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AI-Generated NFT: Integrating AI and Blockchain for New Product Creation

Final Class Project

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Contents

Abstract

This project presents the development of a decentralized application (dApp) designed to generate and mint NFTs from images created by Artificial Intelligence. Inspired by the seminar "Overview of Blockchain: Concepts, Applications, and Relevant Initiatives", the work explores the intersection of AI and blockchain as a foundation for innovative digital product creation. In the proposed system, users submit text prompts to generative AI models, specifically Stable Diffusion v1.5 and v2.1—which produce unique digital artworks. These images are then tokenized as NFTs on a blockchain network, using smart contracts to ensure ownership, authenticity, and provenance. The project also employs AI tools such as Lovart.ai for branding and visual identity creation, and ChatGPT/GitHub Copilot to support code generation and prompt refinement. By integrating AI-driven asset creation with blockchain-based verification, the project demonstrates practical insights into decentralized technologies, highlights real-world implementation challenges, and showcases how the combination of AI and blockchain can enable novel digital products and user experiences.

1 Introduction

The accelerated progress of Artificial Intelligence (AI) and blockchain technologies has enabled significant opportunities for the creation, authentication, and distribution of digital assets. Generative AI models, particularly text-to-image architectures based on diffusion processes, have transformed creative workflows by enabling the automated production of high-quality visual content from natural language prompts. In parallel, blockchain networks and Non-Fungible Tokens (NFTs) have introduced cryptographically secure mechanisms for establishing provenance, ownership, and controlled scarcity of digital artifacts.

This project emerges from the convergence of these technological domains and from practical challenges encountered during experimentation with open-source generative models. While diffusion models such as Stable Diffusion (v1.5 and v2.1) offer flexibility and transparency, their capacity to generate high-fidelity images depends heavily on substantial GPU resources. Initial attempts to run these models locally revealed computational bottlenecks, including slow inference times and memory limitations. These constraints motivated the exploration of alternative architectures, optimized pipelines, and cloud-based inference solutions. Such observations are not only relevant to the development of this project but also highlight broader limitations that persist within open-source AI ecosystems.

Building on these insights, this work proposes a decentralized application (dApp) that integrates AI-driven image synthesis with NFT minting on a blockchain. Users provide textual prompts that are processed by diffusion models to generate unique images, which can then be immutably registered on-chain through smart contracts. This approach ensures traceability, authenticity, and public verifiability of each generated asset.

Beyond image generation, AI systems support additional aspects of the project, including branding and software engineering workflows. Tools such as Lovart.ai were used to create visual identity materials, while large language models including ChatGPT [1] and GitHub Copilot [2] assisted with tasks such as code generation, debugging, documentation, and prompt refinement. Together, these tools demonstrate the multifaceted role of AI across both creative and technical stages of development.

The overarching objective of this work is to provide a practical and systematic exploration of how generative AI and blockchain infrastructures can be combined to produce novel digital products and user experiences. By implementing every component of the pipeline, from model inference to smart contract deployment, the project offers hands-on insights into the technical challenges, computational trade-offs, and innovative potential associated with integrating decentralized systems with modern generative AI technologies.

2 Methodology

The methodology adopted in this project integrates generative AI, decentralized storage, and blockchain-based tokenization. The workflow is organized into three main stages: (1) AI-driven image creation, (2) decentralized storage via IPFS, and (3) tokenization using a custom ERC-1155 smart contract.

2.1 AI Image Generation

All visual assets were generated using Stable Diffusion–based text-to-image models [3].

Initially, Stable Diffusion 1.5 was executed locally on CPU, allowing early experimentation with prompt design and artistic direction. However, generation times were long (approximately 10–15 minutes per image) and visual quality was limited. To overcome computational bottlenecks, the workflow was migrated to Google Colab [4] with GPU acceleration, first using Stable Diffusion 2.1, which reduced generation time but did not significantly improve image fidelity. Finally, SDXL-Turbo was employed in Colab, yielding substantially faster generation and higher-quality images.

A set of structured prompts was designed to ensure stylistic coherence across all outputs. Each prompt underwent iterative refinement until the generated images matched the desired artistic and conceptual direction. For each model and configuration, separate branches were maintained in the repository to preserve versioning and reproducibility.

2.2 Decentralized Storage on IPFS

Following generation, each image was uploaded directly to the InterPlanetary File System (IPFS) [5].

IPFS was chosen for its content-addressable storage mechanism, which guarantees immutability, reproducibility, and verifiability of the assets.

Each upload produced a unique Content Identifier (CID), which is referenced in the token metadata. This approach ensures that each NFT points to the exact same immutable image file, preserving the integrity of the digital asset over time.

2.3 ERC-1155 Smart Contract Architecture

To tokenize the generated images, a modified ERC-1155 smart contract based on OpenZeppelin's implementation [6] was deployed.

The ERC-1155 standard was selected over ERC-721 due to the following advantages:

- **Multi-token capability:** a single contract can manage multiple asset types, reducing gas consumption and simplifying contract administration.
- **Semi-fungible design:** a single artwork can be minted in multiple editions, which aligns with the project's requirement to generate several NFTs from the same AI-generated image.

The contract stores a unique token URI for each token ID, which references the IPFS link of the associated image. Because ERC-1155 supports batch operations, multiple NFTs can be minted or transferred within a single transaction, improving efficiency and reducing costs.

2.4 Metadata Linking

For each token ID, additional information such as the prompt used for image generation, edition number, and copy count (when applicable) is maintained on-chain

or within the token metadata associated with the URI. This ensures transparency, traceability, and reproducibility of the creative process, allowing both creators and users to verify the origin and uniqueness of each digital asset.

3 Results

This section presents the results obtained from the AI-assisted generation of visual assets, the branding of the project, and the comparative evaluation of different generative model versions.

3.1 Branding and Visual Identity

The visual identity of the project was generated using an AI tool called Lovart.ai [7].

The following prompt was used to produce a comprehensive branding package:

> "Minimalist and futuristic logo for a NFT DApp called 'NFT 4U', neon blue and purple colors, digital art style, includes a token icon and modern typography, transparent background"

Using this prompt, the AI generated a complete set of branding assets, including:

- Logo
- Business card
- Mobile application interface
- Social media profile images
- Website UX/UI mockups
- Merchandise designs (e.g., t-shirts, banners)

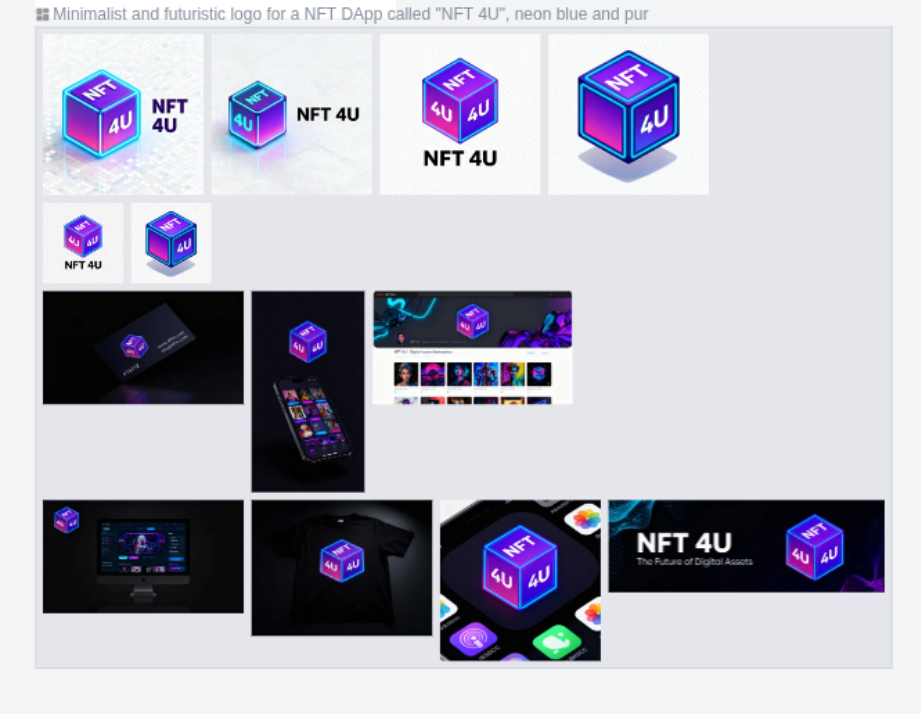


Figure 1: AI-generated branding assets for NFT 4U.

3.2 AI Image Generation Across Model Versions

To evaluate model performance and visual quality, the same test prompt was used across three versions of Stable Diffusion:

> "A small red apple on a wooden table, realistic lighting, high detail, simple background"

- **Stable Diffusion v1.5:** Limited quality, long inference times on CPU.
- **Stable Diffusion 2.1:** GPU acceleration in Google Colab reduced generation time, moderate visual fidelity.
- **SDXL-Turbo:** Best results with higher quality, finer details, faster generation, and more nuanced prompt control.

Figure 2: Comparison of AI-generated images for the same prompt across Stable Diffusion v1.5, v2.1, and SDXL-Turbo.

3.3 Prompt Refinement and Nuanced Generation

The versatility of SDXL-Turbo enabled experimentation with complex prompts to generate specific visual styles:

1. **Prompt 1 – Medieval Fantasy Warrior:**

   "Epic fantasy medieval warrior surrounded by magic energy, wearing ancient runic armor, holding an enchanted sword glowing with arcane light. Dramatic lighting, mystical fog, vibrant color contrast, epic pose, extremely detailed fantasy aesthetic."

2. **Prompt 2 – Comic Studio Style:**

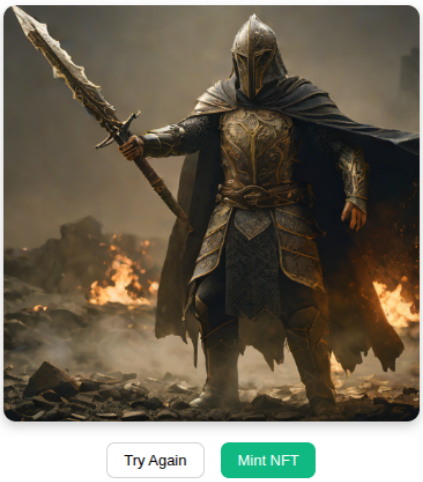
   "Dynamic comic-book illustration in professional comic studio style, bold ink outlines, vivid flat colors, halftone textures, exaggerated action pose, expressive face, dramatic shadows, clean line art, high-energy composition."

3. **Prompt 3 – Cyberpunk Realistic / Photo:**

   "Hyper-realistic cinematic portrait of a futuristic cyberpunk warrior in a neon-lit city. Real human skin texture with pores, subtle imperfections, photorealistic neon reflections on metal implants and visor, natural hair, shallow depth of field, DSLR-quality, zero cartoon or CGI look."

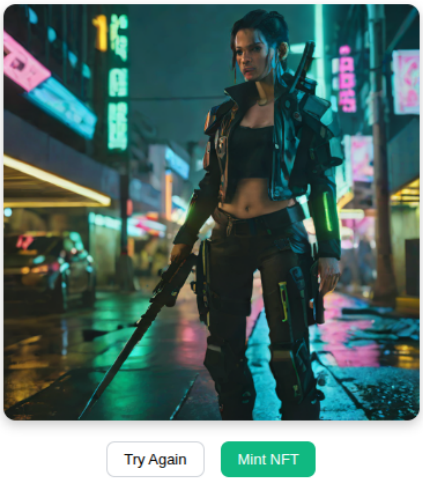
4. **Prompt 4 – Medieval Realistic / Photographic:**

"Ultra-realistic cinematic photograph of a medieval warrior standing in a foggy battlefield. Real human with dirt and sweat on the skin, authentic medieval armor with worn steel and leather details. Heavy sword, embers in the air, dramatic lighting, shallow depth of field, looks like a real historical portrait."

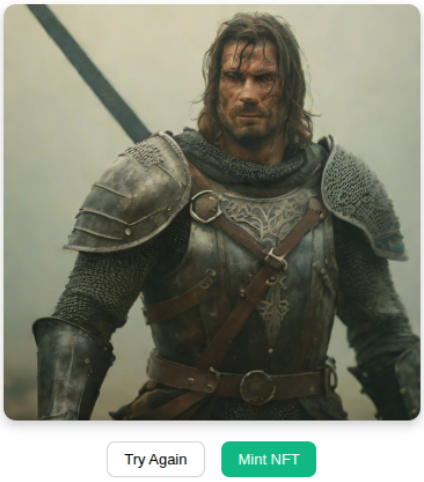


(a) Medieval Fantasy Warrior

(b) Comic Studio Style



(c) Cyberpunk Realistic / Photo



(d) Medieval Realistic / Photographic

Figure 3: Examples of AI-generated images using SDXL-Turbo with different prompts.

3.4 Observations

Overall, the results show that:

- AI-assisted branding provided a complete and coherent visual identity for the project.
- Model version significantly impacts image quality and generation speed, with SDXL-Turbo outperforming previous versions.
- Nuanced prompts allow effective control of artistic style, realism, and scene composition.

4 Conclusions

This project explored the practical integration of generative AI and blockchain technology for the creation of unique digital assets. By developing a decentralized application (dApp) capable of generating NFTs from AI-produced images, the work demonstrated how text-to-image models can be combined with smart contracts to ensure ownership, provenance, and traceability of digital artworks.

Through iterative experimentation with different versions of Stable Diffusion and SDXL-Turbo, the project highlighted the impact of model selection on image quality, generation speed, and prompt versatility. Additionally, AI tools were successfully applied to design the project's branding and visual identity, showcasing the multifaceted role of artificial intelligence across both creative and technical stages.

The use of an ERC-1155 smart contract enabled flexible tokenization, supporting multiple editions of the same artwork and efficient batch transfers. This implementation illustrates how semi-fungible tokens can enhance the scalability and manageability of NFT projects.

Overall, the project provides a comprehensive, hands-on exploration of AI and blockchain integration, offering insights into technical challenges, computational trade-offs, and creative possibilities. For further reference, the complete source code, generated assets, and a demonstration video of the dApp are available at the project repository: `https://github.com/vdsilveira/NFT4U-AIGeneratedAssets/tree/main`.

5 References

[1] OpenAI, "Chatgpt," https://chat.openai.com/, accessed: 2025-11-22.

[2] GitHub Copilot, "Github copilot ai pair programmer," https://github.com/features/copilot, accessed: 2025-11-22.

[3] Stability AI, "Stable diffusion text-to-image models," https://stability.ai/blog/stable-diffusion, accessed: 2025-11-22.

[4] Google Colaboratory, "Google colaboratory," https://colab.research.google.com/, accessed: 2025-11-22.

[5] IPFS, "Interplanetary file system (ipfs)," https://ipfs.io/, accessed: 2025-11-22.

[6] OpenZeppelin, "Openzeppelin contracts: Erc-1155," https://docs.openzeppelin.com/contracts/4.x/erc1155, accessed: 2025-11-22.

[7] Lovart.ai, "Ai-powered branding and visual identity generation," https://www.lovart.ai, accessed: 2025-11-22.