

Blockchain Technology: From the Technological Fringes to the Mainstream and Its Applications

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Abstract

Blockchain Technology which began as a pilot project on the technological fringes aimed at solving the double-spending in a digital exchange of value in a transactional relationship has moved into the mainstream and become the vortex of technological innovations. In technical parlance, blockchain technology is called 'Distributed Database (DD)' or 'Distributed Ledger Technology (DLT)'. Its intrusion into our 'wired world' of cybernetics has thrown open a whole 'Pandora box' of a sort, a jinni out of the technological bottle, whose applicability cuts across not only finance but across the broad spectrum of our social, political, and economic life. Since its debut in 2008 by Satoshi Nakamoto, it has generated a great deal of interest globally; with mixed feelings; swinging between euphoria and trepidation. Euphoric because it has endangered trust, while a feeling of trepidation because of its decentral city based on consensus. This technological breakthrough was made possible by the employment of cryptography and algorithm. This paper is an attempt at exploring the noise and the frenzy about blockchain technology and its unfolding ubiquitous uses across various aspects of our daily existence.

Key words: blockchain technology, cryptocurrency, distributed ledger technology, algorithm, cryptography

J.E.L. classification: O3, O31

1. Introduction

Most innovations or inventions and of course all technological breakthroughs, have always broken new grounds and extended the frontier of knowledge; and learning has always followed a trajectory of a sort. And this is not different from the world of the internet called web 2.0 which took the world by storm and changed our existence to a wired world, back in the 80s. The internet not only brings to us both real life and the world of fantasy or make-believe events as it unfolds but also indulges and immerses us deeply in ways we could never have fathomed, particularly in telecommunication and information technology.

Before the internet, communication internationally and intercontinental is through surface mail and/or telegram. But all that changed with the introduction of the internet, where instant real-life exchange of messages has become a reality and no more a distant fantasy of Science Fiction. We are now witnessing another technological tsunamic revolution being unleashed and suddenly thrust on us, called *Blockchain Technology*, poised to revolutionize, and alter our entire way of life; and indeed, our whole existence pervasively and ubiquitously. During the early stage of its development, the dominant narrative is to view blockchain through the prism of cryptocurrencies, but all that has changed. Bitcoin is the first thing most people will associate with blockchain technology but storing cryptocurrency transactions is one out of so many that blockchain technology can be put to use. In

Mattila (2016) this was buttressed and stated unequivocally that the prospect for the use of blockchain technology across the broad spectrum of human existence is so wide and unfathomed, in more ways than imagined. While it was initially intended to create an innovatively digitized currency as bitcoin it has now transcended cryptocurrencies and found applicability not just in commerce but also in the world of finance; and of course, the whole economic system.

To the dyed-in-the-wool band of techies and the whole gamut of personalities, which includes cyberpunks, corporate organizations, behemoth investment fund managers, and technological geeks, the blockchain is an innovative and cutting-edge technology that represents a new paradigm shift in data and information recording, storage and retrieval. It is a quantum leap forward to the terrain and turf of information gathering/collection, storage, dissemination, and management. It presents a whole new vista in looking at a new technological system for storing information distributed across various nodes without a centrally directed and controlled hub.

Its revolutionary impact is felt more in the area of commerce and means of exchange – money. It is instructive to bear in mind that ever since the first applicability with Bitcoin, other types of blockchains have been created that found use in a whole range of applications, with an integral and built-in feature.

The blockchain as the name connotes is an electronic and virtually dispersed and linked system, which can be equated to a digitized network, that through mathematical manipulation with the aid of faster and high computational power computers, utilizes cryptography and encryption techniques to store information/data which cannot be counterfeited or altered; and of course, where the entire chronicles of the exchanges between the operators of the whole system, are algorithmically engineered (digitally) and cryptographically documented, authenticated, preserved and stored which is also open and accessible to the public.

To underscore the imperativeness and the revolutionary importance of this new technology, and its disruptive imprimatur on the entire world ecosystem, particularly in the world of commerce and international finance, blockchain technology became a major agenda at the Annual World Economic Forum in Davos, Switzerland in August 2016. It brought together heads of Government, leaders, and captains of industries, multinationals, professionals across various disciplines.

It was indeed a gathering of the world's finest financial experts; it lends credence to the revolutionary importance of the 'new kid in the block' in the world of digital technology called Blockchain. (WEF 2016).

2. Literature review

Before the internet, communication internationally and intercontinental is by surface mail and/or telegram. But all that changed with the introduction of the internet, which is called web 2.0, where instant real-life exchange of messages has become a reality. After the introduction of the internet, now comes blockchain. We are now witnessing another technological tsunamic revolution being (unleashed) thrust on us, called blockchain technology, poised to revolutionize and alter our lives, and indeed, configure our whole existence pervasively and ubiquitously. The initial effort and focus were to create a digital currency which is called Bitcoin as an alternative to the current 'fiat' currency (paper currency). But it has now become a useful technological tool across the board. Beyond Blockchain 1.0 which deals with the application of blockchain technology to cryptos, the world is now talking about Blockchain 2.0, Blockchain 3.0 and even beyond that threshold. (Menalie 2018)

Blockchain 2.0 deals with the full range of blockchain-based economy, market, and financial applications that go beyond simple monetary exchanges, including shares, securities, commodities, credits, home equity loans, deeds, and what can be termed smart estate, and self-executing agreements without any intermediary, and in technological parlance is called smart contracts.

It is pertinent to state here that during the evolutionary life of blockchain technology, a very important breakthrough was achieved/made possible along that trajectory sometime in 2014 with the creation of the Ethereum platform by a Russian immigrant programmer in Canada by the name Vitalik Buterin, which is called web 3.0. Just like the anonymous Satoshi Nakamoto, Vitalik Buterin (2014) followed in his footsteps by publishing a white paper in 2014, outlining another alternative platform to blockchain purposefully created that enables and allows software engineers to develop any type of decentralized application. It gives programmers the leeway to modify the computer-

generated codes that can alter and change the configuration/nature of the blocks in the sequence(chain). It also permits them to create, whole new data, not only to store additional data but information ranging from contracts to stocks, including e-voting without physically being at the designated polling booth. It also allows for the execution of iterative action under given conditions.

The development of Ethereum gives programmers the latitude to deploy some applications, configured on autopilot to operate on the platform, and can be executed unaided seamlessly unhindered. Web 3.0 technological infrastructure did not only transcend its use as a cryptocurrency, but it also cryptographically engineered encryption permits and held out a great promise for the development of any decentralized application. Ethereum, just like bitcoin, incorporates a disintermediation mechanism in its storage and authentication of records in its platform. However, it differs from it by laying greater emphasis on speed, and it places a high premium on the temper-proof security of every transaction. Another important feature of Web 3.0 is the fact that it provides seamless operation of multiple applications on its infrastructural platform, besides acting as a peer-to-peer payment system.

Ethereum not only has its own cryptocurrency called Ether, but it also acts as an open-source system that allows anybody who wants to deploy an application to do so unfetteredly.

3. Research methodology

The methodology employed for this paper involves the rigorous review of existing referenced works and numerous national and international Committee Reports, inclusive of literature on blockchain technology, cryptocurrencies which include books, papers by other scholars, journal articles, online publications on the subject matter; in line with the Systematic Review and Evidence Synthesis (SRES) as propounded by Briner and Denyer (2012). Briner and Denyer (2012) emphasize the application of an identical and comparable standard of strict adherence to the technique and procedure in reviewing relevant literature that would be appropriate and applicable to any scientifically conducted and verifiable fundamental research. We also incorporated the "Preferred Reporting Items for Systematic Reviews and Meta-Analyses" (PRISMA) proposed in (Moher, D., et al., 2009).

4. Findings

4.1. Evolution of Blockchain Technology

The evolution of Blockchain Technology was fortuitously and purely incidental due to the financial crisis in the USA in late 2000 which demanded a new technological paradigm shift for a digital currency, as opposed to the current 'fiat' money as a store of value. It initially focused on creating a cryptocurrency that will be used by anybody, without the need for a central control and intermediary to validate the transactions. But the 2008 USA housing loan debacle that almost took out the entire United States financial system had a resonating ripple effect which was felt by many top financial institutions across the major financial centers of the world's capital cities. This undisputedly accelerates the development of this novel technology. The financial crisis brought to the fore the shortcomings and reliance on the current international financial order, which relies on central control by fiat, which is subject to manipulation and distortions. It was the catalyst needed to spur the world into action. This singular iconic event laid the foundation of what is today called cryptocurrency.

The precursor to the introduction of Bitcoin which was the beginning of blockchain technology as its infrastructure, and which was the grundnorm for the adoption of this novel technology was a white paper published by an anonymous personality under the pseudo name called Satoshi Nikamoto in 2009. The white paper lay out the concept, the technology, and the computer-generated codes of what is today called blockchain, which birthed the first cryptocurrency called Bitcoin.

It is important to mention here that since the beginning of civilization particularly from the Babylonian era where information was recorded on clay tablets to the introduction of bookkeeping in the early 15th century, dovetailed by the introduction of a digitized system using computers, the evolvement of infrastructure has extended the frontier of this phenomenon. Therefore, man's

obsession and the quest for proper record-keeping have undergone tremendous innovation and transformation (Daskalakis and Georgitseas 2020). The intrusion of blockchain technology, therefore, as an emerging novelty in digital technological breakthrough, synchronizes cryptography, data processing and management, networking, and artificial intelligence ;(AI) in enhancing and aiding the authentication, implementation, and recording of transactions involving various stakeholders. The main thrust of this new technology is to ingeniously remove intermediaries in the whole process.

According to Xewei et al. (2018), a blockchain ledger is a list (‘chain’) of groups (‘blocks’) of transactions. Parties proposing a transaction may add it to a pool of transactions intended to be recorded on the ledger. Processing nodes within the blockchain system take some of those transactions, check their integrity, and record them in new blocks on the ledger.

The substance of the blockchain records is replicated across many geographically distributed processing nodes or terminals. In conventional networks of digital payments, there is an imperative and the need for an intermediary (usually a bank or non-financial organization like PayPal, etc.), which records the transactions and thus avoids double-spending.

A third party must record all transactions and check that the amount X sent by one person to the other will not be spent again.

In this context, the existence of a bank and the notion of trust of all parties involved are necessary for this model to function properly. In 2009, Satoshi Nakamoto makes the first reference to bitcoin and offers a solution to the problem of double-spending. (Satoshi Nakamoto 2009)

A new decentralized peer-to-peer payment system is proposed, where users will be able to make transactions directly and between themselves without a third trusted party. This is possible with the use of blockchain technology, which was first introduced as a public, decentralized platform, without the need for intermediaries, to record the bitcoin cryptocurrency. Cryptocurrencies are virtual currencies that do not have a material form; rather, they are viewed as digital information. In this context, the blockchain network is usually described as an accounting book, a ledger, where all this digital information is stored, and everyone can have access to the information contained in this ledger.

Imagine the blockchain network as a ledger that records all transactions, but this ledger is not kept by a bank and does not belong to the bank. Instead, it is made public, where everyone has access to it at any time, and everyone can have a copy of it; at the same time, the personal data of the users are not visible, but digitally and cryptographically encrypted. We can liken or imagine the blockchain network as a spreadsheet that is not stored in a central computer but in all the computers (called “nodes”) of the network, located and spread across the globe. Every amendment on this spreadsheet becomes visible to all users of the network at the same time and is validated only when nodes verify it.

The blockchain network is then a digital platform, which uses cryptographic methods for the storage of information, which cannot be falsified or reversed, and where the entire history of the transactions among the users of the network is recorded, validated, stored, and publicly available. We can view blockchain from a different perspective. From a data point of view, it can be seen as an alternative way of storing data, and conversely, it can also be viewed as a ‘protocol’ or means of communication digitally and/or transferring value.

4.2 What is Blockchain

According to (Chuen and Low 2018) Blockchain takes different shapes either public or private, but has a common theme between them, and these can be summarized, viz.: dispersed data storage, cryptography, inalterability, and what we call ‘consensus algorithm’. Data repository in this context takes the form of sequestered and sequenced information in blocks, added, and linked together.

Blockchains come in many forms and generally share four main features: decentralized data storage (a public ledger of transaction records), encryption, immutability, and a consensus algorithm. As a specialized type of decentralized ledger technology (DLT), blockchains store encrypted data across peer-to-peer networks, linking together sequential “blocks” of information into “chains”. The information available to all network participants is a shared ledger of all information transactions on

the blockchain. The consensus algorithmic self-censorship ensures that information is consistent and immutable across this decentralized network and deters individual users from adding to ledger information without authorization from the network. Furthermore, due to the blockchain's structure, prior information on the chain cannot be edited or removed, as doing so would compromise the integrity of the decentralized ledger.

The blockchain can be defined as an electronic and virtually dispersed and linked system, which can be likened to a digitized network, but utilizes cryptography and encryption techniques to store information and data which cannot be counterfeited or altered; in addition, a comprehensive report and records of the exchanges between the stakeholders of the whole system are algorithmically engineered and cryptographically documented, authenticated, preserved and stored. The records of the entire transaction are open and accessible to the public. The operability of the blockchain is enmeshed in the technology and anchored on three main pillars, namely safety, transparency, and irreversibility.

4.3 Uses of blockchain

Since it debuted in 2009 as a new technological infrastructure for the digital currency that birthed Bitcoin, it has given rise to many cryptocurrencies (altcoins), adopting similar architectural infrastructure but incorporating different features, enhancements, and adjustments. It has also been researched by scholars, investors, and academicians and it has found wider application across many fields of endeavors. Every day its applications are constantly being discovered and brought to light.

Ever since the development of blockchain technology, it has found uses across diverse applications, ranging from cryptocurrencies, finance e.g. equity exchange as being developed by NASDAQ (Cheung et. al (2018) to commerce, e-government, digital identity system management, insurance, crime-fighting; to logistics, agriculture, commerce, smart contract, which is self-executory, without the need for a third party. It is also a tool for improving legislation.

To understand how Artificial Intelligence (AI) and blockchain can affect our daily lives, we need to get to grips with the whole concept of the Internet of Things (IoT), which is the ability of a device to send information to a network and exchange that data with other similar devices. A good example is the smart home system. When AI and the IoT are combined, intelligence is the mind, and the Internet of Things is the body. The latter can only process data thanks to AI. If we introduce blockchain into this system, it becomes useful and secure: intruders will not be able to break into the smart home and take advantage of the stolen information. As blockchain technology is the nerve center of Bitcoin and Ethereum, it has also lent itself to ubiquitous applications in virtually every sphere of business.

One of the areas that blockchain technology could be applied is the management and analysis of 'Big Data'. Blockchain technology can be used to store and distribute data securely, quickly, easily, and more efficiently. The public sector can use blockchain to automatically tax the executed transactions since every transaction in the blockchain environment would be visible to the public. Also, interesting applications in the health sector have already been discussed in the previous section.

Another use of this technology is in electronic voting. The technology allows citizens to vote anonymously, avoiding the risk of someone changing the vote, while simultaneously bringing the whole cost of holding elections down. The hospitality industry can also benefit tremendously from the adoption and use of blockchain technology, particularly in hotel management, and ticket reservations, which could be executed automatically with the use of smart contracts without human interference.

Money laundering legislations and laws require banks' compliance in keeping a tab of customers that flout them, and in addition, provide the government with such lists. This also goes together with the 'Know Your Customers (KYC)' as statutorily required by law to obtain pertinent customer data and information. Therefore, Anti-money laundering (AML) laws and Know Your Customer (KYC) details require banks to perform such a complex and often cumbersome, and time-consuming exercise for each customer one by one. The application of blockchain technology in obtaining and storing such information can be done seamlessly and with ease; more so, the fact that such data are immutable and cannot be altered.

Blockchain, through the peer-to-peer payments mechanism, has removed bottlenecks and hindrances to a sharing economy that was absent in the current ecosystem. It also helped open a whole new vista that emphasizes social responsibility in an inclusive economy as against the current profit motive as a prime driver of business.

Blockchain-enabled direct transactions disintermediate the third-party intervention, as can be evidenced in bitcoin created by Satoshi Nakamoto (2009) and which has assumed the undisputed position as the ‘numero uno’ of choice as a means of payment system in cross-border transaction and exchange of value without the need of an intermediary, and of course without any behemoth central coordinating authority policing such transactions. Everything is carried out by means of consensus among the parties involved. It meets all the attributes of the definition of money which are: as a medium of exchange, as a store of value, and as a unit of account.

Other practical uses of blockchain technology can be found in smart and precision agriculture. Blockchain and artificial intelligence have the capacity to help provide food for the entire global population, which is growing in leaps and bound. This powerful combination of AI and Blockchain helps to put available land into effective and efficient use of arable land.

In the area of the Economic and banks, a synergistic combination of AI and blockchain technology has the potential for increased security for financial institutions, particularly banks. It would afford them greater latitude in taking on additional functions in providing services in insurance, digital identity (Ghajiga and Warlimont 2020), and institutional credit rating. Such a powerful innovative infrastructure can render financial scams, fraud, and online identity theft unattainable. The global banking industry is already witnessing an increased interest in going in that direction by exploring alternatives offered by this technology. At the local level, Stellar is a charitable not-for-profit organization that is working assiduously to decentralize access to capital globally.

Stellar is already partnering with Oradian, a FinTech company to deploy blockchain-related technology in powering the operations of hundreds of Microfinance Banks in Nigeria, which are currently saddled with the burden of movement of physical cash across and between branches, with its attendant risks.

5. Conclusions

The development of Blockchain technology and its attendant use and benefits have challenged existing technology on many fronts and have irrevocably transformed our technological landscape for the future. This new paradigm has opened a new vista in looking at data and information storage, management, and retrieval, which finds application in virtually every sphere of national life. Based on various research findings, and within the ambit of given compelling reasons, Kewell, and Ward (2017) justified people’s prediction that blockchain will transcend not just bitcoin and cryptocurrencies, which were the precursor of this novel technology, but will intrinsically and inherently precipitate a dramatic transformation in the world of technology that will affect and influence our daily lives and existence. The untapped benefits of the application of Blockchain Technology transcendent far beyond the economic sphere. It expands to the political, social, and technical realms. It also finds applicability in charitable and trust organizations. Its practical application is already being utilized and has found use in various industries in solving practical and real-life challenges.

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