Building a Mock NFT Marketplace for Learning AI and Blockchain Technologies

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Background

Artificial Intelligence, one of the trending technologies in the world, leverages computer science to build algorithms that make predictions or classifications based on input datasets, enabling capabilities of solving problems and making decisions on behalf of humans [1]. Along with AI, blockchain technology is also rapidly growing in its embryonic stage with much potential for evolution in the coming future. Blockchain is a system that facilitates the recording of transactions in a shared and immutable manner and tracking assets in a peer-to-peer network [2]. Currently, the most crucial function of Blockchain is storing a program called a smart contract, which is basically a collection of code and data defining the rules for transactions [3]. Typically the smart contracts are configured during minting, which is a process of creating digital assets called Non-Fungible Tokens (NFTs) that exist on the Blockchain [4]. This novel technology has been booming since early 2021, and the future of the NFT market seems very promising as it has the potential to be infinitely valuable in numerous industries.

In recent decades, the development of new technologies such as Artificial Intelligence and Blockchain has been accelerating dramatically, significantly influencing the economy and society. This is fueled by the Internet, which has become a global network bridging billions of individuals and companies worldwide [5]. This rapid growth of technology is supported by some statistics showing that the global technology industry makes up 35 percent of the total world market and is worth USD 5.2 trillion [6]. The global AI and blockchain market occupies a large proportion of the technology industry, estimated to reach USD 89.8 billion in 2025 [7] and USD 67.4 billion in 2026 [8].

Technological innovation brings significant benefits to society as a whole. More specifically, Artificial Intelligence technology is actively applied to benefit various social fields such as health care, national security, and criminal justice due to its intelligent and adaptable nature. For example, AI can detect damaged organs or tissues in human bodies or replace human commanders in wars, saving a great deal of time in the decision-making and following actions [9]. Furthermore, AI usage in financial sectors significantly increases their operations’ efficiency by automating their business processes, such as stock trading and customer services. On the other hand, industries and business sectors also benefit from growing blockchain technology. Due to its enhanced security and transparency, Blockchain helps to prevent fraudulent or unauthorized activities across all sectors. Moreover, it provides more resilient supply chains as it tracks the entire journey of the products with excellent efficiency and speed [10].
However, the evolution of these novel technologies is undoubtedly controversial as it causes unintended negative consequences, affecting different aspects of society and industries. The biggest problem is that the third-party regulations or restrictions on the use of these technologies are not abundant and still uncertain and inconclusive even if they exist, leaving many questions in the ethical aspect. One of the examples is a technique called Deepfake, which uses Artificial Intelligence to create media in which a person's likeness in an existing image or video is digitally altered with that of someone else, and an ethical issue arises as this is often performed without their permission. Ninety-six percent of existing deepfakes exist in the form of pornography [11]. Moreover, many fraudulent schemes in the blockchain industries take advantage of the fact that the products built on Blockchain are traded with cryptocurrency payments, which do not own adequate legal protections and are typically irreversible. Transactions of cryptocurrency also involve security issues, including exposure of personal information or wallet address, because a public ledger record the transactions [12]. Essentially, these problems arise from the lack of awareness and knowledge of the general public who encounter new technologies by any means regarding the fundamentals and use of the technologies.

As the field of technology continues to expand, it is imperative to educate people on not only the application of the technology or skills but also the awareness of how the technological product they build or consume can directly or indirectly affect the individual, society, economy, and environment at large. This project aims to build an educational platform accessible to people of all ages and levels of knowledge as a medium to maximize the benefits and minimize the drawbacks of the growth of technology.
Objective

This project aims to implement a web-based application that provides a mock NFT marketplace where users can generate images and mint and trade NFTs while gaining various insights and knowledge on the technologies such as blockchain and artificial intelligence in a user-interactive manner. As the product targets a wide variety of consumers regardless of their ages, education levels, or occupations, it is framed intuitively and user-friendly. So that the users experience a low entrance barrier to the concepts and applications of the exotic technologies they are unfamiliar with.

This platform will consist of mainly three functionalities. Firstly, users will be able to input a keyword in a text format which is then passed into the Artificial Intelligence algorithm to generate images. Secondly, they can mint an NFT with the image they have created on the platform, which will be stored in a decentralized blockchain network and thus cannot be modified, edited, or deleted. Lastly, the users can choose to sell the NFTs they have minted at a predetermined price or buy the existing NFTs on the open mock marketplace. This means they can obtain an end-to-end trading experience with a cryptocurrency with no real monetary value.

Across all the functionalities and services provided in the platform, we will add a thorough explanation of the underlying logic and technologies behind the application, along with the fascinating digital effects and visuals in the user interfaces. Moreover, the consumers will learn how those technologies are applied within the products or services they use and gain a high-level understanding of the technologies in various aspects such as current development trends, impact on the world, and potential direction of the growth. This project aims to stimulate the technology market to be more active and encourage the healthy growth of technologies with appropriate regulations and schemes.
Methodology

Introduction

As mentioned in the objectives, our platform users will experience a three-step learning process on a web-based application. As a first step, Artificial Intelligence automatically creates and displays a few images based on the description of the image the user wants to create. During the whole process of crafting images, the users are shown some educational materials related to AI technology, such as videos and simple interactive tutorials. Users can select one of the automatically generated images after AI training and mint an NFT on the Klaytn blockchain network as a second step. The following section describes the technologies and tools needed to develop our application.

![Figure 1: High-level overview of the project workflow](image)

**Step 1:** User accesses EduNFT front-end web application; **Step 2:** Front-end receives a text description from the user and calls Dall·E API & AI training material API; **Step 3:** While the user watches the training materials, Back-End also returns auto-generated images to Front-end; **Step 4:** Front-End calls NFT Metadata Generator API with selected image by the user & AI training material API; **Step 5:** Back-End saves the image and NFT Metadata in JSON format to IPFS database and returns the metadata URL in step 6; **Step 6:** Back-End returns the metadata URL; **Step 7:** Front-End calls minting function defined in caver-js; **Step 8:** caver-js calls publicMint() function defined in the smart contract deployed in Klaytn blockchain node; **Step 9:** Smart contract mint the metadata to Klaytn nodes and generate NFT;
Equipment / Platform Setup

The application development is divided into three categories, Front-end, Back-end, and Smart Contract.

Front-end

Front-end web development is the process of building a website's graphical user interface that offers users an interactive view [13]. Among many frameworks for front-end development, our project chose React, a free and open-source front-end JavaScript library for building user interfaces as a combination of components [14]. React's use has been widespread in front-end development as it has a low barrier to entry compared to other frameworks. The React repository on GitHub has over 195,000 stars and a significant development community that records over 10 million weekly downloads through a package manager for JavaScript called npm.

The webpage has a function that allows users to mint NFT on Klaytn blockchain nodes directly. To make this possible, it is also necessary to implement a bridge between the front-end and Klaytn nodes to exchange decentralized data through the web application. Caver-js is a Javascript library that pre-defines a set of APIs that can communicate with the Klaytn network. It helps to ease the development difficulties since the library abstracts the complexity of interactions [15].

Back-end

Back-end refers to a computer program's components that allow it to operate and cannot be accessed by a user. The back-end is also called the data access layer of software or hardware and includes any functionality that needs to be accessed. The back-end of this project will be mainly responsible for providing AI and NFT training materials and automatically creating AI images.

In this project, FastAPI will be used to develop the back-end. FastAPI is a modern web framework with high speed and outstanding performance for building APIs with Python 3.7+ based on standard Python-type hints [16]. Also, using a Python-based back-end framework easily enables to use of the DALL·E or DALL·E 2 python library provided by the OpenAI research laboratory. DALL·E and DALL·E 2 are machine learning models developed by OpenAI to generate digital images from natural language descriptions [17]. DALL·E 2 can create original, realistic images and art from a text description. Also, by using the fastAPI framework, we will implement an API that stores the images generated by DALL·E in InterPlanetary File System (IPFS) and generates NFT metadata in the JSON format required for NFT minting.

IPFS is a distributed and decentralized peer-to-peer hypermedia protocol for storing and accessing media assets, including movies and photos. It enables media files, or NFTs, to be
stored permanently without limiting content blocking and deletion on a physical server [18]. In this project, a service called Pinata will be used to support the IPFS Database system.

**Smart Contract**

NFTs use a mechanism called a smart contract, which is stored on a blockchain, and this program runs when predetermined conditions are met. They are typically used to automate the execution of transactional agreements between the NFT owner and the buyer so that all participants in the program can become aware of the outcome immediately without any involvement of intermediaries, central authorities, or time loss [19]. An object-oriented, high-level programming language called Solidity is used to implement smart contracts on the blockchain nodes.

We have chosen to use the Klaytn blockchain network instead of Ethereum, one of the most popular blockchain networks, as it provides a Klaytn Integrated Development Environment (IDE) that allows the users to write, compile, and deploy smart contracts to Klaytn nodes. Klaytn IDE is a browser-based application compatible with Ethereum, and it has been forked from Remix 0.20.0. It supports a fast development cycle through various plug-ins and an intuitive Graphical User Interface (GUI) [20]. The intelligent contract should follow the KIP-17 standard, a free, open standard that describes how to build NFTs on the Klaytn blockchain and provides contracts that track an arbitrarily large number of NFTs [21].

In addition, our smart contracts will be deployed on the Klaytn testnet called Baobab instead of the mainnet. A testnet for a blockchain project is a working prototype used by the developers to test and troubleshoot all the features and functions of a blockchain network before the mainnet launch. Therefore we will take advantage of the testnet to provide the consumers with a mock trading experience without risking real funds using testnet coins [22].
# Tentative Schedule

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<th>Timeline</th>
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<td>October 3 2022 - October 31 2022</td>
<td>Further research on feasibility of the tools and implementation details along with strengthening the methods and contents of education</td>
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<tr>
<td>November 1 2022 - November 15 2022</td>
<td>Development of the smart contracts</td>
</tr>
<tr>
<td>November 16 2022 - December 31 2022</td>
<td>Development of the backend application for providing educational data and integration of DALL·E</td>
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<tr>
<td>January 1 2023 - Feb 15 2023</td>
<td>Development of the web interface including the sections for image generation, NFT galleries and the mock marketplace along with the crypto wallet integration</td>
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<tr>
<td>Feb 16 2023 - March 31 2023</td>
<td>Iterative testing on the product, fixing bugs if found and improvements on UI/UX</td>
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Reference


