooth project uses multiple AI systems. Specifically, the NST technologies, the style interpretation mechanism and the agent responsible for receiving the explanation from the artist and user-specific input. It is challenging to combine these diverse explanations since it requires symbolic information such as the artist's input and the user data as well as sub-symbolic information inside the black-box machine learning system. Using the most recent developments in neuro-symbolic AI, which proposes the integration of symbolic AI systems, is one possible answer to this problem [3]. The latest XAI research indicates that neuro-symbolic integration is best suited and more effective for XAI [2]. Specifically, compared to the current strategy, which is dependent on a simple merging of artist explanations with the visual descriptors arising from the neural network, the neuro-symbolic method permits for a comprehensible system's output since the agent could reason and influence the symbolic information derived from the neural

network. In addition, the extracted information is also made clear and attainable by the artist, who can also communicate with the knowledge to optimize the machine learning technique's performance. The majority of the explanations and observations given



**Figure 2: A digital artwork - Output of the booth with one style**

by the Smart Photobooth are conveyed through voice and video. The information is thus unavailable to people with hearing and/or visual difficulties. Another possibility is to depend on solutions currently being designed to construct cultural heritage reachable to this group of people. Bind photography [12], for instance, may aid users with limited eyesight in taking photographs by giving auditory feedback that improves the focusing of the camera. Additionally, explanations must be available online for individuals who are unable to visit the art galleries [10].

Nowadays, gamification [4, 6, 8] has become popular in various fields, including information studies, education, and human-computer communication [11]. It is also an intriguing method for promoting user involvement and magnifying positive use trends, such as boosting social interaction, user activities, or the productivity and quality of actions [1].

#### 4 CONCLUSION

This research explained the Smart Photobooth, an inter-disciplinary outreach and knowledge dissemination project. The project depends on XAI to explain to the end-users the history of art and artistic styles. Such an explanation involves a mix of explanations from an artist (human expert) and interpretation from a machine learning system. In order to achieve this combination, the research presented an architecture driven by an agent responsible for achieving this combination. The architectural components were identified and discussed. Unresolved difficulties and obstacles were identified with possible solutions. As the Smart Photobooth project began in early 2021, it is still in development. The smart photobooth is now being installed, and the suggested architecture and XAI mechanism are being developed. The last stage is to assess the effectiveness of the

explanations in engaging end-users and improving their knowledge of art history. To accomplish this, particular XAI metrics [7] will be specified, various user studies will be undertaken, and the outcomes of these studies will be statistically verified, investigated, and evaluated.



**Figure 3: Outside the booth**



**Figure 4: Inside the booth**

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