International Journal of Engineering Research and Science & Technology

www.ijerst.org

ISSN : 2319-5991

Vol. 21 No. 3 (1) 2025

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International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com
Vol. 21, No. 3(1), 2025

Research Paper

BLOCKCHAIN-BASED CHEQUE CLEARANCE SYSTEM USING ETHEREUM FOR BANK AND USER TRANSACTIONS

Dr. SK. Mahboob Basha [1], B. Shanmukha Sai Kumar[2], P. Anand[2], Kaspa Tejashwini[2]

[1]Professor, [2]UG Student, [1,2]Department of Computer Science and Engineering (CSBS),

[1,2]Sree Dattha Institute of Engineering and Science, Sheriguda, Ibrahimpatnam, 501510, Telangana.

Abstract

The traditional cheque clearance systems face several challenges, including processing delays, high operational costs, and a lack of transparency—often resulting in inefficiencies and increased risk of fraud. To address these issues, a Blockchain-Based Cheque Clearance System Using Ethereum is proposed, aiming to revolutionize the banking sector by providing a secure, transparent, and efficient mechanism for cheque transactions between banks and users. This system leverages Ethereum's decentralized blockchain network and smart contracts to automate the cheque clearance process, ensuring faster and tamper-proof transactions. Historically, cheque clearance relied on manual or centralized procedures that were prone to errors and fraudulent activities. Traditional methods often required inter-bank coordination, causing delays and inconsistencies. Although some digitized systems were introduced over time, they remained centralized and lacked the trust and security required for critical financial operations. Inspired by the capabilities of blockchain technology, this project seeks to overcome these limitations by decentralizing the cheque clearance process. The motivation lies in the growing need for a solution that enhances security, reduces processing time, and ensures data integrity in financial transactions. By adopting blockchain, the system can provide immutable transaction records, minimize human intervention, and significantly reduce operational inefficiencies. The proposed solution uses Ethereum smart contracts to enable real-time verification, validation, and clearance of cheques. Each transaction is permanently recorded on the blockchain, ensuring transparency and auditability. The decentralized nature of Ethereum removes reliance on a central authority, thereby increasing system resilience and reliability. This innovative approach aims to redefine the cheque clearance process, offering banks and users a seamless, secure, and efficient transactional experience.

Keywords: Blockchain, Ethereum, Smart Contracts, Cheque Clearance, Decentralization, Transparency, Security, Web3.py, Django, QR Code, Hashing, Automation, Fraud Prevention

Received: 14-7-2025 Accepted: 21-8-2025 Published: 28-8-2025

1. INTRODUCTION

In India, cheque transactions have been a vital part of the banking system for decades, accounting for a significant portion of non-cash payments. According to RBI reports, over 1 billion cheques were cleared annually as recently as 2020. However, traditional cheque clearance processes are often plagued by delays, fraud risks, and manual inefficiencies. Blockchain technology, with its inherent transparency, immutability, and decentralized nature, offers a promising solution to transform cheque processing. Applications include fraud prevention, real-time status tracking, and secure transactions. BPM (business process management and modeling) as a discipline tries to increase the performance of companies by studying business processes, and possibilities for business process optimizations [**1**].

In the course of the development of the research branch, it has matured as an academic and professional discipline. The contemporary BPM is a widely adopted and deployed scientific field on both the academic and practitioner sides. BPM tries to respond to and address pressing issues in all sectors of business IT (information technology) and to foster value creation for companies. However, with the rise of the large number of opportunities connected with digitization, the established BPM methods are not fully capitalizing on the latest opportunities that are offered by contemporary technology. For instance, blockchain technology has gained widespread traction, yet its use for business process aims is in its infancy [**2**]. The use of blockchain has the power to revolutionize the interoperability among multi-parties in cross-organization business workflows. It buttresses systems that automatically gather, analyze and process data. Reasonable decentralization is key to promoting trust among different and not directly connected departments of a company. Hence, these are strong motivations that push companies to develop and implement new open business processes that are transparent to everyone, including the final user. A blockchain is a ledger of all transactions which are stored in a distributed database.

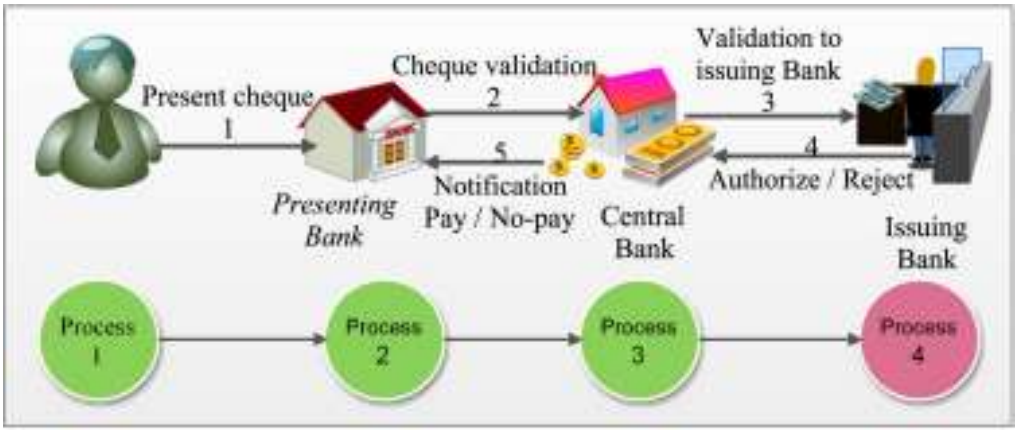

Fig 1: Working of cheque clearances in banks.

One or a single transaction can constitute a block. Each time, a transaction is made, it is linked to a chain, with every block containing a hash of the previous blocks in order of sequence. The fact that the data are stored in a distributed way makes it impossible to change its data. Changing the data would require that one changes the data in each block in each of the distributed databases at the same time. Thus, this solution makes such scenarios impossible within the currently available technologies. Some examples of current applications of blockchain in the financial industry include the Corda platform [**4**]. This platform is a collaborative effort of 40 banks to redesign the current settlement process by enabling financial agreements to be stored on the blockchain and thereby help improve reconciliation processes to become more optimal. The Australian stock exchange implements a system based on a blockchain ledger [**5**]. In the UK welfare program, the welfare payment process uses blockchain technology [**6**]. In Sweden, land records are put on the blockchain so that banks (for purposes of delivering loans and mortgages), government agencies, buyers, and sellers can track changes in real time [**7**]. Recent advancements in machine learning and AI have enabled predictive models for business process management (BPM), yet their adoption remains limited due to a lack of interpretability for business users who are not data scientists. While BPM literature explores predictive insights, it often overlooks the need to translate model explanations into meaningful, domain-specific insights. The BPM community must integrate AI interpretability techniques and leverage business process definitions to enhance explanation quality and relevance. Simultaneously, blockchain technology, particularly Ethereum-based smart contracts, offers transformative potential for financial processes such as cheque clearance. India's traditional cheque systems suffer from

inefficiencies, delays, and fraud risks, which can be addressed through a Blockchain-Based Cheque Clearance System that ensures enhanced security, transparency, reduced processing time, cost efficiency, decentralization, and user empowerment. This research proposes a decentralized protocol for secure, tamper-proof, and efficient cheque transactions, aiming to modernize banking, prevent fraud, support regulatory compliance, and enable global scalability in digital cheque processing.

2. LITERATURE SURVEY

The use of blockchain technology is rapidly expanding [**8**]. Many researchers are looking into it from various angles. It is a technique for storing and transmitting information in the form of a chain of blocks in a decentralized, secure, and transparent manner. Many well-known companies, such as Google, Microsoft, and Blackrock, utilize blockchain. Various research works and literature reviews about blockchain have been recently published [**9**,**10**]. Blockchain is widely used in enabling decentralized cryptocurrency platforms and financial technology [**11**] to reduce the risk and eliminate much of the processing and transaction fees. It is used in (a) international payments, (b) peer-to-peer transactions, (c) fighting bank fraud (security) [**12**], (d) insurance and transaction automation, (cryptocurrencies) [**13**,**14**], (e) decentralized finance (DeFi) and smart contracts [**15**], and (f) health services and sharing medical data (privacy) It helps in gaining more security, accuracy, and in lowering costs. Blockchain is often used to solve more complex problems the importance of using blockchain in distributed applications (dApps). It helps provide trustworthiness in a trustless environment, improving data reconciliation, and optimizing resource distribution. The blockchain has the ability to bring business process management back to life. Blockchain can make processes involving numerous parties in systems transparent by employing its ability to audit distributed ledger technology and smart contracts, as well as obeying some specific regulatory regulations.It can connect data, circulate documents, and track multiple stages of a transaction. The authors presented a blockchain-based business process management system (Caterpillar) which uses smart contracts to encode the status of business process instances and conduct workflow routing. Another paper, shows how blockchain technology may help firms reduce transaction costs, improve collaborative business processes, and reinforce trustworthiness and transparency while also assisting with data consistency and security governance and reconciliation. looked at an automated BPM system for selecting and composing services in an open business environment in another study. They investigated and proposed blockchain technology (BCT) as a means of transferring and verifying the trustworthiness of enterprises and partners. They created a BPM framework to show how blockchain technology may be used to assist in quick, accurate, and cost-effective evaluation and the transfer of service quality in workflow composition and management. Various studies have been conducted on the use of blockchain technology in BPM

3. PROPOSED SYSTEM

The system combines blockchain, cryptography, QR codes, and web technologies to implement a secure and automated cheque clearance platform. The backend is built on Django, a powerful Python web framework, while blockchain communication is handled using **Web3.py**. Encryption, hashing, and QR code operations are performed using specialized Python libraries to ensure data integrity and security.The proposed system leverages blockchain, cryptography, QR codes, and web technologies to develop a secure, automated cheque clearance platform. Built on the Django framework, with Ethereum blockchain integration via Web3.py, the system ensures data integrity and transparency through smart contracts coded in Solidity, enabling functionalities such as cheque creation, verification, and approval. QR codes are used to encode digital cheques, while hashing mechanisms safeguard cheque identity, and email notifications enhance user communication. The platform

supports role-based interfaces for banks and customers, and follows a structured development cycle—beginning with requirement analysis and progressing through blockchain setup, smart contract development, backend and frontend integration, testing, and deployment. Blockchain's core features—decentralization, immutability, transparency, cryptographic security, and consensus mechanisms—make it ideal for transforming traditional cheque processing into a reliable, tamper-proof digital system.

Encryption and Decryption

In this project, encryption is primarily implemented through cryptographic hashing and QR code-based security to protect cheque data without exposing sensitive details. The Python hashlib library is used to generate SHA-256 hashes of QR code images, ensuring each cheque has a unique and tamper-proof digital fingerprint stored on the blockchain. Instead of employing full encryption, hashing is preferred because it provides strong data integrity with lower computational overhead and maintains user privacy without requiring decryption. The QR code, generated using the pyqrcode package, encodes readable cheque information such as sender, receiver, amount, and date into PNG images. These codes can be easily scanned and verified without compromising security. For QR code decoding, the system utilizes the opencv-python (cv2) library, specifically the QRCodeDetector, to detect and extract encoded information from the images. While the current system focuses on hashing, it could be extended to include full encryption using libraries like cryptography or PyCryptoDome if enhanced confidentiality is required.

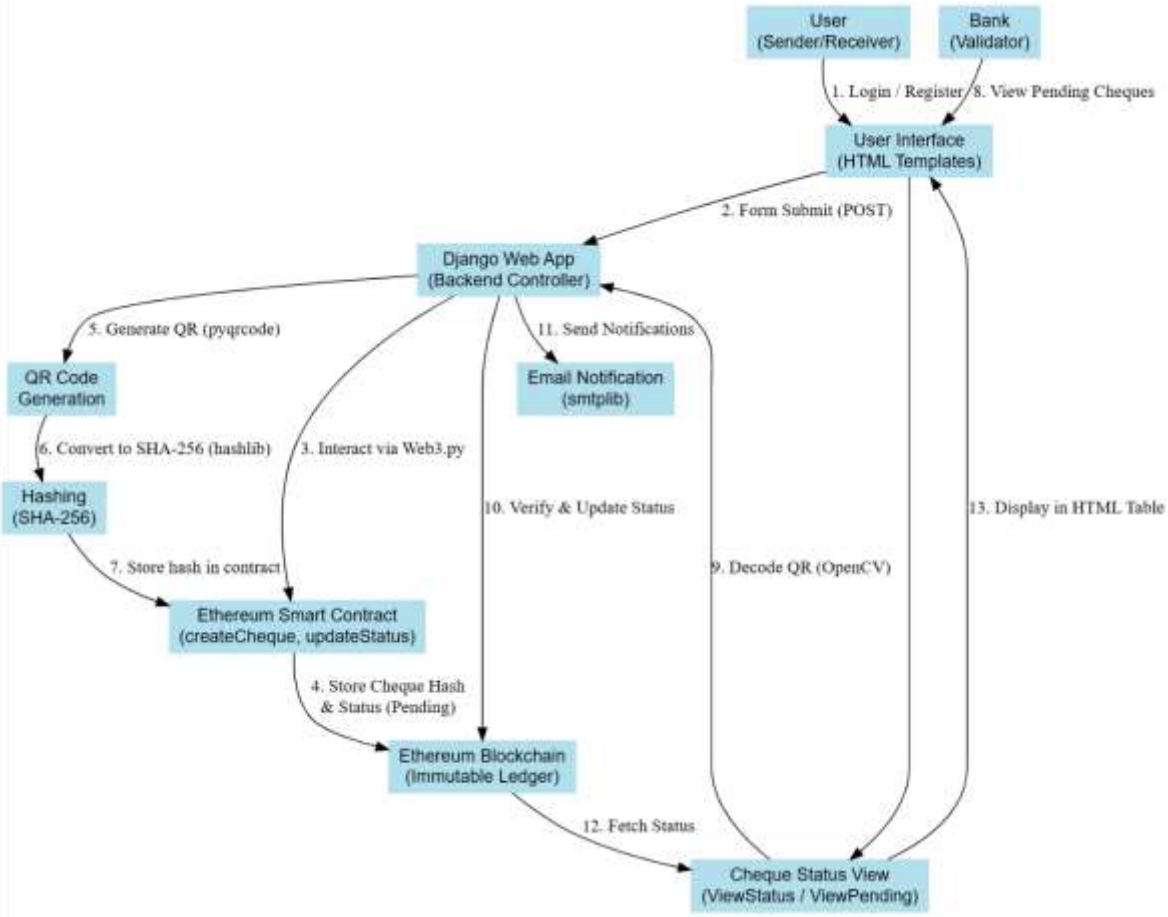

Fig 2: Block Diagram of blockchain based cheque clearance systems.

Smart Contract Development

The smart contract, developed in Solidity, defines key functionalities such as user registration with role distinctions (Bank or User), creation of cheques linked to hashed QR codes, status management (e.g., Pending, Cleared), and query functions for retrieving user and cheque information. Once compiled, the contract's ABI and deployed address are loaded via a JSON file to instantiate a Web3 contract object. The web3.py library facilitates interaction with the Ethereum blockchain by connecting to a local node (such as Ganache), invoking smart contract functions, sending transactions using the transact() method, and waiting for transaction receipts to confirm successful inclusion of data on the blockchain.

User Interface Development

The user interface of the proposed cheque clearance system is built using Django's MTV (Model-Template-View) architecture, a variation of MVC specifically designed for Django applications. In this system, smart contracts on the blockchain serve as the primary data store for users and cheques, while Django models may be optionally used for auxiliary or mirrored data to enhance UI responsiveness. Templates are HTML files (e.g., index.html, BankLogin.html, GenerateCheque.html) that display dynamic content using Django's templating language, enabling interactive forms, QR codes, and status displays. Views in Django act as controllers, handling HTTP requests, rendering templates, processing form submissions, managing authentication for bank and user roles, interacting with smart contracts via Web3.py, and handling QR code generation and verification. Integration with the Ethereum blockchain is facilitated by web3.py.

4. RESULTS

Fig 3: Illustration of GUI interface displaying home page.

Fig 4: Illustration of GUI interface displaying Login Page.

In above screen I adding user details and give valid email id so application send email after clearance

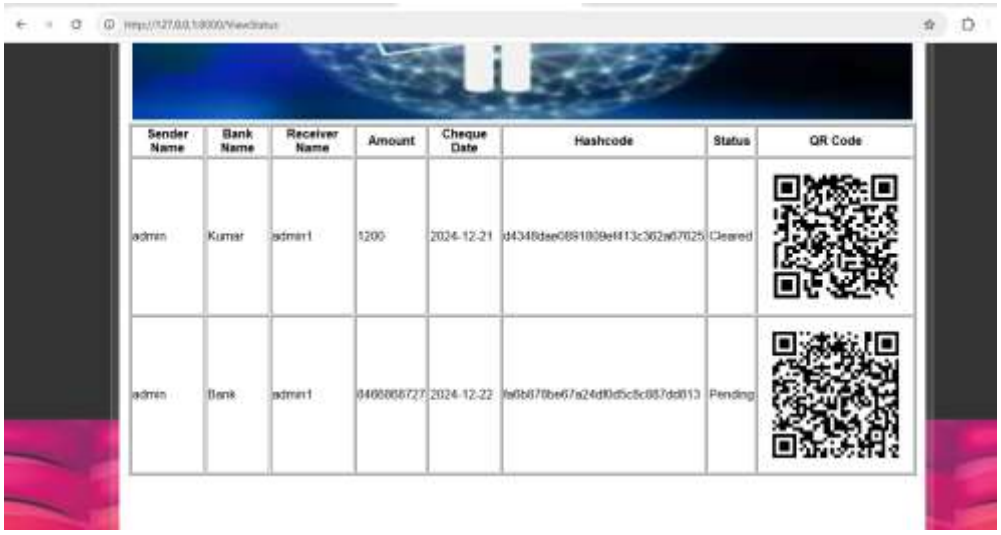

Fig 5: Illustration of GUI interface displaying View Check Status.

Fig 6: Illustration of GUI interface displaying Bank Login screen.

Fig 7: Illustration of GUI interface displaying Bank Dashboard.

Fig 8: Illustration of GUI interface displaying pending checks.

Figure 8 shows user can see details from generated cheque whose status is pending as bank has not yet cleared so logout and login as bank.

International Journal of Engineering Research and Science & Technology

Fig 9: Illustration of GUI interface of checking clearance message.

Figure 9 shows that the cheque cleared successfully and now bank can click on 'Daily Transaction Statistics'

Fig 10: Illustration of GUI interface displaying Daily Transactions.

Figure 10 show bank can see list of transaction day wise

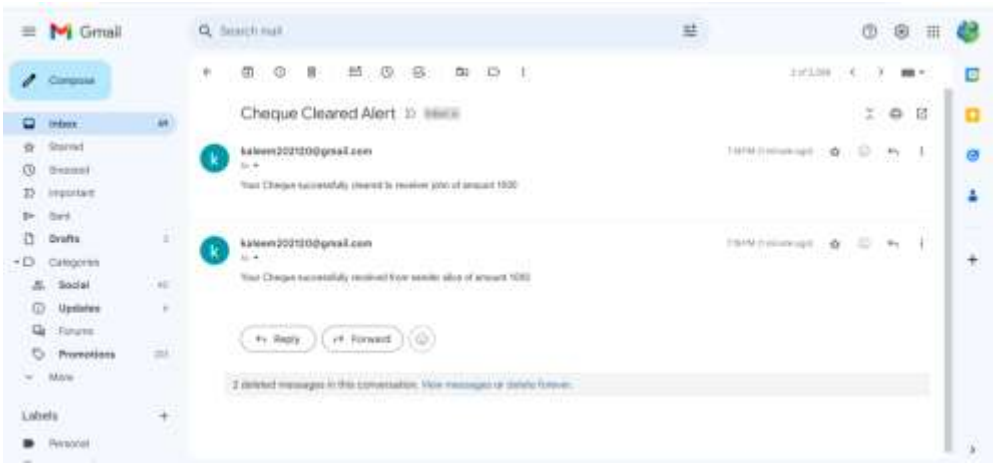

Figure 11: Email verification.

Figure11 shows that both sender and receiver can see email notification

Figure 12: Final output.

In above screen can see cheque clearance status is updated to ‘Cleared’.

5. CONCLUSION

The blockchain-based cheque clearance system using Ethereum offers a revolutionary approach to traditional cheque management by leveraging the transparency, immutability, and security of blockchain technology. This system significantly enhances the process of cheque issuance, validation, and clearance, addressing inefficiencies in traditional methods. By integrating smart contracts, every cheque-related operation is automated, reducing human intervention and minimizing errors. This ensures tamper-proof and secure transactions between users and banks, fostering trust and accountability. The use of QR codes and cryptographic hashing further enhances the security of cheque management by encoding sensitive data and making it verifiable through immutable records on the blockchain. Banks benefit from real-time transaction tracking and a streamlined clearance process, while customers gain confidence in the security and transparency of their transactions. The inclusion of email notifications keeps all stakeholders informed about the status of cheques, enhancing communication and reducing delays. This system also highlights the potential for blockchain in modernizing financial systems, creating an efficient, decentralized, and secure

framework. As a result, it not only improves operational efficiency but also aligns with the digital transformation goals of the banking sector. By replacing manual processes with an automated system, the project demonstrates how blockchain can mitigate fraud, reduce processing times, and cut down operational costs. Overall, this project sets a strong foundation for future innovations in the financial industry.

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