National College of Ireland

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Project Submission Sheet

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Programme:	Master of Science in Cloud Computing	**Year:**	Jan 2024-2025
Module:	Blockchain Concepts		
Lecturer:	Sean Heeney		
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Project Title:	CryptoComicMart: Buy Comics with Cryptocurrency		
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I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.
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Signature: Anurag Singh

Date: 16/04/2024

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4. You must ensure that all projects are submitted to your Programme Coordinator on or before the required submission date. **Late submissions will incur penalties.**
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CryptoComicMart: Buy Comics with Cryptocurrency

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Deployed Application URL: http://crypto-comic-mart-x23180013-env.eba-xzmqmcyh.eu-north-1.elasticbeanstalk.com/
Video URL: https://youtu.be/ZW_E_m1-cao

***Abstract*—Blockchain is a modern online technology that was developed mainly for the financial sector. But in recent times it has proved to have a wide range of applications that can benefit various domains such as health, insurance, supply chain management, education, and more. After Ethereum was introduced in 2015, the execution of smart contracts had a significant development in blockchain technology. Cryptocurrencies have also transformed as an online payment medium over the years since their acceptance as digital currencies. This paper studied one area of its application, namely the retail sector and its payment. CrypoComicMart is a web application that allows users to purchase comics and mangas online via SepoliaETH. It consumes 3rd party API to retrieve a collection of comics and mangas. The UI is designed to provide a seamless, user-friendly shopping experience. The application is developed using node js and Express. It implements MetaMask as a web3 wallet for user account login, thus helping in the transaction of funds securely and transparently. Remix IDE to deploy a smart contract and connect to the application Finally, it is worth mentioning that the application has been deployed on AWS Elastic Beanstalk.**

***Index Terms*—Blockchain, Cryptocurrency, MetaMask, smart contract, SepoliaETH, AWS Elastic Beanstalk, node js and express.**

I. Introduction

Blockchain is a key component of digital cryptocurrency. It is decentralized, meaning that every time a transaction occurs, a new block is generated. Each block is secure and connected through a hashing technique to prevent unauthorized access. Digital currency relies on blockchain to ensure its security and integrity. Blockchain technology plays a vital role in maintaining the safety of digital transactions. [1]. Cryptocurrencies have become popular for investment in recent years. According to major cryptocurrency exchanges, the four most popular cryptocurrencies are Bitcoin, Ethereum, XRP (Ripple) and Bitcoin Cash. The Retail and E-commerce industry has become a hub for the adoption of cryptocurrencies. Cryptocurrency transactions come with lower costs, which is especially advantageous for cross-border transfers. This can potentially lead to significant savings for both individuals and businesses. Cryptographic techniques and blockchain technology ensure a high level of security, making cryptocurrency transactions resistant to fraud.

CryptoComicMart is an online comic store that uses cryptocurrency for transactions. This provides several advantages over traditional retail online transactions. By accepting cryptocurrency payments, the store can reach customers globally without restrictions that come with traditional banking systems or currency conversions. This means that you can tap into a global market of cryptocurrency users while offering a secure and innovative shopping experience for comic book enthusiasts. SepoliaETH is the currency used in the application to perform transactions on the Sepolia test network. This test network allows developers to develop and test their smart contracts without the risk of directly deploying them to Ethereum's mainnet [2]. The use of smart contracts in the application ensures that the transactions are trustworthy, seamless, cheap and efficient as they exclude any 3rd parties or intermediaries such as banks or governments. These smart contracts use the MetaMask wallet to employ transactions. The functional requirements of the application are as follows:

1) Authentication: Users can login into web3 using a MetaMask account.
2) Connect to Contract: Users can connect to smart contracts.
3) Get contract details: Get your account and transactional details.
4) Browse products: Browse through the available products rendered on UI deployed on a mock server in Postman.

The application supports the non-functional requirements:

1) Security: Blockchain technology ensures that cryptocurrency transactions are secure and protected against fraud and chargebacks. This reduces risk for both merchants and customers, providing a high level of safety.
2) Privacy Protection: Customers don't need to share sensitive financial information while making online purchases. This can be a great option for those who prioritize their privacy.
3) Availability and Scalability: As the application is deployed on AWS Elastic Beanstalk it ensures availability

and scalability.

4) Usability: The application UI is user-friendly. Allowing users to easily navigate within the application.

II. Tools used and its purpose

Below are the tools used in the development of the CryptoComicMart application:

Sapolia test net: There are test environments of Ethereum that can be used by developers for the development, testing, deployment, and production of smart contracts. The faucet given by this test network is sapoliaETH to test the deploying smart contracts on remix IDE and sending transactions before deploying the application in production on Ethereum mainnet.

Metamask: It is a software cryptocurrency wallet and acts as an entry point to Web3 applications. It is available as a browser extension and mobile app, and it provides you with a key vault, secure login, token wallet, and token exchange [3]. The wallet is compatible with multiple platforms and has integration with popular dApps.

Remix IDE: Remix IDE caters to the entire smart contract development process and allows you to write, compile, and debug Solidity code. The project used the online version of the IDE.

Postman: It is a popular software tool used for API testing. It helps developers to test, create and document APIs. The mock server used in the application to retrieve product data is created using Postman.

GitHub: GitHub serves as a source control mechanism for managing application code through code commits.

Visual Studio Code IDE: It is an integrated development environment designed to streamline the development process with support for essential features such as compiling, debugging, development, and testing. The web application code written in node js and express is developed using this editor.

AWS Elastic Beanstalk: Elastic Beanstalk [4] can swiftly install and maintain apps on the AWS Cloud without having to learn about the infrastructure that supports them. It decreases administration complexity without limiting options or control by uploading the application, and Elastic Beanstalk will handle load balancing, health monitoring and scaling.

Trello: Figure 1 shows the snapshot of the Trello workspace of this project development.

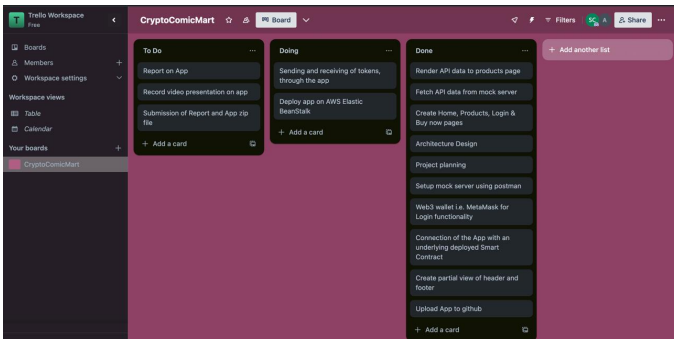

Fig. 1. CryptoComicMart Trello workspace

III. Architecture design

As illustrated in the figure 2, the blockchain developer creates a MetaMask account for managing transactions using SepoliaETH. Sepolia test network mirrors the Ethereum main network through collaboration with it to support the developer community with an always-on environment to develop and test smart contracts. SepoliaETH are test tokens used for testing smart contracts via any web3 wallet. The smart contract development was done using Remix, which was then used to compile and deploy the code. The contract is written in a solidity code snippet called Transactions, specifying the set of instructions, protocols, or rules for bounded blockchain. The code was built using the Solidity Compiler and resolved any errors or warnings shown in the remix console.

After the deployment of the smart contract, VS Code was used for web development. The backend web app framework was implemented using Express and Node.js, while the front end was installed using Bootstrap and EJS. For consuming 3rd party API in the application product page, Postman was used to create a mock server. The mock server was then started and tested by hitting get request with the given URL to get the specific API response. The web app was deployed in AWS Elastic Beanstalk, integrating the application with Node.js as a platform and uploading the zip file of the application code. The environment was created and the domain URL was deployed where the users can send and receive requests/responses. The User can also connect their MetaMask account using its browser extension and on selecting any comic to buy and clicking on the Buy Now button they initiate a withdrawal transaction where their wallet token money for the given amount is deducted and sent to the admin wallet address.

IV. Configuration and setup

This section outlines the process of configuring, setting up, and creating an application in specific steps given below:-

1. I created the MetaMask account for the management of transactions in sepoliaETH, using the Chrome browser extension and registering by creating a Secret Recovery Phrase, then an account address will be displayed e.g.: (0x56...A9) as shown in figure 3

2. Once the MetaMask account is created I employed Remix IDE to create the Smart Contract for handling application transactions. The file, named Transactions where the code is written, is a solidity code snippet that specifies the set of instructions, protocol, or rules for bounded blockchain, as illustrated in figure 4.To build the code, navigate to the ”Solidity Compiler” tab and pick the desired compiler version, such as ”0.8.25+”. We resolve any identified errors or warnings.

3. To deploy and run the code, navigate to the “Deploy Run Transactions” tab and select “Injected Provider – MetaMask” as the environment. Remix IDE’s account address box automatically captures the MetaMask account address. As seen in figure 5, Select the proper GAS Limit, 3000000, since this is the default gas necessary to complete a transaction. In the

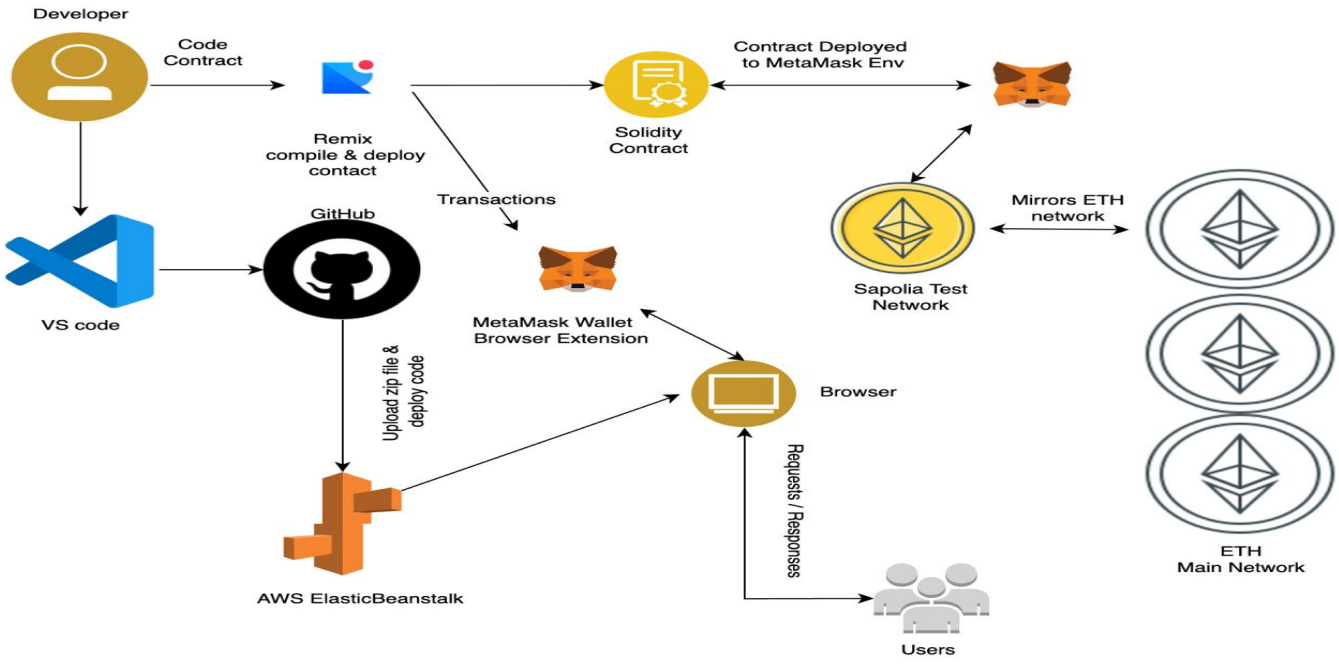

Fig. 2. CryptoComicMart architecture diagram

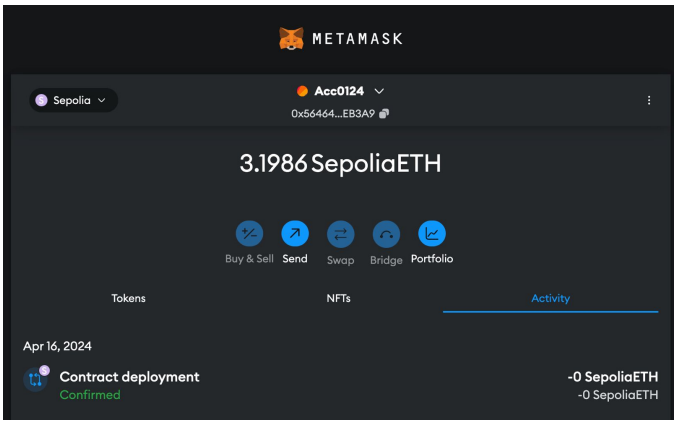

Fig. 3. Metamask account

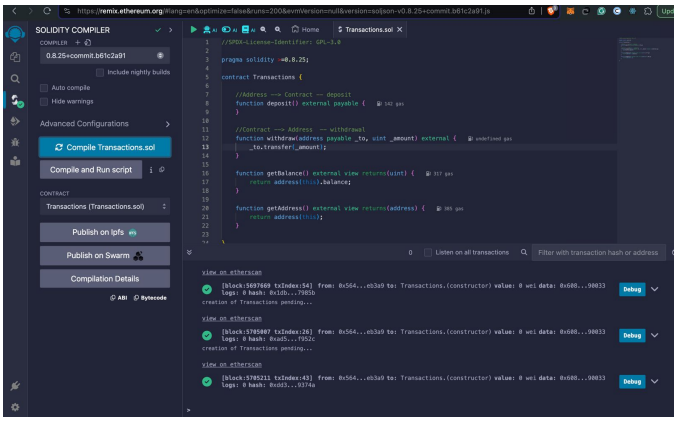

Fig. 4. Remix compile tab

Contracts section, select ”contracts/Transactions.sol” and then click the Deploy button. MetaMask popup window appears where we need to confirm the transaction. After successful deployment “Deployed Contracts” section automatically creates UI for interaction with the deployed function in the contract.

4. All the transaction tracking can be done through the MetaMask account under the activities tab like contract deployment, withdraw, getAddress, and getBalance.

5. After completion of smart contract deployment, VS Code IDE is used for web development. In the VS Code console, express which is a backend web app framework is installed using the command “npm installs express@4.17.1”. For the frontend, Bootstrap which is a CSS framework is installed by running the “npm install bootstrap@5.3.3” command, and EJS which is a template framework for defining HTML pages is installed using the “npm install ejs@3.1.10” command. Once all the dependencies are installed we can run the server locally using the command “npm start” which triggers the script “node ./bin/www”.

6. For consuming 3rd party API in the application product page I used Postman to create a mock server. Steps include creating a new collection, adding a new request, adding an example response sample, and saving it. Then create a mock server and add our collection to it, starting the server and testing it by hitting get request with the given URL to get the specific API response.

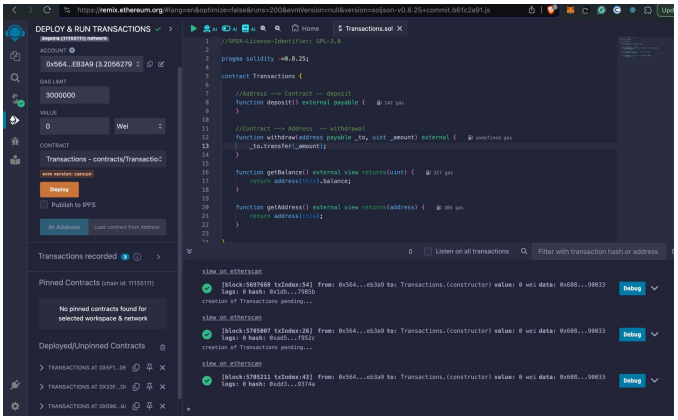

Fig. 5. Remix deploy and run transactions tab

7. Completion of web development including consumption of 3rd party API we deploy the web app in AWS elastic beanstalk. For deployment, we first create an application then an environment integrating it with the application, adding Node.js as a platform and uploading the zip file of the application code. Clicking next then clicking skipping to review and submit button in a few minutes environments get created with health status ok and the domain URL in with the application is deployed as shown in the figure 6

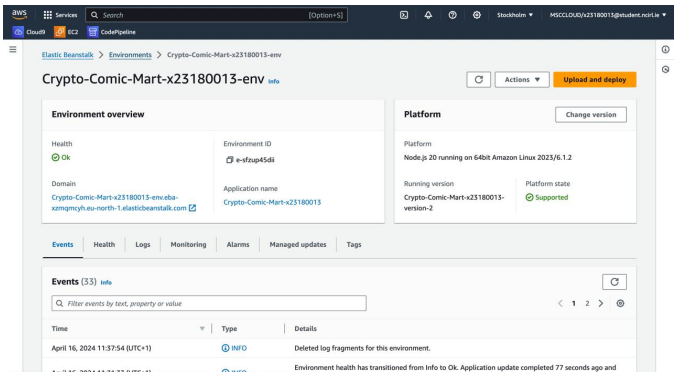

Fig. 6. AWS Elastic Beanstalk environment snapshot

V. Conclusions

In the paper, we have seen the implementation of smart contracts, their transactions by using the Sepolia test network and MetaMask wallet applications for an online comic shopping experience. This project has helped me gain hands-on experience with blockchain technology concepts and tools. For further work in the application, a distributed ledger can be used to track the transfer of ownership over time and serve as a decentralized database, securing data and other important information related to the products. With these advantages, running an online cryptocurrency comic store can provide unique benefits that traditional stores may not have, giving an edge in the market.

References

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Use and Purpose of Smart Contracts

A smart contract may be defined as a digital agreement between the buyer and the seller that is encrypted into the code directly. It runs on the blockchain technology. The smart contract runs automatically when specified rules and protocols are met. Because in smart contracts no third parties or intermediaries are involved it makes transactions reliable, fast, cheap, and efficient. Smart contracts have distinct use cases in many sectors like finance, retail, marketing, real estate, and healthcare.

The smart contract examples are as follows-

- **Decentralized Autonomous Organizations (DAOs):** DAOs are organizations that implement smart contracts. These organizations are governed in a decentralized way and function without any hierarchical management systems where members can vote on options collaboratively. Aragon and DAOstack are examples of platforms that employ smart contracts to create and manage DAOs.
- **Non-Fungible Tokens (NFTs):** NFTs are unique because they are encrypted on the blockchain by using smart contracts making them digital assets. They help in claiming ownership of assets like paintings, artifacts, virtual real estate, etc. Platforms such as OpenSea and Rarible use smart contracts thus helping in the creation, purchase, and selling of NFTs.

As somebody new to blockchain technology, I believe the power to build tokens, NFTs, and smart contract-enabled applications will be a game-changer in various industries. Here are a few of my thoughts:

- **The decentralization of Access:** Blockchain and smart contracts have made financial services, digital assets, and decentralized apps (DApps) more accessible. Due to this every individual belonging to different geographical locations and economic conditions would obtain financial services, and own digital assets securely and transparently.
- **Empowerment creation**: The growth of NFTs has transformed how artists monetize and distribute digital material. Creators may use tokenization to establish ownership rights and communicate with their audience directly eliminating the need for any 3rd parties.
- **Privacy and Security:** Though blockchain is open and unchangeable, it poses privacy and security issues. User privacy might get compromised when public blockchain keeps their data on a visible ledger. Smart contracts can have errors and security risks if they are not reviewed and verified properly. It's important to ensure that they are thoroughly checked to avoid any potential risks.
- **Ethical and social concerns:** The effect on the environment because of blockchain networks and particularly the proof-of-work consensus techniques used by different cryptocurrencies such as Bitcoin. As mining activities for blockchain involve huge energy consumption it raises concerns about the sustainability and future of blockchain and smart contracts.
- **Regulatory uncertainty:** Governments and regulatory agencies are arguing about how to classify and regulate cryptocurrencies, NFTs, decentralized financial platforms, and applications. The regulatory framework for blockchain technologies, cryptocurrencies, and smart contracts is evolving with time. Regulatory uncertainty creates hurdles for industries and investors, causing hesitation and doubts about the implementation of blockchain and its future.