AN IMPLEMENTATION FRAMEWORK FOR BLOCKCHAIN BASED TAX COLLECTION MECHANISM IN THE DECENTRALIZED ERA

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Abstract

The tax recovery system of Sri Lanka is often plagued by lack of transparency, mistrust and tax evasion. Amidst the country is undergoing significant shift toward digital transformation, the attributes of blockchain such as traceability and transparency of transactions match priorities of modern tax system. This article proposes a blockchain-based method to increase transparency and confidence in government expenditure and revenue collection processes. By leveraging the decentralized and immutable characteristics of blockchain technology, the approach ensures real-time transparency and verifiability of tax payments and government expenditures. This approach seeks to improve taxpayer compliance, strengthen fiscal responsibility, and establish a model for Sri Lanka's public sector services' digital transformation.

Keywords*: blockchain technology, digital transformation, government expenditure, tax evasion*

1 Introduction

Ramesh et al. (2013) stated that one of the main causes of the system's mistrust in Sri Lanka was its lack of transparency. Because many Sri Lankans are distrustful of how their government manages the money it receives from them causing, a significant amount of tax avoidance. This lack of trust gravely compromises the integrity and effectiveness of the tax system and threatens the stability of the national economy. The data about tax compliance in Sri Lanka highlights the severity of the problem even further. Out of 5.8 million households, there were only 293,305 tax files registered in 2020 and 120,000 reports filed in 2021 with only 58,000 people submitted taxes. These statistics demonstrated not only

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widespread tax noncompliance but also indicated deep-rooted issues such as a lack of trust in the current system, fears of corruption, and perceived inefficiencies in tax administration. EconomyNext (2023) reported these findings. A survey by the National Audit Office (2020) revealed that 65% of respondents cited a lack of transparency in the allocation and use of tax revenues as a primary reason for noncompliance. Additionally, 70% expressed concerns over the potential misuse of tax funds.

In order to solve these issues in the digital age, state-of-the-art technology is crucial. Blockchain technology, with its reputation for security and transparency, offers a viable means of enhancing Sri Lanka's tax collection process. Every transaction is ensured to be recorded on a public ledger by the decentralized nature of blockchain technology, creating an unalterable and transparent record of taxes paid and government spending. By implementing a blockchain-based tax system, taxpayer compliance and confidence in Sri Lanka can be significantly enhanced. Taxpayers' faith in the integrity and fairness of the system will grow in the presence of an unalterable, transparent record of tax collection and disbursement. This enhances Sri Lanka's reputation abroad and promotes it as a progressive nation, maybe in addition to raising tax revenues. Sri Lanka might become a pioneer in the use of digital technologies for public sector reform and serve as an example for other countries with similar issues if it uses blockchain technology for tax collection. Countries like Germany have also explored blockchain for tax administration, aiming to combat tax fraud and increase transparency. Germany's use of distributed ledger technology (DLT) to prevent tax evasion serves as a notable benchmark for the potential of blockchain in public administration.

2 Literature Review

2.1 Transparency in Tax Systems

Transparency in tax systems was essential for fostering public trust and ensuring compliance. An analysis by Bird and Zolt (2008) highlighted the importance of transparent tax systems in improving taxpayer morale and compliance. The study argued that transparent tax administration could reduce opportunities for corruption and increase voluntary compliance by making the process more understandable and predictable for taxpayers. By clearly communicating tax policies, procedures, and the use of collected revenues, governments can build trust and encourage compliance. Similarly, Heald (2006) emphasizes the role of transparency in public financial management, noting that clear and accessible information about tax collection and expenditure can enhance public accountability and reduce corruption. Heald (2006) suggested that transparency initiatives, such as open budget systems and public access to financial records,

were critical for promoting accountability in tax systems. Bird and Zolt (2008) also supported this view.

2.2 Blockchain Technology in the Context of Tax Systems

Blockchain technology has the potential to revolutionize tax administration by enhancing efficiency and reducing costs. Phadke et al. (2021) proposed a blockchain-based framework to address inefficiencies in current tax collection systems. This framework used the decentralized and immutable characteristics of blockchain to ensure secure and transparent data flow, reducing the difficulty and expense of tax recovery. The use of smart contracts within this framework could automate tax collection and enforcement procedures, cutting administrative costs and improving the effectiveness of tax authorities.

Mazur (2021) highlighted how blockchain technology could digitize and automate tax procedures to boost operational effectiveness and reduce costs. Blockchain technology could significantly reduce data redundancies and improve the transparency and reliability of tax-related data. It also facilitated real-time data sharing between various government agencies, shortening the latency involved in traditional tax administration procedures. This increased efficiency encouraged compliance, reduced administrative expenses, and enhanced the overall taxpayer experience.

Previous attempts to integrate blockchain technology into tax systems have shown promising results but also highlighted several challenges. Grundel et al. (2021) examined the advantages and challenges of integrating blockchain technology with tax systems, including fraud detection, cost-effectiveness, and data security. Their research indicated that blockchain could improve data security and simplify tax administration by creating a decentralized tax ledger that could be viewed by both taxpayers and tax authorities. However, challenges such as the need for technological infrastructure, potential stakeholder resistance, and regulatory support must be addressed.

2.3 Decentralized Identifiers (DIDs) and Secure Identity Management

Chen et al. (2018) and Omar and Wekke (2019) recognized the importance of secure identity management in a tax system; however, they did not effectively implement DIDs due to the challenges of integrating self-sovereign identity systems with existing centralized infrastructures. Empirical studies in other sectors have shown the effectiveness of DIDs in enhancing privacy, security, and trust. Empirical studies in other sectors have demonstrated the effectiveness of DIDs in enhancing privacy, security, and trust. For instance, Zyskind et al. (2015) showcased how blockchain could be used to decentralize privacy and protect personal data, emphasizing the role of secure identity management in such systems. Nguyen (2016) further supported the necessity of secure, user-centric

identity systems, illustrating how DIDs can significantly enhance the integrity of identity management systems. These findings collectively underscore the potential benefits of integrating DIDs into tax systems to improve security and trust.

2.4 Proposed Solution: A Fully Decentralized Blockchain-Based Tax System

Most existing decentralized solutions still have elements of centralization, which undermines the full potential of blockchain technology in ensuring trust and transparency. Previous studies have primarily focused on partially decentralized systems, leaving room for centralized control and potential misuse. This approach proposes a fully decentralized solution that gives more power to the people and makes tax-paying feel like their responsibility. Previous research often fell short by retaining centralized elements within their blockchain applications, which can still be susceptible to control and misuse by central authorities. Our proposed solution fully decentralizes the tax collection process, ensuring that no single entity has control over the entire system. This decentralization is crucial for building trust among taxpayers, as it eliminates the risk of central authority manipulation and fosters a sense of ownership and responsibility among citizens.

While earlier studies recognized the importance of secure identity management, they did not effectively implement DIDs due to the challenges of integrating self-sovereign identity systems with existing centralized infrastructures. Many previous solutions relied on traditional identity verification methods, which limited the potential for true decentralization. DIDs provide a self-sovereign identity management system, allowing individuals to control their own identities without relying on a central authority. Kshetri (2017) indicated that DIDs reduce the risk of identity theft and fraud by empowering individuals to manage their identities independently. This secure identity management is a critical component of our proposed solution, enhancing privacy, security, and public trust in the tax system.

Data privacy and security have been major concerns in previous blockchain applications. However, many studies did not adequately address these issues, leaving sensitive information vulnerable. Our solution differentiates itself by using a combination of encrypted data and off-chain storage to protect taxpayer privacy. All sensitive data is encrypted before being recorded on the blockchain, ensuring that even if transaction details are publicly accessible, the specific data remains confidential and secure. Additionally, private data is stored off-chain using decentralized storage solutions like the InterPlanetary File System (IPFS). Wright and De Filippi (2015) explained that this approach allows for the protection of sensitive information while maintaining the transparency and immutability of the blockchain for transaction records. The use of off-chain storage reduces the load on the blockchain and enhances scalability and efficiency.

By addressing these critical gaps through a fully decentralized approach, the implementation of DIDs, and the use of encrypted data and off-chain storage, our proposed blockchain-based tax collection system uniquely fills the void left by previous studies. This integrated approach not only enhances trust and compliance among taxpayers but also improves the overall efficiency and integrity of the tax collection and expenditure process.

3 Implementation Framework

The proposed implementation framework of this study integrates several key components that work together to enhance transparency, security, and efficiency in tax collection and expenditure tracking. The implementation of DIDs for each taxpayer ensures that each individual has a unique, secure digital identity, empowering taxpayers by providing them control over their identities and reducing the risk of identity theft and fraud. Tax Payment Recording is seamlessly integrated with the government's existing financial systems through robust APIs. This ensures that every transaction is accurately recorded and reflected in real-time on both the blockchain and central financial systems. Each tax payment is assigned a Unique Identifier (UID), which serves as a digital fingerprint for the transaction, linking all relevant information such as the taxpayer's DID, the payment amount, and the payment date, facilitating precise tracking from payment to final utilization in government expenditures. Expenditure Tagging and Tracking provide an additional layer of transparency and accountability by linking each government expenditure to the specific UIDs of the tax payments that funded them, involving assigning a unique tag to each expenditure with details on the amount, beneficiary, and purpose. This creates an open and verifiable pathway from tax collection to expenditure, allowing for real-time oversight and ensuring that funds are allocated and used responsibly. Together, these components form a cohesive system where taxpayer identities are securely managed, tax payments are accurately recorded and tracked, and government expenditures are transparently documented and linked to their funding sources. This integrated approach not only enhances trust and compliance among taxpayers but also improves the overall efficiency and integrity of the tax collection and expenditure process.

3.1 Decentralized ID (DID) for Each Taxpayer

The implementation of DIDs enhances privacy, security, and public trust in the tax system by providing each taxpayer with a unique, secure digital identity. DIDs provide self-sovereign identity management, reducing the risk of identity theft and fraud by empowering individuals to control their own identities independently of centralized authority. The flexibility of this solution with various blockchain

networks and digital platforms ensures ease of integration with other government services.

The DID system used cryptographically secured identities to safeguard taxpayer privacy and maintain transaction integrity, which improved trust and compliance in the tax collection process. Kshetri (2017) supported this approach.

3.2 Tax Payment Recording

For smooth tax payment recording, it is essential to integrate the blockchain system with the government's current financial systems via the creation of reliable APIs. The secure and effective transfer of tax payment data from the blockchain to the central financial systems will be made possible by these APIs, guaranteeing that each transaction is precisely recorded and reflected in real-time. Each tax payment is permanently documented by utilizing the immutable nature of blockchain, resulting in an unchangeable and transparent record of all transactions.

This connection lowered the possibility of errors or fraud while also improving accountability and streamlining the tax collection process. In order to preserve public confidence and transparency in the tax system, the APIs guaranteed that the tax data was consistently synchronized between the blockchain and the government's financial systems. Wright and De Filippi (2015) explained that this allowed for real-time auditing and reporting.

3.3 Unique Identifier for Each Tax Payment

To ensure precise tracking and openness, each tax payment that is registered on the blockchain is assigned a UID. As a digital fingerprint for the transaction, this UID connects all pertinent information, such as the taxpayer's DID, the payment amount, and the payment date. By assigning a UID, the system makes it simple to follow every tax payment from the moment it is made, through its journey on the blockchain, to its final usage in government expenditures.

By facilitating audits and verifications of tax payments and ensuring that all transactions were permanent and publicly available, this unique identity enhanced the transparency and integrity of the tax system. Zheng et al. (2017) explained that the UID encouraged greater trust and compliance by providing taxpayers with a vital point of reference to verify payments and understand how their contributions were being used.

3.4 Expenditure Tagging / Expenditure Tracking

To ensure total responsibility and openness in the use of tax funds, the system makes use of tools for recording and marking expenses. Every government expenditure is monitored on the blockchain and linked to the distinct IDs of the tax payments that made it possible. The process of assigning a unique tag to every

expense that contains details on the spend amount, the beneficiary, and the purpose is known as expense tagging. An open and verifiable route from tax collection to spending is created by the system's capacity to connect these tags to the initial tax payments. Expense tracking makes it possible to carefully monitor how donations are being utilized, which increases taxpayer trust in the system.

In addition to ensuring that funds were allocated prudently, this study provided an accessible and unalterable record of government expenditure. Using the blockchain's immutable ledger feature, the technology made sure that once an expense was recorded, it could not be altered or deleted. By doing this, fraud and careless use of public funds were reduced. Tapscott and Tapscott (2016) and Wright and De Filippi (2015) explained that complete spending tracking not only simplified reporting and auditing processes but also allowed for on-the-spot oversight and responsibility.

3.5 Public Transparency Portal

The Public Transparency Portal is a crucial component of the blockchain-based tax collection system since it provides citizens with immediate access to extensive information on taxes paid and government spending. Apart from offering a user-friendly interface for taxpayers to verify their tax payments and track the usage of their contributions, this web-based portal serves as a public-to-blockchain interface. After logging in with their DID, users can examine full records of their tax transactions by inputting their UIDs.

Every tax payment, related costs, and the justifications for each expenditure were all succinctly and thoroughly summarized on the webpage. Interactive features such as downloadable reports, search and filter tools, and data visualizations enhanced the user experience and made the information more accessible. The platform not only promoted openness but also provided citizens with the tools to hold the government accountable for its expenditures. Nakamoto (2008) and Kshetri (2017) explained that the Public Transparency Portal's simple access to this information encouraged more compliance and interaction with the tax system, which helped to build citizen-government confidence.

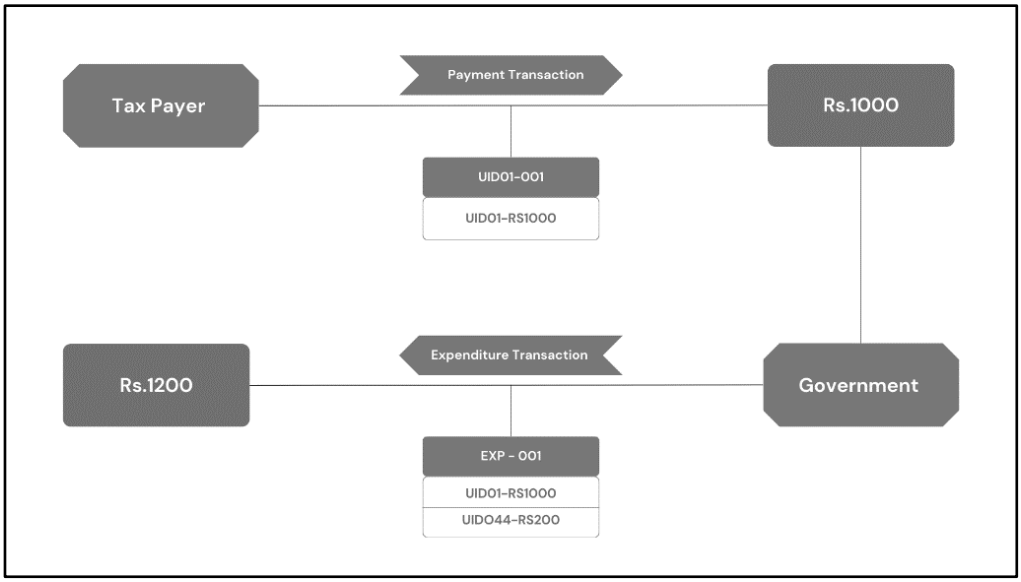

Figure 1: Implementation Framework Diagram

A blockchain-based system for tracking tax payments and government spending is depicted in the above Figure 1 in an effort to increase trust and transparency. A taxpayer's payment is tracked on the blockchain along with all transaction information, identified by a unique identifier (UID-001). Comparably, when the government uses Lankan Rupees, it records the transaction using a unique identifier (EXP-001) that includes information about the amount, reason for the expenditure, and related tax payments (like UID-001 and UID-044). By guaranteeing that all transactions remain unchangeable and open to the public, this system promotes accountability, transparency, and trust in the tax collection process by allowing taxpayers to see how their contributions are being used.

4 Challenges in Implementing Blockchain-Based Tax Collection Systems

When using blockchain technology in a tax collection environment, balancing privacy and transparency is crucial. While blockchain's transparent nature ensures that all transactions are recorded and verifiable, it also raises concerns about the privacy of taxpayers. Publicly accessible ledgers could potentially expose sensitive information about individuals' financial activities. To address these privacy issues, our proposed solution incorporates several key features: encryption and off-chain storage. All sensitive data is encrypted before being recorded on the blockchain, ensuring that even if transaction details are publicly accessible, the specific data remains confidential and secure. Additionally, private data is stored off-chain using decentralized storage solutions like the IPFS. This approach allows

for the protection of sensitive information while maintaining the transparency and immutability of the blockchain for transaction records.

Other associated challenges include scalability, as the number of transactions increases, the blockchain can become slower and more expensive to maintain. Efficiently managing a high volume of transactions while keeping costs low is a significant challenge. Interoperability is crucial, as ensuring that the blockchain system can seamlessly integrate with existing government financial systems and other digital services requires robust APIs and protocols to facilitate smooth data exchange.

Legislative and regulatory changes are also necessary to support the implementation of a blockchain-based tax system. The legal and regulatory framework must evolve to accommodate the unique aspects of blockchain technology. This includes creating standards and regulations that facilitate its use in tax collection without stifling innovation. Governments need to establish clear guidelines on data privacy, encryption standards, and the use of DIDs. Furthermore, regulatory bodies must work to ensure that blockchain transactions are legally recognized and enforceable. This involves drafting new laws and amending existing ones to address the specific requirements and challenges posed by blockchain technology in tax administration.

5 Conclusion

The use of a blockchain-based system to enhance tax collection transparency has the potential to yield significant advantages for Sri Lanka. The solution ensures private and secure identity management for taxpayers by utilizing Decentralized Identifiers. A unique number is assigned to each tax payment, and it is permanently recorded on the blockchain, resulting in an unalterable and transparent record. Expense tagging provides an even more visible and verifiable conduit for accountability by directly linking government spending to tax payments. The Public Transparency Portal serves as an interface for citizens to verify their contributions and monitor how their money is being used in real time. This innovative approach builds public confidence in government while encouraging more taxpayer compliance. In addition, the incorporation of state-of-the-art blockchain technology has elevated Sri Lanka to a leadership position in the digital transformation of the public sector, potentially attracting foreign investment and setting an example for other nations. All things considered, it is anticipated that this strategy will strengthen the nation's governance and economic structure by increasing transparency, increasing tax revenues, and developing a more dependable relationship between the people and the government.

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