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Project Report

AGRICROWD

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Content

Literature Review (LR)

Özet

AGRICROWD, son dönemde büyük bir ilgi odağı haline gelmiş olan blockchain teknolojisi ile kitlesel fonlama konularını mercek altına almaktadır. Blockchain'ın merkezi olmayan, şeffaf ve güvenli yapısı, kitlesel fonlama alanında büyük bir devrim potansiyeli taşımaktadır. Bu literatür taraması, AGRICROWD platformunu oluşturan bu iki önemli bileşen arasındaki kesişimi keşfetmeyi amaçlamakta, temel eğilimleri, karşılaşılan zorlukları ve sunulan fırsatları derinlemesine incelemektedir. Aynı zamanda, geleneksel kitlesel fonlama çalışmalarının da bu incelemenin kapsamında olduğu unutulmamalıdır. İncelemenin amacı, mevcut araştırmaların eksikliklerini ve fırsatlarını anlamak ve gelecekteki çalışmalara yön verecek öneriler sunmaktır. Blockchain'in kitlesel fonlama verimliliği, yatırımcı koruması ve sınır ötesi işlemler üzerindeki etkisine yoğunlaşmaktadır. Ayrıca, farklı yargı alanlarındaki düzenleyici çerçeveleri ve hukuki konuları araştırarak, bu alandaki mevcut durumu ele almaktadır. Bu kapsamlı derleme, etkili kitlesel fonlama girişimlerinin analizini sunmanın yanı sıra, bu alandaki ilgili araştırmaların ve makalelerin kaynaklarını da sağlamaktadır. Bu inceleme, blockchain tabanlı kitlesel fonlama ve geleneksel kitlesel fonlama alanlarında daha fazla araştırma ve geliştirme için güçlü bir temel sunmaktadır.

Abstract

AGRICROWD examines the intersection of blockchain technology and crowdfunding, which has recently garnered significant attention. The decentralized, transparent, and secure nature of blockchain holds immense potential to revolutionize the crowdfunding landscape. This literature review aims to delve into the synergy between these two pivotal components that constitute the AGRICROWD platform, while thoroughly exploring the fundamental trends, challenges, and opportunities. Additionally, it should be noted that traditional crowdfunding studies are also encompassed within this review. The primary goal of this review is to comprehend the shortcomings and opportunities within existing research, offering recommendations that will guide future studies. The review focuses on the efficiency of blockchain in crowdfunding, investor protection, and its impact on cross-border transactions. It also delves into the examination of regulatory frameworks and legal issues within various jurisdictions. This comprehensive compilation not only presents an analysis of effective crowdfunding initiatives but also provides references to pertinent research and articles within this domain. By doing so, this review establishes a robust foundation for further research and development in both blockchain-based crowdfunding and traditional crowdfunding arenas.

1. Introduction

Numerous models of crowdfunding exist, yet they all share the common objective of garnering sufficient funds to manufacture products or offer services. Crowdfunding fundamentally relies on the reciprocal trust between backers and project creators. However, the conventional approach to crowdfunding presents inherent risks, as contributors lack direct control over their invested funds.

The adoption of blockchain technology in the crowd- funding system will aid in the prevention of fraud, and the improvement of the present crowdfunding systems' transparency and security.[1]

Agriculture is one of the world's most essential industries, and food production is critically important for everyone. However, traditional financing models are inadequate to support this sector. Financing of agricultural projects; It is one of the major challenges faced by farmers, food producers and agricultural entrepreneurs. At this point, AGRICROWD's aim is to create a bridge to finance innovations that shape the future of agriculture. This intersection between agritech and crowdfunding will benefit both farmers and investors. In this context, AGRICROWD has the potential to offer a new perspective on the financing of agricultural projects.

AGRICROWD represents the technological transformation of finance – by combining crowdfunding with blockchain – and could be an indication of the agriculture sector working more closely with technology.

2. Crowdfunding

Crowdfunding is the process where funding for a project or venture is sourced from a large community, rather than relying on substantial contributions from one or two investors. For a successful crowdfunding endeavor, it's imperative to attract and engage a considerable group of patrons, compelling them to believe in and financially support the merit of your project. [2]

We can examine crowdfunding applications under four main headings:

2.1. Donation-based crowdfunding

This approach to funding is frequently adopted by non-profit organizations, social innovators, and new businesses, where the expected "return on investment" does not take the form of financial gain but manifests as a societal benefit or a communal contribution. Contributors financially support such initiatives because they resonate with the underlying purpose or cause, rather than anticipating monetary profits. A prominent example of a platform that facilitates this type of donation-driven funding is GoFundMe. [3]

2.1.1. Advantages of donation-based crowdfunding

- *Absence of financial obligations:* Supporters contribute funds to your endeavor or cause with no expectation of reimbursement or business equity, freeing you from the burden of loans or surrendering company ownership.
- *Advocacy for societal benefits:* Crowdfunding based on donations proves especially potent for initiatives or causes with societal, philanthropic, or communal objectives. Individuals are commonly prepared to provide financial backing to causes that align with their values.
- *Cultivation of a supportive network*: Engaging in this type of crowdfunding can effectively cultivate a community of backers who have an emotional stake in the success of your project or cause.

2.1.2. Disadvantages of donation-based crowdfunding

- *Selective impact:* Campaigns based on donations hinge on the project's or cause's ability to evoke an emotional response, which may not resonate broadly, potentially diminishing their effectiveness for more commercial ventures.
- *Uncertainty in funding acquisition:* Similar to other crowdfunding methods, there's no assurance of achieving the financial target. Additionally, certain platforms may stipulate that you forfeit all funds if the goal is not met.
- *Risk of idea exposure:* Engaging in crowdfunding means disclosing your concept to the public, which bears the risk of someone else duplicating your idea.
- *Operational costs:* Although the funds raised are not subject to repayment, most crowdfunding platforms implement a fee that correlates with the total amount collected.

2.2. Reward-based crowdfunding

In reward-based crowdfunding, supporters finance your startup and, in return, receive a "reward," which is often a product or service your company provides. Startups aiming to introduce a new product or service and seeking funds for development or manufacturing commonly use this model. Kickstarter and Indiegogo are notable platforms that facilitate reward-based crowdfunding. [3]

Crowdfunding that offers rewards has become a favored way to gather financial support, particularly for inventive endeavors or the introduction of novel products. Here are some principal advantages and disadvantages of this funding approach.

2.2.1. Advantages of reward-based crowdfunding

- *Retained ownership:* With reward-based crowdfunding, there is no need to relinquish any company equity, unlike models that involve equity exchange.
- *Market validation*: This model enables an evaluation of consumer interest in your offering. A successful campaign indicates market demand for your product or service.
- *Early sales and promotion:* These campaigns can double as a mechanism for pre-selling your product, thereby generating buzz and securing an early adopter customer base.
- *Support network cultivation*: The platforms used for crowdfunding offer a means to connect and interact with contributors, fostering a community of advocates who can amplify awareness of your offering.

2.2.2. Disadvantages of reward-based crowdfunding

- *Fixed-goal requirement:* On numerous crowdfunding sites, you must meet your funding target to access the funds. While not universal, the all-or-nothing model is prevalent.
- *Reward delivery obligations:* Fulfilling the promised rewards can be a complex and potentially expensive process. Failure to deliver can tarnish your reputation and may result in backers demanding refunds.
- *Variable outcomes:* The success of crowdfunding campaigns is not guaranteed, even with a stellar concept. Many elements influence success, such as campaign quality, timing, and luck. There is a risk of misinterpreting the failure of a campaign as a lack of market demand.

- *Idea exposure risk:* By going public with your idea, there's a chance of it being replicated. Striking a balance between gaining visibility and protecting your concept is essential.
- *Associated costs:* Crowdfunding sites usually take a cut from the total funds raised, and there may be extra transaction fees.

2.3. Equity-based crowdfunding

In equity-based crowdfunding, contributors are granted a stake in the company as a counterpart for their investment. This funding mechanism is chiefly utilized by startups demonstrating substantial growth prospects, facilitating the acquisition of more significant capital amounts in return for a share in the company's prospective earnings. Platforms like SeedInvest and CircleUp are renowned for hosting equity-based crowdfunding initiatives.[3]

2.3.1. Advantages of equity-based crowdfunding

- *Potential for substantial funding:* As backers are investing in the company's potential future, they might be inclined to provide more substantial sums compared to reward-based campaigns. This allows startups to secure considerable funding.
- *Enduring partnerships with investors:* Contrary to reward-based initiatives where interactions often conclude post-reward distribution, equity crowdfunding can foster lasting investor relationships, with backers invested in the company's continuous prosperity.
- *Benefit from investor acumen and connections:* Investors typically come with their own set of skills, experiences, and networks, all of which can serve as invaluable assets for startups in their initial stages.

2.3.2. Disadvantages of equity-based crowdfunding

- *Dilution of Ownership:* Issuing equity means relinquishing a share of your company's control and decision-making power, as you distribute ownership among investors.
- *Legal and Regulatory Hurdles:* Navigating the intricate landscape of laws governing equity-based crowdfunding can be daunting and often necessitates expert legal advice, potentially incurring significant expenses.
- *Heightened Reporting Demands:* Managing a larger pool of shareholders typically entails frequent communication and detailed financial disclosures, demanding more time and administrative effort.

- *Expectations for Financial Returns:* In contrast to reward-based crowdfunding, where backers are satisfied with a product or service, equity investors are driven by the pursuit of a financial return, placing heightened performance expectations on the company.
- *Risk of Ownership Dilution:* Future rounds of equity financing might reduce the ownership percentage of initial investors, including those from the crowdfunding phase. If not managed tactfully, this could lead to discontent among your investor base.

2.4. Debt-based crowdfunding

Also referred to as "peer-to-peer lending" or "P2P lending," debt-based crowdfunding operates akin to a conventional loan. Rather than securing a loan from a financial institution, you receive funding from a collective of investors. The startup commits to repaying the loan with interest within a predetermined timeframe. Platforms like LendingClub and Prosper are prominent for facilitating debt-based crowdfunding. [3]

2.4.1. Advantages of debt-based crowdfunding

- *Ownership Preservation:* In contrast to equity-based methods, debt-based crowdfunding doesn't require surrendering any stake in your company. Your obligation to investors concludes once the loan is fully repaid.
- *Expedited Funding Process:* Obtaining a loan through debt-based crowdfunding is often quicker than traditional banking routes. The criteria for qualification can also be more lenient.
- *Predictable Repayment Plan:* Debt-based funding provides a set repayment schedule, offering more predictability compared to the fluctuating nature of equity investments.
- *Potential for Reduced Expenses:* If you secure a favorable interest rate and repayment term, debt-based crowdfunding might prove to be a more economical option than equity-based methods or other loan types.

2.4.2. Disadvantages of debt-based crowdfunding

- *Compulsory Repayment:* Distinct from other crowdfunding models, debt-based crowdfunding necessitates the repayment of the principal amount plus interest. This fixed financial obligation needs to be planned for, irrespective of your business's performance.

- *Interest Burden:* The loan's cost encompasses the original borrowed amount and the interest accrued throughout the loan's duration.
- *Credit Score Implications:* Failing to meet loan repayment schedules can adversely affect your credit score, potentially hindering your ability to obtain future financing.
- *Collateral Risk:* Certain debt-based crowdfunding arrangements may demand collateral or a personal guarantee. Failure to repay the loan could result in the forfeiture of the assets you've secured against the loan.

Comparison of popular crowdfunding applications is as follows:

Applications → / Features ↓	Agricrowd	Kickstarter	Indiegogo	Patreon	GoFundMe	Ideanest	Arıkovanı
Mutual Financing Reward-Based Crowdfunding	✓	✓	✓	×	×	✓	✓
Locality	✓	×	×	×	×	✓	✓
Ongoing Support	✓	✓	×	✓	✓	×	×
Support Duration Limitatitons	×	×	✓	×	✓	✓	✓
Donation For Personal Purposes and Charties	✓	✓	✓	✓	✓	✓	✓
Project Type Restriction	✓	×	×	×	×	×	×
Fund Approval Tracking	✓	✓	×	×	×	✓	×
Partial Fund Payment	✓	×	×	✓	×	×	×
Vote System	✓	✓	✓	×	×	×	×
Fund Tracking	✓	✓	✓	✓	✓	✓	✓
Need to Achieve Fund Goal	×	✓	×	×	×	✓	×
Debt Based	✓	×	×	×	×	✓	×
Project Filtering System	✓	✓	✓	✓	✓	✓	×

Figure 1 Comparison of popular crowdfunding applications

2.5. Constraints of Crowdfunding

Traditional crowdfunding platforms often grapple with significant fraud concerns. Critics argue that the online nature of crowdfunding might increase the risk of fraud, as standard legal and reputational safeguards might be less effective.

- Typically, these platforms don't require user verification for project initiation, and legal responsibilities to fulfill project commitments are minimal once a project is live. [1]
- Risks include the platform shutting down unexpectedly, funds being retained by the platform, delayed reward distribution, creators halting communication, non-delivery of promised products, and incomplete refunds to backers. [4]
- A primary issue with the standard operations of crowdfunding sites is that backers lack control over their funds once contributed, leading to frequent occurrences of fraud and scams. [5]

- Additional challenges encompass fund accountability, copyright infringements, and compromised project data privacy. There are instances where project ideas yet to be funded are appropriated and executed by more affluent entities using web scrapers. [1]

3. Blockchain

In his article "Bitcoin: A Peer-to-Peer Electronic Cash System" (https://bitcoin.org/bitcoin.pdf), which outlined the mathematical underpinnings of the bitcoin cryptocurrency, Satoshi Nakamoto initially disclosed the technology known as the blockchain. This was a pioneering study, but the author's identity is unknown and the research was never officially submitted to a standard peer-reviewed publication. In addition to being the basis of all cryptocurrencies, blockchain technology is also being used in the more established financial sector. Additionally, it made way for fresh uses like smart contracts. [6]

The birth of bitcoin in 2008 exposed the globe to a new notion that is now poised to transform the whole civilization. It has the potential to affect every business, including but not limited to banking, government, and media. Some characterize it as a revolution, while others believe it will be an evolution that will take many years before any practical benefits from blockchain are realized. Since we agree that this technology is going to be revolutionary, we also think that the effects of blockchain technology have already begun. Many big companies started to use this technology.

3.1. Advantages of Blockchain Technology

Nakamoto used the blockchain to tackle the issue of building confidence in a decentralized system. More precisely, the challenge of developing a distributed system for storing timestamped documents that prevents any third party from secretly tampering with the data's content or timestamps.

Thus every computer engaged in the transaction of a particular coin (or fraction of a coin) maintains a copy of the history of that currency's transactions thanks to the distributed ledger feature offered by bitcoin and other cryptocurrencies. The use of blockchain technology ensures that no party keeping this information may alter it covertly.[6]

3.1.1. Higher Accuracy of Transactions

This can lower error since a blockchain transaction has to be confirmed by several nodes. The other nodes would notice a difference and identify the fault if one node had a mistake in the database. [8]

3.1.2. No Need for Intermediaries

Blockchain technology allows two parties to a transaction to confirm and finish something without the need for a middleman. This saves money on paying for an intermediary such as a bank, and it also saves time.[8]

3.1.3. Extra Security

A decentralized network, such as blockchain, should theoretically make fraudulent transactions almost difficult. They would have to alter every ledger and hack every node in order to insert fake transactions. Many cryptocurrency blockchain systems include proof-of-stake or proof-of-work transaction verification techniques, which make it difficult and counterproductive for participants to add fake transactions, while it's not inherently impossible.[8]

3.1.4. More Efficient Transfers

People may transfer money and assets more effectively thanks to blockchains' round-the-clock operation, especially when transferring assets abroad. They don't have to wait days for a government agency or bank to verify everything by hand.[8]

3.2. Disadvantages of Blockchain Technology

3.2.1. Limit on Transactions per Second

Blockchain can only go so fast since it requires a wider network to authorize transactions. For instance, Visa can handle 1,700 transactions per second, but Bitcoin can only process 4.6. Moreover, a rise in transactions may cause problems with network performance. Scalability is a problem till this gets better.[8]

3.2.2. High Energy Costs

It uses a lot more power to have every node functioning to validate transactions than it does for a single database or spreadsheet. This raises the cost of blockchain-based transactions and adds significantly to the environmental impact of carbon emissions.[8]

3.2.3. Risk of Asset Loss

Certain digital assets, such as bitcoin stored in a blockchain wallet, are protected by a cryptographic key. This key must be kept under close supervision. You cannot phone your bank or any other central authority to request access again since the system is decentralized.[8]

3.2.4. Potential for Illegal Activity

Due to its decentralized nature, blockchain offers increased secrecy and privacy—a feature that regrettably attracts criminals. Tracking criminal transactions on a blockchain is more difficult than tracking name-tied bank transactions.[8]

3.3. Distributed Systems

Since blockchain is fundamentally a distributed system, it is necessary to understand distributed systems in order to fully comprehend blockchain. It is a distributed, decentralized system, to put it more accurately.

Distributed systems refer to a computer paradigm in which two or more nodes collaborate to achieve a shared goal. The systems are designed such that users see them as a single logical platform.

An individual participant in a distributed system is referred to as a node. Every node has the ability to send and receive messages with other nodes. Nodes have their own memory and CPU and might be malevolent, malfunctioning, or honest. Another name for a node that is capable of arbitrary behavior is a Byzantine node. The network's ability to function may be negatively impacted by this random behavior, which may be maliciously intended. In general, any unexpected network node behavior falls within the Byzantine category. This word is used to describe any unexpected or malevolent conduct. [7]

3.3.1. CAP Theorem

Because distributed systems are so difficult to design, it is possible to establish the CAP theorem, which holds that a distributed system cannot have all of its desirable attributes at once. In other words, in a distributed system, it is not feasible to simultaneously provide consistency, availability, and partition tolerance.

- **Consistency** is a feature that guarantees that every node in a distributed system has access to the most recent copy of the data.
- **Availability** indicates that the system is operational, available for usage, and capable of receiving requests and providing data without any errors when needed.
- **Partition tolerance** guarantees that the distributed system will continue to function properly even in the event that a group of nodes fails.

Blockchain is able to accomplish all three of these characteristics at once, something that a distributed system is unable to do.

Replication is used to achieve fault tolerance. This is a popular and extensively applied technique for achieving fault tolerance. Consensus techniques are used to guarantee that every node has an identical copy of the data, hence achieving consistency. Another name for this is state machine replication. In essence, blockchain is a technique for replicating state machines.[7]

3.3.2. Consensus

A process of agreement on a final state of data between distrusting nodes is called consensus. Various algorithms can be employed to reach a consensus. In client-server systems, for instance, it is simple to come to an agreement between two nodes. However, in distributed systems with several nodes, reaching consensus on a single value becomes exceedingly challenging. Distributed consensus is the idea of reaching agreement across several nodes.

In order for a consensus process to provide the intended outcomes, a number of conditions must be satisfied. These are their requirements, along with brief explanations:[7]

- **Agreement:** The same value is chosen by AII honest nodes.
- **Termination:** The consensus process is terminated by AII honest nodes, and a decision is finally made.
- **Validity:** The value that at least one honest node first offered and that all honest nodes agree upon must match.

- **Fault Tolerant:** Even with malfunctioning or malevolent nodes present, the consensus mechanism ought to be able to function.
- **Integrity:** This condition states that no node may choose to make the same choice more than once. In a single consensus cycle, the nodes only decide once.

3.3.2.1. *Proof of Work*

Prior to recommending a value for network acceptance, this kind of consensus process needs evidence that sufficient computing power has been used.

3.3.2.2. *Proof of Stake*

This algorithm operates on the premise that a node or user has sufficient stakes in the system; for instance, the user has made sufficient investments in the system to make any harmful effort less profitable than carrying out an assault on the system. Peercoin was the first to develop this concept, and the Ethereum blockchain will employ it. Coin age, which is based on the quantity of time and coins that haven't been spent, is another crucial idea in Proof of Stake (POS). According to this concept, the coin age increases the likelihood of proposing and signing the subsequent block.

3.3.2.3. *Delegated Proof of Stake*

An improvement over traditional point-of-sale systems is called Delegated Proof of Stake (DPOS), which allows any node with a stake in the system to assign voting authority to other nodes for transaction validation. The bitshares blockchain makes advantage of this.

3.4. Various Technical Definitions of Blockchain

Blockchain is a type of data structure that essentially use hash pointers rather than regular pointers in a linked list. The prior block is referred to using hash pointers. The following diagram can be used to visualize the structure of a generic blockchain:

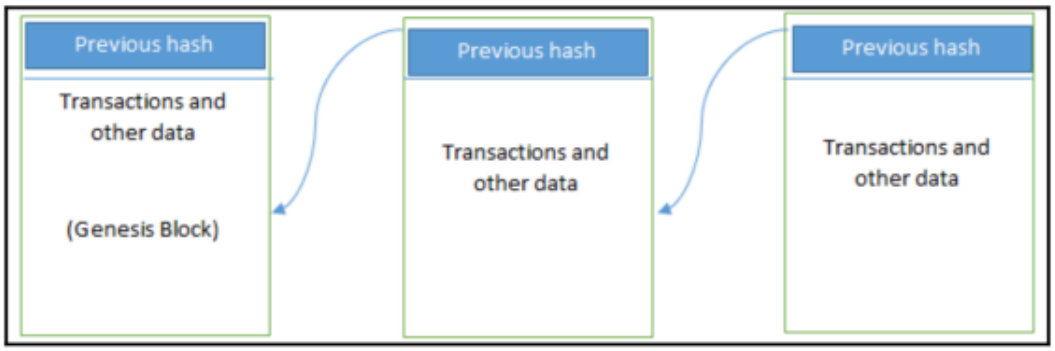

Figure 2 Generic structure of a blockchain

Addresses: In a blockchain transaction, addresses serve as distinct identities for senders and receivers. Typically, an address is a public key or one that is generated from one. Although a user may repeat an address, addresses are distinct in and of themselves. In actuality, though, a single user may create a new address for every transaction and not reuse the same one twice. This address has just been created and is distinct.

Transaction: The essential building block of a blockchain is a transaction. A transfer of value from one address to another is represented by a transaction.

Block: A block is made up of several transactions as well as other components including the nonce, date, and hash pointer from the previous block.

Nonce: In the language of cryptocurrencies, "nonce" refers to an arbitrary number that is used just once in a cryptographic transmission. To prevent replay attacks and maintain the privacy of communications, this number is produced at random.

Peer to Peer Network: This is a network architecture where all peers may send and receive messages and communicate with one another, as the name suggests.

Virtual Machine: This is a transaction script that has been extended. A transaction script's functionality may be restricted, but Turing complete code may be executed on a blockchain through the use of virtual machines, or smart contracts. Not all blockchains support virtual machines, but many do. For instance, the Ethereum Virtual Machine (EVM) and the Chain Virtual Machine (CVM) are two examples of blockchains that employ virtual machines to run applications.

Nodes: Depending on the role it plays in a blockchain network, a node can carry out a variety of tasks. To promote consensus and safeguard the blockchain, a node can mine, propose, and validate transactions. To do this, a consensus process is followed. (This is typically POW.) Depending on the kind of blockchain being used and the job allocated to the node, nodes can also carry out additional tasks like validators, basic payment verification (lightweight nodes), and many more.

Smart Contracts: These programs run on top of the blockchain and encapsulate the business logic to be executed when certain conditions are met. The smart contract feature is not available in all blockchains but is now becoming a very desirable feature due to the flexibility and power it provides to the blockchain applications.

3.5. Types of Blockchain

3.5.1. Public Blockchains

A public blockchain allows everyone to sign up and take part in the main operations of the blockchain network. The self-governed, decentralized aspect that is frequently praised when discussing blockchain is made possible by the fact that anybody may read, publish, and audit the current operations on a public blockchain network.[10]

3.5.2. Private Blockchains

Only those who get an invitation and provide legitimate and confirmed identification or other necessary information can join a private blockchain network. Network operators or a well defined set protocol applied by the network using smart contracts or other automatic approval methods carry out the validation.. [10]

3.5.3. Semi-Private Blockchains

In this case, there are private and public portions of the blockchain. While anybody is welcome to participate in the public portion, the private portion is run by a select number of people. [7]

3.5.4. Tokenized Blockchains

These blockchains are typical blockchains that produce bitcoin through initial distribution or mining as part of a consensus process. [7]

3.6. Blockchain and Smart Contracts

Other ideas that have been put out in literature are also supported by the current growth of blockchain technology. Szabo presented the idea of "smart contracts," which leverage user interfaces and computer protocols to carry out a contract's conditions. Because of the blockchain, Smart Contracts are gaining traction because, compared to the technology available when they were first developed 20 years ago, blockchains make it easier to use them. Depending on specified parameters, this novel method may, for instance, take the place of banks and attorneys who have been involved in asset transactions contracts.[9]

Property ownership may also be managed with the use of smart contracts. These properties might be intangible (like shares or access rights) or physical (like homes and cars). Ethereum is a well-known illustration of blockchain technology that views smart contracts as first-class citizens. Ethereum is a decentralized network that Buterin first suggested. [9]

The banking sector is even considering if the blockchain may eventually replace a sizable portion of their present operations. The payment procedure serves as an example of this.

Today, when consumers pay for things with credit cards, the settlement happens many days later. This delayed settlement would be unnecessary if the blockchain were used, as payments could be made in real time simply updating the ledger.

3.7. Applications of Blockchain and Future Trends

3.7.1. Financial applications

- **Crypto-currencies:** Networks and trade channels that use encryption to protect transactional data.
  - Bitcoin
  - Litecoin
  - Ripple
  - Monero

- **Securities issuance, trading and settlement:** In order to become public, companies issue shares directly, without using a bank syndicate. Shares that are less liquid and private can be exchanged on a secondary market powered by blockchain. Initial initiatives focus on securities settlement.
  - NASDAQ private equity
  - Medici
  - Blockstream
  - Coinsetter

- **Insurance:** Properties (such as vehicles, real estate, etc.) might be registered with blockchain technology. Policyholders have access to the transaction history.
  - Everledger

3.7.2. Nonfinancial applications

- **Music industry:** Regulating music rights ownership and calculating royalties.
  - Imogen heap
- **Decentralized proof of existence of documents:** Storing and validating the signature and timestamp of a document using blockchain.
  - www.proofofexistence.com

- **Decentralized storage:** Sharing documents without the need of a third party by using a peer-topeer distributed cloud storage platform.
  - Storj
- **Anti-counterfeit solutions:** The blockchain network, which consists of all market players in electronic commerce, verifies the authenticity of items (producers, merchants, markets)
  - Blockverify
- **Internet applications:** DNS is governed by all users in a decentralized manner, as opposed to companies and governments.
  - Namecoin

3.7.3. Future Trends

Blockchains appear to have a wide range of applications, particularly in industries where establishing a certain level of confidence has traditionally been dependent on third parties. According to Atzori [11], the blockchain has the potential to completely transform civilization, including politics. If individuals were to use decentralized platforms to organize and safeguard society, many functions may become outdated. He comes to the conclusion that "decentralization of government services through permissioned blockchains is desirable and feasible, as it can greatly enhance the functionality of public administration." In developing nations, society restructuring is crucial. The blockchain offers more efficient wealth protection. Landowners often struggle to establish their ownership, particularly in developing nations where the local government may want to take property away from the populace. The blockchain may be used to control these existential dangers by including land rights.

4. Blockchain in Crowdfunding Systems

The primary objective of crowdsourcing is to assist business owners or startups in obtaining finance from a large number of sources. a peer-to-peer network that eliminates the need for financial institutions by enabling payments to be sent directly between individuals. Financial transactions are transparent thanks to blockchain technology. Users of the site may view their accounts and payments made to fundraisers thanks to the Blockchain. According to the report, using blockchain technology in businesses would increase donor appeal while also improving efficiency and dependability. It will aid in raising revenue as well. Blockchain technology was utilized to develop a crowdfunding website for charitable organizations in Russia.

They point out that most blockchain systems are not fully decentralized as data storage and transactions on the blockchain are more costly and take longer than they do on traditional methods. Instead, a hybrid strategy is used to deploy them, with the unnecessary data often being saved on a cloud storage platform and the critical data exclusively being stored on the blockchain. [1]

4.1. Merits of blockchain based crowdfunding

- Blockchain technology may be used to solve the problems with trust, misuse, and confidentiality that exist in traditional crowdfunding systems. The single point of failure is eliminated by the decentralized network.
- Without the need for any middlemen, distributed ledger technology will guarantee that an investor's money reaches the designated recipient.
- The technique that has been suggested gives contributors authority over their invested funds and guarantees that project creators may efficiently raise and reserve cash with the aid of an independent smart contract. The contract retains donated cash and disburses them to project creators in accordance with their expenditure requests. Contributors cast their votes to approve or disapprove the expenditure proposals. A similar concept was put out in.
- Tracing transactions is made considerably simpler by using a system that associates addresses with the parties to the transaction. Blockchain technology facilitates the recording of transactions and makes this data easily accessible. [12]
- Crowdfunding platforms are merging reward-based and equity-based crowdfunding to cater to the diverse needs of supporters and crowdfunders. This gives backers the opportunity to function as both shareholders and customers.
- Blockchain technology enables us to support transparency of records, decentralisation, and trust, as well as providing a low-cost alternative to a platform for recording business activity.

  Blockchain technology has great promise for assisting donations in overcoming many challenges. Consequently, the use of blockchain as a crowdfunding method has been the subject of various investigations. The key characteristics of blockchain are as follows [2]:
- **Decentralized:** Blockchain networks are not under the authority of a single entity, preventing a single point of failure and the takeover of the network by a selected few users.

- **Transparency:** Data recorded in a blockchain is accessible to the general public and is visible to all network participants.
- **Immutability:** Data entered into the Blockchain cannot be altered after it has been saved.
- **Security and Privacy:** The cryptographically secure process in the Blockchain is one of its key aspects because it aids in boosting privacy and security.

A public and private key is also used by network users for identification and verification. A user's digital signature makes it simple to verify him throughout a transaction.

5. Web Programming

5.1. What is Web?

The web, known as the "World Wide Web" or simply "Web", is a global network that enables information sharing between computers. The web hosts a variety of content including documents, texts, images, videos, and other types of media. This network, accessed through internet browsers, allows users to access information from around the world quickly and interactively. Developed by Tim Berners-Lee in 1989, the web has gone through different phases over time, evolving from static information presentation to interactive and participatory platforms. This evolution has manifested itself in different stages such as Web1.0, Web2.0, and Web3.0, constantly improving the functionality of the web.

5.2. Web 1.0, Web 2.0 and Web 3.0

5.2.1. Web 1.0

Web 1.0 is a period that represents the first phase of the Internet and is often referred to as the "static web". During this period, websites generally aim to present information and users consume content as passive viewers. Distinctive features of Web 1.0 include one-way communication, limited user participation, and general presentation of information. This period generally covers the late 1990s to the early 2000s.

5.2.2. Web 2.0

Web 2.0 marks a major milestone in the evolution of the internet and delivers a more interactive, user-focused experience. In this era, websites go beyond simply providing information and allow users to create, share, and interact with content. Applications such as social media platforms, blogs, and online communities form the basis of Web 2.0. The ability of users to provide feedback, produce content, and interact with other users makes the dynamic and participatory nature of Web 2.0 evident [1].

5.2.2.1. Web 2.0 in the Project

The project focuses on establishing a strong interaction with users by using the interactive features offered by Web 2.0. Web 2.0 provides a dynamic experience to our users through various features integrated into our project's website, and thanks to these features, users have more opportunities to understand the basis of our project, participate, and be included in our community.

Our project's website adopts the pioneering principles of Web 2.0 to provide a user-friendly interface and easy usability. Thanks to the website, users can publish agricultural ideas and projects that they want to invest in, and investors can access content and details that interest them.

Tech Stack

In the part of the project to create a website that will interact with the user, some technologies will be used to make it user-friendly, fast, accessible, and efficient. The website basically consists of 2 parts:

a.Frontend Part (Client-side)

Frontend is a term that defines the part of a web application or website that is visible to the user. Users interact with an application or site through the front end, viewing content and performing actions. This part is a client that usually runs in the browser and plays a fundamental role by rendering the user interface, arranging the content, and enhancing the user's experience.

Frontend includes core technologies such as HTML, CSS, and JavaScript. While HTML is used to create web pages, CSS stylizes and organizes HTML elements. JavaScript is used to add dynamic and interactive features. Apart from these basic components, various tools and libraries are also used to meet the needs of modern web development.

JavaScript libraries and frameworks such as React, Angular, and Vue.js are preferred to manage complex user interfaces more effectively. These tools provide a component-based structure, ensuring that the code is organized and reusable. In addition, more advanced and user-friendly frontends can be created by using elements such as CSS preprocessors (SASS, LESS), tools (Webpack, Babel), and responsive design techniques.

What is React.js

React.js is a JavaScript library for creating user interfaces. Thanks to its component-based architecture, it is ideal for breaking down, developing, and maintaining web applications into modular and reusable parts. React optimizes performance by using virtual DOM and provides an efficient user experience with one-way data flow.

Advantages of React.js

- Maintenance processes can be managed smoothly and effectively.
- It offers fast page load times and impressive performance.
- It provides powerful and reliable development tools.
- Data management and status control are easily achieved with Redux.
- It allows mobile application development with a single code base.
- It offers a stable and organized code structure.
- It is supported by a large developer community.
- JSX allows writing clearer and more readable code.
- The reusability of components makes code more efficient [2].

b.Backend Part (server-side)

Backend is a system that supports basic functionality in the background of a web application or website, with which the user does not directly interact. It manages operations outside the user interface and ensures the smooth operation of the application. This includes a number of tasks such as data processing and storage, business logic management, security, third-party service integration, server management, API provisioning, email sending, etc. The backend is usually developed using server-side languages and frameworks. Technologies such as Node.js, Django, Ruby on Rails, and Laravel are frequently used examples in backend development.

What is Node.js?

Node.js is a JavaScript-based runtime environment and was developed specifically for server-side applications. Node.js is used to create network applications interactively and quickly. It basically works with a single thread and has an event-driven architecture. This makes Node.js high-performance and scalable. Node.js is based on Chrome's V8 JavaScript engine and is optimized for asynchronous I/O operations. In this way, it can quickly process many requests at the same time.

Node.js is generally preferred for the development of web servers, APIs, microservices, and real-time applications.

What is Express.js?

Express.js is a lightweight, flexible, and minimalist web application framework used to build Node.js based web applications and APIs. Express.js enables quick and easy development of web applications using the powerful features of Node.js.

Express.js provides basic web application features but does not impose too many restrictions on the user, allowing flexibility and customization to the developer. Thanks to its middleware structure, it provides extensive control over HTTP requests and responses. This framework includes a number of features such as routes, template engines, and static file serving, making it possible to build applications quickly.

When used together, Node.js and Express.js create a powerful combination that enables the development of scalable, fast, and effective web applications.

What is MongoDB?

MongoDB is a documented NoSQL database. Stores data using JSON-like BSON documents. It is particularly suitable for applications working with large data sets and dynamic data models. MongoDB's document-based structure supports flexible and variable data schemas, which enables it to be used in many scenarios, especially cloud-based applications, content management systems, and real-time applications.

MongoDB's compatibility with JavaScript makes it compatible with popular JavaScript frameworks such as Node.js and Express.js. MongoDB drivers offer easy integration to JavaScript developers so that codes related to database operations can be easily written. An ODM (Object Data Modeling) tool like Mongoose makes it even easier to integrate MongoDB into JavaScript-based applications.

5.2.3. Web 3.0

Web 3.0 represents an evolving phase of the internet and aims to deliver a smarter, connected, and semantic web experience. It has features such as semantic links, distributed ledger technologies, machine learning, and artificial intelligence integration. This evolution enables the sharing of more meaningful and relevant information through the ability to understand and relate content.

For agricultural crowdfunding projects, Web 3.0 offers benefits in reaching wider audiences, secure financing, automated transactions, big data analysis, and increasing community engagement. Blockchain technology enables secure and transparent financing, smart contracts facilitate automated transactions, and semantic connections strengthen community participation [3].

6. Geographic Information System(GIS) Mapping

A computer system for gathering, storing, verifying, and presenting data about locations on Earth's surface is called a geographic information system (GIS). GIS may assist people and organizations in better understanding geographical patterns and relationships by connecting seemingly unconnected data.

The White House defines geographic data infrastructure as "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data." GIS technology is an essential component of this infrastructure.

Any data that contains a location can be used by a GIS. Numerous parameters can be used to describe the location, including latitude and longitude, address, and ZIP code.

With GIS, a wide range of information kinds may be contrasted and compared. Data on individuals, such as population, income, and educational attainment, may be included in the system. It may contain details on the topography, including the locations of streams, various flora types, and various types of soil. It may contain details regarding the locations of storm drains, roads, and electrical power lines in addition to companies, farms, and schools.

With GIS technology, people can compare the locations of different things in order to discover how they relate to each other. For example, using GIS, a single map could include sites that produce pollution, such as factories, and sites that are sensitive to pollution, such as wetlands and rivers. Such a map would help people determine where water supplies are most at risk.[16]

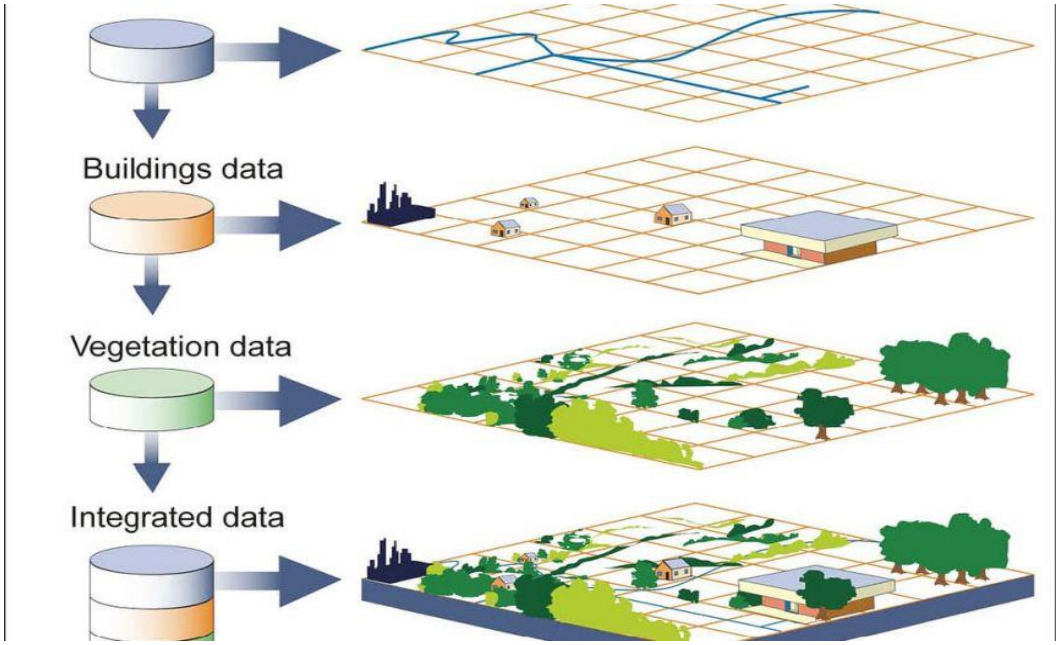

Figure 3. GIS Structure

Software Requirements Specification (SRS)

7. INTRODUCTION

7.1. Purpose

This Software Requirements Specification (SRS) document outlines the requirements and specifications for an innovative agricultural crowdfunding platform. The platform aims to revolutionize traditional funding models for agricultural projects by leveraging cutting-edge technologies such as blockchain, smart contracts, and modern web frameworks. This document serves as a blueprint to define the functionalities, constraints, and technical specifications of the proposed platform.

7.2. Scope of Project

The agricultural crowdfunding platform aims to revolutionize financial support for agricultural initiatives, acting as a catalyst for the advancement of farming practices and investment prospects. It is conceived to cater to a wide array of stakeholders, encompassing individual farmers, agricultural enterprises, and potential investors, establishing a synergistic ecosystem for sustainable agricultural progress. The core objectives of the platform encompass the empowerment of agricultural initiatives, the facilitation of investment opportunities, and the assurance of transparency among all participants. By providing a dynamic online hub, the platform enables farmers and agricultural project initiators to showcase their ventures, solicit financial backing, and establish collaborations within a global network of potential investors. Key functionalities include the creation of comprehensive user profiles, detailed project listings, secure and transparent payment processing, implementation of smart contracts, blockchain-based transaction records, and audit trails ensuring transparency and traceability. The platform targets a diverse audience, including farmers, agricultural entrepreneurs, investors, and donors keen on supporting innovative agricultural endeavors. On the technical side, the development involves utilizing React.js, Node.js, and Express.js for frontend and backend functionalities, employing MongoDB for robust database management, and enforcing stringent security measures to safeguard user data and uphold platform integrity.

7.3. Glossary

Term	Definition
Blockchain	Blockchain" is a distributed database or ledger used in many industries. This technology can be used for a variety of purposes, including cryptocurrencies, decentralized finance (DeFi) applications, non-unique tokens (NFTs), and smart contracts.[1]
Smart Contracts	A "Smart Contract" is a self-executing program that automates the necessary processes in an agreement or contract.[2]
Cryptocurrency	A digital or virtual currency secured by cryptography, allowing secure and anonymous transactions, commonly built on blockchain technology.
Decentralization	The distribution of control and authority across multiple nodes or individuals rather than being concentrated in a single central entity.
Transparency	Refers to the openness and accessibility of information within a system, ensuring that data and processes are visible, accountable, and easily understood by stakeholders.
Crowdfunding	Crowdfunding is the process of raising funds for a project or venture by obtaining small amounts of money from a large number of people, often facilitated through online platforms.
Transaction	A "transaction" in blockchain refers to the transfer or exchange of digital assets, utilizing a transparent, secure, and decentralized record-keeping system.
Entrepreneur	Entrepreneur is an individual with the ability to establish, manage their own business, and often implement innovative projects with new ideas or ventures.

7.4. References

[1]. https://decrypt.co/resources/blockchain-basics-what-is-blockchain

[2]. https://www.investopedia.com/terms/s/smart-contracts.asp

7.5. Overview of the Document

The SRS document encompasses various sections, outlining both functional and non-functional requirements, system features, technical architecture, and constraints. It provides a comprehensive understanding of the agricultural crowdfunding platform's specifications, guiding the development process and ensuring alignment with project goals.

8. OVERALL DESCRIPTION

8.1. Product Perspective

The agricultural crowdfunding platform embodies an innovative digital environment specifically designed to revolutionize the financial landscape within the agricultural sector. Functioning as an independent and comprehensive online solution, it serves as a pivotal point of connection between agricultural project initiators, encompassing individual farmers, cooperatives, and larger-scale agricultural enterprises, and potential investors, including individuals, organizations, or institutions interested in supporting these initiatives.

8.1.1. Development Methodology

The platform's development methodology is anchored in the agile framework, an iterative and flexible approach that accommodates evolving project requirements and ensures a responsive development lifecycle. Agile methodology, with its emphasis on adaptability and collaboration, allows for incremental development, continuous feedback, and adjustments throughout the project lifecycle.

The development process initiates with a comprehensive analysis of stakeholder requirements, establishing a foundational understanding of the platform's core functionalities and features. Following this, the development team engages in a series of iterative sprints, each focused on specific aspects of the platform's architecture, design, and functionality.

The agile methodology's hallmark of iterative cycles fosters constant communication and collaboration between development teams, stakeholders, and end-users. Regular sprint reviews and retrospectives enable the team to evaluate progress, identify potential bottlenecks, and adapt swiftly to changing requirements.

Furthermore, embracing an agile mindset encourages the integration of best practices and innovative technologies into the development process. This facilitates the seamless incorporation of emerging trends and technologies, ensuring the platform remains adaptable, scalable, and aligned with industry standards.

Throughout the development lifecycle, agile principles, such as flexibility, adaptability, and customer-centricity, guide the development team in delivering a robust, user-friendly, and feature-rich agricultural crowdfunding platform.

8.2. User Characteristic

8.2.1. Investee

- Investee must upload details of the own project.
- Investee must enter the progress of the project into the system in detail.
- The investee should distribute the profits generated from product sales back through the system, particularly in a reward-based system.

8.2.2. Investor

- Investors should be able to thoroughly examine the details of projects.
- Investors should have the option to either contribute donations or engage in reward-based funding for projects.
- Investors should have the option to either contribute donations or engage in reward-based funding for projects.

8.2.3. Investor

- The Admin must have the capability to schedule maintenance operations within the system to ensure its smooth functioning.
- The Admin should regularly review system performance and apply necessary updates or fixes to enhance functionality and security.
- The Admin may need to oversee the system's infrastructure to optimize for performance and cost-efficiency.
- Additionally, the Admin should monitor user activities for compliance with platform policies and take appropriate action when necessary.

9. REQUIREMENTS SPECIFICATION

9.1. External Interface Requirements

9.1.1. User Interfaces

The platform will feature an intuitive and user-centric web interface developed using React.js. It will offer a user-friendly dashboard enabling farmers and project initiators to showcase their ventures and allowing investors to explore projects and participate in crowdfunding activities seamlessly. The interface will prioritize accessibility, ensuring ease of navigation and interaction across various devices and screen sizes.

9.1.2. Hardware Interfaces

The platform's hardware requirements are minimal and will support standard web browser functionalities, allowing users to access the platform across a broad spectrum of devices including desktops, laptops, tablets, and smartphones.

9.1.3. Software Interfaces

To ensure seamless interaction between various components, the platform integrates Node.js and Express.js for the backend, MongoDB for data storage, and blockchain technologies for secure and transparent transactions. Additionally, the platform communicates with third-party digital wallets such as MetaMask. This integration is essential in providing users with a secure and efficient mechanism for managing digital assets, enabling the smooth processing of transactions and the execution of smart contracts, which are pivotal to the platform's digital transaction capabilities.

9.1.4. Communications Interfaces

The platform will utilize HTTPS (Hypertext Transfer Protocol Secure) for secure communication between users' browsers and the platform's servers, ensuring data confidentiality and integrity.

9.2. Functional Requirements

9.2.1. Profile Management Use Case

Use Case:

- Register
- Login
- Modify User Information
- Logout

Diagram:

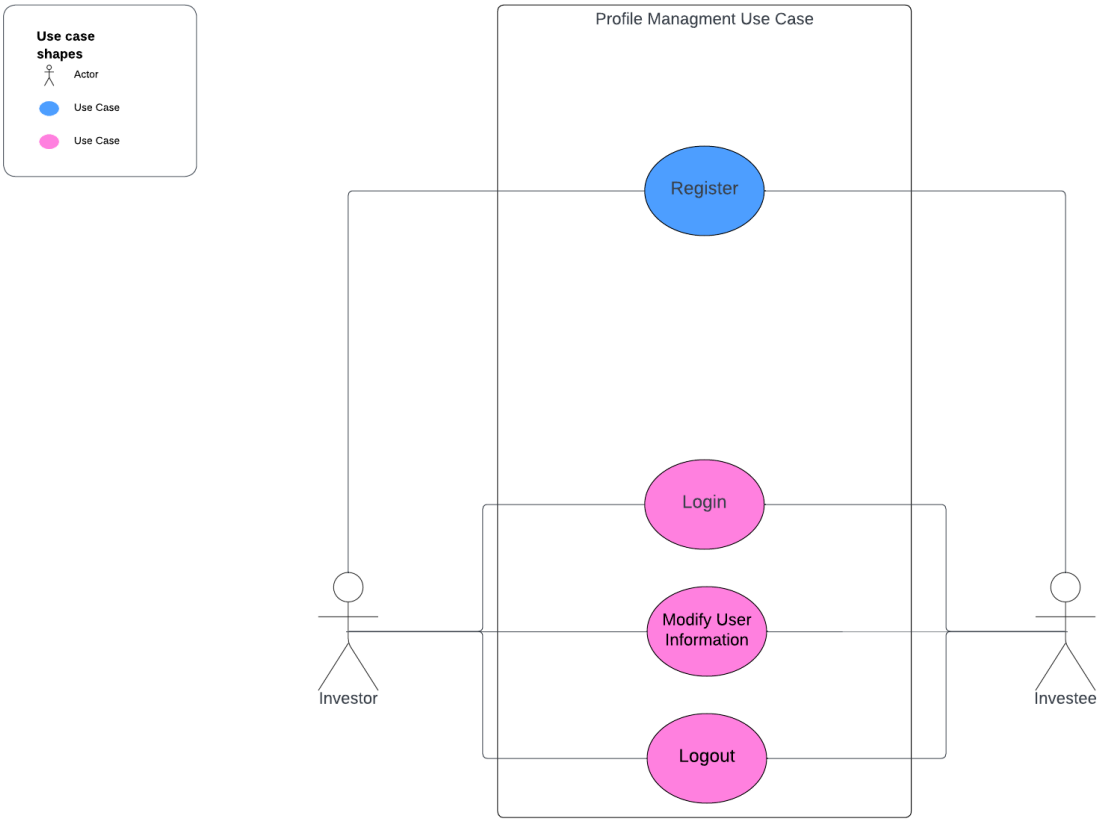

Figure 4: Profile Management Use Case

Brief Description: This use case involves users on the system registering with different roles (Investor, Investee), logging in, managing user information, and terminating their sessions.

Initial Step by Step Description

- *New User Registration:*

Pre-Conditions:

- The user must intend to register in the system.
- The user should provide necessary information (name, email, password, etc.) during registration.

Scenario:

New users provide the necessary information to register in the system and choose their preferences among role options. These preferences determine whether they will register as an investor or a user seeking investment (Investee). After entering their personal information, users can register in the system.

Post-Conditions:

- The user must register by selecting one of the role options (Investor or Investee).
- The system successfully completes the registration process, allowing the user to log in to the system.

- *Login Process*:

Pre-Conditions:

- The user must have previously registered.
- The user must enter the correct username and password.

Scenario:

Registered users can log into the system with the accounts they created earlier. They log in by authenticating their identity with a username and password. This enables them to access their accounts and be authorized by the system.

Post-Conditions:

- The user safely logs out of the system.
- The system terminates the user's session and restricts the user's access.

- *Modify User Information:*

Pre-Conditions

- The user must have logged into the system.
- The user must have permission to edit their profile information.

Scenario

After logging in, users have the authority to edit their profile information. They can use the "Modify User Information" option to update their user details, correct any incomplete or inaccurate information. This step allows users to keep their personal information up to date.

Post-Conditions

- The user can successfully update their profile information.
- The system records the user's changes and identifies the user with updated information.

- *Logout Process*:

Pre-Conditions

- The user must want to log out while being logged into the system.

Scenario

The logout process allows users to sign out of the system. Users securely log out, terminating their session and exiting the services provided by the system.

Post-Conditions

- The user safely logs out of the system.
- The system terminates the user's session and restricts the user's access.

9.2.2. Investment Use Case Diagram

Use Case:

- Add a project
- Invest a project
- Receive Investment
- Give Reward
- Receive Reward

Diagram:

Figure 5: Investment Use Case Diagram

Brief Description: This use case involves transactions between Investee and Investor users. The first scenario covers listing projects and making investments. The second scenario includes the Investee seeking investment and the Investor making the investment by either purchasing company shares or donating to the project. The final scenario encompasses transactions such as acquiring products or company shares in return for the investments made.

Initial Step by Step Descriptions of Scenarios:

- Scenario 1: Add Project List, View Project List, Invest a Project

    - *Add Project List*

Pre-Condition

- Investee must have logged into the system.

Scenario

- Investee adds new projects to the system.

Post-Condition

- A new project is successfully added to the system and listed.

    - *View Project List*

Pre-Condition

- Investor or Investee must have logged into the system.

Scenario

Investor views the list of existing projects.

Post-Condition

- The list of existing projects is displayed to the user.

    - *Invest a Project*

Pre-Condition

- Investor must have viewed the projects and made a selection.

Scenario:

Investor chooses to invest in a specific project and comp Post-Condition

- Investment is made into a specific project.

- Scenario 2: Receive Investment, Buy Company Project Shares, Donation, Invest a Project

    - *Receive Investment*

Pre-Condition

- Investee must have added the projects to the system and they should have been selected by investors.

Scenario

- Investee receives investment for their projects.

Post-Condition

- Investment is made into the project.

    - *Buy Company Project Shares*

Pre-Condition

- Investor must have identified suitable projects to purchase shares of the company, enabling them to receive a proportional share of profits corresponding to the invested amount.

Scenario

- This scenario emphasizes that the "Buy Company Project Shares" step requires the investor to select appropriate projects for purchasing shares, allowing them to gain a proportionate share of profits based on their investment amount.

Post-Condition

- Shares of the company's projects are successfully acquired, entitling the investor to a proportional share of profits based on the invested amount.

- *Invest a Project*

Pre-Condition

- Investor must have decided to invest in a new project.

Scenario

- Investor invests in a new project.
- Donation: Investor makes the investment through a donation.
- Invest a Project: Investor makes the investment by purchasing company shares.

Post-Condition

- Investment is made into the new project.

- Scenario 3: Give Reward, Reward(Product, Company Share, Receive Reward)
  - *Give Reward*

Pre-Condition

- Investee or Investor must have selected the project to reward participants.

Scenario

Investee provides the Investor with a reward in return for their investment.

Post-Condition

- Rewards are given to the project participants.

  - *Receive Reward*

Pre-Condition: Investee or Investor must have determined the project from which they will receive the reward.

Scenario

- Product: Investor receives the return in the form of a product.
- Company Share: Investor receives the return in the form of company shares.

Post-Condition: Users receive the reward.

9.2.3. Maintenance Use Case Diagram

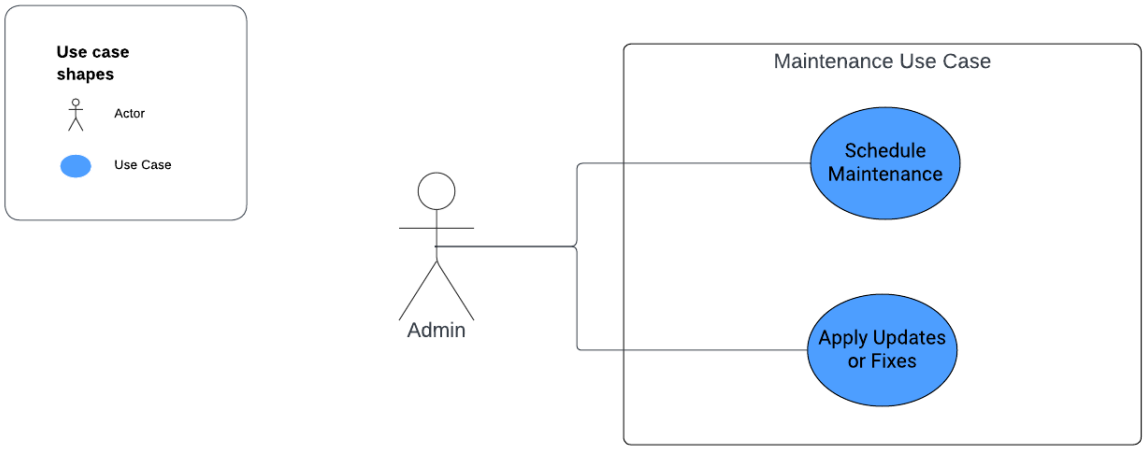

Figure 6 Maintenance Use Case Diagram

Brief Description: This use case outlines the steps and interactions involved when the Admin schedules maintenance and applies updates or fixes to the system.

Actors

- Admin

Preconditions

- The Admin is authenticated and has the necessary privileges.

Flow of Events:

- *Schedule Maintenance*
  - The Admin logs into the system.
  - The Admin navigates to the maintenance section.
  - The Admin selects the option to schedule maintenance.
  - The Admin specifies the date and time for the maintenance activity.
  - If applicable, the Admin provides a brief description of the maintenance tasks.
  - The system confirms the scheduling and notifies users about the upcoming maintenance.

- *Apply Updates or Fixes*

- At the scheduled maintenance time, the Admin logs into the system.
- The Admin selects the option to apply updates or fixes.
- The Admin uploads the required patches or updates to the system.
- The system applies the updates, and the Admin receives a confirmation upon successful completion.

Postconditions

- The system is updated with the latest patches or fixes.
- Users are notified of the completed maintenance.

Exceptions:

- If the Admin encounters errors during maintenance, appropriate error handling procedures are followed.
- If the system cannot apply updates successfully, the Admin takes necessary steps to resolve the issue.

Notes:

Detailed documentation should be available to guide the Admin through the process of scheduling maintenance and applying updates or fixes.

This simplified use case focuses specifically on the scheduling and application of updates or fixes, providing a clear and concise description of the maintenance activities performed by the Admin actor. Adjust and expand the use case based on the specific needs and intricacies of your system.

9.3. Performance Requirement

The platform aims for optimal performance, with page load times optimized for efficiency. It should support a substantial number of simultaneous users without compromising performance, ensuring a responsive user experience even during peak traffic.

9.4. Non-Functional Requirements

9.4.1. Portability

The platform's design will prioritize cross-platform compatibility, ensuring seamless operation across various operating systems including Windows, macOS, and Linux, as well as compatibility with major web browsers such as Chrome, Firefox, Safari, and Edge. This approach ensures that users can access the platform from a wide range of devices and environments without compromising functionality or usability.

9.4.2. Performance

Performance optimization will be a key focus throughout the development process. The platform will undergo rigorous performance testing to ensure swift response times, minimal latency, and high throughput. The system will be designed to handle concurrent user interactions efficiently, maintaining stable performance levels even during periods of heavy traffic or increased user activity.

9.4.3. Usability

Usability is central to the platform's design ethos. The user interface will be intuitive, employing clear navigation, logical layout, and informative feedback mechanisms. Accessibility standards will be adhered to, ensuring compliance with guidelines for users with disabilities. Additionally, user feedback will be gathered and analyzed to continuously enhance the platform's usability.

9.4.4. Adaptability

The platform will be architected with a modular and flexible structure, allowing for easy integration of new features, upgrades, and enhancements. APIs (Application Programming Interfaces) will be developed to enable seamless interaction with external systems, facilitating future integrations and extensions. The platform's architecture will be designed to accommodate technological advancements and evolving industry standards.

9.4.5. Scalability

Scalability is a core consideration in the platform's architecture. The system will be designed to scale horizontally and vertically, enabling it to handle an increasing volume of users, projects, and transactions. Load balancing mechanisms and cloud-based infrastructure will be leveraged to ensure optimal performance as the user base grows, without compromising on reliability or responsiveness.

9.5. Safety Requirement

The platform will adhere to stringent security measures, employing encryption standards, secure authentication protocols, and regular security audits to protect user data, financial transactions, and overall platform integrity.

Software Design Document (SDD)

10. INTRODUCTION

10.1. Purpose

This Software Design Document (SDD) defines the detailed software design and architecture of the "Agricrowd" platform. Agricrowd is designed to facilitate the more efficient distribution of financial support and resources in the agricultural sector, providing farmers and agricultural entrepreneurs with the necessary tools and resources to realize innovative projects. This document provides in-depth information required to understand the functional and technological aspects of the platform, guiding developers, designers, and project managers. By comprehensively addressing the system's components, interfaces, data structures, security policies, and user interactions, it offers a clear understanding and consistent vision across all aspects of the project. The goal is to position the Agricrowd platform as a sustainable and effective solution, overcoming current challenges in the agricultural sector. This will enable agricultural projects to reach a broader investor base, fostering innovation and development in the agricultural sector and ultimately contributing to global food security.

10.2. Scope

This SDD comprehensively addresses the software components, technological framework, functionality, and user interactions of the "Agricrowd" platform. The scope includes the system's architecture, data models, user interface design, security measures, performance requirements, scalability strategies, and future development pathways. It is designed to provide a clear explanation of how the platform offers a solution for various types of users, the technological infrastructure of this solution, and how users will interact with the platform.

10.3. Glossary

Term	Definition
Agricrowd	Agricultural crowdfunding platform.
Software Design Document (SDD)	A document outlining software design.
Blockchain	Distributed ledger technology for secure and immutable data recording.
Investee	Typically the project or entrepreneur seeking funds.
Investor	An individual or organization providing capital to projects or ventures.
Smart Contract	Self-executing contracts running on a blockchain, triggered by specific conditions.
Cryptocurrency	Digital or virtual currency secured using encryption techniques.
Wallet	Secure digital asset storage for blockchain transactions.
React	React is an open-source JavaScript library for building user interfaces on web applications, known for its efficiency in rendering and managing dynamic, interactive components.

10.4. Overview of Document

This section provides a concise summary of the document's structure and content, offering readers a clear guide to the information and details they will encounter in the following sections. It also outlines the purpose of each section and its role in the overall development process of the "Agricrowd" project. By doing so, this section provides readers with a comprehensive understanding of what to expect as they navigate through the document and presents a general framework for the design and development process of "Agricrowd."

10.5. Motivation

"Agricrowd" has been designed in response to the current challenges and opportunities in the agricultural sector. This section elaborates on the sources of inspiration behind the project, its objectives, and its long-term vision. It provides an in-depth perspective on how "Agricrowd" aims to transform the agricultural sector, offer new opportunities to farmers and entrepreneurs, and create value for investors. Additionally, it emphasizes the project's social impact, its potential to promote sustainable agricultural practices, and how it intends to bring together the global. agricultural community. The Motivation section highlights that "Agricrowd" is not just a technological initiative but also possesses a comprehensive social mission.

11. SYSTEM DESIGN

The system design of Agricrowd has been thoughtfully and thoroughly planned to meet the functional and technological requirements of the platform. This section details the fundamental architectural building blocks, components, and their interrelationships within Agricrowd. The system design is meticulously prepared to ensure that users can use the platform efficiently, securely, and effectively.

11.1. Architectural Design

The architectural design of Agricrowd lays the foundation for the agricultural crowdfunding platform and effectively brings together farmers and investors. Utilizing modern and scalable technologies (Node.js, React, MongoDB, and Ethereum), the platform enables users to easily create, showcase, and fundraise for projects. With a focus on security and efficiency, Agricrowd provides a transparent and reliable environment to meet the financing needs of the agricultural sector.

11.1.1. Problem Description

Agricrowd is a crowdfunding platform aimed at addressing a fundamental issue in the agricultural sector — the limited access to financing for farmers and agricultural entrepreneurs. The constraints of traditional financing methods pose significant barriers, particularly for small-scale farmers and new ventures. The platform seeks to tackle this problem by presenting these users' projects to a broad investor base and facilitating the fundraising process. The primary challenge is creating a reliable, accessible, and transparent environment that meets the varying needs of different user groups such as farmers, entrepreneurs, and investors. Agricrowd aims to fulfill these needs, thereby fostering sustainable growth and supporting innovative projects in the agricultural sector.

11.1.2. Technologies Used

Agricrowd utilizes modern and powerful technologies to create an effective crowdfunding platform in the agricultural sector. The technologies selected to meet the needs for performance, scalability, and security include:

- *Frontend:* React - Offers dynamic and responsive user experiences. Its component-based architecture allows for the rapid and efficient development of user interfaces. [17]
- *Backend:* Node.js - Provides robust data processing and API services, ensuring the platform operates quickly and reliably. Node.js is particularly adept at managing high concurrent transactions. [18]
- *Database:* MongoDB - An ideal choice for flexible data structures and fast query responses. It effectively manages large data sets and offers high performance. [19]
- *Blockchain:* Ethereum - Used for smart contracts and secure transactions. Ethereum's widely-adopted platform ensures transparent and reliable fund management. [20]
- *MetaMask Wallet:* Enables users to easily interact with the Ethereum network. It's a fundamental tool for managing crypto assets and interacting with smart contracts. [21]
- *Solidity and Remix:* Solidity is the preferred language for developing Ethereum smart contracts. Remix is a web-based IDE used for the development, testing, and deployment of these contracts. [22]
- *IPFS and Pinata:* Distributed file storage solutions. IPFS offers efficient data storage, while Pinata provides easy access and management. Together, they optimize the platform's data storage and access processes. [23]
- *Blockchain Test Networks (Sepolia, etc.)*: Ethereum's test networks are used to test smart contracts and transactions before they are deployed on the main network. These networks help identify errors and security vulnerabilities early in the development process, ensuring the platform is safer and more effectively presented to users. [24]

The integration of these technologies makes Agricrowd a reliable, accessible, and transparent crowdfunding platform for farmers, entrepreneurs, and investors in the agricultural sector. Each technology has been carefully selected and implemented to enhance the overall performance and user experience of the platform.

11.1.3. Data Flow Diagram

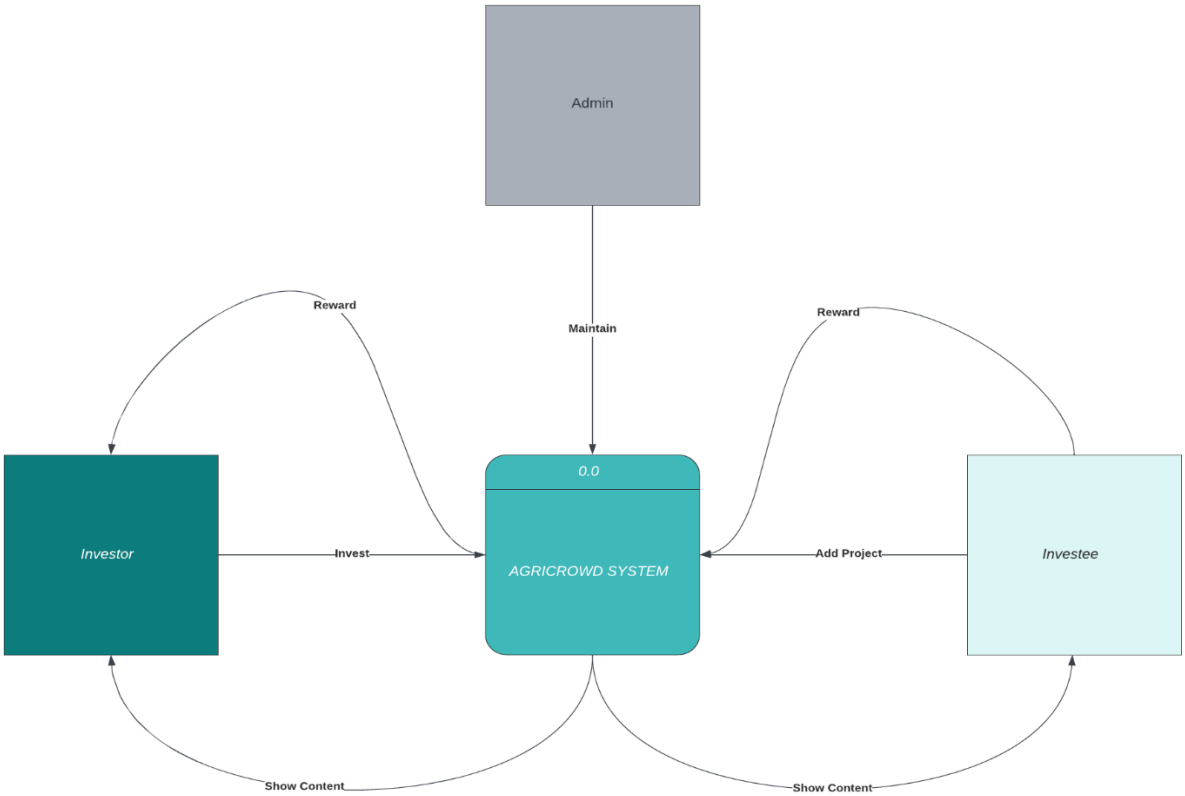

Figure 7 Context Diagram - DFD Level-0

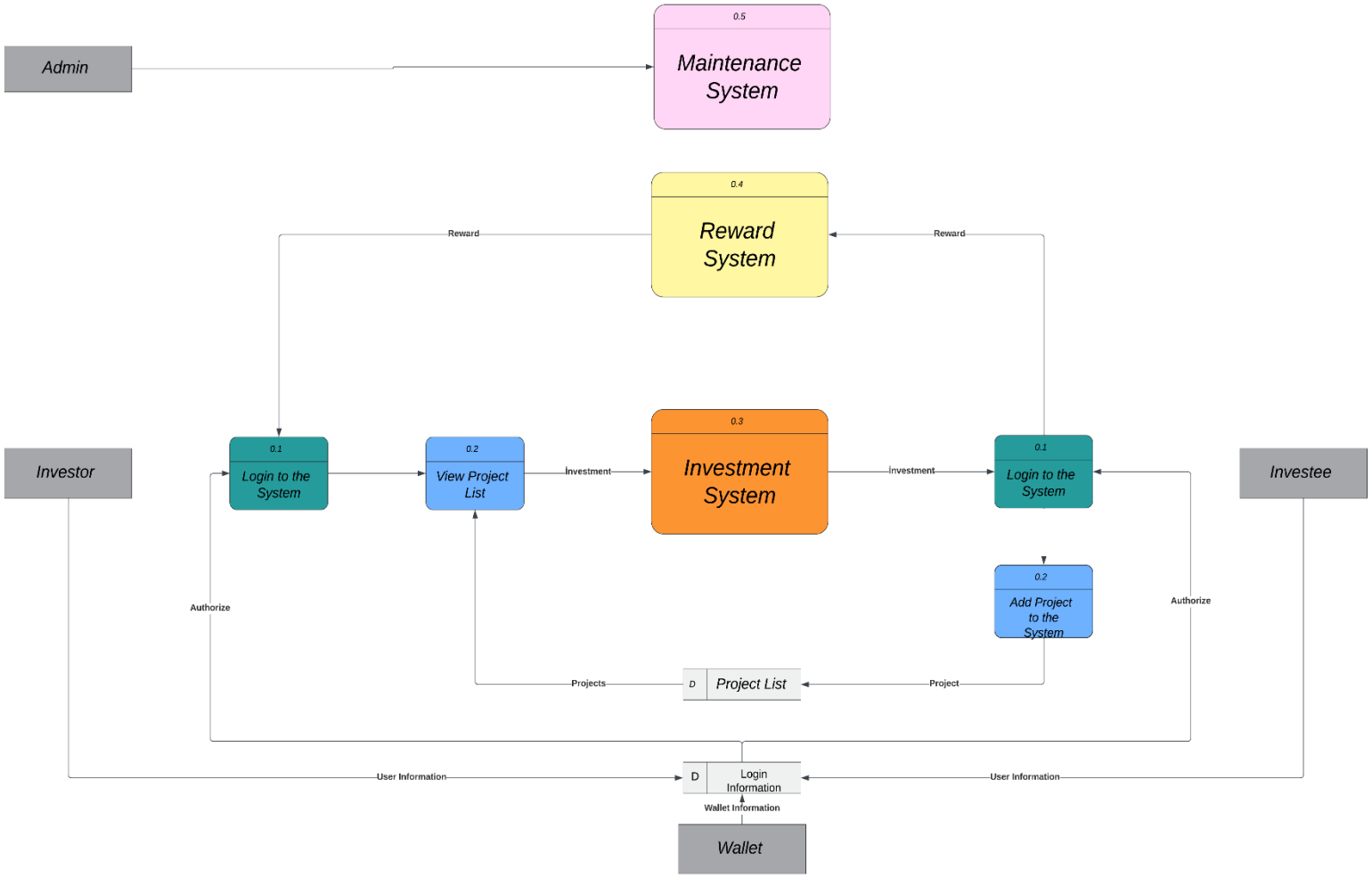

Figure 8 DFD Level-1

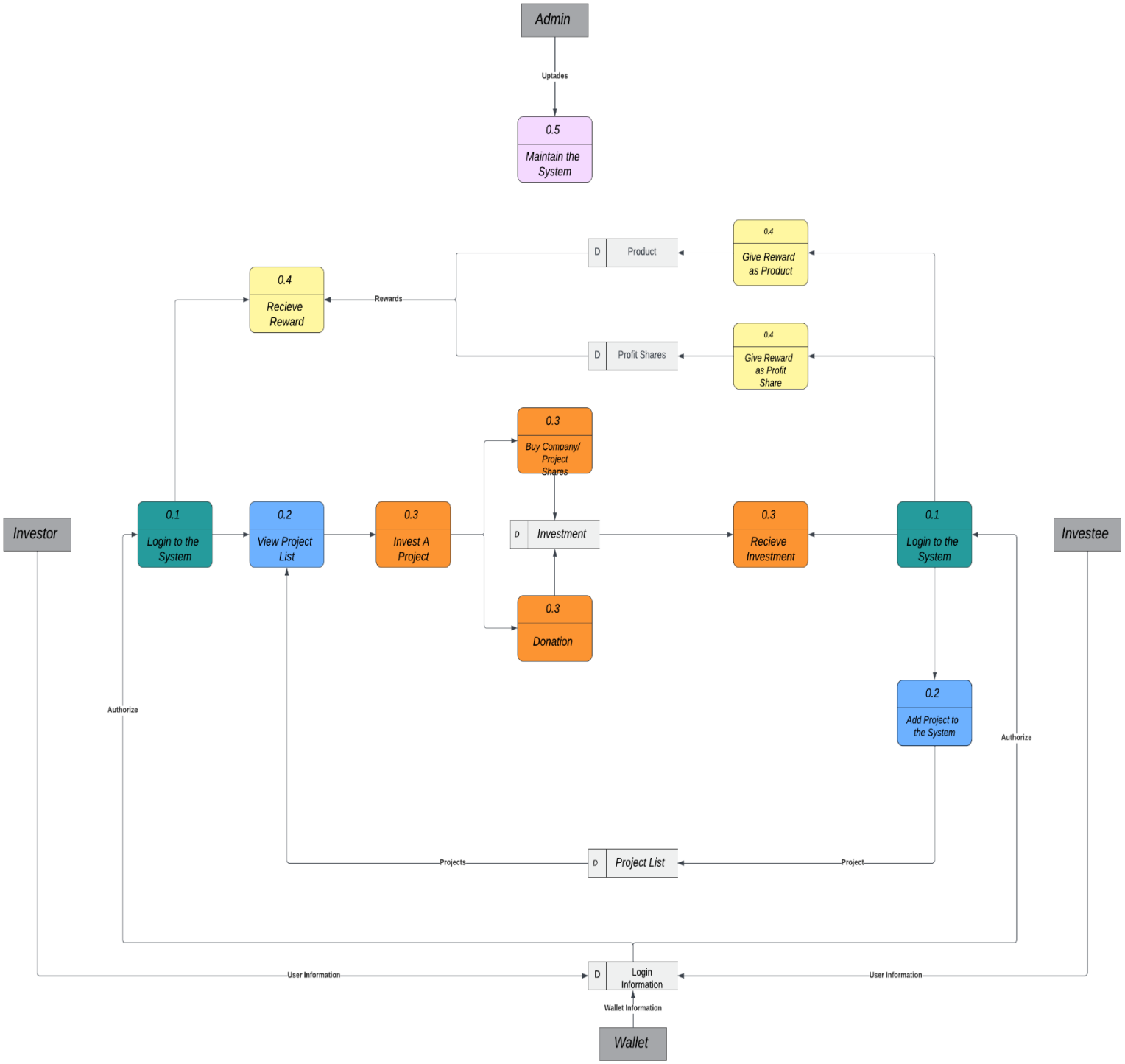

Figure 9 DFD Level-2

11.1.4. Activity Diagram

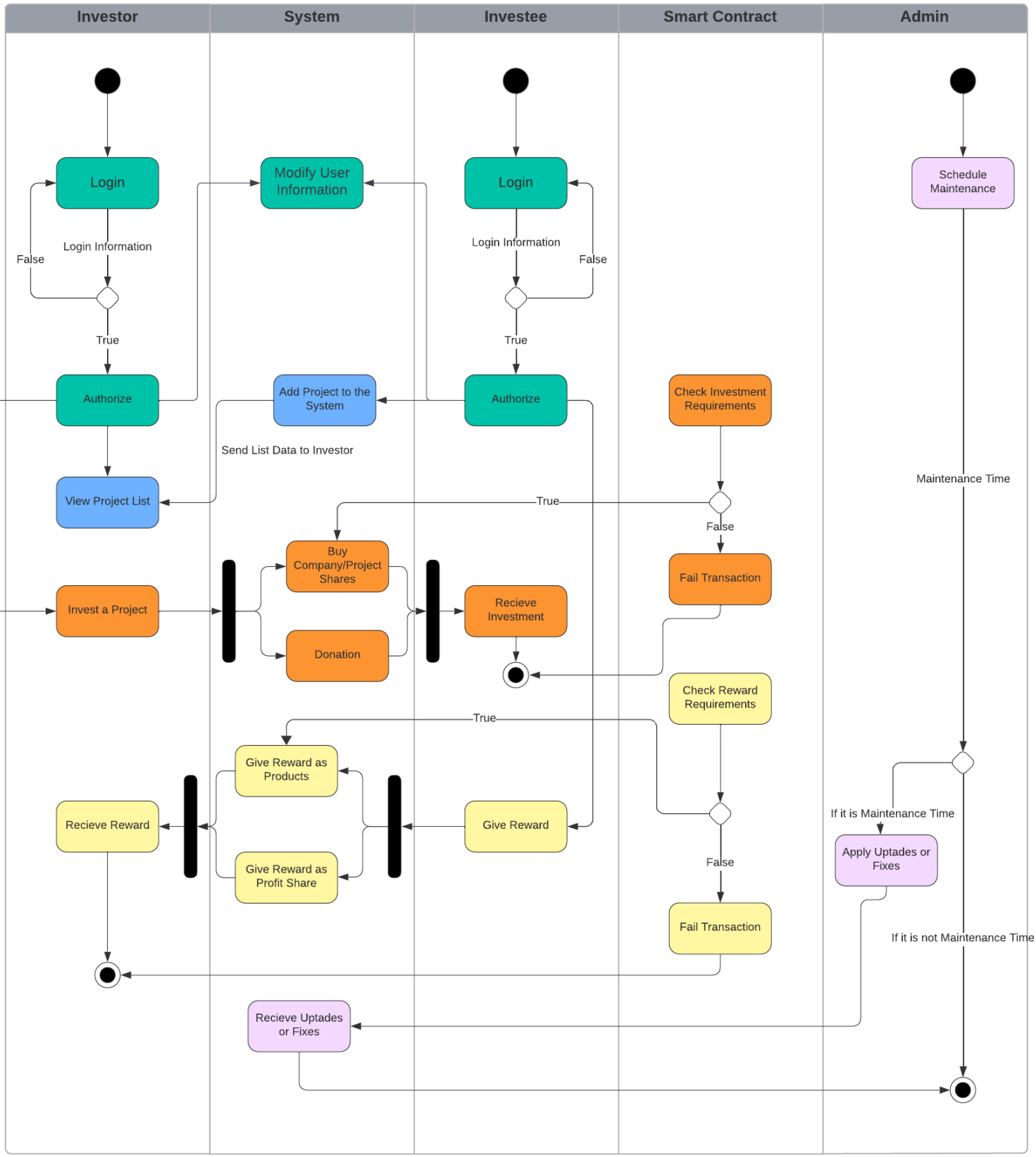

Figure 10 Activity Diagram

11.1.5. Class Diagram

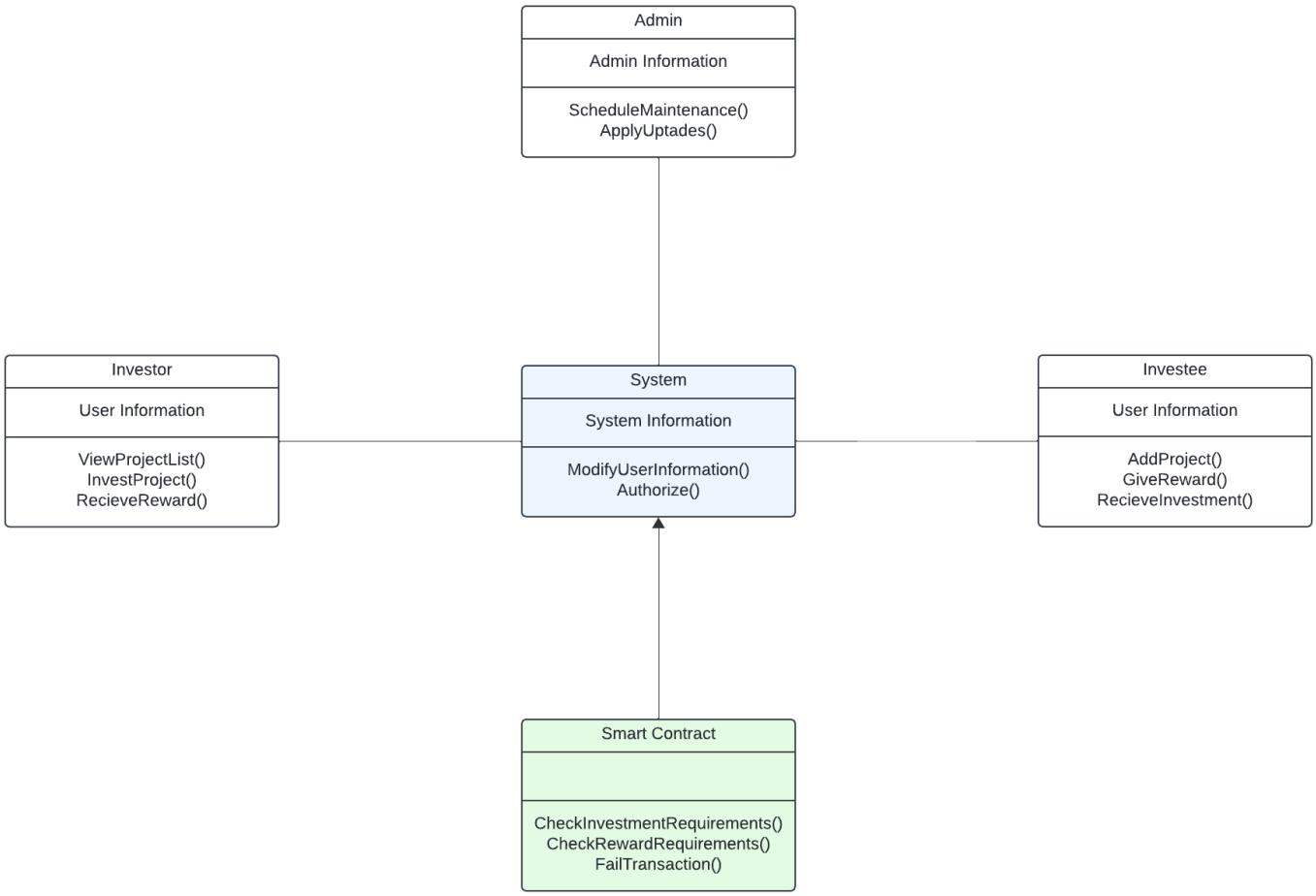

Figure 11 Class Diagram

11.1.6. Sequence Diagram

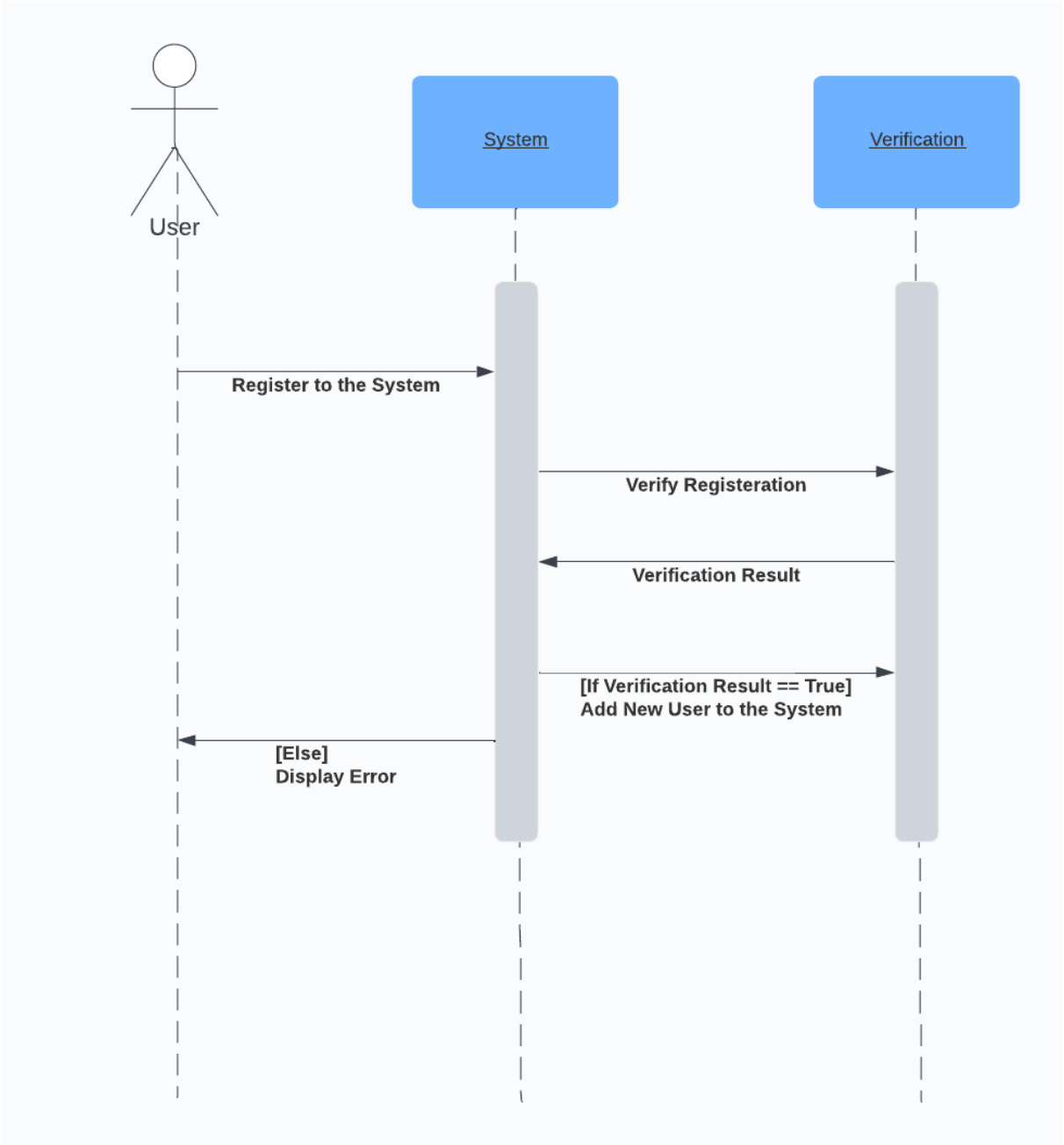

Figure 12 Register Sequence Diagram

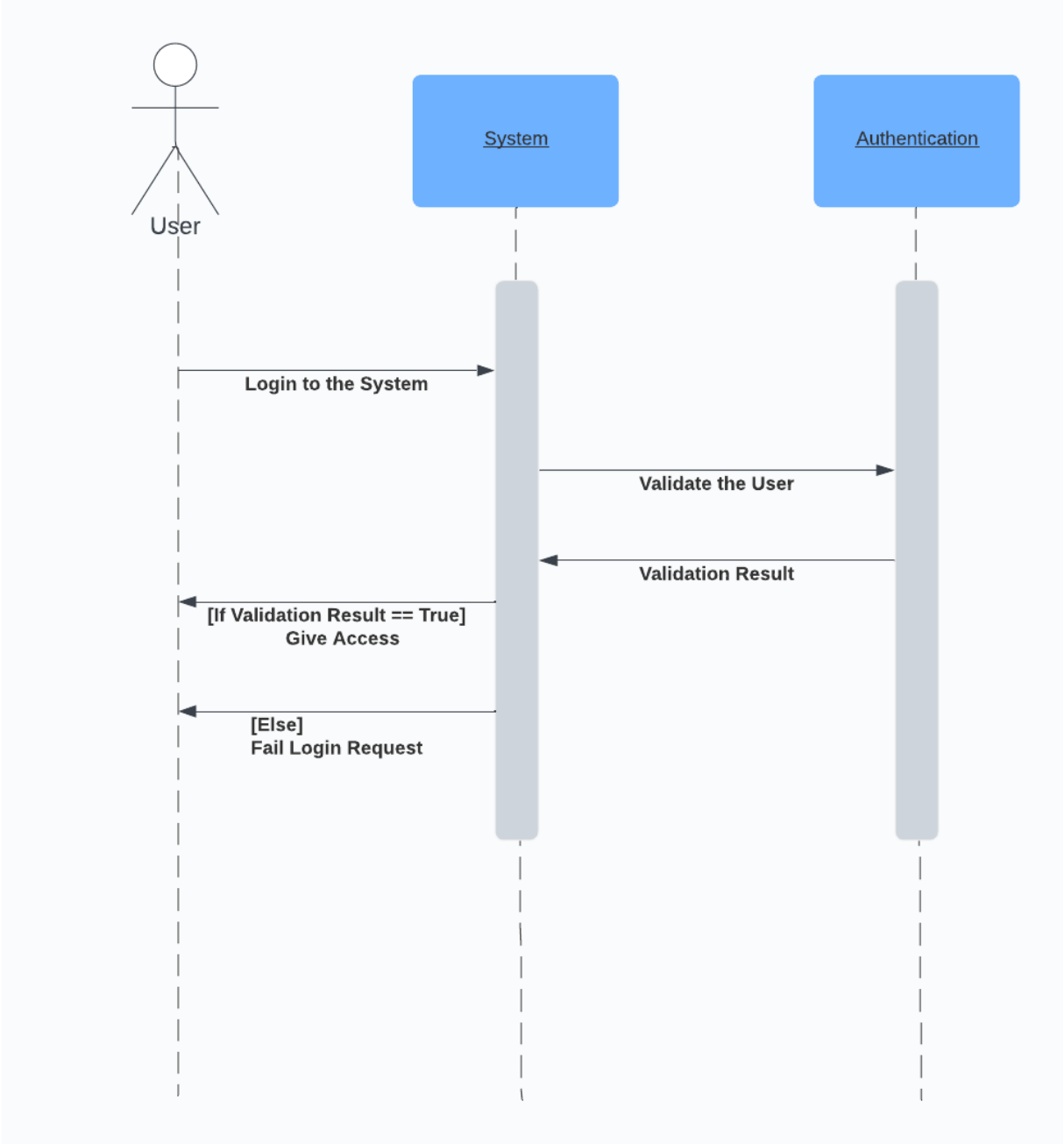

Figure 13 Login Sequence Diagram

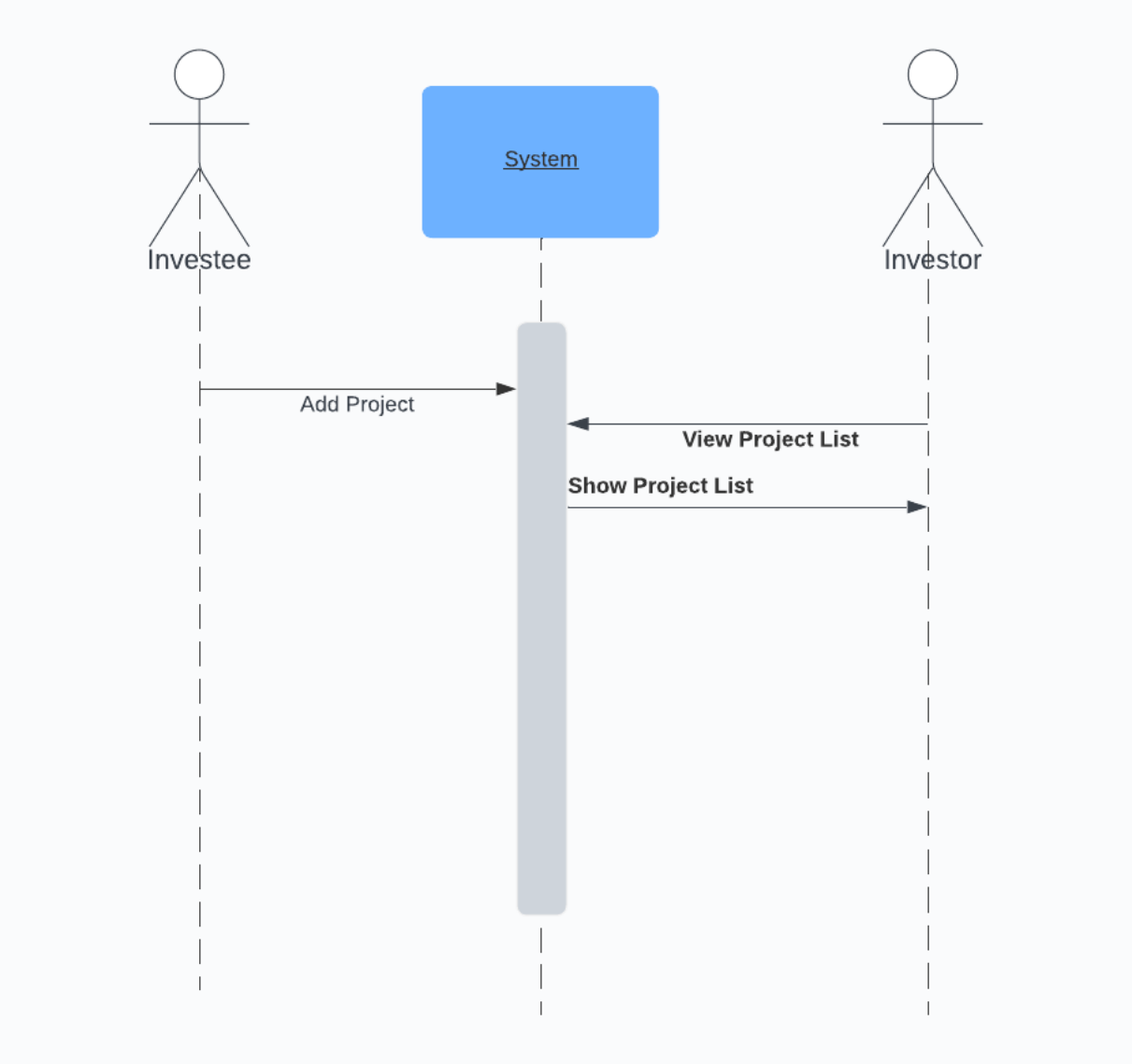

Figure 14 Add Project Sequence Diagram

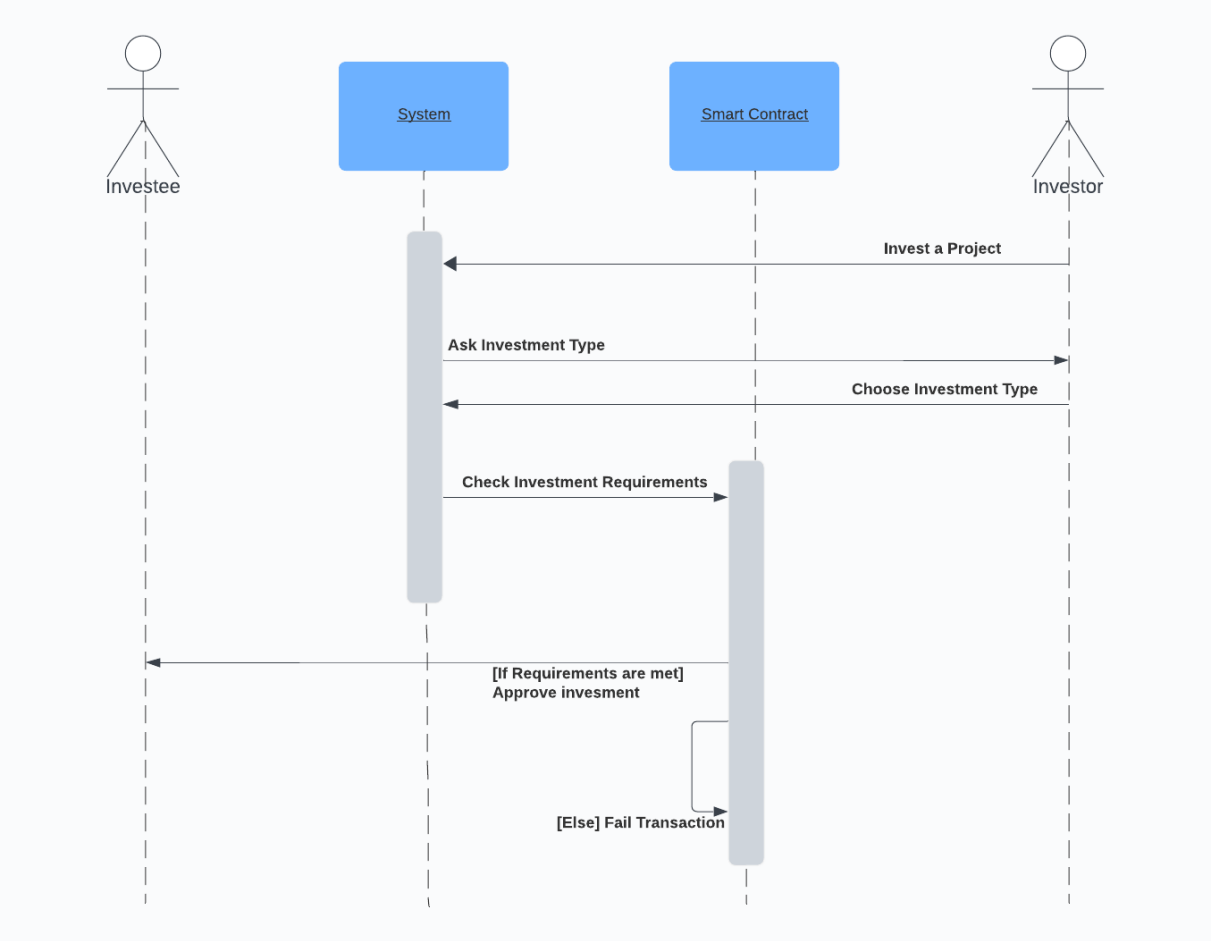

Figure 15 Investment Sequence Diagram

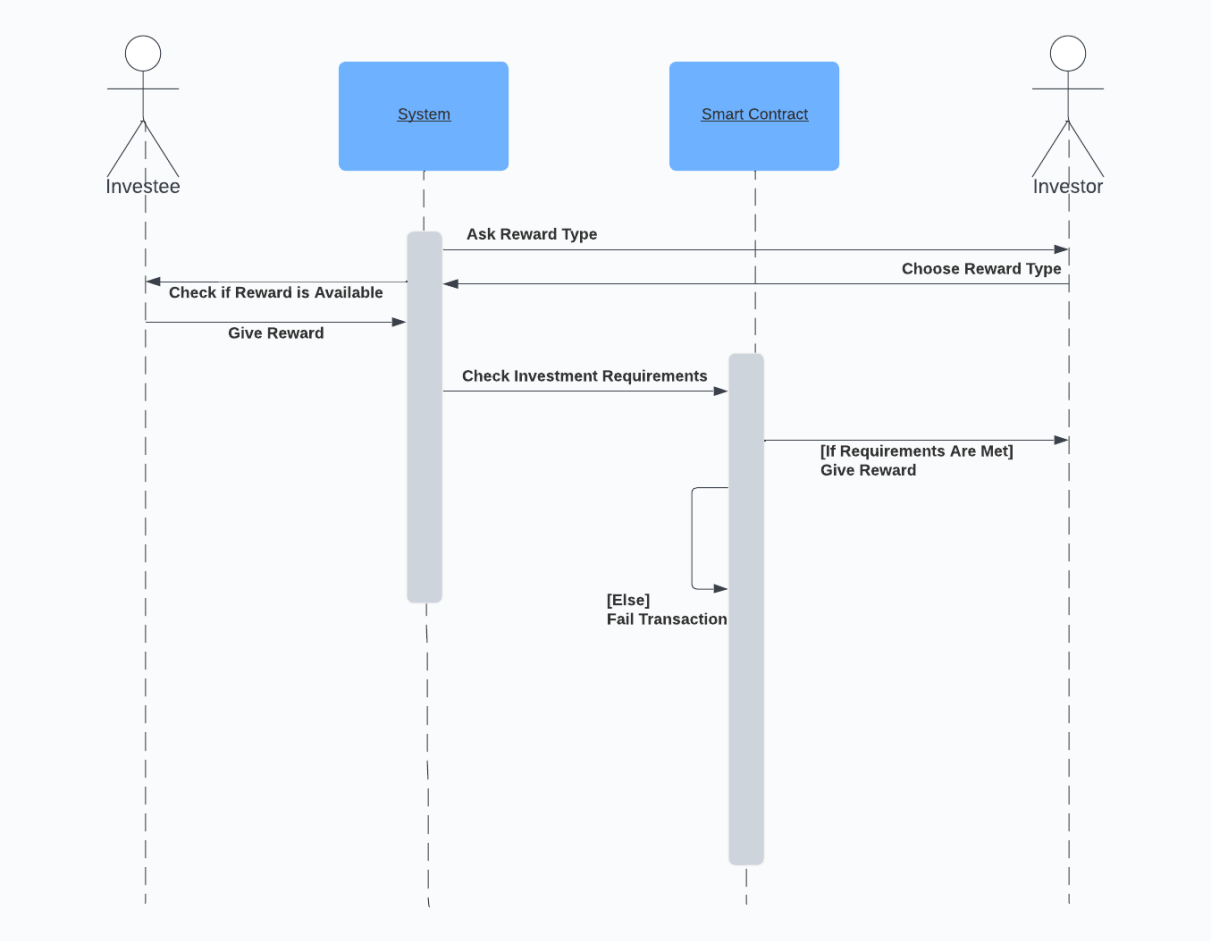

Figure 16 Giving/Receiving Sequence Diagram

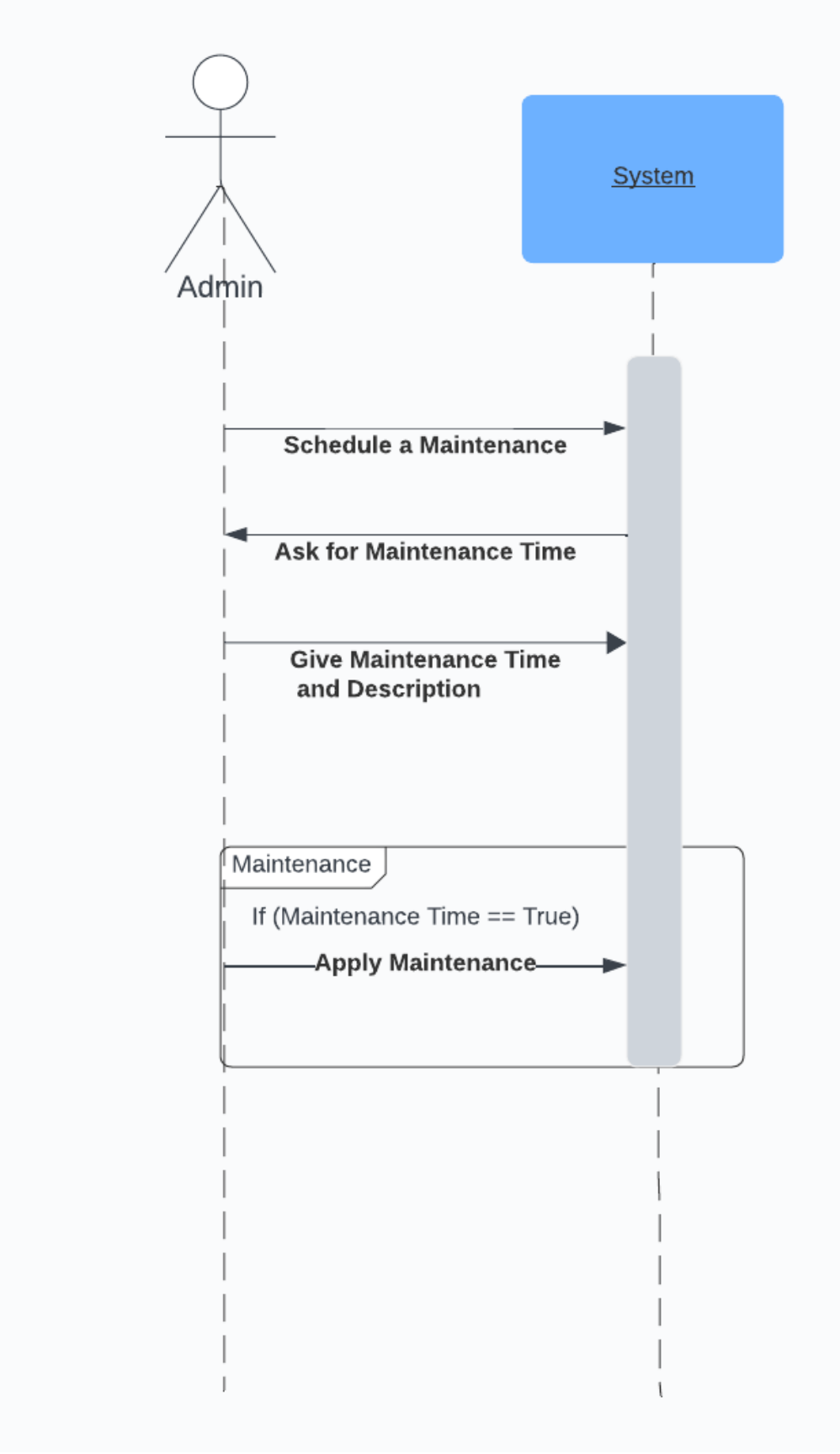

Figure 17 Maintenance Sequence Diagram

12. USER INTERFACE DESIGN

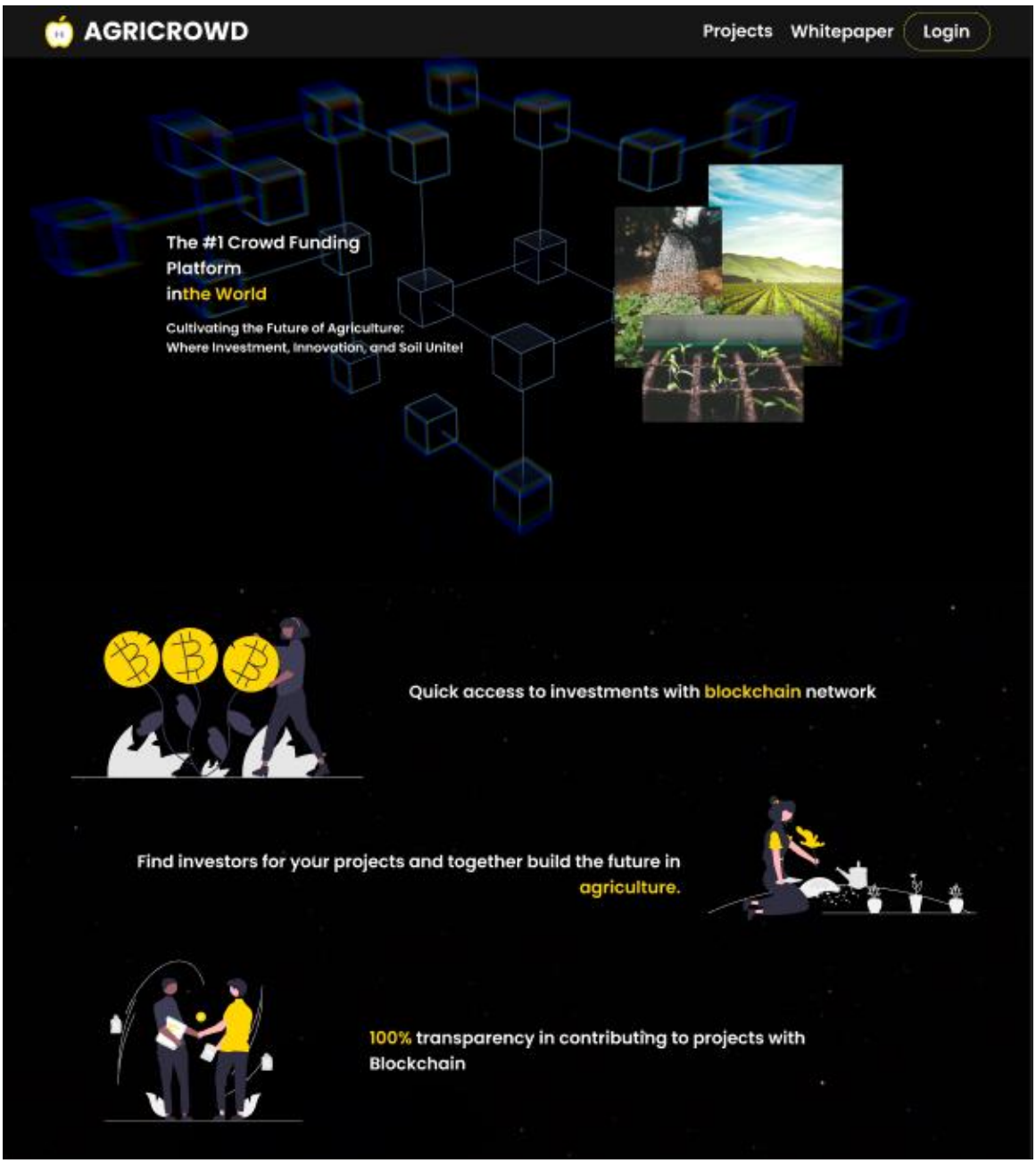

Figure 18 Main Page

In Figure 18, we can generally see the purpose of the project, and it is the first page we encounter when entering the site.

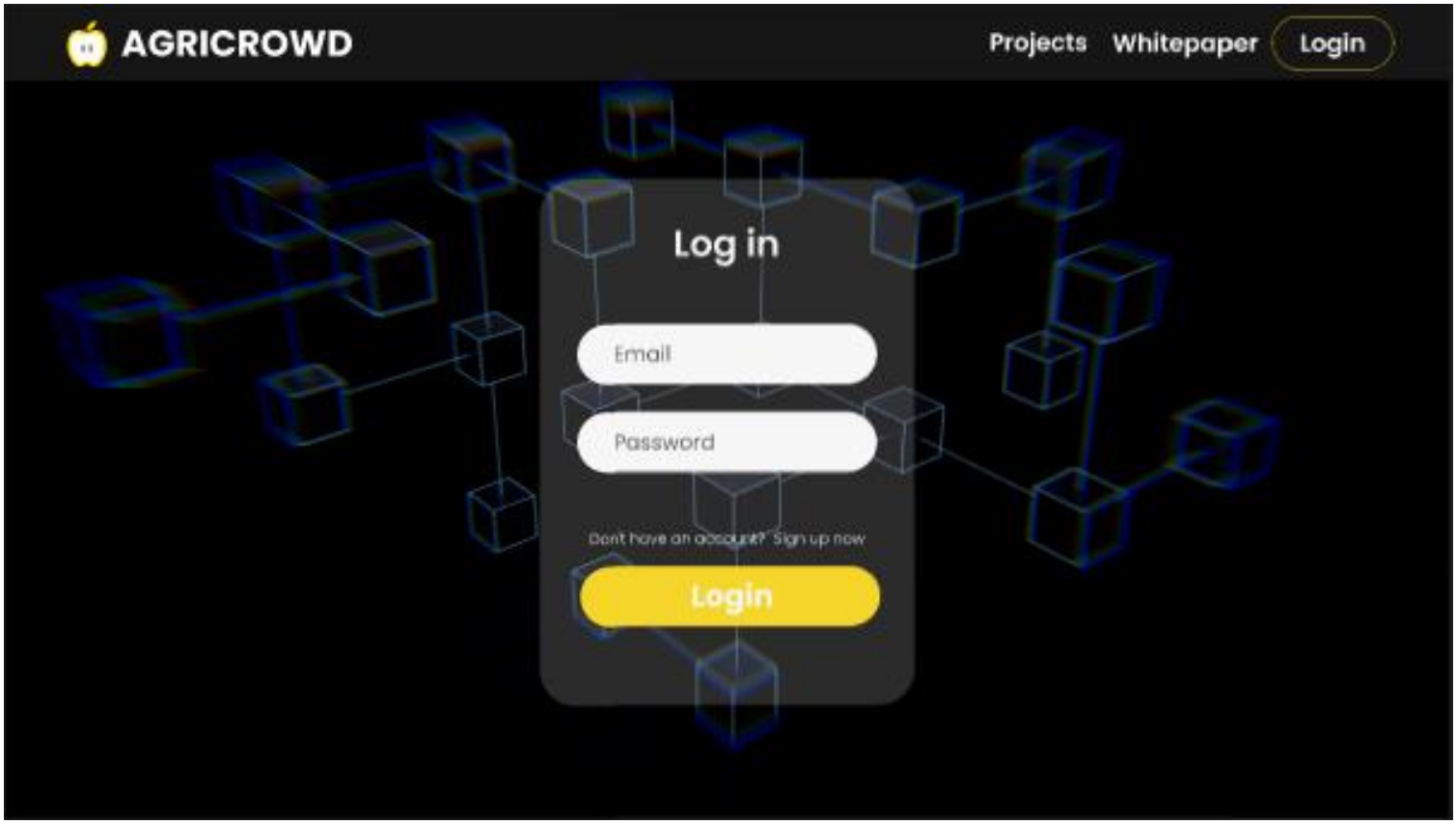

Figure 19 Login Page

In Figure 19, there is a section where we can register to view projects in the system and make investments. This is also the area where we can log in to the system.

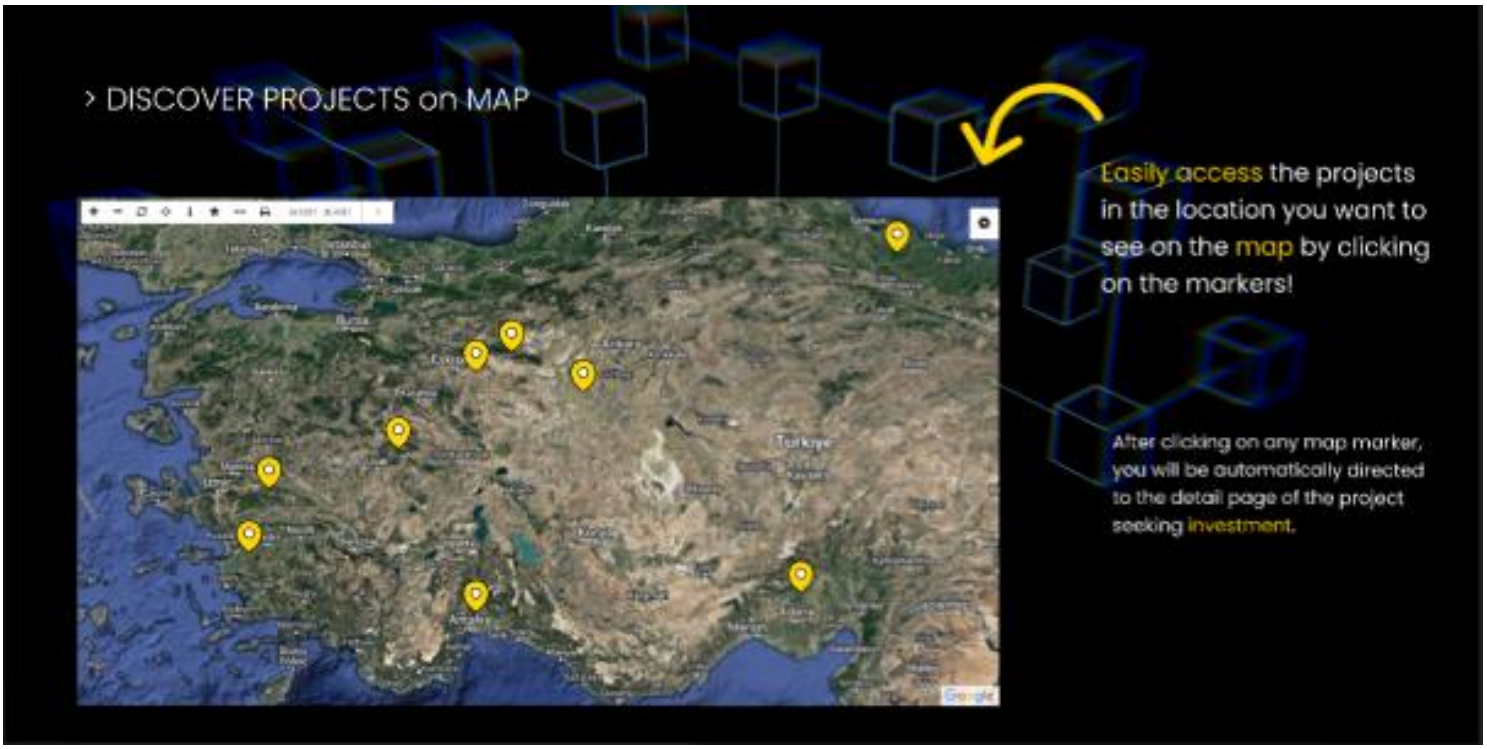

Figure 20 Projects on Map

In Figure 20, there is a mapping system where we can obtain information about the exact locations and progress of existing projects.

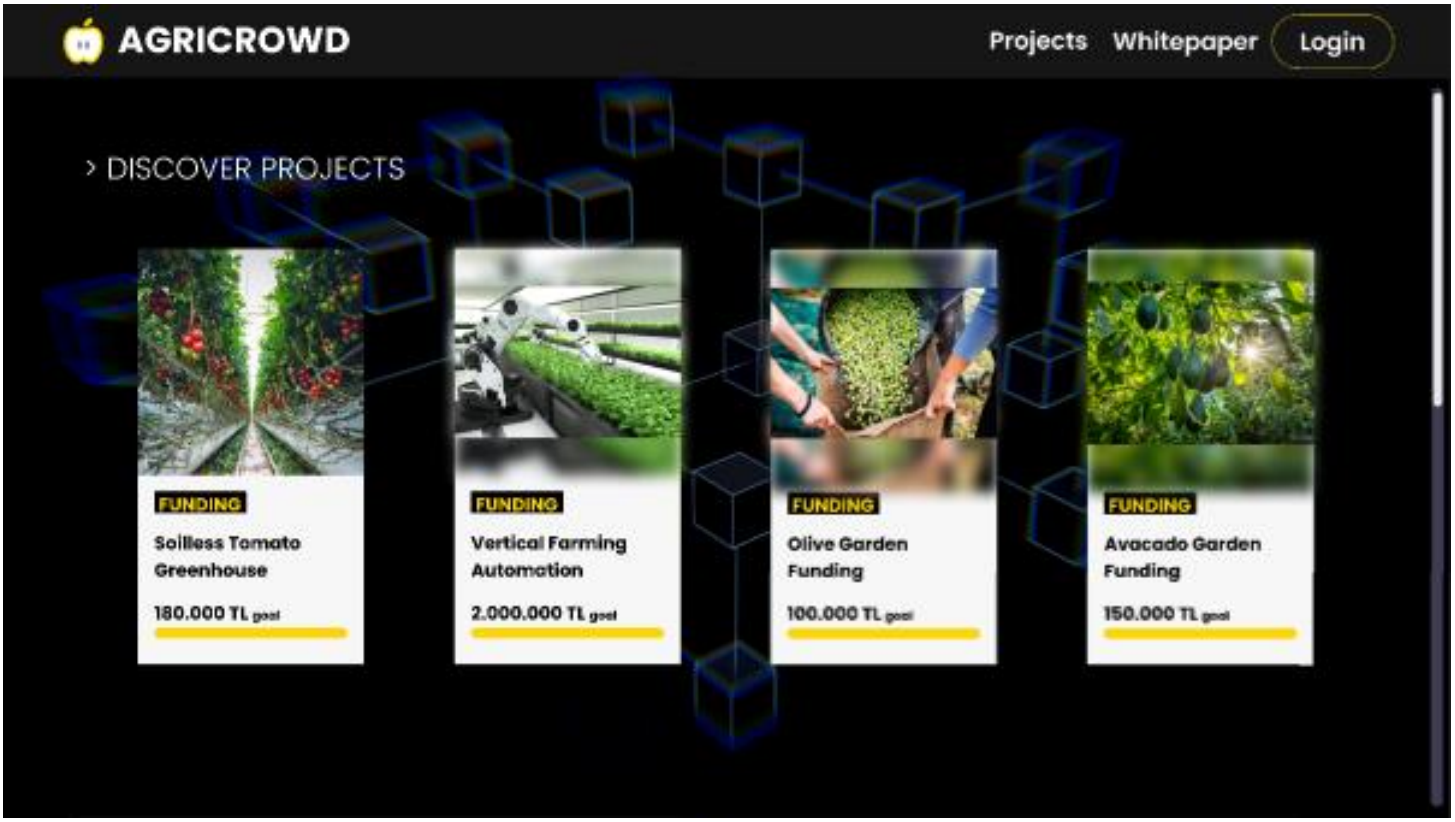

Figure 21 Discover Projects Page

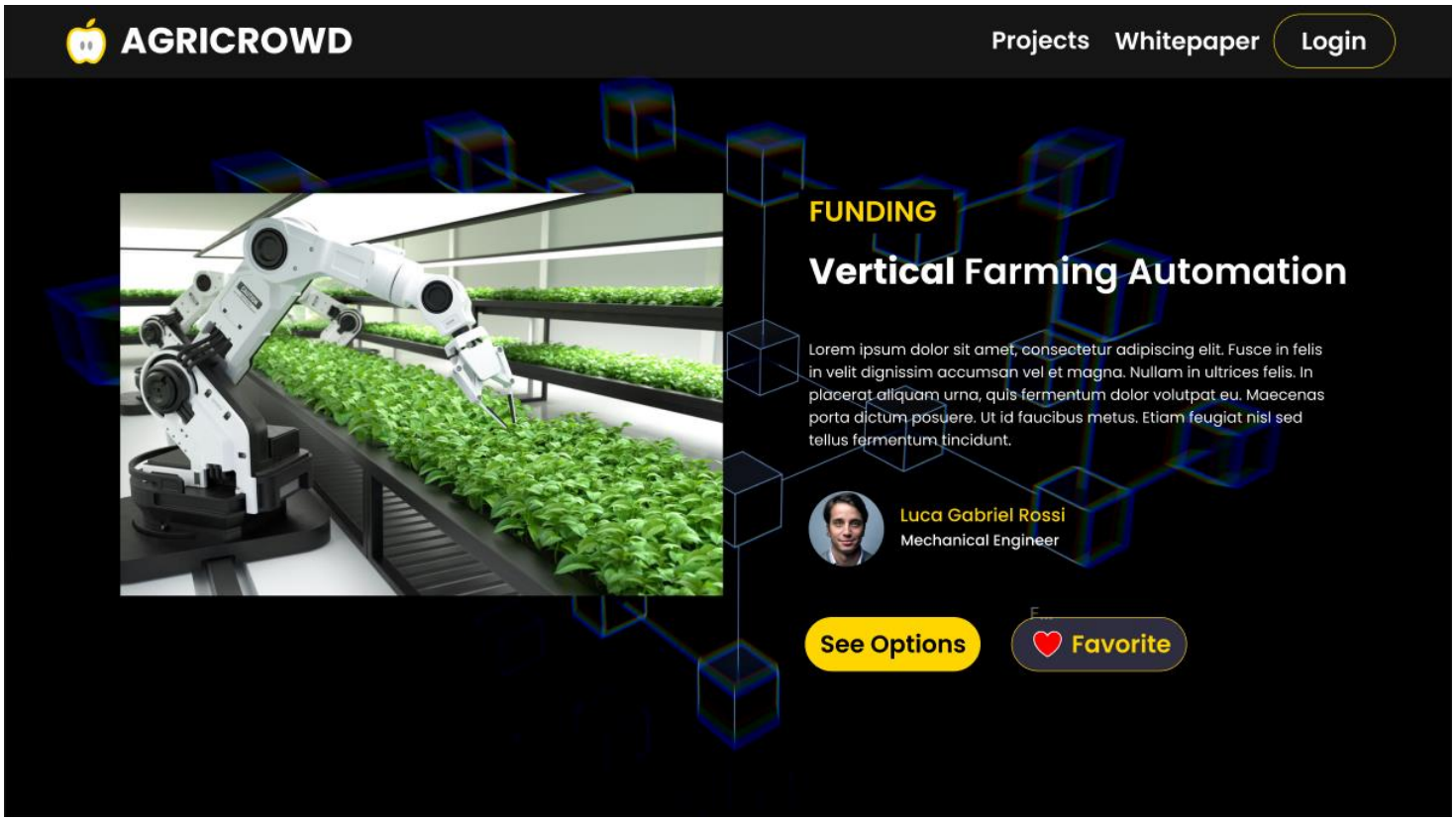

Figure 22 Project Description

In Figure 22, there is a page where the user can see the details of the project they selected in the project selection screen. With the 'see option,' they can explore investment choices, and with the 'favorite' button, they can add the project to favorites for future reference.

Figure 23 Whitepaper

In Figure 23, we have our whitepaper document that outlines the working principle, application areas, and advantages of our product.

13. Work Plan

AGRICROWD **Advisor:** Assoc. Prof. Dr. Gül TOKDEMİR														
Task \ Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Baseline survey														
Team Setup	All													
Project Proposal Form		All Members												
Project Selection Form														
Github Repository			All											
Project Workplan			All Members											
Literature Review				All Members										
Software Requirements Specification					All Members									
Project Webpage								All						
Software Design Description									All Members					
Project Report / Project Tracking Form												All Members		
Presentation														All

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