

Decentralized Blockchain Time Clocking Application
Issues Impacting Public Perception of Blockchain Technologies

A Thesis Prospectus
In STS 4500
Presented to
The Faculty of the
School of Engineering and Applied Science
University of Virginia
In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Computer Science

By
Alexander Johnson

November 3, 2023

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

ADVISORS

Prof. Pedro Augusto P. Francisco, Department of Engineering and Society

Introduction

Of all the technologies to emerge from the past decade, few have received more talk than the blockchain and the subsequent technologies that it has enabled. Bitcoin, the first cryptocurrency, went from being worth fractions of a cent in 2009, to over \$18,000 in 2018. The current cryptocurrency market cap is in the trillions. But for all the talk, for the thousands of megawatts of electricity used, for all the riches won and lost, it seems that the blockchain has failed to enable anything more than speculative investing. For the blockchain to become something more than a digital gold rush, there first must be a large change in the perception of the technology. From the Bitcoin mining craze that caused GPU prices to skyrocket to the NFT boom that saw rappers and celebrities promoting “Bored Apes,” blockchain technologies have been ridden with bad PR, and the blockchain has become synonymous with grifters pushing “get rich quick” schemes. As it stands, beyond the massive saliency of the largest technologies, the average person has little to no understanding of what the blockchain is capable of. For example, the blockchain can be used to run decentralized programs that track state on shared hardware. (Li, 2016) The technical section will focus on outlining a practical decentralized blockchain application that can be used to provide a simple service. In doing this, it will examine how the actors and processes interact with the technology, elucidating the viability of a possible use case. The sociotechnical section will explore the reasons for public mistrust in blockchain technologies. By following the avenues in which the public became aware of the blockchain and how public understanding grew from there, we can investigate if and how ethical blockchain technology can improve its reputation.

Decentralized Blockchain Time Clocking Application

As blockchain technologies are relatively new, many possibilities for its applications remain unexplored. As such, the future of what the blockchain can provide for society remains unclear. As it stands, the pros and cons of adopting blockchain into areas of importance cannot be fairly weighed. In order to make an effort to solidify the form of blockchain technologies, attempts should be made to apply this technology in as many areas as possible.

My proposed addition to this collective trial of blockchain integration is a blockchain powered decentralized time clocking system. Time clocking systems exist to resolve the conflict of trust between employers and employees when it comes to recording and paying out hourly wages. The incentive of the employee is to overreport in order to earn more wages, while the employer is incentive to underreport in order to pay less wages. Currently, time clocking systems are centralized, and run by a third party chosen by the employer. The proposed decentralized time clocking system would eliminate the need for a third-party, while still maintaining the trust that it provides.

This system would run as a "smart contract" on the Ethereum blockchain. This does not necessarily mean that the system pays employees in cryptocurrency, though that is absolutely a possible feature if cryptocurrency is adopted to the point where wages are paid directly though the blockchain. At the minimal amount of involvement, cryptocurrency is only necessary as an incentive for miners to maintain the Ethereum blockchain, and the timekeeping system can be used to pay wages in traditional fiat currency.

The idea is for employees to run an application on a local device such as a phone. Once at the physical time clock, they are able to acquire a time sensitive cryptographic signature from the time clock (through means such as nfc scanner or qr code) and use that to verify their "clock in," which their mobile application will then send to the blockchain. Once minted to the blockchain, the "clock ins" and "clock outs" are irreversible, and stored forever, as long as the Ethereum blockchain is maintained. The employers will be able to run programs that check the hours worked by each employee, and the employee will have concrete, public and unchangeable records of their work.

This proposed system is not meant to be a finalized transformation of the time clocking system, rather an exploration into one of many applications of blockchain technologies. This exploration will deepen understanding of the interaction of individuals and organizations with the blockchain, and the challenges that arise therein.

Issues Impacting Public Perception of Blockchain Technologies

Though blockchain technologies have been purported to have revolutionary and widespread use, they have struggled to capture the good will of the public, and thus have seen limited actual use. This research aims to examine the reasons for why public opinion remains skeptical of blockchain technologies, and additionally examine certain attempts to fix the underlying issues.

An issue with cryptocurrency, a decentralized blockchain technology, is its volatility. Its price can plummet one day and skyrocket the next at seemingly random. If a cryptocurrency such as Bitcoin's price "drops below a certain threshold," it could

trigger a “sudden” exit of all users maintaining the system, in which it would “[cease] to be a usable currency.” (Iwamura, 2019)

One attempted solution to the problem of volatility are stablecoins. The goal of a stablecoin is to tie their value to that of an existing currency or resource, in the case of TerraUSD, that would be the US dollar. (Pierce, 2019) While Bitcoin may fluctuate hundreds of dollars in value in a single day, a stablecoin tied to the USD should always be worth a single dollar. A stablecoin can achieve this by backing its cryptocurrency with real fiat currency, or with self -adjusting algorithms that adjust the amount of currency in circulation in order to adjust for market forces. This research will examine the successes and failures of stablecoins, attempting to evaluate their ability to solve the problem of volatility.

While volatility is an issue that affects only holders of blockchain assets, the environmental impact of blockchain technologies is something that affects us all. Decentralized blockchain technologies, when scaled up to a global level , use massive amounts of computing power and electricity, totalling to 0.4-0.9% of global electricity consumption, according to the White House. This has led to outcry from environmentalist groups, who rightly condemn the massive amount of resources needed to power these decentralized systems. As society becomes increasingly sustainability focused, environmental concerns over blockchain technologies become more and more pressing. If not addressed, these problems will continue to stain the image of blockchain technologies, making the acceptance and adoption of these technologies extremely difficult.

The reason why Cryptocurrency is so electricity intensive is because of its “Proof-of-work” consensus method. In order for the network to agree on the state of system (balance of each account, transactions made, etc.), blocks are added to the chain by a single node and verified by the rest of the network. This is called “mining.” To encourage the mining of new blocks, a cryptocurrency reward is issued to the miner. But who decides who gets to mine the block and get the reward? “Proof-of-work” essentially creates a lottery system where the more computing power you use, the more tickets you get. The “proof-of-stake” method recently adopted by Ethereum in 2022 attempts to greatly reduce the environmental impact of the system. This research will examine the success of this switch, and if this will be sufficient to alleviate the major environmental concerns raised with Blockchain. This research aims to examine the reasons for why public opinion remains skeptical of blockchain technologies, and certain attempts to fix the underlying issues.

Conclusion

The main goal of this research is to examine the divide between the potential benefits of blockchain technologies and the historical issues preventing their adoption. Blockchain technologies have the potential to revolutionize huge sectors of our society, and suchly it would be a mistake to dismiss them based on issues that have not had the time to be considered holistically. This is a two sided approach. One side is concerned with the development of new technologies that can aid the public understanding of the potential of the blockchain, and the other an investigation into current societal issues that plagues the blockchain. Together, this research seeks to, if not push, nudge the

technology towards a place where we can better understand what the blockchain is, what it can be, and and the end, if it is worth our efforts.

References:

- Li, V. (2016). Bitcoin's Useful Backbone: Blockchain technology gains use in business, finance and contracts. *ABA Journal*, 102(3), 31–31. <http://www.jstor.org/stable/24806927>
- Pierce, B. (2014) Tether: Fiat currencies on the Bitcoin blockchain. <https://assets.ctfassets.net/vyse88cgwfb/5UWgHMvz071t2Cq5yTw5vi/c9798ea8db99311bf90ebe0810938b01/TetherWhitePaper.pdf>
- Stackpole, T. (2023, January 10). What is web3?. Harvard Business Review. <https://hbr.org/2022/05/what-is-web3>
- Ho, C. (2023, October 11). One Year After The Merge: Sustainability Of Ethereum's Proof-Of-Stake Is Uncertain. Forbes. <https://www.forbes.com/sites/digital-assets/2023/10/11/one-year-after-the-merge-sustainability-of-ethereums-proof-of-stake-is-uncertain/>
- Iwamura, M., Kitamura, Y., Matsumoto, T., & Saito, K. (2019). CAN WE STABILIZE THE PRICE OF A CRYPTOCURRENCY?: UNDERSTANDING THE DESIGN OF BITCOIN AND ITS POTENTIAL TO COMPETE WITH CENTRAL BANK MONEY. *Hitotsubashi Journal of Economics*, 60(1), 41–60. <http://www.jstor.org/stable/45124706>
- Mason, M., Spoke, M., & Centre for International Governance. (2019). Programmable Trust: A Practical Approach to Governance in the Digital Age. <http://www.jstor.org/stable/resrep26129.17>