BLOCKART: THE BLOCKCHAIN SOLUTION TO E-COMMERCE

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Abstract

A blockchain is a global, digital, consensus-based method of securely storing information. The article that follows gives a general overview of blockchain-based electronic voting methods. This analysis' main objective is to assess the current state of blockchain-based E commerce research and any possible roadblocks that may be present to forecast future trends. A systematic review methodology was applied in the study. Following a brief overview of the fundamental characteristics and structure of the blockchain in relation to E- Commerce, we give a conceptual description of the proposed blockchain-based e-commerce application. The growth of blockchain systems depends on advances in both symmetrical and asymmetrical cryptography.

Keywords: Blockchain, E-Commerce, Cybersecurity, Cryptography, Hashing

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1. Introduction

E-commerce, banking, energy, and other industries are currently advancing quickly, and new technologies are emerging every day. User information leakage risk events occasionally happen in conventional e-commerce. There is a pressing need to figure out how to use blockchain technology to increase the security of e-commerce networks. The number of cross-border payments is growing along with the size of cross-border e-commerce trade. The records of Conventional e-commerce transactions rely on centralized organizations to maintain their records, which can be costly, inefficient, and lacking in transparency. In contrast, blockchain technology uses a decentralized ledger system that ensures the authenticity and fairness of transactions, while eliminating the potential for fraudulent activities and validity of the transaction. Business process optimization, expense savings, and increased synergy effectiveness are benefits of blockchain-based apps. Supply chain management and financial services have progressively benefited from these benefits.

A safer, effective, quicker, less expensive, open, dependable, and low-risk e-commerce tool may result from using Blockchain as the platform. This essay will suggest using blockchain as the system and design of an e-commerce network.

There are a few limitations on how blockchain technology may be used and used effectively in e-commerce. Scalability problems, high prices, a lack of standards, low user uptake, and security risks are a few of them. Before blockchain is widely used in ecommerce, these obstacles need to be fixed.

2. Literature Review

In paper [1], it has been explained that a better protected method for communication between a buyer and a seller is increasingly necessary as the world of e-commerce as it expands rapidly. Although we benefit from a data-driven culture, we also need to think carefully about how our data is collected, used, and shared. Users of centralized organizations have no control over how these organizations use and manipulate the vast amounts of personal data they hold about them. A review reveals that only 20% of the research work has been done on smart contracts and other blockchain applications, while 80% of the research in 41 blockchain-related papers is based solely on bitcoin.

Blockchain interoperability, refers to the capacity of blockchains to operate outside of their respective closed environments. Interoperability for blockchain-based systems can mean a variety of things in this context, including supporting asset exchange, asset transfer, or data exchange. Interoperability and programmability were not intended for Bitcoin, the first cryptocurrency to garner significant attention. But many new concepts have been added to the blockchain world since the emergence of Ethereum, which was followed by the emergence of numerous other blockchains. Ethereum, for instance, introduced programmable smart contracts and the capacity to send any data.

In paper [2], Alshudukhi & etc, tried to explain an interoperability solution's widespread adoption can directly be attributed to its upgradeability and adaptability. Decentralized relays, hub and spoke systems, and decentralized oracles are three general integration modes that can be seen in these projects among the solutions that have been discussed. Decentralized relay architecture is more flexible and suitable for handling arbitrary data. However, the level of security may also be lower depending on the third-party validation service. By using secondary blockchains to implement the system, the hub and spoke architecture can provide better security and validation. Complete upgradeability, on the other hand, can be trickier to achieve and calls for more effort from developers to integrate new networks into the system. Blockchains can use off-chain data by using the decentralized oracle approach. Even though it is unidirectional, it can still promote interoperability by allowing different blockchains to read information from one another.

In paper [3], Cekerevac & etc., emphasis that there are essentially no capacity restrictions because of the decentralized system. Blockchain offers users better privacy in addition to improved transaction security. The risk of inaccurate manual data entry is decreased by reducing the amount of human labor required. Because "third-party" involvement is not necessary, transactions can become much more affordable. Due to the transparency of the entire system, transactions are also more secure. Although transactions are typically simple, they cannot be free because they require a lot of computer time, dependable hardware, and a high amount of power.

In paper [4], Syed & etc., researched that blockchain applications in commercial and dynamic industries in South Asia may have

significant advantages. The most crucial aspects of blockchain technology for business and industry are highlighted in this study. It will be a revolution for nations if it can be put into practice. Eliminating fraud and corruption will thus be Bangladesh and Pakistan's most notable historical accomplishment. Only in a network can blockchain innovation be used to its fullest extent. To provide the most value to all of its participants, it would be beneficial to have a fully developed ecosystem on the blockchain. We can therefore see how blockchain technology would benefit the commercial ecosystem. South Asian nations like Bangladesh and Pakistan have a particularly terrible impact on corruption and economic consequences.

Supply chain management and data management can benefit all factories, including those that make clothes, by lowering costs and fostering a budget-friendly environment for decentralized industrialization. This disruptive innovation has the potential to significantly alter entire industries as well as many current business models. Therefore, it is very advantageous to conduct research on the intersection of technology, markets, and business models. We firmly believe that this paper will aid future research studies by business scholars.

In paper [5], Mukherjee & etc., studied that Blockchain 4.0 is a further promising advancement in the development of blockchain. In order to make Blockchain Technology fully mainstream, it aims to provide a business-friendly platform on which developers can build and deploy applications. It may combine blockchain technology with other successful technologies like artificial intelligence. In order to meet business and industry demands, Blockchain 4.0 enables the proliferation and seamless integration of numerous platforms.

In paper [6], Kaur & etc., explained that Blockchain technology provides a high level of security through its consensus mechanism and hashing algorithms. Consensus is the process by which all nodes on a blockchain network agree on the validity of a transaction or block of transactions. This agreement is achieved through a complex mathematical algorithm that requires a majority of nodes to confirm the transaction before it can be added to the blockchain. This makes it nearly impossible for any single node or group of nodes to manipulate the blockchain's data.

Additionally, blockchain uses hash functions to secure its data. Hashing is the process of taking a string of any length and producing a fixed-length output called a hash. The hash is unique to the input string, and any change in the input string will result in a different hash output. This makes it nearly impossible for anyone to alter data on the blockchain without being detected, as any changes to the data would result in a different hash value.

3. Proposed System

Developing an ecommerce website using blockchain as a backend can be a complex project, but it can provide many benefits such as enhanced security, transparency, and decentralization. Here are some steps you can follow to get started.

Define the scope and requirements of your project: Before starting to develop your ecommerce website, it's important to define what you want to achieve and what features you need. This will help you select the appropriate blockchain technology and tools to use.

Choose the right blockchain platform: There are many blockchain platforms available, each with its own strengths and weaknesses. Some popular options include Ethereum, Hyperledger Fabric, and Corda. Consider the type of ecommerce website you want to build and select the blockchain platform that is most suitable for your needs.

Define the smart contracts: Smart contracts are self-executing programs that can be used to automate transactions and enforce business rules. Define the smart contracts that you will need for your ecommerce website, such as payment processing, order tracking, and product verification.

Develop the front-end of your website: Once you have defined the blockchain components of your ecommerce website, you can start developing the front-end. This will include designing the user interface and integrating it with the blockchain components.

Test and deploy your website: Before launching your ecommerce website, it's important to test it thoroughly to ensure that everything works as expected. Once you are satisfied with the testing results, deploy your website and make it available to your customers.

Maintain and update your website: As with any website, it's important to regularly maintain and update your ecommerce website to ensure that it remains secure and up-to-date with the latest technologies and trends.

The following figure depicts the working of the final model, here the user of the site is connected to the network via a wallet in our case being MetaMask, Metamask provides the user the ability to use their cryptocurrencies to make transactions. The Smart Contract is the central part of the architecture. The smart contract is deployed on the blockchain and is self-executed whenever a need arises, the smart contract ensures that all the data regarding the stock, customer details, cost of the articles and everything is updated.

The smart contract handles both listing and buying of articles. The contract has extra features like event logging and the contract owner's ability to withdraw money.

The smart contract implements a simple decentra lized marketplace on the Ethereum network, which can be accessed and interacted with using any Ethereum-compatible wallet or dApp browser, such as MetaMask.

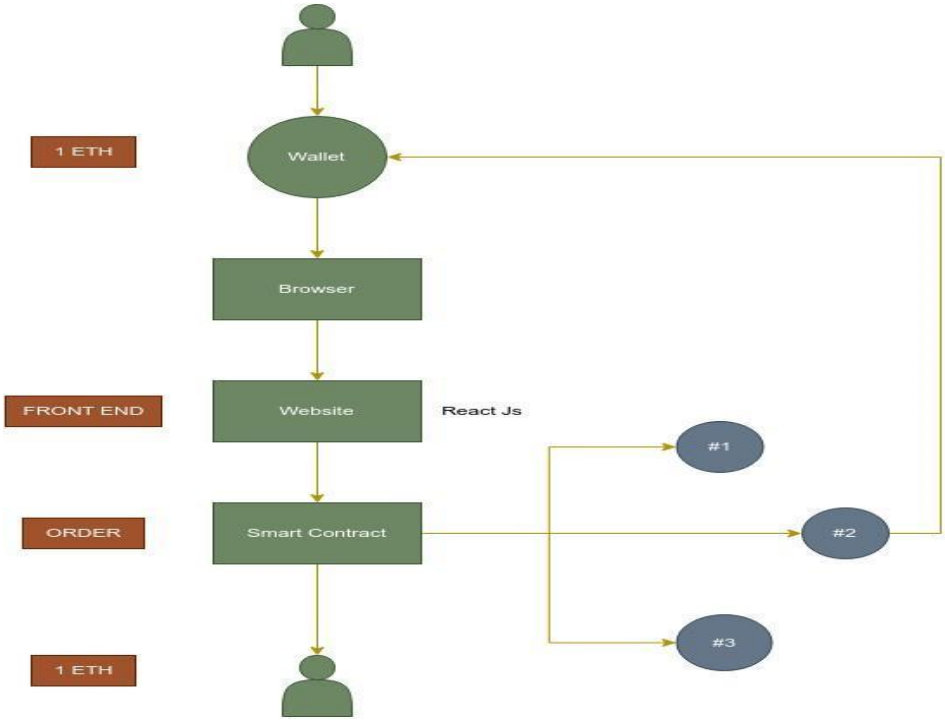

Figure 1: Architecture of Website

Algorithm:

Developing an ecommerce website using blockchain as a backend requires the use of a number of algorithms. Here are some key algorithms that may be involved in the development process:

Consensus algorithm: In a blockchain network, consensus algorithms are used to validate transactions and ensure that all nodes in the network agree on the state of the ledger. Depending on the blockchain platform used, different consensus algorithms may be employed, such as Proof of Work, Proof of Stake, or Byzantine Fault Tolerance.

Smart contract algorithm: Smart contracts are self-executing programs that automate the execution of certain tasks on a blockchain. These contracts are coded in a specific programming language such as Solidity for Ethereum or Go for Hyperledger Fabric. Algorithms for writing smart contracts are typically based on standard programming concepts such as conditionals, loops, and data structures.

Payment processing algorithm: In an ecommerce website, a payment processing algorithm is required to handle the transfer of funds between buyers and sellers. This algorithm will typically involve the use of a smart contract to facilitate the transaction and ensure that all parties are satisfied with the outcome.

Order tracking algorithm: An order tracking algorithm is required to track the progress of orders and provide real-time updates to buyers and sellers. This algorithm may involve the use of a smart contract to record the state of the order and notify parties when certain milestones are reached.

Product verification algorithm: To ensure that products listed on the ecommerce website are genuine, a product verification algorithm may be used. This algorithm may involve the use of unique identifiers such as serial numbers or QR codes,

which are recorded on the blockchain to ensure authenticity.

Databases:

The choice of database for an ecommerce website using blockchain as a backend may depend on the specific requirements and constraints of the project. However, here are some common database options that are frequently used:

Distributed databases: Since blockchain is inherently distributed, it may be appropriate to use a distributed database that can operate efficiently in a decentralized environment. Distributed databases like Apache Cassandra, MongoDB, and Amazon DynamoDB can be suitable for ecommerce websites using blockchain as they provide high scalability, fault tolerance, and low-latency data access.

Relational databases: Relational databases like MySQL, PostgreSQL, and Microsoft SQL Server are also commonly used in ecommerce websites. They offer strong data consistency and support for complex queries, which can be useful for ecommerce applications.

Hybrid databases: Some ecommerce websites use a combination of relational and NoSQL databases to take advantage of the strengths of both types of databases. Hybrid databases like Apache HBase and Google Cloud Spanner can provide the benefits of both relational and NoSQL databases.

Blockchain-based databases: Some blockchain platforms, like Ethereum, provide a built-in database as part of their infrastructure. These databases are optimized for storing data on the blockchain and may be suitable for certain types of ecommerce applications.

4. Significance of Work

Implementing a blockchain-based database is more appropriate for the architecture than doing so with a traditional database system. The architecture can periodically update and amend the data on the blockchain network's nodes. It can make sure the data is encrypted and difficult for third parties to access. Data is organized into blocks and linked together using hash values. The following blocks will be impacted by a change in the data. Further, the data is always accessible to assist corporate operations because of the enormous size of scalability of data and efficiency in the aspect of data storage's backup. In essence, it is possible to overcome the limitations of blockchain and database systems by integrating them to create a hybrid system that can offer secure and scalable e-commerce operations. This system is particularly suitable for businesses that require a high level of data security, flexibility, and stability in their transactions.

In everyday operation, this system is appropriate for e-commerce businesses. The problems with data breaches can be effectively avoided at the same time.

5. Results And Discussion

The final version of the Website is displayed in the Screenshots attached below the following site comprises a user-friendly interface which allows the user to look at the various articles available for purchase just like any other web 2.0 website. Here the Users can interact with the website, place orders for the products etc.

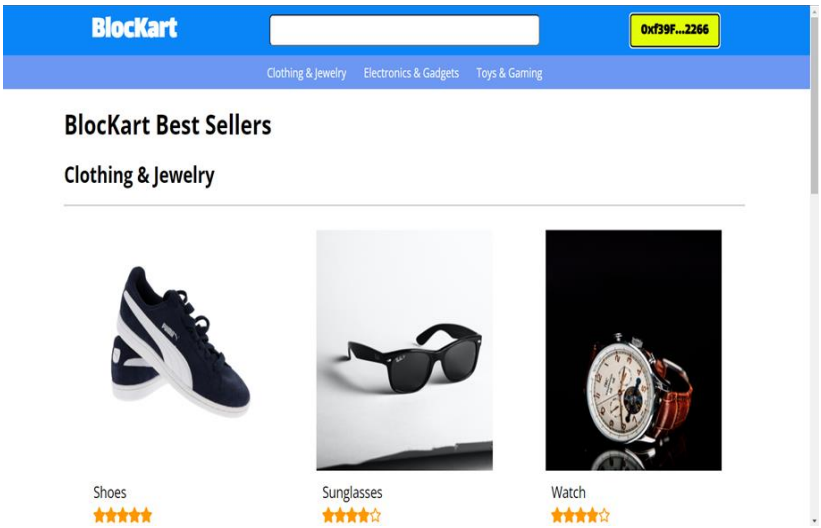

Figure 2

The additional functionality of the website is added in the backend where the website stores all the data and information the blockchain. Hardhat is used to run a local blockchain for testing and development

purposes. Hardhat provides a built-in network called "Hardhat Network" which allows us to simulate a local Ethereum blockchain.
All the information about the stock and the orders about the customers and their addresses are stored on this Blockchain and are recalled whenever needed by the system whether to check inventory or to place an order. The changes made to the blockchain are immutable i.e., No one without the knowledge of the user can interfere with the information stored on the blockchain.

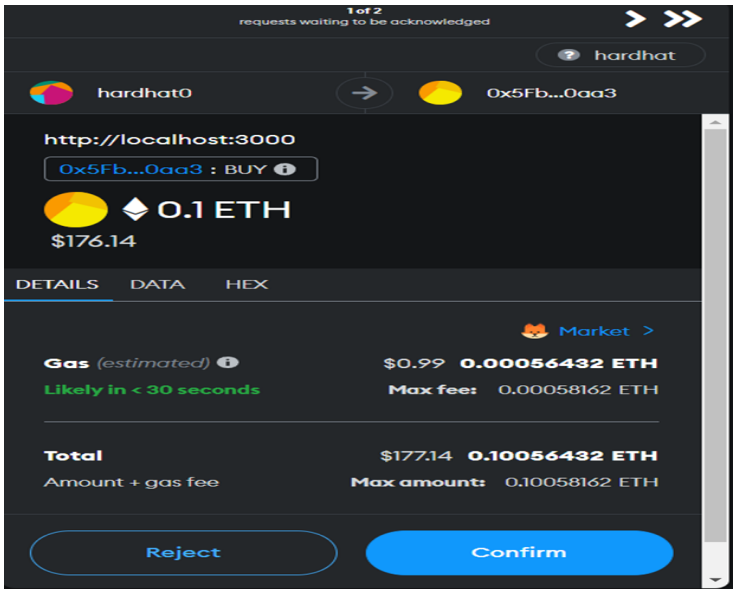

Figure 3

The above screenshot depicts a transaction being made using MetaMask from the user's wallet to the site owner's address thus ensuring that the transaction is completed successfully. MetaMask allows users to manage their Ethereum accounts and interact with decentralized applications (Dapps) on the Ethereum network.

Upon completion of a transaction the user sends the amount in ETH to the owner and the Stock for the article that the user placed an order for is reduced by the number of articles the user ordered and the blockchain on the backend is updated for the same.

SOURCE CODE -

```
function buy(uint256 _id) public payable {
    // Fetch item
    Item memory item = items[_id];

    // Require enough ether to buy item
    require(msg.value >= item.cost);

    // Require item is in stock
    require(item.stock > 0);

    // Create order
    Order memory order = Order(block.timestamp, item);

    // Add order for user
    orderCount[msg.sender]++; // <-- Order ID
    orders[msg.sender][orderCount[msg.sender]] = order;

    // Subtract stock
    items[_id].stock = item.stock - 1;

    // Emit event
    emit Buy(msg.sender, orderCount[msg.sender], item.id);
}
```

Figure 4

```
function list(
    uint256 _id,
    string memory _name,
    string memory _category,
    string memory _image,
    uint256 _cost,
    uint256 _rating,
    uint256 _stock
) public onlyOwner {
    // Create Item
    Item memory item = Item(
        _id,
        _name,
        _category,
        _image,
        _cost,
        _rating,
        _stock
    );

    // Add Item to mapping
    items[_id] = item;

    // Emit event
    emit List(_name, _cost, _stock);
}
```

Figure 5

This code defines a smart contract called "BlocKart" on the Ethereum blockchain using Solidity programming language. BlocKart is a marketplace for buying and selling items, where users can list items for sale and other users can buy them using Ethereum cryptocurrency.
The contract has two main data structures: "Item" and "Order". Items have properties such as name, category, image, cost, rating, and stock. Orders contain information about the time of purchase and the item that was bought.

The contract provides two main functions: "list" and "buy". The "list" function allows the owner of the contract to add new items for sale to the marketplace. The "buy" function allows users to purchase items by providing the ID of the item they want to buy and the required amount of Ethereum. The contract includes additional functionality such as event logging and withdrawal of funds by the contract owner.
Overall, this code implements a simple decentralized marketplace on the Ethereum network, which can be accessed and interacted with using any Ethereum-compatible wallet or dApp browser, such as MetaMask.

6. Conclusion

In conclusion, blockchain technology has the ability to completely transform the e-commerce sector by enhancing transaction security, transparency, and efficiency. Because blockchain technology is decentralized, intermediaries are no longer necessary, which reduces costs and fosters more confidence between buyers and sellers. Scalability and interoperability problems, as well as regulatory obstacles, continue to prevent the widespread deployment of blockchain technology in e-commerce. These issues should be addressed in future studies, along with the potential of blockchain technology to support new business models and enhance the e-commerce experience as a whole. Stakeholders in the sector should constantly monitor the use of blockchain technology in e-commerce since it has the potential to unleash enormous value for both businesses and consumers.

References

1. Khan, Mohammad & RoJa, Nesat & Almalki, Faris & Aljohani, Maha. (2022). Revolutionizing E-Commerce Using Blockchain Technology and Implementing Smart Contract. Security and Communication Networks. 2022. 1-8. 10.1155/2022/2213336.
2. Alshudukhi, Khulud & Khemakhem, Maher & Eassa, Fathy & Jambi, Kamal & An, Interoperable & Blockchain, & Alshudukhi, Khulud & Khemakhem, Maher & Eassa, Fathy & Jambi, Kamal. (2023). Citation: An Interoperable Blockchain Security Frameworks Based on Microservices and Smart Contract in IoT Environment. Electronics. 12. 10.3390/electronics 1203 0776.

3. Cekerevac, Zoran & Cekerevac, Petar. (2022). BLOCKCHAIN AND THE APPLICATION OF BLOCKCHAIN TECHNOLOGY. MEST Journal. 10. 14-25. 10.12709/mest.10.10.02.02.
4. Syed, Madiha & Abadin, Zain. (2023). A Pattern for Proof of Stake Consensus Algorithm in Blockchain. 1-5. 10.1145/3551 902.3564854.
5. Mukherjee, Pratyusa & Pradhan, Chittaranjan. (2021). Blockchain 1.0 to Blockchain 4.0—The Evolutionary Transformation of Blockchain Technology. 10.1007/978-3-030-69395-4_3.
6. Kaur, Gurdip & Habibi Lashkari, Arash & Sharafaldin, Iman & Lashkari, Ziba. (2023). Blockchain Security. 10.1007/978-3-031-23340-1_4.
7. Ismanto, L & Ar, H & Fajar, A & Sfenrianto, Sfenrianto & Bachtiar, Sukarman. (2019). Blockchain as E-Commerce Platform in Indonesia. Journal of Physics: Conference Series. 1179. 012114. 10.1088/1742-6596/ 1179/1/012114.
8. Kotey, Seth & Tchao, E. T. & Ahmed, Abdul-Rahman & Agbemenu, Andrew & Nunoo-Mensah, Henry & Sikora, Axel & Welte, Dominik & Keelson, Eliel. (2023). Blockchain interoperability: the state of heterogenous blockchain-to-blockchain communication. IET Communications. 1-24. 10.1049/ cmu2.12594.
9. Teo Min Xuan, Maen T. Alrashdan, Qusay Al-Maatouk and Mosab Tayseer Alrashdan, Blockchain Technology in E-commerce Platform, International Journal of Management, 11 (10), 2020, pp. 1688-1697.
10. L Ismanto, H Suwito Ar, A N Fajar, Sfenrianto and S Bachtiar Published under licence by IOP Publishing Ltd Block chain E-Commerce Platform in Indonesia.
11. Revolutionizing E-Commerce Using Blockchain Technology and Implementing Smart Contract(Mohammad Monirujjaman Khan)
12. Lansiti, M. and R. Lakhani, K., 2020. The Truth About Blockchain.
13. Medium. 2020. How Blockchain Technology Works.
14. Metelin, S., 2020. The Role Of Blockchain In Data Security.
15. Muzammal, M., Qu, Q. and Nasrulin, B., 2019. Renovating blockchain with distributed databases: An open source system. Future Generation Computer Systems, 90, pp.105-117.
16. Nathan, S., Govindarajan, C., Saraf, A., Sethi, M. and Jayachandran, P., 2019. Blockchain meets
17. database. Proceedings of the VLDB Endowment, 12(11), pp.1539-1552 O'Neal, S., 2020. Blockchain Interoperability, Explained.
18. Paik, Hye-young & Xu, Xiwei & Bandara, Dilum & Lee, Sung & Lo, Sin Kuang. (2019). Analysis of Data Management in Blockchain-based Systems: From Architecture to Governance. IEEE Access. PP. 1-1. 10.1109
19. Palavesh, S., 2020. Here's How You Can Secure Your Data With Blockchain. [online] Entrepreneur. Available at: <https:// www. entrepreneur.com/article/318477> Teo Min Xuan, Maen T. Alrashdan, Qusay Al-Maatouk and Mosab Tayseer Alrashdan
20. Panoho, K., 2020. Council Post: The Age Of Analytics And The Importance Of Data Quality.
21. R. Mathew, A., 2019. Cyber Security through Blockchain Technology. International Journal of Engineering and Advanced Technology, 9(1), pp.3821-3824.
22. Ramachandiran, Rajesh. (2018). Using Blockchain Technology To Improve Trust In eCommerce Reviews. 10.13140/RG.2.2. 29324.00646.
23. Roussev, V., 2009. Hashing and Data Fingerprinting in Digital Forensics. IEEE Security & Privacy Magazine, 7(2), pp.49-55.
24. Saleh Hadidi, Maen Al-Rashdan, Mamoun Hadidi, 2020. Impact Web On Decision Support Systems On The Organizations. Journal of Critical Reviews, 7(3):2020.
25. Saakian, H., 2020. How Blockchain Has Helped The Business Of E-Commerce - Asia Blockchain Review - Gateway To Blockchain In Asia. [online] Asia Blockchain Review - Gateway to Blockchain in Asia
26. Sharma, T., 2020. Top 10 Blockchain Solutions For E-Commerce. [online] Block chain council. org.
27. Suciu, P., 2020. The Biggest Cybercrime Threats Of 2019. [online] Ecommerce times. com.
28. SZ Chuen, Al-Rashdan M, Al-Maatouk Q: Cloud Data Processing Network Via Online Game Users. Journal of Critical Reviews 2019, 7(3):2020. https://doi.org/10.31838/ jcr.07.03.17
29. Trivedi, D., Zavarsky, P. and Butakov, S., 2016. Enhancing Relational Database Security by Metadata Segregation. Procedia Computer Science, 94, pp.453-458.Underwood, S., 2018. Blockchain

Beyond Bitcoin. Blockchain Beyond Bitcoin, 59(11).
30. Wen M., Yu S., Li J., Li H., Lu K. (2016) Big Data Storage Security. In: Yu S., Guo S. (eds) Big Data Concepts, Theories, and Applications. Springer, Cham Wertz, J., 2019. While Data Breaches Accelerate, It's Critical That E-Commerce Businesses Stay Safe. [online] Forbes.
31. Xu, M., Chen, X. & Kou, G. A systematic review of blockchain. Financ Innov 5, 27 (2019).
32. Zimprich, S. and Field fischer, e., 2020. Data Protection And Blockchain. [online] home.