

LAB 2 - ART-GUARDIAN PRODUCT SPECIFICATION OUTLINE

CS 411W Lab II

Product Specification

Team Blue

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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 has been observed that more and more NFTs were basing their content off of counterfeiting copyrighted digital works of art from Digital 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 compared to 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)

Currently, there are not many solutions that aim to prevent digital artwork from being counterfeited and sold on NFT marketplaces for a profit. As of now, many digital artists must invoke a manual process. The first of this process involves discovering which works of art were stolen and put up for sale as NFTs, which can only be done through a manual search on NFT marketplaces. After identifying the counterfeit NFTs, digital artists must then manually issue a Digital Millennium Copyright Act (DMCA) takedown request through the NFT marketplace. Overall, the process is time consuming and tiresome, and the number of counterfeit NFTs continues to increase to this day.

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 based on artwork owned by digital artists through the DMCA takedown process. To achieve this, Art Guardian provides an automated system which searches for counterfeit NFTs plagiarizing artwork uploaded by the artists by scouring through NFT marketplaces. Art Guardian also provides an automated process that issues DMCA takedown notices to NFT marketplaces regarding the identified counterfeit NFTs. The goal of Art Guardian is to legally compel NFT marketplaces to remove any counterfeit NFTs detected by Art Guardian, and to automate the manual work described in the

previous section. The product does not aim to be a solution which will fix the issue of counterfeit NFTs fraudulently minted from digital artist's artwork; instead, it seeks to provide a mitigation for the issue. The Art Guardian system ensures robustness through several safeguards which prevent any misidentification of NFTs or abuse of the system.

1.2 Scope

Art Guardian aims to protect digital artists, both those who do and do not mint NFTs from incidents of theft where art is minted and sold in the form of NFTs. Art Guardian will do this by tracking art uploaded into the database and searching NFT marketplaces for cases of theft and automating any subsequent DMCA Takedowns. The benefit to the artist is the protection of their from theft online. The benefit to NFT artists is the security of their product from any counterfeits.

Art Guardian's prototype will fully implement art upload, whitelisting, art tracking, image matching, theft alert, DMCA generation, and DMCA cataloging. Due to constraints Art guardian will partially implement DMCA filing, as test DMCA's cannot be sent to real websites and instead will be sent to test emails. The prototype will eliminate user verification and DMCA tracking.

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

1.4 References

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1.5 Overview

- This product specification provides the hardware and software configurations, external interfaces, capabilities, and features of the Art Guardian Prototype. The remaining sections of the documents include detailed descriptions of the hardware, software, and external interface architectures of the Art Guardian prototype. It will also include the key features and the parameters that will be used to implement the feature as well as the performance characteristics of that feature in terms of user interaction, display, and output.

2 General Description

2.1 Prototype Architecture Description

- Web Server: The Art Guardian prototype will be using AWS Amplify hosting service to host our Web Application. The frontend and backend will be connected via Amplify.
- Database: The database the Art Guardian prototype will use will be AWS DynamoDB. This database is used to store our end users' information, profiles, and artwork.
- APIs: GraphQL APIs will be used to connect the Art Guardians' database to its web server. A Gmail API will be used by the Art Guardian prototype for email generation.

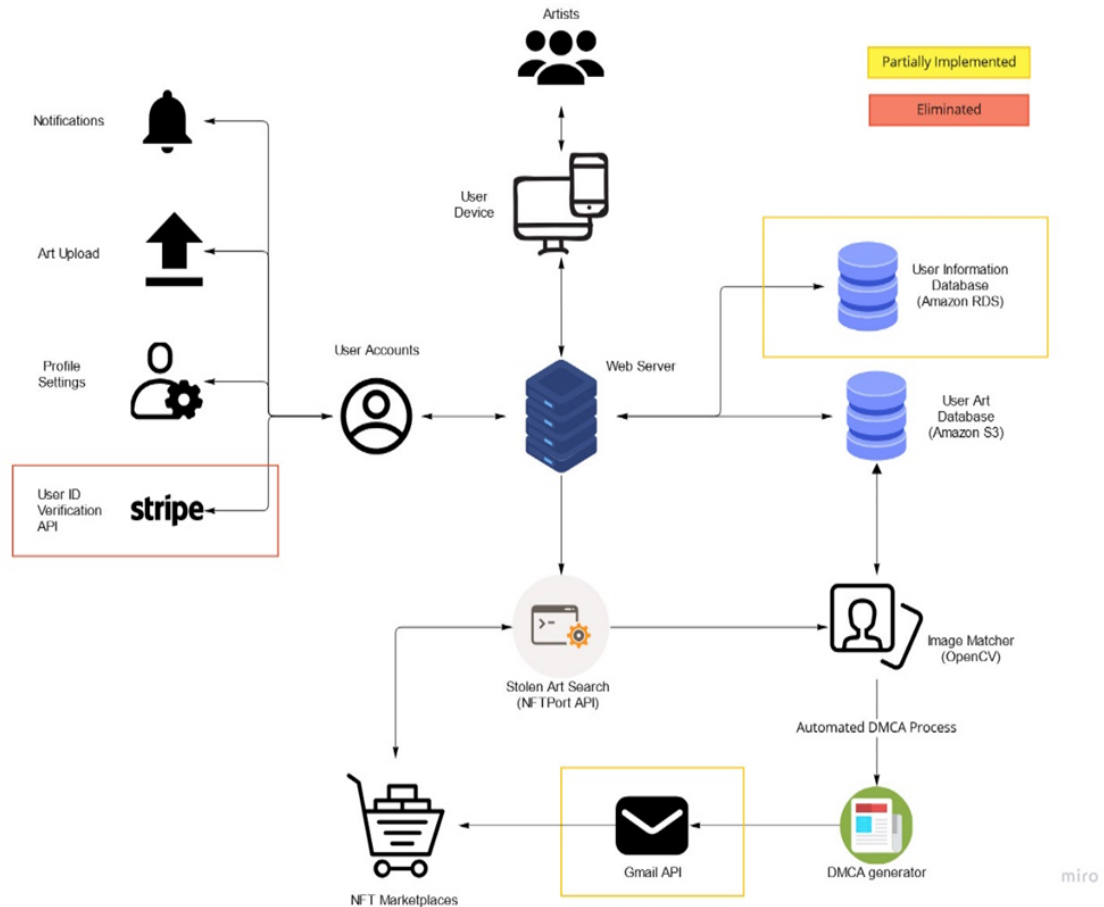


Figure 1. Art Guardian Prototype Architecture Diagram.

2.2 Prototype Functional Description

The major functional components of the Art Guardian prototype include the following:

- Web Server: AWS will be used to deploy the Art Guardian web application
- User Accounts: Users will require an account in order to upload and protect their art on Art Guardian
- Notifications: Alerts and push notifications will be sent to the user for art theft detection and DMCA status updates
- Art Upload: Users will upload images of their art to be stored on the database
- Art Gallery: The database will store images of all art uploaded by users
- Databases for User Information: The database will store and encrypt account information
- NFTPort API: This is a dependency API that assists with monitoring NFT marketplaces for minted artwork
- OpenCV Library: This is a library that will perform the image matching between the NFT and the user's image on the database
- DMCA Generator: Automatically generates a DMCA takedown request with a fixed format while including the correct information of the NFT
- Gmail API: Sends the DMCA takedown request through email (partially implemented)

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

Figure 2. RWP vs Prototype Diagram.

2.3 External Interfaces

- This section identifies the physical and logical interfaces used within and by the prototype. The characteristics of each type of interface used and the type of information transferred should be described.

2.3.1 Hardware Interfaces

- Desktop or Laptop running Windows, MacOS, or Linux

2.3.2 Software Interfaces

- React Framework
- Gmail API
- OpenCV Library
- NFTPPort API
- AWS Amplify
- AWS RDS/DynamoDB
- Github
- Git Version Control

2.3.3 User Interfaces

- Identify the mechanisms for interacting with users (if applicable). E.g., flat-screen color displays capable of xxx by yyy resolution, keyboard for data entry, joystick for maneuvering.
 - Mouse for desktop navigation.
 - Keyboard for data input.
 - Monitor capable of displaying 1280x720 or higher resolutions.

2.3.4 Communications Protocols and Interfaces

- Protocols and interfaces used with the product/prototype, such as TCP/IP via 100mb Ethernet, IEEE 802.3/802.11 etc. should be identified here.
 - HTTP(S) for secure communication over the internet.

- TCP/IP for communications between the internet and the device.

3 Specific Requirements

3.1 Functional Requirements

3.1.1 User Interface

The web application shall be available on desktop computers or laptops running Windows, MacOS, or Linux operating systems. If not logged in, the web application will be defaulted to a sign-in/sign-up page. If logged in, the user will be directed to the home page and utilize the navigation bar to access various features of Art Guardian.

3.1.2 Account Creation

This function shall create and store accounts with a username, password, and confirmed email address. An account shall be required for users to utilize features of Art Guardian.

3.1.3 Art Upload

This function shall allow users to upload images of their artwork to be stored on the database.

3.1.4 Image Library

This function shall allow users to see their uploaded artwork on the web application.

3.1.5 Whitelisting

This function allows users to remove any uploaded artwork from the periodic image search.

3.1.6 Marketplace Monitoring

This feature shall run on the backend to monitor NFT marketplaces for stolen artwork on a minted NFT

3.1.7 Image Matching

This feature shall run on the backend to compare images collected from the NFT marketplace and the images on the Art Guardian database

3.1.8 Stolen Art Alert

This function shall send an alert and/or push notification to users for detection of stolen art and DMCA request updates

3.1.9 DMCA Generation

This function shall automatically generate a DMCA takedown request with NFT information filled into their respective fields

3.1.10 DMCA Filing

This function shall send the DMCA takedown request through email. This function shall be partially implemented in the prototype, in which the DMCA takedown request will be sent to a testing email.

3.1.11 DMCA Cataloging

This function tracks and catalogs information regarding generated DMCA takedown notices.

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3.2 Performance Requirements

Initial startup should not take more than 30 seconds and each navigation through pages/ sections of the application should not take more than 5 seconds. DMCA generation should not take longer than 30 seconds. Art Guardian should be able to store and track 100 pieces of artwork without skipping scans.

3.2.1 Scanning Frequency

Art Guardian will scan NFT marketplaces for counterfeit NFTs using artwork uploaded by the user once every two weeks.

3.2.2 Web Application Performance

3.2.3.1 Web Pages

All web pages will load within five seconds.

3.2.3.2 Image Upload

Uploading images shall not take more than one minute.

3.2.3.3 Image Loading

All entries within the Image Library will load within one minute.

3.2.3.4 Image Matcher

Results will be returned from the Image Matcher within one minute.

3.2.3.5 DMCA Generator

DMCA takedown notices will be generated within 30 seconds.

3.2.3.6 Network Performance

Given that the user has a stable internet connection with a speed >700 mbps, all operations involving the transfer of data from a non-UI component to the UI and vice versa will not require more than two minutes in completion time.

3.3 Assumptions and Constraints

Condition	Type	Effect on Requirements
Users cannot occupy more than one profile.	Constraint	Bounds the problem of matching users to available profiles
Only valid data entries will be provided.	Assumption	Allows for minimal error checking for the purposes to developing and demonstrating the prototype
The desktop web application will be hosted through AWS services.	Dependency	The AWS Amplify platform must be simulated if AWS cloud services are not available

Table 2. Effects of Assumptions, Dependencies, and Constraints on Requirements.

3.4 Non-Functional Requirements

3.4.1 Security

- Security requirements:
- Encrypted data transfer
- Database access control
- Multi-level password protection

3.4.2 Maintainability

3.4.2.1 The Art Guardian uses the Amazon Amplify platform to provide a low-maintenance configuration for accomplishing NFT Uploading and Tracking. The Art Guardian

Amplify project is updated on a quarterly basis to provide the very latest updates for NFT monitoring and detection. Maintenance procedures for all other components, such as the database, are conducted semiannually and can be performed by personnel appropriately skilled.

3.4.3 Reliability

Art Guardian art upload will be available 24 hours a day, 7 days a week. A marketplace search will be done once when art is uploaded then once a month from then on. Art searches will happen in batches of at most 100 pieces of art at off peak hours, 12AM- 6 AM EST. The prototype must be able to complete at least 90% of its searches, DMCA generations, and dispatches without error.

Art upload and DMCA generation must be available at all times. Tutorials and tips and tricks may go down as long as the aforementioned features are still available without affecting critical performance.

Art Guardian must have a 90% reliability so theft does not go without notice and artists are able to act. Artists must be able to upload their art and have it tracked and DMCA's generated without interruption as that is the core function of Art Guardian. Tutorials and tips and tricks sections are non critical as they support artists in protecting their art but do not add to the core features of Art Guardian.