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Fake Currency Detection Using Image Processing

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ABSTRACT:

The suggested system proposes a solution to the longstanding issue of counterfeit currency using image processing techniques. Given the rise in technological advancements, which have made it easier to produce fake money, there's a pressing need for accessible methods to detect counterfeit currency. Unlike banks and commercial establishments equipped with specialized machines for authentication, the average person lacks these resources.

The system involves a series of steps, starting with converting the currency image into grayscale to simplify subsequent processing. Noise reduction techniques are then applied to remove unwanted artifacts. Edge detection algorithms like Canny edge detection are used to identify prominent features in the currency image. Segmentation is employed to isolate specific regions of interest such as watermarks and security features. Feature extraction involves capturing relevant attributes like texture patterns and geometric shapes.

Keywords: Counterfeit currency, Image Processing, Python programming language, Grayscale conversion, Edge detection, Segmentation, and Feature extraction.

1. INTRODUCTION

The Reserve Bank of India (RBI) holds the exclusive authority to issue banknotes within the country. Like central banks worldwide, the RBI periodically updates the design of banknotes to combat counterfeiting. These measures typically include intricate details achieved through raised intaglio printing, allowing even non-experts to identify forgeries easily. Moreover, coins are equipped with milled or marked edges featuring parallel grooves, preventing the scraping off of valuable metal and serving as an additional anti-counterfeiting measure.

2. LITERATURE REVIEW

1. **REVIEW ON DETECTION OF FAKE CURRENCY USING IMAGE PROCESSING TECHNIQUES.** Identifying paper currency involves intricate steps like edge detection, feature extraction, segmentation, acquisition, grayscale conversion, and image comparison. Selecting suitable features is crucial for enhancing the system's efficiency.

2. **A HYBRID FAKE BANK NOTE DETECTION MODEL USING OCR, FACE RECOGNITION AND HOUGH FEATURES.**

Currency replication is a growing global concern due to technological advancements. Traditional detection systems are costly and prone to errors. Integrating image processing, neural networks, and machine vision shows promise. This paper proposes a model with OCR, Face Recognition, and the Hough transformation for Bangladeshi.

Besides these conventional methods, the RBI employs various advanced techniques to detect fake currency, ensuring the security of the nation's currency system. notes. It extracts features like microprinting, watermarks, and ultraviolet lines to authenticate genuine notes, offering a robust solution against counterfeiting.

3. **AUTOMATIC RECOGNITION OF FAKE INDIAN CURRENCY NOTE**

This study presents a method for identifying fake Indian currency notes using image processing techniques, including acquisition, pre-processing, segmentation, feature extraction, reduction, and comparison with reference images for authentication. It aims to enhance counterfeit detection in Indian currency notes.

4. **EVALUATION OF MACHINE LEARNING ALGORITHMS FOR DETECTION OF FAKE BANK CURRENCY.**

This paper investigates six supervised machine learning algorithms for authenticating bank currency using a dataset from the UCI repository. The tested algorithms include Support Vector

Machine, Random Forest, Logistic Regression, Naive Bayes, Decision Tree, and K-Nearest Neighbors, evaluated across various train-test ratios (80:20, 70:30, and 60:40). Performance assessment relies on metrics such as precision and accuracy, with the goal of determining the most efficient approach for currency authentication.

3. METHODOLOGY

The methodology for detecting fake currency using image processing typically involves several steps:

1. Image Acquisition
2. Gray Scale Conversion
3. Edge Detection
4. Image Segmentation
5. Feature Extraction
6. Output

Image Acquisition:

In the process of detecting fake currency using image processing, the initial step involves acquiring images. This is done by capturing digital images of currency notes using cameras or scanners. High-quality images are preferred to ensure accurate analysis of currency features. Multiple images may be taken from different angles or under various lighting conditions to capture the details effectively. These acquired images serve as the primary data for further analysis, enabling the detection of counterfeit currency through subsequent image processing techniques.

Grey Scale Conversion:

Grayscale conversion is a crucial preprocessing step in currency counterfeit detection using image processing. It simplifies the image data by converting RGB color images to grayscale, focusing solely on pixel intensity values. This simplification enhances subsequent analysis, particularly in detecting subtle variations in currency features such as texture and patterns. Grayscale conversion standardizes the representation of currency notes, facilitating consistent analysis and aiding in accurate counterfeit detection based on visual cues.

Edge Detection:

Edge detection is a pivotal step in currency counterfeit detection using image processing. It involves identifying boundaries and transitions between different regions in the image, highlighting important features such as text, patterns, and security elements. By detecting edges, the system can effectively isolate currency features from the background, facilitating accurate analysis and detection of counterfeit notes. Common edge detection algorithms include Sobel, Canny, and Prewitt, which help enhance the visibility of edges and aid in subsequent processing steps.

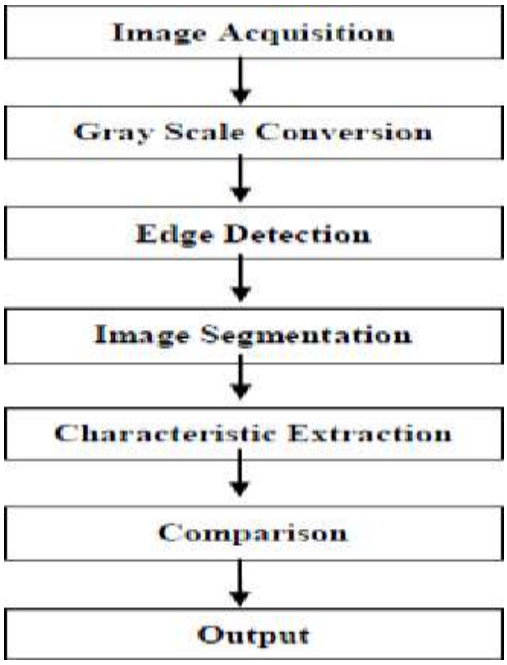


Fig.1 Block Diagram Of Fake Currency Detection Using Image Processing

Image Segmentation:

Image segmentation divides the image into meaningful segments based on criteria like pixel intensity or texture. This isolates currency features such as watermarks or security threads, aiding accurate counterfeit detection. Techniques like thresholding or clustering achieve this segmentation, focusing analysis on relevant areas.

Feature Extraction:

Feature extraction is vital in currency counterfeit detection. It involves identifying key characteristics from segmented currency images, such as patterns, textures, and security elements. These features provide a compact representation for comparison and authentication. Common techniques include edge detection and texture analysis, aiding accurate differentiation from counterfeit notes.

Comparison:

Comparison is crucial in image processing for currency authentication. It involves assessing extracted features from tested currency notes against those of genuine ones. This step determines the authenticity of the currency.

Output:

The output of currency counterfeit detection is a binary classification result indicating if the tested note is genuine or counterfeit. It's determined by comparing extracted features from the tested note with genuine ones. Visualizations of detected features may accompany the classification for transparency.

4. PROPOSED SYSTEM

The proposed system operates on images of Indian currency notes obtained via a digital camera. The method involves the following steps:

a) Acquiring an image of the Indian currency note using a simple digital camera or scanner.

b) Converting the acquired RGB image to a grayscale image.

c) Performing edge detection on the entire grayscale image.

d) Cropping and segmenting the observed and reverse Indian currency features of the paper currency.

e) After segmentation, extracting the features of the Indian currency note.

An architecture diagram depicting the proposed system is illustrated in Figure 2.

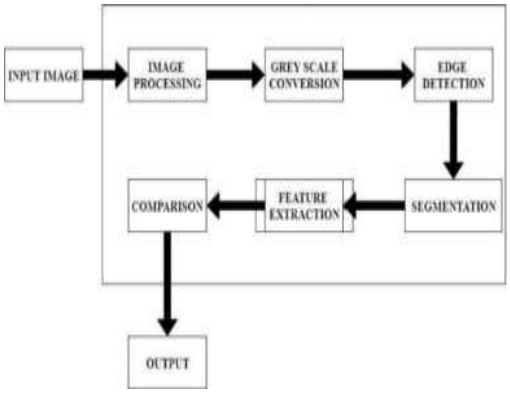


Fig. 2 Architecture diagram of proposed System

Step1:

Input Images: In this Project input images consisting of 500 notes of Real and Fake Currency are Placed in Figure 3 as shown in below.

Fig.3 Input of Real & Fake Currency of 500 Note

Step2:

Image Preprocessing: In the process described, image preprocessing is essential. It refines raw intensity-level images, removing distortions and enhancing crucial features for subsequent processing stages. Noise elimination, particularly salt and pepper noise, is a key preprocessing task.Once this pre-processing step is completed, the resulting image is displayed, as shown in the accompanying figure.

Fig.4 Input under Image Preprocessing

Step 3:

Grayscale conversion simplifies the coding process by reducing image complexity. Various methods exist for converting RGB images to grayscale, including averaging, luminance, and desaturation. In this system, the luminance method is employed for grayscale conversion. The resulting grayscale image is displayed in Figure 5.

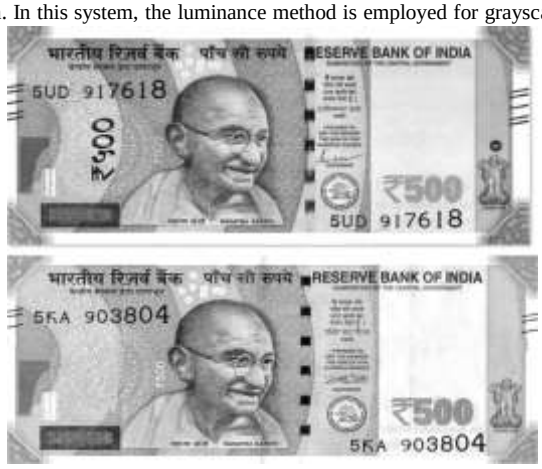


Fig.5 Input under Gray-Scale Conversion

Step 4:

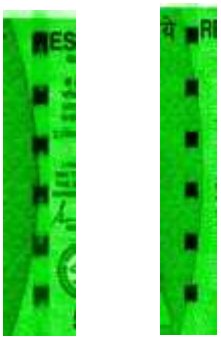
In the edge detection stage, the grayscale image serves as the input. The system adopts the Canny edge detection method due to its superior performance compared to other techniques. Canny edge detection is renowned for its ability to extract valuable structural information from visual objects while significantly reducing the volume of data to be processed.

Input Under Edge Detection

Step5:

Image segmentation, a vital step in image processing, encompasses techniques like thresholding, clustering, and region-based segmentation. In this system, segmentation is achieved via the thresholding method, using threshold values derived from the histogram of the original image's edges. The resulting segmented image is illustrated in Figure 6

Input Under Image Segmentation of Mahatma Gandhi’s Portrait



Input Under Image Segmentation of Security thread

Fig .6 Input Under Image Segmentation

Step 6:

Feature extraction plays a vital role in capturing relevant information from input data. Carefully chosen features are expected to provide meaningful insights. In this system, the SSIM (Structural Similarity Index Method) is employed for feature comparison. The resulting comparison is illustrated in Figure 7.

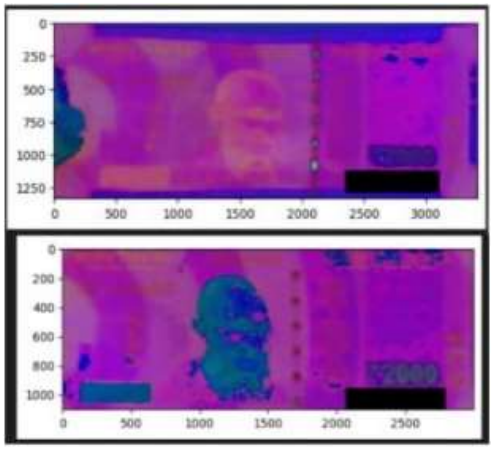
Fig.7 Feature Extraction of Input Image

1. Transparency Features are incorporated within the denominational numeral.
2. Hidden image of the denomination numeral that becomes visible under certain conditions.
3. Denomination numerals inscribed in the Devanagari script.
4. Central depiction of Mahatma Gandhi's portrait, facing to the right.
5. Security thread embedded within the note, transitioning in color from green to blue upon tilting.
6. Inclusion of the guarantee clause, Governor's signature accompanied by a promise clause, and the RBI emblem oriented towards the right.
7. Presence of portrait and electrotype watermarks.
8. Number panel displaying numerals progressively increasing in size, positioned on the top left and bottom right corners.
9. Denomination numerals accompanied by the rupee symbol, rendered in color-changing ink (green to blue) located on the bottom right corner.
10. Representation of the Ashoka pillar emblem situated on the right side.
11. Raised printing of a circle containing the denomination value "Rs 500" on the right side.
12. Incorporation of five raised lines on both the left and right sides for tactile recognition.

Step 7:

Output:The system offers a comprehensive output upon image upload

for currency authentication. It presents four images for comparison: the original currency reference, the uploaded currency image, grayscale overlays of extracted features for visual inspection, and segmented features under the HSV color space. Finally, the system conclusively determines the authenticity of the uploaded currency, providing user assurance.



HSV image of Real and Fake Currencies

HSV image of Real & Fake Currencies Security Thread

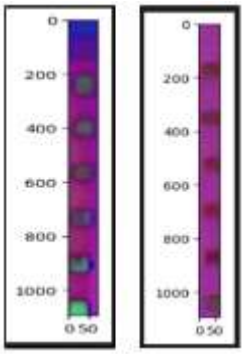


Fig.8 Input Under HSV Image

The overlapped image of the features is performed Binary Thresholding on and shown as a result to detect the difference in the images more clearly in Figure 9.

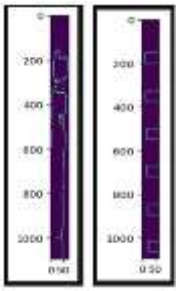


Fig.9 Binary Threshold Image Of Real and FaKe Currencies Strip Image

V. RESULT AND CONCLUSION

Currency usage is integral for daily survival, making it crucial to ensure its authenticity. With paper currencies being extensively utilized in India, there arises a pressing need for a robust system to detect counterfeit currency. The proposed system offers a promising solution, leveraging advanced feature extraction techniques to compare numerous features for enhanced accuracy. Unlike other existing systems, it goes beyond providing a simple binary result by pinpointing the specific areas of divergence between genuine and counterfeit currencies.

Moreover, the versatility of this system extends beyond Indian rupees, holding potential for implementation with various foreign currencies such as Dollars, Euros, Taka, and others. This broader applicability opens up opportunities for combating counterfeit currency on a global scale. As a result, the proposed system serves as a vital tool in safeguarding financial integrity and promoting trust in currency transactions, both domestically and internationally.

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