Building Blockchain and Web3 Technology Applications in the Development of an Ethereum-based Decentralized Crowdfunding Platform

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***Abstract*— This research explores the integration of blockchain and Web3 technologies in the development of an Ethereum-based decentralized crowdfunding platform. The goal is to leverage the transparency, security, and decentralization of blockchain to overcome challenges in traditional crowdfunding, such as the lack of trust and inefficiency in managing collected funds. Ethereum, as a cryptocurrency, was implemented to facilitate fast, secure, and low-cost transactions, thus allowing contributors from all over the world to participate without geographical or financial barriers. This paper will discusses the architecture, functionality, and impact of the platform, providing insight into the potential of blockchain in reshaping the crowdfunding landscape.**

Keywords— Crowdfunding, Web3, Blockchain, Ethereum

I. INTRODUCTION

The massive development of digital technology today is inseparable from human social life. This not only facilitates access to information, but also allows the emergence of various innovations that can facilitate daily human activities. The use of technology in the 21st century has encouraged the mastery of creative, collaboration, and problem-solving skills oriented to the digital world. [1]. In social activities, for example, technology is used as a medium to deliver an open call to a group of individuals and the general public to participate in fundraising activities without using standard financial intermediaries.

Speaking of crowdfunding, it refers to the raising of small amounts of money from a large number of people as a way that some fundraisers such as artists, researchers and entrepreneurs often use to fund their projects. [2]. In this era of digitalization, there are many platforms that provide a platform for this concept such as Kickstarter and Patreon. [3]. It can provide an opportunity for sponsors to feel directly involved in realizing the projects they believe in, thus creating a more personalized relationship between the fundraiser and the contributor or investor.

Despite the number of service providers, challenges remain unavoidable. One of these is the lack of transparency in the management of the funds raised. Many contributors are concerned about the potential misuse of funds or the mismatch between the original purpose of the appeal and the end result. [4]. This requires many platforms to provide stricter oversight mechanisms, such as regular project progress reports just to ensure funds are only used as intended.

In this era of digitalization, technology has become a part of modern life, many effective and innovative solutions are presented for various daily needs. In this digitalized life, the internet has become a medium that connects individuals, groups, communities, and businesses around the world. One of the tangible forms of digital technology is the presence of web-based technology.

Web-based technology has had several versions until the latest one has reached version 3.0. According to Lai [5], Since the end of the Web 1.0 era in 2004 which only focused on information exchange and static portal displays, we have moved on to the Web 2.0 era. In this era, users can create and share their own content. Meanwhile, many platforms have started to utilize user-generated content (UGC) as a tool to build and activate larger and more diverse user communities.

Unlike the Web 2.0, which was dominated by the role of technology giants as the main mediators in user interaction, Web 3.0 emphasizes a new paradigm in the digital ecosystem. Web 3.0 emphasizes the principle of decentralization, where control and ownership of data is no longer in the hands of a handful of large companies, but rather spread among the users themselves [6].

Blockchain is a major part of Web 3.0 technology that promotes the principle of decentralization. This technology works by systematically creating a collection of interconnected blocks where every transaction is permanently and transparently recorded. Each block on the network will store transaction information, then encrypted with cryptographic techniques to maintain user security and privacy [7]. This system can make the need for a third party as an intermediary disappear, allowing direct transactions between users with a high level of trust. [8].

Thus, the solution offered by blockchain can be used as a solution to the lack of data transparency, especially the management of funds collected from crowdfunding activities. Furthermore, through a decentralized system, this research can implement more deeply the application of Web 3.0 and blockchain technology on a crowdfunding platform.

In this research, the use of Ethereum as a cryptocurrency on the platform will also be implemented to ensure that the platform will not limit the ability of contributors to provide support [9]. It is intended for faster, safer transactions and lower fees, and makes it easier for contributors from different countries to engage in crowdfunding projects without geographical or financial barriers.

II. LITERATURE REVIEW

The development of this platform is based on several research references such as “Blockchain-Based Decentralized E-commerce Using Ethereum and Smart Contracts” [9]. In that study, the authors built a decentralized platform for e-

commerce, where users can buy and sell products without the need for intermediaries with the guarantee of transparency and security provided by blockchain technology.

There are also other studies similar to this research entitled "Blockchain Based Crowdfunding Systems" [10]. The author of the study explains how blockchain technology is used as an application of crowdfunding platforms. In addition, there are several platforms that have implemented similar technology when this research was written, some of which are WeiFund.

The focus of this research will be emphasized on the general user experience to be able to contribute to each crowdfunding campaign that will be available on the platform. Not only as a contributor, but users can create their own campaigns or projects.

Using the combination of several web technologies, React.js will be used as a tool to build the platform's interface. Through React.js, developers can easily create dynamic features such as project creation forms, contributor views, as well as real-time tracking of fund usage. This tool will also be integrated with other tools such as Web3.js to make it easier for developers to manage Smart Contract-related features. The Solidity programming language will also be used in this research as a language base in creating Smart Contracts on the platform.

This research also uses supporting tools as a tester of information systems created with blockchain technology. Hardhat as additional supporting software in developing a crowdfunding platform in this research. In addition, to support the development process, the use of the Interplanetary File System (IPFS) as a blockchain-based digital storage media protocol will be used to store all forms of media-type data on the platform. This media protocol allows data in the form of media to be stored in a distributed file system so that access becomes more efficient, faster and minimizes redundancy.

In addition to facilitate the research, the author added the use of Extreme Programing (XP) methodology in developing this information system platform. There is one study that the author uses as a reference in conducting this research using the methodology in question. The research is entitled "Development of a REST API for the Rinjani Visitor Application using Extreme Programming" [11] which focuses on developing information systems to help local communities market ecotourism packages online more effectively. Finally, the author concludes that the choice of methodology is aimed at flexibility in using methods that suit the needs, especially when there are sudden changes when developing the platform.

III. Methodology

This research uses Extreme Programing (XP) software development methodology, a methodology that emphasizes rapid development through prototyping, iterative iteration, and active user involvement. With this method, the possibility of flexibility that exists can provide users with the suitability of using the method according to their wishes and needs, especially when sudden changes occur. This method has several stages, namely exploration, planning, iteration, and release as shown in "Fig. 1".

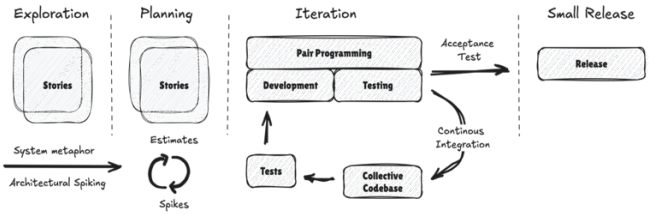

Fig. 1. Extreme Programing Life Cycle

In the exploration phase, data collection and analysis of system requirements were conducted to determine the necessary specifications. Over the next few days, planning focuses on prioritizing key features and estimating the development effort. This process continues into the iteration phase, which includes intensive collaboration such as pair programming, iteration-based development, and refactoring to improve the code structure. This stage ends with a product that is ready for launch. Before the final release, the software undergoes additional testing and performance analysis to ensure quality, followed by a maintenance phase to adapt the system to future user needs.

IV. Result and Discussion

A. Exploration Phase

In the early stages, development will begin by first identifying user needs. By understanding user needs, the author can prioritize key features, critical functions, and design elements that are relevant to the issues raised.

1) User Use Case: The stage begins by identifying equirements based on user needs. The next step is to create a detailed use case diagram, which visually represents the interactions between users and the system. This includes various actions, including those that are either part of or excluded from specific processes. Each use case provides a clearer understanding of how users will engage with the system and what functionalities are essential. For further clarity, the complete use case diagram can be viewed below.

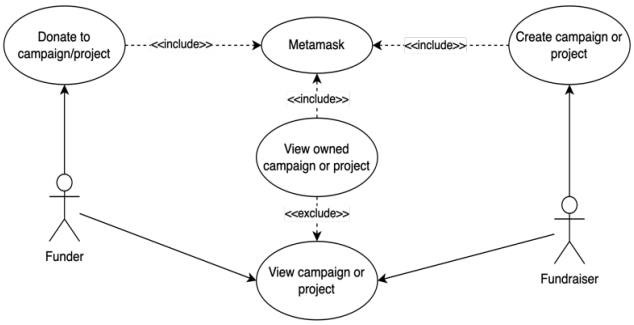

Fig. 2. Use Case Diagram

2) Architecture Design: Based on the results obtained previously in the first point, the next step is to design the technology that will be used in the blockchain architecture. Here we use docker to speed up development process of the platform so that it is easier and accessible for testing purpose.

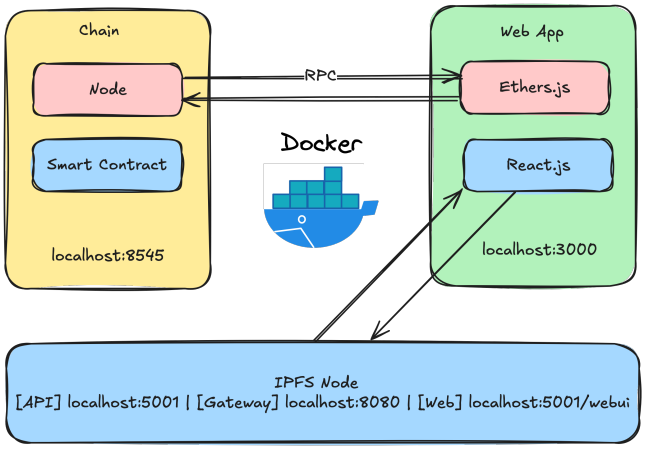

Fig. 3. Architecture Design Topology

3) Smart Contract: The contract is needed to determine how the website will communicate with the blockchain network, specifically Ethereum. You can access the Smart Contract code through the following link here.

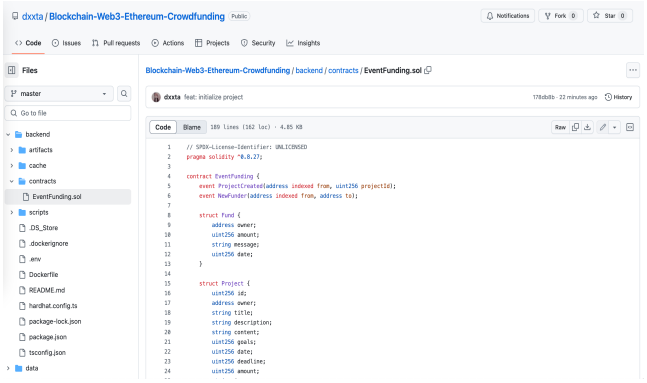

Fig. 4. Github Repository

B. Planning Phase

This stage begins by identifying needs related to how the system created will run according to user needs. Based on the needs, there are two types of users who will run on the system. Users will act as funders and fundraisers. Funders can view and donate to available projects, while Fundraisers will manage their own projects or campaigns. Therefore, user stories are made which you can see in full through the following "Table 1".

TABLE I. USER STORIES

Code	Domain	Actor	Description
US-1	Funder Page	Funder	Page for funder to view projects and manage their funds
US-2	Web3 Integration	Funder, Fundraiser	Feature to allow funder or fundraiser to connect their wallet through Metamask
US-3	Fundraiser Page	Fundraiser	Page for funder to manage their projects

Based on the user stories above, the needs that have been designed as user stories before will be determined in the order of work based on the features that have the highest level of urgency. For details can be seen in the following description.

TABLE II. USER STORIES

Code	Feature	Iteration	Priority
First Iteration			
US-1	Funder Page	1	High
US-2	Web3 Integration	1	Medium
Second Iteration			
US-3	Fundraiser Page	2	Low

C. Iteration Phase

This stage is carried out based on the user stories and priority planning that have been designed in the previous stage. Each user story will be divided into processes based on the iterations in "Table 2" and each feature has its own priority scale.

1) First Iteration: In the first iteration, some features began to be worked on based on the User Stories that had been created previously. User Stories with codes US-1 and US-2 were created first so that funders can see a list of available projects and can make donations to these projects. In this iteration, integration between the website, Smart Contract and Metamask was also done. For more details, the results of the first iteration are presented as follows.

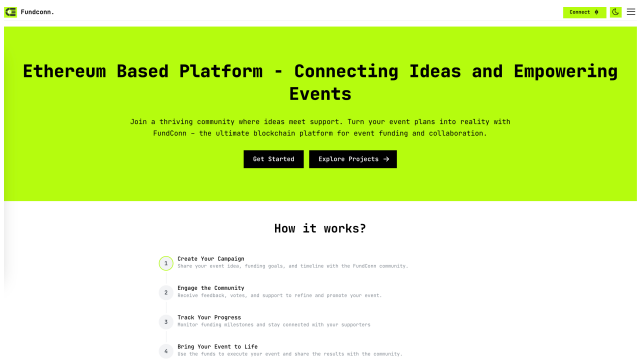

Fig. 5. Funder Home Page

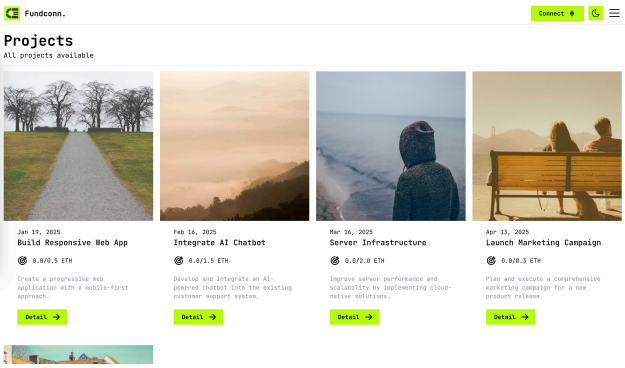

Fig. 6. Funder Project Page

2) Second Iteration: Futhermore in the second iteration, the developed crowdfunding web page will provide the ability for users to create their own projects or campaigns using Ethereum-based blockchain technology and MetaMask integration. Users can connect their wallets to directly start crowdfunding campaigns, manage funds, and receive donations. Every project created will be connected to a Smart

Contract on the Ethereum network, which ensures transparent and secure transactions, as well as immutable records. Fundraisers will also be able to see the history of transactions and contributions recorded on the blockchain, ensuring security and trust in every project created. In addition every media files on this page will be stored on IPFS to improve the performance of the web pages.

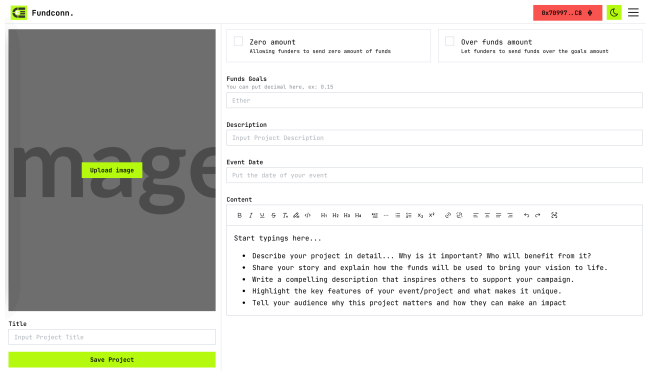

Fig. 7. Fundraiser Create Project Page

D. Release Phase

Before proceeding to the next stage, the author ensures that all steps that have been carried out in the previous phase are complete by retesting according to the endpoints that have been determined in the iteration phase. This test aims to ensure that all features function properly before proceeding to the next step. After that, the system architecture will be containerized using Docker, which allows all existing services to be wrapped in a container to simplify management and deployment. This process follows the model described in "Fig 3" in the exploration phase. A more detailed explanation of the use of docker-compose and how it is applied in the context of this project can be seen in the following figure below.

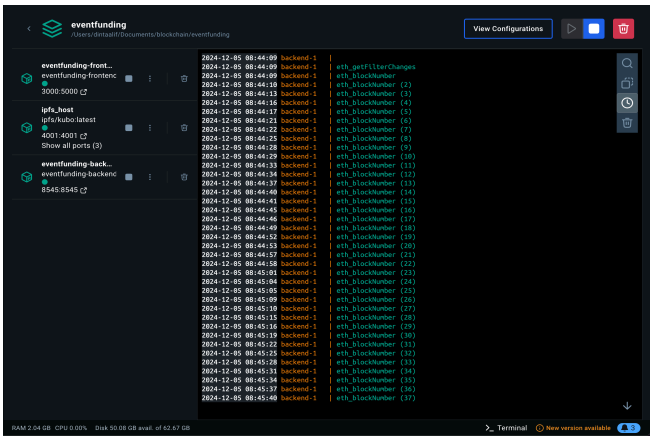

Fig. 8. Docker Desktop

To perform containerization, we uses docker-compose, a Docker tool that allows easy management of various containers through a configuration file. This file contains the scripts needed to run and configure containers that contain various interconnected services. These scripts manage how the containers interact with each other and ensure that the system can be run in isolation while still functioning as a whole.

V. Conclusion

Blockchain offers a solution to the problem of lack of transparency in fund management in crowdfunding, by ensuring that transactions are recorded securely, transparently, and irreversibly. With the implementation of a decentralized system, this research also delves deeper into the potential of Web 3.0 and blockchain technology in increasing efficiency and participation in crowdfunding platforms.

The implementation of Ethereum as a cryptocurrency on the platform ensures faster, safer, and lower-cost transactions, and allows contributors from different countries to participate without geographical or financial constraints. Thus, blockchain technology can expand the scope and enhance the integrity of crowdfunding platforms globally.

Although in its development there are still some features that are not optimal and experience delays. Some developments that are expected in the future are the addition of an edit feature that maximizes the use of version history on blockchain technology. Finally, the author hopes that in the future this information system can be used as a reference for developing further research.

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