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Decentralized Research Funding Application: Utilizing Blockchain Technology to Ensure Transparency

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The purpose of this thesis was to investigate and study the various issues faced by educational and technological researchers while raising the funds for their respective projects and the issues faced by the fund's providers. Multiple existing traditional fundraising platforms were identified, and their advantages and disadvantages were studied to check if it was suitable for educational and technological researchers to carry on their funding campaign using the existing platforms. Finally, the goal was to develop a decentralized research funding application which would replace the existing traditional methods of raising funds by providing the researchers the ability to create a fundraising campaign on Ethereum blockchain while ensuring the transparent and auditable usage of the funds provided for the development of the project by the stakeholders.

The research funding application was developed and deployed to Ethereum blockchain. During the development process, the technologies used were Solidity, HTML, CSS, Javascript and React. The requirements for the Minimum Viable Product of the research funding application were finalized and the project was implemented by following the Waterfall software development model.

As a result, the requirements set for the research funding application were accomplished and the application was deployed to the blockchain and can be accessed by the general public. Furthermore, additional features such as the ability to create and manage multiple funding campaigns by a single entity were also developed successfully.

Keywords	Blockchain, Ethereum, Transparency, Research

Contents

List of Abbreviations

HTML	Hypertext Markup Language
UI	User Interface
DApp	Decentralized Application
IDE	Integrated Development Environment
MVP	Minimum Viable Product
ETH	Ethereum
JS	Javascript
OOP	Object Oriented Programming
P2P	Peer-to-Peer Computing
Txns	Transactions

1 Introduction

Nowadays, technology is advancing at a very fast pace. With the use of modern technology, humans have learned to deal with the encountered problems in a compact and efficient way. However, there are several sectors in today's modern world where outdated means of processes and decades-old technologies are still being used. One example is the way existing educational and technological researchers secure funds for their idea or project.

There are several hurdles and multiple hidden processes through which researchers have to go before they are able to secure funding. The majority of the projects require a steady stream of funding during the whole development process. However, most of the projects are abandoned because of either insufficient funding or mismanagement of the already secured funds. In such a situation, trust issues emerge between the researchers and the stakeholders as there is no clear way for the stakeholders to monitor the fund usage.

The primary goal of this thesis is to understand the way existing traditional fundraising models work and develop a decentralized crowdfunding application which allows the users to create and deploy a fundraising campaign on Ethereum blockchain and allow the stakeholders and related entities to track and audit the fund usage at any stage of development process. The application should be carefully developed and must reach the quality level to be used by users as real money is at stake. At the same time, the funding application should be easy enough to operate so that anyone can create a funding campaign and use the funds secured through the crowdfunding process to develop the initially proposed project.

2 Background to Crowdfunding

Crowdfunding is a process of raising resources or funds for a project from a big group of investors. The crowdfunding process is usually carried out on the internet and it is usually based on three entities: the initiator who comes up with the idea for a project, individuals or a group of people who support the idea, and a mediatory organization which provides support to the initiator of the idea and the group of people who support that idea by providing them a pre-built platform to carry on the funding process [1].

Figure 1. Existing traditional crowdfunding platforms [2]

There are several crowdfunding platforms providing their services not only to researchers but the general public as well. Some of the most famous crowdfunding platforms are Kickstarter, Gofundme and Indiegogo as displayed in Figure 1. The platforms have a very large amount of existing registered user base ready to invest in quality projects.

The existing crowdfunding platforms provide the initiator and the backers of the project an already functional platform where an idea can be hosted, and funds can be raised if the project appeals to the public interest.

2.1 Benefits of Using Traditional Crowdfunding Platforms

It is very easy for any individual or a group of people to introduce their idea to the general public using existing crowdfunding platforms. It can be a very fast way to raise funds and at the same time, it can result in a valuable form of marketing and gather media attention. Once the idea is hoisted on the platform, it is also open to criticism and the initiator can get valuable feedback on how to improve it.

It is also an alternative way of financing your idea. Instead of using banks to obtain a loan for your idea or take into account the traditional funding methods, one can easily crowdfund their idea. The people who contribute to the idea, may often become loyal customers and result in indirect promotion.

2.2 Drawbacks of Using Traditional Crowdfunding Platforms

Anyone can create a crowdfunding campaign on the current crowdfunding platforms. This can result in scammers creating the crowdfunding campaigns and swindle people as the existing crowdfunding platforms clearly state that it is the contributor's responsibility to research the background of the idea initiator. The funds, when the funding campaign concludes, are directly transferred to the initiator's bank account. The existing platforms take no responsibility whatsoever to make sure how the raised funds are being used and if the initiator is able to deliver to the final product or not.

If the funding target is not reached, any finance which has been pledged is returned back to the investors which can leave the initiator with huge losses as significant resources are required to plan and execute the promotion of the idea.

3 Blockchain Technology

The term “Blockchain” was coined in 2008 when a person or a group of people identifying themselves as “Satoshi Nakamoto” proposed a system with peer-to-peer distributed timestamps server that serves as a generator of the computational proof of the chronological order of transactions [3].

In simple words, blockchain is a database which is routinely getting updated as new blocks get created and are then processed by the nodes which are connected to the blockchain. Blockchain provides its users with the property of immutability which makes sure that the data stored on it is tamper-proof and the state of the blockchain cannot be altered.

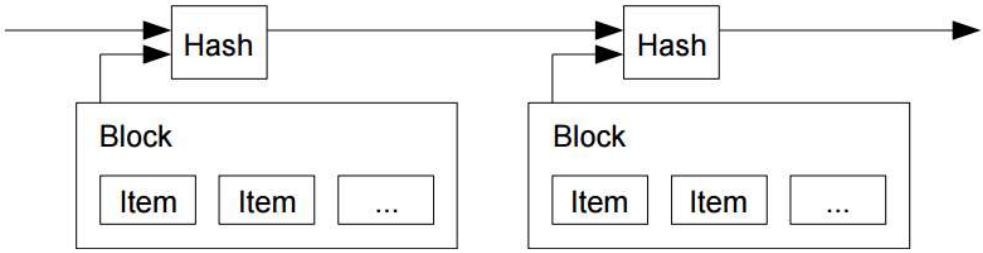

Figure 2. Data getting added to a blockchain [4].

After a specific interval of time, a block gets created. As shown in Figure 2, each block contains some or almost all of the recent transactions which took place but are yet to be added to the blockchain. In short, we can think of a block as a page with transactions and a blockchain as a group of blocks combined together forming a book. The process of validating that the transactions which are included in the block is achieved by the nodes. Nodes are the computers which are directly connected to the blockchain and carry out resource-intensive tasks to validate the blocks. Each node usually has a copy of the whole blockchain to date and remain in sync in order to keep the local copy as recent as possible.

3.1 Public Blockchain

A public blockchain can be termed as an open network and it can be joined by any individual by connecting their computer with the blockchain [5]. In order to do that, the computer must act as a node by obtaining a copy of the whole blockchain and participating in the validation of the new blocks being added to the blockchain. While doing so, the nodes are rewarded to attract more participants to join in. Some of the most famous public blockchains today are Bitcoin and Ethereum. As of today, Bitcoin and Ethereum are the largest public production ready blockchains with more than 10080 [6] and 12900 [7] functional nodes respectively.

The main advantage of a public blockchain is that a single entity is not in control of the information present on the blockchain. Furthermore, a single entity can not change the rules governing the blockchain. Since there are thousands of nodes operating at the same time and each node contains a full copy of the whole blockchain, no one can take down the blockchain network and it continues to operate as long as there is at least a single node with a full copy of blockchain through which the blockchain can be recovered. These nodes also make sure that the blockchain is available to everyone with access to a computer and the internet.

One of the main drawbacks of a public blockchain is that it requires a huge amount of computing resources in order to operate a distributed ledger at a large scale. Each node connected to the blockchain network must compute a solution to a cryptographic problem to reach a consensus. This process is referred to as ”Proof of work”.

Another disadvantage is that the data present on the public blockchain is visible to everyone. Each transaction can be tracked to its origin. This is an advantage of blockchain as well, but this use case must be taken into consideration before proceeding.

3.2 Private Blockchain

A private blockchain, in contrast to a public blockchain is only available to a selected group. This ensures that the data available on a private blockchain is not available to the general public. Since the data available on a private blockchain is not available to the general public, it can not be audited and serves the purpose to hide the data. A node is still required for a private blockchain to function properly [5]. Similar to a public blockchain, each node contains a full copy of blockchain.

Private blockchains are usually owned by a single individual or an enterprise which gives them the ability to modify the data available on the private blockchain. Since private blockchains are quite fast and preserve the privacy of the data, they are usually desired by government projects or individual needs where privacy is the main factor involved.

3.3 Adding Data on a Blockchain

Any type of data can be stored on a blockchain. However, blockchain is not designed to solely store data on it. Blockchains are inherently fast when processing single or multiple transactions. On the other hand, if a file with a huge size is stored on a blockchain, it will result in the consumption of resources worth thousands of transactions. In addition, it will increase the overall size of blockchain and will add a burden on the nodes as each node has to keep a full copy of blockchain all the time.

4 Ethereum Platform

Ethereum is a decentralized platform based on blockchain technology that runs smart contracts-based applications with zero downtime, no censorship, fraud or third-party intervention. Ethereum was released to the public on July 30, 2015 [8]. It enables the developers to develop and deploy applications on the Ethereum's blockchain. The Ethereum blockchain uses Ether as its native token which can be transferred between accounts or to compensate the nodes for the performed computations as a reward.

Ethereum is not controlled or governed by a single entity. Most of the existing modern and old applications or services are built on a centralized system of governance. Due to the nature of centralized governance, the risk of failure is fairly high. A single point of failure can result in the system being open to security vulnerabilities or even power outages. This can result in a disaster as there is a risk of a data breach which can result in privacy breach and revenue loss.

Ethereum, on the other hand, is a decentralized system which is completely autonomous and is not controlled by anyone. It is being run by nodes which are connected with each other. As of today, there are 12900 [7] nodes around the world which means that it can never go offline. As long as there is a single functional node, the whole blockchain can be recovered at any given time.

4.1 Decentralized Applications

Decentralized applications (often called Dapps) are the applications which with the help of smart contracts are deployed to the blockchain. Once deployed, it connects the users and providers directly. Deploying a decentralized application to the blockchain is similar to deploying the application to a ”Decentralized app store” where anyone can publish their applications. Unlike traditional applications, it does not require the mediator to function or to manage the user’s personal information.

There are three types of applications that can be built on the top of Ethereum [9] which are:

- Financial Applications
- Semi-financial Applications
- Governance Applications

Financial applications are the applications which provide the users with the ways to manage and interact with the contracts using their money whereas Semi-financial applications also have money involved but a heavy non-monetary side is present as well.

Governance Applications are the applications where voting and decentralized governance comes into play instead of finance.

Decentralized applications are resistant to censorship as they can not be taken down. Dapps are similar to usual web applications and the front end of the application uses the same technologies to render the application. The main difference between the conventional web applications and Dapps is that instead of an API connecting to a database, smart contract connects with the blockchain. The backend code is running on a decentralized P2P network. All of the Dapps consist of the whole package, in other words the frontend and the backend where the smart contract is one of the parts of the Dapp.

4.2 Smart Contracts

The term ”Smart Contracts” was introduced by a renowned cryptographer named Nick Szabo in 1994 [10]. A smart contract is also called as a crypto contract. It is an actually a computer program that overlooks the transfer of assets or digital currencies between two or more parties under certain conditions. It can also include certain rules and penalties related to an agreement just like a traditional contract. Furthermore, a smart contract can automatically enforce the terms and conditions.

The use of smart contracts is extensive in modern era blockchains and Ethereum is one of those blockchains. The blockchain is considered as an ideal platform to host smart contracts because of properties such as security and immutability provided by blockchain. The data inside the smart contract is encrypted on a blockchain; hence, making it impossible to lose data which is being stored in the blocks.

One of the main advantages of using smart contracts is that it eliminates the need for a third party being involved in the contract execution. This is because the code or logic inside the smart contract is executed automatically by the network. Since the execution process is automated, it increases the speed of transactions and eliminates the risk of anything getting changed or deleted. It also eliminates the cheating factor as all the rules and penalties are already defined in the contract and that makes it certain that none of the two or more parties are at risk while carrying out their desired business.

5 Crowdfunding on Ethereum Blockchain

Ethereum blockchain, by utilizing the power of smart contracts, provides an efficient alternative to existing traditional crowdfunding platforms. The first step in order to create a successful crowdfunding platform is to identify the disadvantages present in the existing platforms and then handle those scenarios in the smart contract. When the requirements for the smart contract are identified and implemented, the contract is then deployed to Ethereum blockchain where the general public can then interact with it and contribute.

5.1 Advantages of Utilizing Blockchain Technology

Holding a crowdfunding campaign on Ethereum blockchain can benefit the educational and technological researchers in several ways. The main advantage is that they will be the in charge of the whole crowdfunding process: hence, giving them the complete power instead of having a mediator in between. Furthermore, all the transactions which will be carried out during the crowdfunding process will be available publicly and can be audited. This way the contributors can keep track of the development process and make sure that their funds are being used responsibly. This process will eliminate the trust issues between the initiator and the contributors. Another advantage is that the operational cost of the whole crowdfunding process will be significantly low when compared with traditional crowdfunding platforms.

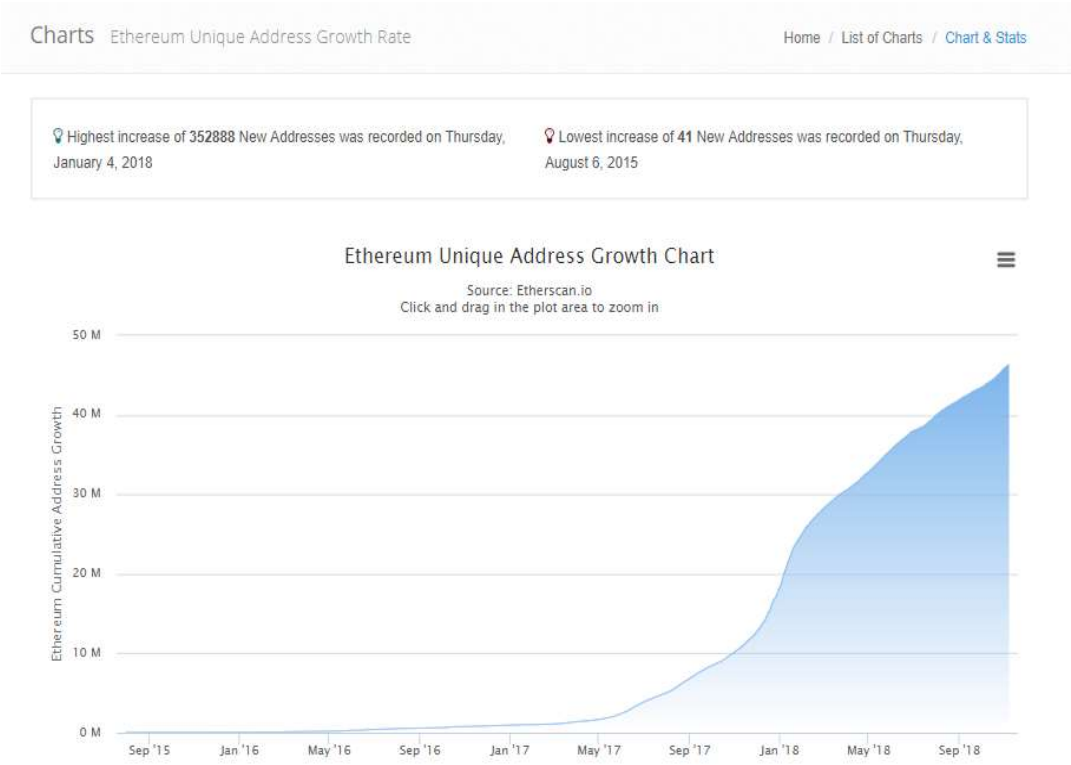

Figure 3. Number of Ethereum addresses created on Ethereum blockchain [11]

The user base of Ethereum network has been on a rise since its inception. As of today, more than 46 million Ethereum active addresses are available as illustrated in Figure 3. Since blockchain is still in its infancy stage and the general public is yet to be exposed to it, it provides an opportunity for the developers to tap this hidden market and generate steady revenue.

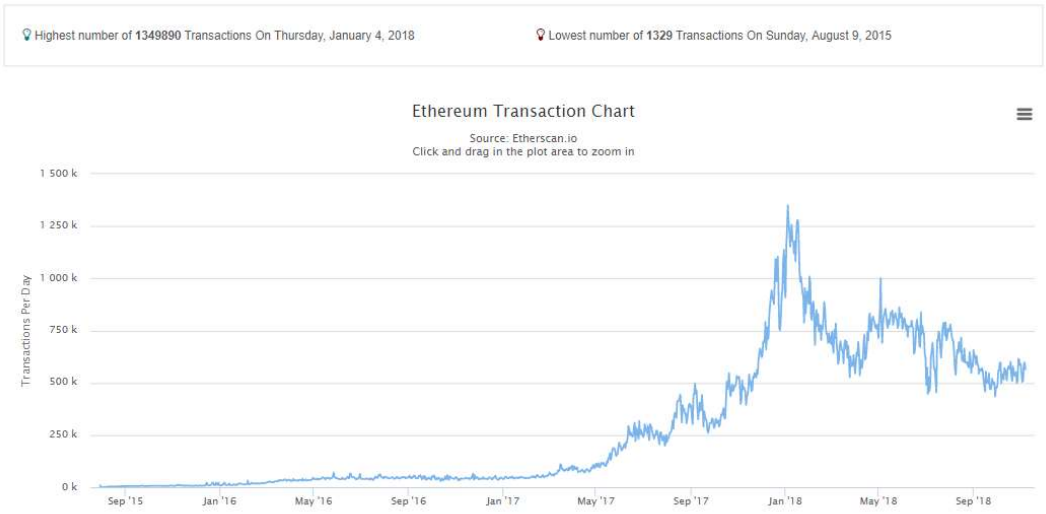

Figure 4. Growth of transactions carried out on Ethereum blockchain [12]

On par with the growth of the number of accounts being created on Ethereum blockchain, the number of transactions has steadily increased to a reasonable number as illustrated in Figure 4. The rise in the number of transactions depicts the user interest in the platform.

5.2 Disadvantages of Utilizing Blockchain Technology

There are several benefits of using blockchain for the purpose of obtaining funds. However, there are some disadvantages as well. One of the main disadvantages is that the users can only use the tokens native to the Ethereum blockchain such as ”Ether” and ”Tether”. The contributors cannot use any traditional currencies such as ”Euros” and ”Dollars”.

If there is a project which requires privacy, then deploying that project on Ethereum blockchain is not ideal. This is because all the transactions that are carried out on Blockchain are visible to the general public. Since the data will be available to the public, it will create privacy issues for the initiator of the project and the contributors.

Another disadvantage is that the Ethereum is still in its infancy stage and goes through volatility all the time. For example, if a contributor contributes a single Ether which is worth 300€, and after a couple of minutes the price fluctuates, the current price might

be 290€ which affects the total amount raised. However, this issue can be resolved by immediately converting the ”Ether” to a stable currency such as ”Tether” which is pegged to 1-1 ratio with US dollars.

In addition to the above issues, Ethereum platform can some time get clogged for a small duration of time due to thousands of transactions in the queue at the peak hour. However, the queue gets processed in a couple of hours but creates issues for its users.

6 Decentralized Research Funding Application Design

The most important element in the creation of a decentralized research funding application is the design of the smart contract and the public visibility of the whole funding process. There are several existing crowdfunding applications which are operating at the moment with millions of registered users but the Ethereum platform provides us with almost endless possibilities to handle the crowdfunding process. In the same way, the Etherum platform provides the users with its native security features which makes it almost impossible to hack if handled properly.

6.1 Requirements of Minimum Viable Product

The existing crowdfunding platforms, even flawed, provides the users with a very user-friendly and robust interface to interact with their platforms. Users can easily register and create a funding campaign in a matter of minutes. It should be made sure that the application which is going to be built to interact with the smart contract which is deployed on the blockchain should be user-friendly. The following requirements must be fulfilled in order to deliver a Minimum Viable Product:

- The user should be able to create a funding campaign for their project.
- The user should be able to specify the minimum amount of contribution allowed to be received by the smart contract.
- The user should be able to deploy the campaign to Ethereum blockchain.

- Initiator and the contributors should be able to create Ethereum addresses using Metamask wallet.
- The user should be able to see the information about the campaign in the UI.
- The user should be able to contribute funds to an available campaign.
- The user should be able to use hardware wallet to save the raised funds.
- The user should be able to send the raised funds to another address.
- The user should be able to track each and every transaction occurred during the fundraising process.
- The user should be able to create a funds withdrawal request.
- The user should be able to approve the fund withdrawal request.
- The user should be able to provide funding information to tax authorities for audit purpose

6.2 Descoped Requirements

The following features were dropped in order to be able to focus on the most viable features. However, these features will be scheduled for future development plans in an upcoming release.

- Production ready platform
  - Robust with 0% downtime.
  - Automated tests for frontend components to avoid regression
- Implementation of Know Your Customer (KYC) measures

- Ability to contribute using cryptocurrencies other than Ethereum based native tokens

- Ability to contribute using FIAT currencies

Once the requirements scope was frozen, the development of the application was initiated by following the Waterfall software development model.

7 Decentralized Research Funding Application Implementation

7.1 Version Control System

The first step before starting the implementation of the Decentralized Research Funding Application was to select an appropriate version control system. A version control system is a computer program which tracks the changes made by a user to a file(s) and helps coordinate workflow within teams of several people working on those file(s). Git, one of the most popular version control system was created by Linus Torvalds to support Linux kernel development [13]. For the development of the application, Git was selected as the version control system.

7.2 Version Control System Hosting Service

The application was hosted on Github, which is a very popular Git version control system hosting service. Github is one of the largest source code hosting service with more than 31 million registered users and more than 96 million repositories [14]. It offers its users the services like issue tracking, collaboration tools and several other beneficial features due to which this platform was selected as a hosting service for the Git version control system.

7.3 Choice of Programming Languages and Frameworks

In order to develop an application in a compact and an efficient way, software developers use libraries and Software Development Kits. This also allows them to prevent reinventing the wheel and to build upon what is already available. There are three major components of this application which are:

- Front end
- Smart Contract
- Testing Code

The front end of the application makes use of HTML, CSS, and Javascript along with React, Node.js and Next.js. The Smart contract was written in Solidity which is an Object Oriented Programming Language and is quite similar to Javascript. Once the smart contract is compiled using the solidity compiler, it generates JSON files when are then later used to interact with the smart contract through frontend components. The testing code makes use of Truffle wallet and Mocha test framework to make sure that the crowdfunding process remains regression free.

7.4 Smart Contract Deployment

The smart contract includes all the methods which are required to interact with the contract once it is deployed to Ethereum blockchain. Once deployed, the deployment status of the smart contract can be verified by finding the smart contract on the blockchain explorer as can be seen in Figure 5.

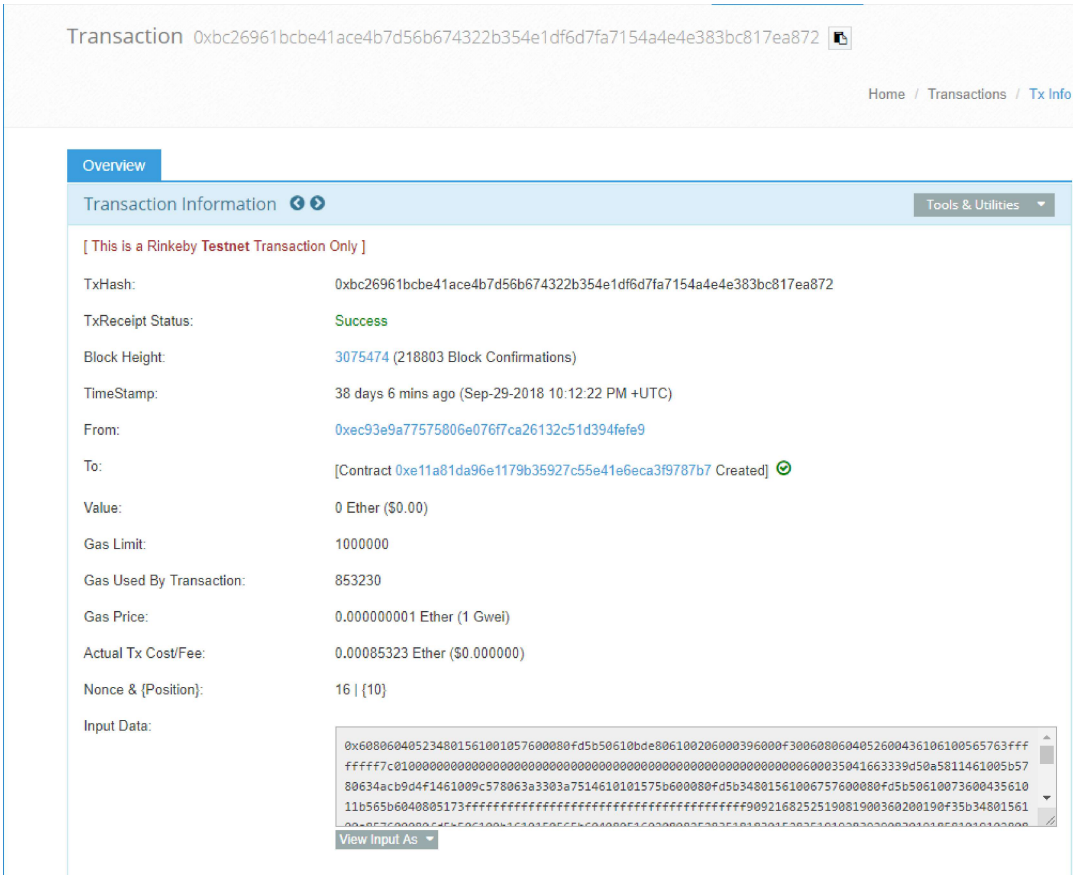

Figure 5. Deployment of smart contract to ethereum blockchain

The smart contract above was deployed using the initiator's Ethereum address which is "0xEc93E9a77575806e076F7CA26132C51d394FefE9" and is named as "Researcher" for readability. The following methods are available inside the smart contract to interact with through frontend components:

- contribute()

  The contribute method is called by a user who is willing to contribute to the funding campaign.

- initiateRequest()

  The initiateRequest method is called when the initiator wants to get a request approved by the contributors

- approveRequest()

  The approveRequest method is called by the contributors if they think that the request which is being made by the initiator is valid.

- confirmRequest()

  The confirmRequest method is called by the initiator when the request created gets approved by the contributors. The funds are released at this point.

- RequestCount()

  The RequestCount method returns the number of requests available for the funding campaign

- getProperties()

  The getProperties method returns the basic information about the funding campaign.

7.5 Funding Campaign Deployment

The first step in order to start the fundraiser interacting with the smart contract is to create an Ethereum address for the ”Contributor” and the ”Seller”. A contributor is a person who will donate to the funding campaign created by the Researcher. Whereas, ”Seller” is the person who will sell the research equipment to the Researcher so that Researcher can continue his research. The addresses can be created through the metamask application which is directly connected to the Ethereum blockchain as seen in Figure 6.

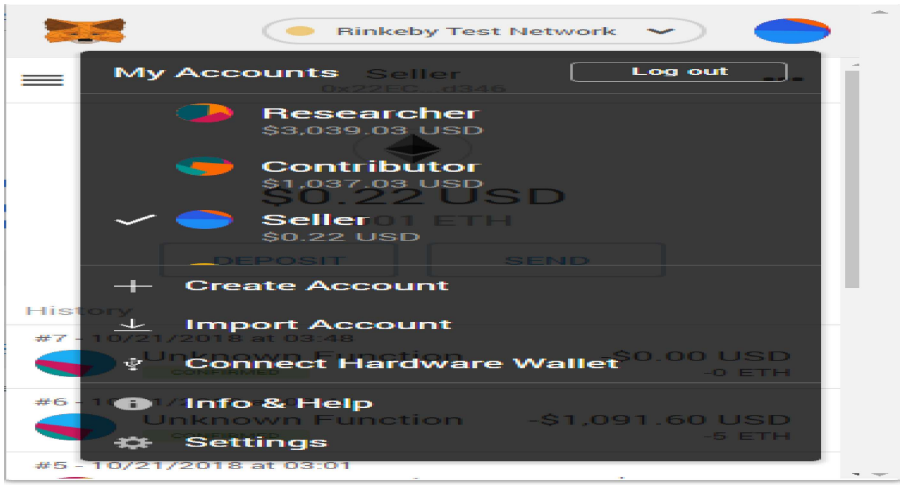

Figure 6. Creating new address using Metamask application

Once the addresses get created, the Researcher will create a funding campaign for his project and at the same deploy it to the Ethereum blockchain as illustrated in Figure 7.

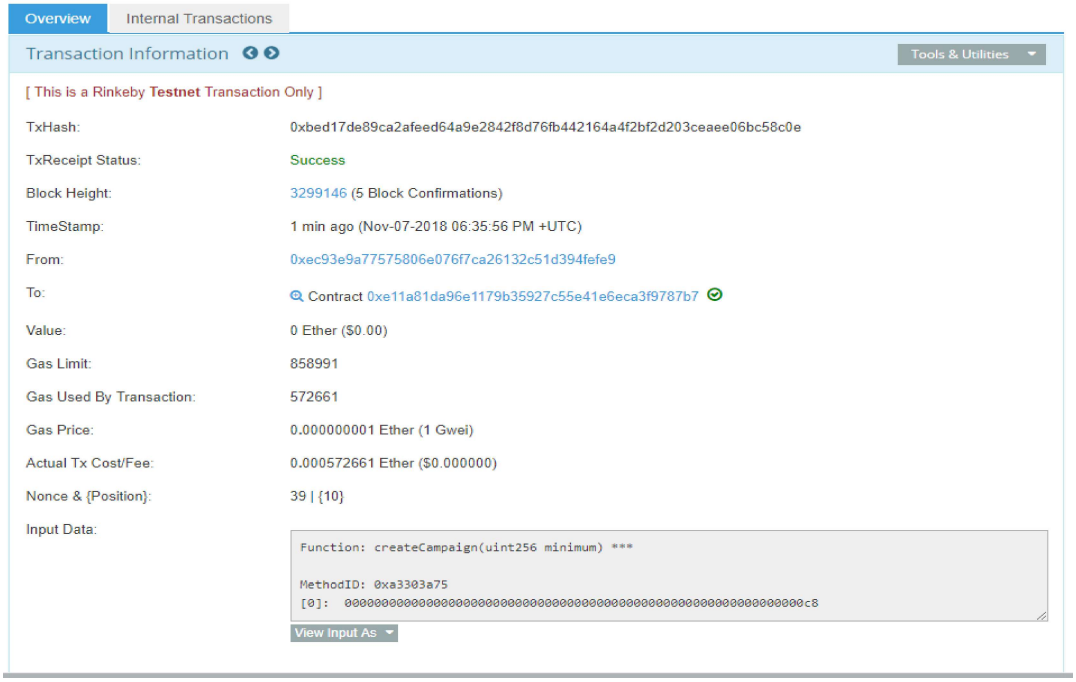

Figure 7. Deployment of funding campaign to Ethereum blockchain

At this stage, the funding campaign is completely functional, and contributors can contribute funds towards the campaign which are then stored inside the smart contract. However, the researcher can not contribute to the same funding campaign. Another user with a unique Ethereum address is required to contribute to the funding campaign.

8 Contribution and Withdrawal Process

8.1 Sending Funds to the Campaign

Anyone except the creator of the funding campaign can contribute to the funding campaign. In order to do so, the user must use the Metamask extension and switch to the desired address with funds intended for the contribution purpose. Once the correct account is selected in the Metamask extension, the user can contribute towards the funding campaign created by the researcher as illustrated in Figure 8.

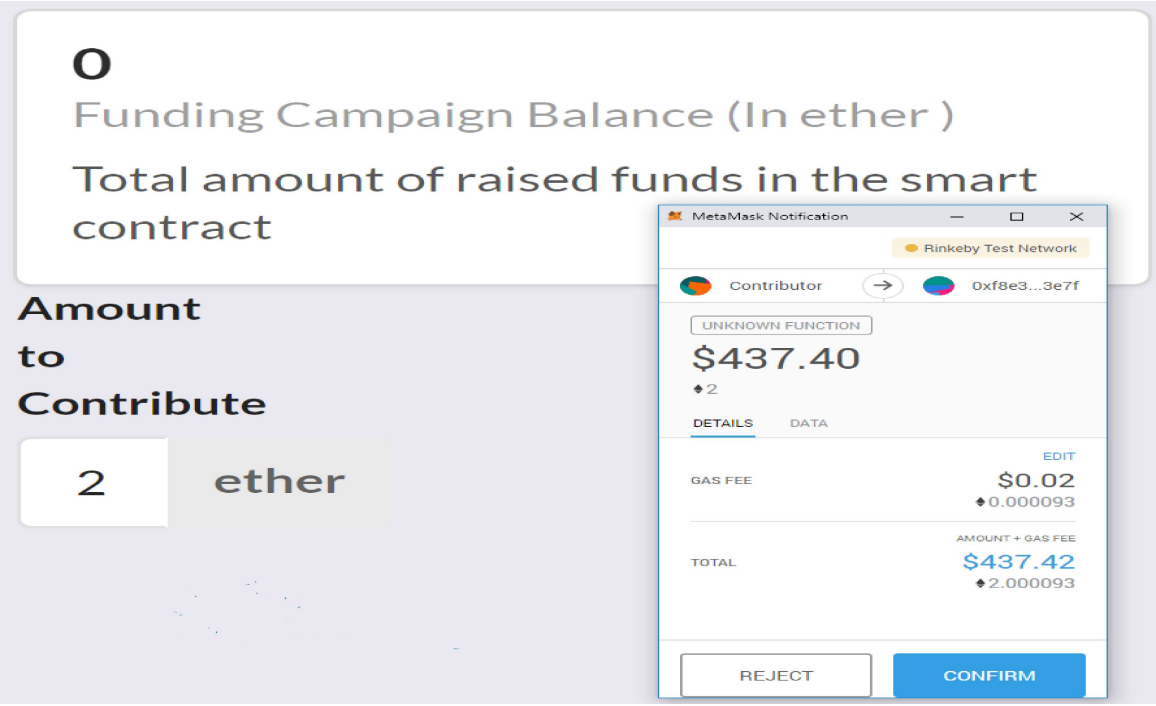

Figure 8. Sending a contribution to the funding campaign

At this point, the smart contract holds the amount sent by the contributor which can be verified through the smart contract as shown in Figure 9.

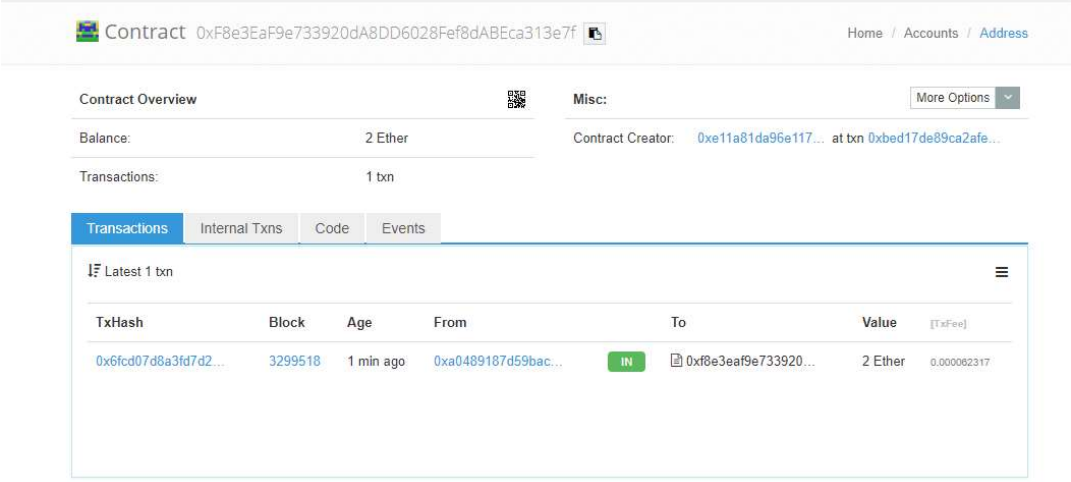

Figure 9. The balance inside the smart contract

The funds inside the smart contract cannot be used by the researcher as they are locked unless the contributor or several contributors allow the researcher to withdraw funds after verifying the withdrawal request.

8.2 Funds Withdrawal Request

Once the Researcher account is selected in the Metamask wallet, the researcher can create a request to withdraw funds from the smart contract for a specific purpose. The researcher must specify the reason for which funds are needed along with the total amount of funds needed. In addition, the recipient address must be provided so that the funds can be dispatched to that address if approved by the contributors as illustrated in Figure 10.

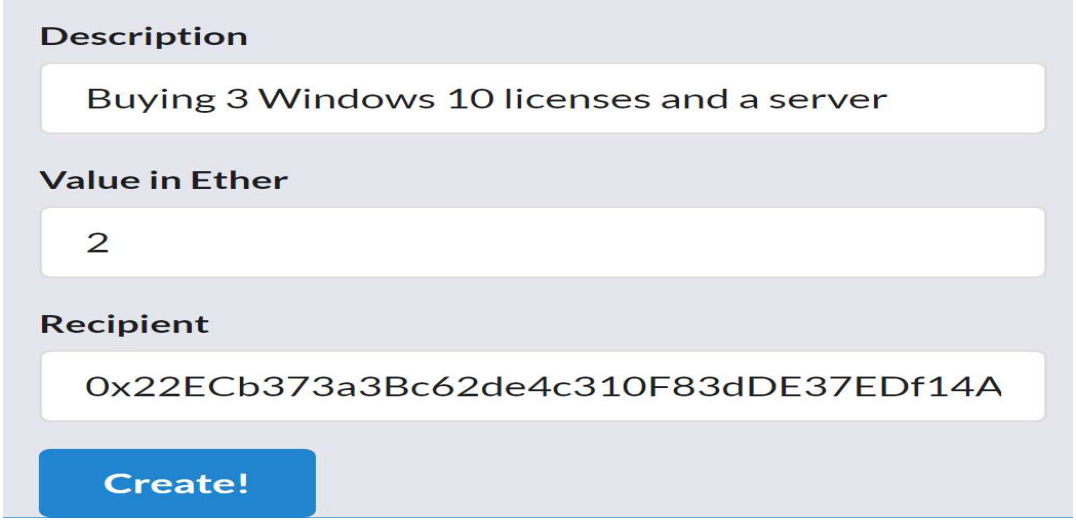

Figure 10. Creation of funds withdrawal request

The same request gets recorded on blockchain and can be illustrated in Figure 11.

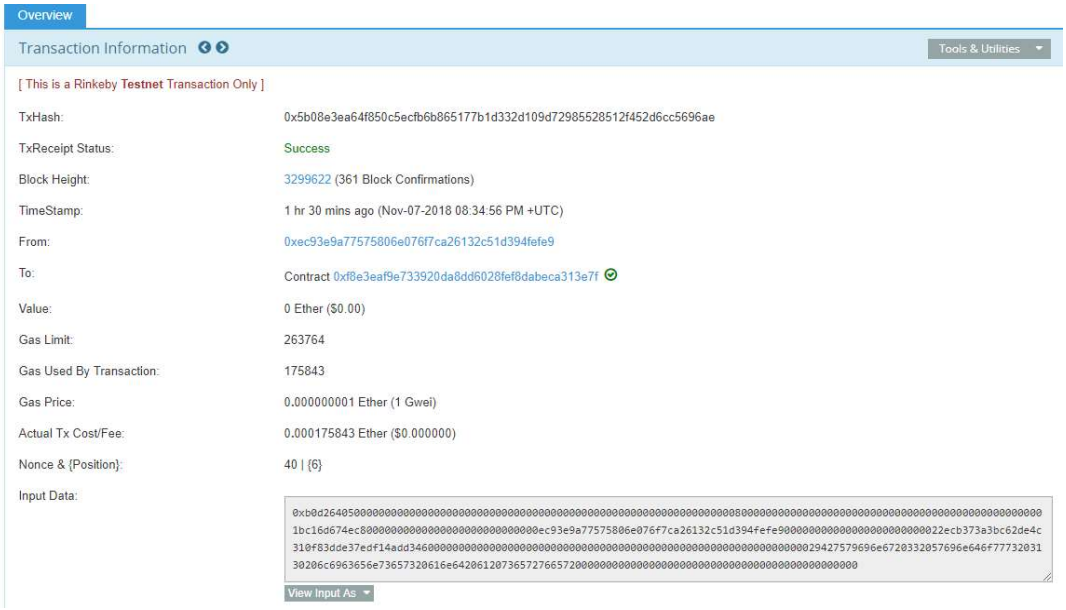

Figure 11. Funds withdrawal request on ethereum blockchain

The fund's withdrawal request is visible to the contributors and this step makes sure that the contributors audit the withdrawal request. If the details inside the request are suspicious, the contributors can exercise their voting power and reject the request. This process creates a relationship of trust between the initiator and the contributors by giving both of the parties the power to effectively play their roles.

8.3 Withdrawal Request Confirmation

When the fund's withdrawal request is finalized and submitted, the request is visible to the contributors for audit and approval. If the details present inside the withdrawal request are satisfactory and within the scope of the project, it can be approved as can be viewed in Figure 12.

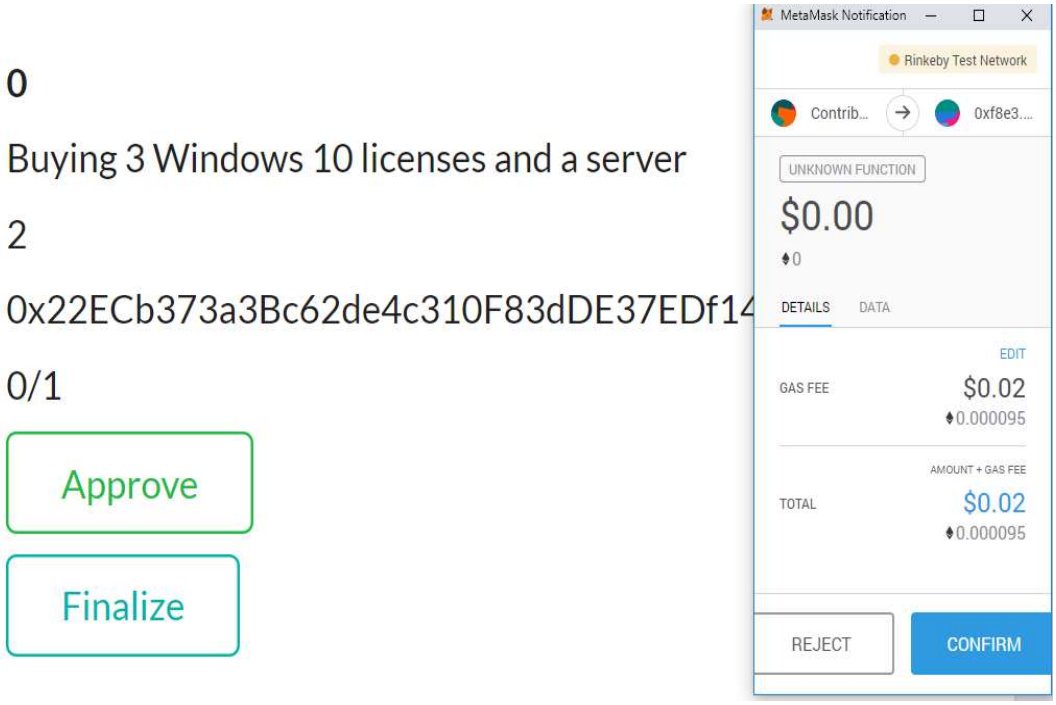

Figure 12. Approving a funds withdrawal request

The fund's withdrawal request can furthermore be viewed on Ethereum blockchain as illustrated in Figure 13.

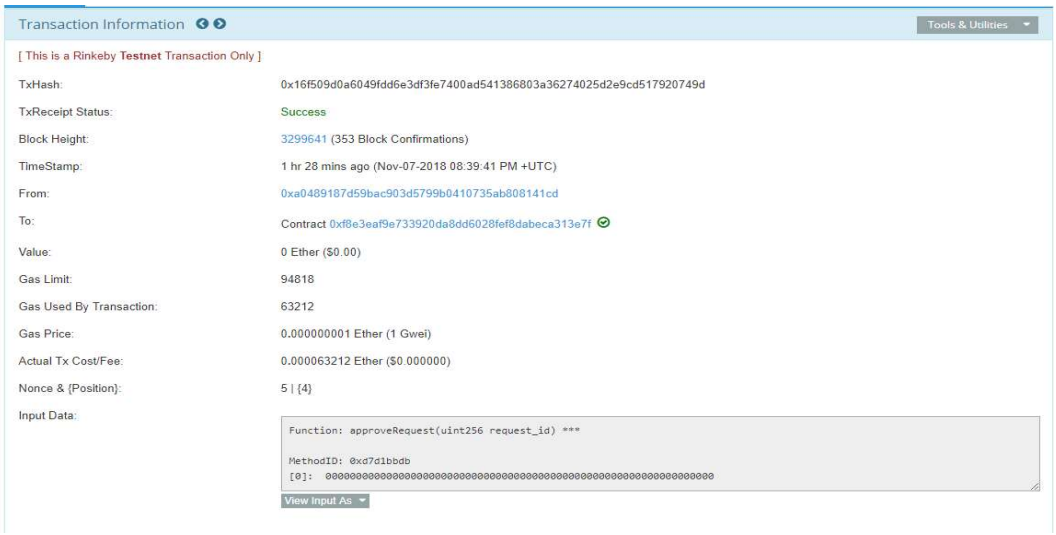

Figure 13. Withdrawal request approval on Ethereum blockchain

Each request takes almost 30 seconds to be processed on the blockchain. Furthermore, each block requires several confirmations or endorsements before it gets added to the blockchain.

8.4 Finalizing the Withdrawal Request

Once the withdrawal request has been approved by the contributors, the researcher can finally approve the whole funding process which results in the release of funds to the seller. This process can be visualized in Figure 14.

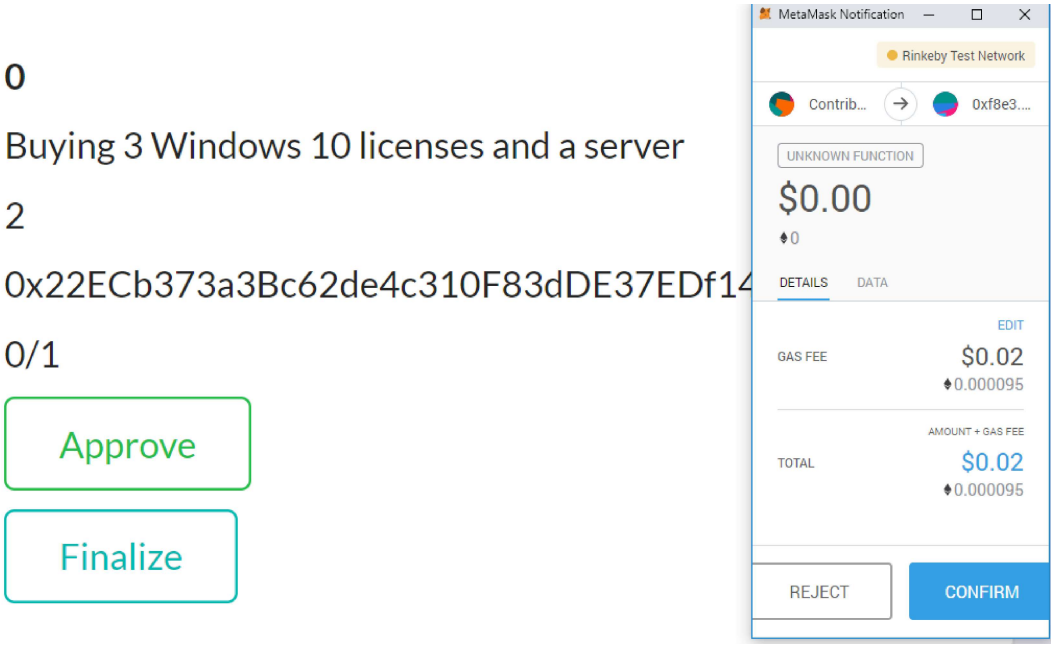

Figure 14. Finalizing the withdrawal request

This step allows the researcher to once again cross verify everything before the funds are actually dispatched to the third party seller because once the funds are released, there is no way to reverse the transaction.

8.5 Release of Funds

Once approved, the funds are ready to be released to the seller for the purchase of software licenses and the server as specified in the withdrawal request. The last step is to get the request finalized by the researcher to dispatch the funds as illustrated in Figure 15 and Figure 16

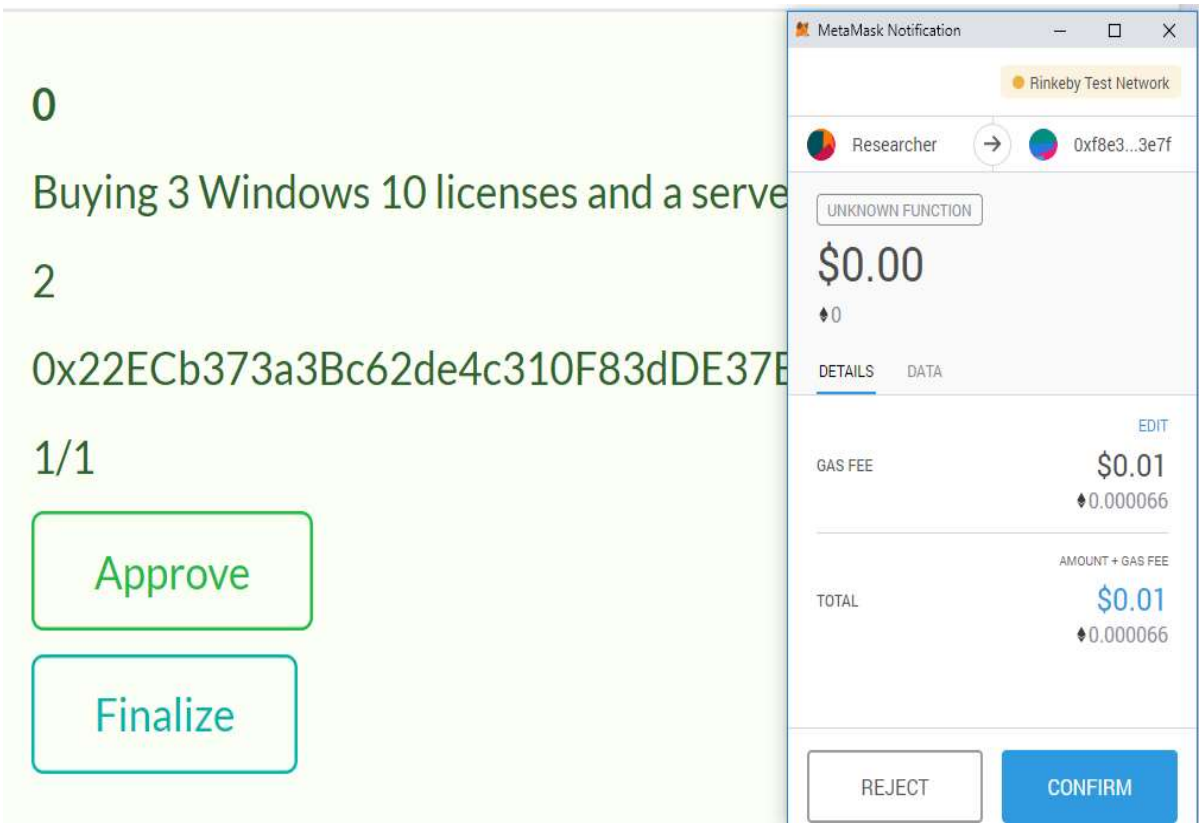

Figure 15. Finalizing the funds withdrawal request

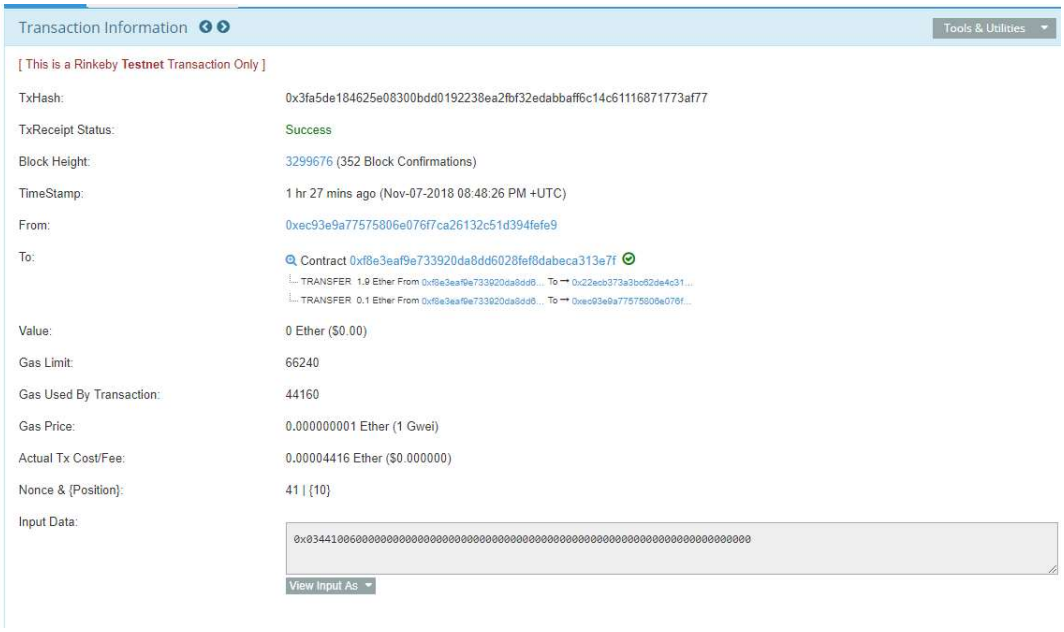

Figure 16. Finalizing the funds withdrawal request on Ethereum blockchain

Once the fund's withdrawal request is finalized, the funds are dispatched to the seller where those funds can be utilized to buy the necessary equipment and software licenses in order to proceed further with the product development to help deliver the final product to the contributors.

8.6 Verification of Funds Delivery

The dispatched funds are received by the seller inside the Ethereum address which was provided inside the fund's withdrawal request. The balance of the account can be verified by searching for the Ethereum address in the blockchain explorer as illustrated in Figure 17.

Figure 17. Verification of funds available in the seller's account

The delivery of funds confirms that the whole funding process was a success and the funds were successfully raised in a compact and an efficient way using non-traditional crowdfunding platforms.

9 Results and Discussion

This section summarizes the results of the project and then compares them with the initially proposed requirements. Furthermore, the problems encountered during the implementation as well as the sought solutions will be reviewed and discussed.

9.1 Project Outcome Summary

The result of the project is a functional decentralized research funding application platform which allows the researchers to create their own funding campaigns. Instead of using the traditional crowdfunding platforms, users can deploy their funding campaign contracts on Ethereum blockchain. Once the smart contract is deployed, the contributors can interact with the smart contract code using the frontend components.

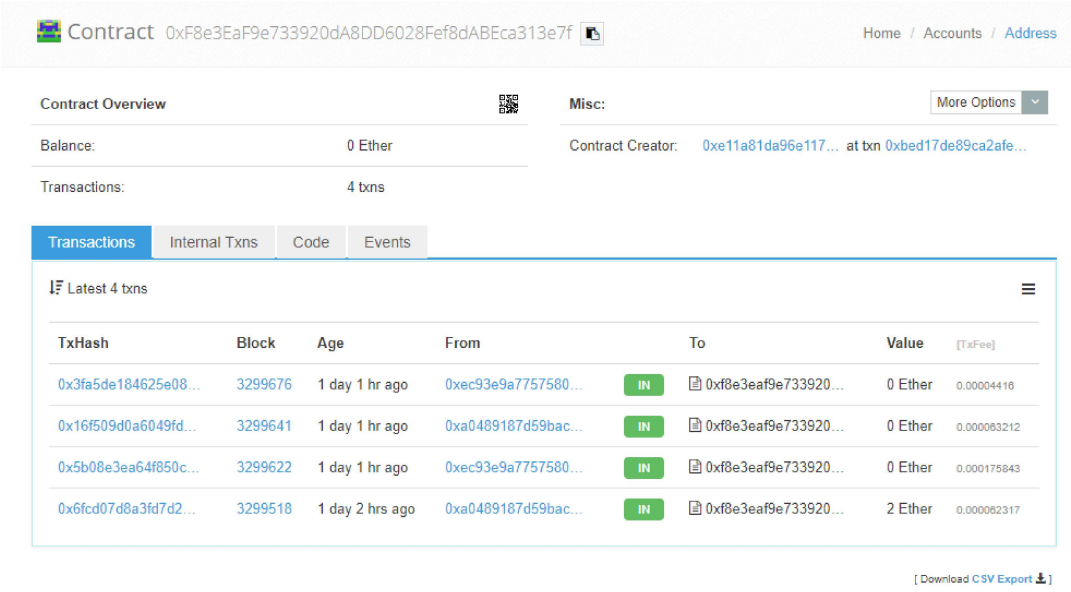

Figure 18. Transactions related to funding process

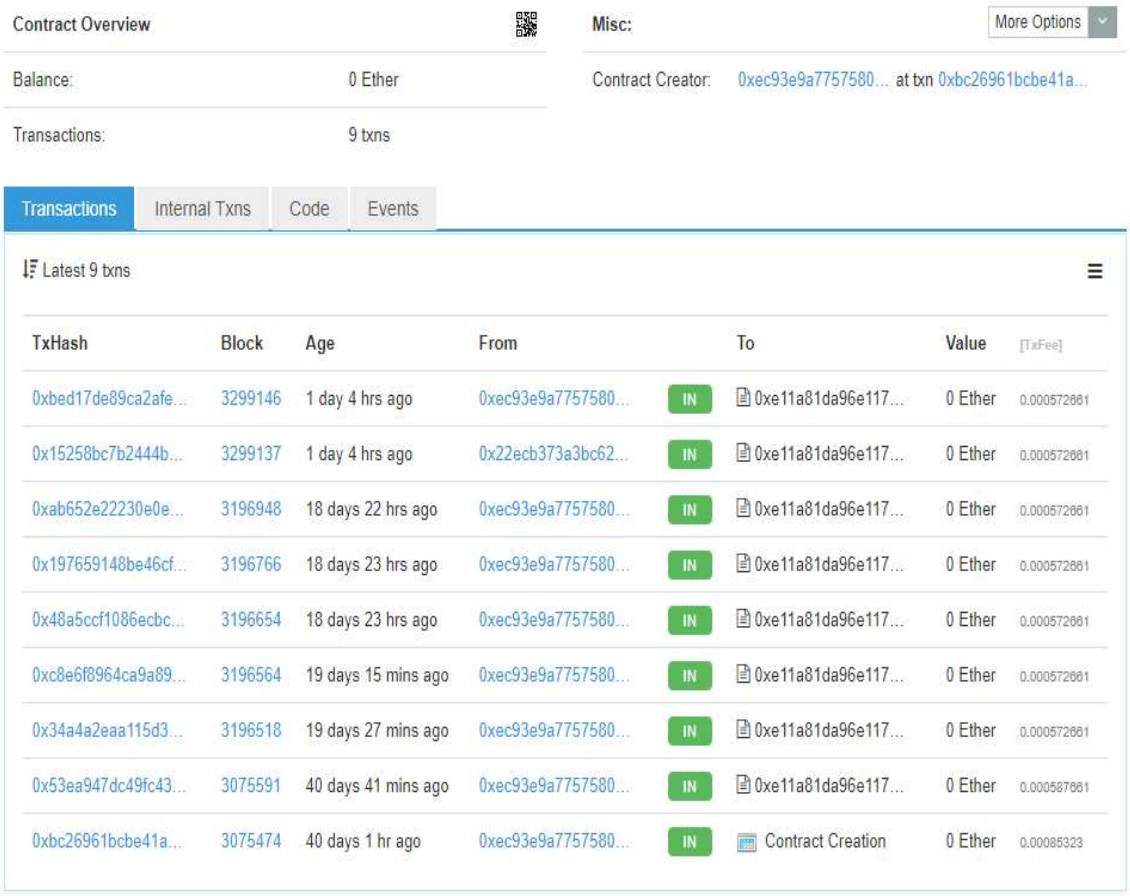

Figure 19. Contract creation and method invocation transactions

All of the transactions that are carried out during the funding process are available to the public as illustrated in Figure 18 and Figure 19. The transactions can be audited by the contributors or the tax authorities to avoid any sort of legal and trust issues.

Furthermore, the cost of the whole funding process is less when compared with traditional crowdfunding platforms which allow the researchers to efficiently manage their project by utilizing the raised funds in a compact and robust way.

9.2 Development Challenges

One of the main challenges faced during the project development process was to learn the Solidity programming language. Since the Ethereum platform is still in its infancy stage, the documentation and developer support is quite poor. It was difficult to find a solution to the problems faced during the development process.

Furthermore, each transaction on Ethereum blockchain takes almost 30 seconds to be confirmed. This delay resulted in several hours consumed during the development and testing phase. Since there was no workaround to handle this issue, frontend had to handle the delays.

Given the immaturity of the already developed libraries and frameworks available to develop decentralized applications on Ethereum blockchain, the choice of implementation features needs to be taken with care. However, over time, the blockchain development resources will improve as more and more developers will develop around this eco-system and the immaturity will decrease over time. The native language of Ethereum blockchain known as ”Solidity” is being improved day by day and the support for the language is increasing along with it. Since it is an open source project, the developer community is contributing by creating proper documentation and general improvements along with several bug fixes.

In the end, all of the encountered problems were solved in order to deliver the minimum viable product which allows the user to create and interact with the funding smart contract in order to achieve their desired goal. Challenging tasks were solved by identifying the underlying problems and then dealing with them in an organized way.

10 Conclusion

The goal of this thesis was to develop a minimal viable product to help educational and technological researchers to raise funds for their idea or project in a compact and efficient way while maintaining the transparency of the fund's usage between the initiator and the contributors during the whole development process.

Over the course of this thesis, it was concluded that by utilizing the blockchain technology, the goal of obtaining transparency between the initiator and the contributors was achievable. Furthermore, by holding the funding event on the Ethereum blockchain, the cost of the funding process was reduced, and the funding process time was reduced greatly.

In short, a working decentralized research funding application was developed and successfully deployed to the Ethereum network. Users were able to create and deploy a copy of the smart contract to Ethereum blockchain using their local machines and the interested contributors were able to contribute to that campaign in an organized manner.

In addition, during the development of the application, additional functionality was introduced in the smart contract which allows the creator of the application a flat fee for each request generated. That fee will be used to maintain the product in the future by implementing new features.

Furthermore, valuable feedback was obtained during the user meetings regarding the platform usage. The feedback was recorded, and those suggestions will be reflected in the future version of the application.

Nevertheless, in the end, the development process was completed successfully with a pleasant and satisfying outcome. Even though most of the features are provided in the current release and serve the purpose, the next version will be released to the public in 2019.

References

1. Endrit Kromidha. A Comparative Analysis of Online Crowdfunding Platforms in USA, Europe and Asia. 25 March 2018; Page 1. IEEE Electorinic Library URL: https://ieeexplore-ieee-org.ezproxy.metropolia.fi/stamp/stamp.jsp?tp=&arnumber=7441070 (accessed 08 November 2018)

2. Clive Reffell. Top 10 US Crowdfunding Platforms (Reward and Equity). URL: https://crowdsourcingweek.com/blog/top-10-usa-crowdfunding-platforms/ (accessed 08 November 2018).

3. What is Bitcoin?. URL: https://bitcoin.org/en/faq#how-does-bitcoin-work (accessed 08 November 2018)

4. Peter Kovary, Fangyi Zhou, Mark Adoul. Blockchains: Technical Details. URL: http://www.doc.ic.ac.uk/~ma7614/topics_website/tech.html (Accessed 08 November 2018).

5. Praveen Jayachandran. Differences between public and private blockchains URL: https://www.ibm.com/blogs/blockchain/2017/05/the-difference-between-public-and-private-blockchain/ (accessed 08 November 2018)

6. Addy Yeow. Global Bitcoin Nodes Distribution. URL: https://bitnodes.earn.com/ (accessed 08 November 2018)

7. Ethernodes.org – The ethereum node explorer. URL: https://www.ethernodes.org/network/1 (accessed 08 November 2018)

8. Ethereum Project.

   URL: https://www.ethereum.org/foundation (accessed 08 November 2018)

9. What is a dApp? Decentralized Application on the Blockchain. URL: https://blockchainhub.net/decentralized-applications-dapps/ (accessed 08 November 2018)

10. K. Christidis, Michael Devetsikiotis. Blockchains and Smart Contracts for the Internet of Things. 10 May 2016; Page 2296. IEEE Electorinic Library URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7467408 (accessed 08 November 2018)

11. Ethereum Unique Address Growth Chart. URL: https://etherscan.io/chart/address (accessed 08 November 2018)

12. Ethereum Transactions Growth Chart.
URL: https://etherscan.io/chart/tx (accessed 08 November 2018)

13. Git – A Short History of Git.
URL:https://git-scm.com/book/en/v2/Getting-Started-A-Short-History-of-Git (accessed 08 November 2018)

14. The State of the Octoverse | The State of the Octoverse reflects on 2018 so far, teamwork across time zones, and 1.1 billion contributions.
URL: https://octoverse.github.com/ (accessed 08 November 2018)