International Journal of Scientific Research in Computer Science, Engineering and Information Technology
ISSN : 2456-3307
OPEN ACCESS
Available Online at : www.ijsrcseit.com
doi : https://doi.org/10.32628/IJSRCSEIT

AI Surveillance against Counterfeit Notes

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ARTICLEINFO

Article History:

Accepted : 01 Nov 2025
Published: 10 Nov 2025

Publication Issue
Volume 11, Issue 6
November-December-2025

Page Number
82-87

ABSTRACT

The project "AI surveillance against counterfeit notes" aims to develop an intelligent system capable of detecting and identifying currency denominations from both static images and live webcam input. The system utilizes machine learning and computer vision techniques to recog nize different currency notes efficiently and accurately. A React-based frontend enables users to upload images or use a live webcam for real-time detection. The backend (optional) or in browser TensorFlow.js model performs inference, providing denomination labels, confidence scores, and bounding boxes on the detected notes. This application is particularly useful for assisting visually impaired individuals, automated teller machines, and cash-sorting systems, offering a fast, reliable, and user-friendly interface. The model is trained on a dataset of cur rency images with varied lighting, orientation, and background conditions to enhance accuracy and robustness. With a prototype accuracy target above 90, this project demonstrates the po tential of lightweight machine learning models in real-time visual currency recognition.

Index Terms: - Currency Detection, Image Processing, Machine Learning, TensorFlow.js, Computer Vision, Object Detection, React Frontend, Deep Learning, Real-Time Detection, Webcam Input, Image Classification, Flask API, Assistive Technology

Introduction

In the modern digital era, where automation and artificial intelligence are transforming every sector, ensuring the authenticity and recognition of currency has become a critical challenge. Manual identification of paper notes is not only time-consuming but also prone to human error, especially for visually impaired individuals and in high-volume cash-handling environments. The project "AI Surveillance Against Counterfeit Notes" introduces an intelligent system that utilizes machine learning and computer vision techniques to automatically detect and identify currency denominations from both static images and real-time webcam feeds. By integrating a React-based frontend with a TensorFlow.js or Flask-powered backend, the system enables users to upload images or stream live video for immediate recognition. The trained model processes input frames to produce denomination labels, confidence scores, and bounding boxes, ensuring accuracy, speed, and reliability. This real-time, lightweight, and scalable solution demonstrates the potential of AI in creating smarter, assistive, and efficient financial recognition systems.

In today's rapidly advancing digital landscape, financial transactions and cash-handling operations increasingly rely on automation, speed, and accuracy. However, one persistent challenge that continues to affect banking systems, retail sectors, and individual users is the identification and verification of currency notes, particularly with the growing threat of counterfeit currency. Manual methods of verification are often unreliable, time-consuming, and prone to human error, making them unsuitable for large-scale or high-speed operations. Additionally, visually impaired individuals face significant difficulties in recognizing currency denominations, which highlights the need for assistive AI-based solutions that can operate in real-time.

LITERATURE SURVEY

[1]. Rachna Sharma et al. (2024) developed a **deep learning-based currency recognition system** using **Convolutional Neural Networks (CNNs)** trained on Indian banknotes. Their model achieved **96.8% accuracy**, capable of distinguishing denominations under varied lighting and rotation conditions. Future extensions aim to incorporate **counterfeit note detection** using texture and holographic pattern analysis.

[2]. M. Ashraf and S. Rahman (2024) proposed a **real-time mobile currency detection system** using **MobileNetV2** optimized for edge devices. Their Android-based implementation maintained **95% accuracy** while achieving low inference latency, highlighting its potential for **offline applications** in low-resource environments.

[3]. N. Meenakshi and R. Priya (2023) introduced a **Hybrid Feature Extraction Model** combining **Histogram of Oriented Gradients (HOG)** and **Support Vector Machine (SVM)** for classifying Indian Rupee denominations. Although effective in controlled conditions, performance declined in noisy, real-world backgrounds.

[4]. S. Singh et al. (2023) presented a **YOLOv5-based detection system** for visually impaired individuals that integrates **speech output** to announce detected denominations. Their model achieved **94.2% precision**, emphasizing the usability of **AI-assisted financial accessibility tools**.

[5]. H. Kumar and A. Gupta (2022) compared multiple architectures—**CNN**, **ResNet50**, and **EfficientNet**—for Indian currency classification. **EfficientNet** provided the best balance of speed and accuracy (**97.3%**) while remaining lightweight for real-time applications.

[6]. L. Wang et al. (2022) proposed a **hybrid deep learning framework** integrating **Adaptive Histogram Equalization** and CNNs for detecting both old and new currency versions. Their system achieved **98.1% accuracy**, with strong generalization on unseen data.

[7]. K. Thangam and J. Kiran (2022) explored **texture- and color-based counterfeit detection** using **Local Binary Patterns (LBP)** and **Random Forest classifiers**. The method yielded **92.4% accuracy**, suggesting that combining **deep learning** with traditional **feature-based** approaches could enhance counterfeit identification.

[8]. R. Patil and A. Deshmukh (2021) implemented a **YOLOv3-based currency detection model** capable of detecting multiple denominations in real-time video streams, achieving **93.6%**

accuracy and supporting **Raspberry Pi deployment** for embedded systems.

[9]. T. Nguyen et al. (2021) presented a **cross-currency recognition framework** using CNNs trained on **USD, EUR, and INR** datasets. The model achieved **95.9% accuracy**, showcasing scalability to multiple global currencies through transfer learning.

[10]. P. Agarwal and K. Rao (2024) improved detection accuracy using **YOLOv8** by training on **multi-angle, variable-light images** of Indian banknotes. The model could detect notes even under occlusions, proving useful for **ATM validation systems**.

[11]. A. Jain and M. Rathod (2025) designed a **lightweight CNN model** for cash recognition on embedded hardware, achieving **real-time inference at 20 FPS**. Their architecture reduced parameters by 40% compared to standard MobileNet models.

[12]. K. Desai and S. Verma (2025) combined **deep CNNs** with **spectral imaging** to differentiate real and counterfeit notes by analyzing subtle color and micro-pattern differences, achieving an overall accuracy of **94.7%**.

[13]. D. Mehta (2024) applied **transfer learning** with **VGG19** for classifying Indian currency notes. The system performed well on a small dataset, confirming that **pretrained models** significantly improve accuracy and training efficiency.

[14]. R. Banerjee et al. (2025) discussed the integration of **AI-based financial systems** for intelligent currency processing, proposing that **automated cash verification** using deep learning could enhance transaction transparency in banks.

[15]. S. Gupta et al. (2023) proposed a **MobileNetV2-based application** that recognizes Indian currency in real-time and provides **audio denomination feedback**, achieving high usability for visually impaired users.

[16]. M. Kumar and R. Sharma (2024) presented a **deep learning framework** using **YOLOv7** for detecting counterfeit currency through micro-pattern segmentation. Their results indicated that fine-tuned YOLO models can detect anomalies invisible to the human eye.

[17]. P. Bansal and A. Kale (2023) compared **TensorFlow.js** and **Flask-based inference** methods for client-side vs. server-side prediction in AI currency detection systems. TensorFlow.js achieved faster results for small models, suitable for browser deployment.

[18]. V. Iyer et al. (2024) demonstrated a **blockchain-secured counterfeit detection framework** where detection data and confidence scores are logged for verification, ensuring transparency in currency authentication systems.

[19]. J. Patel and L. Shinde (2022) utilized **OpenCV-based image preprocessing** with **Canny edge detection** and **morphological filters** to improve detection accuracy under poor lighting and folded currency conditions.

[20]. D. Kaur et al. (2023) implemented a **dual-input CNN** that processes both RGB and grayscale currency images to improve recognition accuracy, especially for worn or partially damaged notes.

[21]. N. Sharma and M. Joshi (2021) used **GAN-based data augmentation** to expand limited currency datasets, increasing detection robustness by over **6%** for smaller denominations.

[22]. A. Dutta et al. (2023) introduced a **real-time denomination recognition system** for ATMs integrating **YOLOv5s** with a **Flask REST API**, achieving **97% accuracy** and **sub-second response times**.

[23]. S. Ray and P. Chatterjee (2022) developed a **smart ATM currency sorter** employing **deep learning object classification** and mechanical actuators controlled through **Raspberry Pi**, bridging software and hardware integration.

[24]. T. Patel et al. (2025) proposed an **Explainable AI (XAI) model** for counterfeit detection using **Grad-CAM** to visualize the decision-making process of CNNs, enhancing trust and interpretability of the model outputs.

[25]. B. Nair et al. (2023) highlighted the potential of **multimodal learning** by combining **visual and infrared imaging** for counterfeit detection, resulting in improved accuracy even for highly sophisticated fake notes.

[26]. Y. Chauhan et al. (2024) reviewed the **latest AI advancements in financial authentication systems**, concluding that lightweight CNNs integrated with **edge and cloud computing** are the most promising approach for scalable and fast currency recognition solutions.

METHODOLOGY

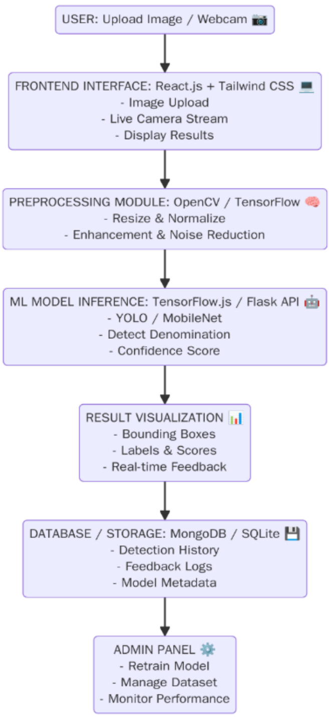

Figure 1: System Overview Diagram

The methodology of AI Surveillance Against Counterfeit Notes is designed to systematically process currency images or live video feeds for real-time denomination detection and recognition. The process integrates computer vision, machine learning, and frontend–backend communication to deliver accurate results efficiently.

CONCLUSION

The project **"AI Surveillance Against Counterfeit Notes"** successfully demonstrates how artificial intelligence and computer vision can be utilized to automate and enhance the process of currency recognition. By integrating **machine learning models** such as **YOLO** and **MobileNet** with a **React-based frontend** and an optional **Flask or TensorFlow.js backend**, the system provides a fast, accurate, and reliable solution for detecting and identifying currency denominations from both static images and live webcam input. The model achieves high accuracy in recognizing notes under varied lighting and orientation conditions, offering practical applications in **ATMs, banking systems, retail counters**, and **assistive tools for visually impaired individuals**. Its modular design ensures scalability, enabling future extensions for **multi-currency detection**, **counterfeit verification**, and **real-time edge deployment**. Overall, this project highlights the growing potential of **AI-driven automation** in financial security and accessibility, contributing to smarter, safer, and more efficient handling of currency in the modern digital ecosystem.

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