

DECENTRALIZED CROWDFUNDING SYSTEM FOR PROPERTY INVESTMENT USING ETHEREUM BLOCKCHAIN

¹AKINODE, JOHN LEKAN AND ²ODUNNAIKE, JOSEPH SEUN

¹DEPARTMENT OF COMPUTER SCIENCE,

²DEPARTMENT OF ESTATE MANAGEMENT AND VALUATION,
THE FEDERAL POLYTECHNIC, ILARO, OGUN STATE, NIGERIA.

¹john.akinode@federalpolyilaro.edu.ng; +2348056149269

²joseph.odunnaike@federalpolyilaro.edu.ng; +2348035733348

ABSTRACT

Investment in Real Estate is an endeavor that requires huge capital which can be gotten from sources such as self-financing, mortgage institutions, commercial banks merchant banks among others. Recently, crowdfunding has become a global practice that is generally used to raise capitals from individuals to finance a project, this is due to its potential to gather huge capital raised from the crowd. Despite the success recorded in Real Estate financing using crowdfunding in some countries, it still has some shortcomings in terms of the platform's accountability and transparency. Crowdfunding projects targeted toward real estate acquisition and development have become increasingly common, changing the nature of real estate investment by allowing Property Developers to access funds from the general public. In this research, we have integrated blockchain technology into the crowdfunding model for property investment to address some of the challenges inherent in the crowdfunding model. The blockchain-based systems are in demand across real estate industry because they are safe, dependable, and decentralized as well as the fact that they are more effective than conventional systems. This research work implemented a crowdfunding system that utilize the Ethereum Blockchain and its native coin (ETH) for property funding and was deployed on Goerli Ethereum testnet and netlify for usage. Integration of Ethereum blockchain network solves some of the issues identified in the traditional systems across real estate landscape. Some benefits of the Blockchain-integrated network include greater security, increased transparency, increased efficiency, and lowered fraud risk.

KEYWORDS: *Real Estate, Property Financing, Investment, Blockchain Technology, Crowdfunding*

1.0 INTRODUCTION

In recent years, financing (i.e., lending and borrowing money) is fundamental in real estate business. Businesses are seeking financial support to make investments to continue in this new era. Mortgage is the traditional way of financing real estate property. In a typical mortgage loan transaction, the lender loans the home buyers a large

portion of the purchase price and requires them to provide rest out of their own resources, as down payment. In return for the loan, the buyers must execute a mortgage or deed of trust in the lender's favor. This creates a lien, giving the lender a security interest in the property being purchased, so that the property serves as collateral for the loan. If mortgage financing were not available, buyers would have to pay cash for their home, something few people can

afford to do (Dorsey & Rockwell 2015). Crowdfunding can be used for mortgage shortcomings. Crowdfunding is the process of soliciting for funds from individuals to sponsor personal or business initiatives. Crowdfunding has been applied for various purposes such as: an alternative financing option that can be used to provide initial capital for new business ventures, to raise additional funds for an ongoing project, to finance real estate projects, to finance non-profit initiatives, individual patients' medical needs, and other philanthropic purposes.

A number of online platforms have emerged in recent years that allow people to donate (often small) amounts of funding to projects of their choice. Crowdfunding such as Kickstarter, Indiegogo, GoFundMe, etc is different from platforms like Kiva, which gives users the opportunity to make money by borrowing to people, and other platforms that accept traditional donations like Fundable or Donors Choose. As a good method of raising seed fund, crowdfunding has caught the attention of a few business researchers (Mollick et al, 2018), as it mixes established components of microfinance (Morduch, 2015) and crowdsourcing (Poetz and Schrier, 2014).

Crowdfunding is unique for two main reasons. Firstly, crowdfunding provides better matches between funders and project investors from all around the world. Secondly, investors definitely have access to more information right from the beginning of the project. This information is very valuable to investors and might boost their eagerness to invest on such crowdfunding projects (Schlueter et al, 2018).

However, despite having several advantages, crowdfunding platforms still have many flaws that needed to be improved. One of the main issues that have been in traditional crowdfunding platform is fraud cases, stated that online crowdfunding leaves contributors susceptible to fraud because traditional legal and reputation security measures may not work (Gabison et al, 2017). Some other crowdfunding problems highlighted by other researchers includes: the rewards are significantly delayed, the campaign initiators cease communicating with their backers for more than six months after an unmet delivery date or, the promised product is never delivered and the backers are not fully refunded (Cumming et al 2019).

By implementing Blockchain (smart contracts) in crowdfunding system, we can create a contract that will hold a contributor's money until any given date or goal is reached. Depending on the outcome, the funds will either be given to the project owners or safely returned to the contributors (Zheng et al, 2017). Blockchain can be defined as a distributed database of records of all transactions that have been executed and shared among participated parties. The characteristics of blockchain includes decentralization of data, persistency, anonymity and auditability.

As a result, the main of this research work is to develop a decentralized crowdfunding system for property investment that incorporates Ethereum blockchain technology, with multiple incentive models available to both property investors and investees to addresses transaction accountability and transparency flaws using password-less authentication for account security.

2.0 LITERATURE REVIEW

2.1 Property Investment Financing

Since real estate assets are frequently pricey, investors rarely pay the whole acquisition price of a property in cash. A significant percentage of the purchase price is typically funded with some kind of financial instrument or debt, like a mortgage loan secured by the actual property. Leverage is the percentage of the purchase price that is financed by debt. Equity is the sum financed by the investor's own capital, through cash or other asset transfers. One way to calculate the risk an investor is taking when using leverage to fund the purchase of a property is the ratio of leverage to total assessed value, often known as "LTV" or loan to value for a conventional mortgage. In order to maximize their return on investment, investors typically look to reduce their equity requirements and raise their leverage. For real estate investments that they are asked to finance, lenders and other financial institutions frequently have minimum equity requirements, which are normally in the range of 20% of appraised value. Investors looking for low equity requirements may investigate other financing options when buying a home (for instance, seller financing, seller subordination, private equity sources, etc.).

2.2 Crowdfunding

Crowdfunding is the technique of funding a project or business venture by seeking contributions from many people, most commonly online in the modern era (Goran Calic, 2018). Although related ideas can also be implemented through charity events, mail-order subscriptions, and other techniques, the term "crowdfunding" refers to Internet-mediated registries. Three different types of actors typically

make up this modern crowdfunding model: the project initiator who suggests the idea or project to be funded, individuals or groups who support the idea, and a moderating organization (the "platform") that brings the parties together to launch the idea. Khallikunaisa et al (2022) developed a Blockchain-Based Crowdfunding Platform for Disaster Relief and Effective Charity. They strongly believe that utilizing this technology will boost trust, increase efficiency, and encourage more donations. So, they embark on developing a blockchain-based charity foundation platform that facilitates the trustful network's formation and is accountable for collecting donation funds. The blockchain network contains publicly recognized, trustful, and prestigious organizations.

The complete system will be decentralized using Blockchain Technology, Smart Contracts and Cryptocurrency. They strongly believe that utilizing our technology will boost trust, increase efficiency, and encourage more donations. All organization's operations and functions within the platform will become fully transparent and visible, leveraging properties of immutability, provenance, and non-repudiation to the users. All organizations operations and functions within the platform will become fully transparent and visible; therefore, the platform will reduce the results of dishonest actions, revealing fraudulent organizations' activity. Jakob et al (2019) developed tokenization of assets using blockchain for equity crowdfunding. According to the authors, one of the biggest challenges for small startups and new projects is to find investors, willing to support the company with seed capital. . In order to proffer solution to the existing system, they present tokenization of equity crowdfunding on a Blockchain as a possible approach to ease access to capital for startups.

They propose a categorization of token standards into UTXO-based, layer-based and smart contract-based tokens. In the second step, they analyze the advantages that tokenization can bring, such as cryptographically secured ownership, programmability of assets, access to the Blockchain ecosystem, enhanced divisibility of shares as well as the formation of a well-functioning secondary market.

Iman et al (2018) discussed about crowdfunding the insurance of a cyber-product using Blockchain. Organizations are interested in transferring their cyber-risks to insurers aiming to mitigate the cost of cyber-threats. However, cyber-insurance has not been widely accepted due to several obstacles.

2.3 Blockchain

A blockchain is a particular kind of digital ledger that comprises of a growing collection of blocks, that are safely linked together using cryptography encryption (Morris, 2017). Blockchains are primarily managed over peer-to-peer (P2P) computer networks for use as public distributed ledgers. To add and validate new transaction blocks, nodes cooperate according to a consensus algorithm protocol. Blockchains may be regarded as safe by design and serve as an example of a distributed computing system with strong Byzantine fault tolerance even if blockchain records are not unchangeable and blockchain forks are conceivable (Lansiti et al, 2019).

2.3.1 Public Blockchain

A public blockchain is a type of blockchain which has no access limitations meaning that anyone with

access to the Internet can use it to send transactions and sign up as a validator (i.e., participate in the execution of a consensus protocol). Such networks typically provide financial rewards to individuals that protect them using a Proof of Stake or Proof of Work method. The bitcoin blockchain and the Ethereum blockchain are two of the biggest and best-known public blockchains in cryptocurrency world.

2.3.2 Private Blockchain

A private blockchain is a blockchain which has access limitations. Unless the network administrators invite you, you cannot join. Access is only allowed for participants and validators. The name Distributed Ledger (DLT) is typically used for private blockchains to distinguish them from other peer-to-peer decentralized database applications that are not open ad-hoc compute clusters (Bob, 2017).

2.4 Ethereum

A decentralized, open-source blockchain with smart contract capabilities is called Ethereum. The platform's native cryptocurrency is ether (also known as ETH). The market capitalization of Ether is second only to that of Bitcoin among cryptocurrencies. Programmer Vitalik Buterin created Ethereum in 2013. Gavin Wood, Charles Hoskinson, Anthony Di Iorio, and Joseph Lubin were further founding members of the Ethereum project. Crowdfunding for the network's development work started in 2014, and on July 30, 2015, it went live (Nick, 2018).

3.0 METHODOLOGY

The software development methodology used for this paper was agile software development methodology, which is used when a software team expects changes to the requirements or any increments to the existing functionalities. The software development is done in an iterative manner along with the changes. This development methodology follows the iterative approach, where software is released in iterations. This iterative approach allows the team to find defects early on and fix them which improves the efficiency of the development process. The software development in a Feature-driven approach is done feature by feature, where features are the piece of work that is prioritized by the client and the delivery timeline is of two weeks.

3.1 Overview of the New System

The proposed system is a web3 crowd funding application that runs mainly on Ethereum Block chain for property investment where the backers get ERC-20 token as rewards for supporting the project. The front end of the system will be developed using a JavaScript framework called Vue.js whereas, the back end will be develop using Solidity.

The new system will works as follow:

- i. A Company X seeking some seed fund to finance their real estate project will visit the system.
- ii. A Company X creates a new project panel requesting money from public.
- iii. A Company X Project becomes visible to backers for donations from all around the world.
- iv. The backers start donations and get ERC-20 token as reward.
- v. The Company X reaches the funding cap and withdraws to startup the project.
- vi. The Company X either sells or leases the property.
- vii. The Company X adds funds into the project smart contract.
- viii. The backers begin to sell their ERC-20 token (the previous token gotten as reward for their donation) to get back their initial capital and return on investment (ROI).

3.2 System Design

System design System Design refers to the process of designing the components, architectures, and interfaces for a system so that it meets the end-user requirements.

Use Case Diagram

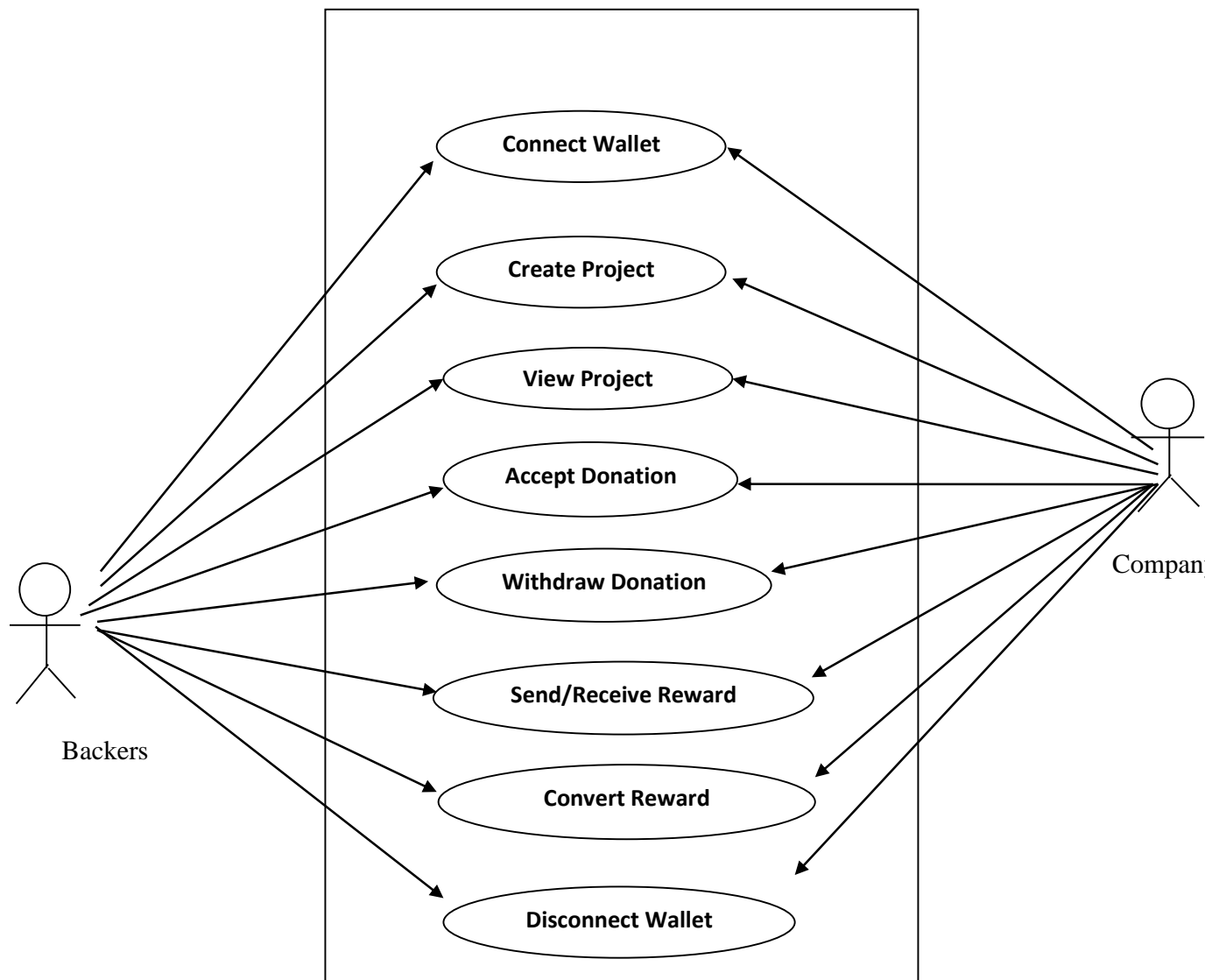


Fig. 3.1: SofinaHub Use Case

3.3 Data Flow Diagram

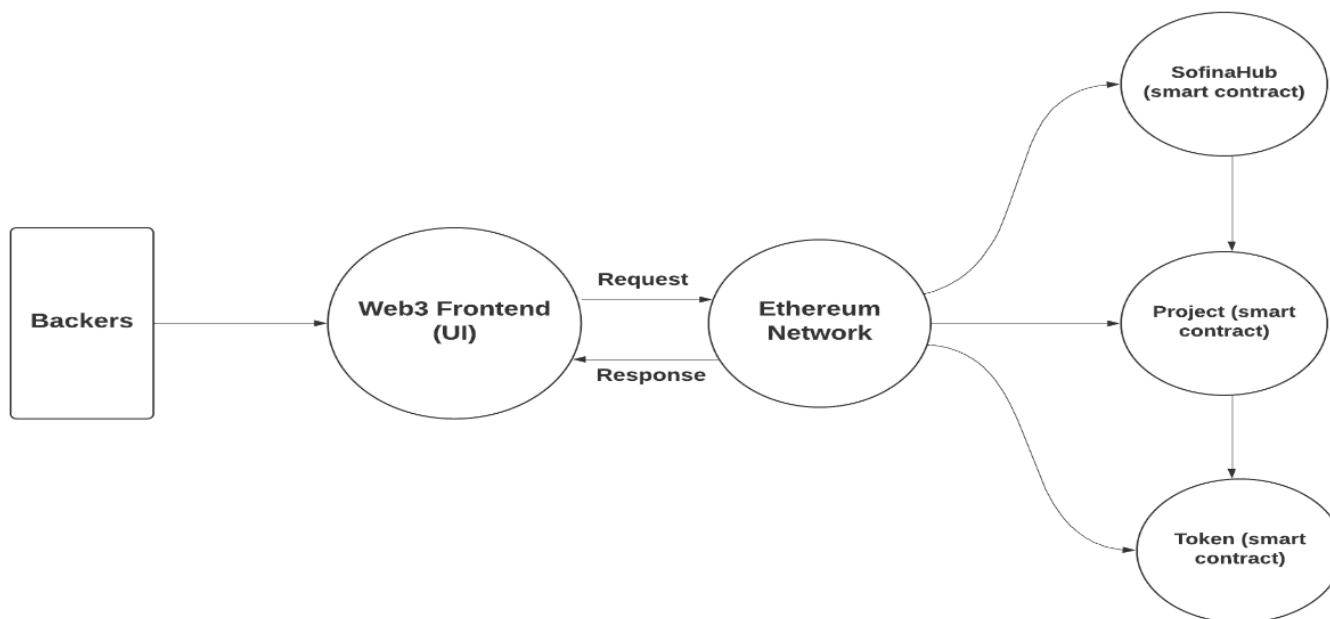


Fig. 3.2: Data Flow Diagram

4.0 SYSTEM IMPLEMENTATION

The system's implementation is covered in this chapter, which also emphasizes the testing process and gives an overview of some of the key GUI elements. The output from the programming language and other tools required to create our system will be provided. This helps to specify the actions to be taken, the resources and equipment to be discussed, and the additional equipment to be purchased in order to implement the new system.

4.1 Software Requirement

The software development tools used for this project software are:

4.1.1 Solidity

Solidity is a high-level programming language for creating smart contracts on various blockchain platform, most notably **Ethereum**. Solidity is a statically typed programming language that uses ECMAScript-like syntax which makes it familiar for existing web developers. Solidity introduces an Application Binary Interface (ABI) that facilitate multiple type safe function within a single contract.

4.1.2 Node.JS

Node.js is a runtime that enables developers to run JavaScript server-side. It runs on Google Chrome v8 Engine. The V8 event loop and its non-blocking I/O architecture make it tools of choice for many developers.

4.1.3 Vue.JS

Vue.js is a progressive, component-based framework for creating modern application(s) like PWA, SPA, etc.

4.1.4 Web3.JS

Web3.js is a global collection of useful libraries that allow users to interact with a local or remote Ethereum node using HTTP, RPC, or WebSocket.

4.1.5 Truffle

Truffle is a world-class development environment, testing framework and asset pipeline for blockchain using Ethereum Virtual Machine (EVM), aiming to make life as a developer easier.

4.1.6 Test-net Faucet

Test-net is an Ethereum test network that allow for blockchain development testing before deployment on Main Ethereum Network (MAINNET).

4.2 Display of Graphical User Interface

4.2.1 Homepage

This is the welcome page of the decentralized crowdfunding system. This page includes various links like launch app, guide, what's web and the project GitHub repository.

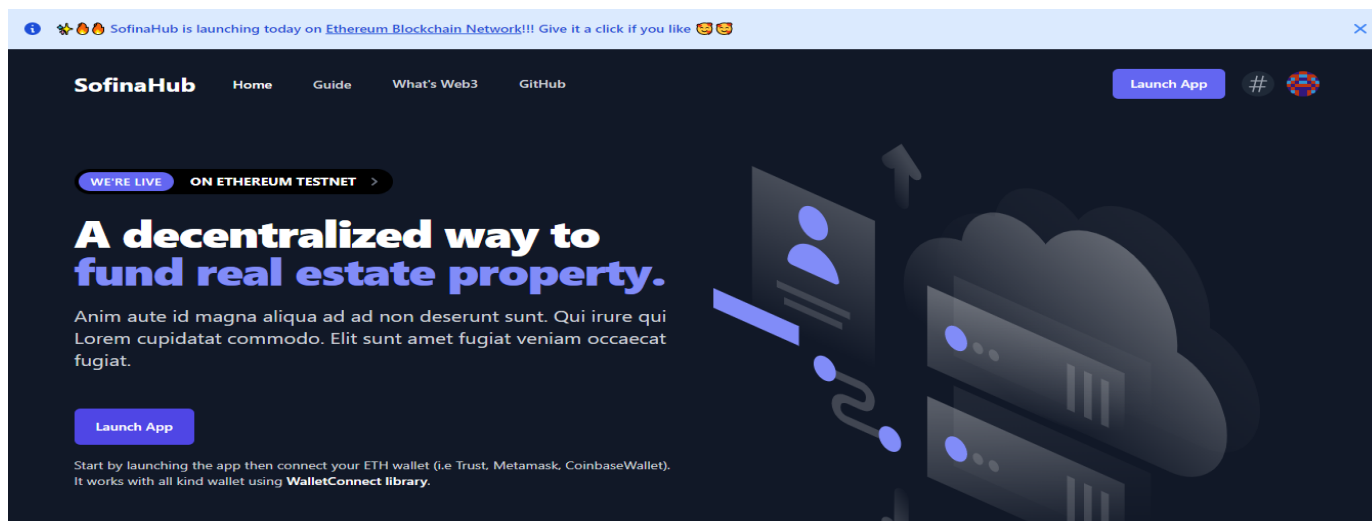


Fig. 4.1: Homepage

4.2.2 Guide Page (How to Use SofinaHub)

This is the page that describes various steps on how to use the system for both company and backers.

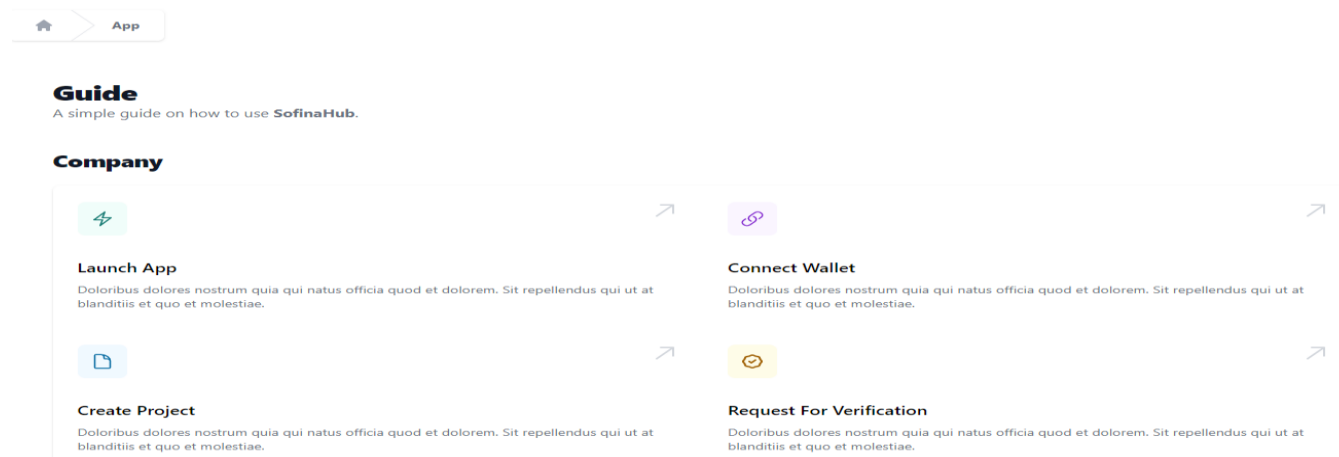


Fig. 4.2: Guide Page

4.2.3 Connection Page

This page is used for establishing connections between the decentralized crowdfunding system and one's crypto wallet.



Fig. 4.3: Connection Page

4.2.4 Company Dashboard Page

This is the company dashboard for creating new project, viewing existing ones and depositing funds to be disbursed back to backers after the project has reached it ROI (Return On Investment) maturity date.

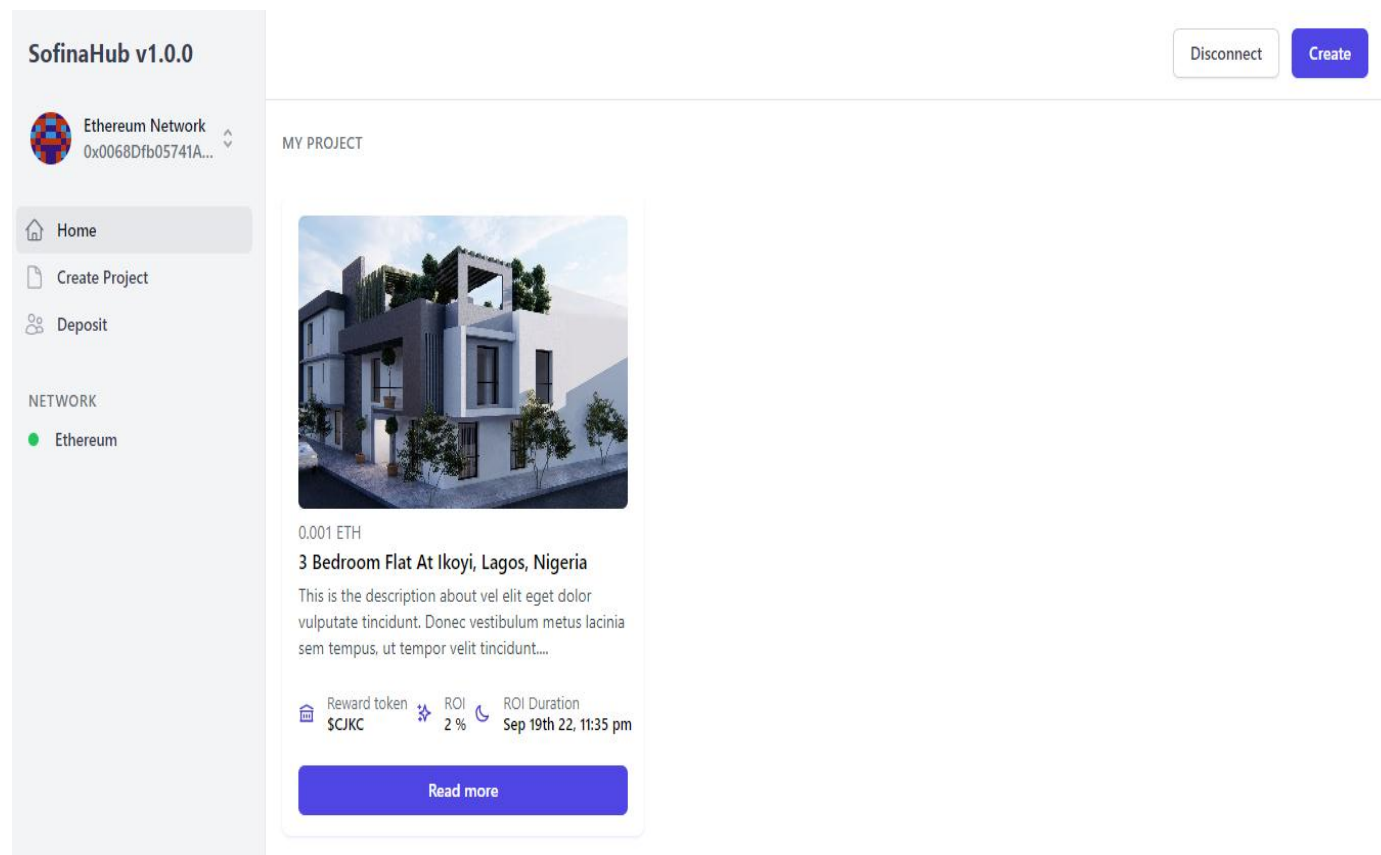



Fig. 4.4: Company Dashboard

4.2.5 Create Project Page

This is the dedicated company page for creating new project.

SofinaHub v1.0.0

 Ethereum Network
0x0068Dfb05741A...

Home

Create Project

Deposit

NETWORK
● Ethereum

Disconnect

CREATE PROJECT

Project Details

This information will be displayed publicly for the project transparency.

Title

Duplex Building At Ajah Lagos, Nigeria

Description

Describe your project here

Goal (in ETH)

5.4

Deadline

mm/dd/yyyy --:-- --

Image source(s)

Image sources seperated by comma

Video source(s)

Video sources seperated by comma

token name

BAT Coin

Token symbol

BATC

Token decimal

0

Token total supply

0

Return on Investment (ROI)

This information will be displayed publicly for the project backers.

ROI (in %)

0

ROI Duration

mm/dd/yyyy --:-- --

Create Project

Fig. 4.5: Create Project Page

146

A Publication of the School of Environmental Studies, The Federal Polytechnic, Ilaro, Nigeria.

4.2.6 Deposit Page

This is the page for company to deposit backers' funds and their ROI.

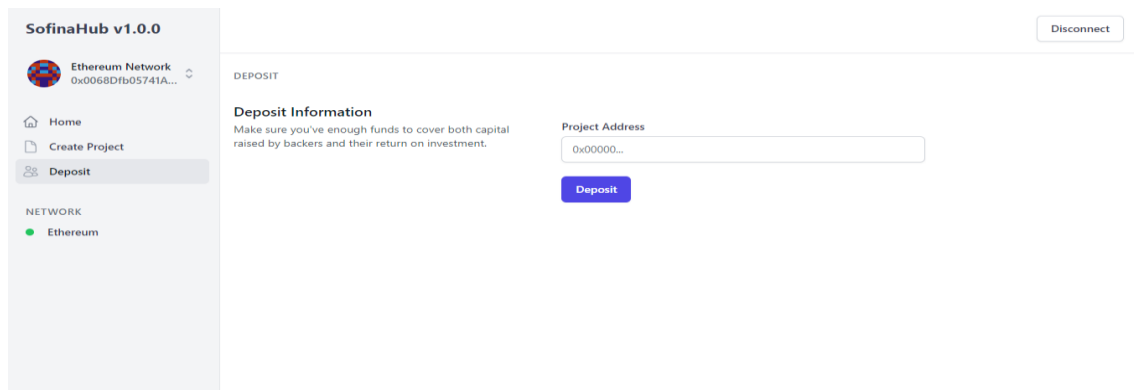


Fig. 4.6: Deposit Page

4.2.7 Backer Dashboard

This is the backers' dashboard for viewing all existing project, already backed projects, ask for refund from project, and claim their fund (with ROI).

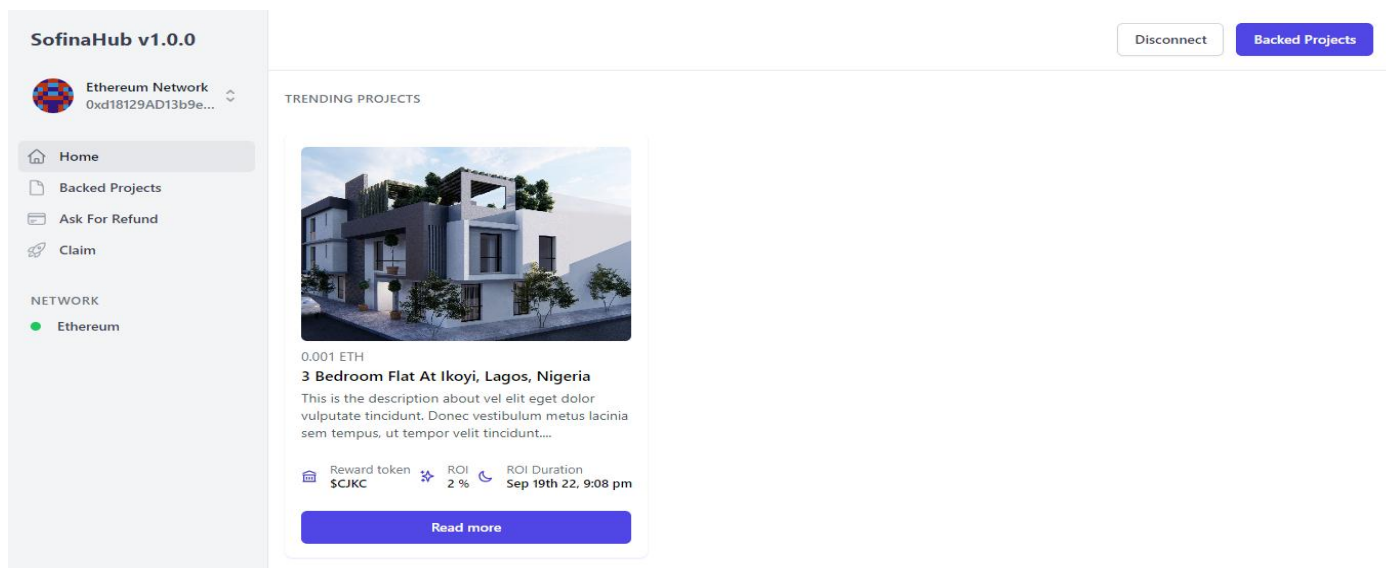


Fig. 4.7: Backers' Dashboard

4.2.8 Backed Project Page

This page lists all the backer's backed projects.

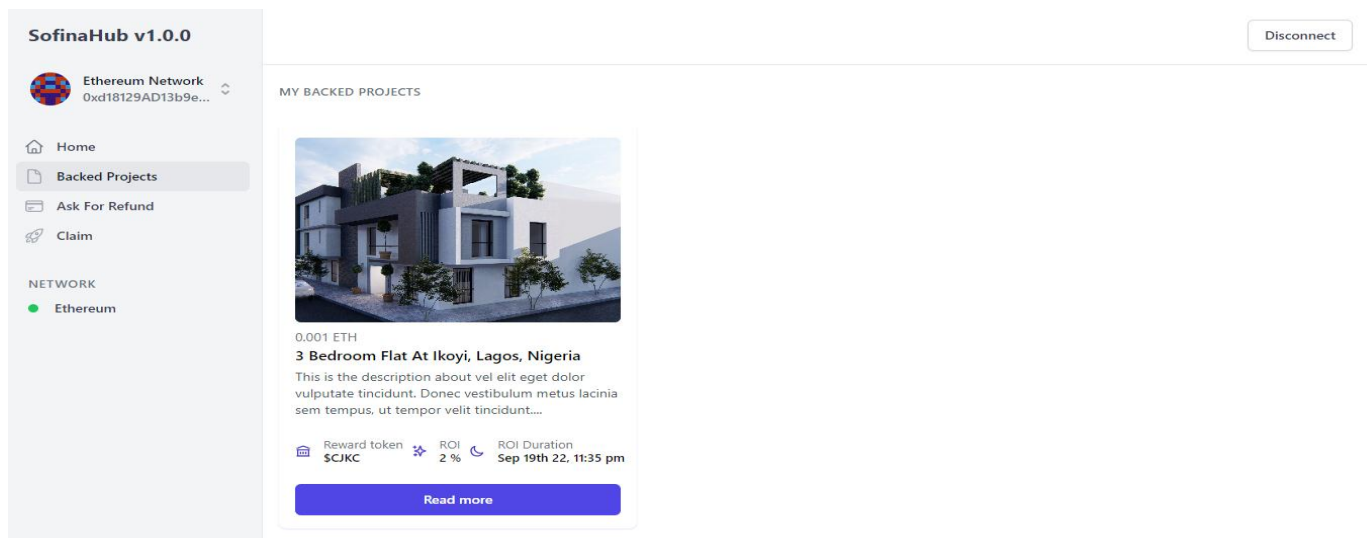


Fig. 4.8: Backed Project Page

4.2.9 Ask For Refund Page

This page is used by backer to ask for refund from company when the funding capital not reached.

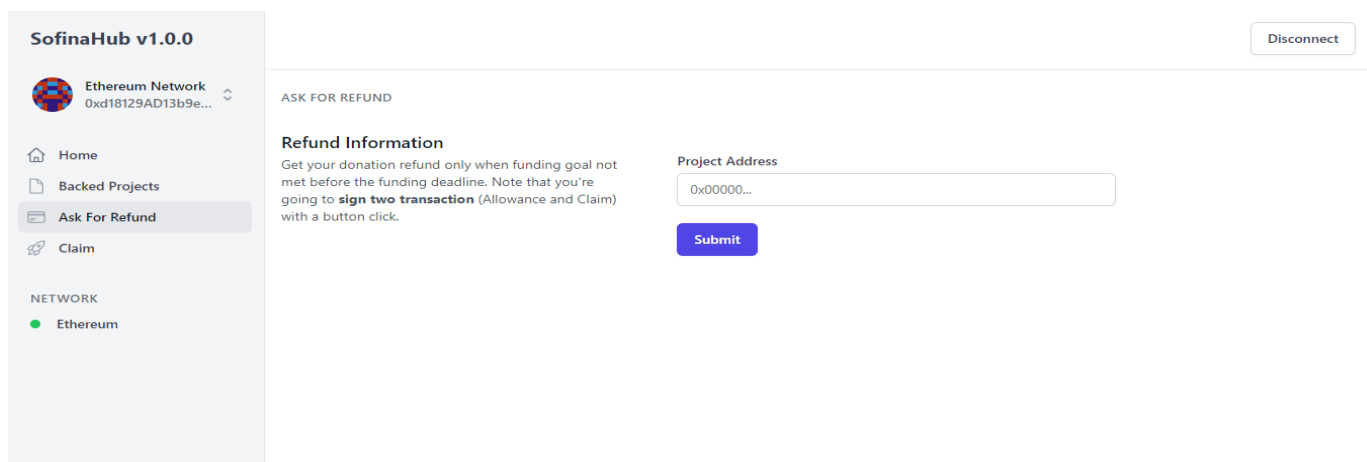


Fig 4.9: Ask For Refund Page

4.2.10 Claim Page

This page is used for claiming initial funding capital and ROI after maturity date has been reached.

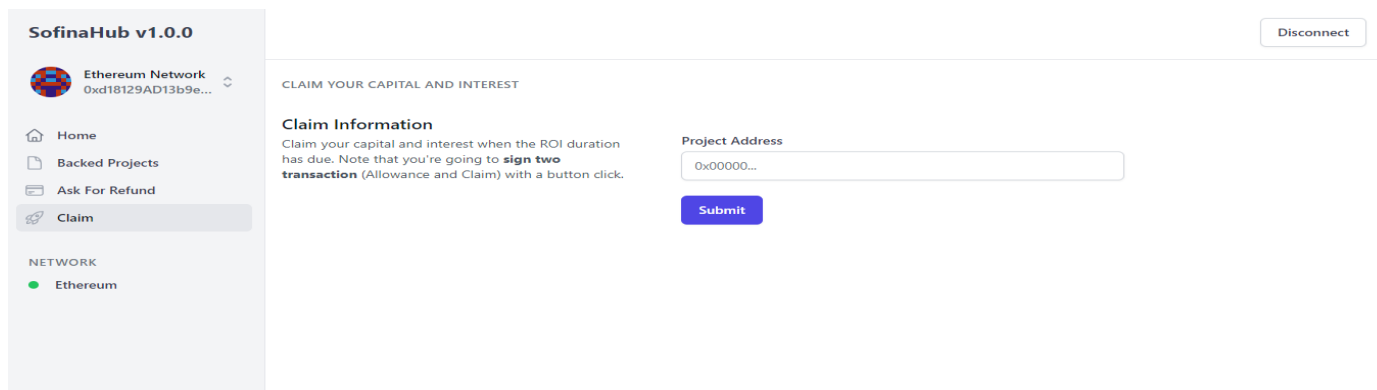


Fig. 4.10: Claim Page

4.2.11 Admin Dashboard

This is an admin dashboard for viewing all projects and verifying legitimate project to prevent backers from scam projects.

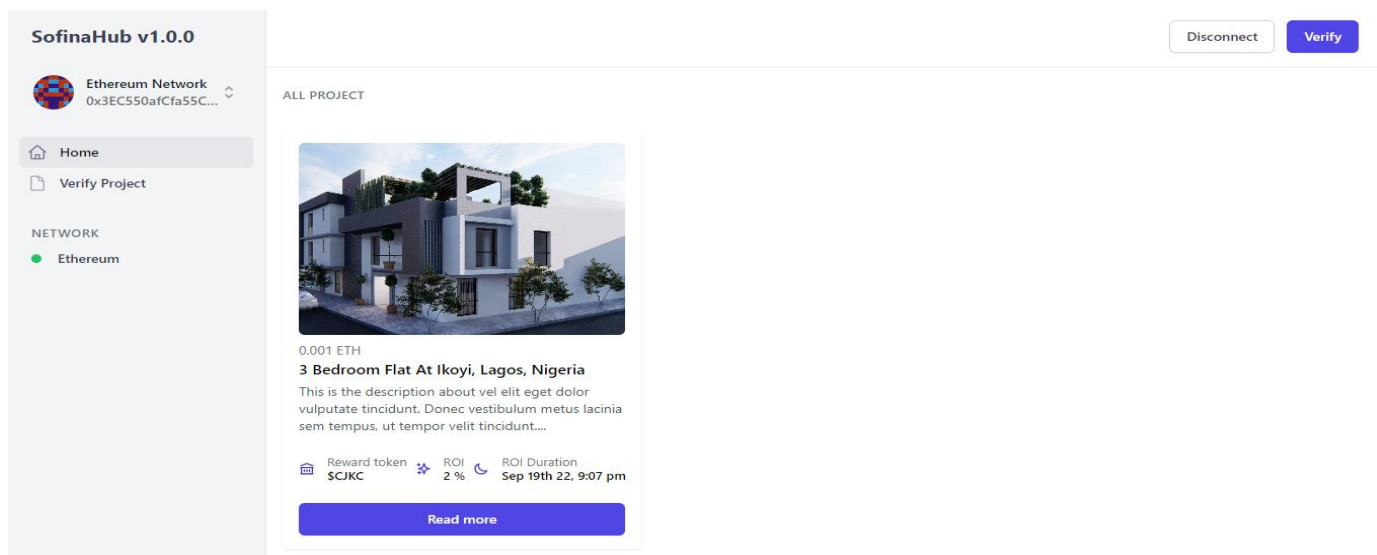


Fig 4.11: Admin Dashboard

5.0 CONCLUSION

Financing is one of the major problems affecting the Real Estate investment. Even though there are so many sources of financing Real Estate investment, so many Property Developers have chosen crowdfunding to raise money for their projects as it is harder to gain loans from bank or other investors. The main reason is the duration of processing loans from the banks. This project work proposes a decentralized crowdfunding system for property investment using Ethereum Blockchain (smart contracts) to provide more transparent transactions. By implementing smart contracts in crowdfunding system, we can create a contract that will hold a contributor's money until any given date or goal is reached. Depending on the outcome, the funds will either be given to the project owners or safely returned to the contributors. This technique will entrench trust, transparency and openness in real estate financing.

REFERENCES

- Agrawal, Ajay; Catalini, Christian; Goldfarb, Avi (2014). "Some Simple Economics of Crowdfunding". *Innovation Policy and the Economy*. 14 (1): 63–97.
- Anton Hasselgren, Jens-Andreas Hanssen Rensaa, Katina Kravlevska, Danilo Gligoroski, and Arild Faxvaag (2021). "Blockchain for Increased Trust in Virtual Health Care: Proof-of-Concept Study" (*J Med Internet Res* 2021;23(7):e28496) Available at <http://dx.doi.org/10.2196/28496>.
- Bill Payne for Gust. (2015). *US Crowdfunding in 2014*.
- Bob M. (2017). "Blockchain: The Invisible Technology That's Changing the World". *PC MAG Australia*. Ziff Davis, LLC. Archived from the original on 25 September 2017. Retrieved 25 September 2017.
- Catherine Clifford (2014). "Crowdfunding Generates More Than \$60,000 an Hour (Infographic)". *Entrepreneur*. Entrepreneur Media, Inc. Retrieved May 25, 2014.
- Cumming, et al. (2016). "Crowdfunding from Fraud-funding", Max Planck Institute for Innovation & Competition Research Paper No. 16-09. Available at SSRN: <https://ssrn.com/abstract=2828919> or <http://dx.doi.org/10.2139/ssrn.2828919>.
- Dailyfintech.com (2018). "Blockchain may finally disrupt payments from Micropayments to credit cards to SWIFT". Archived from the original on 27 September 2018. Retrieved 18 November 2018.
- Dannberg T. (2017). "Advantages and Disadvantages with Crowdfunding: - and Who are the Users?" Unpublished Dissertation.
- David M. Freedman and Matthew R. Nutting (2016). *A Brief History of Crowdfunding* Archived at the Wayback Machine. Updated June 22, 2016.
- Distributed Ledger Technology: Hybrid Approach, Front-to-Back Designing and Changing Trade Processing Infrastructure, By Martin Walker, First published: 24 OCT 2018 ISBN 978-1-78272-389-9.
- Dorsey, & Rockwell (2015). *Financing Residential Real Estate*. (17th Edition).
- Foundation, Ethereum (2015). "Ethereum Launches". blog.ethereum.org. Archived from the original on 11 August 2015. Retrieved 9 January 2020.

- Gabison et al. (2015). "Understanding Crowdfunding and its Regulation", 2015, doi:10.2791/562757.
- Gerlis, Melanie (2021). "Christie's gets digital with the art world's non-fungible craze". Financial Times. Archived from the original on 23 February 2021. Retrieved 25 February 2021.
- Goran Calic (2017). "Crowdfunding", The SAGE Encyclopedia of the Internet, 2018.
- Jakob Roth, Fabian Schär and Aljoscha Schöpfer (2019). "The Tokenization of Assets: Using Blockchains for Equity Crowdfunding" Electronic copy available at: <https://ssrn.com/abstract=3443382>
- Khallikunaisa J., Hemanth P A, Arun Kumar B, Chethan K, Burhan Pasha (2022). "Blockchain-Based Crowdfunding Platform for Disaster Relief and Effective Charity", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 9 Issue 2, pp. 121-126, March-April 2022. Available at doi : <https://doi.org/10.32628/IJSRST229225>
Journal URL : <https://ijsrst.com/IJSRST229225>.
- Lansiti, Marco; Lakhani, Karim R. (2017). "The Truth About Blockchain". Harvard Business Review. Harvard University. Archived from the original on 18 January 2017. Retrieved 17 January 2017.
- Levy, Richard M. (2019). Introduction to Real Estate Development and Finance. Routledge. ISBN 978-0-429-89113-7.
- MacGregor, Bryan D.; Schulz, Rainer; Green, Richard K. (2018). Routledge Companion to Real Estate Investment. Routledge. ISBN 978-1-317-68785-6.
- Michael. "Ethereum Cofounder Joe Lubin Talks Trump, Blockchain's 'Frankenstein' And Willingness To Work With China". Forbes. Archived from the original on 22 June 2020. Retrieved 1 June 2020.
- Mollick, E. (2018). "The Dynamics of Crowdfunding: An Exploratory Study," The Journal of Business Ventures, 29, 1–16.
- Mollick, E. R. and R. Nanda (2018): "Wisdom or Madness? Comparing Crowds with Expert Evaluation in Funding the Arts," Harvard Business School Entrepreneurial Management Working Paper, 14-116.
- Morduch, J. (2015). "The Microfinance Promise," Journal of Economic Literature, 37, 1569–1614.
- Morri, Giacomo; Benedetto, Paolo (2019). "Introduction to Property Valuation". Commercial Property Valuation: Methods and Case Studies. John Wiley & Sons. ISBN 978-1-119-512158.
- Morris, David Z. (2016). "Leaderless, Blockchain-Based Venture Capital Fund Raises \$100 Million, And Counting". Fortune. Archived from the original on 21 May 2016. Retrieved 23 May 2016.
- Nathaniel (2017). "Business Giants to Announce Creation of a Computing System Based on Ethereum". The New York Times. Archived from the original on 20 June 2017. Retrieved 5 June 2017.
- Nick (2018). "The Prophets of Cryptocurrency Survey the Boom and Bust". The New Yorker. Archived from the original on 9 January 2020. Retrieved 7 December 2021.
- Olaf Simons (2016). "Crowdsourcing Comte". positivists.org. Retrieved March 10, 2016.

- Poetz, M. and M. Schrier (2012). “The value of crowdsourcing: can users really compete with professionals in generating new product ideas?” *Journal of Product Innovation Management*, 29, 245–256.
- Popper, Nathaniel (2016). "Ethereum, a Virtual Currency, Enables Transactions That Rival Bitcoin's". *The New York Times*. Archived from the original on 24 July 2016. Retrieved 2 September 2016.
- Schlueter et al (2018). “Underlying Benefits and Drawbacks of Crowdfunding from the Perspective of Entrepreneurs in Germany”, 5th IBA Bachelor Thesis Conference, University of Twente. Available at: http://essay.utwente.nl/67409/1/Schlueter_BA_MB.pdf [Accessed 15 Aug 2018].
- Schwienbacher, et al. (2015). “Crowdfunding of Small Entrepreneurial Ventures”, *Handbook Of Entrepreneurial Finance*, Oxford University Press. <http://dx.doi.org/10.2139/ssrn.1699183>.
- Wood, Gavin (2018). "Ethereum: A Secure Decentralized Generalised Transaction Ledger (EIP-150)". *yellowpaper.io*. Archived from the original on 3 February 2018. Retrieved 3 February 2018.
- Young, Michael J.; Scheinberg, Ethan (2017). "The Rise of Crowdfunding for Medical Care". *JAMA*. 317 (16): 1623–1624. doi:[10.1001/jama.2017.3078](https://doi.org/10.1001/jama.2017.3078)
- Z. Zheng et al (2017), "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends", *IEEE International Congress on Big Data (BigData Congress)*, Honolulu, HI, 2017, pp. 557-564.doi: 10.1109/BigDataCongress.2017.85.