

BLOCKCHAIN'S APPLICATION AND POTENTIAL DEVELOPMENT
EMERGING TECHNOLOGIES IMPACT ON INDIVIDUAL EMPOWERMENT

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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.

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The use and concept of currency, conceived thousands of years ago, has been an inseparable feature from the human societal experience. Preceded by bartering, which involved the direct trade of items, currency was propped on the foundation of money, an item that served as a medium of exchange which also had the additional benefit of quantitatively evaluating the inherent value of a commodity or service. With a history of thousands of years, it has manifested in many forms, including metallic coins, commodity-backed bills, and even commodities themselves. However, in contemporary times, it has emerged as a bill backed by no intrinsic value or commodity, instead being based on “faith” within a country or its government. More recently, advances in technology have enabled a shift from physical currency to digital ones, with online banking providing a tangible increase in the ease-of-use of monetary transactions.

In conjunction with the advent of digital currency, the idea of a cryptocurrency, introduced initially as “cyber currencies,” was first conceptualized and discussed. In contrast to the traditional banking system, cryptocurrency was characterized as a form of currency that was inherently decentralized, free from the fetters of regulation from central bankers and the government. Although cryptographic hashes and protocols were first introduced and developed during this time frame, a paper outlining the creation of a framework that bypassed the necessity of a traditional third-party (i.e: a bank) was penned by the pseudonym Satoshi Nakamoto (2008) allowed for the development of contemporary cryptocurrency (p.1). The foundation for the framework, the blockchain, gained a reputation for security through its application in cryptocurrency, and has been a topic discussed in the mainstream for many years. Furthermore, as blockchain technology becomes more rigorous and advanced, its potential for use has shifted from its original use in cryptography to a myriad of fields.

Technological and social innovation, in fields not limited to currency, have also resulted in radical changes within society's social structure and governance. After the Neolithic Revolution, in which the invention of agriculture enabled vast groups of people to coalesce, according to Hariri (2012) the primary form of government was what some would consider peak authoritarian, with kings and monarchs overseeing groups of people (p.2). However, technology has been a force that, historically, flattened the social inequality pyramid. This trend, in which technological advancements began empowering individuals, especially those at the bottom of the social hierarchy, has been one that has held since the invention of agriculture. Nonetheless, certain emerging technologies, including specific uses of the aforementioned cryptocurrency, surveillance, and manufacturing, have threatened to buck the trend, potentially signaling a pivot from technology being a force which empowers individuals to it being used as a means of control. Within my loosely coupled STS discussion, I plan on analyzing applications, and subsequent potential, of certain emerging technologies and come to a conclusion on whether or not concerns over the previously mentioned pivot are unfounded or feasible.

BLOCKCHAIN'S APPLICATION AND POTENTIAL DEVELOPMENT

A cryptocurrency, defined by Satoshi Nakamoto (2008), is a "peer-to-peer version of electronic cash [that] would allow online payments to be sent directly from one party to another... without going through a financial institution" (p.1). Nakamoto, the pseudonym of the person(s) who developed Bitcoin, pioneered the concept of the blockchain in his paper describing Bitcoin. Blockchain, as described by Schaupp and Festa (2018), is a "public ledger that securely records the trading of a cryptocurrency in the form of a chain of interlocked blocks" (p.1). This form of monetary transaction, although in its embryonic form, has garnered the

attention of society through its inherent security, the foundation of the blockchain lies on adding “blocks” of transaction data that, once validated, is nigh impossible to tamper with. With the innate decentralized nature of blockchains, according to Chen et al. (2008), it has found itself incorporated in numerous “banks, internet companies, car manufacturers, and even governments,” translating into impacts on multiple fields, including “healthcare, advertising, insurance, copyright protection, energy and [general] societal impacts” (p. 17). The aim in my technical topic is to analyze the state of the art of current blockchain technology, and determine the fields in which blockchain technology could infiltrate, and subsequently evolve, due to its novel and unique characteristics. This will be conducted primarily through journal articles, although the concentration of different sources of references may increase as I delve deeper into my research since cryptocurrency, an application of blockchain technology, has been in the mainstream for years as of this point.

Focusing attention on the initial use-case of blockchain technology, within cryptocurrency, will provide insight on how it has evolved from its nascent form. When cryptocurrency first emerged, it broke away from traditional forms of currency for a myriad of reasons. For one, Perkins (2020), a specialist in Macroeconomic Policy, stated that the money itself had to either have an “intrinsic value” or that it “derived value from government decree” (p. 5). Furthermore, he alludes to the historical precedent of digital currency acquiring legitimacy through the use of “private ledgers” and systems of “one trusted intermediary” (p. 1). However, cryptocurrency has broken the aforementioned trend through their use of the blockchain.

The use of the blockchain has unquestionably been a cornerstone within the field of cryptocurrency. It provides, according to Ghaemi et al. (2021), a means to send money digitally that results in “simpler, cheaper, and faster transactions” (p. 1507). They elaborate on the

additional benefits that utilizing blockchain can provide, including decentralization, which allows the database and history of a transaction to be “accessible for either side... without [the] permission from a third party,” and anonymity, in which participants of within the ecosystem are given a “unique alphanumeric address,” where “no party stores the information of users.” Ghaemi et al. also allude to the consensus mechanism, in which 51% of the nodes within a network need to approve a block, or new record within the network (p. 1507), which is then appended onto the most recent block, thus creating a “chain of blocks” as outlined below in Figure 1.

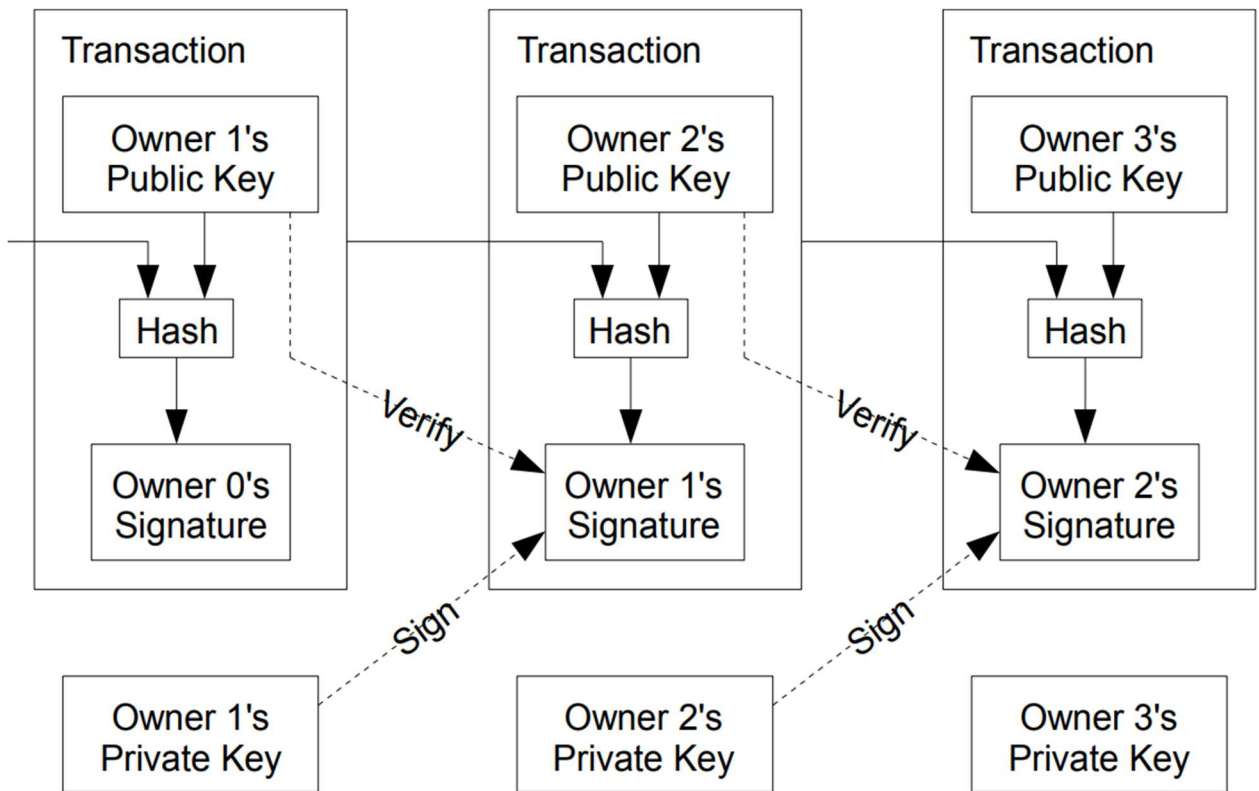


Figure 1: Coins are transferred by digitally signing the previous transaction’s hash and the public key of the next owner (Satoshi Nakamoto, 2008).

Although blockchain technology is considered to be in its infancy, it has begun to see use in a myriad of fields. In the field of healthcare, it offers a multitude of services, since the field is

especially data and information driven. According to Ramzan et al. (2022), the motivations for its use include, but are not limited to, safety/data security, in which blockchain technology provides a guarantee for the “safety, storage, and transmission” of medical data, data integrity, of which a storage system holding high reliability and integrity to patients, users, and hospitals, and data privacy, in which private data leaks are extremely difficult as a result of the “decentralized distribution ledger” (p. 4). However, the authors directly allude to the fact that it is primarily used for “access control, data sharing, and EHRs,” but it rarely sees use within other fields such as “medicine prescription management.” As such, its potential remains relatively “unexplored” (p. 15), and undoubtedly has the potential for growth.

Shifting to the field of agriculture, Sendros et al. (2022) also references blockchain technology as, despite being in its “early stages,” providing useful “monitoring of production steps, products” and maintaining the integrity of “agriculture production records (p. 1). They note that agriculture is one of the industries with the least exposure to digital technology, in which blockchain technology could “potentially provide solutions” in order to ensure the “integrity and immutability of transactions” (p. 2).

As shown, there is a plethora of potential for blockchain technology within a myriad of fields. Although still currently most prevalent within its “initial” field of cryptocurrency, it has potential applications that may not have been explored yet. The intended purpose of this scholarly paper is to analyze the blockchain’s future applications and potential use within the near future, outside of its initial use-case within cryptocurrency.

EMERGING TECHNOLOGIES IMPACT ON INDIVIDUAL EMPOWERMENT

When our forefathers wandered the earth, during the hunter-gatherer era, groups of people tended to be small, egalitarian, equal, and abiding to political concepts that contemporary

society would categorize as democratic. Inequality amongst hunter-gatherers was extremely limited, and while there were some people who had power over others, like chiefs, their society was held together under a relatively egalitarian structure (Chakraborty, 2008, p.63). However, upon the discovery, and subsequent adoption of agriculture, the population within society grew exponentially - leading to the formation of large groups of people. As such, according to Hariri (2012) , to introduce stability, authoritarian rule was determined to be the most effective form of government (p.2). However, as time progressed, societal norms inevitably shifted towards more democratic means of governance. While the shift is certainly a natural consequence of the human psyche, technological advancements have undoubtedly played a major role in facilitating it. Moldbug (2009), a philosopher who rejects modernity, aptly puts it: “Cthulhu [society] may swim slowly. But he only swims left” (p.5). However, certain emerging digital technologies have allowed for technology to shift right, including, but not limited to, surveillance, 3-D printing of guns, and certain aspects of cryptography, namely cryptocurrency. At an extreme level, Feldstein states that “[technological innovation] is bringing new dimensions to the authoritarian playbook, enabling governments to more easily manipulate information consumed by citizens.” Although technology is inherently indifferent, it certainly has an impact on the political landscape within society, and instead of being a force that serves to empower users, it becomes one that does the opposite. Although certain emerging technologies, including cybersecurity, artificial intelligence, 3-D printing, are the focal points within this discussion, I hope to focus my attention on surveillance, which is what I would consider to be the motivating factor that essentially enabled for the widespread use and development of blockchain technology. As such, the goal of my discussion is to examine and analyze issues in which surveillance is used and determine whether users may become more empowered or lose agency under the effects of said surveillance.

Counterintuitive to the common conception of surveillance being a force with suppressive effects on users and individuals, surveillance of users and individuals can empower them. As articulated by Darmondy and Zwick (2020) in the scientific journal *Big Data and Society*, digital marketing is reliant on “Big Data” and “environmental surveillance,” the process of which provides consumer data to “see... predict, manipulate behaviors, and address consumers... [in a] personalized manner,” with an underlying goal of “producing revenue and market control” (p. 1- 2). However, they argue that despite the intrusiveness that manifests as a result of “surveillance capitalism,” it is a necessity that actually results in the empowering of the consumer (p. 9-10). This particular work was written in response to the emerging concern of the proportional rise in surveillance and data gathering with the expansion of the internet. It argues that, despite the knee-jerk reaction one might have of such practices being manipulative and controlling, they actually greatly empower consumers.

Darmondy and Zwick (2020) introduce the concept of “relevancy” to justify consumer empowerment in the context of marketing. Digital marketers are aware that their efficacy is a result of the evolving span of control over consumer decision-making and emerging technology that enable them to surveil consumers; but they are also aware of the fact that this process is fraught with “critical scrutiny,” as it is the direct manipulation of a “consumers’ belief and choices” (p.2). As such, they certainly have a vested interest in maximizing the surveillance, control, and manipulation of consumers and minimizing any potential backlash. However, the authors believe that the aforementioned surveillance, control, and manipulation actually result in an empowered consumer by citing relevancy, in which, marketers decide what consumers want, and vice versa. Pivotal to this, marketers require information pertaining to the consumer in order to determine what they want, hence the contradictory relationship in which marketers need

consumers, and consumers want marketers, as “consumers prefer targeted and meaningful interactions” (p. 2-4). As such, the authors argue that the relevancy that marketers provide consumers leads them to be empowered, despite their surveillance, control, and manipulation of consumers.

This confusing and especially contradictory idea, of consumer surveillance resulting in consumers becoming empowered through indirect means, is by no means a novel topic. Hurtado-de-Mendoza et al. (2015), in a paper discussing pills with sensors embedded within them that enable outsiders to track consumption, argue that users of such a pill can become empowered as a means of “dispersed agency,” in which the “enhanced support and communication [between patients and medical staff]... ultimately empower patients” (p. 333). Although in a slightly different context, it can be shown that although “agency” may or may not be taken from consumers as a result of surveillance, they will be compensated through indirect means regardless of the field in discussion, as reflected in Figure 2.

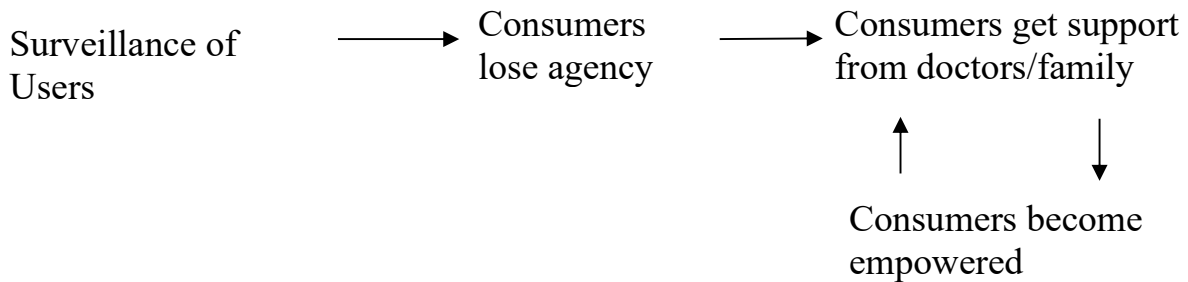


Figure 2: Reflects the dynamics of surveillance on individuals, in which users may initially lose agency, but will recover and retain it because of surveillance. Adapted from ‘Rethinking agency and medical adherence technology: applying Actor Network Theory to the case study of Digital Pills’ by Hurtado-de-Mendoza et al., 2015,. *Nursing Inquiry*, 22(4), 326–335.

Notwithstanding, an analysis of the Actor Network within this specific case allows one to gain insight on whether there is a tangible loss of agency or net gain in empowerment. As

depicted in Figure 3, according to Hurtado-de-Mendoza et al. (2015), the true medication intake is dependent on a variety of different interrelated actors (p. 326). The patient is the one who chooses to take, or not to take, the medication. Furthermore, they can decide whom they wish to share this information with, which is also dependent on the patient’s sociocultural context. In turn, such information can impact the patient’s medication intake awareness, and have a transitive impact on patient behavior and thus alter interactions between patients and doctors as they become education with regards to adherence. Healthcare providers would also hold the responsibility to include their judgement on considering the “level” of adherence of the patient, as well as technological understanding of Digital-Pill applications, such as the Helius database (p. 329). As such, medication intake is no longer within the realm of a sole individual, but rather models behavior, dependent on the social context, that is set within a network of human and non-human actors that impact each other.

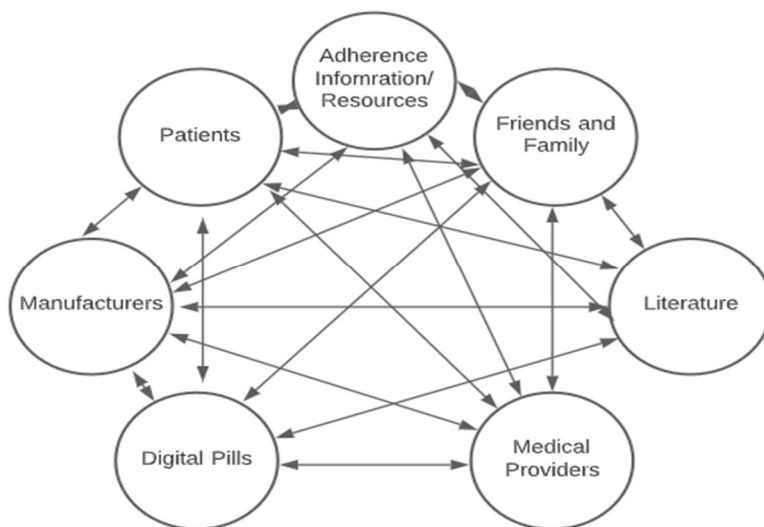


Figure 3: Actor Network Theory diagram depicting the behavior of patients within a network of human and non-human actors. Adapted from ‘Rethinking agency and medical adherence technology: applying Actor Network Theory to the case study of Digital Pills’ by Hurtado-de-Mendoza et al., 2015,. *Nursing Inquiry*, 22(4), 326–335.

Furthermore, there is also the recurring idea that technology itself is not the force that should be under scrutiny. Social construction of technology argues the fact that human and social actions usher in technological leaps, opposed to the existing theory of technology being the primary driving force. Furthermore, according to Johnson (2005), it shares the belief that the social context of technology is integral to understanding its uses (p. 1792). Social construction of technology draws upon the ideas of sociology of scientific knowledge, and references actor-network theory, regulations, economics, and culture to justify the acceptance or rejection of a certain technology lying within social desires. Furthermore, the foundation on which social construction sits inherently refutes the concept of technological determinism, which states that technology progresses with its own inherent logic, shaping societal and cultural values, an idea that has existed since the mid-19th century.

Circling back to the idea of technology being a source that empowered individuals, under the lens of Social Construction of Technology (SCOT), it is unveiled that technology itself is not the driving force of society, it is instead the social forces that are a result of technology. Nonetheless, the development of technology undoubtedly empowered individuals. With this assertion, I believe that the general trend will share features of humanities historical one, of which surveillance becomes force that ultimately empowers consumers.

Blockchain, along with other emerging digital technologies, will have a profound impact on the social hierarchy. My technical and STS explain and analyze their roles within the future, and whether or not the general trend of technology empowering individuals will hold, or whether or not certain emerging technologies will exhibit a force that serves to reconstruct the social pyramid that has existed since the Neolithic revolution.

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