T.C. KOCAELİ ÜNİVERSİTESİ MÜHENDİSLİK FAKÜLTESİ

AN AUTHENTICATION AND ASSET EXCHANGE MARKETPLACE USING NFT TECHNOLOGY

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CONTENT

FIGURES INDEX

ICONS AND ABBREVIATIONS

NFT: Non Fungible Token
HTML: HyperText Markup Language
HTTP: Hypertext Transfer Protocol
CSS: Cascading Style Sheet
PHP: Hypertext Preprocessor(This is a script Language)

1. INTRODUCTION

One of the biggest problems faced by most of the luxury goods producers is plagiarism. The evolving technologies in countries like China and the relatively cheap high skilled labor, makes it easier and easier to reproduce luxury goods with extremely high precision. A lot of measures have been taken to fight against this problem but it still stays a major issue as these measure are unable to meet their purpose. One of the reasons for this failure could be the lack of a centralized system for authenticating the originality of any luxury good or asset.

The blockchain is an amazing technology in the sense that it provides a means of authenticating ownership of digital assets using the recent smart contract principle. The confidence that an authentication can be accepted as true comes from the fact that blockchains are decentralized and powered by a network of miners. Nowadays, it even provides a means of creating unique assets that can't be reproduced illegally called NFTs.

NFT means non-fungible tokens (NFTs), which are generally created using the same type of programming used for cryptocurrencies. In simple terms these cryptographic assets are based on blockchain technology. They cannot be exchanged or traded equivalently like other cryptographic assets.

Like Bitcoin or Ethereum. The term NFT clearly represents it can neither be replaced nor interchanged because it has unique properties. Physical currency and cryptocurrency are fungible, which means that they can be traded or exchanged for one another.

Nowadays, NFTs are mostly used for digital assets, but our goal with this project is to start implementing this technology to the authentication of physical assets as well.

The platform proposed in this work will serve as a market place for people to sell their valuable goods and assets across distances in all confidence, because each of these assets will be backed up by an nft whose owner can be verified, or change within a translation.

1.1. Project's General Operation

Every user of this platform will be able to create an NFT on this platform. In order to create a product(or NFT), the product's creator must provide us with a way to verify their ownership of the real asset, such as an official bill, a lease agreement, just to name a few.

Once a product is uploaded and it's corresponding NFT created, it can be traded by investors all around the world. The vision is to include charting facilities for everty asset(NFTs) that will be added to the platform, so that users can track price history, analyse and trade assets in real time.

Every physical transaction can be represented on our platform as an NFT. Some examples of assets that we can accept as NFTs on the marketplace include; realestates, luxury watches, physical arts, precious metals and jewelry, historical findings, etc.

1.2. Research Literature

Here's the timeline of events in the brief history of NFTs in a little more depth.

1.2.1. The Early History of NFTs (2012-2016)

Long before Ethereum existed, the concept that became the driving force of NFTs was already thought up when in 2012, a paper by Meni Rosenfield was released that introduced the 'Colored Coins' concept for the Bitcoin blockchain.

The idea of Colored Coins was to describe a class of methods for representing and managing real-world assets on the blockchain to prove ownership of those assets; similar to regular Bitcoins, but with an added 'token' element that determines their use, making them segregated and unique.

The limitations of Bitcoin meant that the Colored Coins concept could never be realised, however, it did lay the foundation for the experiments that led to the invention of NFTs.

On May 3rd, 2014, digital artist Kevin McCoy minted the first-known NFT 'Quantum' on the Namecoin blockchain. 'Quantum' is a digital image of a pixelated octagon that hypnotically changes colour and pulsates in a manner reminiscent of an octopus.

Following these events, a significant amount of experimentation and development occurred and there were platforms built on top of the Bitcoin blockchain. The Ethereum blockchain also started its initial reign over NFTs.

The Counterparty platform (Bitcoin 2.0) was established and gained ground as a platform that enabled the creation of digital assets.

Spells of Genesis followed close behind in the footsteps of Counterparty and began pioneering in the issuing of in-game assets.

2016 beckoned on the age of the meme and saw the release of a host of Rare Pepes NFTs on the Counterparty platform.

Important to note, however, is that the Bitcoin blockchain was never intended to be used as a database for tokens representing the ownership of assets, and thus began the big shift for NFTs to the Ethereum blockchain.

1.2.2. NFTs Go Mainstream(2017-2020)

The big shift for NFTs to Ethereum was backed up with the introduction of a set of token standards, allowing the creation of tokens by developers. The token standard is a subsidiary of the smart contract standard, included to inform developers how to create, issue and deploy new tokens in line with the underlying blockchain technology.

Two software developers; John Watkinson and Matt Hall, followed up the success of the Rare Pepes with their own generative series of NFTs on the Ethereum blockchain which they branded as CryptoPunks. CryptoPunks are considered some of the first NFTs created and originally offered for free. The experimental project, limited to 10,000 pieces with no two characters the same, was inspired by London punk culture and the cyberpunk movement.

During the world's largest hackathon for the Ethereum ecosystem, the Vancouver-based venture studio Axiom Zen introduced CryptoKitties.

CryptoKitties is a virtual game based on the Ethereum blockchain, the game enables players to adopt, breed and trade virtual cats, storing them in crypto wallets. After its announcement it wasn't long before the game became a viral sensation, becoming so popular that CryptoKitties clogged the Ethereum blockchain and people began making unbelievable profits.

Following the huge success of CryptoKitties, NFT gaming really began to gain momentum and move forward with NFTS gathering increasingly more public attention.

NFT gaming and metaverse projects were in the spotlight and the first to break ground in this space was Decentraland (MANA), a decentralised VR platform on the Ethereum blockchain. Decentraland is an open-world gaming platform that allows players to explore, play games, build, collect items and more, and everything that you find, earn and build there, you own on the blockchain.

It wasn't long before other platforms and games using Enjin Coin (ENJ) appeared on the scene, allowing developers to tokenise their in-game items on Ethereum, giving those in-game items a value in the real world.

Another blockchain-based trade and battle game also emerged, Axie Infinity (AXS), a game that is partially owned and operated by its players.

1.2.3. The Year Of The NFT(2021)

2021 became the year of the NFT and there was a huge explosion and surge in NFT supply and demand.

One of the biggest factors in this boom was the huge changes that occurred within the art market and the industry at large, when prestigious auction houses; Christie's and Sotheby's namely, not only took their auctions into the online world but also began selling NFT art.

This led to Christie's record-breaking sale of Beeple's Everydays: the First 5000 Days NFT for $69 million. Such a huge sale from such a prestigious auction house validated the NFT marketplace significantly.

As well as the surge in demand for NFTs that resulted from the famous Christie's auction another knock-on effect was other blockchains getting involved and starting their own versions of NFTs. These included blockchains such as Cardano, Solano, Tezos and Flow. With these newer platforms for NFTs, some new standards were established in order to ensure the authenticity and uniqueness of the digital assets created.

Towards the end of the year, once Facebook rebranded as Meta and moved into the metaverse, the surge in NFT demand and especially within the metaverse was remarkable.

1.2.4. What's The Future Of NFTs?

Despite some uncertainties that have been shared about NFTs over the past couple of years, one thing remains absolutely certain, NFTs are here to stay and they will be a huge part of the future of the art world.

The art market has already transformed a lot in recent years and the results of the pandemic on the art market have caused an even bigger shift away from the traditional modus operandi.

Moving away from the age of invention, experimentation and the big explosion, there are endless opportunities and unlimited potential for the future of NFTs now that they exist within the mainstream space.

2. SOFTWARE AND HARDWARE USED

In this project, most of the front end will be done using HTML, CSS and JavaScript meanwhile the backend will mostly be done using python and php. Some inclusions of mongoDB will be made in order to handle certain database needs alongside mysql. The pre-implementation phase, that is the UI/UX design of the platform is mostly done using adobe illustrator.

2.1. Software

2.1.1. HTML

HTML stands for Hyper Text Markup Language. It is the standard markup language for creating Web pages and it describes the structure of a Web page. It consists of a series of elements that tell the browser how to display the content. HTML elements label pieces of content such as "this is a heading", "this is a paragraph", "this is a link", etc.
In the scope of this project, most of the HTML is used to create thet markup of the front end. That is to tell the browser how to display the data and information which it will be provided with,

This HTML will mostly be used with CSS to make it more eye catchy, with Javascript to make it more dynamic and with PhP for interactions with the database.

Below is a HTML code example:

```
1   <!DOCTYPE html>
2   <html>
3   <body>
4
5   <h1>My First Heading</h1>
6   <p>My first paragraph.</p>
7
8   </body>
9   </html>
```

Figure 2.1. HTML code example

2.1.2. CSS

CSS stands for Cascading Style Sheets with an emphasis placed on "Style". The latest version of CSS is CSS 3.

While Hypertext Markup Language (HTML) is used to structure a web document (defining things like headlines and paragraphs, and allowing you to embed images, video, and other media), Cascading Style Sheet language comes through and specifies your document's style. Page layouts, colors, and fonts are all determined with CSS syntax.

HTML is the foundation, and Cascading Style Sheets(CSS) is the aesthetic choice. Both languages are needed to create a web page and JavaScript to make it interactive.

In the scope of this project, CSS will mostly be used in the realization of the UI/UX concept, alongside HTML and javascript.

Below is a sample CSS code:

```css
h1:hover{
    border-style: double;
    border-color: blue;
    border-radius: 30px;
    font-weight: bolder;
    text-align: center;
    padding: 50px;
    text-transform: uppercase;
    background-image: linear-gradient(blue, red);
    color: aliceblue;
}
```

Figure 2.2. CSS code example

2.1.3. Javascript

JavaScript is a scripting or programming language that allows us to implement complex features on web pages. Javascript handles tasks like, displaying timely content updates, interactive maps, animated 2D/3D graphics, scrolling video jukeboxes, etc. It is the third layer of the layer cake of standard web technologies coming after the first two which are HTML and CSS.

In the scope of this project, javascript is mostly used to handle the website's dynamism. Some of the main tasks which javascript will handle are; communication with/running of php scripts using the AJAX framework and handling of forms.

2.1.4. Python

Python is a popular programming language created by Guido van Rossum, and released in 1991. It is used for web development (server-side), software development, mathematics, system scripting, machine learning and artificial intelligence just to name a few.

Python can be used on a server to create web applications, it can be used alongside software to create workflows, it can connect to database systems. It can also read and modify files. Python can be used to handle big data and perform complex mathematics, and can also be used for rapid prototyping, or for production-ready software development.

This project will be highly python intensive. This is because most of the NFT creation process and API communications will be handled using python in the backend. One of the main advantages of python is that it is easy to use. Since it is a very popular language, there are a lot of resources online to help developers create projects with python. This is going to serve as an advantage for us as we will be able to create something that will easily integrate with other software solution already existing, that are complementary to our solution.

Below is a python code example.

```python
10    face = ["White", "Black"]
11    face_weights = [60, 40]
12
13    ears = ["No Earring", "Left Earring", "Right Earring", "Two Earrings"]
14    ears_weights = [25, 30, 44, 1]
15
16    eyes = ["Regular", "Small", "Rayban", "Hipster", "Focused"]
17    eyes_weights = [70, 10, 5 , 1 , 14]
18
19    hair = ['Up Hair', 'Down Hair', 'Mohawk', 'Red Mohawk', 'Orange Hair', 'Bubble Hair', 'Emo Hair',
20    'Thin Hair',
21    'Bald',
22    'Blonde Hair',
23    'Caret Hair',
24    'Pony Tails']
25    hair_weights = [10 , 10 , 10 , 10 ,10, 10, 10 ,10 ,10, 7 , 1 , 2]
26
27    mouth = ['Black Lipstick', 'Red Lipstick', 'Big Smile', 'Smile', 'Teeth Smile', 'Purple Lipstick']
28    mouth_weights = [10, 10,50, 10,15, 5]
29
30    nose = ['Nose', 'Nose Ring']
31    nose_weights = [90, 10]
```

Figure 2.3. Python code example

2.1.5. Adobe illustrator

One of the great software we use in this project that shouldn't be neglected is Adobe illustrator. It is a design software that permits users to create amazing graphics, from vector graphics, to image modifications and UI/UX displays.

In the scope of this project, it is mostly used for the realisation of our visual needs, such as the creation of GUI template/guide, to be used as reference while coding.
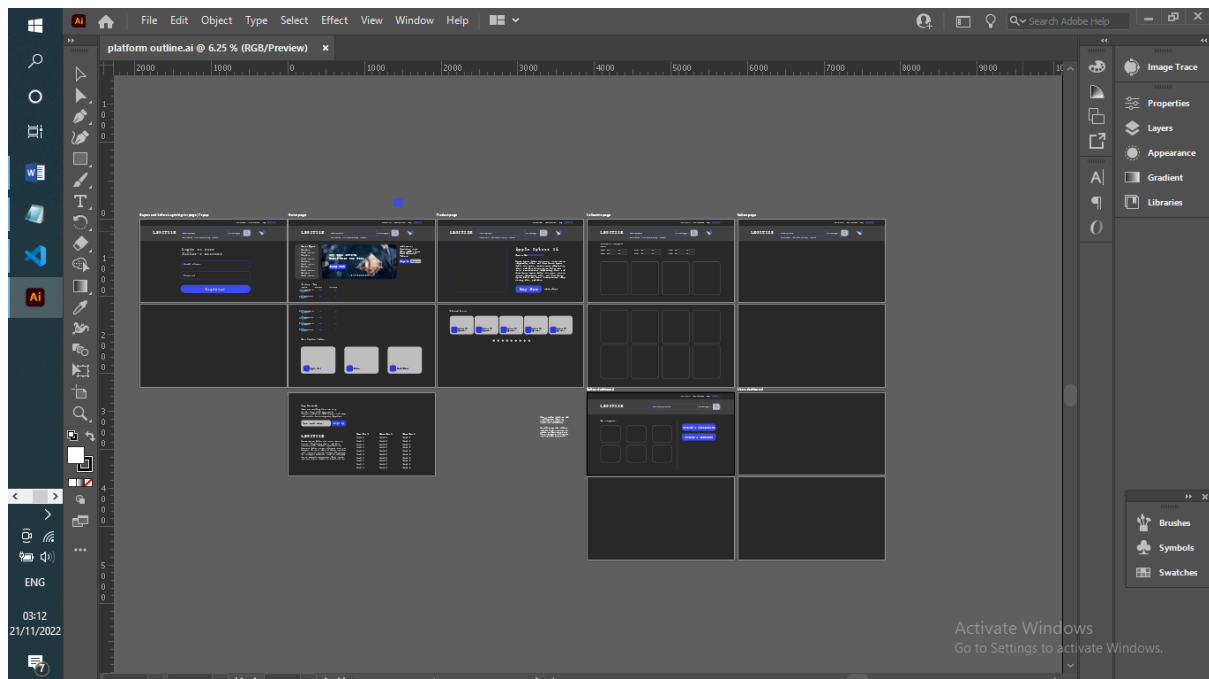
Figure 2.4. Adobe Illustrator example

2.1.6. MongoDB

MongoDB is an open source NoSQL database. As a non-relational database, it can process structured, semi-structured, and unstructured data. It uses a non-relational, document-oriented data model and a non-structured query language.

MongoDB is highly flexible and enables you to combine and store multiple types of data. It also stores and handles larger amounts of data than traditional relational databases. MongoDB uses a document storage format called BSON, which is a binary form of JSON (JavaScript Object Notation) that can accommodate more data types.

In the scope of this project, MongoDB will be used to handle the needs of our data-intensive marketplace.

2.1.7. Mysql

MySQL is the most popular Open Source SQL database management system and is developed, distributed, and supported by Oracle Corporation.

In the scope of this project, MySQL will be used as a database for storing users data, as well as product's information.

3. REALIZATION

3.1. Front-End Conceptualization.

The concept for this market place is pretty simple and consists of a series of pages who's UI/UX designs are made on Adobe Illustrator.

3.1.1. The home page

The home page is the mother screen and consists os a slider that shows the most popular collections. Users cas search for specific Asset, login or signin to an account or even view the content of their cart.
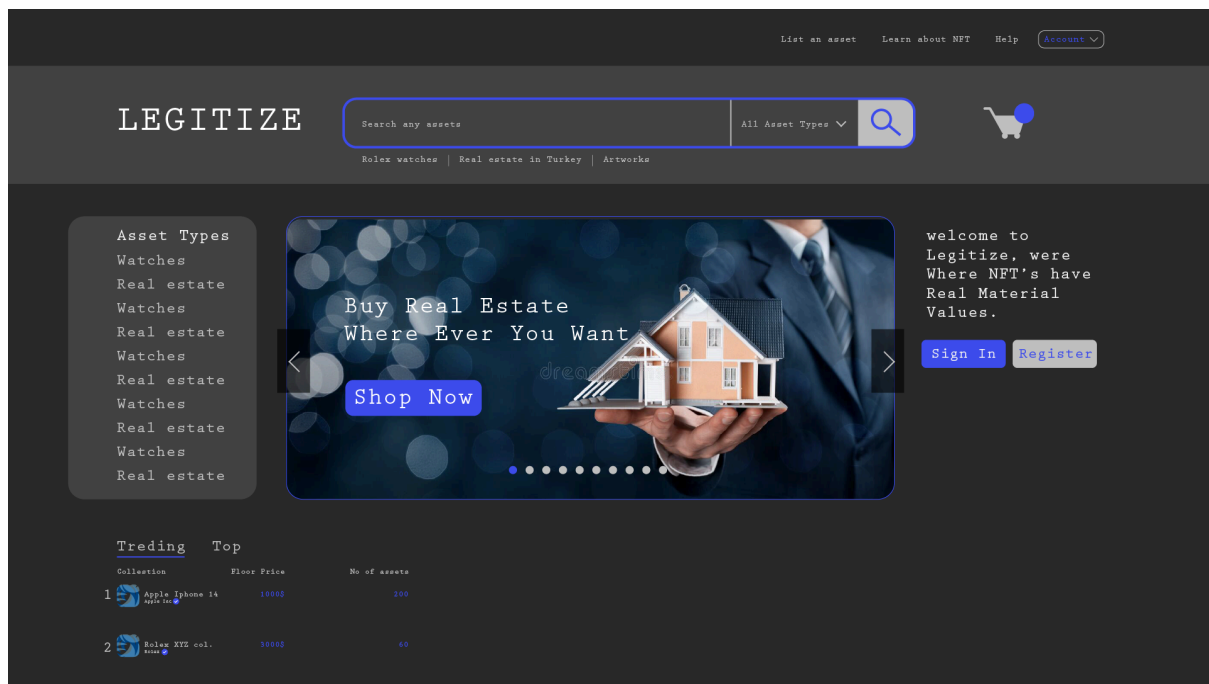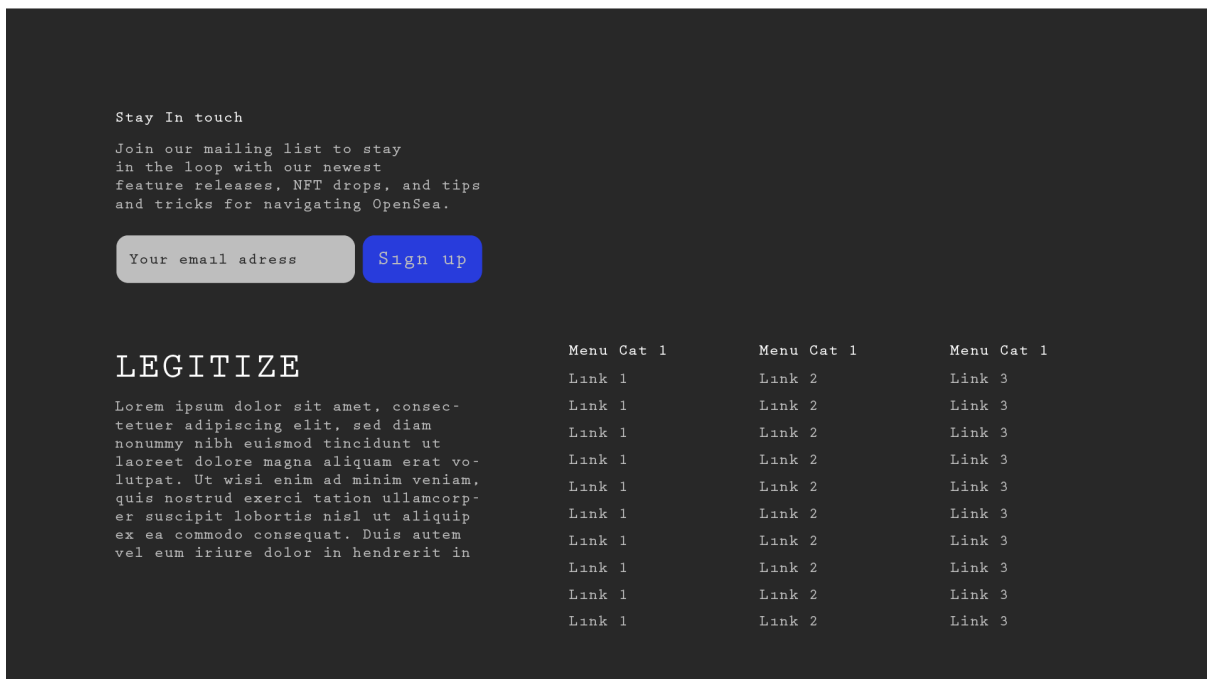

Figure 3.1. Home page main screen

Figure 3.2. Home page second screen

Figure 3.3. Home page footer

3.1.2. The product page

The product page consists of an image of the product, a "Buy Now/Add to cart" button, the products'(or In our case the NFT representing the physical asset) description, the product's name and Series no, the product's seller and a button permitting the user to view how the price has changed over the past. A footer is also included.
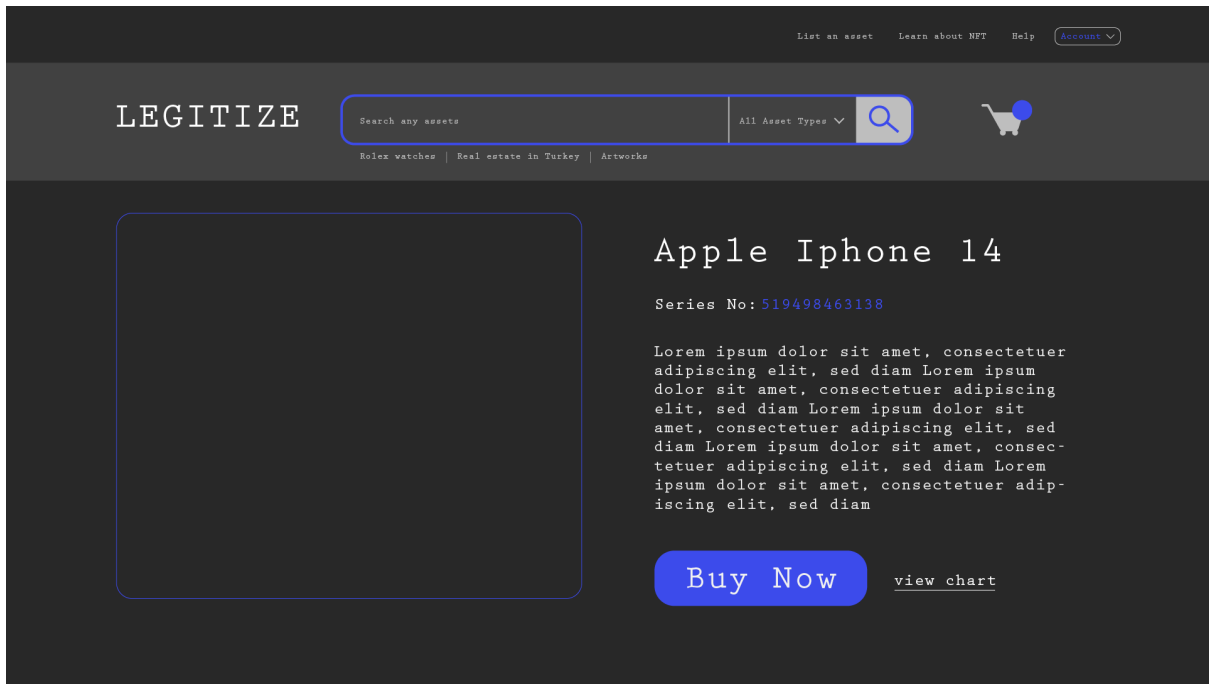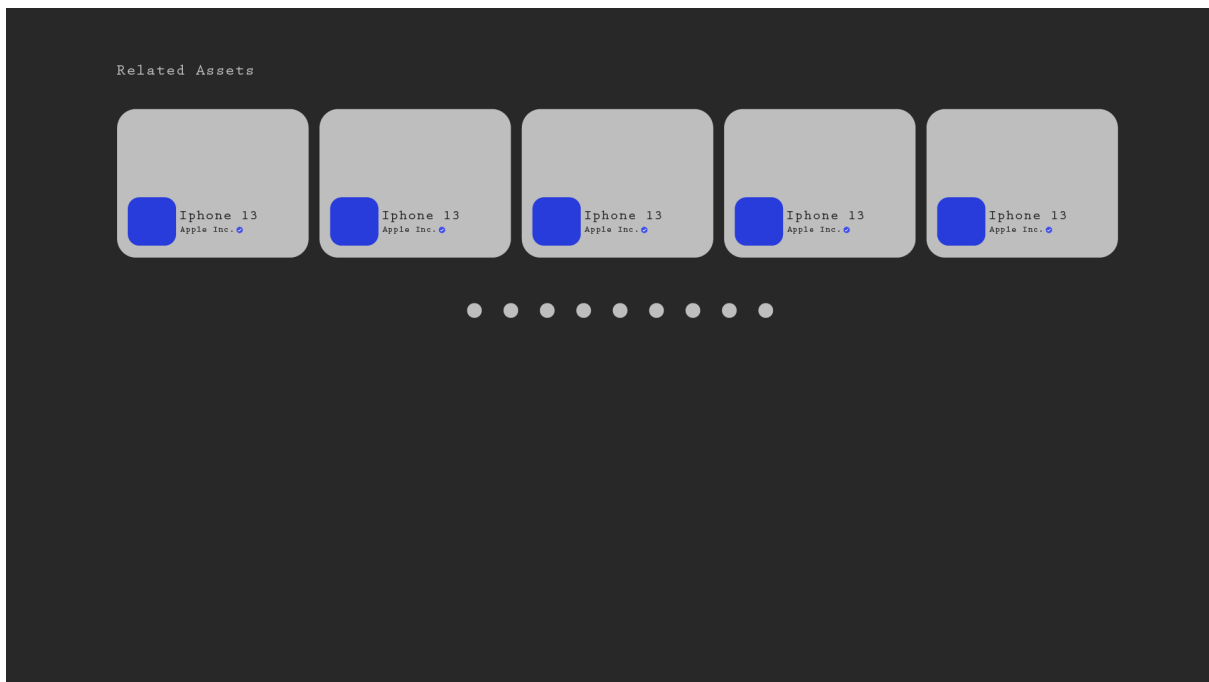
Figure 3.4. Product page main screen

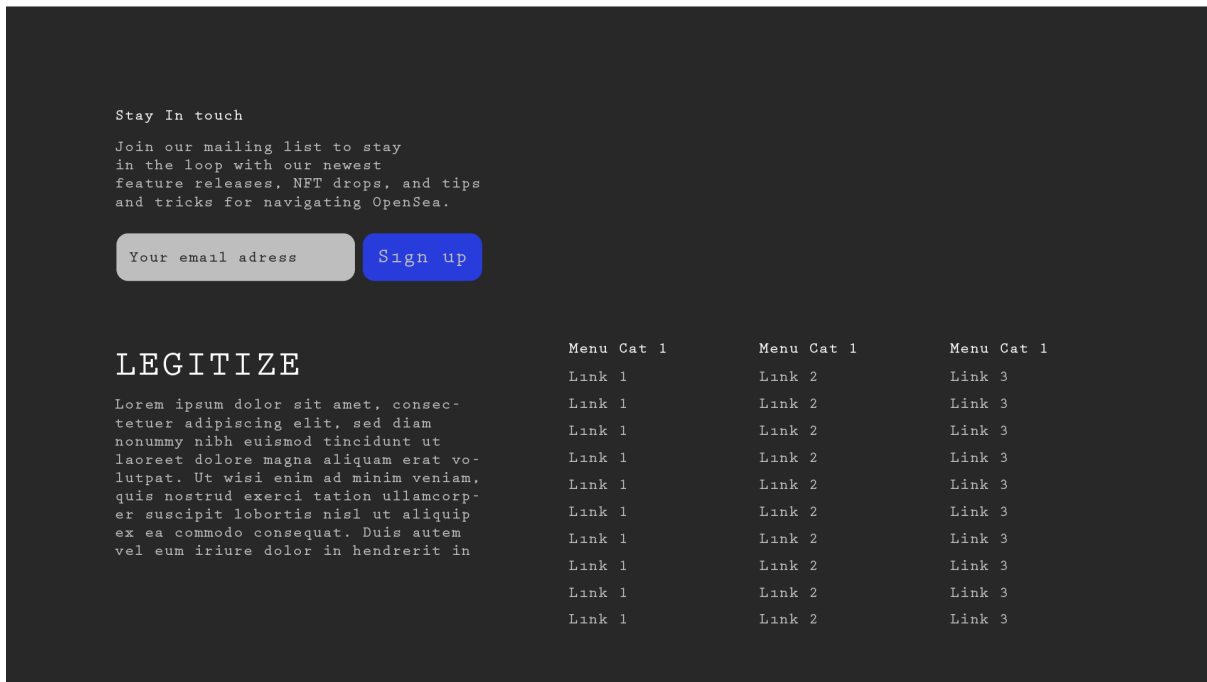
Figure 3.5. Product page second screen

Figure 3.6. Product page footer

3.1.3. The Collection page

The collection page consist of a Filter to filter product(assets) according to their price, the various products resulting from the filter as well as their respective information, and a footer.
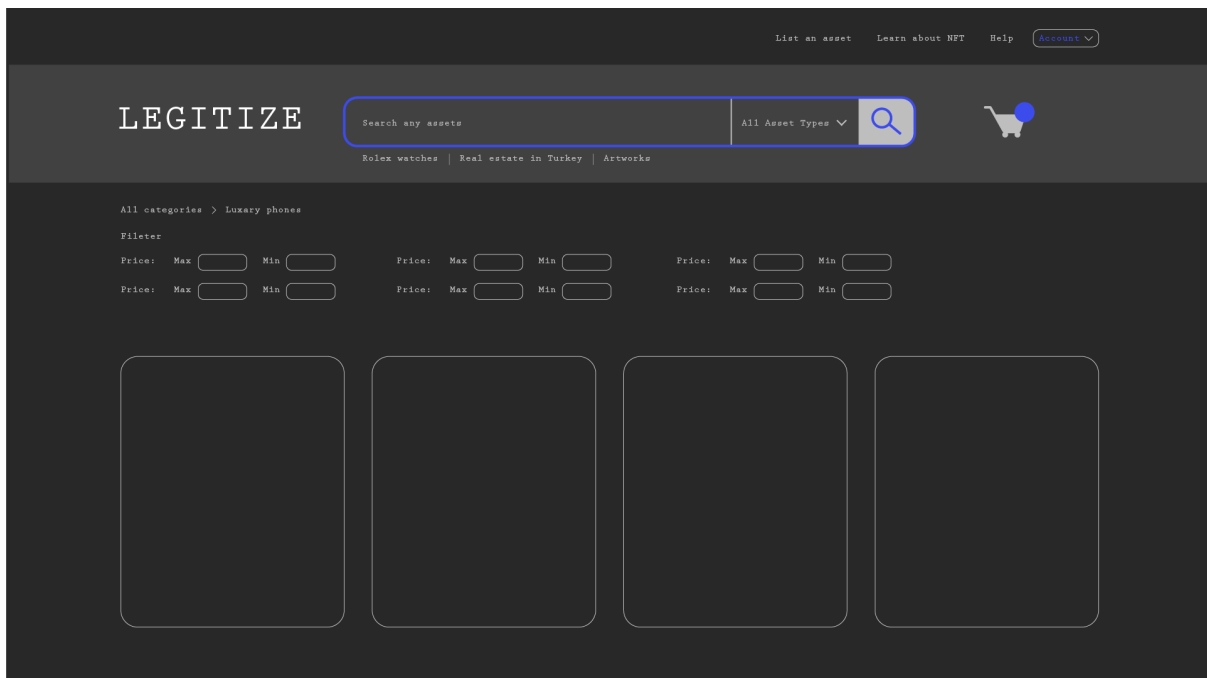

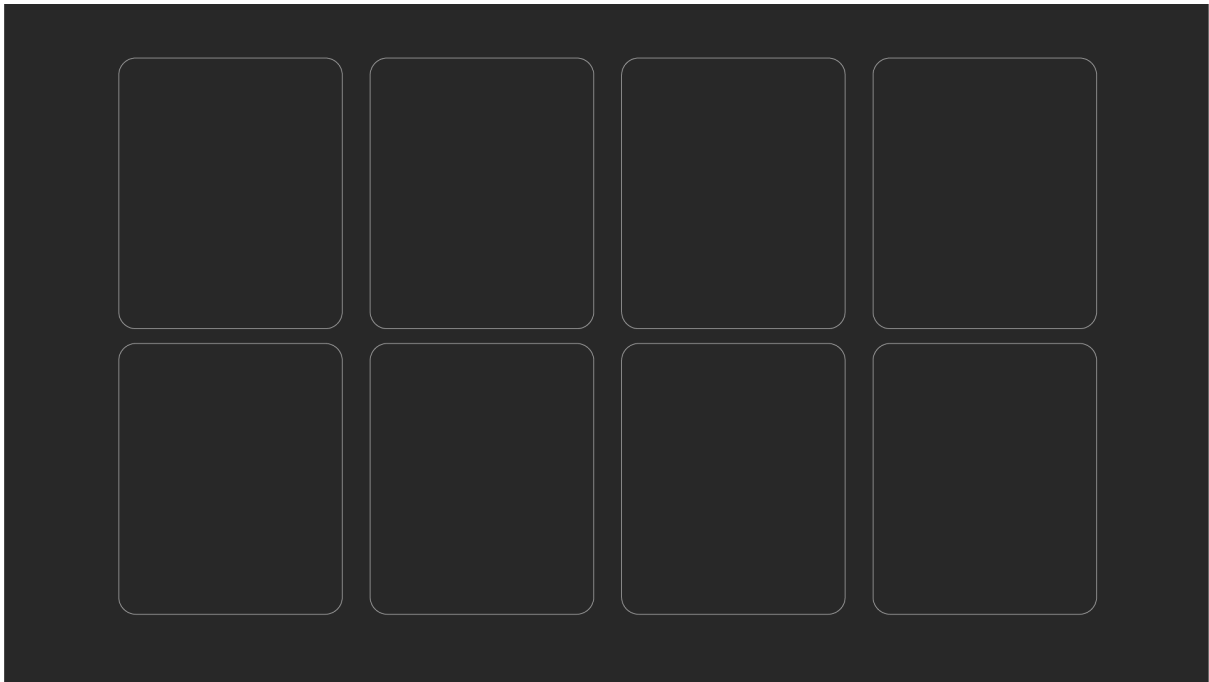
Figure 3.7. Collection page main screen
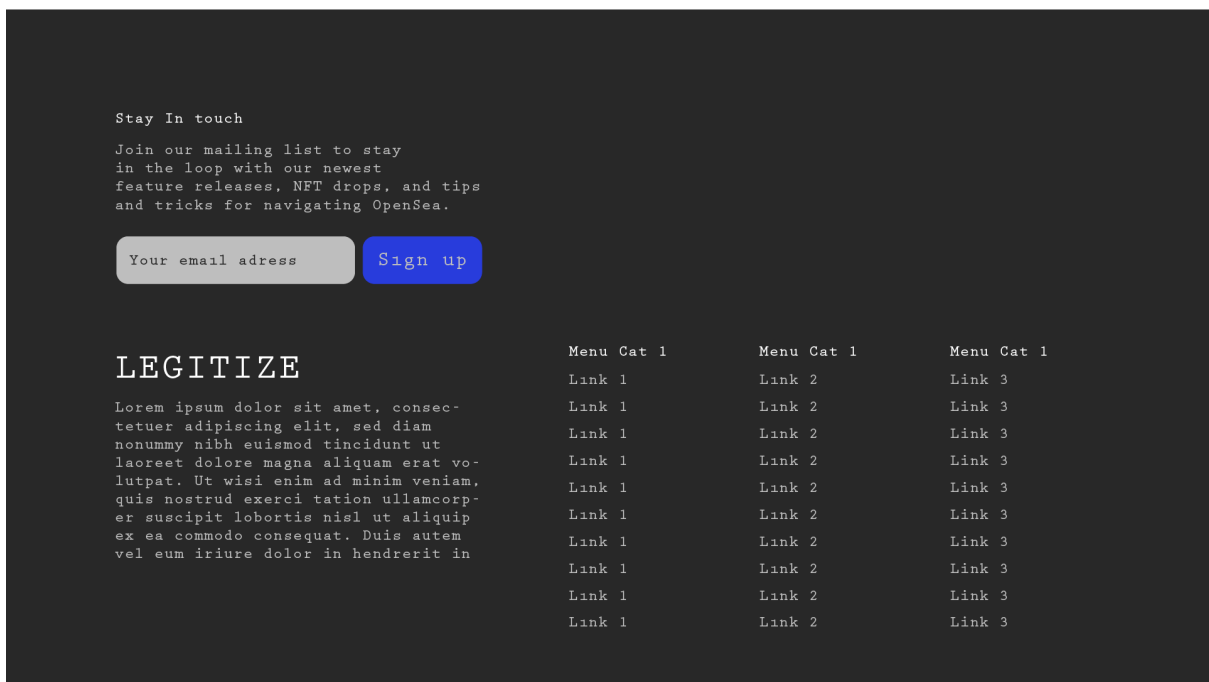
Figure 3.8. Collection page second screen

Figure 3.9. Collection page footer

3.1.4. The Users dashboard

The user dashboard contains the various assets owns(Both the ones they have created and those they purchased), as well as a link for them them to create a collection or to list and asset.
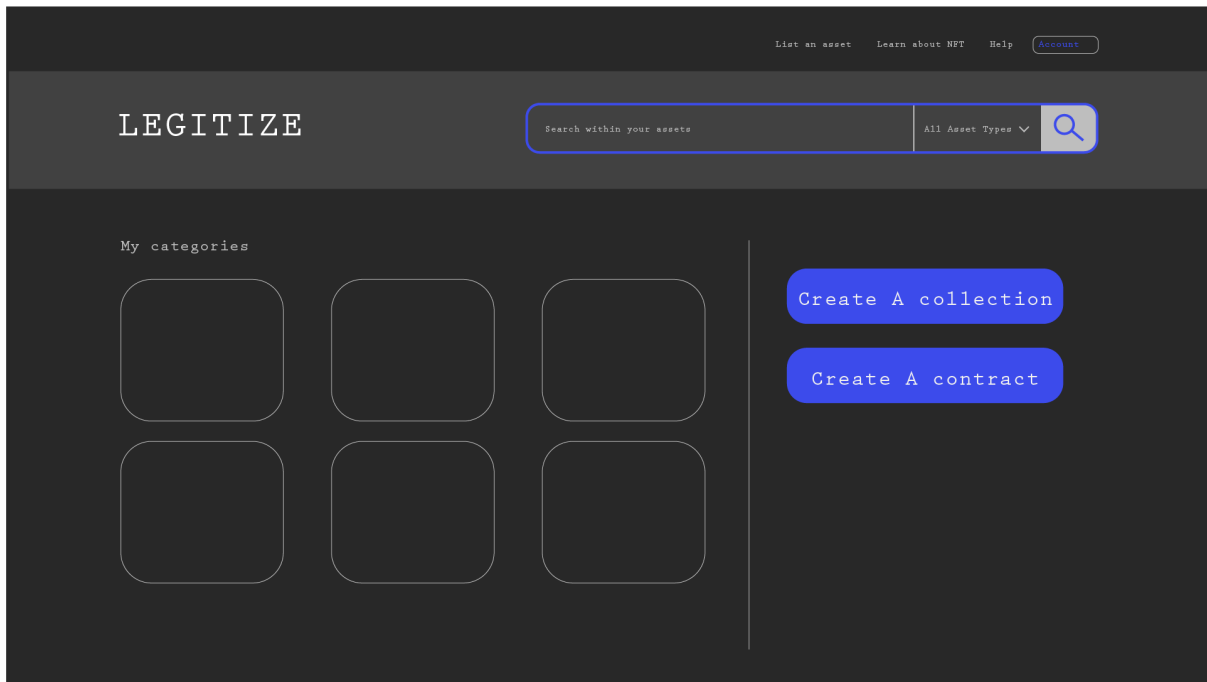
Figure 3.10. User dashboard

3.1.5. Login/Subscribe page

The login/subscribe page(or popup in our case) is a simple form to create an account or loggin to an account using a email and password.
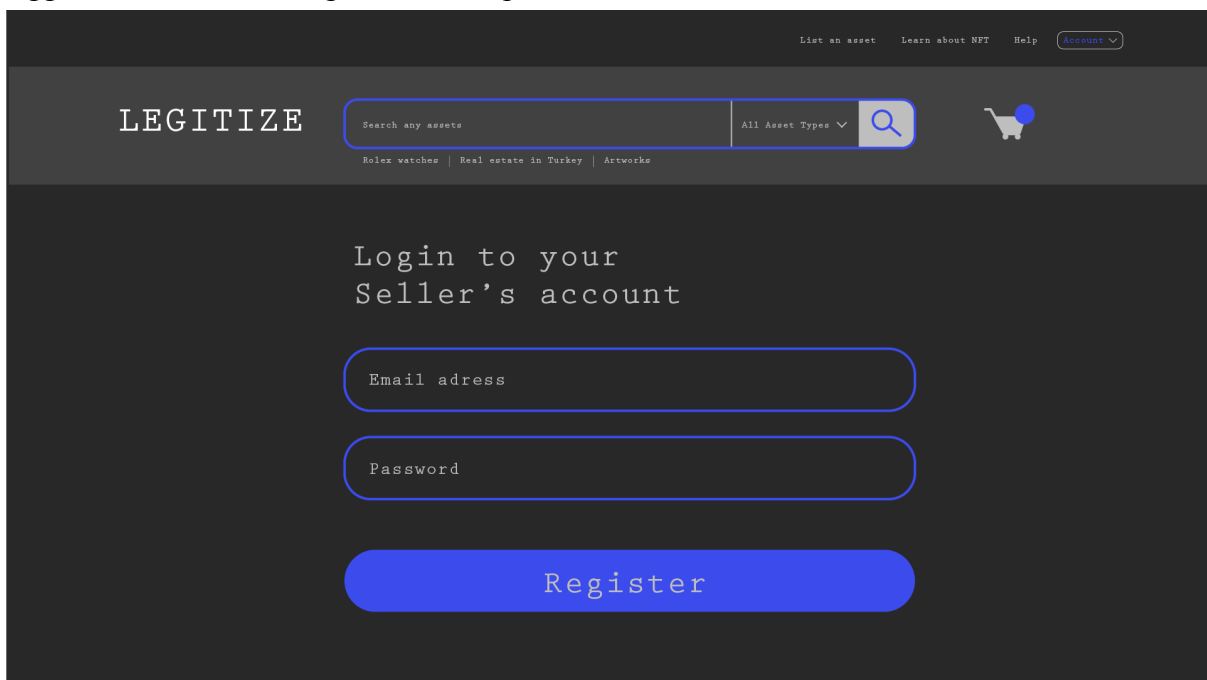

Figure 3.11. Login/Sign up screen

3.2. Back-End Realisation.

For the mean time, most of the backend is made of python codes, which will help in creating NFTs.

3.2.1. NFT generation

The below code is used to generate NFTs different layers and will subsequently be developed to deploy the nft directly to the platform.

In the first step, we import the necessary libraries as shown in the piece of code below.

```python
1   from PIL import Image
2   from IPython.display import display
3   import random
4   import json
5   import os
6
```

Figure 3.12. NFT generation code library import

In the second step, we specify the trait of the NFT to make it as rare as we possibly can. This is what will give the NFT its uniqueness.

```python
7   # Each image is made up a series of traits
8   # The weightings for each trait drive the rarity and add up to 100%
9
10  face = ["White", "Black"]
11  face_weights = [60, 40]
12
13  ears = ["No Earring", "Left Earring", "Right Earring", "Two Earrings"]
14  ears_weights = [25, 30, 44, 1]
15
16  eyes = ["Regular", "Small", "Rayban", "Hipster", "Focused"]
17  eyes_weights = [70, 10, 5 , 1 , 14]
18
19  hair = ['Up Hair', 'Down Hair', 'Mohawk', 'Red Mohawk', 'Orange Hair', 'Bubble Hair', 'Emo Hair',
20      'Thin Hair',
21      'Bald',
22      'Blonde Hair',
23      'Caret Hair',
24      'Pony Tails']
25  hair_weights = [10 , 10 , 10 , 10 ,10, 10, 10 ,10 ,10, 7 , 1 , 2]
26
27  mouth = ['Black Lipstick', 'Red Lipstick', 'Big Smile', 'Smile', 'Teeth Smile', 'Purple Lipstick']
28  mouth_weights = [10, 10,50, 10,15, 5]
29
30  nose = ['Nose', 'Nose Ring']
31  nose_weights = [90, 10]
32
```

Figure 3.13. NFT generation code trait specification

In the 3rd step, we clarify the traits to make all the difference between all the NFT's in the User's collection.

```python
33    #Classify traits
34
35    face_files = {
36        "White": "face1",
37        "Black": "face2"
38    }
39
40    ears_files = {
41        "No Earring": "ears1",
42        "Left Earring": "ears2",
43        "Right Earring": "ears3",
44        "Two Earrings": "ears4"
45    }
46
47    eyes_files = {
48        "Regular": "eyes1",
49        "Small": "eyes2",
50        "Rayban": "eyes3",
51        "Hipster": "eyes4",
52        "Focused": "eyes5"
53    }
54
55    hair_files = {
56        "Up Hair": "hair1",
57        "Down Hair": "hair2",
58        "Mohawk": "hair3",
59        "Red Mohawk": "hair4",
60        "Orange Hair": "hair5",
61        "Bubble Hair": "hair6",
62        "Emo Hair": "hair7",
63        "Thin Hair": "hair8",
64        "Bald": "hair9",
65        "Blonde Hair": "hair10",
```

Figure 3.14. NFT generation code trait clarification

REFERENCE