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Enhancing security in Customer Relationship Management (CRM) application by integrating Blockchain technology

Faiz Irfan[1], Ana Nadeem[2], Osama Haseeb[3], Danish Ahmed[4]
Computer Science and Engineering (Data Science and Artificial Intelligence),
Integral University Lucknow, India
muhamadfaiz4566@gmail.com[1]

Abstract: Blockchain has matured into a disruptive technical application in information technology, and it is now considered as a primary driver of cloud computing progress. As a decentralized and tamper-proof ledger, it allows for transparent and auditable data management. India is also aggressively promoting this invention. Since 2018, the government of India has been striving to discover viable blockchain applications in citizen-focused service systems. The NITI Aayog is developing a national-level plan to identify areas for blockchain deployment. This study examines the current state of blockchain in India and the obstacles that may occur during its incorporation into the Indian market. It provides an overview of blockchain's fundamentals and platforms. Furthermore, it examines the scalability of technology and its possible applications in public service delivery, with a focus on poor populations, to ensure transparency and traceability in the provision of direct benefits to customer relation services.

Keywords: Blockchain, Customer Relation Services, Parallel Computing.

1. Introduction:

Blockchain is increasingly recognized as the next big technical breakthrough, best suited among new developments projected to have a disruptive impact on future socioeconomic applications. These technologies are deemed disruptive since they often start with specialist applications such as customer service and economic operations. They grow throughout time to handle more sophisticated functions and may eventually replace existing technology. This shift can result in major changes to how digital systems work, lowering costs and improving overall system performance [1]. Blockchain is an excellent example of Distributed Ledger Technology (DLT). It specifically enables data storage and administration via a cryptographically secure, decentralized architecture. A group of users validates data using an established network protocol, avoiding the need for monitoring by a central authority or governing body [2, 3]. Blockchain is acknowledged as a valuable asset for governments aiming to sustain and modernize future public service delivery. It is increasingly evident that blockchain is transforming the way public sector operations are developed and executed, especially in the context of citizen-centric services [4]. While there is an optimistic belief that emerging technologies will inherently lead to positive change, this assumption may result in overly idealistic implementations and evaluations of routine tasks [5], [6]. Moving beyond such utopian perspectives, it is essential to carefully assess both the potential benefits and risks associated with integrating blockchain into public services. A review of current literature indicates that the majority of academic focus remains on Bitcoin and other cryptocurrencies. For instance, a Scopus database search revealed that, in 2022, approximately 61% of all blockchain-related publications were primarily centered on Bitcoin applications.

In recent years, there has been a growing corpus of research concentrating on the development and deployment of blockchain in public sector organizations, particularly in the context of citizen service delivery. These studies give useful insights into the possible use of blockchain to improve public sector services. However, the conclusions are broad, covering a wide range of fields in both the social and scientific sciences. Despite this, a unified and complete literature combines previous evaluations from a multidisciplinary approach, addressing possible benefits, hazards, and cost-related issues that are currently absent.

This study tries to overcome the gap by undertaking a thorough review of the literature. Meanwhile, public organizations and governments all around the world are launching early-stage blockchain deployments and pilot initiatives. Most of these initiatives aim to improve economic efficiency, accountability, and openness in bureaucratic operations [7].

2. Proposed Algorithm:

The suggested technique consists of three main steps: importing the Data Record System database into MATLAB software, using the blockchain mechanism and database verification algorithm, and mapping the data. After importing the database into MATLAB, the user picks the consensus method and data mapping strategy depending on the expected blockchain node configuration. The hashed database is sent for discrete data segments, allowing various server-side applications to be executed on the dataset. The basic components of the proposed algorithm are discussed in the next section [8, 9].

• Data Importing into MATLAB Software: The customer relationship services record database is imported into MATLAB using either a CSV file format (usually for dynamic blockchain kinds) or web-based model files (suitable for both dynamic and static blockchain modes). Done with the Parallel Computing Toolbox in MATLAB via the program. The data was processed either as a single-time snapshot or in a temporal series. Once imported into MATLAB, the data is formatted as a matrix representing

network configuration tables, such as network type, node identities, node coordinates, and edge values. Databases are kept in block format, with each block undergoing verification before being allocated a unique hash value. Only validated blocks are uploaded to the blockchain, with separate node ID, nonce, and self-generated hash. Nonce (short for Number Only utilized Once) is a vital component utilized in the hashing process to maintain database uniqueness and integrity [10, 11].

• Algorithms for Blockchain and verification of data : Verification and communication are two important functions of a blockchain-based system. The consensus mechanism is a blockchain algorithm that manages actions, primarily through a predetermined dataset verification procedure. This report's blockchain method focuses mostly on re-hashing the customer relationship services database in line with the logic given by the consensus mechanism used. Essentially, the procedure checks the customer registry ID via a consensus technique while also verifying that the current hash is accurately connected to the hash of the preceding block—with the exception of the genesis block, which has no predecessor [12, 13]. Each consensus algorithm includes rules that all peer nodes must obey, based on the blockchain scheme and the methods for confirming blocks and providing the corresponding service. This project creates algorithms for five different consensus mechanisms: proof of time (PoT), proof of work (PoW), proof of assignment (PoA), proof of authentication (PoAuth), and proof of vote (PoV). PoAuth and PoA were introduced in the project [15] because to the necessity for rapid processing rates in customer relationship service applications, as well as voting-based methods and real-time verification procedures. IoTw is a developing blockchain technique aimed particularly at factories and industries. It stands out for its remarkable adaptability and security, particularly for smart devices. A comparison of IoTw with other industrial blockchain initiatives, such as IoTex and IoTa, reveals its better capabilities [16]. In this context, PoV, PoA, and PoAuth are designed to work seamlessly with customer relationship management tools.

Proof of Work (PoW) is the original consensus mechanism, first introduced with cryptocurreny. In this method, each participant is required to verify transactions, and customer database is accepted only after the validators approve them. The Proof of Time (PoT) mechanism, on other hand, relies on selecting peers with highest reputation for verifying database. It maintains reputation value table for all blockchain nodes, where each node's reputation increases upon successful database validation. Peer selected for verification is node with highest reputation value. To prevent overflow and maintain fairness, system includes ReputationThreshold, which limits maximum reputation values and dynamically adjust based on the network size. While PoT significantly improves energy efficiency compared to PoW, it introduces a semi-centralized network structure due to its reliance on reputation-based peer selection. Currently, the PoV process is implemented as an algorithm that employs a consensus-based voting system based on hash functions [36]. This technique uses all blockchain peers to authenticate the staff/customer database and determine if the gathered replies result in a validation index larger than 75%. After achieving this requirement, the block and its accompanying registration are approved and added to the blockchain for respective customer relation services. Innovative protocols such as PoAuth and PoA have been investigated to provide lightweight and speedy validation procedures [17]. PoA uses a random network node to do database validation. Using a fast verification technique is critical for allowing real-time data handling while expediting authentication processes. Nonetheless, the picked random verifier may be corrupted or malevolent. PoAuth is a suggested technique created for network nodes that uses self-authentication as a proof mechanism during database transmission. This method is particularly useful for IoT-based applications that do not require a high level of security. A Bloom filter is used to validate node authentication and is directly applied to traditional assets [18].

Database Mapping: Two main types of database mapping are utilized to combine blockchain with base-level block verification. In a dynamic blockchain architecture, data registration is connected sequentially using individual timestamps. When all timestamped data from a certain period is combined into a single block, this is referred to as a "keyword transaction per timestamp." When the complete database associated with a single timestamp is saved in one transaction or block, the method is known as "transaction per timestamp" [19, 20].

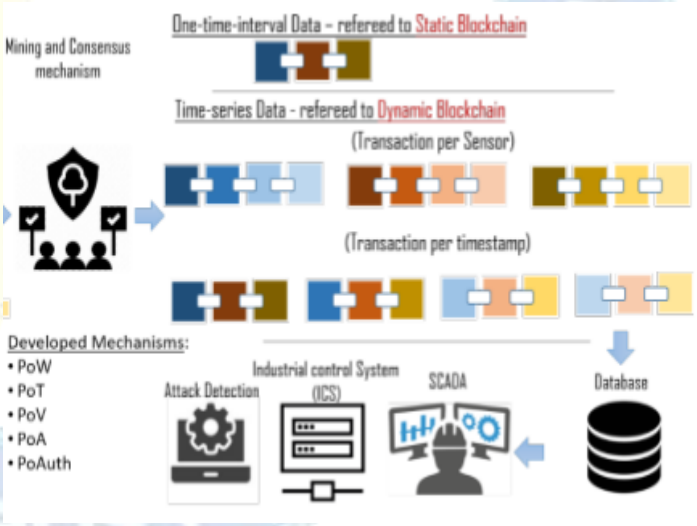

Figure 1: Blockchain system architecture for customer relation services.

Simulation starts with an input file created in MATLAB. Initially, users were asked to choose between static and dynamic blockchain modes. Static mode is meant for integrating short-duration service allotment registration data into blockchain, with a single registration monitoring all readings within a set timeframe. Dynamic execution mode allows you to import time series data from files or internet networks. A data-flow file is given to simulate the method. Various operational characteristics for customer relation services registry and allocation, such as the first inquiry of a

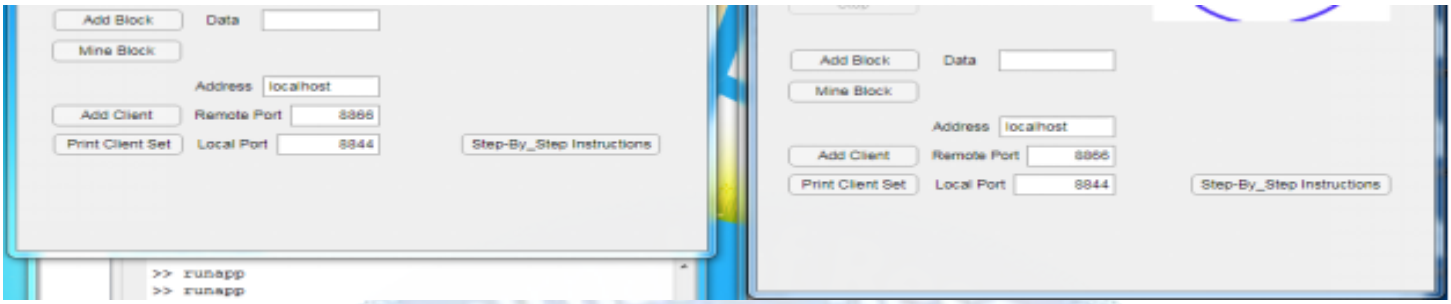

Figure 2 : GUI running parallel for user for respective customer relation services.

given service in a defined region, are chosen for validation and chained following verification. During execution, the user is needed to pick the consensus mechanism. If the PoAuth technique is adopted, each block is validated by comparing its unique ID to a list of preconfigured nodes. Additionally, users can choose their own data mapping technique.

Different consensus mechanisms analyzed under this work described below:

Proof-of-Work (PoW), Proof-of-Trust (PoT), Proof-of-Assignment (PoA), Proof-of-Vote (PoV), Proof-of-Authentication (PoAuth)

PoW: The Total mining time = 2362secs

POT: The Total mining time = 223secs.

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3. Results and Discussions

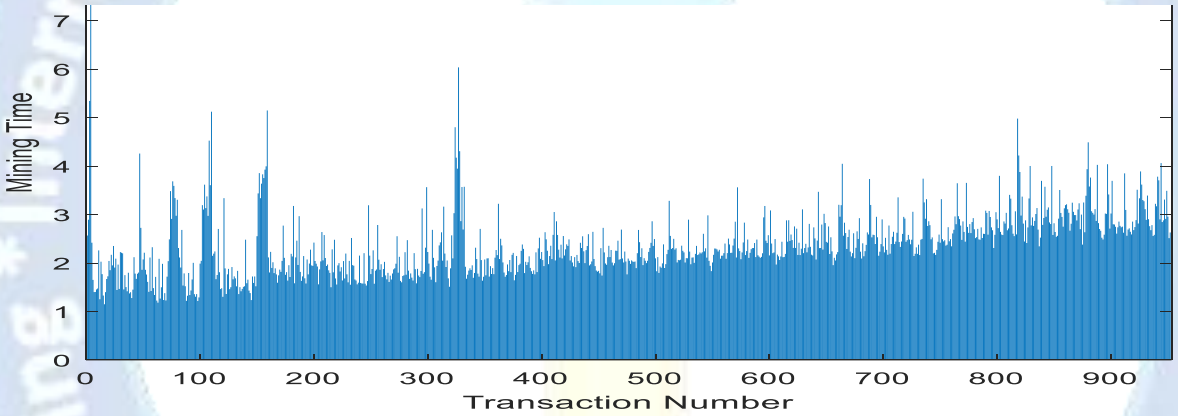

Figure 3: Mining time with respective customer registration ID under Proof of work mechanism

newBlock = Block with properties: index: 618 data: {' 1997 62666 56956 51551 78513 4285 96173 75569'}
previousHash: '0087754a3805981d70a7d76c5108b8d2' selfHash: '0064e4001273def5df27e41caabe60fd' nonce: 7
YEAR ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
USER USER USER USER USER USER USER
1997 62666 56956 51551 78513 4285 96173 75569
newBlock = Block with properties: index: 619 data: {' 1997 62666 56956 51551 78513 4285 96173 75569'}
previousHash: '0064e4001273def5df27e41caabe60fd' selfHash: '00d7f134852d2ee0a76d963e79ca5612' nonce: 49
YEAR ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
USER USER USER USER USER USER USER
1997 62666 56956 51551 78513 4285 96173 75569
newBlock = Block with properties: index: 620 data: {' 1997 62666 56956 51551 78513 4285 96173 75569'}
previousHash: '00d7f134852d2ee0a76d963e79ca5612 selfHash: '00a1bafe7dcfad66d85b751c88f48608 nonce: 170
newBlock = Block with properties: index: 626
data: {' 1997 62666 56956 51551 78513 4285 96173 75569'}
previousHash: '002417550a1757926d3f4953fce637c6' selfHash: '006253bcf0730eda653a3653291af92f' nonce: 5
YEAR ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
USER USER USER USER USER USER USER
1997 62666 56956 51551 78513 4285 96173 75569
newBlock = Block with properties: index: 627 data: {' 1997 62666 56956 51551 78513 4285 96173 75569'}
previousHash: '006253bcf0730eda653a3653291af92f' selfHash: '00a0fe73706163e586d537e05f262795' nonce: 220
YEAR ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
USER USER USER USER USER USER USER
1997 62666 56956 45160 78513 4285 96173 75569
Service related to the order 3 requested from user 51551 to user 45160
newBlock = Block with properties: index: 628 data: {' 1997 62666 56956 45160 78513 4285 96173 75569'}
previousHash: '00a0fe73706163e586d537e05f262795 selfHash: '00d430b90af5663c570e8f0695e86357' nonce: 46
YEAR ORDER1 ORDER2 ORDER3 ORDER4 ORDER5 ORDER6 ORDER7
USER USER USER USER USER USER USER

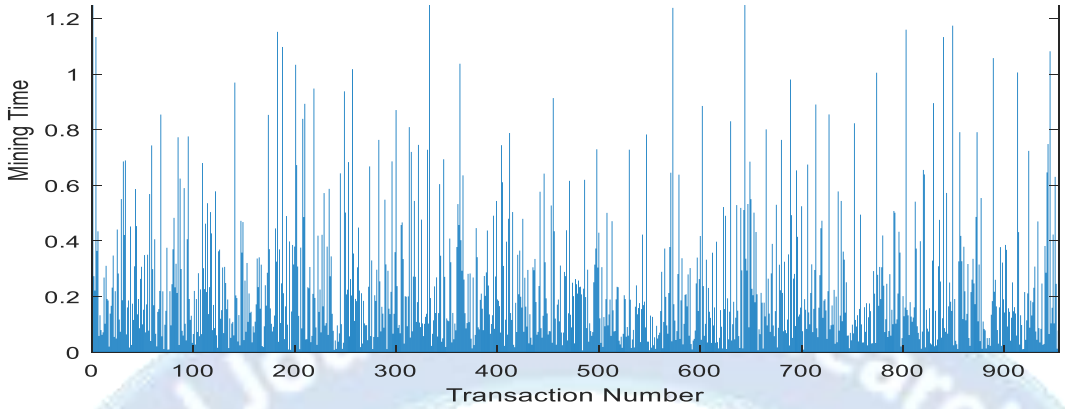

Figure 4: Mining time for respective customer registration ID under Proof of trust mechanism.

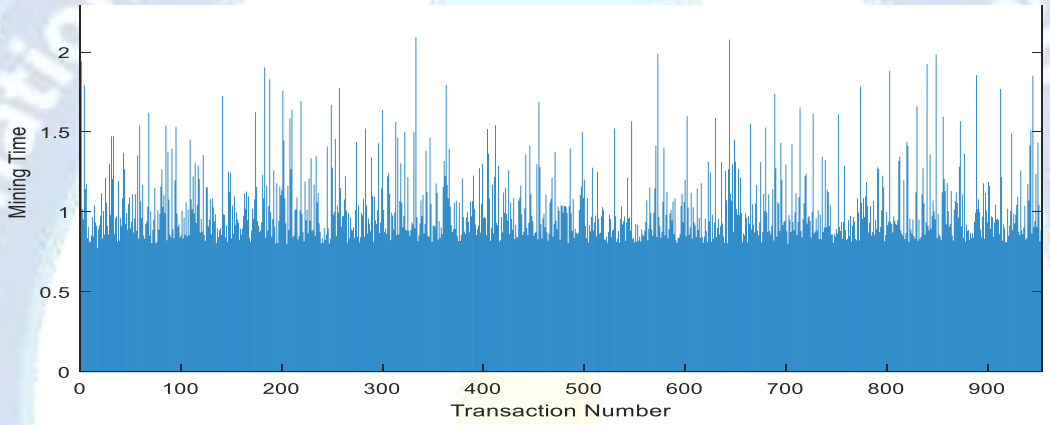

Figure 5: Mining time for respective customer registration ID under Proof of Assignment mechanism.

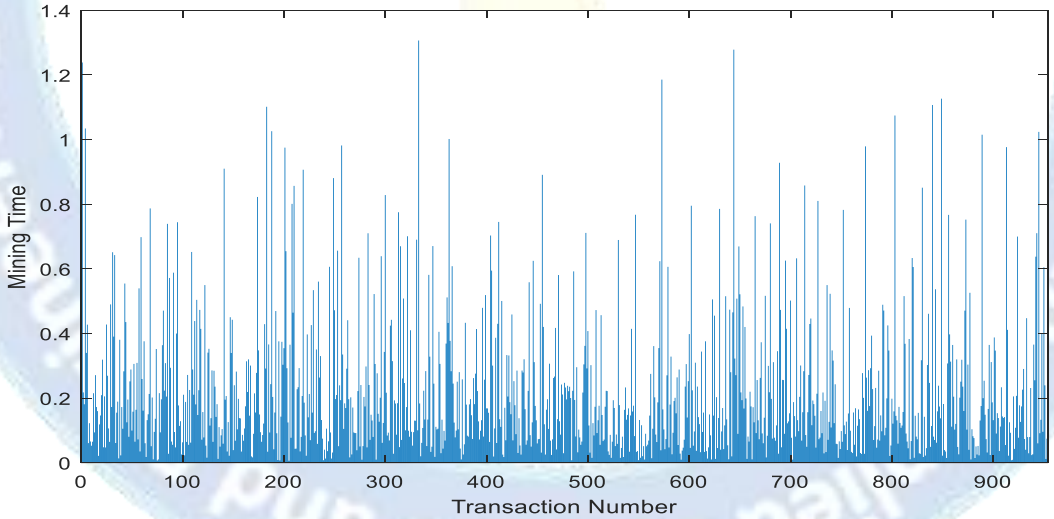

Figure 6: Mining time for respective customer registration ID under Proof of vote mechanism.

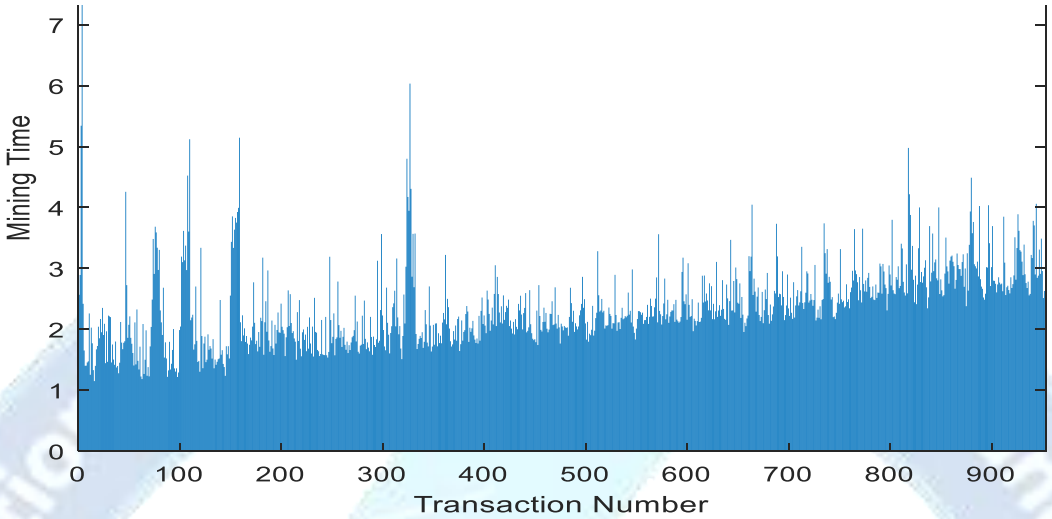

Figure 7: Mining time for respective customer registration ID under Proof of Authentication mechanism.

PoA:The Total mining time = 210.924275615738
PoV: Total mining time = 974secs.

PoA: Total mining time = 25918secs.

Table 1:Total mining time representation under different consensus mechanism

S.No.	Algorithm	Total mining time
1.	PoAth: Proof of Authentication	25918
2.	PoW:	2362
3.	PoT:	223
4.	PoV:	974
5.	PoAs: Proof of Assignment	211

4. Conclusions

One advantage of using blockchain is a significant decrease in administrative load connected with accounting services. Offline manual operations are unnecessary; transactions are processed in real time. Blockchain enables the implementation of transaction-based applications, with each transaction being visible and tamper-resistant. The level of openness enables customers to confirm how specific items/service passes through multiple production steps, making tracking verifiable. Traceability streamlines auditing tasks, reduces the possibility of fraud/errors, and gives visibility through logs. Smart systems improve dependability by proactively avoiding any errors or fraudulent activity. The conclusions of this study are based on a rigorous comparative examination of traditional government service delivery and blockchain-enabled services, with a particular emphasis on cost efficiency and risk management. It also solves scalability issues connected with the development of blockchain systems.

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