G. Sudheer kumar, 2026, 14:4
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Deep Learning-Based Intelligent Bank Cheque Verification Using Advanced Image Processing Techniques

G. Sudheer kumar[1], K. Bhagyasree[2]

[1]Assistant Professor, Department ofComputer Science and Engineering, Megha Institute of Engineering and Technology for Women, Edulabad (Village), Ghatkesar (Mandal), Medchal District, Telangana, India.

[2]M Tech Student, Department of Computer Science and Engineering, Megha Institute of Engineering and Technology for Women, Edulabad (Village), Ghatkesar (Mandal), Medchal District, Telangana, India.

Abstract- Bank cheque verification is a critical banking operation that requires high accuracy to minimize fraud and processing delays. This study introduces an intelligent cheque verification framework that combines image processing with deep learning techniques to automate the authentication process. The proposed approach extracts essential cheque details such as the IFSC code, cheque number, account number, handwritten amount, printed text, and account holder's signature from scanned cheque images. Image preprocessing techniques are applied to enhance image quality and isolate important regions before analysis. Optical Character Recognition (OCR) is employed to recognize printed characters, while a Convolutional Neural Network (CNN) is utilized for identifying handwritten numerical values. Signature verification is performed using Scale-Invariant Feature Transform (SIFT) for feature extraction and a Support Vector Machine (SVM) for classification. The integrated framework improves verification reliability, accelerates cheque processing, and reduces manual intervention. Experimental evaluation on a standard cheque image dataset demonstrates that the proposed system achieves high recognition accuracy for text, handwritten digits, and signatures, making it a practical solution for secure and efficient banking applications.

Keywords— Bank Cheque Verification, Deep Learning, Image Processing, Optical Character Recognition (OCR), Convolutional Neural Network (CNN), Signature Verification, SIFT, Support Vector Machine (SVM), Handwritten Digit Recognition, Banking Security.

I. INTRODUCTION

Bank cheques continue to serve as an important financial instrument for transferring funds, particularly in commercial transactions, government payments, and institutional banking operations. Although digital payment systems have significantly increased in popularity, cheque-based transactions remain essential due to their legal validity, security, and widespread acceptance. Traditional cheque verification methods rely heavily on manual inspection, where banking personnel validate cheque details such as the account number, IFSC code, cheque number, date, written amount, numerical amount, and account holder's signature. This manual process is time-consuming, labor-intensive, and vulnerable to human errors, resulting in delayed transaction processing and an increased risk of fraudulent activities. Therefore, there is a growing need for intelligent automation systems capable of improving the speed, reliability, and security of cheque verification.

Recent developments in Artificial Intelligence (AI), Deep Learning, and Digital Image Processing have created new opportunities for automating document authentication tasks with high precision. Advanced image processing techniques can effectively preprocess scanned cheque images by correcting orientation, removing background noise, enhancing image quality, and isolating important regions of

interest. These preprocessing operations significantly improve the performance of subsequent recognition algorithms and enable accurate extraction of relevant cheque information. As a result, automated cheque verification systems can perform document analysis more efficiently than conventional manual approaches.

Optical Character Recognition (OCR) has become an effective solution for recognizing machine-printed information present on bank cheques, including account numbers, branch codes, cheque numbers, and printed text. However, recognizing handwritten values such as courtesy amounts and signatures remains a challenging task because handwriting styles vary greatly between individuals. Deep learning models, particularly Convolutional Neural Networks (CNNs), have demonstrated excellent performance in handwritten digit recognition by automatically learning meaningful image features from large datasets. Likewise, feature extraction methods such as Scale-Invariant Feature Transform (SIFT), when combined with Support Vector Machine (SVM) classifiers, provide reliable signature authentication by distinguishing genuine signatures from forged ones. The integration of these technologies enables a comprehensive and secure cheque verification framework.

An automated bank cheque verification system offers several advantages to financial institutions by minimizing manual intervention, reducing processing time, improving operational efficiency, and enhancing fraud detection capabilities. Such systems are capable of accurately extracting essential cheque components, validating numerical and textual information, and verifying signatures within a unified workflow. This not only accelerates cheque clearance procedures but also improves customer satisfaction by enabling faster and more reliable banking services. Furthermore, automation reduces operational costs and supports large-scale cheque processing with consistent accuracy, making it highly suitable for modern banking environments.

The proposed research presents an AI-driven bank cheque verification framework that integrates image preprocessing, Optical Character Recognition (OCR), Convolutional Neural Networks (CNN), Scale-Invariant Feature Transform (SIFT), and Support Vector Machine (SVM) techniques to automate cheque authentication. The system extracts critical cheque information, recognizes both printed and handwritten content, and verifies account holder signatures to ensure transaction authenticity. By combining deep learning with image processing, the proposed approach delivers a secure, accurate, and efficient solution for bank cheque verification while reducing human effort and strengthening the overall reliability of financial transaction processing.

II. LITERATURE SURVEY

Dhanva et al. (2018)
Dhanva and colleagues presented a secure cheque image verification approach for online banking environments. Their work focused on strengthening cheque image protection during digital transmission by applying image security techniques. The proposed method improved the confidentiality of cheque images and minimized the possibility of unauthorized modifications during banking transactions.

Singh and Tigga (2012)
Singh and Tigga examined the influence of information technology on banking services in India. Their study explained how automation has transformed financial operations by improving transaction speed, minimizing manual work, and increasing service quality. They highlighted that intelligent banking technologies can significantly improve operational efficiency and customer satisfaction.

Wang and Shiau (1972)
Wang and Shiau developed an optical character recognition technique for identifying printed Chinese characters using transformation algorithms. Their research demonstrated the importance of pattern recognition methods for extracting textual information from scanned documents and laid the foundation for future OCR-based document processing systems.

Zramdini and Ingold (1998)
Zramdini and Ingold introduced a font recognition approach based on typographical characteristics. Their technique accurately distinguished different printed fonts, improving the reliability of optical character recognition systems used in document analysis applications.

Zhu et al. (2002)
Zhu and co-authors proposed a texture-based font recognition method that analyzed global image features instead of individual characters. Their approach enhanced the accuracy of printed text recognition and demonstrated that texture analysis can improve document classification performance.

Saenthon and Sukkhadamrongrak (2014)
The researchers compared multiple neural network training algorithms for recognizing English and Thai characters. Their study showed that selecting appropriate training methods significantly influences recognition accuracy and computational performance in multilingual OCR applications.

Ramanathan and Sharma (2017)
Ramanathan and Sharma implemented a Support Vector Machine (SVM)-based multi-class classification model for pattern recognition tasks. Their research demonstrated that SVM classifiers provide reliable classification accuracy while effectively handling complex feature spaces generated from document images.

Stewart et al. (2018)
Stewart and colleagues developed a handwriting recognition framework that combined segmentation and stitching techniques. Their method successfully recognized handwritten text even when only a limited amount of training data was available, making it suitable for practical document recognition applications.

Kajale et al. (2017)
Kajale and co-authors proposed a supervised machine learning approach for recognizing handwritten and printed characters from document images. Their intelligent recognition framework effectively classified different text patterns and improved character extraction accuracy through machine learning algorithms.

Singh et al. (2015)
Singh and colleagues introduced a handwritten legal amount recognition system for English bank cheques. Their work focused on identifying textual monetary values written by customers and demonstrated that accurate word recognition plays an important role in automated cheque verification systems.

Miah et al. (2015)
Miah and co-researchers designed a neural network-based system for recognizing handwritten courtesy amounts and signatures on bank cheques. Their framework improved the accuracy of handwritten content recognition and highlighted the effectiveness of artificial neural networks in financial document authentication.

Jayadevan et al. (2010)
Jayadevan and associates proposed an automated recognition method for identifying legal amounts written on Indian bank cheques. Their technique successfully extracted handwritten monetary values and demonstrated improved recognition performance for cheque processing applications.

Raghavendra and Danti (2009)
Raghavendra and Danti developed a cheque recognition system based on invariant geometric features. Their model accurately identified important cheque components despite variations in image orientation and scale, thereby improving document verification reliability.

Lu et al. (2017)
Lu and colleagues proposed an image enhancement technique to eliminate shadows and improve OCR performance. Their preprocessing method enhanced text visibility in scanned documents, resulting in more accurate character recognition under challenging imaging conditions.

Wiraatmaja et al. (2017)
Wiraatmaja and co-authors introduced a deep convolutional denoising autoencoder for OCR

preprocessing. Their approach effectively removed image noise before text recognition, significantly improving OCR accuracy and reducing recognition errors in degraded document images.

III. RESEARCH METHODOLOGY

The proposed research presents an intelligent bank cheque verification framework that combines image processing, optical character recognition, deep learning, and machine learning techniques to automate cheque authentication. The methodology is designed to verify the authenticity of scanned cheque images by extracting essential information, recognizing handwritten and printed content, and validating account holder signatures. The complete workflow consists of image acquisition, preprocessing, segmentation, text recognition, handwritten digit identification, signature verification, and final validation. This systematic approach minimizes manual effort while improving the accuracy, speed, and reliability of cheque processing in banking applications.

Initially, cheque images are obtained using a high-resolution scanner or digital imaging device. Since raw scanned images may contain noise, skew, uneven illumination, and unnecessary background information, preprocessing techniques are applied to enhance image quality before further analysis. The preprocessing stage includes image rotation correction, grayscale conversion, Gaussian filtering, morphological operations, and noise removal. These operations produce a clean and standardized cheque image that improves the performance of subsequent recognition algorithms. The enhanced image serves as the foundation for extracting important cheque components with greater precision.

Following preprocessing, the cheque image undergoes segmentation to isolate different regions containing critical financial information. The segmentation process separates fields such as the account number, cheque number, IFSC code, date, courtesy amount, legal amount, and signature. Accurate segmentation ensures that each field is processed independently, reducing interference from surrounding text or graphical elements. By focusing only on the required regions of interest, the system increases computational efficiency and improves the overall recognition accuracy of the verification process.

The extracted machine-printed information is processed using Optical Character Recognition (OCR), which converts printed text into editable digital data. OCR accurately identifies fields such as the cheque number, account number, branch code, and other printed information available on the cheque. For handwritten numerical values, particularly the courtesy amount, a Convolutional Neural Network (CNN) is employed to recognize individual digits. The CNN automatically learns complex visual patterns from handwritten samples and accurately predicts numerical values despite differences in writing styles. The recognized numerical amount is then compared with the textual amount written on the cheque to ensure consistency before transaction approval.

Signature authentication is performed using a combination of Scale-Invariant Feature Transform (SIFT) and Support Vector Machine (SVM). Initially, SIFT extracts stable and distinctive features from the signature image that remain unaffected by changes in scale, rotation, or orientation. These extracted features are then supplied to the SVM classifier, which determines whether the signature is genuine or forged by comparing it with trained signature patterns. This hybrid approach enhances signature verification accuracy while reducing the possibility of fraudulent cheque transactions.

Finally, the outputs generated by OCR, CNN, and the signature verification module are integrated to make the final authentication decision. The system validates all extracted cheque details, compares handwritten and printed information for consistency, and confirms signature authenticity before approving the cheque. If any mismatch or abnormality is detected during verification, the cheque is flagged for manual inspection. By integrating advanced image processing, deep learning, and machine learning techniques into a single automated framework, the proposed

methodology provides a secure, efficient, and reliable solution for modern bank cheque verification while significantly reducing processing time and human intervention.

IV. EXISTING SYSTEM

Existing bank cheque verification systems primarily depend on manual inspection and conventional image processing techniques to validate cheque authenticity. In these systems, bank personnel examine important cheque components such as the cheque number, account number, branch code, handwritten amount, printed details, and account holder's signature before approving financial transactions. This verification process requires considerable human effort and is often slow when handling a large number of cheques. Furthermore, manual inspection is susceptible to human errors, inconsistencies, and delays, which can negatively affect banking efficiency and increase operational costs.

Several automated systems have attempted to simplify cheque verification by utilizing Optical Character Recognition (OCR) for extracting machine-printed information. OCR-based approaches successfully recognize printed text such as account numbers, cheque numbers, dates, and bank branch information. However, these methods perform poorly when processing handwritten fields because handwriting styles differ significantly among individuals. As a result, conventional OCR systems alone cannot provide complete cheque authentication, particularly when handwritten amounts and signatures require verification.

Some existing research has incorporated traditional machine learning algorithms for handwritten character recognition and signature verification. These systems generally rely on manually designed features extracted from cheque images before classification. Although such methods improve recognition performance compared to purely manual verification, they remain sensitive to image quality, background noise, rotation, scaling, and handwriting variations. Consequently, their performance decreases when processing complex or low-quality cheque images encountered in real-world banking environments.

Image preprocessing and segmentation techniques are also widely employed in existing cheque verification systems to isolate important regions such as the courtesy amount, legal amount, signature, and account details. While these preprocessing methods improve recognition accuracy, many existing solutions require manual adjustments during segmentation because cheque layouts may vary across different banks and countries. This semi-automatic nature limits scalability and increases processing time during high-volume banking operations

V. PROPOSED SYSTEM

The proposed system introduces an intelligent and automated framework for bank cheque verification by integrating image processing, Optical Character Recognition (OCR), deep learning, and machine learning techniques. The primary objective of the system is to verify the authenticity of scanned bank cheques with minimal human intervention while ensuring high accuracy and faster processing. The framework is designed to automatically extract essential cheque information, recognize both printed and handwritten content, verify the account holder's signature, and validate all extracted details before approving the cheque. This integrated approach enhances operational efficiency and strengthens the security of financial transactions.

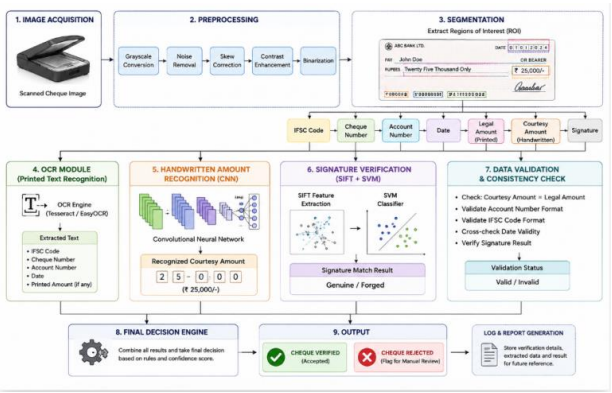
The verification process begins with acquiring a high-quality scanned image of the bank cheque. Image preprocessing techniques are then applied to improve image quality by correcting orientation, removing background noise, converting the image into grayscale, and enhancing important regions. After preprocessing, image segmentation is performed to isolate critical cheque components such as the IFSC code, cheque number, account number, date, courtesy amount, legal amount, and signature. These segmented regions are processed individually, enabling more accurate extraction and recognition of cheque information.

Machine-printed text is extracted using Optical Character Recognition (OCR), which accurately identifies printed fields including the cheque number, account number, branch details, and other textual information. Handwritten numerical values, especially the courtesy amount, are recognized using a Convolutional Neural Network (CNN). The CNN automatically learns complex handwriting patterns from training data, enabling accurate recognition of handwritten digits even when writing styles differ. The recognized numerical value is then compared with the written legal amount to ensure consistency and detect possible discrepancies before further processing.

To authenticate the account holder's signature, the proposed system employs the Scale-Invariant Feature Transform (SIFT) algorithm for extracting unique signature features, followed by a Support Vector Machine (SVM) classifier for determining whether the signature is genuine or forged. This combination provides robust signature verification by identifying stable feature points that remain consistent despite variations in scale, rotation, or writing style. The integration of SIFT and SVM significantly improves the reliability of signature authentication and reduces the likelihood of cheque fraud.

Finally, the outputs generated by OCR, CNN, and the signature verification module are combined to perform comprehensive cheque validation. The system cross-checks all extracted information, verifies the consistency between handwritten and printed values, confirms signature authenticity, and identifies any mismatches or suspicious alterations. If all verification stages are successfully completed, the cheque is authenticated; otherwise, it is flagged for further inspection. By integrating advanced image processing, deep learning, and machine learning techniques into a unified workflow, the proposed system provides a secure, accurate, scalable, and efficient solution for automated bank cheque verification, reducing processing time, minimizing human errors, and improving the overall reliability of banking operations

VI. SYSTEM ARCHITECTURE



The proposed system architecture provides a structured and automated framework for verifying bank cheques using image processing, Optical Character Recognition (OCR), deep learning, and machine learning techniques. The architecture is designed to perform every stage of cheque authentication, beginning with image acquisition and ending with the final verification decision. Each module performs a specific task that contributes to improving the accuracy, efficiency, and security of the cheque verification process. By integrating multiple intelligent technologies into a single workflow, the system minimizes manual intervention, reduces processing time, and enhances the reliability of banking transactions. The overall workflow is consistent with the cheque verification pipeline described in the uploaded paper.

The first stage of the architecture is image acquisition, where a bank cheque is captured using a scanner or high-resolution camera. Since raw cheque images may contain noise, skew, shadows, or unwanted background information, the captured image is forwarded to the preprocessing module. During preprocessing, the system performs operations such as grayscale conversion, noise filtering, skew correction, image enhancement, and binarization. These operations improve image clarity and produce a standardized cheque image that is suitable for accurate feature extraction and recognition.

After preprocessing, the system performs image segmentation to divide the cheque into multiple

regions of interest. Important fields such as the IFSC code, cheque number, account number, date, legal amount, courtesy amount, and signature are separated into individual image segments. Segmenting the cheque enables each field to be processed independently, reducing interference from surrounding text and improving recognition performance. Accurate segmentation also increases computational efficiency by allowing algorithms to focus only on relevant cheque components.

The segmented printed fields are processed using the Optical Character Recognition (OCR) module. OCR converts printed characters into machine-readable text and extracts important information such as the IFSC code, cheque number, account number, printed amount, and date. This extracted information is stored in digital form for further verification and comparison. OCR significantly reduces manual data entry while improving the speed and consistency of printed text recognition.
The handwritten amount recognition module uses a Convolutional Neural Network (CNN) to identify handwritten numerical values written by the account holder. The CNN automatically learns complex handwriting features during training and accurately recognizes digits despite differences in writing style, size, or orientation. The recognized courtesy amount is converted into numerical form and later compared with the legal amount written on the cheque to verify consistency. This deep learning approach provides higher recognition accuracy than traditional handwritten digit recognition methods.

The signature verification module authenticates the account holder's signature using Scale-Invariant Feature Transform (SIFT) and Support Vector Machine (SVM). SIFT extracts unique feature points from the signature image that remain stable under rotation, scaling, and slight variations. These extracted features are then classified by the SVM model to determine whether the signature is genuine or forged. This hybrid verification technique improves authentication reliability and provides strong protection against signature forgery.

After all recognition modules complete their tasks, the extracted information is forwarded to the data validation module. This module compares the courtesy amount with the legal amount, verifies the account number and IFSC code formats, checks the validity of the cheque date, and confirms the signature verification result. If all extracted information satisfies the verification criteria, the cheque is considered valid. Otherwise, the system identifies inconsistencies and flags the cheque for further inspection.

Finally, the decision engine combines the outputs of all processing modules and generates the final authentication result. If every verification stage is successfully completed, the system marks the cheque as Verified and approves it for further banking operations. If any mismatch, recognition error, or suspected fraud is detected, the cheque is Rejected and forwarded for manual review. The final verification details, extracted information, and processing results are stored in the reporting module for future reference and auditing purposes. This integrated architecture provides a secure, intelligent, and efficient solution for automated bank cheque verification, improving transaction reliability while reducing operational cost and human effort

VII. CONCLUSION

The proposed bank cheque verification system demonstrates an effective approach for automating cheque authentication by integrating image processing, Optical Character Recognition (OCR), deep learning, and machine learning techniques. The framework systematically extracts important cheque information, recognizes both printed and handwritten content, and verifies account holder signatures with minimal human intervention. By combining these intelligent technologies into a unified workflow, the system enhances the accuracy and reliability of cheque verification while significantly reducing manual effort and processing time. The methodology provides a practical solution for improving operational efficiency in banking environments where large volumes of cheque transactions must be processed securely.

The implementation of advanced preprocessing and image segmentation techniques enables the system

to accurately isolate critical cheque components, resulting in improved recognition performance even when dealing with complex cheque layouts. The OCR module effectively extracts machine-printed information, while the Convolutional Neural Network (CNN) accurately recognizes handwritten numerical values. Furthermore, the combination of Scale-Invariant Feature Transform (SIFT) and Support Vector Machine (SVM) provides dependable signature authentication by distinguishing genuine signatures from forged ones. The integration of these modules creates a comprehensive verification framework capable of minimizing verification errors and strengthening transaction security.

The proposed system also contributes to fraud prevention by validating multiple cheque attributes before approving financial transactions. Cross-verification of printed information, handwritten amounts, and signature authenticity helps identify inconsistencies that may indicate forged or manipulated cheques. This multi-level verification strategy increases the confidence of banking institutions in processing financial documents while reducing operational risks associated with manual verification procedures.

Overall, the proposed intelligent cheque verification framework offers a secure, scalable, and efficient solution for modern banking applications. The automation of cheque authentication improves transaction speed, reduces operational costs, enhances customer service, and supports reliable financial document processing. The study demonstrates that the integration of image processing with deep learning techniques provides an effective foundation for developing next-generation banking security systems capable of delivering accurate and trustworthy cheque verification in real-world financial environments.

REFERENCES

1. Y. K. Singh, R. Jaiswal, P. Choudhary, and B. Chugh, "Verifying Bank Checks Using Deep Learning and Image Processing," Proceedings of the 2024 International Conference on Intelligent Systems for Cybersecurity (ISCS), IEEE, 2024, pp. 1–6.
2. K. Dhanva, M. Harikrishnan, and P. U. Babu, "Cheque Image Security Enhancement in Online Banking," Proceedings of the 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT), 2018, pp. 1256–1260.
3. H. K. Singh and A. E. Tigga, "Impact of Information Technology on Indian Banking Services," Proceedings of the 1st International Conference on Recent Advances in Information Technology (RAIT), 2012, pp. 662–665.
4. P. Wang and C. R. Shiau, "Machine Recognition of Printed Chinese Characters via Transformation Algorithms," Pattern Recognition, vol. 5, no. 4, pp. 303–321, 1972.
5. A. Zramdini and R. Ingold, "Optical Font Recognition Using Typographical Features," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 20, no. 8, pp. 877–882, 1998.
6. Y. Zhu, T. Tan, and Y. Wang, "Font Recognition Based on Global Texture Analysis," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23, no. 20, pp. 1192–1200, 2002.
7. A. Saenthon and N. Sukkhadamrongrak, "Comparison of Neural Network Training Methods for English and Thai Character Recognition," Proceedings of the APSIPA Annual Summit and Conference, 2014, pp. 1–4.
8. T. T. Ramanathan and D. Sharma, "Multiple Classifications Using SVM-Based Multi-Knowledge System," Proceedings of the International Conference on Advances in Computing and Communications (ICACC), 2017, pp. 307–311.
9. S. Stewart, L. Pinto, and B. Barrett, "Segmentation and Stitching Improves Handwriting Recognition on Datasets with Few Samples," Proceedings of the 16th International Conference on Frontiers in Handwriting Recognition (ICFHR), 2018, pp. 465–470.
10. R. Kajale, S. Das, and P. Medhekar, "Supervised Machine Learning in Intelligent Character Recognition of Handwritten and Printed Nameplates," Proceedings of the International Conference on Advances in Computing,

Communication and Control (ICAC3), 2017, pp. 1–5.
11. S. Singh, T. Kariveda, J. D. Gupta, and K. Bhattacharya, "Handwritten Word Recognition for Legal Amounts of Bank Cheques in English Script," Proceedings of the 8th IEEE International Conference on Advances in Pattern Recognition (ICAPR), 2015, pp. 1–5.
12. M. B. A. Miah, M. A. Yousuf, M. S. Mia, and M. P. Miya, "Handwritten Courtesy Amount and Signature Recognition on Bank Cheques Using Neural Networks," International Journal of Computer Applications, vol. 118, no. 5, pp. 21–26, 2015.
13. R. Jayadevan, U. Pal, and F. Kimura, "Recognition of Words from Legal Amounts of Indian Bank Cheques," Proceedings of the 12th International Conference on Frontiers in Handwriting Recognition, IEEE, 2010, pp. 166–171.
14. S. P. Raghavendra and A. Danti, "Recognition of Indian Bank Cheques Based on Invariant Geometrical Features," Proceedings of the International Conference on Trends in Automation, Communications and Computing Technology, 2009, pp. 1–5.
15. K. Shirai, M. Akita, M. Okamoto, K. Tanikawa, T. Akiyama, and T. Sakaguchi, "Removal of Background Patterns and Signatures for Magnetic Ink Character Recognition of Checks," Proceedings of the 10th IAPR International Workshop on Document Analysis Systems, 2012, pp. 190–194.