iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: XI Month of publication: November 2025

DOI: https://doi.org/10.22214/ijraset.2025.75424

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue XI Nov 2025- Available at www.ijraset.com

# Fake Currency Detector Using Image Processing and Computer Vision Techniques

Drashti Mehta, Nisha Modi, Karman Rao, Kartik Patel, Rahul Kumar
*Assistant Professor, Parul Institute of Engineering and Technology, Vadodara, India*

***Abstract: Counterfeiting of currency has become a real threat to the livelihood of people as well as the economy of our country. Though fake currency detectors are available, they are restricted to banks and corporate offices leaving common people and small businesses vulnerable.***
***This project investigates the various secu- rity features of Indian currency and prepares a software-based system to detect and invalidate fake Indian currency by using advanced image processing and computer vision techniques. The proposed authentication system is implemented completely in Python, within a Jupyter Notebook environment, and achieves an accuracy of up to 83% in counterfeit detection.***
***Index Terms: Fake currency, counterfeit detection, image processing, feature extraction, ORB detector, SSIM.***

## I. INTRODUCTION

Counterfeiting notes are a worldwide problem specifically the devaluation of real currency, and the inflation as the money supply increases.

Manual authentication techniques are generally time consuming and error prone. This paper describes an automated counterfeiting detection system for Indian currency notes (Rs. 500 and Rs. 2000) using computer- vision based techniques. The automated system uses three different algorithms to confirm the presence of key security features including bleed lines, number panels, watermarks and texts inscriptions etc. The output of the system is displayed in an intuitive graphical user interface (GUI) for ease of authentication.

## II. LITERATURE SURVEY

Several approaches for currency authentication exist:

1) Sonali R. Darade [1] presented a solution that employed image processing and feature extraction, which worked well but relied on external cameras.
2) Binod Prasad Yadav et al. [2] used MATLAB, and allowed recognition segment after processing the image using HSV image processing.
3) Adiba Zarin and Jia Uddin [3] proposed a hybrid ap- proach using OCR, Hough Transform and Face Recogni- tion accuracy of 93.33
4) Shripad Veling [4] published a study that made verifi- cation by imaging using hyperspectral imaging, but the process was expensive.
5) P. Mangayarkarasi et al. [5] Proposed a system that was based on image processing with voice assistance for visually impaired users.

## III. PROBLEM STATEMENT AND OBJECTIVES

The objective is to verify the authenticity of Indian currency notes through an automated process based on image processing and computer vision techniques.

### A. *Objectives*

1) Automatically identify counterfeit Indian notes.
2) Provide accurate results and time-efficient.
3) Develop a user-friendly interface that anyone can use.

## IV. METHODOLOGY

### *A. Dataset Preparation*

We constructed a dataset consisting of original counterfeit Rs. 500 and Rs. 2000 currency notes. The characteristics of important security features of each denomination were saved as separate files along with various templates for comparison.

### *B. Image Acquisition and Pre-processing*

Currency notes images were acquired either by scanner or a digital camera. The images were pre-processed by scaling, converting to grayscale and then converted to gaussian blurred images to mask noise.

*1) Algorithm 1: Feature 1–7*

The INDIAN RUPPEE [watermark] logo; the image of mahatma; RBI logo's and the denomination text, in the cur- rency notes there are possible features matched with original or counterfeit was analyzed using ORB detector and the regions captured in the extracted images were compared with templates using the Structural Similarity Index (SSIM).

$$SSIM(x, y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu^2_x + \mu^2_y + c_1)(\sigma^2_x + \sigma^2_y + c_2)} \quad (1)$$

*2) Algorithm 2: Bleed Line Verification*

Bleed lines for processing of for the Rs.500 were five and Rs. 2000 were seven were extracted, thresholded, and counted by contour detection.

*3) Algorithm 3: Number Panel Detection*

The one number Panel was segmented and thresholded to detect the number panels with spatial arrangement of bound- ing rectangles were drawn around the detected characters to confirm whether or not there were nine characters.

### *C. GUI and Output*

The output interface uses the Tkinter GUI to load the images of currency for testing. The test notation was used considering each feature inspection returned with Pass or Fail, and a decision was provided as well.

## V. IMPLEMENTATION

The development of the system follows an iterative method- ology:

1) Requirement Analysis: Establishing usability, accuracy, and speed requirements.
2) System Design: Developing dataset workflows and ar- chitecture diagrams.
3) Development: Implementing preprocessing scripts, CNN model training, and GUI elements.
4) Integration: Integrating all modules into seamless pipeline from start to finish.
5) Testing: Evaluating performance using real world pho- tos and multiple datasets.


Fig. 1. GUI start

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538*
*Volume 13 Issue XI Nov 2025- Available at www.ijraset.com*


Fig. 2. Note uploaded

## VI. RESULTS AND ANALYSIS

### *A. Performance Statistical Assessment*

*1)* Fake notes: 83% accuracy (10/12 correct detections).

*2)* Real notes: 79% accuracy (15/19 correct detections).

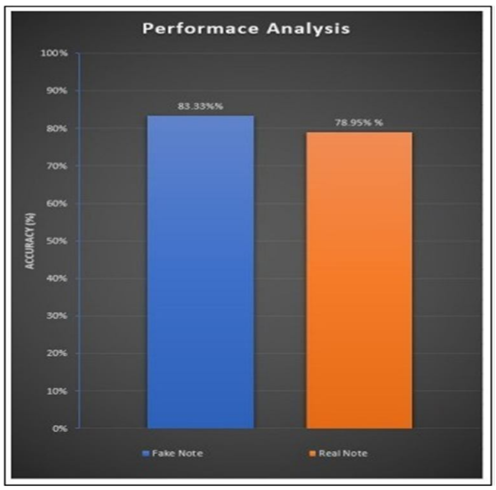


Fig. 3. Performance evaluation

### *B. Time Analysis*

When only the end results are viewed, the time to process one note is about five seconds. A complete analysis with features for more than 100 images takes about 35 seconds.

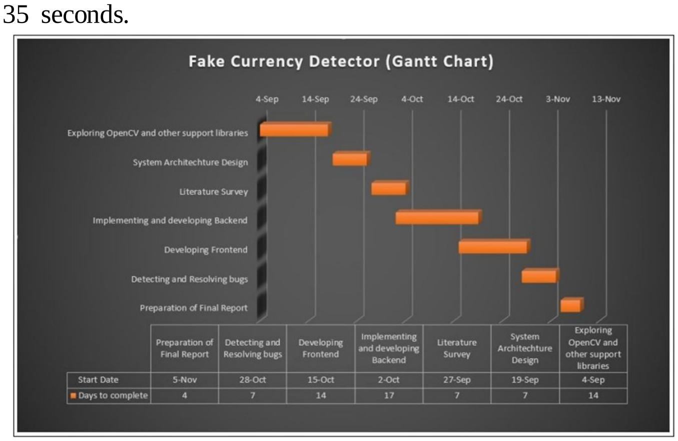


Fig. 4. To ensure systematic development, a project timeline was followed. The Gantt chart shows the various stages, from literature survey to implementation and final report preparation.

## VII. FUNCTIONALITIES

### A. Image Preprocessing

The system will do some preprocessing on the currency images before they can be processed for analysis. Several preprocessing steps are taken including converting the image to gray scale, resizing, normalizing pixel values, and applying edge detection. the preprocessing steps adds consistency to the input data, to reduce unwanted noise and increase classification accuracy. By standardizing the size, and delineating key fea- tures such as contour and patterns, the model can distinguish fake and real currency more effectively.

### B. Training and Classifying the Model

The training of a deep learning model such as a Con- volutional Neural Network (CNN) on a large collection of real and fake currency images is one of the key components of the system. The CNN will automatically learn to detect distinguishing features such as watermark designs, the print quality of the text, and fine edges of the currency note. Once trained the CNN classifier can be used in the real-time classification of a currency note which is either real or fake quickly and accurately.

### C. Predicting and Displaying the Results

The system has a prediction module that accompanies the trained classifier. The prediction module will take the processed image and perform the classification and present the results in a more intuitive format to be able to visualize and interpret the model. Instead of just indicating whether the note was real or counterfeit, the prediction module will support deep learning specific outputs such as confidence scores, confusion matrices and error analysis, which will make the outputs clearer to the user and ultimately increase the trust in the decision making capacity of the system.

### D. Graphical User Interface (GUI)

A simple and intuitive GUI is provided to create accessibility to the system for all of its users, so that they can view results immediately once they have uploaded images of currency notes: there is no complexity of step-by-step technical processes taking place in the background. With features like drag-and-drop for uploads, a history of previous checks, and other real-time feedback, the tool is pragmatic for non-technical use, such as for the use of a shopkeeper or someone who simply needs a fast way of confirming currency notes.

## VIII. TECHNOLOGIES

### A. Deep Learning with CNN

The main focus of the project is CNN, which is a type of ML model with strong performance on image classification problems. CNNs are capable of figuring out different levels of features, including different types of textures, shapes, or patterns, without the need for feature engineering. By changing to VGG16 or EfficientNet architectures, the model can extract intricate details from the currency notes, leading to accurate results.

### B. Image Processing Libraries (OpenCV)

OpenCV is all about the preprocessing step and features such modules as converting color images to grayscale, resizing images for model input, reducing noise made by the image capture process, and detecting edges. Once the images get further processed, this additional step makes them ready for training and predicting. In addition to preprocessing step, OpenCV also provides more advanced visualizations, making it easier to interpret and explain the decision making process of the system.

### C. Software Programming and Development (Python)

Python is being utilized as the primary programming language due to its adaptability and extensive selection of libraries. Its ability to combine deep learning, image manipulation, and GUI programming provides a robust end- to-end processing toolchain. Tools for development such as Jupyter Notebook and PyCharm allow for effective testing and debugging and enable rapid testing and prototyping.

### D. GUI Framework (Tkinter/Flask)

To implement the GUI, Tkinter provides a lightweight method to program a user-friendly desktop application, while Flask can be used to implement the web-deployed application that provides an interactive venue for users to upload notes through their browser.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue XI Nov 2025- Available at www.ijraset.com

The ability for both desktop offline modes, versus online verification services is beneficial to the experiment and provides greater flexibility for utilizing the TL/Research Tool.

## IX. FUTURE SCOPES

### A. Support for Multiple Currencies and Denominations

Enhancements may allow the system to identify counterfeit, detected notes for different currencies and denominations. Training the model on different datasets from distinct countries would increase the flexibility of the system for regional charac- teristics such as holograms, watermarks, and microprints. This would enhance the generalizability of the model and increase the practical applications by using an even larger selection of currencies.

### B. Deployment on Mobile and Cloud

The system can be further enhanced for better accessibility, to mobile devices and cloud platforms. A mobile application with the specifically-trained model would allow for instant verification using smart phone camera evidence, while a cloud- based service would provide large-scale verification that could be utilized for banks, ATMs, retail stores and e-commerce platforms. Together, the two options allow for both portability and scalability for real-world use.

### C. Machine Learning Frameworks (TensorFlow and Keras)

Utilizing cutting-edge machine learning frameworks, such as TensorFlow and Keras, can further reinforce how models can be trained and deployed to fulfill the previous goals. In particular, these frameworks contain modular tools for designing CNN architectures, optimizers that can allow models to converge faster such as Adam, and useful loss functions such as categorical cross-entropy. Moreover, both frameworks support GPU acceleration, which would allow for costly com- putations to be comparable to training simpler neural networks while enabling the networks to be more complex and accurate for counterfeit detection.

### D. Cloud and Mobile Technologies

Integrating cloud and mobile technologies means the system can easily operate as more than standalone applications. Prod- ucts built on cloud platforms, like AWS, Azure, or Google Cloud, can run and deploy the trained model and APIs for easy integration into 3rd party systems (including service providers, applications financial services). On the mobile side, lightweight frameworks provide on-device inference (e.g., TensorFlow Lite), so that there is less reliance on an internet connection or external servers. Overall, these technologies provide a nice balance between real-time performance, a cost- efficient solution and accessibility.

## X. SYSTEM ARCHITECTURE AND DESIGN

### A. Complete System Design

This system was developed to have a layered architecture consisting of image capture, preprocessing, classification with deep learning, and visualization of the results. The first layer is the input layer, in which images of a banknote are provided to the scanner or camera. The images then travel through the preprocessing pipeline, and when it is time for analysis, a trained CNN will analyze the image, and the output layer produces output that is then communicated to the user through a graphical interface. This modular design keeps the system organized, maintaining a higher degree of ease with mainte- nance, extension, and scaling.

### B. Data Flow Architecture

The progression of data in the system is illustrated via a layered Data Flow Diagram (DFD). In Level 0, the entire system is represented as one singular process—fake currency detection. Level 1 divides the system into smaller processes, namely: image acquisition, preprocessing, training, and detec- tion. Level 2 provides a more detailed look as to how datasets flow into preprocessing, the order of CNN layers and output. This stratified flow illustrates the transparent flow of data while highlighting the relationships between each of the components.

### C. Use Cases Design

The use case diagram illustrates interactions with the system based on types of users. The primary actors are lay users, re- tailers and financial institutions that upload images of currency notes for verification. After images are uploaded, the system evaluates the images and provides results for authenticity in real-time. The design of the system emphasizes accessibility so that anyone with little or no technical knowledge can operate the system easily.

## XI. CONCLUSION

This paper describes the design and development of a system for counterfeit currency detection developed in Python. The proposed model achieves up to 83generate results in a matter of a few seconds. Current system may correctly identify specific denominations while future improvements could integrate greater deep learning capabilities for feature extraction and more currencies and note values to make a more holistic solution.

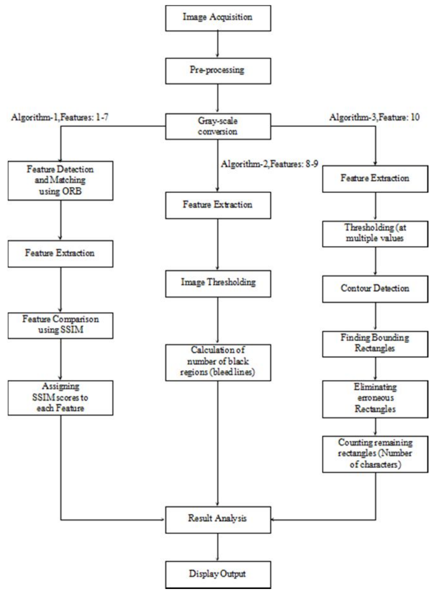


Fig.5. Flow Chart

## REFERENCES


[1] S. R. Darade, “Automatic System for Identification of Fake Currency Notes,” 2018.
[2] B. P. Yadav, P. H. Patil, “Recognition of Fake Indian Paper Currency Note using MATLAB,” 2019.
[3] A. Zarin, J. Uddin, “Hybrid Fake Currency Detection Model for Bangladeshi Notes,” 2019.
[4] S. Veling, “Fake Note Detection using Hyperspectral Imaging,” 2020.
[5] P. Mangayarkarasi, A. S. Anakha, M. K. Meghashree, “Currency Recog- nition and Verification for Visually Impaired,” 2021.
[6] Authentication of Indian paper currency using digital image processing
[7] Sarkar, S., Pal, A. K. 2022.
[8] Detection of Counterfeit Currency Using Supervised Machine Learning Algorithms — Yadav, R. K., Valecha, P., Paliwal, S. 2020.
[9] Evaluating Machine Learning Algorithms for Fake Currency Detection
[10] Keerthana S.N., Chitra K., Journal of Data Science, 2024.
[11] Fake Indian Currency Detection System — P. S. Purohit, Sanika Datta- traya Bhosle, Ashish Hemant Ghatule, Tejaswini Vijay Kolekar, Ritesh Arvind Kataktalware, Vishal Ramkrishna Patil, IJRASET, 2025.
[12] Identification of Fake Indian Currency Using Convolutional Neural Network — Raja Sekhar, P., et al. 2023
[13] Image Based Fake Currency Detection Using Explainable AI — Sakinala Jhosna, Geethanjali, Manoj Kumar et al. 2022.
[14] Banknote Verification using Image Processing Techniques — Barrera Nazir, Muhammad Imran Babar Jehangir. 2019.
[15] Fake Currency Note Detection using Image Processing and Convolution Neural Network — Dr. S. Sahaya Tamil Selvi et al. 2023
[16] Authentication of Indian Currency using Image Processing Techniques “Image Processing Technique for Authentication of Indian Paper Currency” — Rencita Maria Colaco et al. 2023
[17] Fake Currency Detection using Deep Learning Technique — Ruheena, Bibi Fathima, Harshitha B M, etc. 2022