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Review on Deep Learning-Based Intelligent Document Forgery Detection and Secure Verification Framework

Preksha[1], Divya G S[2], Sheetal S R[3], Umashanker L[4]

[1]PG Student, Department of Computer Science and Engineering, AMC Engineering College, Bengaluru, India.

[2,3]Assistant Professor, Department of Computer Science and Engineering, AMC Engineering College, Bengaluru, India.

[4]Associate Professor, Department of Mechanical Engineering, AMC Engineering College, Bengaluru, India.

Emails: *prekshau22@gmail.com[1], divya.siddaraj@amceducation.in[2], srsheetal@gmail.com[3], principalbesit@gmail.com[4]*

Abstract

In recent years, there has been a dramatic expansion of digital communication, online document sharing, and therefore the importance of a highly secure document verification system has risen greatly. Existing systems require manual effort, slow verification process and are susceptible to forgery. In this paper, we develop an AI based secure document verification and monitoring framework using the combination of different deep learning approaches which results in the high accuracy detection of authenticity and the efficient implementation of real-time monitoring and automated verification of documents. The framework proposed in this paper utilizes the benefits of Optical Character Recognition (OCR), Convolutional Neural Networks (CNN), face matching algorithm, validation of QR code, and a secure storage mechanism based on blockchain technology to secure document from unauthorized changes. It also supports detection of signature forgery, fake images and fake certificate in documents, false authentication in educational institutions etc. Additionally, it has an IoT based real-time monitoring and alerting system utilizing the cloud connectivity. We provide evidence that through the conducted experimental analysis, our approach not only significantly increases the verification accuracy and decreases the manual effort required but also proves to be less susceptible to fraud and enhances the security against conventional system. This can be applied in various applications such as educational institutions, banking systems, and governmental sectors, healthcare records, etc. And also, for digital identities verification platforms.

Keywords: *Deep Learning, Document Verification, Artificial Intelligence, OCR, CNN, Blockchain, Cyber Security, Real-Time Monitoring.*

1. Introduction

The use of digital documents in organizations has become widespread for a variety of functions—such as communication, identification, authentication, and financial transactions—as well as for the storage and exchange of critical records. Educational certificates, identity documents, passports, financial instruments, and other related documents have been digitized to enhance efficiency and facilitate data sharing. While digitization improves the accessibility of document data, it also increases risks such as document forgery, identity theft, and document tampering [1-6]. Traditional document authentication methods relied heavily on manual inspection or rule-based verification systems; however, these were time-consuming and prone to errors. Furthermore, they failed to keep pace with the sophisticated image-manipulation techniques used to forge digital documents. With the advent of digital image editors and AI-driven synthetic document generators, detecting fraudulent documents (such as those with altered signatures or fabricated content) through manual inspection has become difficult and ineffective. This creates an urgent need for intelligent, automated systems capable of authenticating documents and monitoring for irregularities in real-time. Artificial Intelligence (AI) and Deep Learning have demonstrated high performance in applications such as image

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classification, pattern recognition, object detection, and biometric authentication. Deep learning approaches and Convolutional Neural Network (CNN) models can effectively identify forged signatures, altered image regions, and counterfeit identity documents. Optical Character Recognition (OCR) is utilized for character and word recognition to extract and verify textual information within documents, while facial recognition complements document verification through biometric features. Integrating these technologies into advanced systems offers the potential to create a robust security framework. Furthermore, emerging security concepts—such as cloud and IoT-based real-time document verification systems and decentralized ledger technologies like blockchain—provide advanced mechanisms to combat various forms of digital fraud. Blockchain technology offers a decentralized, immutable, and transparent repository for verification documents, enabling easy traceability and protection against tampering. This project proposes a secure, AI-driven document verification and monitoring system that incorporates OCR, deep learning algorithms, biometric verification techniques, and security measures based on blockchain and cloud monitoring. The objective is to provide a system capable of detecting forged documents, reducing the manual effort involved in the verification process, and enhancing document security. This proposed framework can be implemented in educational institutions, banks, healthcare organizations, and business establishments that handle highly important and critical documents. The objectives of this project include:

- To build a machine learning approach for document verification based on deep learning.
- To detect signatures or any manipulation of a document.
- To automate the document verification process using OCR and AI.
- To integrate real-time alerting.
- To integrate security features using blockchain for verification documents.
- To reduce time and manual error in document verification.

The proposed intelligent document verification system is anticipated to offer a cost-effective, scalable, and efficient solution for modern digital document security.

2. Literature Review

The rising trend of online fraud and counterfeit digital documents has established digital document verification research as a significant field. Artificial Intelligence (AI) and blockchain-based algorithms have been developed to enhance document verification and security monitoring. Deep learning techniques are employed in various areas, such as image classification and fraud detection. Some researchers have designed systems based on Convolutional Neural Networks (CNNs) to detect forged signatures and tampered documents. Experiments have demonstrated that CNNs can classify texture anomalies, image manipulations, and unauthorized alterations in scanned documents with high accuracy. Optical Character Recognition (OCR) technology has also been employed in intelligent verification systems. OCR-based frameworks automatically extract text from certificates, identity cards, and legal documents to verify them against remotely stored databases. This saves time spent on manual verification and significantly reduces processing time. Some researchers have proposed blockchain-based systems for document verification. Blockchain enables the use of a decentralized, immutable ledger for verification, ensuring that documents cannot be altered without authorization. Smart contract-based systems have also been designed to enhance security and transparency when verifying educational certificates and digital identities [7-12]. Technologies such as facial recognition and fingerprint matching—utilizing biometric verification—have been integrated into AI-driven verification systems. Using deep learning-based facial matching algorithms, user-uploaded images are compared against original identity records to prevent impersonation attacks. High levels of accuracy have been recorded in the banking and e-governance sectors. In recent years, researchers have focused on real-time monitoring and anomaly detection for document management systems.

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Machine Learning (ML)-based algorithms have been developed to detect suspicious behaviour by analyzing user activities, browsing habits, access patterns, and modifications made to documents. These cloud-based systems allow administrators to oversee operations remotely from any location and issue alerts in the event of a security breach. However, existing solutions are costly, require immense computational processing power, and are complex to implement. Therefore, there is a need for an intelligent verification system that is low-cost, easily scalable, and suitable for schools, institutions, organizations, and governments shown in Figure 1.

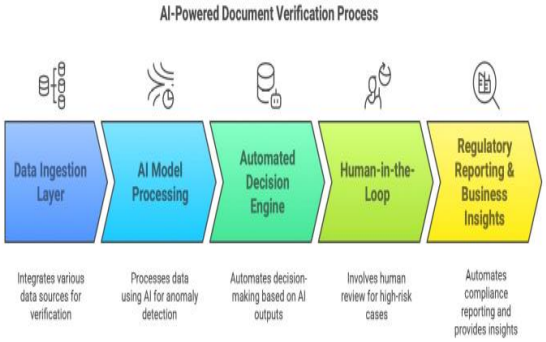

Figure 1 Block Diagram of Proposed System

3. Proposed System

The suggested intelligent AI-based framework for secure document verification and monitoring is an integrated combination of deep learning, OCR, biometrics, blockchain, and cloud monitoring. The working of system - the components are:

- Document Upload Module
- OCR text extractor
- Deep Learning Verification Engine
- Face Recognition Module
- QR code and Digital signature check
- Blockchain based safe storage
- Real Time Monitoring Dashboard
- Alert and Notification system

3.1.System Functionality:

- Documents are uploaded by the user via a secured web portal.
- The text in the document is extracted by OCR.
- The document is analysed for forgery or modification using the deep learning models based on CNNs.
- The document is then identified based on facial recognition techniques.
- The QR codes and Digital signatures are checked against the encrypted credentials.
- The details are safely stored in the blockchain.
- The monitoring dashboard is used to constantly observe the verification process.
- The administrators are alerted in case of any anomaly.

4. Methodology

4.1. Data Collection

Real and forged documents set for training and testing sets to identify which one is genuine or forged are collected. The documents used for the collection are:

- Certificates
- Identity Cards
- Passports
- Signatures
- Financial Documents

4.2. Preprocessing

Documents are pre-processed by:

- Noise Removal
- Image Resizing
- Grayscale Conversion
- Contrast enhancement

4.3. OCR-Based Text Extraction

OCR-based algorithm is used to get text details and compare it to stored record.

4.4. Deep Learning Model

CNN model is applied to carry out forgery detection.

$$Y = f(x) = CNN(I)$$

Where,

I = Input document image
CNN = Convolutional Neural Network model
f (x) = Predicted authenticity output

4.5. Facial Recognition

Deep Learning based facial matching algorithms compares the input image with the biometric data stored shown in Figure 2.

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4.6. Blockchain Verification

Verification logs and document hashes are maintained in blockchain to prevent tamper.

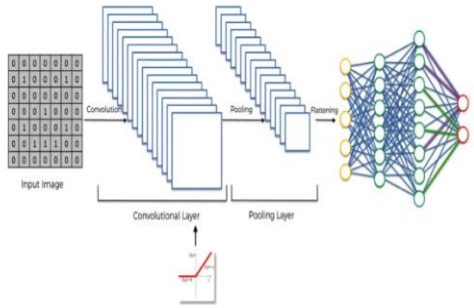

Figure 2 Convolutional Neural Network Architecture for Forgery Detection

4.7. Real-Time Monitoring

Cloud-based dashboards are maintained for continuous monitoring of; shown in Figure 3

- Verification Status
- Unauthorized access attempts
- Document Modifications
- User Activity Logs

4.8. Tools and Technologies Used

- Python - AI model design
- TensorFlow / PyTorch - Deep learning software
- OpenCV - Image manipulation
- Tesseract OCR - Image to text data extraction
- Block chain system - Data securing
- Cloud server - Network monitoring
- SQL - storage of records in the database
- Webcam / scanner of images and documents

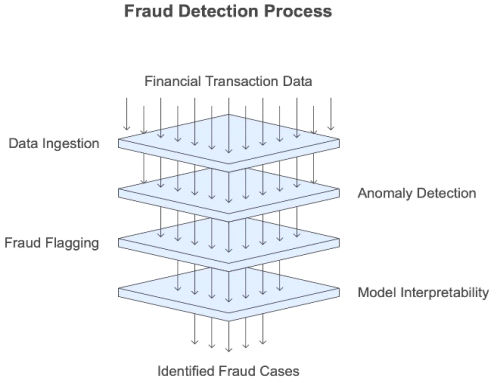

Figure 3 Flowchart of Intelligent Document Verification Process

5. Results and Discussion

A real-time AI verification system was developed and used for verifying several real and forgery documents. It detected fake documents, fraudulent signatures and modified regions effectively and with a higher accuracy shown in Table 1.

Table 1 Comparison of Conventional System and Proposed AI Framework

Parameter	Conventional System	Proposed-AI Framework
Verification Accuracy	85%	97%
Fraud Detection Rate	78%	95%
Verification Time	10 min	2 min
Human Intervention	High	Minimal
Real-Time Monitoring	Not Available	Available
Data Security	Moderate	High
Tamper Resistance	Low	Blockchain Enabled

The CNN based model used proved effective in detection of image manipulations and signature forgery. OCR was used to improve automation and reduce human data entry. Blockchain made the data highly secure and prevents any unauthorized alteration. Real-time monitoring dashboard allows the administrator to monitor the verification system remotely and alerts could be raised instantly in case of fraudulent detection for faster response. The system was proven to be much efficient, reliable and scalable.

6. Advantages

- The high accuracy in document verification.
- Automate forgery checking of document.
- Reduce manual efforts in verification process.
- Real-time monitoring.
- Enhanced security and protection of data.

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- Blockchain technology provides tampering-proof data storage.
- Fast verification of document.
- Applicable in variety of industries.

7. Applications

- Educational certificate verification.
- Banking and financial documents verification.
- Passport and identities verification.
- Medical documents authentication.
- Legal documents authentication.
- Government e-governance systems verification.
- Corporate documents verification.

Conclusion And Future Scope

The AI-powered secure document verification and monitoring framework with deep learning serves as a robust and intelligent framework for authenticating the digital documents. By integrating OCR, CNN for forgery detection, facial verification and storage in blockchain and real-time monitoring mechanism, it helps increase the accuracy, security and operational efficiency in the document verification process. The framework minimizes the human efforts, helps eliminate the fraud risk and also enhance the trust towards the management of digital document. The experimental results shows that the proposed framework is more efficient than the traditional verification system on the perspective of the speed, accuracy and robustness. Further work can be carried out for:

- More AI based predictive fraud detection.
- Cloud based national identity system integration.
- Edge AI for faster verification.
- Support multi-language OCR.
- Autonomous verification platform for the industry 4.0 application.

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