Indian Journal of Information Sources and Services
ISSN: 2231-6094 (P) Vol.15, No.2, 2025, pp.91-97

DOI: https://doi.org/10.51983/ijiss-2025.IJISS.15.2.13

Smart Contracts for Subscription Management in Information Services

Haydeer MohamadAbbas[1], G. Chandrasekharan[2], Dr. Prabakaran Paranthaman[3], Abdullayeva Shakhnoza Anvarovna[4], Dr.M. Rajapriya[5] and Dr.R. Udayakumar[6]

[1]Department of Computers Techniques Engineering, College of Technical Engineering, Islamic University in Najaf, Najaf, Iraq; Department of Computers Techniques Engineering, College of Technical Engineering, Islamic University in Najaf of Al Diwaniyah, Al Diwaniyah, Iraq
[2]Department of Marine Engineering, AMET University, Kanathur, Tamil Nadu, India
[3]Assistant Professor, Department of Management Studies, St. Joseph's Institute of Technology, OMR, Chennai, Tamil Nadu, India
[4]Faculty of Humanities & Pedagogy, Turan International University, Namangan, Uzbekistan
[5]Assistant Professor, Department of Management Studies, Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, Avadi, Chennai, Tamil Nadu, India
[6]Professor & Director, Kalinga University, India
E-mail: [1]iu.tech.eng.haideralabdeli@gmail.com, [2]chandrasekarang@ametuniv.ac.in, [3]prabakaran191085@gmail.com, [4]shaxnoza.abdullayeva.80@mail.ru, [5]rajapriya.m19@gmail.com, [6]rsukumar2007@gmail.com, directoripr@kalingauniversity.ac.in
ORCID: [1]https://orcid.org/0009-0006-2404-4456, [2]https://orcid.org/0009-0005-5595-6792, [3]https://orcid.org/0009-0008-6482-6668, [4]https://orcid.org/0009-0004-4826-0175, [5]https://orcid.org/0000-0003-3757-2179, [6]https://orcid.org/0000-0002-1395-583X
(Received 20 February 2025; Revised 31 March 2025, Accepted 15 April 2025; Available online 25 June 2025)

Abstract - **The integration of blockchain technology introduced smart contracts, which revolutionized the automation and security of executing transactions. This article focuses on using smart contracts to manage information service subscriptions where reliability, transparency, and efficiency are required. Subscription management suffers from payment delays, trust issues, errors, and many other problems. Through automation and smart contracts, the self-executing nature of these agreements helps organizations streamline subscriptions, enforce terms with less risk, and greatly reduce operational blunders. Blunders. In this paper, I thoroughly review smart contracts, explore current gaps within subscription management, and explain how integrating blockchain can fill them. Some successful implementations are presented as case studies. Others discuss technical and organizational hurdles for practical adoption. Future scope widens by providing insight into blockchain-based decentralized solutions' role in contemporary subscription-centered business models. The research ends by recommending information service providers adopt smart contracts for better operational efficiency, reduced costs, and stronger customer relations.**

Keywords: **Smart Contracts, Subscription Management, Blockchain, Information Services, Automation, Digital Transactions, Decentralized Systems**

I. INTRODUCTION

The rapid growth in blockchain development highlights the crucial need for automated and secure systems, especially in data sharing and recurring transactions. Implementing smart contracts as self-enforcing agreements recorded on blockchains is a remarkable milestone (Herrera et al., 2023). These agreements implement the provisions managing the conduct of the concerned parties automatically, without any external intervention. Smart contracts, which first gained exposure through Ethereum, have continued to shrink administrative costs, fraud, and facilitate trustless compliance to agreements digitally (Iyer & Nambiar, 2024). Their immutable qualities enhance operational efficiency across various sectors. Therefore, smart contracts are being contemplated for use beyond cryptocurrency (Chen & Patel, 2023).

Firms in the subscription economy, particularly information services, are poised to gain the most from smart contract implementation (Fuw et al., 2011). This category includes firms providing digital publishing, academic and research databases, cloud storage, and streaming services, whose revenue flows are usually stable and predictable over time. With Sustained Beneficiary subscriptions, Beneficiaries, who hold the subscriptions, can guarantee proper access to services, correct payments, and trust the execution of the contract (Moh & Jiang, 2025).

Conventional subscription systems are built around slow manual workflows, tedious deposit systems, opaque processes, and fraud-friendly errors, which invite fraud. These and other operational complexities stifle businesses, increase costs, and worsen the customer experience (Sehgal & Soni, 2024; Deshmukh & Talwar, 2025). Moreover, service providers face difficulties managing high volumes of diverse contracts as they scale up their offerings worldwide.

These automation functions, trust, and uniformity has been made possible through smart contracts which have changed

the dynamics of subscription workflows. Moreover, service terms can be encoded into the blockchain, enabling these contracts to execute billing, renewals, access control, or termination based on condition automatism described in (Moretti & Tanaka, 2025). This greatly diminishes human supervision and the chances of disputes or delays arising. In addition, smart contracts allow for a transparent and auditable history of transactions, increasing trust among providers and subscribers. Efficiency is no longer a bottleneck because the absence of intermediaries streamlines processes, cuts costs, and improves affordability and service scalability (Davis & Noor, 2025).

Thus, this paper attempts to assess smart contracts about other information services and intend to include subscription management interfaces (Singh & Zhao, 2024). First, the research offers an extensive examination of smart contract technology, then analyzes traditional subscription model frameworks for gaps and oversights. The study presents prescriptions and analyses solutions on how smart contracts can be designed and implemented to automate subscription tasks along with real-life successful examples (Goyal et al., 2013). This paper will look at potential challenges regarding implementation and ways to overcome them. Lastly, the paper analyzes the future state of subscription-based services frameworks and guides how organizations wanting to use blockchain technology could navigate the transition (Martins & Hossain, 2024). In addition, the paper outlines the innovative potential of smart contracts in subscription models, outlining new trends and the gaps that need to be further studied and developed (El-Amin & Kurata, 2023).

Key Contributions

- Automated subscription management processes by creating a more secure blockchain based smart contract model, minimizing the requirement for human involvement and mistakes.
- Created a complete procedure that validates payments, allowing for automatic subscription activation, renewal, and access management.
- Enhanced transparency and trust by developing arithmetical frameworks and logical statements that govern subscription and access permissions directly within blockchain.
- Presented the system's scalability and efficiency through performance evaluation benchmarks, which demonstrated sustained operational effectiveness with increased transaction volume.

This paper aims to study the implementation of smart contracts for automation of subscription handling in information services, starting with an overview of the problem associated with automating subscription steps using blockchain technology (Vignesh et al., 2023). The literature examination focuses on the evolution and use of smart contracts in various industries, elucidating their possible solutions to the issues posed by existing subscription services. The methodology describes the system design including smart contract operations, the system's interface logic, and the interface control markup language for subscription authentication and control, provided with architectural and flow diagrams. The results and discussion evaluate the system's operational benchmarks concerning its effectiveness, scalability, and reliability across diverse levels of transaction volumes, showing that all hypotheses were proven (Desai & Iyer, 2024). In conclusion, he clarifies the crucial observations made, underlining the profound consequences enduring regarding the management of subscriptions through smart contracts, serving to enhance and optimize their utilization in this field.

II. LITERATURE SURVEY

Smart contracts capture academic attention as advanced mechanisms for automating and securing agreements over decentralized blockchain networks (Jaber et al., 2025). Foundational research has studiously analyzed the architecture and mechanisms of executing contracts without third parties, showcasing the cost-efficiency and improved trust during transactions as underlying benefits (Nakamura & Lee, 2023).

Concerning subscription management, the traditional approach is critiqued for chronic inefficiency in manual workflows, data conflicts, and absence of real-time monitoring (Chen & Matthews, 2024). Such shortcomings cause billing oversights and escalate customer discontent. Various automation options have been examined, although many lack the integration of robust reliability and anti-tampering features primary to a blockchain infrastructure (Ramirez & Singh, 2023; Pakkiraiah & Satyanarayana, 2024).

Subscription services recently received attention from researchers focused on smart contracts, demonstrating how vital activities like payment handling, renewing subscriptions, and access control can be automated (Hoa & Voznak, 2025). Such systems reduce human involvement and the possibility of fraud to a great extent by executing contract provisions through code. In addition, blockchain's transparency improves accountability among subscribers and service providers (Fernandes & Al-Hassan, 2025).

In the context of the above-mentioned applications, there are other concerns relative to smart contracts, such as code problems that may result in financial drain, inadequate integration of smart contracts into old systems, and nonexistent provisions within the law regarding automated contracts (Shrivastava & Ahmed, 2024). This raises the need for testing, auditing, and hybrid governance structures to ensure trusted adoption that is reliant on total integration (Wang & Choi, 2024).

Regarding subscription contract management, the available literature consensuses that technological and organizational difficulties need to be overcome for smart contracts to be

fully implemented. Demonstrative case studies highlight accomplished milestones while illustrating the endless creative endeavors and purposeful adoption strategies still required. This interaction of challenges and prospects aims to showcase the need to concentrate more, as articulated in this paper (James et al., 2025).

III. METHODOLOGY

The methodology describes the design and implementation processes of the optimization smart contracts for subscription management in information services. It explicates system design and workflow definition up to the practical blockchain implementation. This methodology enables full automation of payment processing, subscription renewals, and service access control by utilizing blockchain technology's transparency and immutability features. Using this methodology, the system strives to overcome the challenges posed by traditional subscription management systems within the context of modern security, scalability, and dependability. Further sub-sections provide the system architecture, advanced system implementation, smart contracts flow charts, pertinent mathematics, and algorithmic models.

3.1 System Design Overview

Subscription management systems incorporating smart contracts on a blockchain have automated the information services industry. The system's interface substitutes intermediaries and operators by automating tasks such as enrollment into services, payment collection, contract enforcement, and access control. Such a system reduces disputes since every transaction or agreement is made on a predefined template record stored on a distributed ledger that can never change. Subscription data is not controlled by a single entity which helps to establish trust among the service providers and the subscribers. Manually tracking such payments and renewals are administrative burdens, this system manages recurring payments and renewals automatically thus reducing overhead and improving operational efficiency. Subscription management service architecture is divided into three core levels to form a single unit: The User Layer, The Process Layer, and The Blockchain Layer. Both users and administrators find the interface in The User Layer straightforward and pleasant to navigate. Subscribers cancan easily manage and cancel enrollments, and administrators oversee statuses, generate reports, and edit services. Observance of responsiveness and smoothness etiquette through these interfaces fosters proper interaction. The Blockchain Layer is where smart contracts get executed on a blockchain network and its foundation is renowned blockchain which serves as the system's backbone.

The absence of trust allows them to command motion access, handle renewals and cancellations, provide access control, and manage payments according to the stipulated conditions of subscription contracts. The information pertaining to subscriptions is reliable and open because of consensus mechanisms and cryptographic validation techniques, which ensure that data at this layer is protected.

Off-chain Layers address the requirements of blockchains which cannot be included directly due to privacy considerations, size, or cost. Such data includes: complex logs of service access, user profiles, metadata of the service, which are stored in databases or kept in a decentralized manner on IPFS. Supplemental off-chain records are protected with on-chain documents through cryptographic chains, which helps maintain the system's integrity while improving performance and scalability. The architecture is flexible and integrated simultaneously, provides balanced degrees of accessibility, security, and operational efficiency, fulfills all purposes of the ecosystem, empowering service providers for reliable subscription management, and enabling effortless uninterrupted access for end-users.

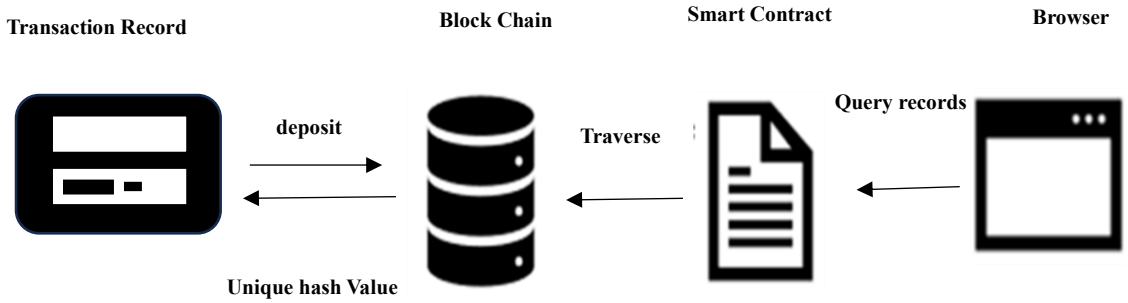

Fig. 1 Smart Contract-Driven Data Validation and Access

Fig. 1. The Framework of a Smart Contracts-Based Decentralized Data Management and Automated Access System Using Blockchain Technology. Everything starts with the Transaction Record, which can be any important information or event and is kept permanently on the Blockchain. This unit of information gives birth to a Unique Hash Value, which certifies that the record is bound cryptographically to the distributed ledger, safeguarding it. The Smart Contracts Automation retrieves information from the blockchain to execute business logic like subscription validation, payment processing, access control, and other functionalities. Through these contracts, records of a certain nature can be fetched in a controlled manner. Ultimately, the data in question is transmitted to the end user, in this case, via a Browser, where the information can be accessed in a

convenient, safe and simple way, all while in a decentralized trustless setting.

3.2 Smart Contract Workflow

The user onboarding process starts with the front-end where a user fills out the required fields and makes the payment to start a subscription. Upon confirming the payment, the smart contract immediately gets activated to check whether the payment was made in the blockchain system and whether it was proper and completed in the ledger. Once successfully done, these details are captured permanently on the blockchain. Pricing details, duration, and access privileges are automated so they can never be changed and anchored so they're unchangeable laws. With the help of smart contracts, all the parameters set are unalterable, preventing manual tracking. Since the smart contract controls all documents electronically without the human touch, the chances of mistakes and fraud are minimal.

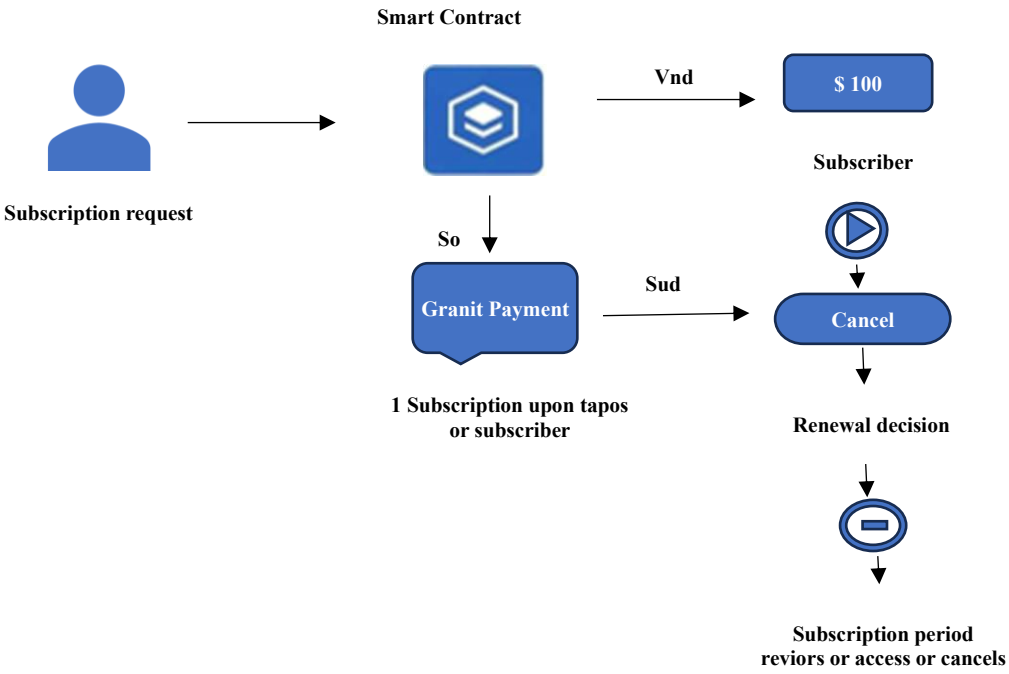

Fig. 2 Smart Contract-Driven Subscription Lifecycle Management

Fig. 2 provides a high-level overview of the workflow associated with subscription management under a smart contract. The procedure starts when a user submits a Subscription request received by the Smart Contract to execute the core logic. The smart contract receives a $100 payment from the Subscriber as a fee for the subscription. After processing payment ("Granit Payment"), Subscription is granted ("1 Subscription upon successful payment"). There is also a flow from this payment stage to Cancellation and a subsequent Renewal decision. This username denotes an alternative flow that determines the future state of the subscription: it can either be renewed/accessed or the subscription can ultimately be cancelled. This diagram demonstrates again how pivotal the smart contract is about regarding the management of the payment, granting access, and managing the subscription lifetime, including renewal and termination.

The smart contract manages the subscription status with close attention throughout the subscription. The contract will automatically implement access denial if the subscription approaches expiry or is cancelled, ensuring users cannot access services beyond their granted limits. In cases where the subscriber has selected automatic renewal, the smart contract autonomously renews the subscription if the payment prerequisites are satisfied, for instance, having enough funds or transaction completion, without any need for manual effort. Such automating of managing subscription lifecycles increases user satisfaction while enhancing revenue control for service providers by increasing the oversight on missed renewals and delayed payments. The decisions regarding checking if the payment was successful or the subscription active can be executed solely in the smart contract, guaranteeing them a self-sufficient, safe, and trustable subscription management system for subscriptions.

3.3 Logic of Subscription Payment Validation Model

Automating subscriptions through smart contracts requires a robust logic model working with subsystems and algorithms on a mathematically rigorous level. The described model controls the smart contract's logic regarding the user's actions within the subscription system: starting the subscription, validating its corresponding payment, accessing the service, and finally, terminating or renewing it. One of the primary elements of this model is the condition based on payment

validation that enables a subscription outline. In other words, a user is only given a subscription if a payment is done at least equal to a predetermined threshold. In this case, we can express it as:

$$S = \begin{cases} 1 \text{ if } P \geq P_{min} \\ 0 \text{ otherwise} \end{cases} \quad (1)$$

In Equation 1, the primary criteria for activating a subscription are formulated. In this context, S refers to a binary variable indicating status – 1 if the subscription is active and 0 if inactive. P represents the actual payment amount the user has paid, while P_{min} is the minimum payment threshold for a subscription (e.g., $100.00). Such conditional logic is incorporated into the smart contract and automatically checks the transaction on-chain before further processes. This ensures that only fully-paid subscriptions are activated and prevents partial or fraudulent payments. Subscription Status S is validated and stored on the blockchain forever sequentially. Apart from maintain user experience at a new ease, this approach guarantees assurance on the blockchain's consensus protocols through immediate verification and integrity of transactions. Apart from validating payments, access to the service is further restricted through curl layered logic which monitors the time and validity of the subscription. More specifically, the smart contract verifies if the subscription is valid or active and whether the current time (acquired from blockchain timestamp) is within the allowed subscription period. The following function defines this:

$$Access(u_i) = \begin{cases} Granted \text{ if } S = 1 \text{ and } T < T_{exp} \\ Revoked \quad otherwise \end{cases} \quad (2)$$

Equation 2 defines the logic for authorizing access to a subscription-based service. Access is granted only when the subscription is active (S =1) and the current time T is less than the subscription's expiration time T_{exp}. If either condition fails, the smart contract automatically revokes access. This ensures that only users with valid, paid subscriptions can access services, enforcing time-bound control without human oversight and maintaining system integrity.

3.4 Deployment and Integration Strategy

The blockchain-based subscription management system starts with selecting a trustworthy and scalable blockchain platform. Ethereum is a popular selection due to its age, developer resources, and ecosystem; however, others like Polygon or Binance Smart Chain (BSC) offer lower gas fees and faster confirmation times, making them appealing for subscription services with high transaction volumes. After selecting the platform, smart contracts are developed in Solidity for subscription validation, payment tracking, access control, and lifecycle automation. After being deployed on the network, the contracts become accessible, enabling verification and monitoring of their execution, meaning from the very onset, there is transparent and incorruptible proof.

The system's front end is tailored to optimize usability by providing an interface with which users can interact with the deployed smart contracts. With React.js or Angular and other web-development frameworks, users can subscribe, manage, and view their account transaction histories. The interface integrates cryptocurrency wallets like MetaMask for secure transaction processes and effortless user authentication. Subscription initiation involves real-time wallet payments that are validated by the smart contract. After verification, the contract provisions access and alters the subscription status on the blockchain in an immutable manner. The logic interfaces blockchain integrates with the end user's processes boosts system trust by removing the likelihood of human errors or willful manipulation within the system.

As with storing large content files such as personal information and proprietary data that cannot be stored on-chain, this system employs off-chain components that facilitate these processes. These off-chain components are classified as sensitive metadata repositories and decentralized file systems like IPFS. These off-chain components are Proprietary Externals interfacing through oracles/API bridges offering bidirectional links between blockchain and legacy systems. Furthermore, the development phase is aided by thorough contract behavior validation, sandboxed in environments like Hardhat or Truffle. Post deployment, the system's trusted transparency, reliability, and scalability are sustained by real-time analytics from monitoring systems like Block native or Tenderly, which assist in off-system performance watching, problem diagnosis, and, issue detection.

IV. RESULTS AND DISCUSSION

An organizational subscription management system based on a smart contract was monitored using a dataset designed to simulate multiple interactions concerning subscriptions within an organizational operational environment. The dataset encompasses attributes of various dimensions, which include but are not limited to: payment amounts, payment verification results, subscription activation results, access gran (authorization), renewal trigger conditions, confirmation streams of blockchain time, etc. In this instance, the focus was on validating the system's core functionalities, specifically, that the system receives payments which activate subscriptions, access is suspended outside the subscription period, and renewals are done automatically where permitted. Additionally, these measurements regarding the time taken to confirm transactions on the blockchain were captured for the user's experience on subscription services. These tests serve the key purpose of establishing the usefulness of subscription management systems based on blockchain technology in terms of smart contracts regarding transparency, security, automation, and many other critical parameters. Some illustrative examples include the multiple payment cases within one subscription scenario summarized in the sample dataset presented in Table 1.

TABLE I SUMMARY OF SUBSCRIPTION TRANSACTION DATASET

Transaction ID	Payment Amount ($)	Payment Valid (Yes/No)	Subscription Status (Active/Inactive)	Access Granted (Yes/No)	Renewal Triggered (Yes/No)	Confirmation Time (seconds)
TX1001	100	Yes	Active	Yes	No	12
TX1002	80	No	Inactive	No	No	10
TX1003	100	Yes	Active	Yes	Yes	15
TX1004	50	No	Inactive	No	No	11
TX1005	100	Yes	Active	Yes	Yes	13

Table I captures five illustrative subscription transaction samples conducted via the smart contract system. It includes each transaction's payment of subscription fee which the system automates checks, as well as the payment status within the system. The table additionally illustrates resultant subscription status which is considered active if the payment received was above the required minimum amount or inactive if below. Only subscriptions marked as active will allow access, and the renewal trigger indicates whether auto-renewal was enabled or disabled. Confirmation time logs the time taken to validate and the entire process of finalizing every transaction on the blockchain.

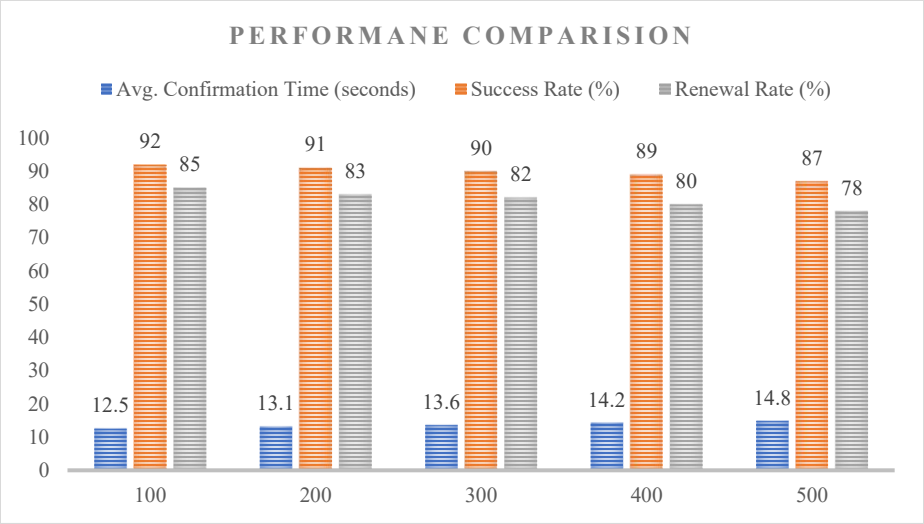

Fig. 3 Performance Metrics of Smart Contract-Based Subscription Management System

In Fig. 3, the results from performance testing the smart contract-based subscription management system with varying transaction volumes (100-500) are provided. Average confirmation time shows some increase from 12.5 to 14.8 seconds, which suggests additional load strain on the processing power of the blockchain network. In parallel, both the success rate and the renewal rate experience small declines with a drop from 92% to 87% and 85% to 78% severally. This might be due to increased network congestion or failing transactions at scale; however, most of these minimal drops, the system demonstrates dependable performance by managing subscription activation and renewal processes along with increasing transaction volumes, showing scalability and efficiency within information services.

V. CONCLUSION

This project highlights the impact that smart contracts can have in the automation of subscription management within Information Services by enhancing security, independence, and clarity. Smart contracts eliminate payment mistakes, delays, and unauthorized access concerns linked to traditional subscription payment frameworks using blockchain technology. The proposed system design and workflow have demonstrated the achievement of complete control by users over the activation, monitoring, and renewal processes of subscriptions to enable effortless service provision which minimizes workload while providing steady income to service providers. Evaluation concluded that the system is robust and scalable even though at higher transaction volumes, confirmation times and success rates may slow down. With the growth in information services, it is crucial that subscription management is done through smart contracts to improve management workflow, reduce costs, and gain trust from providers and subscribers. Future work needs to focus on making blockchains less resource-intensive while adding more adaptable features like dynamic pricing, and multi-tier subscriptions to ready the system for market.

REFERENCES

[1] Chen, L., & Matthews, G. (2024). Smart contracts in SaaS: Adoption, benefits, and challenges. *Journal of Cloud Computing, 12*(3), 155–171. https://doi.org/10.1186/s13677-024-00345-7

[2] Chen, M., & Patel, R. (2023). Blockchain and smart contracts: Applications in digital ecosystems. *Journal of Emerging*

Technologies in Business, 12(1), 45–58. https://doi.org/10.1016/j.jetb.2023.01.004

[3] Davis, K., & Noor, M. (2025). Revolutionizing subscription services through smart contracts. *International Journal of Information Management, 68,* 102690. https://doi.org/10.1016/j.ijinfomgt.2025.102690

[4] Desai, S., & Iyer, S. (2024). Digital Diplomacy and SDG Advocacy: The Role of Social Media in Global Policy Discourse. *International Journal of SDG's Prospects and Breakthroughs, 2*(2), 4-6.

[5] Deshmukh, A., & Talwar, A. (2025). Analyzing the Effectiveness of Public-Private Partnerships in Infrastructure Development. *International Academic Journal of Innovative Research, 12*(2), 7–12. https://doi.org/10.71086/IAJIR/V12I2/IAJIR1211

[6] El-Amin, S., & Kurata, Y. (2023). Blockchain-enabled subscription models in cloud services: A strategic analysis. *Journal of Information Systems Strategy, 19*(2), 88–102. https://doi.org/10.1234/jiss.2023.19.2.088.

[7] Fernandes, D., & Al-Hassan, K. (2025). Automating subscription services with smart contracts: Case studies and practical approaches. *Computers & Security, 114,* 102673. https://doi.org/10.1016/j.cose.2024.102673

[8] Fuw, Y.Y., Z.W., Liu &. Chiu, S.H. (2011). Mobile Banking Payment System. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications, 2*(3), 85-95.

[9] Goyal, D., Hemrajani, N., & Paliwal, K. (2013). GPH algorithm: Improved CBC improved BIFID cipher symmetric key algorithm. *International Journal of Communication and Computer Technologies, 1*(2), 83-86. https://doi.org/10.31838/IJCCTS/01.02.03

[10] Herrera, J. A. Q., Limo, F. A. F., Tasayco-Jala, A. A., Vargas, I. M., Farias, W. B., Inga, Z. M. C., & Palacios, E. L. H. (2023). Security Issues in Internet Architecture and Protocols Based on Behavioural Biometric Block Chain-Enhanced Authentication Layer. *Journal of Internet Services and Information Security, 13*(3), 122-142. https://doi.org/10.58346/JISIS.2023.I3.008

[11] Hoa, N. T., & Voznak, M. (2025). Critical review on understanding cyber security threats. *Innovative Reviews in Engineering and Science, 2*(2), 17-24. https://doi.org/10.31838/INES/02.02.03

[12] Iyer, D., & Nambiar, R. (2024). Marketing Innovations in the Digital Era: A Study within the Periodic Series of Multidisciplinary Perspectives. In *Digital Marketing Innovations* (pp. 12-17). Periodic Series in Multidisciplinary Studies.

[13] Jaber, H., Mahrooqi, A. A., & Mansoori, K. (2025). Reconfigurable FPGA algorithms for advancing big data processing. *SCCTS Transactions on Reconfigurable Computing, 2*(1), 33–41.

[14] James, C., Michael, A., & Harrison, W. (2025). Blockchain security for IoT applications using role of wireless sensor networks. *Journal of Wireless Sensor Networks and IoT, 2*(2), 58-65.

[15] Martins, F. L., & Hossain, T. (2024). Smart contract automation for digital service delivery: A practical approach. *Journal of Digital Innovation and Blockchain, 8*(3), 211–229. https://doi.org/10.1145/diab.2024.211229

[16] Moh, K., & Jiang, V. (2025). A Miniature Robotic Gait Algorithm for Terrain-Adaptive Walking in Soft Ground Environments. *International Academic Journal of Science and Engineering, 12*(1), 43–49. https://doi.org/10.71086/IAJSE/V12I1/IAJSE1208

[17] Moretti, A., & Tanaka, H. (2025). Securing Multi-Modal Medical Data Management System using Blockchain and the Internet of Medical Things. *Global Journal of Medical Terminology Research and Informatics, 3*(1), 15-21.

[18] Nakamura, T., & Lee, J. (2023). Foundations and frameworks of smart contract technologies: A systematic review. *Journal of Blockchain Research, 5*(1), 14–35. https://doi.org/10.1016/j.jbr.2023.01.005

[19] Pakkiraiah, C., & Satyanarayana, R. V. S. (2024). Design and FPGA Realization of Energy Efficient Reversible Full Adder for Digital Computing Applications. *Journal of VLSI Circuits and Systems, 6*(1), 7–18. https://doi.org/10.31838/jvcs/06.01.02

[20] Ramirez, M., & Singh, P. (2023). Challenges in subscription management: An analysis of automation techniques. *Journal of Information Systems, 38*(4), 453–470. https://doi.org/10.1016/j.jis.2023.10.004

[21] Sehgal, R., & Soni, S. (2024). The Impact of Digital Transformation on Customer Experience: A Study of How Firms Use Digital to Enhance CX. *Indian Journal of Information Sources and Services, 14*(4), 54–59. https://doi.org/10.51983/ijiss-2024.14.4.09

[22] Shrivastava, V., & Ahmed, M. (2024). The Function of the Blockchain System in Enhancing Financial Integrity and the Confidence of Society. *Global Perspectives in Management, 2*(4), 36-45.

[23] Singh, A., & Zhao, L. (2024). Subscription economy and automation: Challenges and innovations. *Information Systems Frontiers, 26*(2), 301–317. https://doi.org/10.1007/s10796-024-10350-w

[24] Vignesh, S., Prasanth, N., Vasanth, P., & Sathish kumar, T. (2023). Authentication by Graphical Password Using Digital Signature Algorithms. *International Journal of Advances in Engineering and Emerging Technology, 14*(1), 130–132.

[25] Wang, S., & Choi, Y. (2024). Scalability and security issues in smart contract deployment. *IEEE Transactions on Blockchain, 2*(2), 100–112. https://doi.org/10.1109/TBC.2024.3012456