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A Block-Chain based Framework for Educational Domain and its Benefits

Dr. S. K. Saravanan[1], Dr. G. N. K. Suresh Babu[2]
[1]*Assistant Professor, (Sel.G), Department of Computer Science and Engineering, SRM Valliammai Engineering College, Kattankulathur, Chennai – 603203*
[2]*Associate Professor, Department of Computer Science and Engineering, Prince Shri Venkateswara College of Engineering, Ponmar, Chennai – 603203*

Abstract: ***A chain of blocks that contains information is the definition of Blockchain. The technique is intended to timestamp digital documents so that it is not possible to temper them. The purpose of blockchain is to solve the double records problem without the need of a central server. Blockchain provides a creative approach to storing information, executing transactions, conducting tasks and trust building. Blockchain is an emerging technology for the applications Smart Cities, Smart Grids, Healthcare, Education, Crypto-currency and Supply chain. This research work would offer a detailed analysis of Blockchain in the Educational domain. It also studies the various applications of Blockchain technology.***
Keywords: Blockchain, Smart Cities, Healthcare, Education, Supply Chain, Privacy, Security.

I. INTRODUCTION

Blockchain is a technology for now, introduced in 2008. The transaction of Bitcoin crypto currency registration in the ledger was first application of Blockchain. To eliminate the third-party intermediary and allow users to make their transaction directly was the aim of Blockchain when it was introduced. As Bitcoin continues to grow in popularity, researchers and practitioners realize the enormous potential of its underlying technology [3]. Blockchain's unique capabilities including immutability, transparency, and trustworthiness was found to be useful not only in crypto currencies but also in many other fields. Therefore, an increasing number of blockchain-based applications have been developed in various fields [4]. This paper aims to recognize various blockchain implementation fields that are already in use and potential blockchain applications in education. It focuses on three key themes: (1) blockchain-based educational technologies, (2) the opportunities that blockchain technology could bring to education, and (3) the complexities of implementing blockchain technology in education. Document authentication is a critical topic with a variety of challenging and time-consuming procedures to authenticate. Various reports are also available, including banking notes, government documents, transaction documents, and educational certificates [3].

II. BLOCKCHAIN TECHNOLOGY

A blockchain is a novel technology that is continuously evolving and being applied in various domains. Its inception is from the famous digital currency, it was used only for financial transactions, but now it is being used or being proposed in every domain that needs immutable and secure record-keeping or ledger. A Blockchain is a chain of blocks which contain information. The data which is stored inside a block depends on the type of blockchain.

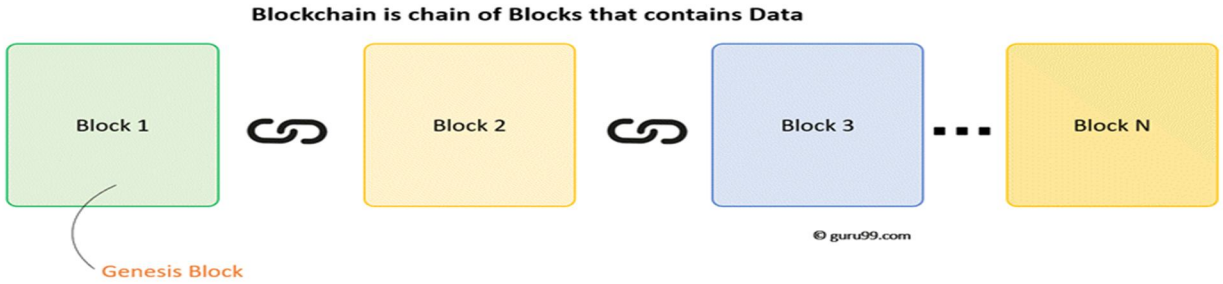


Fig.2.1: Blockchain is Chain of blocks that contains Data

Blockchain is a collection of generated blocks using cryptographic hash functions and connected together with the previous block in the form of a secure chain using cryptographic algorithms.

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A. *Blockchain Types*

Private and public block chains are the two main styles of block chains. There are, however, several variants, such as Consortium and Hybrid block chains.

1) *Public Block Chain:* In this type of block chains, ledgers are visible to everyone on the internet. It allows anyone to verify and add a block of transactions to the blockchain. Public networks have incentives for people to join and free for use. Anyone can use a public blockchain network. A public Blockchain node or user can search current and historical records, verify transfers, proof-of-work incoming blocks, and mine. Crypto currency mining and trading are the most common uses of shared block chains. As a result, the most commonly used decentralized block chains are Bitcoin and Lite coin. Public block chains are largely secure if users closely apply safety guidelines and procedures
2) *Private Blockchain:* The private blockchain is within a single organization. It allows only specific people of the organization to verify and add transaction blocks. However, everyone on the internet is generally allowed to view. Private block chains are functionally similar to public block chains, but their network is smaller and more limited. Private Blockchain is generally applied in voting, supply-chain, digital identity, wealth management, and other applications.
3) *Federated or Consortium Blockchain:* In this Blockchain variant, only a group of organizations can verify and add transactions. Here, the ledger can be open or restricted to select groups. Consortium blockchain is used cross-organizations. It is only controlled by pre-authorized nodes. Government departments, financial institutions and other organizations also use consortium block chains.
4) *Hybrid Blockchain:* A hybrid blockchain combines the benefits of both proprietary and public block chains. It incorporates features from all forms of block chains.

B. *Blockchain Features*

Blockchain technology is not only used for crypto currencies but it is being used in various diverse applications and being proposed in many more due to the following features [10]:

1) *Immutability:* One of the most important blockchain characteristics is immutability, which ensures that the technology remains where it is – a stable, unalterable network.
2) *Decentralized:* The network is decentralized, which means there is no one controlling body or individual in charge of the system.
3) *Improved Security:* Since there is no need for a central authority, no one can simply adjust network features to their advantage. Encryption adds another layer of protection to the device.
4) *Distributed Ledgers:* A public ledger typically contains details about a transaction and its participants. There's nowhere to hide because it's just out in the open. The argument for private or federated Blockchain, on the other hand, is a little different. However, in such situations, a large number of people will see what is actually going on in the ledger. It is because all those users on the device maintain the ledger on the network. To get a better result, the computing power was spread through the machines.
5) *Consensus:* Consensus is a community of participating nodes on the network's decision-making mechanism. The nodes will accept easily and reasonably quickly in this case.
6) *Faster Settlement:* As opposed to conventional banking schemes, Blockchain allows for a quicker settlement. It will enable a person to pass funds more quickly, which saves time in the long run.

C. *Blockchain Applications and Use Cases*

Blockchain has been proposed to be used in different applications and use cases, as shown in Figure 3.3.1.

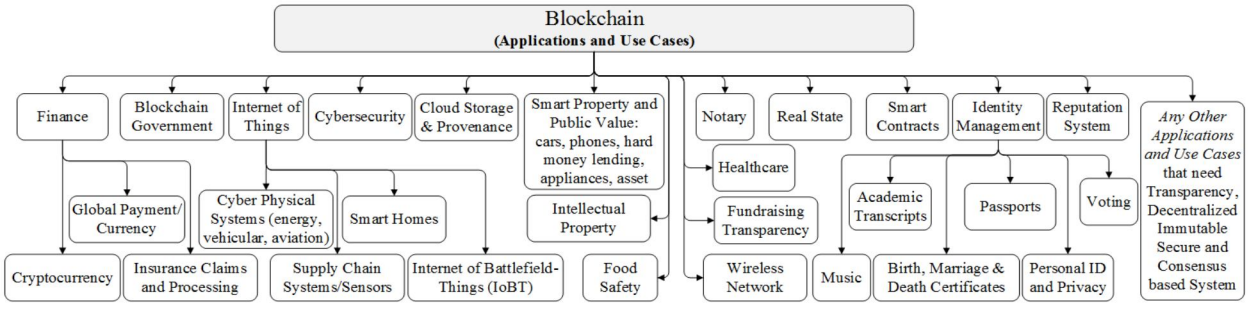


Fig.3.3.1: Different Application of Blockchain

1) *Financial Applications:* Blockchain technology is currently being used in various financial areas, including business services, financial asset settlement, prediction markets, and economic transactions. Marketplace systems (PMS), which operate as oracles or intelligence sources, are another fascinating area that can influence companies and crypto currencies. Blockchain is set to play a critical role in the financial economy's long-term viability, benefiting investors, the existing banking system, and society as a whole [12].
2) *Healthcare Management:* Blockchain technology may provide a critical solution for the healthcare providers that have implementations in healthcare management, demographic healthcare history, electronic insurance claims settlement and remote patient patients' medical data sharing. It will provide user-oriented medical investigation, stop counterfeit products & medicines, and manage clinical trial data [18]. In specific, Blockchain along with Smart Contracts, may solve issues such as clinical trial outcomes' scientific credibility and patient informed consent [16].
3) *Governance:* Governments have been tasked with managing and maintaining official accounts of residents and/or businesses for several years. Through disintermediating transactions and record-keeping, blockchain-enabled applications can transform the way local and state governments function [10]. Blockchain's transparency, automation, and security for managing public information could potentially prevent corruption and improve government services. Blockchain may be used as a secure networking network for combining physical, social, and industrial infrastructures in a smart city framework [13]. Blockchain governance aims to have the same resources as the state and its related public bodies in a decentralized and effective manner whilst retaining the same legitimacy.
4) *Voting:* E-voting is being proposed as a promising and game-changing technology to ease out the election process, reduce the law and order complications and reduce time and financial expenditure. Still, due to security issues and cybersecurity threats, it has not gained momentum. Blockchain can provide a trusted and secure platform for e-voting that can remain consistent with domestic laws.
5) *Business and Industrial Applications:* Blockchain may become an important source of novelty in business and management through reinforcing, optimizing, and automating enterprise processes. The IoT and the Blockchain are spawning a slew of innovative e-business models. In a business model, SCs are used to carry out transactions between devices on a distributed network based on Blockchain [18].
6) *Internet of Things (IoT):* The application of the Internet of Things (IoT) to population growth has resulted in its applications in each daily life domains and become critical for growth [15]. Although there are many advantages of using IoT, various security threats outnumber these advantages [16]. Due to limited hardware capabilities, the traditional cryptographic security mechanism cannot be applied in such an environment. Blockchain can provide a platform and mechanism for securing the IoT network, and it can provide an open IoT network for a secure, reliable and interoperable IoT network [17].
7) *Energy Sector:* Blockchain's potential applications in the energy market are many, and they would have a significant impact on both processes and networks. Blockchain can minimize costing and enable new business models, while marketplaces and grids could be best equipped to manage sophistication, data security, and ownership. It can also make the power grid operate more efficiently and effectively control demand response and provide a foundation for more proficient resource consumption monitoring and billing in energy sources [14].
8) *Miscellaneous Applications:* Crowdfunding is a suitable use case of blockchain technology. In the humanitarian and philanthropic fields, blockchain implementations may be used to tackle hunger. Blockchain can also build intelligent, secure, distributed, and autonomous transportation networks and securely manage event tickets in smart city contexts. Edge computing and the creation of computational resource sharing networks, grid computing, cloud computing, and the usage of Blockchain as a device connector are several of the IT-related blockchain applications that are of particular concern.

III. BLOCKCHAIN IN EDUCATION

The Blockchain can help educational institutions strengthen their ability to assist teachers, deliver knowledge to guardians and community members, empower new learning systems, and expand and provide learning opportunities for more students. Figure 1 depicts the general structure of Blockchain and users in the domain of education. There are several uses and advantages of using blockchain technology in the field of education:

A. Online Education

Online education, also known as distance learning or electronic learning, uses data and internet technology to deliver information and facilitate learning. It's referred to as a web-based learning technique. With blockchain invention, an ideal solution to online learning issues, such as legitimacy and protection, will be offered. The Blockchain will also create non-modifiable learning documents for online teaching without the need for third-party oversight, ensuring that course credits are adequately recognized.

B. Student Records

Academic transcripts are one of the most time-consuming and labour-intensive processes in higher education. Each entry must be manually checked for authenticity before a validated record of a student's grades is available. Course content certification is another type of student record that is often sought. Each page should be signed and stamped for each student who requests this record (to ensure accuracy). If material courses and academic accomplishments were stored on a blockchain, an individual could get an accurate, authenticated record with just a few taps [18].

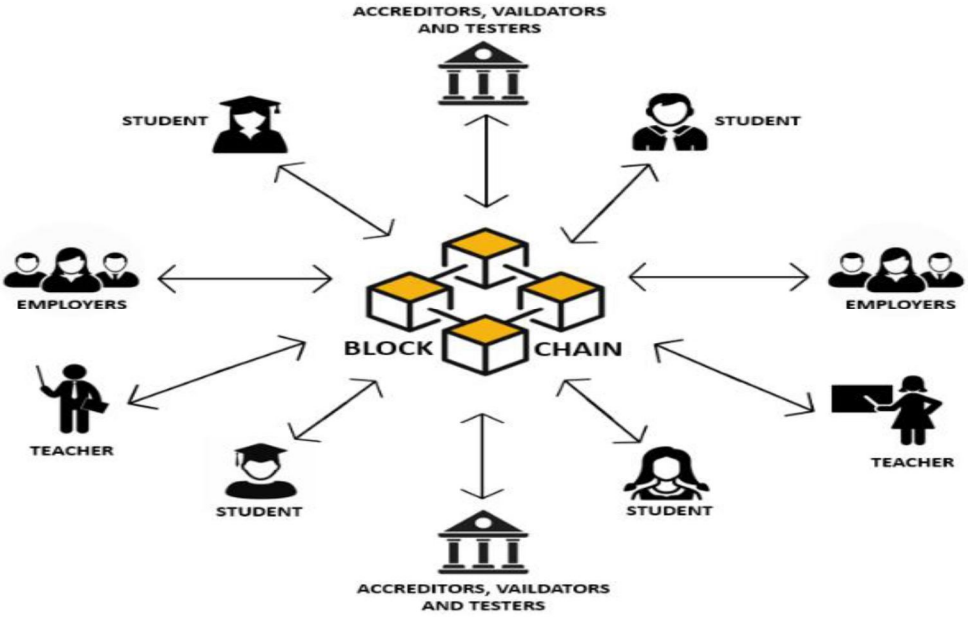


Fig 4.2.1: Blockchain in Education

C. Diplomas and Certificates

Diplomas and certificates for students could be provided and stored on a blockchain, much like grades. Employers will then need to be given a referral to a digital certificate instead of requiring the agency that issued the diploma to certify a paper copy. It is also in progress. Since most of the available instructive credential administrations are unable to guarantee the confidentiality and reliability of student data. Although using Blockchain to address confidence problems could be a viable solution, Blockchain has drawbacks that limit its complete adoption. Small throughput and access time are found in Blockchain. It stops users from using fake degrees or certificates to possible employers or institutions for higher education.

D. Badges

Aside from degrees, a standard resume provides a wealth of additional details that employers can find helpful. We're talking about qualities like foreign language proficiency, engineering competence, or unique talents that aren't inherently relevant to one's occupation. However, these abilities are difficult to prove. However, an individual may hire a third-party professional to validate their competence and issue a credential or badge. If these are stored on a blockchain, they can be used to show that an individual has the necessary skills. Open Badge Passport, for example, is the first step in this direction.

E. Student Examination and Evaluation

Students will then take the test remotely using personal computers or smartphones, with the Blockchain performing the evaluation. Teachers would have more time to devote to other scholarly or cultural pursuits if they didn't have to grade tests. Teachers can use smart contract and Blockchain with defining the correct answers and scoring criteria for evaluation. Student's will then appear for the examination on their PC or devices. Students' academic success and academic successes in education, preparation, tournaments, work, and other events outside of school can be measured using blockchain technologies to assess their capability, which benefits both students and businesses looking to hire them. A blockchain-based student technical skill assessment system that can test student ability measurement methods using a clustering algorithm. The framework can also allow for the development of a student skill assessment ecosystem.

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F. Lessons and Courses.

Many blockchains also support smart contracts. It ensures that lessons and courses can be coded into the Blockchain and run spontaneously when those criteria are encountered. An instructor may assign students assignments. The smart contracts on the Blockchain could verify the execution of each mission automatically. Teachers could be paid in crypto tokens for finishing all assignments, and students can get credits. This method may be used to layout whole classes also.

G. Identity

With the proliferation of learning apps and services, identity management is becoming crucial in education. Platforms like uPort help users carry their identity around with them, uploaded to the network, and easily accessible. Identity management is very important in education. It enables schools to:

1) Facilitate effective access to numerous systems such as billing, canteen usage, checking out books from the library, etc.
2) Satisfy increased state and federal regulatory requirements.
3) Offer the latest IT systems to staff and students.
4) Keep educational credentials secure.

Instead of storing the student identity document, the blockchain stores information about that document. Using blockchain, students can identify themselves online while maintaining control over the storage and management of their personal data.

H. Attendance and Assignment Completion Tracking

Blockchain secures student data and improves the information retrieving process for students' attendance, assignment completion tracking, etc. As blockchain networks save all the information about students and their achievements, it is possible to track their progress in learning and other activities. In the long run, this will guide educational institutions to make necessary changes in the educational process.

I. Infrastructure Security

Currently, educational institutions are faced with the challenge to protect their networks from hackers. As already mentioned, blockchain technology offers a secure network and it is impossible to fake the information stored in the blockchain. Companies like Xage are using blockchain's tamper-proof ledger that protects every element, including new and legacy systems, and secures every interaction, enabling dynamic data security.

J. Efficient Data Storage

Educational institutions these days store more data than ever before. The distributed ledger technology (DLT) cloud storage offers safer and potentially cheaper alternatives for storing and retrieving data. For example, File coin is a high-profile crypto project that rewards the hosting of files. It connects the world with a new storage model, creating hyper-local and efficient storage.

K. Simplification of Records Management

Blockchain technology in K-12 eliminates paper-based processes and simplifies record management. It is more than suitable for records such as students' certificates, degrees, and transcripts. In addition to encrypting records, blockchain offers a means for documenting and tracking the breadth of a student's learning experiences.

L. Next-Generation Library Platform

Blockchain is seen as a foundation in the next-generation library platform. It offers a much more efficient and easier way to accumulate, keep track of, and store information. That is a huge advantage which could be used to improve library and information services in schools. For example, San Jose State University School has received a substantial grant to work on the potential of blockchain technology for the information profession.

IV. CONCLUSION AND FUTURE WORK

The application of blockchain technology to the education field is in its infancy. Therefore, an analysis of the state-of-the-art blockchain research in the field of education was conducted. It yields several findings. First, it indicated that blockchain technology is mostly used to: issue and verify academic certificates, share students' competencies and learning achievements, and evaluate their professional ability. However, a wide range of other applications are emerging rapidly.

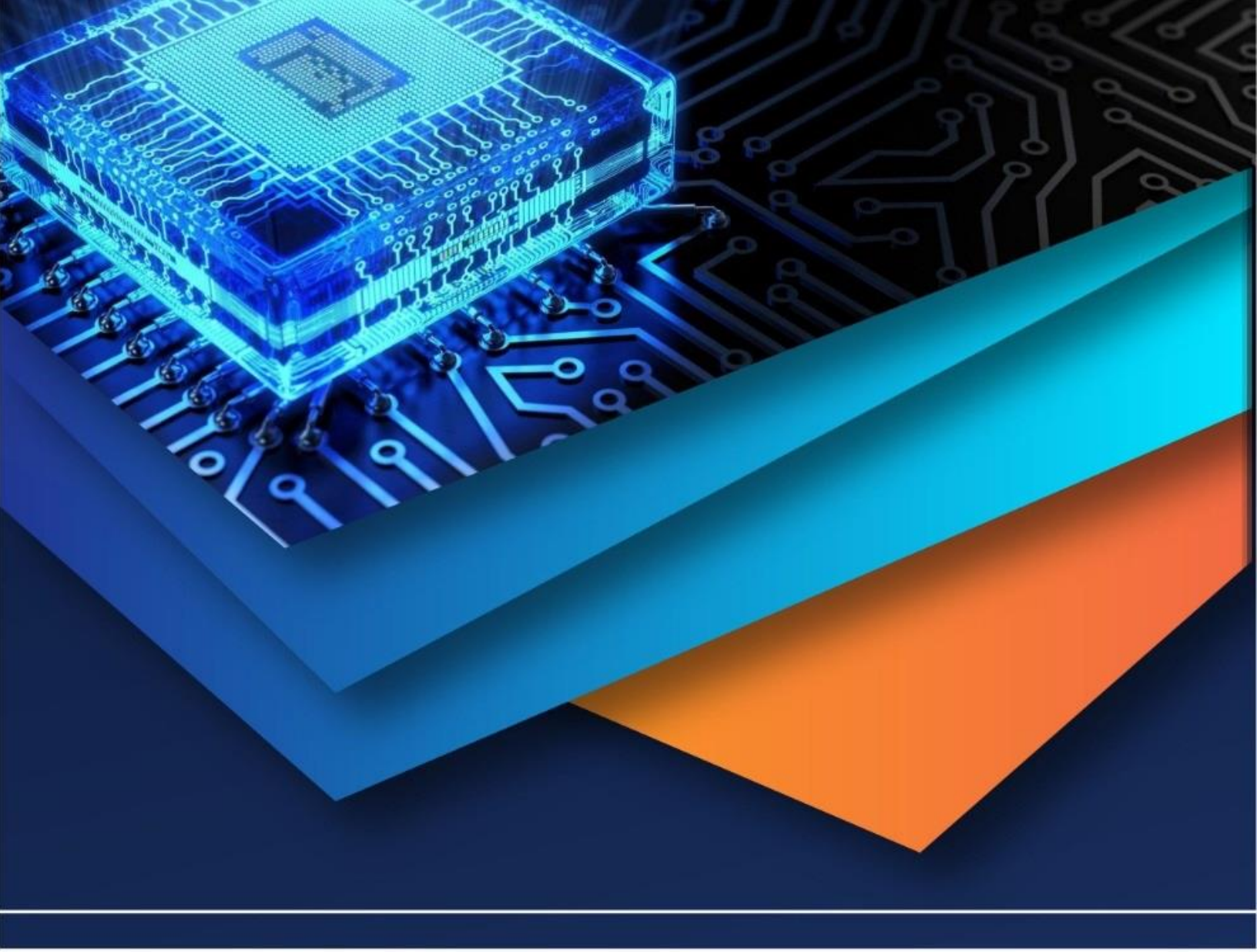
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Second, it shows that blockchain could bring significant benefits to education including providing a secure platform to share students' data, lowering cost, and enhancing trust and transparency. Third, it illustrates that the use of blockchain technology is not without challenges. Managers and policymakers should consider challenges related to security, privacy, cost, scalability, and availability before adopting the technology. Lastly, it shows that the educational areas in which blockchain technology was applied are still limited. Therefore, the potential for blockchain is still unexploited.

Blockchain is a rapidly spreading technology, and it will be a pillar for many applications in the next few years. A suggestion for future work is to continue this work by conducting more interviews to identify some additional characteristics for the current application areas of Blockchain. In particular, the field of education in detail. Make Educational courses that explain blockchain technology at a reasonable cost so many people can join and review the smart contracts in more detail and study the potential risks within this area.

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