International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 05 Issue: 03 | March – 2026 DOI:10.55041/ISJEM05982
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

Automated Cheque Clearance and Instant Settlement System using Hybrid OCR and Banking API Orchestration

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Abstract

Cheque-based transactions remain a critical component of high-value payments in the Indian banking ecosystem. However, conventional cheque clearing through the Cheque Truncation System (CTS) introduces settlement delays ranging from 24 to 48 hours. This paper presents a fully automated cheque clearance and instant settlement system using a hybrid Optical Character Recognition (OCR) approach combined with secure banking API orchestration. The proposed system integrates Tesseract OCR for machine-printed fields and EasyOCR for handwritten text extraction.
Extracted data is validated and processed through IMPS, NEFT, or RTGS channels in real time. Experimental evaluation across multiple Indian bank cheque formats demonstrates an average end-to-end processing time of 1.45 seconds with extraction accuracy exceeding 95%, significantly improving liquidity, operational efficiency, and fraud mitigation.

Keywords

Cheque Processing, Optical Character Recognition, Banking APIs, IMPS, NEFT, RTGS, FinTech Automation

Introduction

Despite the rapid adoption of digital payment systems such as UPI, traditional paper-based cheques continue to be widely used in India for high-value, institutional, and
business-to-business transactions. According to the Reserve Bank of India (RBI), billions of cheques are processed annually, representing transactions worth trillions of rupees. Existing cheque processing mechanisms rely on
batch-based clearing, manual verification, and inter-bank reconciliation, leading to significant settlement delays and increased operational costs.

1. Related Work

Several studies have explored automation in cheque processing using MICR technology and OCR. Kumar et al. demonstrated that hybrid OCR models significantly outperform
single-engine OCR systems when applied to Indian bank cheques, which exhibit diverse layouts, fonts, and handwritten fields. Recent research also emphasizes integrating legacy instruments such as cheques with real-time payment infrastructure to improve liquidity and customer experience.

2. System Architecture

The proposed system follows a four-layer architecture comprising acquisition, preprocessing, extraction, and integration layers. The acquisition layer captures cheque images from scanners or mobile devices. The preprocessing layer applies grayscale conversion, noise reduction, skew correction, and adaptive thresholding using OpenCV. The extraction layer employs a hybrid OCR framework, while the integration layer orchestrates secure fund transfer using banking APIs.

[Figure 1: System Architecture Diagram – to be inserted]

3. Operational Workflow

The operational workflow begins with cheque image upload, followed by bank identification using MICR or IFSC patterns. Textual fields

such as payer name, payee name, date, and amount are extracted and validated. The amount in words is cross-verified against the numeric amount. Upon successful validation, a secure API payload is generated and transmitted to the banking system for real-time settlement.

[Figure 2: End-to-End Workflow Diagram – to be inserted]

4. Algorithm and Mathematical Model

Let I represent the input cheque image. The preprocessing function P(I) produces a noise-free, deskewed image. The hybrid OCR function O(P(I)) extracts structured cheque data. Validation V(D) ensures data consistency. Upon successful validation, the settlement function S(V(D)) initiates fund transfer.

Total Processing Time T is given by:

$T = T_p + T_o + T_v + T_s$

where T_p is preprocessing time, T_o is OCR time, T_v is validation time, and T_s is settlement time.

5. Results and Discussion

The system was evaluated using cheques from SBI, HDFC, ICICI, Axis Bank, and Punjab National Bank. The hybrid OCR approach achieved 100% accuracy for MICR and IFSC extraction and 92% accuracy for handwritten fields. The average processing time from image upload to settlement initiation was 1.45 seconds. Compared to conventional CTS-based clearing, the proposed system reduces settlement time by over 99%.

6. Conclusion

This paper demonstrates the feasibility of near-instant cheque clearance using intelligent automation. By combining hybrid OCR with secure banking API orchestration, the system eliminates traditional settlement delays while improving accuracy, security, and operational efficiency.References

1. RBI – ***Payment Systems in India: Vision 2021–2025***
Defines India's strategic roadmap for payment systems with focus on **digitalisation, security, financial inclusion, efficiency, and innovation**. Emphasises reduced cash usage, stronger regulation, improved customer protection, and scalable payment infrastructure.

🔗 https://www.rbi.org.in → Payments → Vision Documents

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2. NPCI – ***IMPS Technical Specifications v2.3*** Details the **architecture, message formats, security standards, and transaction flows** of IMPS, enabling **real-time, 24×7 interbank fund transfers**. Forms the backbone for instant payment services in India.

🔗 https://www.npci.org.in (member login required for specs)

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3. Kumar et al., ***OCR Systems for Indian Bank Cheques*** **(2020)**
Presents OCR-based methods for **automated cheque processing**, focusing on **image preprocessing, segmentation, feature extraction, and machine learning** to recognize handwritten and printed cheque fields with improved accuracy.

🔗 https://scholar.google.com (search paper title)