Lab 2 – Art Guardian Product Specification

Tobin Zheng

Old Dominion University

CS411W

Professor James Brunelle

11 November 2022

Final Version

Table of Contents

List of Figures

List of Tables

1. Introduction

The market value and popularity of Non-fungible Tokens (NFTs) have increased dramatically over the span of Q1 2021. This unprecedented rise resulted in a year over year growth from less than $100 million in Q1 2020 to $1.5 billion in Q1 2021 of tradable volume within NFT marketplaces. (Chang, 2021) By the end of 2021, the volume of these NFT marketplaces increased to $41 billion. (Collins, 2021) Throughout the course of 2021, it was observed that more NFTs were basing their content off counterfeiting copyrighted digital works of art from artists. DeviantArt, a popular platform for hosting and sharing digital artwork, had reported that there were 90,000 probable counterfeit thefts in December 2021, which was a three-times increase from the reported 30,000 thefts in November 2021. (Beckett, 2022) These NFT sales are also highly profitable, with approximately 50% of all sales reaching over $200 at the beginning of 2022. (Dailey, 2022)

The solutions that aim to prevent digital artwork from being counterfeited and sold on NFT marketplaces for a profit are currently lacking. Many digital artists must follow a long manual process to remove counterfeit NFTs from NFT marketplaces. The first step of this process requires artists to discover which of their works of art were stolen and put up for sale as NFTs. This is done by manually searching on NFT marketplaces. After identifying counterfeit NFTs, artists must then issue a Digital Millennium Copyright Act (DMCA) takedown request through the host NFT marketplace. This process is overall time consuming and tiresome for the artist. It also does not effectively counter the increasing number of counterfeit NFTs.

1.1 Purpose

Art Guardian is a desktop web application designed to protect copyrighted artwork owned by digital artists from being stolen, minted as NFTs, and sold on NFT marketplaces. The product

aims to prevent the future sale of counterfeit NFTs through the DMCA takedown process. To achieve this, Art Guardian provides an automated system which searches for counterfeit NFTs on NFT marketplaces using artwork submitted by the artists. Art Guardian also provides an automated process which issues DMCA takedown notices to NFT marketplaces for any counterfeit NFTs. The goal of Art Guardian is to legally compel NFT marketplaces to remove counterfeit NFTs detected by Art Guardian, essentially automating the manual process described in the previous section. The product does not aim to be a solution which will completely fix the issue of NFT counterfeiting. Instead, it seeks to provide mitigation on the issue through an effective automated system.

1.2 Scope

The Art Guardian prototype will allow users to setup and manage their accounts. No user verification will be implemented for the prototype as no legal documents will be collected. All six pages: the home page, the profile page, the notifications page, the settings page, the sign-in page, and the registration page, will be implemented into the prototype. Users will be able to upload their artwork to the Art Guardian prototype database through the art upload feature on the home and profile pages. The prototype will take the images uploaded by each user and search for counterfeit NFTs using the NFTPort API. The results of each search will then be passed to the prototype image matcher, which will take the image uploaded by a user and compare it with the NFTPort results. The top matching NFT will then be passed on to the prototype notifications algorithm, which will notify the user about potential matches between their artwork and counterfeit NFTs.

The notifications algorithm will also allow the user to confirm matches, cemented through digital signatures. Each confirmed counterfeit NFT will be processed by the DMCA algorithms.

The DMCA algorithms consist of generation, sending, tracking, and cataloging. In the prototype, sending will only be partially implemented as no actual DMCAs will be send to NFT marketplaces. On the other hand, tracking will not be implemented in the prototype, as there will be no statuses of actual DMCAs to track.

As a case study, the Art Guardian prototype will target ODU undergraduate art students. Students will provide general feedback on prototype functionality and user interface design. They will also specifically test the art upload feature, the counterfeit NFT art detection, and the implemented DMCA algorithms. In addition, the prototype will feature several guidelines that will provide helpful information on how to protect their art. The prototype will also include a tutorial which will detail steps on how to use the web application and also provide a general workflow of the prototype algorithms.

[*This space is intentionally left blank.*]

1.3 Definitions, Acronyms, and Abbreviations

NFT: a sellable, tradeable, non-fungible token that exists on the blockchain and represents some form of data

Blockchain: a decentralized, immutable, public ledger that is split among multiple computers

Art Platform: a site that artists use to publish their art

DMCA (Digital Millennium Copyright Act) takedown: act of taking down a copyrighted work from a website on behalf of the owner of that work

Minting: Using a piece of data, such as an image, to create a unique NFT

NFT Marketplace: website where NFTs are sold

AWS (Amazon Web Services): Largest provider of various cloud computing services

AWS Amplify: an AWS service for building full-stack web applications

Amazon RDS (Relational Database Service): cloud-based database service which can work with other AWS services

Amazon DynamoDB: cloud-based database service which can work with other AWS services

NFTPort API: interface for working with popular NFT blockchains and markets

React: open-source, front-end JavaScript library for creating websites with modern user interfaces

Stripe API: programming interface for verifying a user's identity

OpenCV: open-source computer vision library for Python

Gmail API: a programming interface for the creation and sending of emails

MySQL: a relational database management system

Git: version control system for tracking software changes

GitHub: online hosting of the git version control system

JavaScript: a general-purpose programming language often used for web development

HTML: markup language for displaying documents in the web browser

CSS: style sheet language that specifies the style and layout of how documents are displayed in a web browser

[*This space is intentionally left blank.*]

1.4 References

Collins, B. (2021, December 23). Fungible vs Non-Fungible Tokens: What's The Difference? Bryan Collins. https://www.bryancollins.com/fungible-vs-non-fungible-tokens/

BBC. (2021, March 12). What are NFTs and why are some worth millions? BBC News. https://www.bbc.com/news/technology-56371912

Telmo Subira Rodriguez. (2018, December 2). Blockchain for Dummies. Medium; The Startup. https://medium.com/swlh/blockchain-for-dummies-d3daf2170068

Coincorner. (2022, February 11). What Is Nft Minting? Coin-Corner. https://coin-corner.com/what-is-nft-minting/

Beckett, L. (2022, January 29). 'Huge mess of theft and fraud:'artists sound alarm as NFT crime proliferates. The Guardian. Retrieved January 31, 2022, from https://www.theguardian.com/global/2022/jan/29/huge-mess-of-theft-artists-sound-alarm-theft-nfts-proliferates

Dailey, N. (2022, January 6). NFTs ballooned to a $41 billion market in 2021 and are catching up to the total size of the global fine art market. Markets Insider. Retrieved February 23, 2022, from https://markets.businessinsider.com/news/currencies/nft-market-41-billion-nearing-fine-art-market-size-2022-1

Abrol, A. (2022, January 14). What is an NFT marketplace and How Do You Create Your Own? Blockchain Council. Retrieved February 23, 2022, from https://www.blockchain-council.org/nft/nft-marketplace/

Mr. DMCA Helper. (2022, February 23). What is a DMCA Takedown? Dmca.com. https://www.dmca.com/FAQ/What-is-a-DMCA-Takedown?ref=why_is_sol5a32

Palmer, R. (2022). @arvalis. Retrieved 1 March 2022, from https://twitter.com/arvalis/status/1369230566843813891?s=20

Chang, J. (2021, April 12). How Did NFTs Become So Popular? Medium. https://medium.com/geekculture/how-did-nfts-become-so-popular-f894eea22f90

[*This space is intentionally left blank.*]

1.5 Overview

The rest of the paper includes specifications on the major components, capabilities and constraints, hardware and software performance, external interfaces, requirements, and functionalities of the Art Guardian prototype.

2. General Description

The Art Guardian prototype will be a web application designed for desktop environments on personal computers and laptops. The prototype will include all the major functionalities for user accounts, marketplace monitoring, image matching, DMCA generation, DMCA tracking and DMCA cataloging. However, the prototype will contain minor differences in functionalities that require legal information or copyrighted artwork. Simulated data will be used instead of real legal information or artwork for functionalities that require such parameters.

2.1 Prototype Architecture Description

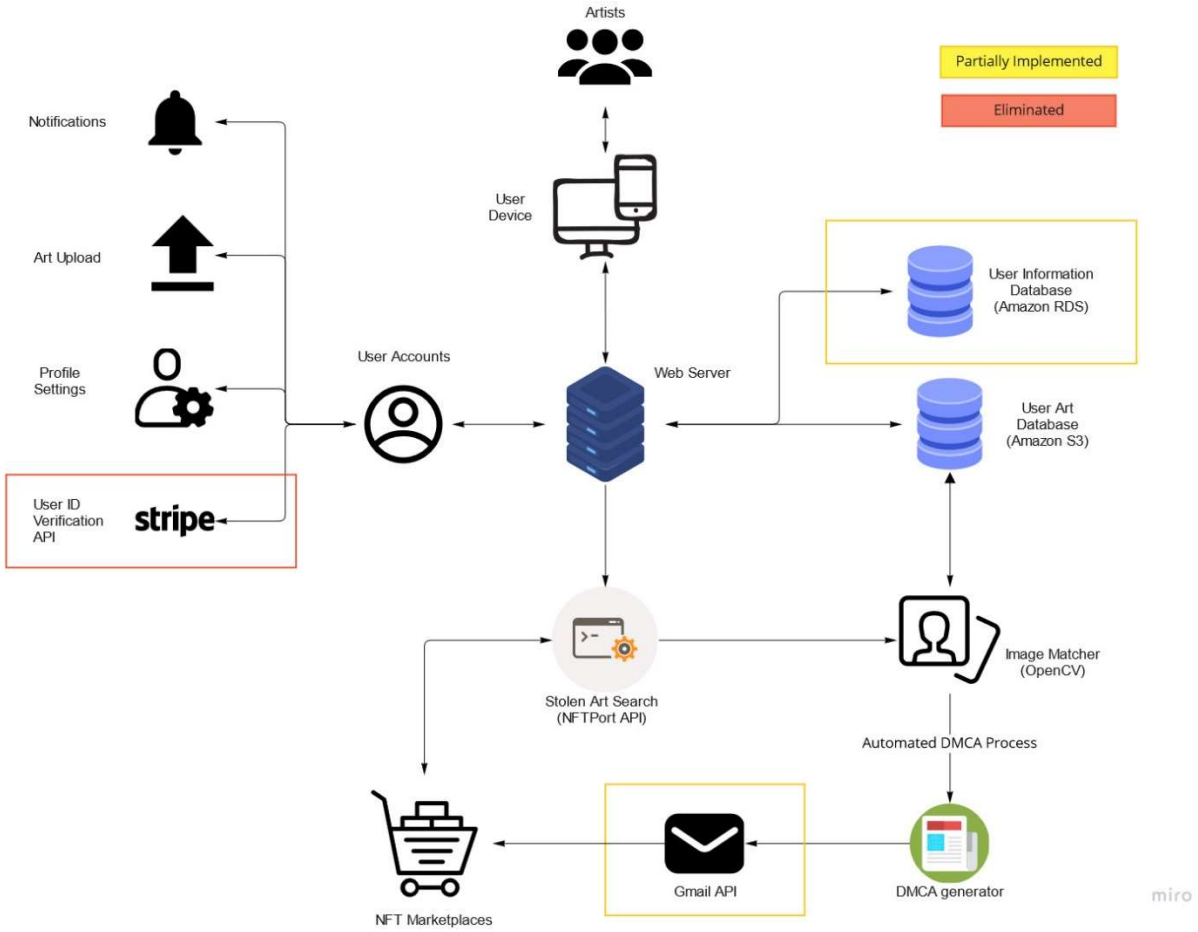
The Art Guardian prototype will be hosted by the AWS Amplify service, which will connect front-end user interfaces, back-end algorithms, and databases. The AWS Amplify service will act as the central web server that will facilitate requests and responses between major components. The user accounts component will consist of the following sub-components: notifications, art upload, and profile settings. The profile component contains user account information along with account configuration capabilities. The art upload component will allow users to upload select artwork for protection. The notifications component will contain any alerts detailing the detection of counterfeit art based on their uploaded artwork.

There will be two databases for the prototype. One database will rely on the DynamoDB service to store user account information. Another database will rely on the S3 object storage service to store user uploaded images. The stolen art search component will be powered by the

NFTPort API, which searches for counterfeit NFTs on NFT marketplaces based on artwork uploaded by the user. Results from the stolen art search will be passed on to the image matcher component, which will then ensure that the NFT image(s) match the user uploaded artwork. If the image matcher confirms one or multiple matches, then the DMCA generator will be invoked to generate a DMCA takedown request. Takedown requests will then be sent to NFT marketplaces using the Gmail API.

Figure 1

Art Guardian Prototype Major Functional Component Diagram



As seen in Figure 1, there will be three major components that will be partially implemented or removed from the prototype. The three affected components are the user identification component powered by the Stripe API, the Gmail API, and data within the user information database. The user identification component that relies on the Stripe API will be eliminated from the prototype as the component requires real legal information. The Gmail API will not send any actual DMCA takedown notices to the OpenSea NFT marketplace, therefore the component will only be partially implemented. The data within the user information database will only contain mock user accounts, and thus will only be partially implemented.

2.2 Prototype Functional Description

Table 1 describes the full extent of which features will be fully implemented or partially implemented in the Art Guardian prototype. Features eliminated from the prototype will not be present in the table.

Table 1

Prototype Features Table

Features	**Description**	**Prototype Implementation**
Account Controls		
Account Creation	Create account for users to utilize Art Guardian features	Fully Implemented
GUI		
Art Upload	Users upload images of artwork to the database	Fully Implemented
Image Library	Users view the artwork they have uploaded	Fully Implemented
Whitelisting	Remove art previously uploaded to the database	Fully Implemented

Automated Processes		
Marketplace Monitoring	Checks NFT marketplaces periodically for image matching	Fully Implemented
Image Matching	Matches images from NFT marketplaces to images on the database	Fully Implemented
Stolen Art Alert	Send the user notifications of stolen art and DMCA request statuses	Fully Implemented
DMCA Takedown		
DMCA Generation	Generate DMCA takedown notices that are automatically prefilled based on a template.	Fully Implemented
DMCA Filing	Issue generated DMCA takedown notice to the offending NFT marketplace through the Gmail API.	Partially Implemented
DMCA Cataloging	Catalog and monitor all generated DMCA takedown notices.	Fully Implemented

Almost all of the functionalities planned for Art Guardian will be fully implemented in the prototype. Account creation will be fully implemented as a feature in the prototype; when a user creates an account, the account information will be entered in to the DynamoDB database. The user interface functionalities, which include the art upload, image library, and whitelisting features, will also all be implemented in the prototype. Art upload allows users to upload their artwork to the S3 bucket database, which the image library pulls from to display all artwork uploaded by the user on the web application. Users will be able to utilize the whitelisting feature to remove any NFT from the marketplace monitoring functionality, such as minted NFTs under their possession.

Marketplace monitoring will be an automated feature which will periodically search for counterfeit NFTs on NFT marketplaces based on the artwork uploaded by the user. The image matching functionality will ensure that any counterfeit NFT found by marketplace monitoring is

confirmed to be matching the user artwork. Stolen art alert will notify users for any instances of counterfeit NFTs confirmed by the image matcher. Once the user manually verifies each match, then the DMCA generation feature will generate DMCA takedown notices based on a template that will be filled using the legal information provided by the user. DMCA filing will be partially implemented in the prototype as DMCA takedown requests will not be sent to an actual NFT marketplace. Instead, a testing email will receive all DMCA takedown notices. However, DMCA cataloging will be fully implemented, and all DMCA takedown requests will be catalogued and monitored.

2.3 External Interfaces

The Art Guardian prototype will rely on specific hardware, software, user, along with communication protocols and interfaces that will enable the components and features to function. Hardware interfaces include requirements regarding operating systems (OS), processing speeds, etc. Software interfaces will be used to develop the functionalities of the user interface. Communication protocols and interfaces will define the recommended network technologies that the user should have to use the prototype.

2.3.1 Hardware Interfaces

The Art Guardian prototype will run on desktops or laptops that have an Intel Pentium 4 processor or later that's SSE3 capable. The prototype will run on Windows 7, Windows 8, Windows 8.1, Windows 10 or later. For MacOS systems, the version of the operating system must be OS X El Capitan 10.11 or later. For Linux-based systems, the following distributions are accepted: 64-bit Ubuntu 18.04+, Debian 10+, openSUSE 15.2+, or Fedora Linux 32+.

2.3.2 Software Interfaces

The prototype product will be developed using the React framework of JavaScript for the web application, and the OpenCV library of Python for the image matching feature. The NFTPort API will be used for marketplace monitoring and the Gmail API will be used to issue DMCA takedown notices to OpenSea. AWS Amplify, AWS DynamoDB, and AWS S3 will be the three AWS cloud computing services that will host the databases and the web application. GitHub and Git will be used for version control purposes. AWS Lambda will be used to implement most of the automated processes.

2.3.3 User Interfaces

The Art Guardian web application will be accessed through a web browser on a desktop or laptop device. The list of targeted browsers for the prototype are Google Chrome, Opera, Firefox, and Microsoft Edge, but other browsers may be compatible with the prototype web application. The size of the web application, along with other styling elements, will be adjusted accordingly to the user's desktop or laptop resolution. Targeted resolution sizes for the web application will range from 1280x720 to 1920x1080. The landing page of the web application will be the login or registration page. Once logged in, the features of the web application will be accessible to the user. There are no plans for the prototype in terms of caching or storing logins within the browser. In terms of input/output devices, the user must have a mouse for navigation, a keyboard for data input, and a monitor with a resolution within the targeted range.

2.3.4 Communication Protocols and Interfaces

The two web protocols that should exist on the user's network are the HTTPS protocol for secure hypermedia communications over the internet, and the standard TCP/IP protocol for

communications between the device and the internet. The user should have network speeds of at least 10 Mbps for downloads, and 1 Mbps for uploads.

[*This space is intentionally left blank.*]