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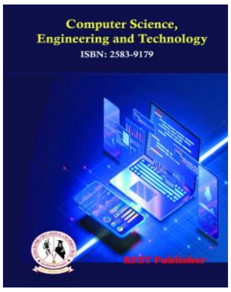

Improving Healthcare Data Storage by Enhance the Blockchain Scaling Using Snake Optimization Method (SOM)

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Abstract: *Blockchain (BC) is a new technology that has been utilized to create innovative approaches in a variety of industries inclusive of healthcare. The Blockchain Network (BCN) is utilized in the HealthCare Sector (HCS) to protect and communicate patient data across hospitals, pharmacies, clinicians and diagnostic laboratories. The BC applications are capable of identifying serious as well as deadly errors in the healthcare sector. As a result, it is potential to revolutionize the performance, transparency and security of medical details sharing in the HCS. This kind of technology allows medical organizations to acquire knowledge and improve the medical record analysis. Scalability is a significant challenge to Blockchain Technology (BCT) that restricts its capacity for widespread adoption in large-scale transactions applications. This research provides a novel solution to this problem by incorporating the Snake Optimization Algorithm (SOA) into a BCT to improve the rate of transactions and reduce delay. A detailed literature study situates our approach within the present state of BC scalability initiatives which offer a mechanism for incorporating SOA towards the transaction authentication process in BCN. The findings reveal a significant reduction of latency using optimized system has attained faster average transaction rates through a range of transaction amount. The results of this research show that SOA is extremely effective in batch transactions events that exhibit a reverse scalability trend than traditional BCN and substantial contribution to BC scalability with consequences for the creation of improved and scalable BCN ideal for high-volume business applications.*

Keywords: *Scalability, blockchain, data storage, Snake Optimization Algorithm, latency, Healthcare*

1. INTRODUCTION

BCN is a network of distributed ledgers in which entries are added yet neither deleted nor modified without a shared consensus. The value of a BC hash is determined by a cryptographic hash that relates freshly updated data block entries to individual data blocks. The distributed BC ledger architecture assures that information is not handled in a centralized location, thus rendering it available and responsible to all users of the network. This decentralized architecture prevents just one assault while improving and safeguarding the entire network. It improves controlling health record control as well as healthcare by minimizing medical practice as well as tracking by twofold that save resources as well as time for both practitioners and patients. Thus, patient will have control over where the data gets through storing health records on a BC [1]. The use of this technology allows scholars to evaluate a vast amount of previously unknown information regarding a certain group of users. It contributes to the growth of precision healthcare by providing proper support for long-term research. They employ BC for HCS in real-time utilizing the Internet of Things (IoT) and mobile devices for storing and maintaining critical patient information like blood pressure and sugar levels. It enables clinicians to monitor patients who have a high risk as well as, in the event of an emergency, provide guidance and alert to them and their relatives. BC's decentralized structure makes it secure to hack while preserving every instance of the records [2]. BCN are distinguished by decentralization, trustless-trust, transparency, and traceability and immutability due to the give each participant node with the same chance to affect the ledger. The network's transparency as well as immutability are preserved through permitting nodes to access and preserve the ledger that can only be changed with the agreement of other processing nodes. Although, Bitcoin has represents the most prominent example of BCT, its use has grown dramatically in fields such as healthcare, banking, e-government, and even supply chain management because of its security, decentralized and immutability qualities. The wider use of BC is fueled by research that goes beyond cryptocurrencies, concentrating on diverse business strategies, domain relevance, as well as optimization with various applications. Platforms such as Ethereum, Hyperledger and Multichain are essential in expanding the application of BCT past bitcoin, resulting in broad adoption [3, 4]. Despite the inherent advantages of BC, its growing use in a variety of industries has revealed a number of difficulties that must be addressed before widespread acceptance can occur. A specific difficulty is transaction flexibility, a significant danger to BC-based applications that requires robust protection methods to combat [5]. BC's possibility of broad adoption is greatly impacted by its capacity to manage massive volumes of transactions, demanding scalable solutions. Experimental investigation reveals that Bitcoin can handle approximately seven transactions per second, which is insignificant while comparison with VISA's as 2000 transactions per sec (second) [6]. This constraint is noticeable in applications necessitating concurrent handling of multiple transactions including public voting platforms [7]. These examples highlight the importance of doing particular studies to improve the BCT scalability and handle the accompanying problems. There is a widespread perception of BC as a "black box" for constructing effective applications that are decentralized. However, gaining effectiveness in decentralized applications utilizing BCT necessitates a thorough evaluation of numerous properties. These involve the transaction processing speed, block production rate and block size. Scalability in BCT has various significant benefits, especially for improving performance as well as widening the use of BCN. Scalability is an important consideration in the advancement and adoption of BCT since it affects the system directly with application range, user pleasure and efficiency. Recent developments have mostly aimed upon enhancing consensus algorithms as well as transaction verification methods. However, scalability represents a barrier to mainstream BC implementation, especially in high throughput situations. Conventional methods of improving scalability frequently result in higher latency, providing an undesirable trade-off in real-time processing of transactions. In the present scenario, the SOA concepts are implemented in BCN. SOA is an optimization approach influenced upon snake forage behavior, is well-known because of its agility as well as precision in exploring various environments. Through the implementation of SOA to BC, the suggested strategy is not only addressing the latency challenges related to scalability, yet streamlines the pipeline of transaction processing. This paper will explain the use of SOA in BCN including is the proposed approach and the resulting influence on scalability and even examine existing literature to position the proposed method in the present state of study, as well as share empirical results demonstrating SOA's efficacy in improving BC transaction throughput. Although, the gap among conceptual optimization methodologies as well as practical BC scaling solutions. It even hopes to add a new viewpoint to the continuing discussion about BCN enhancements in performance.

2. LITERATURE REVIEW

Wang et al. have utilized two methods named Attribute-Driven Design (ADD) as well as quality characteristic workshop. These had utilized in meeting certain requirements for the system with the goal of improving availability and safety. The strategy included three important tactics such as active redundancies for fault recovery, actor identity to validate access, and data encryption for preserving privacy. These strategies have been integrated into the system's design to provide strong security and consistent accessibility [8]. Researcher has presented the BCN distribution as a trust mechanism for addressing scalability issues in BC applications. This concept was created to promote peer-to-peer trust while allowing BCN to manage thousands transactions per second. According to the study, the establishment of global infrastructure for assisting distributed BCN in an impartial manner might assist in grows both BCT and cryptocurrencies. The swift expansion of enterprises has prompted enhanced effectiveness as well as systematic ways of transferring documents [9]. Electronic Data Interchange (EDI) is a crucial technology that enables the requirement and even facilitates the exchange of business-associated data among applications in a standardized which are understandable by machines format. If two corporate partners use EDI in documentation transaction, the crucial data is extracted from every partner's Enterprise Resource Planning (ERP) framework has transformed towards EDI message standards determined through both parties as well as promptly exchanged for processing of transactions [10]. The fundamental infrastructure for EDI is highly sophisticated, requiring data processing, networking capabilities and data management to properly convert data towards electronic representation. Furthermore, secure data broadcast among remote parties as well as strictly data access controller is necessary [11]. Shahriar Hazari and Mahmoud collaborated on improving cross border transactions with a revolutionary BC concept known as asymmetric consortium BC (ACBC). This method has uses a super node that efficiently monitors every transaction throughout time. The group also created a revolutionary smart contract to reduce opportunities loss for every node as well as generate high equitable allocation of profits scheme. The method they used was confirmed utilizing computational experiments with transaction information from Shenzhen and Hong Kong, which demonstrated the ACBC method, is effectiveness as well as intelligence for handling novel cross border transactions [12]. Sundareswaran et al. suggested an IoT-based solution for protecting BCN that incorporates several strategies. This system contains a financial transaction mechanism based on Radio Frequency Identification (RFID), which restricts the utilization of acquired information for authorized users solely. Machine-to-machine (M2M) authentication provides the initial layer of protection by verifying legitimate customers. When it gets authenticated, a user has permission to utilize the transaction process. The approach uses hashing to protect the stored transactional data along with BCT. Experimental verification of the method revealed that it surpasses data security criteria by incorporating numerous security measures to improve the privacy of the produced hashes [13]. Saqib and AL-Talla examined the setting of improving BC verification of transactions time, with one notable technique using optimization algorithms for controlling computer resources with greater efficiency. Particularly, a method centered on the use of simultaneous mining presented in a fundamental study, represents a concentrated attempt to improve transaction processing speeds [14]. Wu et al. have presented the Particle Swarm Optimization Proof of Work (PSOPOW) approach, which defines a framework in which miners mine simultaneously rather than independently, thereby lowering the time as well as resources required per validated transaction. Additionally, this approach stresses the utilization of PSO algorithm to select automatically with the best manager between miners reducing wait times when a manager become unresponsive as well as improving both the system of rewards and assignment of tasks inside the BC. Through a comparison of several mining situations, this study highlights the PSO-POW approach capacity to significantly improve BC scalability that demonstrating its usefulness in actual environments. On an associated issue, boosting performance of BC by consensus algorithms is a focus of research, as demonstrated in a different investigation [15]. The investigation of a Hybrid Consensus (HC) algorithm that combines the benefits of Proof of Stake (POS) as well as Practical Byzantine Fault Tolerance (PBFT) techniques yields a two stage planning, comprising sorting as well as witness phase with the goal of increasing throughput, lowering latency, and improving scalability. The newly developed HC algorithm focuses on decreasing the several consensus nodes by verified pseudorandom sortition as well as performing transaction witness operations among nodes, demonstrating significant advantages in previous unique algorithms as well as resulting in improved throughput, latency and scalability. Furthermore, fresh techniques to optimize supply chain tactics have emerged by combining BCT and big data. Devi and Rammohan have proposed a novel architecture that doesn't utilize only BC to secure data storage inside a supply chain, yet even relies on an improved PSO method in enhancing the scalability of network. The study emphasizes node securities as well as scheduling using a Precedence Partition Scheduling technique in conjunction to the delegation of POS consensus mechanism for validating node. In addition, the study used the message digest with hash technique for transforming input instances towards defined length outcome instances demonstrating the approach's scalability as well as efficiency in comparison to traditional methodologies in a supply chain setting. In order to secure the host from manipulating using the data in BC, this framework uses POS. The data is not decrypted or encrypted before it is transmitted for storaging part leaving user's data privacy and security at risk [16]. BCT was implemented for ensuring the secure as well as freely accessible sharing of data related to health. To ensure the dataset's truthfulness, experts used keys to its location as well as a cloud server for storing the data with encrypted format [17, 18]. BCT is based on the database of shared distributed with a chained data structure and the structure of block data. Blocks are made up of two basic components namely a block head as well as block body, which are linked together by hash pointers [19]. The BC open ledger is built using smart contracts, peer-to-peer networks, cryptography and protocol of distributed consistent between other technologies which are decentralized, traceable, visible and tamper-proof. The information is disseminated, trackable, and open to the public. The problems with shared centralized data namely the regular appearance of failure single points can be effectively solved by combining BT with information dissemination as well as sharing. This method also has an extensive number of potential uses.

3. RESEARCH METHODOLOGY

This research focuses on implementing dynamic sharding as a key tactic for improving scalability. Dynamic sharding divides the BC toward smaller that make easier to manage portions known as shards. The system enables the concurrent transactions and smart contracts process which significantly improving the throughput as well as effectiveness of BCN. Each shard functions separately, handling a portion of transactions, resulting in a significant decrease in resource demands and latency frequently related to BC scaling. By adopting dynamic sharding, it required in addressing the widespread scalability issues, ensuring that BCN can handle an increasing amount of transactions with no security. This scalable design is critical for reacting to our consumers' changing expectations and ensuring reliable performance in an environment that is decentralized as default. This research work describes the unique technique that aims to improve the BC transaction with efficiency and scalability. This technique involves the snackechain concept that combines a proprietary BCT with the ideas of the SOA. This assist in minimize the transaction latency drastically which is important to the general use and functionality of BCT. SOA has influenced the natural snake behaviors and it gets outlined with various step are listed below

Initialization

Initially SOA has generated solution set randomly in the search space which can be accomplished by formulae expressed in equation 1.

$$Sk_i = Sk_{min} + rand \times (Sk_{max} - Sk_{min}) \quad (1)$$

Where,
Sk_i = ith solution position over swarm
Sk_{max} = maximum values for the solved issues
Sk_{min} = minimum values for the solved issues
rand = random number among 0 and 1

Population division

Overall population gets split into male population and female population as per formulated equation 2 and 3

$$N_{male} = Num\_2 \quad (2)$$

$$N_{female} = N - N_{male} \quad (3)$$

Where,
N = Total population size
N_{male} = Male population solution
N_{female} = Female population solution

Best solution selection

This algorithm assists in identifying the best solution in both male snake population and female snake population group. Moreover, it determines the location of food whereas the threshold 1 is set as default with number of iteration until it satisfies in which threshold 1 is a constant set value.

Where,
C_{itt} = current iteration
T_{itt} = total iterations number

Exploration and exploitation

Based on the identification of food or not, the solutions either investigate or exploited the search space. When Quantity of feature < 0.25, the worldwide search has performed by positions update. On the contrary, if Quantity > 0.25, the reactions change with temperature. When the feature is above 0.6, the solutions flow straight to the food. When it is low, alternative modes such as fight or mate are enabled, which alters when solutions update their locations.

Updating Location

The locations of solutions have been updated dependent on the mode namely exploration, fight mode and mating mode. This entails intricate mathematical computations including constants as well as parameters such as the capability in finding food, fight, and mate among population members.

Egg hatch and replacement

When the eggs hatch, the worst solution from male and female have been determined and swapped with specified formulations. Each of these processes includes sophisticated equations as well as algorithms that ultimately describe the solutions' behavior available in the SOA. The proposed SOA framework is shown in figure 1.

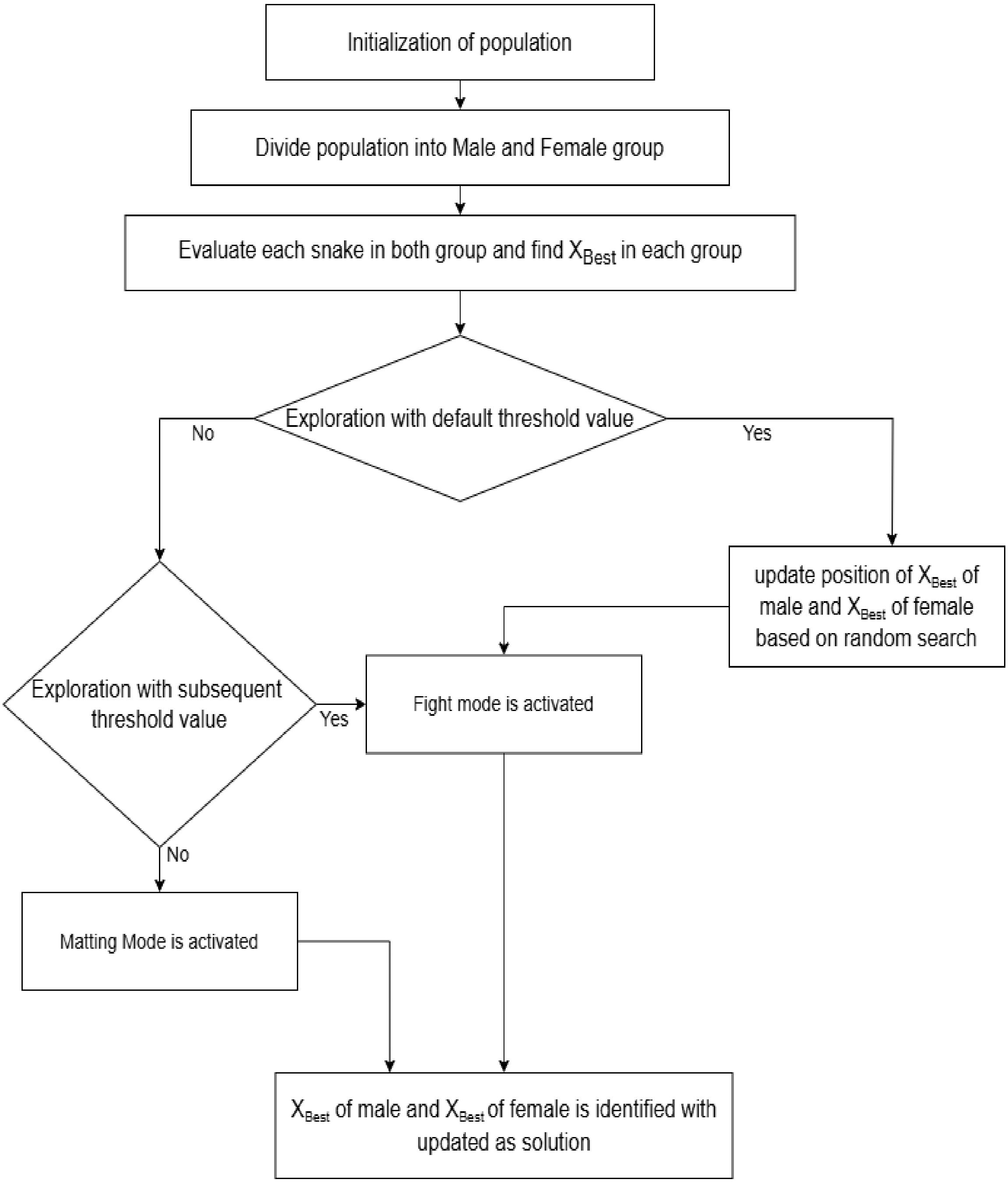

FIGURE 1. Proposed SOA framework

According to this design, each snake symbolizes a possible solution that exists in the optimization search space of the problem with multi-dimension. The dimensions variable denotes the search space complexity that determining the size of the solution setting which the snakes traverse. Transaction number is an important property adapted to the particular necessities of about optimization domain, offering a dependent on context indicator for assessing the efficiency of each snake. The dynamic position field represents each snake's present position in the search space, demonstrating the fluid nature of optimization method. Best Position is a testimonial to snakes' adaptability abilities, indicating the best feasible solution has been met. Finally, "fitness" is a quantitative assessment of a snake's effectiveness that directs its movement into ideal solutions. These features work together to form the spinal column of snake optimizer, which drives its ability. The procedure begins when a user initiates a transaction. The operation in question is allocated a unique identification as well as securely authorized with the user's private key. This BCN has sophisticated verification procedure ensures the authenticity of each transaction's identity.

Transactions containing invalid signatures are immediately declined, maintaining the BC's security as well as integrity. Approved transactions are subsequently gathered into novel blocks. According to this stage, the network generates an encrypted hash to each block that is appended consequently to the BC to ensure a secure as well as tamper-proof transaction records. The hashing process is required for the BC's immutability, which is a key element that supports trust in the system. The dynamic shard distribution procedure is a fundamental component of our system. The system selects the right shard for each exchange with respect to the sender's data. In situations in which existing shard performance is inadequate to manage transaction volume, the proposed BCN with SOA initiates an optimization process in Snakechain. In this instance, the SOA enters into play, determining the optimal shard number needed to be successfully reduce latency. The shard count is subsequently revised consequently, allowing for concurrent processing of transactions as well as considerably increasing network efficiency and scalability.

4. RESULTS AND DISCUSSION

The experimental research implements SOA optimization with BC which has been finely tailored for bulk transaction handling, which can distribute fixed costs across numerous transactions, reducing average process duration per transaction. The feature of optimization might deliver significant reimbursement in scenarios characterized by batch transactions, yet it might not prove as successful in settings whereas transactions obtain primarily in isolation. It emphasizes the SOA's tremendous impact on performance, while simultaneously highlighting an optimization which promotes batch process for single transaction acceleration. Pioneering outcome is committed to improve BC scalability through SOA, differentiates them by employing a revolutionary nature-inspired metaheuristics algorithm based on snakes' particular mating behaviors. This novel strategy aims to reduce latency over transaction on the BC by the shards number optimization, opening up a recent avenue in the continuous drive to improve BC scalability. The comparison with both before as well as after SOA implementation in BC is to observe the latency for 5 different scaling namely 1, 10, 20, 50, and 100.

Table 1 represents the latency analyzed over several transaction volumes. In this experiment, the investigation discovered that the single transaction latency done at 0.63 ms which signifying a very responsive system under low transaction volumes. However, the transactions number increased to 10, the latency also get increased to 30.32 ms that indicating a considerable delay and implying a linear latency scaling with transaction count. An additional increase to 20 transactions may result in a substantial latency of 155.29 ms, highlighting an achievable scalability problem with the system increase of transaction volume. This representation provide as a baseline to scalability considered in BCN is prior to optimization strategies being used.

TABLE 1. Comparison of proposed method latency performance with various transaction

Transaction Number	Latency with BC	Latency with BC-SOA
1	0.63	0.57
10	30.32	0.43
20	61.94	0.42
50	86.15	0.40
100	155.29	0.39

Notably for 10 transactions, the average timing for each transaction was lowered with 0.43 ms, indicating even greater efficiency savings. When performing 100 transactions, the optimization had a significant impact, reducing the average transaction time to 0.39 ms shown in figure 2. This illustrates that our improvement not only lowered the entire latency but also enhanced scalability, as evidenced by lower time of average transaction and also the transactions amount get increased. It implies that the network got improved at managing higher numbers of transactions while decreasing the average time for each transaction, demonstrating the efficiency of the SOA in improving BC performance. Prior to the deployment of SOA, the proposed SOA with BC latency followed a predictable pattern as the volume of transactions increases with the latency. Ascending pattern of this is consistent with traditional system behavior, whereas higher transactions volume automatically delays processing time. In sharp contrast, the implementation of SOA resulted in a significant decrease in latency at all transactional activity levels. Fascinatingly, the use of SOA resulted in an unanticipated event in which the latency for a single transaction is slightly higher than that for all other four transaction categories (10, 20, 50, 100). This unusual conclusion suggests that the SOA excels at maintaining transaction batches rather than individual transactions.

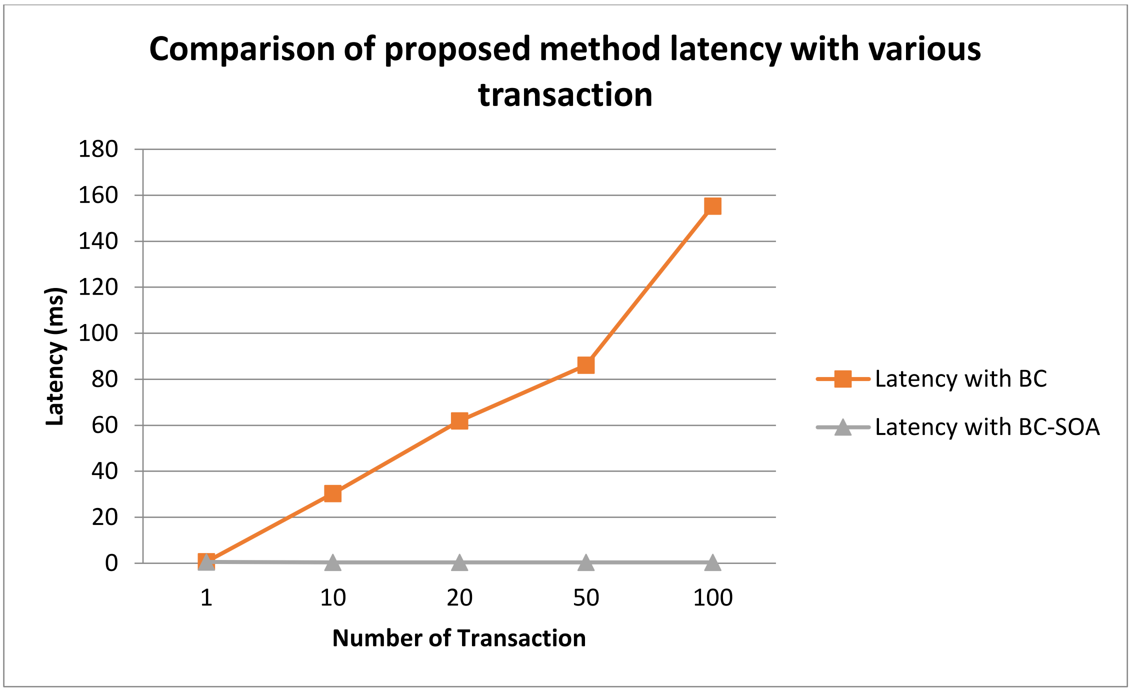

FIGURE 2. Comparison of latency performance with various transactions

Figure 2 determines that BC-SOA is more efficient while handling numerous transactions at once. Thus, the result may imply BC-SOA in which certain overhead gets distributed across multiple transactions, has no major impact on the average processing time. In contrast, while processing individual transactions, this burden becomes more visible. This behavior may be beneficial to systems which maintain transactions batches on a regular basis, but it may be less ideal to the dealing with single transaction at a time. Moreover, BC-SOA has clearly improved the network performance, favoring circumstances in which transactions occur in groups rather than in isolation.

5. CONCLUSION

This study has provided a thorough examination of the issues connected with BC scalability as well as the potential for optimization techniques to overcome these challenges. The proposed BC-SOA included a novel use of the SOA to improve the BC network scalability. The SOA, when applied to BC architecture, showed a considerable latency minimization, especially while managing many transactions. Thus, the reduction implies SOA is extremely successful in circumstances whereas the network must process batch transactions. The BC-SOA resulted with implementation trials revealed an abnormal but advantageous behavior of the algorithm, in which it performed better with a higher number of transactions, essentially inverting the typical performance decrease found with greater load. As a result, BC-SOA stands out as a strong answer to the scalability issue, providing an alternative viewpoint on optimizing BCN. It not only speeds up the processing of transactions but also assures that the system gets improved performance as transaction volume increases. This feature is very critical for BC applications that require high throughput underneath severe loads.

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