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FINANCIAL BASED UNIVERSITY TOKEN WITH ETHEREUM REQUEST FOR COMMENT SMART CONTRACT

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ABSTRACT

The advancement of digital transformation has also obviously prompted the birth of fintech (financial technology) efforts, which are often regarded as some of the most significant developments in the financial industry. However, research in the subject of fintech is still in its early stages. Fintech services include funding, payment (including electronic wallets).

INTRODUCTION

Financial Technology, or FinTech for short, is the digitization of financial services normally provided by banks, credit card companies, credit unions, investment banking and other businesses within the finance industry (Wilson, 2019). The term "fintech" refers to new technology that aims to enhance and automate the delivery and usage of financial services. Fintech, at its heart, is used to assist corporations, company owners, and individuals better manage their financial operations, procedures, and lifestyles via the use of specialized software and algorithms that are run on computers and, increasingly, smartphones (Vincent & Evans 2019).

Financial technology has grown explosively since the internet revolution and the mobile internet/smartphone revolution, and fintech, which originally referred to computer technology applied to the back office of banks or trading firms, now refers to a wide range of technological interventions into personal and commercial finance (Treiblmaier *et al*,. 2020). Fintech currently refers to a variety of financial operations that may be done

e-aggregators, e-trading, and e-insurance, as well as cryptocurrencies like Bitcoin, Ethereum and the upcoming trend in the establishment of the MetaVerse or NFTs(Non-fungible token). This study aims at: showing the current trends in fintech, its strength, application, and weakness and developing Financial Based University Token using "react javascript toolkit" for constructing a simple token wallet for token transfer with the help of the "Metamask". The study was able to achieve a high success rate during implementation by generating token and connecting to major wallets such as Binance and Trust wallet.

Keywords: bitcoin, blockchain, cryptocurrency, ethereum, financial, technology, university

without the help of a human, such as money transfers, depositing a check with your smartphone, bypassing a bank office to apply for credit, seeking funds for a company beginning, or monitoring your investments.(Searing & Macleod, 2019).
Blockchain technology, which includes Ethereum, is a distributed ledger technology (DLT) that keeps track of transactions over a network of computers but does not have a central ledger. Smart contracts are computer programs that automatically execute contracts between buyers and sellers (typically using the blockchain).
Open banking is a blockchain-based idea that proposes that third-parties should have access to bank data in order to build apps that connect financial institutions and third party suppliers (Wang *et al*,. 2019). Mint, an all-in-one money management application, is an example of insurtech, which aims to simplify and streamline the insurance market using technology.

What is the ERC-20?
ERC stands for "Ethereum request for comment," and "request for comment" is a concept similar to that of the Internet Engineering Task Force for communicating important technical concerns and requirements to a community of developers and users (Milne*et al*., 2018). The term "ERC20" refers to the Ethereum blockchain's scripting standard. This technical standard specifies a set of rules and actions that an Ethereum token or smart contract must adhere to, as well as the steps

necessary to put them in place (Osterrieder& Lorenz, 2017). ERC20 may be thought of as a set of fundamental standards and functionalities that must be followed by each new token generated on the Ethereum network.

An ERC-20 token contract is defined by the contract's address and the total supply of tokens accessible to it, but it also contains a number of optional features that are typically offered to provide further detail to users. These are the token's name, symbol, and decimal number. For a long time, the ERC20 standard has been the most popular means to create new tokens in the cryptocurrency market. Thousands of different tokens have now been produced and are compliant with the ERC20 standard. While many ERC20 smart contracts are used to carry out various routines and activities in the digital world, several have also been utilized to produce non-fungible tokens (NFTs).

Key Elements of a Blockchain

a) **Distributed Ledger Technology:** All network participants have access to the distributed ledger and its immutable record of transactions. With this shared ledger, transactions are recorded only once, eliminating the duplication of effort that's typical of traditional business networks (Tama *et al.*, 2017).

b) **Immutable Records:** No participant can change or tamper with a transaction after it's been recorded to the shared ledger. If a transaction record includes an error, a new transaction must be added to reverse the error, and both transactions are then visible.

c) **Smart Contracts:** To speed transactions, a set of rules called a **smart contract** is stored on the block chain and executed automatically. A smart contract can define conditions for corporate bond transfers, include terms for travel insurance to be paid and much more.

How Blockchain Works

1. **As each transaction occurs, it is recorded as a "block" of data:** Those transactions show the movement of an asset that can be tangible (a product) or intangible (intellectual). The data block can record the information of your choice: who, what, when, where and how much.
2. **Each block is connected to the ones before and after it:** These blocks form a chain of data as an asset moves from place to place or ownership changes

hands. The blocks confirm the exact time and sequence of transactions, and the blocks link securely together to prevent any block from being altered or a block being inserted between two existing blocks.

3. **Transactions are blocked together in an irreversible chain:** Each additional block strengthens the verification of the previous block and hence the entire blockchain. This renders the blockchain tamper-evident, delivering the key strength of immutability. This removes the possibility of tampering by a malicious actor and builds a ledger of transactions you and other network members can trust.

Types of Blockchain Networks

1. **Public Blockchain Networks:** A public blockchain is one that anyone can join and participate in, such as Bitcoin. Drawbacks might include substantial computational power required, little or no privacy for transactions, and weak security. These are important considerations for enterprise use cases of blockchain.
2. **Private Blockchain networks**: A private blockchain network, similar to a public blockchain network, is a decentralized peer-to-peer network. However, one organization governs the network, controlling who is allowed to participate, execute a consensus protocol and maintain the shared ledger. Depending on the use case, this can significantly boost trust and confidence between participants. A private blockchain can be run behind a corporate firewall and even be hosted on premises (Duque, 2020).
3. **Permissioned blockchain networks**: Businesses who set up a private blockchain will generally set up a permissioned blockchain network. It is important to note that public blockchain networks can also be permissioned. This places restrictions on who is allowed to participate in the network and in what transactions (Hashemi et al., 2019). Participants need to obtain an invitation or permission to join.
4. **Consortium blockchains**: Multiple organizations can share the responsibilities of maintaining a blockchain. These pre-selected organizations determine who may submit transactions or access the data. A consortium blockchain is ideal for business when all participants need to be permissioned and have a shared responsibility for the blockchain. (Wei *et al*., 2019)

CRYPTOCURRENCY

A cryptocurrency is a digital or virtual currency that is secured by cryptography, which makes it nearly impossible to counterfeit or double-spend. Many cryptocurrencies are decentralized networks based on blockchain technology (Duque, 2020). Cryptocurrencies, according to (Wilson 2019), are a subset of digital currencies that may have centralized institutions or be based on a decentralized network. In a nutshell, cryptocurrencies are a new sort of currency (Duque, 2020) that is digital and generated by cryptographic algorithms and transferred over the Internet using protocols such as peer-to-peer networking (Karpan, 2019).

Another approach to explain cryptocurrencies is that they rely on complicated cryptographic algorithms to offer consumers with a secure and safe medium of trade (Bulut, 2018). The mining process, which is a collection of mathematical algorithms implemented inside the underlying protocol, governs the production of value (or money) and the triggering of transactions (Alam&Zameni, 2019).

LITERATURE REVIEW

Summary of Related Work

This section details a review of related work by categorizing the approaches used.

Table 1: Summary of related work

S/No.	Author(s) and Topic	Objectives	Methodology
1	Wei *et al.*, (2019). Decentralized Hierarchical Authorized payment with online Wallet	To conditionally measure the varied nature of crypto - currencies using several attributes.	Uses stochastic volatility model of Taylor (1986) to describe time varying nature of volatility to build a model in crytocurrency.
2	Raymaekers (2017). Cryptocurrency Bitcon: Disruption, challenges and opportunities	To develop historical and political understanding of bitcoin stack in the crypto market in	Conceptual paper proposing comparison between bitcoin (BTC) on the global

		relation with other developing coins of tokens.	currency regime and indicating its influence on the crypto market.
3	Dostov&Shust (2016). Cryptocurrencies Bitcoin: An unconventional challenge to Bitcoin(BTC) financial regulation.	To examine and argue whether what kinds of crytocurrency can be considered as a means of money	Conceptual paper arguing that, for all currencies, the object of coordination is exchanged on a relative scale to money.
4	Osterrieder& Lorenz (2017). A statistical risk assessment of Bitcoin and its extreme tail behavior	To measure an extreme value analysis of the returns of Bitcoin	In-depth empirical univariate extreme value analysis to compare the exchange rates with those of G10 currencies
5	Bulut (2018). Bitcoin as a complement to emerging market currencies.	To examine the use of Bitcoin as a complement to emerging market currencies.	Empirical study to evaluate the value and volatility of Bitcoin relative to emerging market currencies.
6	Hashemi *et al.,* (2019). Cryptocurrencies, A successful application of blockchain technology.	To identify conditions under which government transactions policy might deter the use of Bitcoin.	Uses a model with endogenous matching and random consumption preferences.

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7	Platanakis *et al*. (2018). Optimal vs. Naïve Diversification in cryptocurrencies.	To shed light on properties of the cryptocurrency market and establish a first formal link between ecological modeling and the study of this system 2013 to 2017.	Considers history and analyzes 1,469 cryptocurrencies from the crypto market and how their growth and influence affect the financial industry or commodity
8	Glaser &Bezzenberger (2017). Beyond cryptocurrency – A taxonomy of Decentralized consensus system	To review an agent-based artificial cryptocurrency market in which heterogeneous agents buy or sell cryptocurrencies, in particular Bitcoins.	Studies two types of typologies – random traders and chartists and proposes a model to produce real-time statistical properties of Bitcoin market.
9	Bouri, *et al*. (2017). On the Return-Volatility Relationship in the Bitcoin Market around the Price Crash	To examine whether Bitcoin can hedge global uncertainty.	Empirical study on decomposition of Bitcoin returns into various frequencies (i.e., investment horizons), using quintile-on-quintile regression in price.
10	Dorfleitner& Lung (2018). Cryptocurrencies from the Perspective of Euro Investors.	To identify the main determinants of crytocurrency price by means of rigorous evaluation to that of the Euro currency.	Evaluation using the ARDL bounds testing method in the Shanghai stock market.

11	Rehmanet *al*., (2019). Trust in Blockchaincryptocurrency Ecosystem.	To explore the effect of increased downloads of Bitcoin apps on specific countries	Collects rank data on all 15 Bitcoin apps and estimates the index of downloads for each country
12	Omane-Adjeponget *al*., (2019). Wavelet Time-Scale Persistence Analysis of Cryptocurrency Market Returns and Volatility.	To propose a reference architecture for adopting such a form of financial asset in a central banking scenario; i.e., Wavelet based time-scale to study the cryptocurrency market.	Provides insights on trends in cryptocurrency and proposes an IT solution to accommodate centrally issue electronic currency
13	Pournaderet *al*. (2020) Blockchain Application in supply chains, transport and logistics.	To review an agent-based artificial cryptocurrency market in which heterogeneous agents buy or sell cryptocurrencies supply, in particular Bitcoins.	Studies two types of typologies of supply and demand in random traders and chartists and proposes a model to produce realtime statistical properties of Bitcoin market
14	Auer (2019) Beyond the doomsday economic of proof of work in cryptocurrencies.	To examine the future of the proof of work mechanism, with respect to various considerations and how it can aid financial increase or	Discusses controversies relating to cryptocurrency's correlation with bankruptcies and thefts and political

		bring about the fall in cryptocurrencies that makes use of it functions	views of libertarians and socialists
15	Volosovych& Baraniuk (2018). Tax control of cryptocurrency transaction in Ukraine	To explore how structural changes in the of a Bitcoin accompanied with significant changes in the exchange price of other cryptocurriencies.	Construction of Principal component analysis of the matrix constructed for the network at different times to identify changes in Bitcoin price
16	Mendoza-Tello*et al.*, (2019). Disruptive Innovation of Cryptocurrencies in Consumer Acceptance and Trust. Information Systems and EBusiness Management.	To analyze Bitcoin using datasets to reconstruct the network of transactions of the crypto market in business management of a consumer wallet for necessary transaction.	Analysis of the structure of the transaction network by measuring network characteristics over time
17	Treiblmaier (2019). Combining Blockchain Technology and the Physical Internet to Achieve Triple Bottom Line Sustainability.	To evaluate whether Bitcoin / blockchain is complex system based on its likelihood to enter the 2010-Flash- Crash	Highlights relevant details of Bitcoin/blockchain using Crutchfield's statistical complexity

		type of chaotic regime measure.	
18	Charfeddine*et al.*, (2020). Investigating the Dynamic Relationship between Cryptocurrencies and Conventional Assets.	To analyze the use of blockchain for digitally enabling organizations	Study of Hainan Airlines (HNA) group that implements blockchain enabled e-commerce platform.
19	Garcia-Medina & Hernandez (2020). Network Analysis of Multivariate Transfer Entropy of Cryptocurrencies in Times of Turbulence	To explore how structural changes in the network accompany significant changes in the exchange price of cryptocurrencies.	Principal component analysis of the matrix constructed for the network at different times to identify changes in crypto currencies price.
20	Treiblmaier*et al.*, (2020) Blockchain as a Driver for Smart City Development.	To evaluate predictive performance of the volatility of three cryptocurrencies and three currencies	Combines traditional GARCH models with machine learning approach to volatility estimation using support.

The six fundamental code functions for ERC-20 token implementation are as follows:

Total supply: Total supply refers to the quantity of coins or tokens that are currently in circulation or are locked in some way. It is the number of tokens previously mined (or issued) minus the total of coins burnt or destroyed. As a result, the total supply comprises both the circulating supply and tokens

that have yet to be traded on the open market. For example, tokens that are subject to a lockup or vesting period following a private sale or Initial Coin Offering (ICO).The total quantity does not include coins or tokens that are eventually burnt.

Balance of: The number of tokens possessed by a specified address that is displayed. The balance of how the holder of a particular token define its total visibly balance in that specified wallet or address.

The balance reflects a value that the contract developer defines the token to be one token contract may use balances to represent actual items, another monetary value, and a third the holder's reputation.

Allowance: Allowance" or "Access permissions to tokens" is a term used to describe a set of parameters defined by a platform's programming. This is a rather frequent function in the realm of tokens, and it allows tokens to interact automatically (Alam&Zameni, 2019). Allowances, also known as access permissions, provide a third party the ability to transact a specified quantity of our tokens connected with our address. All of this without disclosing your address's private key.

Transfer: The transfer function sends tokens from the caller to another address. This isn't a perspective because it entails a state change. When a user invokes this function, a transaction is created that costs gas. It also emits an event called Transfer to notify everyone on the blockchain about the transaction.

Approve: Allows a spender (e.g., a user, a wallet, or other smart contracts) to withdraw an amount of tokens from the approver's token pool up to a certain limit. If this function is called again, the current allowance is overwritten with the new input value.

Transfer from: Allows the spender to actually transfer tokens from the approver to anyone they choose (importantly: not necessarily themselves).It is used to transfer tokens between users.

Design and Implementation of ERC-20

Pos.	Sender	Receiver	Function call
1	A	X	transfer(B, 3)
2	A	X	transfer(C, 7)
3	B	X	transfer(C, 2)
4	C	X	transfer(D, 4)

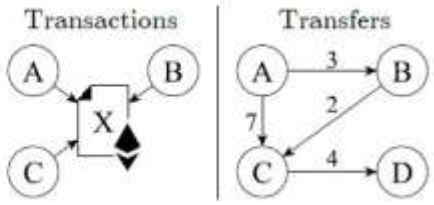

Figure 1: Showing the transfer methods from a sender A to receiver X (Milne*et al*., 2018).

To send tokens from address A to address B, the address A owner submits a transaction to token contract X, using its transfer function. If successful, the contract's balance for both addresses will be adjusted, resulting in a state change. Because balances may be affected by other functions added by the smart contract developer, the ERC20 standard suggests emitting a Transfer event log anytime a token transfer occurs. The link between transactions that call functions and emitted transfers is illustrated in Figure 1 (Milne*et al*., 2018).

These token transfers result in a network, with nodes connected by transfers. This graph may also include addresses that never interacted with the token contract: either during deployment or through a custom protocol. Initial balances, which the contract developer distributes to certain addresses when forming the contract, are a typical approach to connect tokens with specific addresses. Some developers have decided to transmit these allocations as transfer events, with the source address set to 0x0, although these balance allocations are not emitted as transfer events in most cases. Later standard proposals, such as ERC621, added Mint and Burn events to grow and reduce balances without needing any transfers (Tama*et al.,* 2017).

Benefits of Using ERC-20

There are various Ethereum token standards available, including

ERC20, ERC1400, ERC223, ERC721, ERC1203, ERC777, ERC827, and many more. However, the ERC20 token standard stands out among all of them and is highly suggested and encouraged for use, owing to the following prospective benefits:

- Easy usage - The traits of this token is user-friendly.
- Secured with a smart contract - To ensure the security measures, smart contracts are default developed with this token.
- Deployed with wallet - The cryptocurrency wallet is deployed with it to store and assure the token safety.
- Automatic Transaction - Because on the terms of the contract, once it's done then currencies or assets are automatically transferred to the crypto wallet.

- Quick fundraising - Because of its gained trustworthiness in the crypto world, many peoples will be pleased and excited to invest.
- Cost-Effective - The Token is a very cost-effective one while comparing to the

Crypto coin creation.

- Stateless and Scalable - The tokens can be stateless as well as scalable one as per authorized person need or request.
- Security - The tokens are always secured to use and it is highly secured with the usage of private keys.
- Extensibility - The tokens can be upgraded as required.
- Multiple platforms and domains - Tokens can be used in multiple platforms as well as in various domains.
- Standard Based - All token has some standard based on their native blockchain.
- Flexible - The token usage and upgrading version types can be flexible as much as possible.

Algorithm Steps for Transaction

1. Create wallet or Register wallet on MetaMask
2. Connect MetaMask wallet to wallet local host
3. Input wallet address
4. Input amount
5. Approval or verification check
6. Use Token for transaction
7. Select account for token to be transfer to.
8. Transfer MCU token for personal account to receiver account

Implementation and Results

Creating the MCU Token, the following process must be considered when creating a Token on the ERC20 network with the ERC20 Standard.
These processes are as follows:

STEP 1: Using remix.ethereum.org (Remix IDE) to create an ERC20 smart contract

Remix IDE is an open source web and desktop application. It fosters a fast development cycle and has a rich set of plugins with intuitive GUIs. Remix is

used for the entire journey of contract development as well as being a playground for learning and teaching Ethereum.

Remix IDE is part of the Remix Project which is a platform for development tools that use a plugin architecture. It encompasses sub-projects including Remix Plugin Engine, Remix IDE is a powerful open source tool that helps you write Solidity contracts straight from the browser. It is written in JavaScript and supports both usage in the browser, in the browser but run locally and in a desktop version. Remix IDE has modules for testing, debugging and deploying of smart contracts and much more.

STEP 2: Using Geth to generate test accounts on the Blockchain

Geth is a Go-based Ethereum client. This means that installing Geth on a computer turns it into an Ethereum node. Ethereum is a peer-to-peer network in which data is exchanged directly between nodes rather than through a central server. Because they are rewarded in Ethereum's native token, ether, nodes compete to generate new blocks of transactions to send to their peers (ETH). Each node verifies that a new block is valid before adding it to their database. A "blockchain" is a collection of discrete blocks. Geth uses the information in each block to update its "state," which is the balance of each Ethereum account.

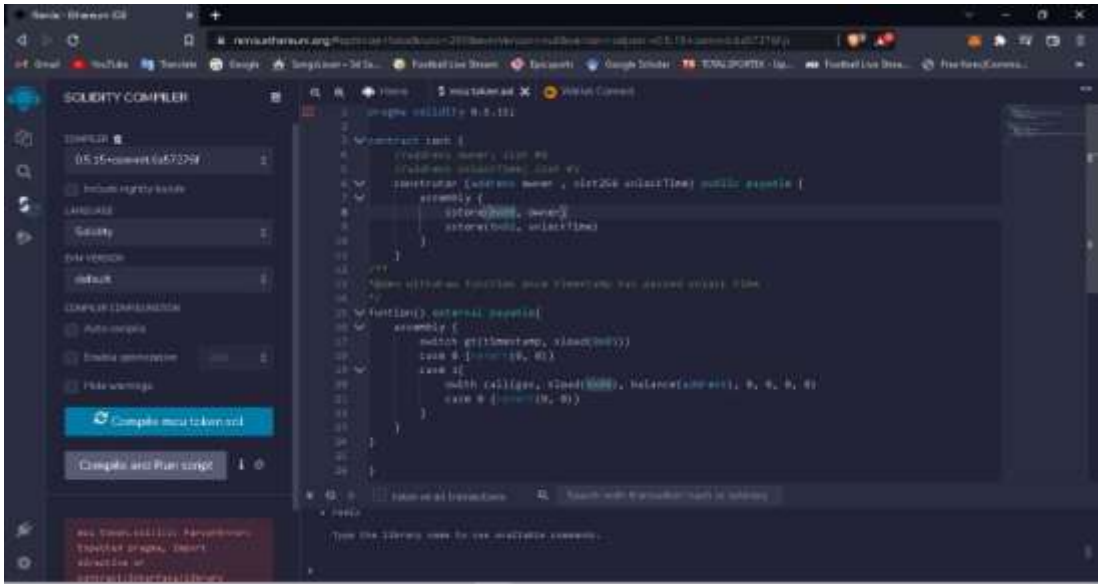

Figure 2: Geth generation process.

STEP 3: Mining test Ethereum on Rinkeby.

Rinkeby is an Ethereum testnet for putting the Ethereum protocol to the test. It's an offshoot of Ethereum'smainnet. The Rinkeby network can be viewed by visiting rinkeby.io and loading the Rinkeby site. Rinkeby displays network statistics such as node count, transactions, and blocks. Furthermore, it displays the number of transactions per second, blocks per second, and peers, as well as assisting individual miners in Ethereum testing, which is the number of nodes connected to Rinkeby.

Figure 3: Showing the mining and nodes processes in the Rinkeby.

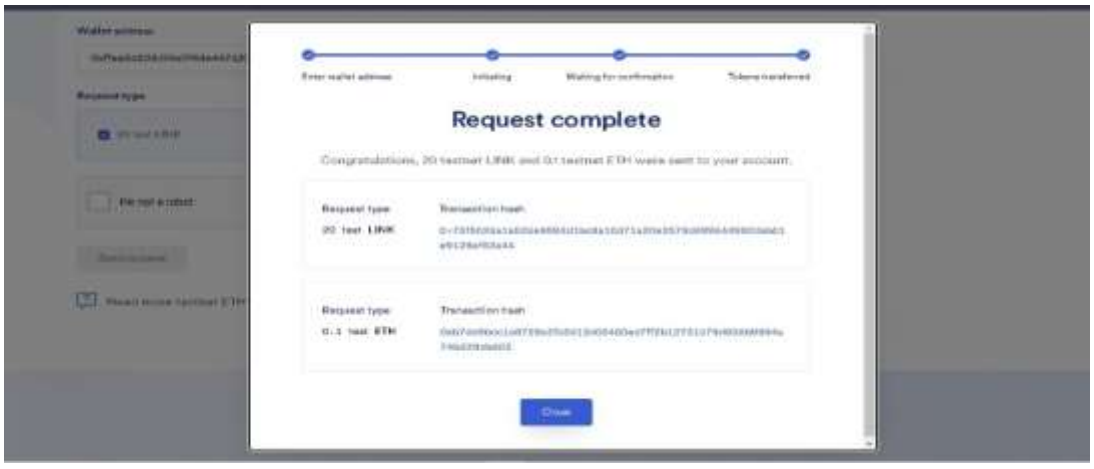

Figure 4: Showing the successful process of mined Ethereum on Rinkeby.

STEP 4: Deploying the "METAMASK" environment.

MetaMask is a software cryptocurrency wallet used to interact with the Ethereum blockchain. It allows users to access their Ethereum wallet through a browser extension or mobile app, which can then be used to interact with decentralized applications. MetaMask is developed by ConsenSys Software Inc., a blockchain software company focusing on Ethereum-based tools and infrastructure.

MetaMask allows users to store and manage account keys, broadcast transactions, send and receive Ethereum-based cryptocurrencies and tokens, and securely connect to decentralized applications through a compatible web browser or the mobile app's built-in browser. Developers achieve a connection between Metamask and their decentralized applications by using a JavaScript plugin such as Web3js or Ethers to define interactions between Metamask and Smart Contracts.

The deploying of my METAMASK followed the certain processes which are listed below:

Process 1: Creating an account:

Creating a new account on Metamask is simple; all one has to do is go to Google, type in the need pharse"metamask," and a download button will appear. Then you install the required software and make a wallet. The steps are also depicted in the following images below:

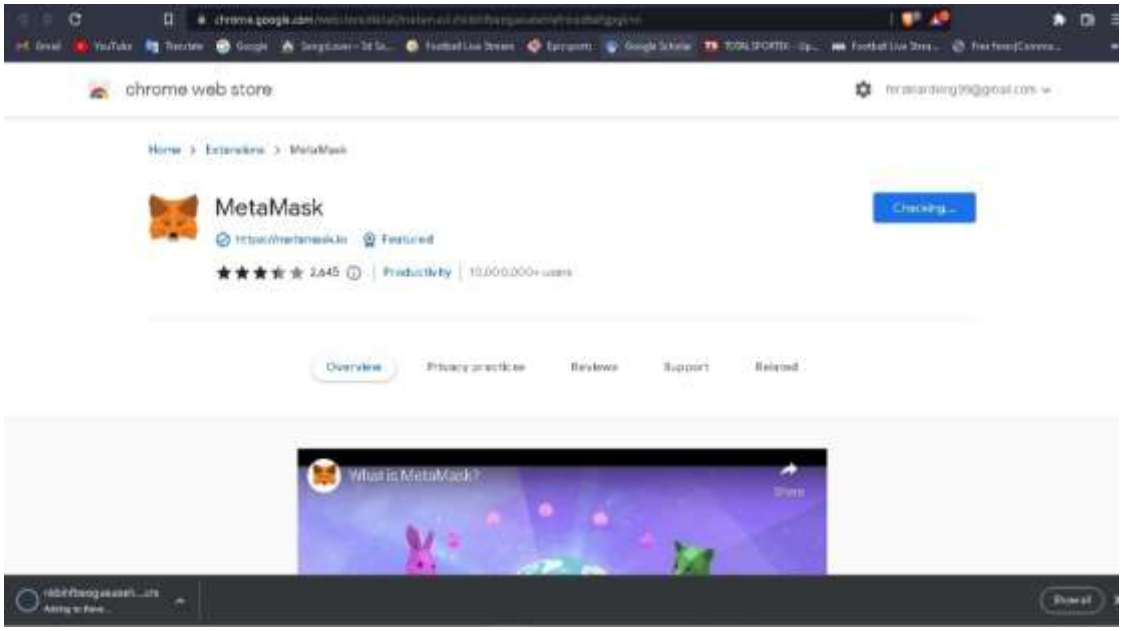

Figure 5: Displaying metamask installation process

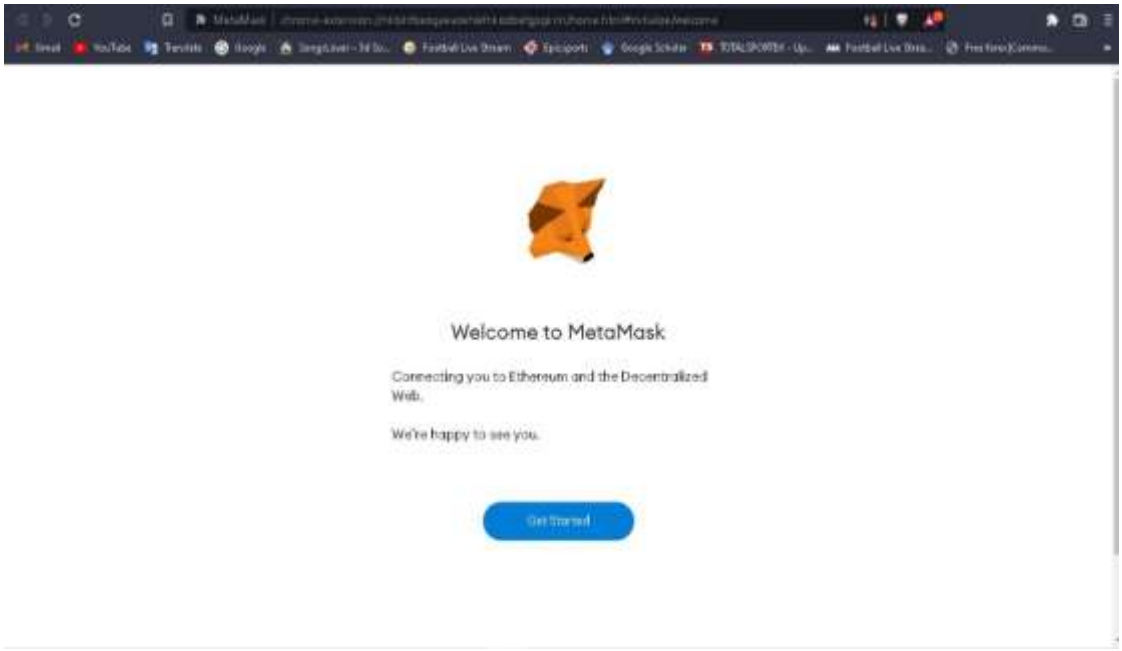

Figure 6: Metamask interface getting started

Process 2:

The connection phase, this is the connections between the metamask, and all other processes ranging from rinkeby, Remix and react to help the transaction process of the token run smoothly. These connection are in the figure below and the reason why this connections are needed for proper transactions. Connection between metamask wallet to rinkeby had to be established in order to receive the mined Ethereum. Images of how the mining and distribution of the test-Ethereum were deployed are shown below:

Figure 7: Connecting Rinkbey and Metamask

Connecting Metamask to Remix

Remix.IDE assists in the establishment of a given ERC20 contract, and thus a connection with MetaMask is established in order for proper check or and payment of the necessary fees and commissions to be removed from MetaMask.

The following figures depict these processes:

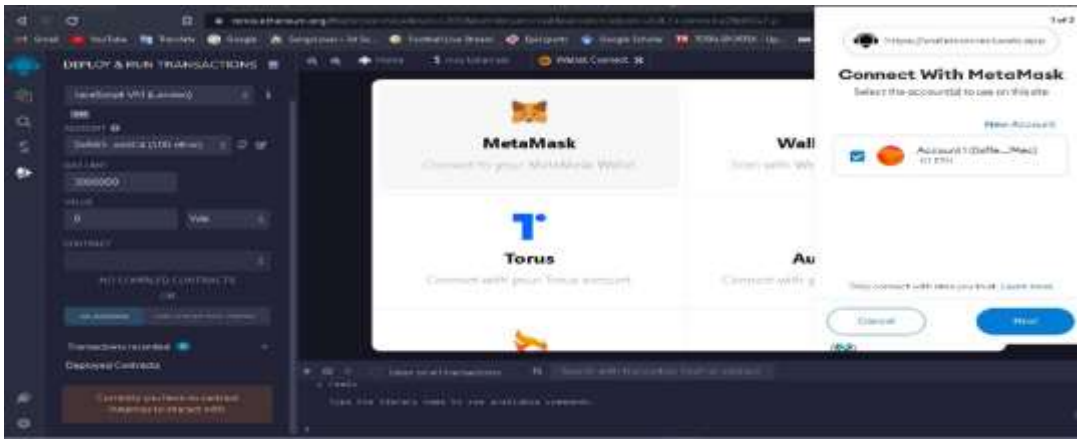

Figure 8: Connecting Metamask to Remix

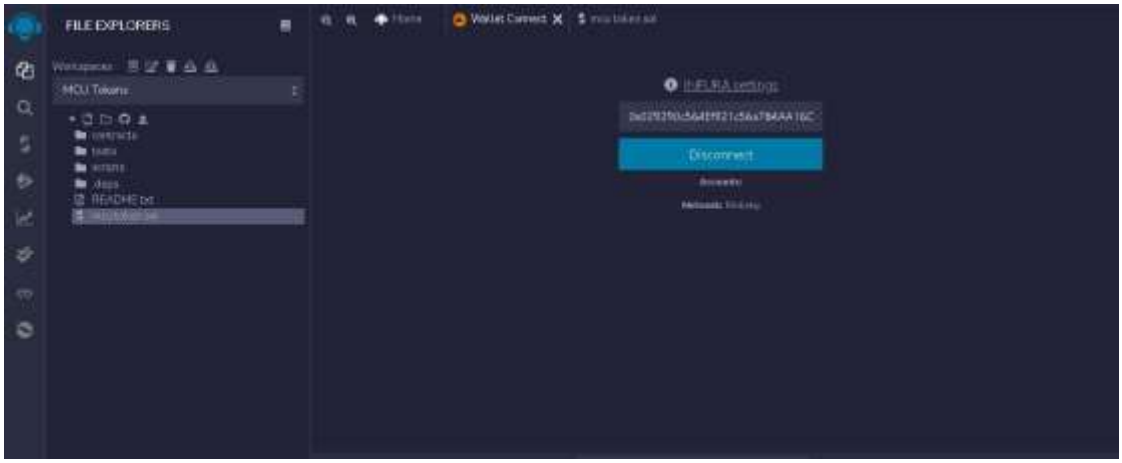

Figure 9: Established connecting between my MetaMask wallet and Remix.

Connecting MetaMask to React

In this case, the Metamask experiment was utilized as a medium to transmit the token on the Rinkeby test network, allowing the transfer details to be recorded on the Rinkeby database. This is seen in the following result:

Figure 10: Connecting react wallet and Metamask address.

The following are some MetaMask wallet transactions involving the MCU Token:

Figure 11: Transaction of 1000 token to another address.

Figure 12: Transaction process.

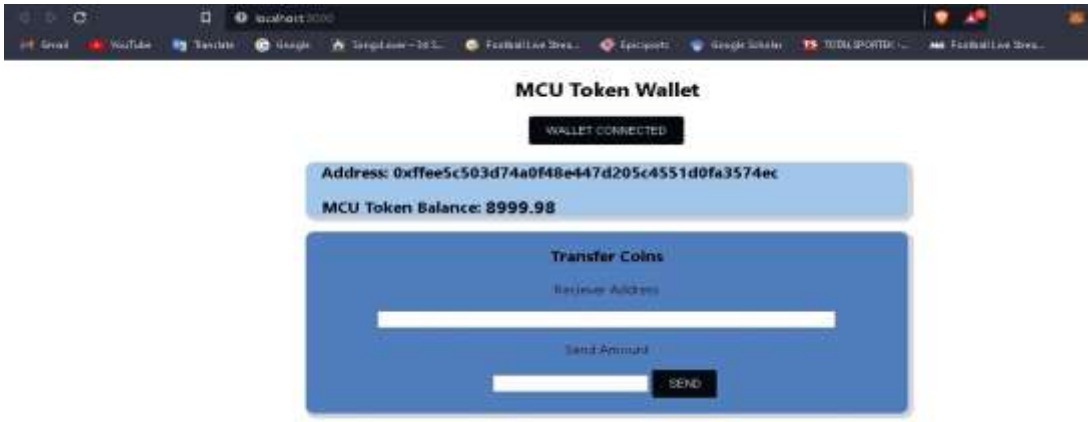

Figure 13: Success of transaction and new wallet balance.

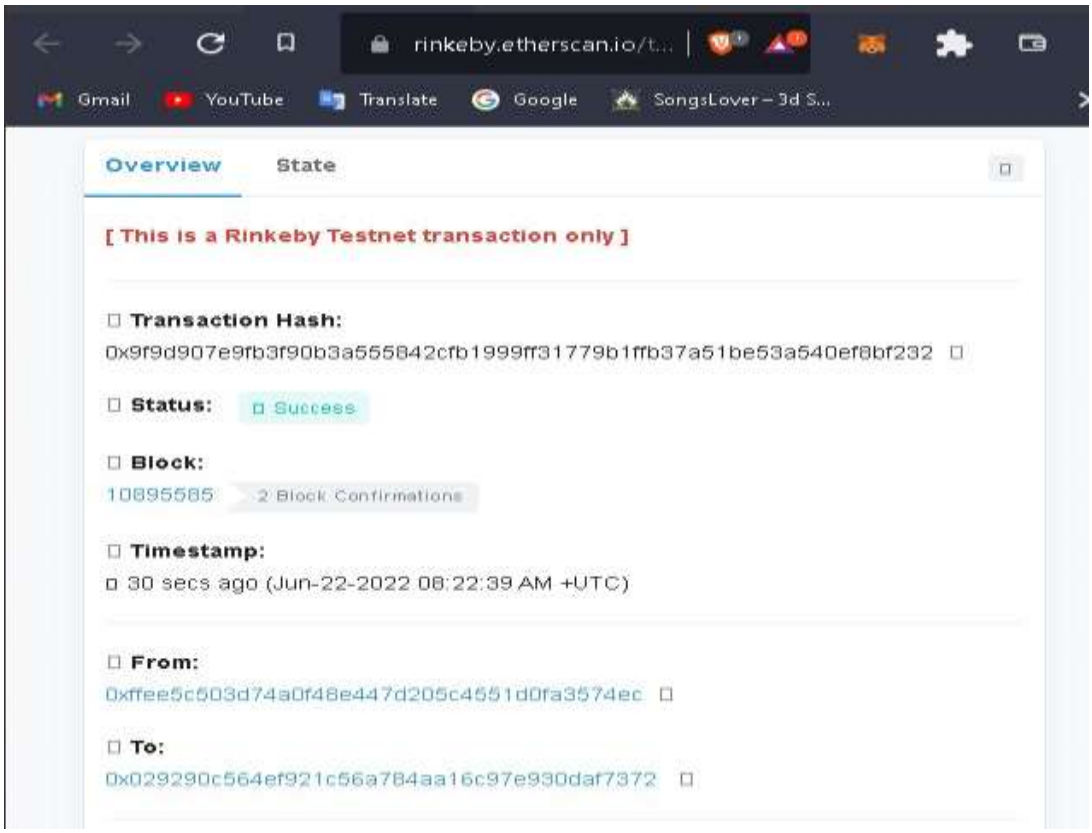

Figure 14: Transaction activity of recent transfer.

Conclusion

The actual goal of this study was to generate and connect the token to major wallets such as Binance and Trust wallet, in order to establish the token as a major means of transaction in a real time wallet such as Bitcoin and Ethereum.

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REFERENCES

Alam, N., & Zameni, A. P. (2019). Existing Regulatory Frameworks of Cryptocurrency and theShari'ah Alternative. In Billah, M (eds). Halal Cryptocurrency Management, 179–194.

Auer, R. (2019). Beyond the Doomsday Economics of Proof-of-Work in Cryptocurrencies. SSRN Scholarly Paper ID 3331413.

Bouri, E., Azzi, G., &Dyhrberg, A. H. (2017). On the Return-Volatility Relationship in the Bitcoin Market around the Price Crash. Economics - The Open- Access, Open Assessment E-Journal, 11, 1–16.

Bulut, A. (2018). Bitcoin as a complement to emerging market currencies. Journal of International Trade, Logistics and Law, 4(2), 45–52.

Clark, B., & Burstall, R. (2018). Blockchain, IP and The Pharma Industry—How Distributed Ledger Technologies Can Help Secure the Pharma Supply Chain. Journal of Intellectual Property Law & Practice, 13(7), 531–533.

Charfeddine, L., Benlagha, N., &Maouchi, Y. (2020). Investigating the Dynamic Relationship between Cryptocurrencies and Conventional Assets: Implications for Financial Investors. Economic Modelling, 85, 198-217. 111

Dorfleitner, G., & Lung, C. (2018). Cryptocurrencies from the Perspective of Euro Investors: A Re-examination of Diversification Benefits and a New Day-of-The- Week Effect in a stock market. Journal of Asset Management, 19(7), 472–494.

Dostov, V., &Shust, P. (2016). Cryptocurrencies: An unconventional Challenge to Bitcon (BTC) Financial Regulations. Journal of Financial Crime, 21(3), 249–263.

Duque, J. J. (2020). State Involvement in Cryptocurrencies. A Potential World Money? The Japanese Political Economy, 46(1), 65–82. 112

García-Medina, A., & Hernández, J. B. (2020). Network Analysis of Multivariate Transfer Entropy of Cryptocurrencies in Times of Turbulence. Entropy, 22(7).

Glaser, F., & Bezzenberger, L. (2017). Beyond Cryptocurrencies—A Taxonomy of Decentralized Consensus Systems. SSRN Scholarly Paper ID 2605803.

Hashemi J, M., Nishikawa, Y., &Dandapani, K. (2019). Cryptocurrency, a Successful Application of Blockchain Technology. Managerial Finance, 46(6), 715–733. 113.

Milne, A., Godart-van der Kroon, A., &Vonlanthen (2018).Cryptocurrencies from an Austrian Perspective: PBanking and Monetary Policy from the Perspective of Austrian Economics, 223–257. Berlin: Springer International Publishing.

Omane-Adjepong, M., Alagidede, P., &Akosah, N. K. (2019). Wavelet Time-Scale Persistence Analysis of Cryptocurrency Market Returns and Volatility. Physical, Statistical Mechanics and Its Applications, 514, 105–120 https://doi.org/10.1016/j.chaos.2019.109563.

Osterrieder, H., & Lorenz F. A., (2017) A statistical risk assessment of Bitcoin and its extreme tail behavior. IEEE Access, 6, 50737–50751.

Platanakis, E., Sutcliffe, C., & Urquhart, A. (2018). Optimal vs Naïve Diversification in Cryptocurrencies. Economics Letters, 171, 93–96.

Raymaekers, W. (2017). Cryptocurrency Bitcoin: Disruption, Challenges and Opportunities. Journal of Payments Strategy & Systems, 9(1), 30–46.

Rehman, M. H., Salah, K., Damiani, E., & Svetinovic, D. (2019). Trust in Blockchain Cryptocurrency Ecosystem. IEEE Transactions on Engineering Management, 1–17.

Searing, J. M., & MacLeod, D. (2019). Cryptocurrency Gift Strategies: Here's What Organizations Should Consider as They Ponder Whether and How to Accept Donations of Virtual Currency. Journal of Accountancy, 227(2), 34-36.

Sudzina, F. (2018). Distribution of Foreign Aid in Cryptocurrencies: Initial Considerations. International Advances in Economic Research, 24(4), 387–388.

Tama, B. A., Kweka, B. J., Park, Y., & Rhee, K.-H. (2017). A Critical Review of Blockchain and Its Current Applications. 2017 International Conference on Electrical Engineering and Computer Science (ICECOS), 109–113.

Treiblmaier, H. (2019). Combining Blockchain Technology and the Physical Internet to Achieve Triple Bottom Line Sustainability: A Comprehensive Research Agenda for Modern Logistics and Supply Chain Management. Logistics, 3(1), 1–13.

Treiblmaier, H., Rejeb, A., &Strebinger, A. (2020). Blockchain as a Driver for Smart City Development: Application Fields and a Comprehensive Research Agenda. Smart Cities, 3(3).

Vincent, O., & Evans, O. (2019). Can Cryptocurrency, Mobile Phones, and Internet Herald Sustainable Financial Sector Development in Emerging Markets? Journal of Transnational Management, 24(3), 259–279.

Volosovych, S., &Baraniuk, Y. (2018). Tax control of cryptocurrency transactions in Ukraine. Banks and Bank Systems, 13(2), 89–106.

Wang, Y., Singgih, M., Wang, J., &Rit, M. (2019). Making Sense of Blockchain Technology: How Will It Transform Supply Chains? International Journal of Production Economics.

Wei, Q., Li, S., Li, W., Li, H., & Wang, M. (2019). Decentralized Hierarchical Authorized Payment with Online Wallet for Blockchain. In Biagioni, E. S., Zheng, Y., & Cheng, S (Eds.), Wireless Algorithms, Systems, and Applications, 358–369. Berlin: Springer.

Wilson, C. (2019). Cryptocurrencies: The Future of Finance? In Yu, F-L. T., & Kwan, D. S. (Eds.). Contemporary Issues in International Political Economy, 359–394. Berlin: Springer.