Lab 1 – Art Guardian Product Description

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1. Introduction

The popularity of non-fungible tokens (NFTs) has drastically increased within the past few years. By the end of 2021, the NFT market had an estimated worth of 41 billion dollars, which is a significant increase from its estimated worth of 100 million dollars in 2020 (Dailey, 2022). These NFT markets do not have many regulations on what can be minted as NFTs, which has caused an art theft problem within the digital art community. Digital artists are having their artwork minted as NFTs without their permission and then sold on these marketplaces. There is evidence that this problem is only getting worse. DeviantArt, an art hosting platform which tracks fraudulent NFTs, reported that the number of alerts, that notified users if their art had been minted as an NFT, doubled from October and November last year, and they have sent over 90,000 alerts in total (Beckett, 2022). If artists find their art stolen on a NFT marketplace they will have to manually fill out a Digital Millennium Copyright Act (DMCA) request and send it to the marketplace. They will have to repeat this process each time they find stolen artwork. Currently, there is no automated process for digital artists to search for stolen art and send DMCA requests to the NFT marketplace.

The solution to this problem is Art Guardian. Art Guardian constantly monitors popular NFT marketplaces for stolen art and sends DMCA requests to take down the fraudulent NFTs. With Art Guardian, digital artists can protect their art from being sold on NFT marketplaces without their permission and stop thieves from profiting off their work. Art guardian automates all the difficult parts of keeping a user's art off the NFT marketplace such as stolen art detection and the DMCA process.

2. Art Guardian Product Description

Art Guardian is a progressive web application that automatically finds solen art and sends DMCA takedown requests to NFT marketplaces to remove fraudulent NFTs. Users can protect their art by uploading their art to the application. Once the art is uploaded, Art Guardian will scan the NFT marketplaces for the art and notify the user if their art has been minted as an NFT. If their art is on the NFT marketplace, Art Guardian will also generate a DMCA request which can be sent to the NFT marketplace.

2.1. Key Product Features and Capabilities

Users can access Art Guardian through a web browser or mobile application on iOS or Android. They will first have to create an account with Art Guardian. Since DMCAs are a legal issue, the identity of the user must be correct, which is why Art Guardian has an identity verification system, and users must connect their art accounts to make sure that they are a legit artist. After creating an Art Guardian account, users can upload their original art to the art database. Art Guardian uses the art in this database and image matching to detect stolen art on the NFT marketplace. If users wish to allow their art on NFT marketplaces, then they can whitelist their art, which will bypass our stolen art detection system. Also, users can see all their uploaded art within their art library.

Once Art Guardian detects a piece of stolen art, it creates a pre-filled DMCA takedown request based on the user's information. Users can send this DMCA request after verifying that the stolen art is their own. After the DMCA request is sent, users can monitor the status of the request. All DMCA requests are stored in a database, so users can obtain information about previous DMCAs if needed. Art Guardian's notification system will alert users when their art is

detected on the NFT marketplace and when the DMCA request has been approved or denied. Art

Guardian also provides a section on tips and tricks for protecting one's digital art against theft.

2.2. Major Functional Components

Users can use Art Guardian through the browser or a mobile application on iOS or

Android. The mobile application uses the React Native framework, which allows it to run on

both iOS and Android, and it is written in the JavaScript programming language. The Art

Guardian website provides all the same functionality as the mobile site, and it uses the React

front-end framework, JavaScript, HTML, and CSS. Git and GitHub are used for version control

during the development process. The user devices connect with a web server, which is powered

by AWS. The web server connects with all the APIs and databases, as seen in Figure 1.

Figure 1

Art Guardian Major Functional Component Diagram
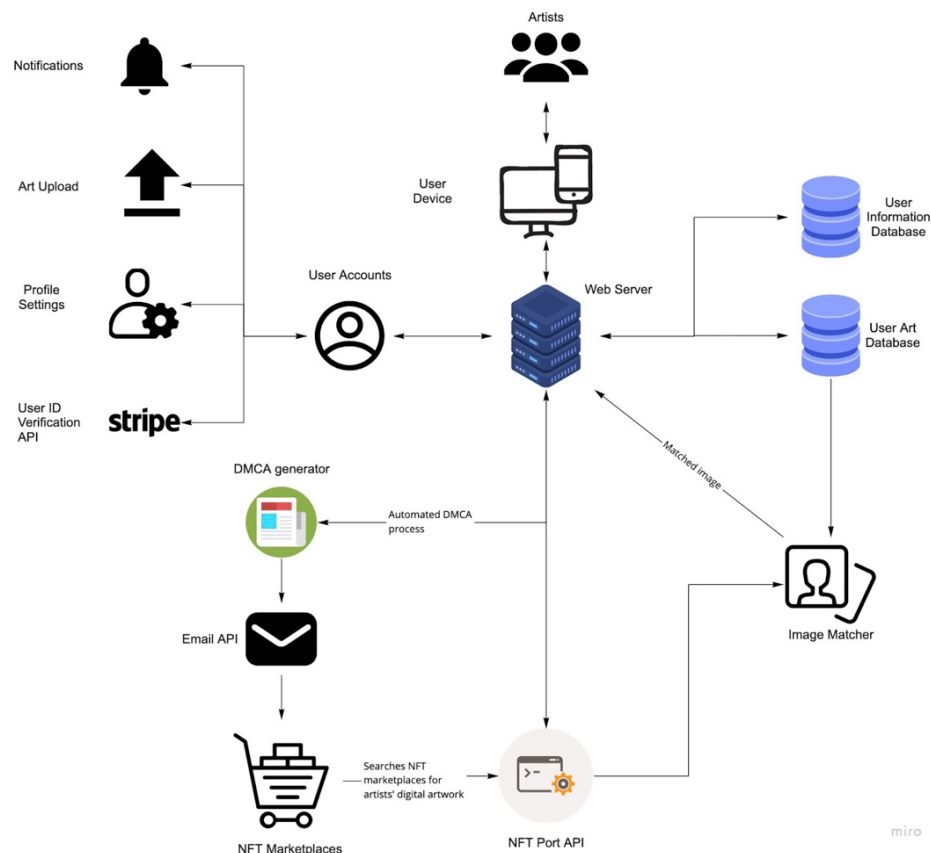
The databases that will store the user information and original art use Amazon Relational Database Services and MySQL. These technologies organize the data and aid in the retrieval of information from the databases. The user information database stores information about the user's information, profile settings, and DMCA history. User accounts are verified through Stripe, which is a user ID verification API. The NFT Port API is used to search for art on the NFT marketplace. The image matcher uses template matching to compare art found on the NFT marketplace with the art in the art database. Then, it sends the matched image back to the web server which starts the DMCA process. The image matcher uses the OpenCV library for template matching. The automated DMCA process uses a custom DMCA generator, which creates DMCAs based on the user and the stolen art. The DMCA is sent to the NFT marketplace as an email by using the Gmail API.

3. Identification of Case Study

The targeted users are commissioned artists and NFT artists. Commissioned artists would get the most benefit since they have a larger monetary incentive to protect their art from being sold without their permission. These artists can protect their art by uploading it to Art Guardian, which will search the NFT marketplace for their art, and alert them if it is found. Then, they can send an automatically generated DMCA request to prevent the sale of their art on the NFT marketplace. Art Guardian also provides these artists with tips on how to prevent any further theft of their art. These artists will feel more at ease knowing that they now have an easy process of removing their art from the NFT marketplace. NFT artists will benefit from Art Guardian, since they know that the NFTs they are selling are not using stolen art.

A case study group for Art Guardian is ODU art students. ODU art students can provide valuable feedback on the Art Guardian prototype, since they are most like digital artists. Students

will be able to upload their art to the prototype. Art Guardian allows the students to check if their

art has been minted as an NFT and is being sold on the NFT marketplace without their

permission. Feedback from this group is especially valuable, since it will give insight into how

artists will use features such as the art library, art upload, and notification system.

While Art Guardian is currently targeting commissioned artists and NFT artists, in the

future, Art Guardian will expand to meet the needs of all digital artists and possibly non-digital

artists, who do not want images of their art being sold as NFTs.

4. Art Guardian Prototype Description

The Art Guardian prototype will contain most of the major features that will appear in the

end product, such as DMCA generation, art uploading, image matching, etc. Some features will

be partially implemented or eliminated and simulated data will be used in place of real user data.

The prototype will still be capable of demonstrating the main purpose of Art Guardian, which is

to detect the presence of and automate the DMCA process for stolen art on NFT marketplaces.

4.1. Prototype Architecture (Hardware / Software)

The prototype architecture for Art Guardian will be similar to the end product

architecture, but some components will be either partially implemented or eliminated. Most of

the components will remain the same for the prototype. For hardware, users will access the web

application through a web browser on their user device such as a desktop or laptop computer.

This will connect to the web server which will run on AWS Amplify. There will be two

databases. One for storing user information using Amazon RDS, and another database for storing

art that users upload which will use Amazon S3. The image matcher will use OpenCV for the

detection of stolen art. The DMCA generator will create the DMCAs which will then be sent to

the NFT marketplaces using the Gmail API. The NFTport will scan the NFT marketplaces for

possible stolen artwork. The major functional component diagram in Figure 2 shows how these components will connect.

Figure 2

Art Guardian Prototype Major Functional Component Diagram
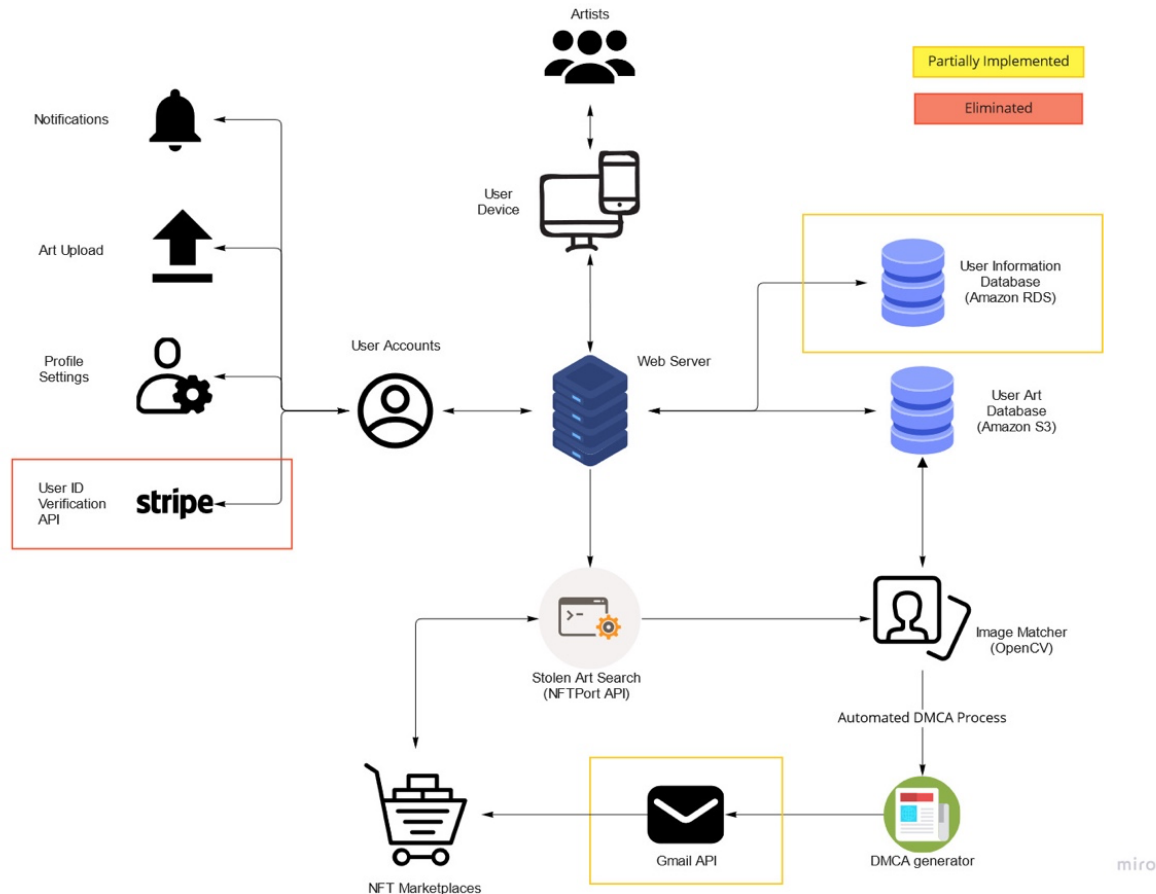
One of the components that will be partially implemented is the Amazon RDS instance, which is used to store the user information. This component will only be partially implemented because only mock user data will be used so that no sensitive information will be stored in the database. Another component that will be partially implemented is the Gmail API, since the DMCA takedowns will not be sent to the NFT marketplaces. The user ID verification API component will be eliminated from the prototype, since no real user data is used. Therefore, there is no need for verifying a user's identity.

4.2. Prototype Features and Capabilities

Most of the features and capabilities of the Art Guardian real-world product will be available in the prototype. As seen in Table 1, only three of the features in the real-world product will either be eliminated or partially implemented in the prototype.

Table 1

Real-World Product vs. Prototype Features

Art Guardian	RWP	Prototype
Account Creation	Fully Implemented	Fully Implemented
User Verification	Fully Implemented	Eliminated: Mock data
Art Upload	Fully Implemented	Fully Implemented
Image Library	Fully Implemented	Fully Implemented
Whitelisting	Fully Implemented	Fully Implemented
Marketplace Monitoring	Fully Implemented	Fully Implemented
Image Matching	Fully Implemented	Fully Implemented
Stolen Art Alert	Fully Implemented	Fully Implemented
DMCA Generation	Fully Implemented	Fully Implemented
DMCA Filing	Fully Implemented	Partially Implemented: Send to testing email
DMCA Cataloging	Fully Implemented	Fully Implemented
DMCA Tracking	Fully Implemented	Eliminated: Simulated Data

User verification will be eliminated from the prototype and mock user data will be used in its place for testing purposes. While the prototype is capable of DMCA generation, those DMCAs will not be sent to the NFT marketplaces since they will not contain real user information. When testing the prototype, DMCAs will be sent to a testing email instead of the actual NFT marketplaces. The last major feature that will not be present in the prototype is DMCA tracking.

Since the DMCA will not be sent to the marketplace, there is no purpose in tracking its status, so simulated data will be used instead. Despite some of the features of the real-world product being partially implemented or eliminated from the prototype, the main goal of Art Guardian, which is to detect stolen artwork on NFT marketplaces and automatically generate DMCA takedown requests, will still be demonstratable in the prototype through the remaining fully implemented features.

4.3. Prototype Development Challenges

The Art Guardian prototype will be a complex, full-stack web application, which presents many challenges to its developers. The prototype will need development in the front-end and back-end. Therefore, it will incorporate many different technologies such as React, AWS, OpenCV, Git, and many more, which means that a lot of time will be needed for the learning of these technologies. Since the prototype must be developed within a single semester, spending time efficiently among developing, planning, and learning is of upmost importance. The limited time frame may mean that not all planned, prototype features will be available. Work will have to be separated into front-end, back-end, and database categories, which also introduces the challenge of ensuring that effective communication occurs between different parts of the team. If the team does not effectively communicate, then there is the possibility that different parts of the prototype will not work well with each other. This could lead to extensive refactoring, which would take up a lot of time and resources.

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5. Glossary

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

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