LendHub – DeFi Lending and Borrowing

HLD Documentation

Document Control

Version	Date	Author	Description
1.1	26 – March- 2023	Shubham Prajapati	Added Introduction, General Description, Design details, Performance. Conclusion, reference
1.2	27 – March- 2023	Sasibhushan Upadrasta	Updated and modified the all the sections

Approval Status

Version	Review Date	Reviewed By	Approved By	Comments

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Abstract

The goal of this project is to develop a decentralized lending and borrowing platform using blockchain technology and smart contracts. The platform will enable individuals and organizations to lend and borrow digital assets in a trustless and transparent manner, without the need for intermediaries such as banks or credit unions.

The platform will be built on top of the Ethereum blockchain, leveraging its robust smart contract capabilities and large developer community. The lending and borrowing process will be governed by a set of rules encoded in smart contracts, which will automatically execute when certain conditions are met. These rules will include parameters such as interest rates and collateralization ratios, ensuring that the platform operates in a secure and efficient manner.

The platform will support a range of digital assets, including stablecoins, cryptocurrencies, and tokens issued on the Ethereum blockchain. Users will be able to lend and borrow these assets, earning interest on their loans and paying interest on their borrowings. The platform will also allow users to withdraw their funds at any time, subject to certain conditions such as repayment of outstanding loans.

In addition to its lending and borrowing features, the platform will also incorporate a reputation system to help users evaluate the creditworthiness of potential borrowers.

1: Introduction

1.1 Why this High-Level Design Document?

The purpose of this High-Level Design (HLD) Document is to add the necessary detail to the current project description to represent a suitable model for coding. This document is also intended to help detect contradictions prior to coding and can be used as a reference manual for how the modules interact at a high level.

The HLD will:

- Present all the design aspects and define them in detail.
- Describe the user interface being implemented.
- Describe the hardware and software interfaces.
- Describe the performance requirements.
- Include design features and the architecture of the project

List and describe the non-functional attributes like:

- Security
- Reliability
- Maintainability
- Portability
- Reusability
- Application compatibility
- Resource utilization
- Serviceability

1.2 Scope

The HLD documentation presents the structure of the system, such as the database architecture, application architecture (layers), application flow (Navigation), and technology architecture. The HLD uses non-technical to mildly technical terms which should be understandable to the administrators of the system.

2: General Description

2.1 Product Perspective

Lendhub operates as a decentralized peer-to-peer lending and borrowing protocol, where lenders and borrowers engage in a direct loan relationship. The protocol facilitates liquidity provision by the lender through cryptocurrency deposits into the pool contract, which can then be borrowed by placing collateral within the same contract. Unlike traditional lending models, individual loans do not need to match. Instead, Lendhub relies on the pooled funds and the amount borrowed, as well as the value of the collateral. This approach enables instant loans with characteristics that are determined by the state of the lending pool.

2.2 Problem Statement

When individuals deposit money into a bank, the bank typically lends the funds to other individuals or businesses as loans or credit, generating interest income and profits. However, this model can become problematic if the bank issues undercollateralized loans, where the loaned amount exceeds the value of the collateral securing the loan. If a bank has too many undercollateralized loans on its books, it can face liquidity problems and ultimately fail, causing depositors to lose their savings and other financial institutions to suffer losses. For instance, in 2019, the Punjab Maharashtra Cooperative (PMC) bank, one of the largest cooperative banks, failed due to lending a significant portion of its funds to a single borrower, causing difficulties for depositors trying to retrieve their funds.

Traditional banking systems rely on centralized databases that can be vulnerable to cyber-attacks, as all financial and personal data is stored in a single location. This makes it an attractive target for hackers seeking to exploit system vulnerabilities to gain unauthorized access and steal sensitive information. Additionally, traditional banking heavily relies on intermediaries such as banks, clearinghouses, and other financial institutions, resulting in delays, high fees, and potential fraud.

Centralized control in traditional banking can also lead to a lack of transparency, high fees, and limited access to financial services for individuals who don't meet certain requirements.

2.3 Proposed Solution

LendHub is a blockchain-based lending and borrowing platform that seeks to revolutionize traditional banking transactions by leveraging decentralized technology. It eliminates the need for intermediaries and instead utilizes a decentralized database comprised of interconnected blocks, which is more efficient and secure than the traditional centralized database model.

By being accessible to anyone with an internet connection, LendHub offers greater financial inclusion to individuals who may not have access to traditional banking services, such as those living in remote areas or without a bank account. Through DeFi platforms, these individuals can access funds and earn interest without relying on traditional financial institutions.

LendHub operates on a public blockchain, enabling all parties involved in a transaction to see the details of the transaction, including the amount borrowed, interest rates, and repayment terms. This

level of transparency helps to reduce the risk of fraud, as all parties can verify the authenticity of the transaction and ensure that the terms are being upheld.

Because LendHub is built on decentralized blockchain networks, it requires no physical locations or large staff, resulting in significantly lower overhead costs. This translates into lower fees for borrowers and higher returns for lenders, making DeFi lending and borrowing a more cost-effective alternative to traditional finance.

Overall, LendHub's decentralized model offers greater transparency, lower fees, and broader access to financial services, making it a compelling alternative to traditional banking.

2.4 Further Improvement

LendHub has the potential to integrate various use cases to enhance its platform capabilities. Here are some examples:

1. **Time-lock for lent and borrowed assets**: LendHub could enable time-lock features for both the lender and borrower. This would ensure that assets are locked up for a specific period, providing certainty for both parties during the loan term.
2. **Fixed deposit schemes for lenders**: LendHub could offer fixed deposit schemes for lenders who want to lend their assets for a fixed period. This would enable lenders to earn a fixed rate of interest on their assets, providing greater predictability and stability.
3. **Off-chain data computation:** LendHub could implement off-chain data computation to determine more optimal loan options. This would enable LendHub to analyze data from various sources to provide borrowers with more personalized loan options based on their creditworthiness and other factors.
4. **DAO for governance purposes:** LendHub could incorporate a DAO (Decentralized Autonomous Organization) for governance purposes. This would enable token holders to participate in decision-making processes related to the platform's development, management, and future direction.
5. **Dynamic interest rates & Interest rate per asset:** LendHub could integrate dynamic interest rates and interest rate per asset based on the Beta or volatility. This approach would enable LendHub to adjust interest rates based on the perceived risk of the asset being lent or borrowed. By analyzing the volatility of an asset's price, LendHub can determine the level of risk and offer interest rates accordingly. This approach would incentivize lenders to lend their assets to borrowers who are more likely to repay their loans, while discouraging borrowers who pose a higher risk of default.
6. **Fixed-point arithmetic:** LendHub could implement fixed-point arithmetic to ensure precision in calculations. This approach would enable LendHub to perform precise calculations without losing accuracy due to rounding errors. This is particularly important in the context of financial transactions, where even a small error in calculation could have significant consequences.
7. **Chainlink Automation**: LendHub could leverage Chainlink's upkeep automation to enable liquidation based on price fluctuations. This approach would enable LendHub to monitor the price of assets being lent and borrowed in real-time, and automatically trigger liquidation in the event of a price drop. This would reduce the risk of default and enable lenders to minimize losses.

8. **Mutual Funds implementation:** LendHub could also incorporate mutual funds implementation to enable diversification of assets for both lenders and borrowers. By pooling assets from multiple lenders and offering them as a single investment option, LendHub can provide borrowers with access to a wider range of assets while enabling lenders to spread their risk across multiple assets. This approach would also enable smaller investors to participate in lending and borrowing activities, thereby increasing the overall pool of available capital.

9. **LendRank**: Implement "LendRank," that assigns a score to borrowers based on their creditworthiness.

These use cases would enhance LendHub's capabilities and provide greater value to its users. By implementing these features, LendHub could establish itself as a leading decentralized lending and borrowing platform in the blockchain ecosystem.

2.5 Tools used

Solidity programming language and tools such as Hardhat, Etherjs, Metamask, Infura, Chainlink have been used to build this project

- Solidity is a programming language specifically designed for writing smart contracts that run on the Ethereum blockchain.
- Hardhat is a development environment used to build and test smart contracts, including Solidity contracts.

- Etherjs is a popular JavaScript library used to interact with the Ethereum blockchain and send transactions.
- Infura is a hosted Ethereum node service that allows developers to access the Ethereum network without running their own nodes.
- MetaMask is a browser extension wallet that allows users to interact with Ethereum-based applications and websites.
- Chainlink is a decentralized oracle network that provides smart contracts with access to external data sources.
- Sepolia is a decentralized identity and access management solution that enables users to control their own digital identity.
- Ethereum is a blockchain platform that enables the creation of decentralized applications (dApps).
- Chai is a mobile payment application built on the Ethereum blockchain that enables users to make payments using cryptocurrency.
- Git is a popular version control system used by software developers to manage code changes.
- Next.js is a popular JavaScript framework used for building server-side rendered web applications.
- Tailwind CSS is a utility-first CSS framework that makes it easy to rapidly develop and design websites.
- OpenZeppelin is a library of reusable smart contracts that can be used to build decentralized applications.
- Netlify is a cloud-based platform used for hosting and deploying web applications.
- VSCode is a widely-used code editor developed by Microsoft.
- Remix is an open-source browser-based integrated development environment (IDE) used for writing, testing, and deploying smart contracts on the Ethereum blockchain.

2.5.1 Hardware Requirements

Some hardware components are required to be present on a computer for all computer software needs. The hardware is the most common set of requirements are the physical computer resources needed by a software application. These prerequisites are known as system requirements.

- Process: Intel i5 core
- RAM: 8 GB
- Hard Disk: 512 GB or SSD: 256 GB
- Internet: 20 MBPS

2.5.2 Software Requirements

Software requirements constitute software resource requirements and prerequisites that should be installed on a computer to provide optimal functioning of an application.

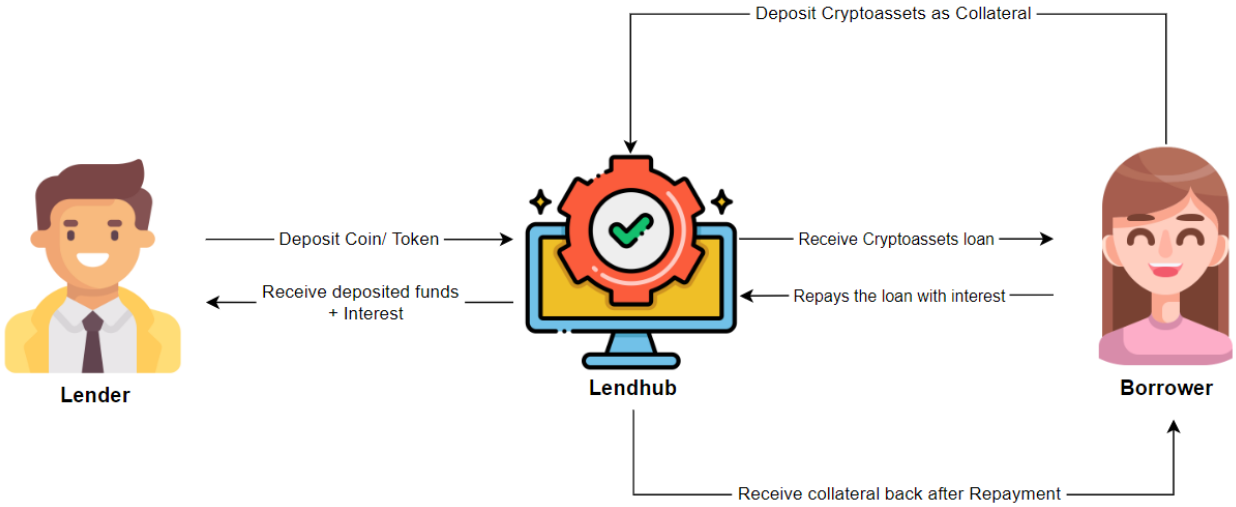
- Windows edition: Window 7 Home Premium
- User Interface: Nextjs, Tailwind CSS
- Client-side Scripting: JavaScript
- Server-side Scripting: Solidity

- Database: Ethereum Blockchain
- Web Browser: Google Chrome or any Browser

3: Design Details

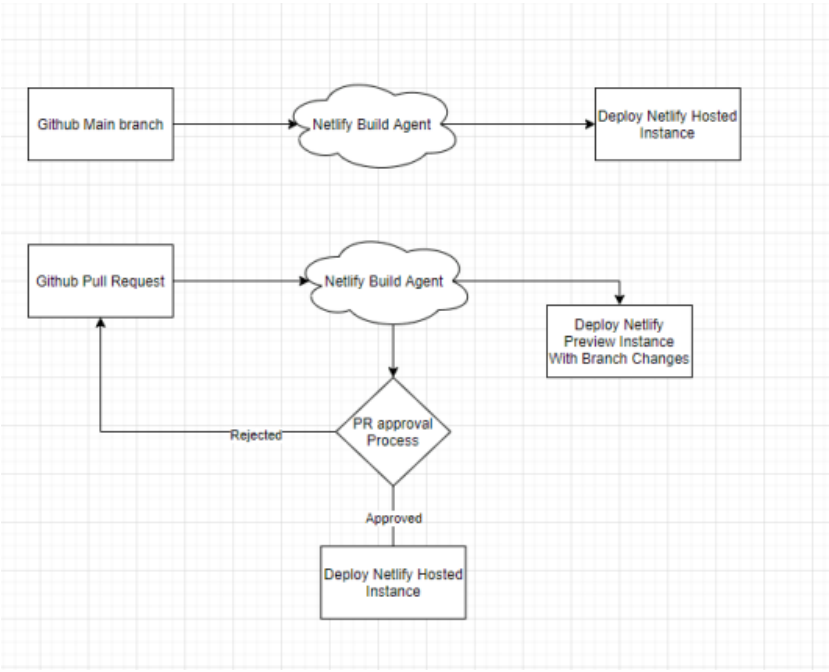
3.1 Process Flow

The Process flow of the LendHub is show in below diagram:



3.1.1 Deployment Process

At LendHub, we have integrated Netlify, which offers a comprehensive CI/CD solution for seamless deployment. This integration is easily achievable through Github, allowing for smooth and efficient code management.



3.2 Event Log

Event logging is an essential aspect of decentralized finance (DeFi) lending and borrowing. Because it helps to ensure transparency, accountability and security of transactions on the blockchain.

Here are some key events that are logged in lendHub:

1. **Collateral Deposit**: Every time a user makes a collateral deposit in LendHub, an event log is generated on the blockchain. This event log captures crucial details such as the user's information, the token involved, and the specific amount of collateral deposited.

2. **Collateral Withdrawal**: Whenever a user withdraws his collateral from the lendHub, an event log is created on the blockchain. This event contains information about the user, the token, and the amount withdrawn.

3. **Asset Borrow**: Whenever a user borrows crypto assets from lendHub, an event log is created on the blockchain. This event contains information about the user, the token, and the amount borrowed.

4. **Repayment of Borrowed Assets**: Whenever a user repays their loan plus interest, an event log is created on the blockchain. This event contains information about the user, the token, and the amount repaid.

3.3 Error Handling

Error handling is the process of identifying and addressing unexpected issues, errors, and bugs that can arise during program execution. In LendHub, we have implemented several key error handling strategies to ensure smooth operation:

1. Logging: Error messages are logged and displayed on the frontend to help us diagnose and fix issues quickly.
2. Exception handling: We use try-catch blocks for every backend operation to catch and display errors from the backend.
3. Input validation: We validate all input data using appropriate regular expressions to prevent unexpected errors.
4. Testing: We conduct unit testing to identify and address any errors and bugs in the program.

4: Performance

4.1 Reusability

Code reusability is crucial in software development as it enables developers to reduce redundancy, enhance efficiency, and promote innovation. LendHub has been designed with a modular approach, where components are broken down into smaller, independent pieces that can be reused across the platform. This promotes code efficiency and accelerates the pace of development.

In addition, LendHub follows standardized interfaces, making it easier for developers to reuse code across the platform. This helps to reduce development costs and speeds up the time to market for new features and functionalities.

By leveraging modular design and standardized interfaces, LendHub aims to improve code reusability, which ultimately leads to more efficient and cost-effective development, faster innovation, and a better user experience.

4.2 Application Compatibility

LendHub is a web-based platform that is designed to be responsive, ensuring that it functions effectively across various browsers, devices, and operating systems. This means that users can access and use LendHub from their desktop, laptop, tablet, or smartphone, regardless of the operating system or browser they are using.

The platform is optimized for different screen sizes and resolutions, ensuring that users can navigate and use the platform without any difficulty. This approach provides a seamless and consistent user experience, regardless of the device or browser being used.

4.3 Resource Utilization

Lendhub is built on the top of Next Js which is used for server-side rendering, image optimization, server optimization and resource prioritization, which significantly reduce the load time of the webpage.

4.4 Deployment

For the smart contact deployment, we have used the Sepolia testnet which is built on Ethereum blockchain, designed to help developers test and experiment with DApp before deploying them on the mainnet.

For the Frontend site deployment, we have used Netlify which is a popular cloud-based platform for deploying and hosting web applications.

5: Conclusion

In conclusion, Lendhub is one of the most promising use cases and applications of blockchain technology in the financial industry. It eliminates the need for intermediaries such as traditional banks, offering greater accessibility, transparency, and flexibility to individuals seeking to borrow or lend funds. With the use of blockchain technology, Lendhub has made it possible for anyone to earn interest on their crypto assets, an opportunity previously only available to institutional investors. By leveraging the benefits of blockchain technology, Lendhub is transforming the way people access financial services, empowering them with greater control over their assets and financial futures.

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