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FAKE CURRENCY DETECTION USING IMAGE PROCESSING

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Abstract:

Counterfeit currency is a serious problem that can cause financial loss and affect the reliability of monetary transactions. Manual verification of currency notes can be difficult and time-consuming, especially when security features are not easy to identify. This paper presents a fake currency detection approach using image processing techniques. The proposed system is developed using Python and uses OpenCV, NumPy, and Pillow for image processing and image analysis. The user provides an image of a currency note through the application. The uploaded image is resized and processed to obtain useful visual information. Image processing operations such as grayscale conversion, noise reduction, edge detection, color analysis, texture analysis, and image comparison are used to examine the characteristics of the currency note. Features such as the overall appearance, edges, texture, watermark-related patterns, security-thread-related regions, and serial-number-related information can be considered during the verification process. The extracted information is compared with the characteristics of a genuine reference note, and a result is generated to indicate whether the input note is considered genuine or fake. The proposed approach provides a simple computer-based method for assisting currency verification through image analysis and can be further improved by using larger datasets, additional security features, and advanced machine learning techniques.

Keywords: Banknote Authentication, Computer Vision, Currency Detection, Image Processing, OpenCV, Python

1. INTRODUCTION

Currency is an important part of daily financial transactions. The circulation of counterfeit currency can create financial losses for individuals, businesses, banks, and other organizations. Identifying a fake currency note manually requires careful observation of different security features and can take time.

Traditional currency verification mainly depends on physical inspection of security features. A person may need to check the color, texture, watermark, security thread, serial number, and other visible characteristics of a note. Human inspection may become difficult when the note is damaged, the lighting condition is poor, or the person is not familiar with all security features.

Image processing provides a computer-based approach for analyzing the visual characteristics of currency notes. Previous research has investigated digital image processing for differentiating genuine and counterfeit Indian currency notes [1].

Other banknote-verification research has examined color, shape, and texture features for automated verification [2].

The objective of this project is to develop a simple fake currency detection application using image processing techniques. The system accepts a currency image as input, processes the image, extracts useful visual characteristics, and compares the obtained information with genuine currency characteristics. The final result is presented to the user as a genuine or fake indication.

The project is implemented using Python. OpenCV is used for image-processing operations, NumPy is used for numerical image operations, and Pillow is used for image handling. The approach is designed as a basic image-processing solution and does not claim to use a deep-learning model.

2. METHOD

2.1 System Overview

The proposed system follows an image-processing workflow. The user first uploads an image of a currency note. The image is then prepared for analysis through preprocessing operations. Important visual characteristics are extracted from the processed image. These characteristics are compared with the characteristics of a genuine reference currency image. Based on the comparison, the system produces the final detection result.

The major stages of the proposed method are:

Currency Image → Image Upload → Preprocessing → Feature Extraction → Feature Comparison → Score Calculation → Genuine/Fake Result.

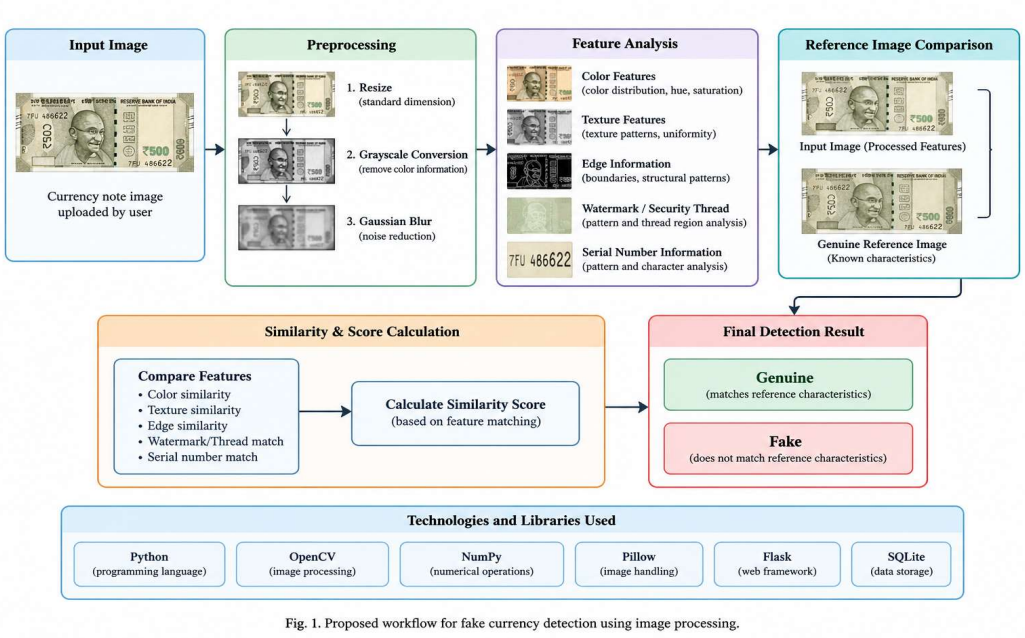

Fig. 1. Proposed workflow for fake currency detection using image processing.

2.2 Image Input

The system accepts a digital image of a currency note as input. The image can be obtained using a mobile phone camera, digital camera, or other image-capturing device. The uploaded image is checked and prepared for further processing.

2.3 Image Preprocessing

Preprocessing is performed to make the input image suitable for analysis. The image is resized to a suitable dimension so that different input images can be processed consistently.

The image may then be converted into grayscale for operations that depend mainly on intensity information. Noise reduction is applied to reduce unwanted variations in the image. Gaussian filtering can be used for smoothing and noise reduction; OpenCV provides GaussianBlur for this operation [3].

2.4 Edge Detection

Edge detection is used to identify important boundaries and structural patterns in the currency image. Edges can provide information about printed structures, borders, symbols, and other visual patterns.

The project uses image-processing operations such as Canny edge detection to obtain edge information from the processed image. OpenCV provides the Canny function for finding edges in an input image [4]. The resulting edge information can be used to calculate characteristics such as edge density and structural similarity.

2.5 Feature Extraction

The system analyzes visual characteristics of the currency image. The features considered in the project include:

- Color characteristics
- Texture characteristics
- Edge information
- Overall image appearance
- Watermark-related patterns
- Security-thread-related regions
- Serial-number-related information
- Similarity with a genuine reference image

These features help the system determine whether the input image is visually similar to the characteristics expected from a genuine currency note.

2.6 Image Comparison

After feature extraction, the processed input image is compared with a genuine reference image. The comparison evaluates the similarity between the input characteristics and the reference characteristics.

A similarity score can be calculated from the extracted image characteristics. A higher similarity indicates that the input image has characteristics closer to the genuine reference image, while a lower similarity indicates greater differences.

2.7 Detection Decision

The calculated result is used to generate the final detection decision. Based on the implemented comparison and threshold conditions, the system displays one of the following results:

Genuine Currency or Fake Currency

The result is intended as an image-based verification output and should not be treated as a replacement for official physical authentication procedures.

2.8 Software and Tools

Python – Main programming language
OpenCV – Image processing and computer vision
NumPy – Numerical and array operations
Pillow – Image handling
Flask – Web application framework
SQLite – Storage of user and report details

3. RESULTS AND DISCUSSION

3.1 System Output

The developed application accepts a currency image from the user and performs the defined image-processing operations. The input image is processed before the relevant characteristics are extracted.

The system then compares the processed information with the genuine reference characteristics and generates the corresponding detection result.

The developed application output is shown in Fig. 2.

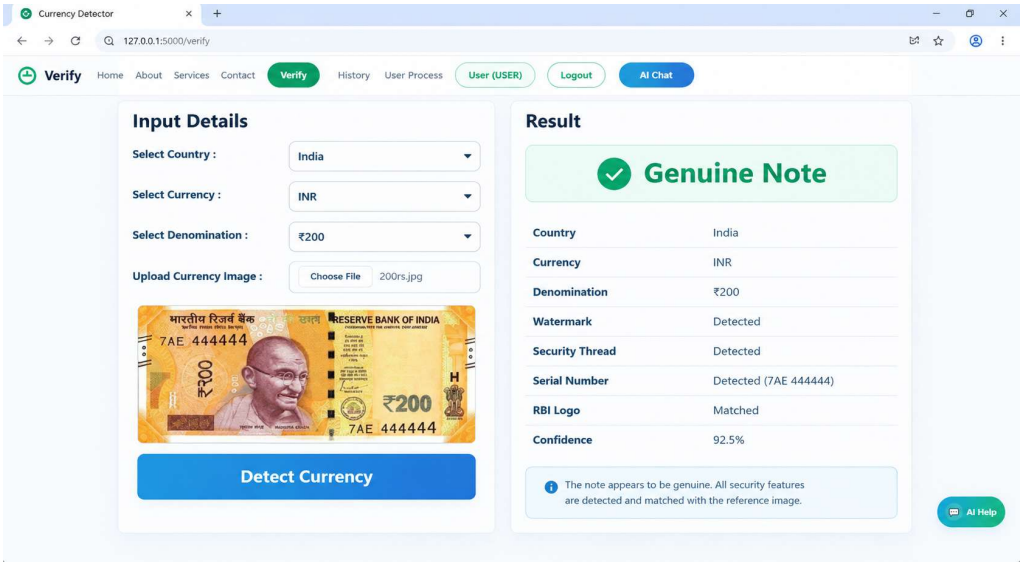

Fig. 2. Currency detection result.

3.2 Detection Result

The system is designed to classify the uploaded currency image as either genuine or fake according to the implemented image-comparison procedure.

Input: Currency image
Processing: Image preprocessing and feature analysis
Output: Genuine / Fake

The result depends on the quality of the input image and the visual characteristics available for comparison. Images captured under different lighting conditions, different angles, blur, shadows, folds, or damage may affect the extracted features.

3.3 Discussion

The project demonstrates that image processing can be used to analyze visible characteristics of currency notes. Operations such as resizing, grayscale conversion, noise reduction, edge detection, feature extraction, and image comparison provide a basic framework for automated currency verification.

The approach has the advantage of being comparatively simple to implement and understand. It does not require a deep-learning training process and can be developed using commonly available Python image-processing libraries.

However, the performance of an image-based approach depends strongly on the quality and variety of the reference images and test images. A limited reference set may not represent all possible genuine and counterfeit notes. Changes in lighting, camera quality, rotation, perspective, note condition, and image background can also influence the result.

Therefore, the present implementation should be considered a prototype for image-based currency verification. A larger and more diverse dataset and additional validation would be required before making claims about real-world detection accuracy.

3.4 Performance Measurement

The project was tested using genuine reference images and sample currency images.

Genuine reference images tested: 3

Genuine classifications: 3

Fake/sample images tested successfully: 6

Fake classifications: 6

Processing failure: 1 (notefront.jpg)

Genuine output confidence: 97.5%

Fake output confidence: 15%

Note: The confidence values are the output values produced by the implemented image-processing algorithm. They should not be considered as overall classification accuracy.

4. CONCLUSION

This paper presented a fake currency detection approach using image processing techniques. The system was developed using Python with OpenCV, NumPy, and Pillow. The proposed method accepts a currency image, performs preprocessing, extracts visual characteristics, compares the extracted information with genuine reference characteristics, and produces a genuine or fake detection result.

The project shows how image processing can be applied to the problem of currency authentication in a simple and understandable manner. The use of image characteristics such as color, texture, edges, and image similarity provides a basic approach for identifying differences between genuine and suspected counterfeit currency images.

The current system can be improved by increasing the number and variety of reference images, improving feature extraction, handling different lighting and viewing conditions, and introducing more advanced classification techniques. Future versions can also support multiple currencies, real-time camera-based detection, mobile applications, and explainable detection results.

5. ACKNOWLEDGMENTS

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6. AUTHOR CONTRIBUTIONS

The authors contributed to the design, development, implementation, testing, documentation, and preparation of the research paper. All authors reviewed and approved the final manuscript.

7. CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest related to this research work.

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