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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.

Art Guardian 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 will allow artists to sign up for an account, which will be verified by linking an art account such as twitter or instagram account. After this artists can upload their own artwork into the database and begin to protect their art., On initial upload artists can choose to whitelist any art they upload if it is associated with an NFT that they themselves have minted. After upload, as well as every 30 days, Art Guardian will perform a search of NFT marketplaces for their art to find any instances of theft on the blockchain and alert users if any instances of

theft via a notification. The artist can choose to pursue the theft after which a DMCA Takedown notice will be generated for the user to check then send. Art Guardian will track the DMCA and catalog any information that will be useful for further legal action by the user such as date of generation, artwork, token id of infringing NFT, and a copy of the DMCA.

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**.**

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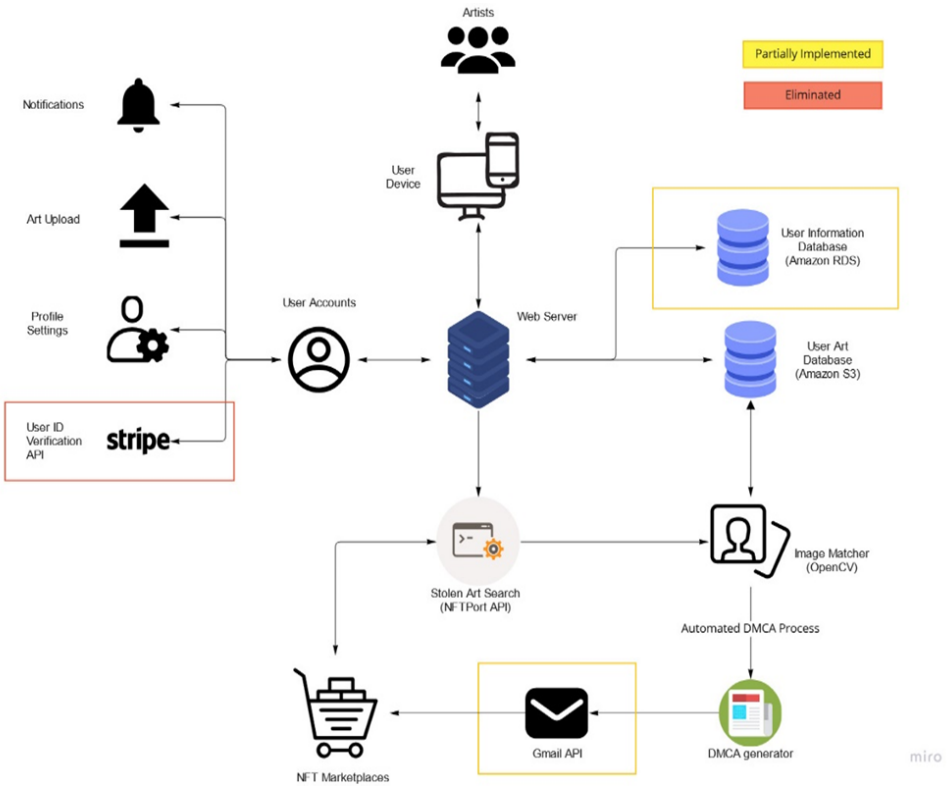
2 General Description

The Art Guardian prototype will be developed as a desktop webapp using desktop architecture. The prototype of Art Guardian will show the core features of Art Guardian and demonstrate its core ideals of art protection. The prototype will retain the image matching, DMCA generation features, and whitelisting features that are at the core of the application. User data and DMCA status will need to be simulated, and the DMCAs will not be sent to the legitimate marketplace addresses.

2.1 Prototype Architecture Description

Art Guardian will be hosted on AWS Amplify, with both the frontend and backend being connected using Amplify. This is where most features for art guardian will be developed and implemented as seen in Figure 1.

Figure 1. Art Guardian Prototype Architecture Diagram.



Art Guardian Prototype's various databases will use AWS DynamoDB. These databases will store end user personal information, profiles, artwork, and DMCA information. The various API's that will be used in the prototype such as NFT Port for search functionality and Gmail API for email generation and dispatch will be implemented to bring in the prototype's various features. The database will be connected to the webserver via GraphQL API so the Prototype can access information regarding the various profiles that will be used for testing

2.2 Prototype Functional Description

The prototype of Art Guardian will retain most of the real world product features. Capabilities and features that cannot be demonstrated in the prototype will be partially

implemented or eliminated. The features that will be fully implemented in the prototype, as well as those that will be partially implemented or eliminated can be seen in table 1.

Figure 2. RWP vs Prototype Diagram.

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

The Art Guardian Prototype will fully implement account controls, all aspects of GUI, all aspects of Automated Processes, as well as DMCA Generation and cataloging. DMCA Filing will only be partially implemented as the DMCA will be sent to a test email and not the real marketplace.

Art Guardian Prototype will allow users to create and login to an account. In the prototype users can adjust the color settings, such as enabling dark mode, adjust notification settings to tamper down frequency, and adjust their username and information.

The prototype will allow users to upload their art. Upon upload they will be able to whitelist the art if so desired. To do so the artist will need to provide a token for an NFT they have minted associated with the art. Doing so will prevent the user from receiving notifications for art theft regarding a NFT that they own.

The prototype will run the search on the art every 30 days. In the case that theft is found the user will receive a notification in the app. The user can navigate to the DMCA page to begin the DMCA takedown process. They can choose to submit a DMCA, which will prompt the prototype to generate one to be checked for accuracy by the user, which will then be dispatched. Due to the partial implementation of the DMCA Filing process the DMCA will not be sent to the marketplace itself but instead to a testing email.

Notifications will be fully implemented, allowing users to click on the notification to navigate to the associated pages. In the event that a user forgets to send the DMCA, a reminder notification will be sent every 5 days for 30 days, after which the DMCA will be discarded.

2.2.1 Hardware Interfaces

The Prototype will require a laptop or desktop computer that runs windows, linux, or MacOs. The prototype will not be a progressive web app and as such will not require a phone to use.

2.2.2 Software Interfaces

The prototype will use the Gmail API to dispatch DMCA's to the test email. In order to search for stolen art the prototype will use the NFTport API to search Opensea, in combination with the image matching algorithm which will be developed with the OpenCV library. React Framework will be used to develop the web application and AWS Amplify will be used for staging and hosting. AWS DynamoDB will be used for the databases that the prototype will need with Amplify being used to connect the frontend and backend. Github will be utilized for collaboration and version control.

2.2.3 User Interfaces

The user interface of the art guardian prototype will require a mouse for desktop navigation. In order for the user to input data a keyboard will be needed as well. Art Guardian will be optimally displayed on a monitor of 1280X720 or higher resolution.

2.2.4 Communications Protocols and Interfaces

Art Guardian will use HTTP(S) for secure communication over the internet and TCP/IP for any communications between the internet and the device.

Appendix

Art Guardian Site Map