# FAKE CURRENCY DETECTION USING IMAGE PROCESSING TECHNIQUES

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**Keywords:**

Structural Similarity Index Measure (SSIM), Oriented FAST and Rotated BRIEF (ORB), Descriptors, Hamming Distance.


**Introduction:**

The widespread circulation of counterfeit currency poses significant challenges to financial systems worldwide. With progressions in printing innovation, forgers are getting to be progressively advanced, making it more troublesome to recognize fake cash from veritable notes. This has led to a growing demand for efficient, automated solutions capable of detecting counterfeit currency with high accuracy. Image processing, a branch of computer vision, offers powerful tools for analysing visual data. By leveraging techniques such as feature extraction, pattern recognition, and machine learning, image processing systems can analyse currency notes and identify key distinguishing features that separate the notes.

The Fake Currency Detection Using Image Processing aims to an intelligent system that automates the detection of counterfeit currency. By coordination this arrangement into banks, retail segments, and open settings, the framework has the potential to altogether diminish the predominance of fake cash and improve money related security. Through this project, we aim not only develop a cost-effective and scalable counterfeit detection system but also contribute to the ongoing research in applying computer vision and machine learning to real-world problems.

**Objectives:**

1. To examine the various security components of Indian currency notes. Using a scanner or camera to gather paper money.
2. To extract characteristics from the captured image by cropping and segmenting.
3. To leverage advanced techniques in computer vision to identify unique features and patterns in currency notes that distinguish genuine notes from fakes.
4. To develop a robust image processing model capable of accurately detecting counterfeit currency notes through image analysis.
5. To create an Intuitive User Interface for Multi-Media Data Interaction.

**Methodology:**

The dataset used for this project comprises 150 high-quality images of Indian currency notes across seven denominations: ₹10, ₹20, ₹50, ₹100, ₹200, ₹500, and ₹2000 from publicly available resources such as Google Images and Kaggle.

Preprocessing: First, image acquisition is performed using the cv2.imread() function to read the currency images into a usable format in BGR color space. Second, conversion to RGB using cv2.cvtColor() for better compatibility with image processing operations. Each image is then resized to a smaller resolution (5x5 pixels) using cv2.resize(). Third, the images are converted from RGB to grayscale using the averaging method. Fourth, to enhance image clarity and remove unwanted noise such as wrinkles or scanning artifacts, Gaussian filtering is applied.

Feature Detection: For this, the ORB (Oriented FAST and Rotated BRIEF) algorithm is employed. Key features are extracted using ORB. The algorithm analyses keypoints and their descriptors and compares them between a template (authentic) image and a query (test) image. The descriptors are matched using Hamming Distance, a method that measures the number of differing bits between two binary strings. A perfect match indicates strong similarity, whereas a mismatch suggests possible forgery.

Similarity Measure: The similarity of images is further quantified using the Structural Similarity Index Measure (SSIM), which evaluates luminance, contrast, and structural changes between two images. SSIM returns a score from -1 to 1, where greater than 0.5 indicates real currency, less than 0.5 indicates fake currency.

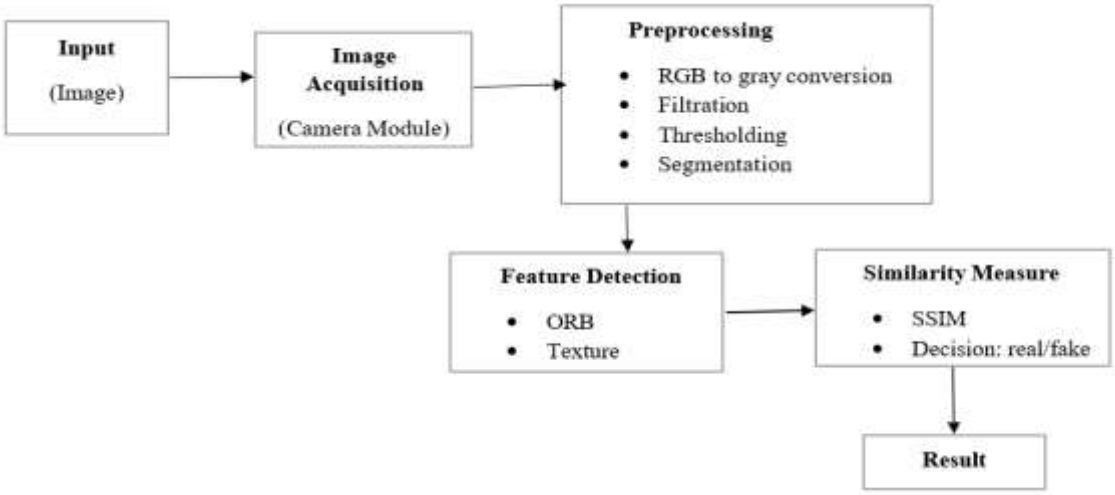


Figure 1: Architectural Diagram of the proposed system.

**Result and Conclusion:**

The system calculates SSIM values between the uploaded note and the reference note. A higher SSIM score indicates that the uploaded note closely resembles a genuine banknote, suggesting authenticity. A lower SSIM score suggests structural differences, hinting at potential counterfeiting. This system designed in a such a way that it can scan both front and back side of the currency to detect the counterfeit one.

Conclusion: The Structural Similarity Index (SSIM) and the Oriented FAST and Rotated BRIEF (ORB) algorithm were used in this study to provide an efficient method for detecting fraudulent notes. The combination of these two methods offers a powerful way to distinguish between real and fake money. By automating the identification process, this can be deployed in banks, retail outlets, and ATMs to reduce circulation of fake notes. Overall, this project demonstrates how modern image processing can be a powerful tool in securing financial systems against counterfeit threats.

**Project Outcome & Industry Relevance:**

This project offers a low-cost, automated solution for detecting counterfeit currency using image processing. It reduces human error and speeds up the verification process. By applying ORB and SSIM algorithms, it contributes to the fields of computer vision and digital forensics. The project demonstrates how traditional image processing techniques can solve real-world financial security problems. It can be integrated into ATMs, point-of-sale systems, and cash deposit machines. Retailers and currency

exchange centres can use it for quick note verification. Law enforcement agencies may apply it for counterfeit investigations. Overall, it bridges the gap between technology and financial security.

**Working Model vs. Simulation/Study:**

This project was primarily a simulation-based study that involved the development of a software-based model for detecting counterfeit currency using image processing techniques. It did not involve the creation of a physical working device or hardware system.

**Project Outcomes and Learnings:**

The key outcomes of the project include successful implementation of an image processing system that can detect counterfeit currency using ORB and SSIM algorithms. It demonstrated how visual features and similarity measures can identify differences between real and fake notes. Through this project, we learned how to apply theoretical image processing concepts to a practical problem, gained hands-on experience with OpenCV.

**Future Scope:**

1. Real-time video-based currency detection using webcams or smartphone cameras could also be developed for mobile or retail applications.
2. Another extension could be the integration of Optical Character Recognition (OCR) to verify serial numbers and textual patterns on the notes.
3. Adding multi-currency support could make the system useful for international exchange centres.
4. Future research could explore hybrid models combining traditional image processing with AI for improved performance.
5. Security features like holograms and UV patterns could also be explored using multispectral imaging for high-security verification.