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Indian Fake Currency Note Recognition

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ABSTRACT

Currency counterfeiting has now become one of the biggest threats to individuals' economic well-being and to the economy of India in general. Devices for detecting counterfeit currency exist; however, their use is confined primarily to banks and corporate establishments, leaving the general population and small enterprises exposed. Present research attempts to analyze various features of Indian currency notes to authenticate them and then provides a software-based method to detect and nullify fake Indian currency using advanced image processing and computer vision algorithms. The proposed system of authentication of currency notes is implemented in the Python programming language and developed within the Jupyter Notebook environment. The backbone of this project is image processing technology and its application in verifying genuine currency notes. Specific features will be extracted from the notes to detect counterfeit currency by the software. The efficiency of the software can be measured regarding the accuracy and speed at which it processes the information.

Keywords: Fake Note Detection, Image Processing Technology, Currency Recognition

I. INTRODUCTION

Counterfeiting of currency means the unauthorized reproduction of legal tender notes, and such notes are not backed by the government. The right to print currency notes is solely entrusted with the Reserve Bank of India. Every year, the RBI faces the problem of fake Indian currency notes sifted and distributed in the market. The production and distribution of fake Indian currency notes by imitating the genuine production process is a serious problem for many countries.

Counterfeit currency may devaluate genuine currency and thus cause inflation by supplying money artificially without authorization. Individual authentication of currency notes can be one of the alternatives, but it is a time-consuming and an inaccurate process, which is quite tedious. It is, therefore, imperative that currency-note authentication be automated to deal with large batches of currency notes and yielding accurate outputs in minimal time.

The proposed system aims at verifying Indian currency notes in the denominations of ₹500 and ₹2000. It involves three major algorithms, which check the authenticity of a number of features within a currency note. First, there is an algorithm that involves image acquisition, followed by pre-processing, converting into grayscale, extraction of features, segmentation of images, comparison of images, and finally, the generation of output with the use of some advanced image-processing methodologies: ORB & SSIM. The second algorithm authenticates the bleed lines of Indian currency notes, and the third algorithm verifies the number panel. Later, the respective processed output was displayed for every currency note. This system provides an effective way of speedy and proper authentication of currency notes. This automated system may replace traditional manual techniques and can easily be employed by a common man to identify counterfeit currencies.

I.1 Problem Statement

The technological developments are going on rapidly in today's times. The banking industry, therefore, is also upgrading itself day by day. This development has introduced the need for automatic currency detection. The "Fake Indian Note Detector Machine" is mainly present in banks, making the device inaccessible to ordinary people. These conditions develop the requirement of finding a way through which the common man can detect forged banknotes and save the value of the Indian currency.

I.2 Objective of Project

This system will be designed for the automatic detection of counterfeit Indian currency notes by means of image processing and computer vision. It should also ensure highly accurate and speedy results. It will have a user-friendly interface to facilitate ease of operation and understanding, hence being more user-accessible. This efficient and effective solution aims at combating the problem of fake currency notes with great efficacy.

II. LITERATURE REVIEW

Several research papers are based on fake Indian currency detection systems using various advanced image processing techniques:

[a] One of the studies presented an automated fake Indian Currency Identifier, mainly concentrating on denomination like ₹100, ₹500, and ₹1000. The entire process starts from image acquisition, followed by pre-processing like crop-the image, smoothening, grayscale, segmentation, feature extraction, and then comparisons. The study was a concern for increasing counterfeiting due to the facilities provided by advanced technologies like color printing and scanning.

[b] Another project developed an automated recognition system using MATLAB and utilized HSV color space-based feature extraction and some image processing techniques, including edge detection and segmentation. The camera captures the currency note and MATLAB verifies the authenticity of the note. Then, the MATLAB software has been used to display messages like ₹100, ₹500, and ₹1000 notes.

[c] The Bangladeshi Currency Detection hybrid model employed Optical Character Recognition (OCR), Hough Transformation, and face recognition (MSD). The overall steps involved in this model include data collection, pre-processing, edge detection, feature extraction, and the comparison of the result. This model, though not as efficient, worked with an accuracy of 93.33%.

[d] Another approach combined hyper-spectral imaging and feature extraction, using UV and LED lights with different wavelengths of 360-800 nm to identify counterfeit and genuine notes. Using MATLAB, the model showed almost accurate results using clear distinct imaging modules.

[e] This new system for the visually impaired combined the recognition of denomination with voice output. The currency will be identified with their variations due to image processing techniques including feature extraction and texture analysis, by the use of text and voice output for accessibility.

III. EXISTING SYSTEM

The present system would proffer a basic image-processing technique-based classification and validity verification method for Indian paper currency. The system compares the input banknotes against some reference values of the several parameters derived from genuine banknotes under similar conditions. This concept keeps the system simple, yet providing accuracy of 100% in classification and 90% in the validity check.

IV. PROPOSED SYSTEM

The proposed method of counterfeit currency detection extracts general attributes, latent images, and identification marks from currency images. Feature extraction may be challenging as both visible and invisible features of Indian currency need to be extracted. Circulating notes after demonetization in India are ₹500 and ₹2000 notes, which are higher order notes targeted by counterfeiters. In this regard, software is used for the detection of fake notes with the help of image processing techniques.

V. ARCHITECTURE DIAGRAM

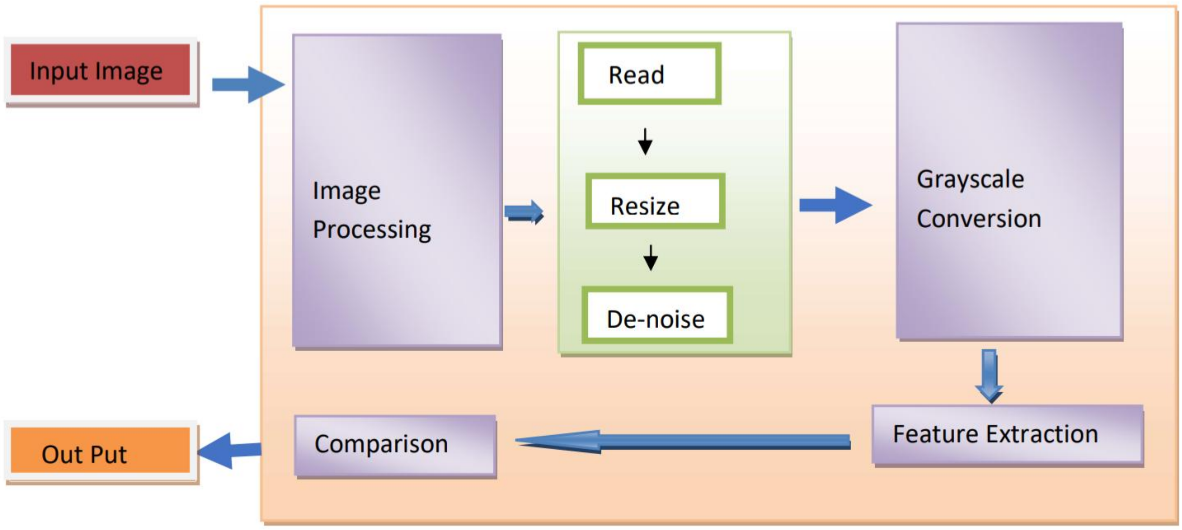

Fig: Architecture diagram of proposed System

VI. IMPLEMENTATION

Image processing can be defined as the application of computational methods for image quality enhancement or for the extraction of valuable information. It is a subclass of signal processing that takes an image as input and gives a processed image or specific associated features as output. In fake currency detection, different image pre-processing and analysis steps are adopted.

Image noise consists of random variations in brightness or color, often caused by electronic noise in sensors or circuits. Denoising, a crucial image processing task, aims to reduce noise while preserving original image details.

The process starts by first reading an image using OpenCV for further processing. The image is resized to ensure uniformity in dimensions for consistency in processing. Denoising is done using fast Denoising to reduce random brightness and color changes. The image is then gray-scaled, simplifying the details it contains by keeping only the luminance information, hence reducing complexity but maintaining all the crucial details.

Feature extraction identifies key attributes, such as latent images and identification marks, crucial in differentiating fake from genuine notes. It generates a database of authentic currency notes by extracting and storing features which could then be used in making comparative analysis for verification.

Fig: Color Image of Currency ₹2000

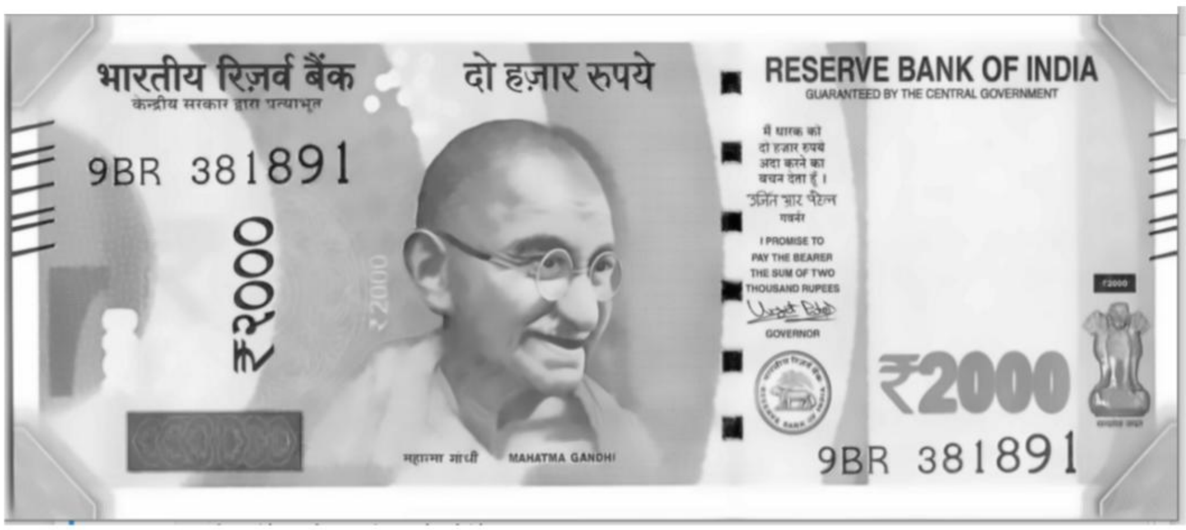

Fig: Grayscale Image of Currency ₹2000

The comparison stage: This stage tests the extracted features of input notes against stored authentic data. Binary image segmentation and filtering out minor components make the image fine. Repeat the process to generate a binary image for comparison. Difference calculation between input image and authentic image is done and stored, and thus, counterfeit note detection is possible.

This comprehensive image processing pipeline ensures the identification of fake currency using advanced techniques for accurate detection, automated to deliver efficient results.

VII. ALGORITHM

Dataset Preparation and Feature Identification

The first step of the system is to prepare an insightful dataset for the robust detection and validation of authenticity in currency. The dataset consists of images of original and fake ₹500 and ₹2000 currency notes, which are, in turn, kept in separate sub-repositories for each denomination. In the case of each type of note, there are several templates included for key security features, considering brightness, resolution, and other image conditions for diverse situations that may occur in real-life scenarios. The ten critical features of security identified in the case of ₹ 500 are: Scripts of "₹500" in Devanagari and English, Ashoka Pillar emblem, RBI symbols in Hindi and English, "500 Rupees" written in Hindi, the RBI logo, bleed lines on both left and right edges, and the number panel displaying the serial number. At least six templates are kept in storage for each feature to ensure adequate variability for correct matching.

Image Acquisition and Pre-Processing

The system requires an input image of the currency note for initiating the process of validation. So, an image of the currency note is captured using a high-resolution digital camera or scanner to ensure clarity in the features of the currency note. It should not contain blurring, noise, or poor brightness, as these parameters are really very important for detection. After capturing the image, it undergoes pre-processing. First, it is resized to a fixed dimension to standardize computations. Then, Gaussian blurring is added in order to reduce noise and improve feature detection by smoothing out the image. The next step is converting the images to grayscale to reduce the computational burden by simplifying the image data from three color channels (RGB) into one intensity channel. This allows for faster and more efficient processing of features.

Algorithm 1: Feature Detection and Validation Using ORB and SSIM

The first algorithm is devoted to detection and validation of security features, such as scripts, emblems, logos, and symbols, totalling seven in number. This would employ the ORB algorithm, used for feature detection that picks out distinctive key points and descriptors in the image. Each feature will be associated with an ROI, reducing the search space in interest. Each identified feature is further matched against the previously stored templates of the dataset. The matching gives a highlight of the detected area on the input image, which is then cropped and pre-processed using Gaussian blur and grayscale conversion.

The SSIM is computed for the evaluation of the authenticity of the extracted feature. SSIM measures the similarity between the detected feature and the corresponding template, with a range from -1 to 1; thus, a higher SSIM score means a higher similarity. The system computes the average SSIM score corresponding to each feature for a group of templates. A feature is considered as real if the average SSIM is larger than a pre-set threshold or if the highest SSIM for any template exceeds a predefined threshold, say 0.8. It has been observed that this two-level thresholding provides very good reliability in features validation.

Algorithm 2: Bleed Line Detection and Validation

The second algorithm focuses on the detection of bleed lines, which is a critical security feature on the left and right edges of ₹500 and ₹2000 notes. The ₹500 note has five bleed lines on each edge and seven on the ₹2000 note. This algorithm first isolates the areas near the edges from where bleed lines are expected. Then, these regions go through thresholding. The result of this process is a binary image in which the bleed lines have become black lines on a white background.

Then, the algorithm counts transitions from white to black pixels to find the number of black regions in each column of the thresholder image. Columns with counts very high above the normal range, say $\geqslant 10$, are rejected as false. Then, the average count of black regions for valid columns is calculated. If this count approximates to the calculated expected count for the denomination in question-five in case of ₹500 and seven in case of ₹2000-the feature is accepted as genuine.

Algorithm 3: Number Panel Validation

The third algorithm checks the serial number panel situated at the bottom right of the currency note. The panel in an authentic note must have exactly nine characters, considering no spaces between them. In order to do this, the algorithm applies thresholding with various values, from an initial value, say 90, and increased successively, say by 5, up to a maximum value, say 150. This ensures that variations in the conditions of imagery will not impede the detection of the characters.

Contour detection is applied to the thresholder image; bounding rectangles are drawn around the detected contours. Perform filtering of these rectangles in order to remove noise-like objects, such as those that have an area that is too large or too small, or completely enclosed in others. Only valid rectangles corresponding to characters are left. The count of the rectangles gives the number of detected characters. The process continues for several threshold iterations, considering an early stop where nine characters are consistently detected in three consecutive iterations. If this is the case, the authenticity of the number panel is confirmed.

Comprehensive Validation Process

The system integrates all three for robust validation of all critical security features. Each feature is thoroughly checked against consistency with the dataset using some of the most sophisticated image processing techniques, such as ORB, SSIM, thresholding, and contour detection. The process involves a multistep algorithmic mechanism that ensures low false positives and false negatives, hence offering a reliable solution for counterfeit currency detection.

Displaying Output

Finally, the output of all the algorithms is represented to the user. The extracted image of each feature and the different important data collected corresponding to each feature is displayed properly in a GUI window. Further, the status of each feature is displayed along with the details. Finally, it displays the total number of features that have passed successfully for the input image of currency note and based upon that it is decided whether the note is fake or not. The entire GUI is programmed in python itself using Tkinter library.

VIII. TESTS AND RESULTS

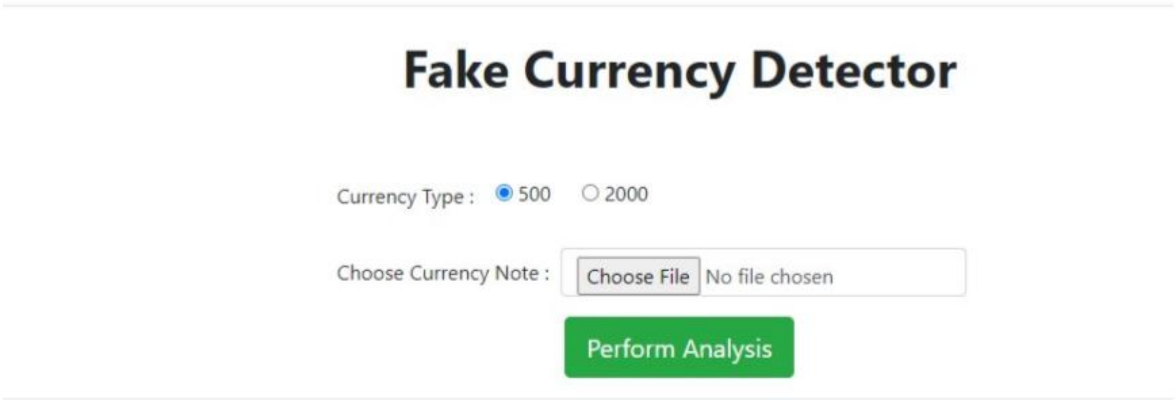

Fig: Upload Image of Indian Currency

Feature No.	Image	Average Score	Max Score	Verification Status
1		0.505426992297373	0.6630521054421394	Pass
2		0.5762328718781838	0.8811729232208602	Pass

3		0.531847045445897	0.8885498906167913	**Pass**
4		0.4055279541656799	0.9451098108261444	**Pass**
5		0.6551416305766121	0.9044553854167919	**Pass**
6		0.37694331059261277	0.8172365448817062	**Pass**
7		0.6787161962428229	0.8818562313693475	**Pass**
8		7.5	7.6	**Pass**

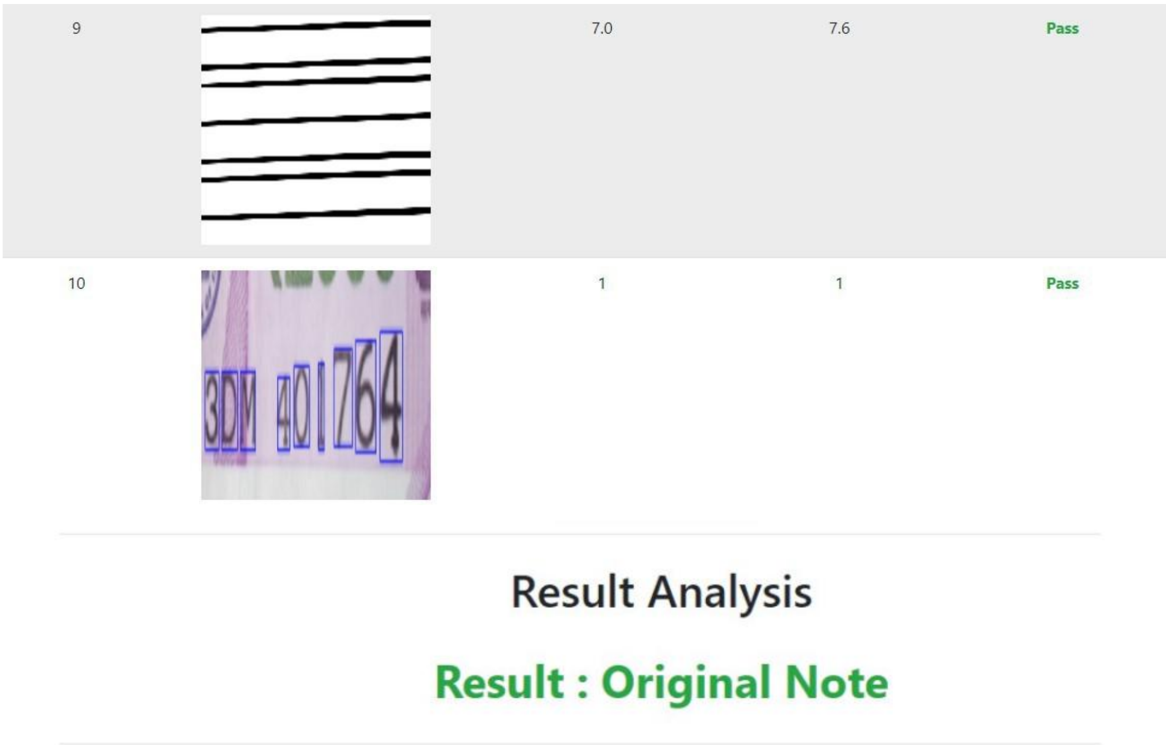

Fig: Output Showing Currency Result

IX. CONCLUSION

The main motivation for this project was to come up with a friendly and efficient system for the average person. This Python-based application is intended for the automatic authentication of genuine/fake Indian currency. A low-cost and effective image processing approach was adopted to ensure high-throughput performance with precision and reliability. The authentication result of the currency is provided as text in a GUI text box.

This paper proposes a model that performs verification of Indian currency notes with denominations of 500 and 2000 using the OpenCV image processing library of Python3. It checks 10 features of the input currency note using three different algorithms. The user can select an image file from the device through a GUI, which then feeds into the model. The result, with proper feature analysis of the model, is shown using a graphical user interface designed by the Tkinter GUI library.

The processing time for an input image is approximately 5 seconds when only the final results are shown, excluding unnecessary details.

X. REFERENCES

[1] S. R. Darade and G. Gidveer, “Automatic recognition of fake Indian currency note,” in 2016 international conference on Electrical Power and Energy Systems (ICEPES). IEEE, 2016, pp. 290–294.

[2] B. P. Yadav, C. Patil, R. Karhe, and P. Patil, “An automatic recognition of fake Indian paper currency note using MATLAB,” Int. J. Eng. Sci. Innov. Technol, vol. 3, pp. 560–566, 2014.

[3] A. Zarin and J. Uddin, “A hybrid fake banknote detection model using ocr, face recognition and hough features,” in 2019 Cybersecurity and Cyberforensics Conference (CCC). IEEE, 2019, pp. 91–95.

[4] M. S. Veling, M. J. P. Sawal, M. S. A. Bandekar, M. T. C. Patil, and M. A. L. Sawant, “Fake Indian currency recognition system by using MATLAB.”

[5] F. A. B, P. Mangayarkarasi, Akhilendu, A. A. S, and M. K, “Fake Indian currency note recognition,” vol. 7, pp. 4766–4770, 2020. [Online]. Available: https://www.irjet.net/archives/V7/i5/IRJET-V7I5915.pdf

[6] Rafael C. Gonzalez (University of Tennessee), Richard E.Woods (MedData Interactive) and Steven L. Eddins (The MathWorks, Inc.), in ‘Digital Image Processing Using MATLAB’ Second Edition, 2009 by Gatesmark, LLC.

[7] Simulation of Iris Comparison and Recognition System Using MATLAB: Srishti Roy SSRG International Journal of Computer Science and Engineering- (ICCREST’17) - Special Issue - March 2017.

[8] Alasdair McAndrew, in ‘An Introduction to Digital Image Processing with MATLAB, Notes for SCM2511 Image Processing 1’, School of Computer Science and Mathematics, Victoria University of Technology.

[9] M.Deborah and SoniyaPrathap “Detection of Fake currency using Image Processing”. IJISET- International Journal of Innovative Science, Engineering & Technology, Vol. 1, Issue 10, 2014.

[10] P. Mohanaiah” Image Texture Feature Extraction Using GLCM Approach” International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013 1 ISSN 2250-3153.