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Indian Currency Detection Using Image Processing Technique

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***Abstract*—This initiative addresses the pressing challenge of counterfeit currency in India by employing state-of-the-art image processing and machine learning technologies, specifically Convolutional Neural Networks (CNN) and OpenCV. CNNs are exceptionally effective in recognizing detailed and delicate patterns on currency notes, such as watermarks, security threads, and holograms, which are commonly replicated by counterfeiters. By deeply analyzing image data, CNNs help differentiate authentic currency from forgeries with remarkable precision. OpenCV supports this by providing robust capabilities for real-time image processing, ensuring that the currency images prepared for CNN analysis are of the highest quality. This synergy between CNNs for deep learning-driven detection and OpenCV for image processing establishes a comprehensive system for verifying currency authenticity. This system not only enhances the detection rate of fake notes but also keeps pace with evolving counterfeiting methods, thus maintaining the reliability of financial transactions and boosting public confidence in the monetary system.**

***Keywords*—ImageProcessing,Machine Learning,Convolutional Neural Networks (CNN),OpenCV,Currency Authentication,Data Set**

I. INTRODUCTION

The persistent issue of counterfeit currency continues to threaten the stability of global financial systems, exposing economies to significant risk. Traditional methods for detecting fake banknotes, largely dependent on manual checks and basic detection tools, are proving insufficient against increasingly sophisticated forgery techniques. The advent of artificial intelligence, particularly Convolutional Neural Networks (CNNs), presents a transformative opportunity to revolutionize this field. CNNs excel in image recognition and classification, making them ideal for identifying complex patterns and subtle distinctions in genuine and counterfeit banknotes. This research project aims to harness the power of CNNs to significantly enhance the detection of counterfeit currency. Key goals include assembling an extensive image dataset, crafting a bespoke CNN architecture, and implementing vigorous training and optimization strategies.

Additionally, the project focuses on creating a real-time detection system and conducting a thorough performance evaluation.

By achieving these objectives, the project will advance technologies that not only heighten the detection capabilities of counterfeit. notes but also strengthen the overall security of financial systems, safeguarding them against the detrimental impacts of fraudulent activities.

II. RELATED WORK

Recent advancements in color printing, duplication, and scanning technologies have significantly exacerbated the issue of counterfeiting, making it one of the most pressing challenges in recent years. Historically, the ability to produce counterfeit paper currency was confined to specialized printing operations. However, today, with access to basic equipment such as computer systems and laser printers, virtually anyone can manufacture counterfeit currency from their home, office, or other locations. This widespread capability has intensified the challenge of distinguishing fake currency from genuine notes using automated detection devices or computer systems.

Swetha yadav et al[1] presented a methodology This paper introduces a Currency Recognition System (CRS) designed to assist visually impaired individuals by identifying Indian banknotes. The system utilizes the Oriented FAST and rotated YOLO V3 algorithms, processing images by converting them to grayscale and using the Sobel method for edge detection. The YOLO V3 algorithm clusters features to classify the currency as 200, 500, or 2000 rupee notes. This approach aims to enhance the ease of monetary transactions for the visually impaired.

Mandhatya Singh et al[2], Recognizing currency is a significant challenge for blind and visually impaired individuals, particularly in developing countries like India.

This paper introduces IPCRNet, a lightweight network designed for resource-constrained environments, incorporating Dense connections, Multi-Dilation, and Depth-wise separable convolutions.

A diverse dataset of over 50,000 Indian currency images was created, and a public Android app named "Roshni-Currency Recognizer" was developed. Experimental results show that IPCRNet outperforms current models, improving classification accuracy by over 2%.

Pratiksha Ganjave et al[3] Currency recognition is crucial for visually impaired individuals who struggle to differentiate between denominations. This paper explores various image processing techniques, such as SIFT, ORB, FAST, and SURF, to aid in identifying Indian rupee banknotes. By implementing these algorithms, the proposed system aims to help the visually impaired recognize currency, enhancing their financial independence.

Sneha Saraf et al[4] This paper presents a mobile system for recognizing Indian currency across different views and scales, developed using an Android platform. The system employs the Scale-Invariant Feature Transform (SIFT) algorithm for its robust local invariant feature description, highlighting the importance of color in accurate object classification. This approach aims to simplify currency identification for visually impaired individuals.

III. EXISTING SYSTEM

The current currency recognition system operates through image processing and employs a hybrid correlation method combining Local Binary Patterns (LBP) and Principal Component Analysis (PCA). This system identifies currency by analyzing specific extracted features from the notes. However, it lacks the capability to detect hidden features, such as latent images and watermarks. To enhance its effectiveness, the system could be upgraded to include these hidden features along with recognition capabilities from multiple angles. Additionally, there is potential to develop this technology into a portable format, making it accessible on mobile devices for broader and more convenient usage.

Limitations in Existing System

Limited to Grayscale Images:

As previously noted, the PCA (Principal Component Analysis) and LBP (Local Binary Patterns) techniques are often used on grayscale images. This method streamlines processing and cuts down on computational demands, but it restricts the system from identifying counterfeit Indian currency using only grayscale traits. Consequently, this might miss specific features or security elements that are present in colored or multi-tonal notes.

Complexity and variability currency design:

Indian currency notes are characterized by complex designs, security features, and diverse textures, which may not be fully captured or accurately distinguished using only PCA and LBP techniques. Consequently, this could lead to difficulties in precisely detecting counterfeit notes that adeptly replicate these intricate features.

Feature Vector:

The process of selecting principal components in PCA may eliminate minor but critical features from currency images.

Furthermore, the parameters chosen for LBP's feature extraction significantly impact its ability to distinguish between different notes, which in turn influences the accuracy of detection. It's essential for feature vectors to be resilient to variations such as changes in lighting and note orientation to ensure dependable detection.

IV. PROPOSED SYSTEM

This project proposes that the Currency Recognition System uses advanced computer vision algorithms and cutting-edge technology to accurately recognize the Indian counterfeit notes and specify through announcement. The system consists of the following components:

Camera Interface:

The suggestion system uses a smartphone camera or special device as an input interface. Users can capture images of bills with cameras and provide the visual data needed for further processing.

Image Processing Algorithms:

Once an image is captured, the system uses powerful image processing algorithms to analyse the bill's visual features such as colour, shape, pattern and security features.

Denomination Recognition:

The processed image is compared to an extensive database of bill characteristics to identify the denomination. The system uses machine learning techniques to improve accuracy and adaptability across different currencies.

Speech Output:

After recognizing the denomination, the system converts the information into a clear synthetic speech output. Users can hear denominations read aloud, allowing them to uniquely identify and distinguish between different denominations of banknotes.

Counterfeit detection:

In addition to currency detection, the proposed system also features counterfeit bill detection. It analyses bill security features, microprints, watermarks and other features to identify potentially counterfeit bills and alert users.

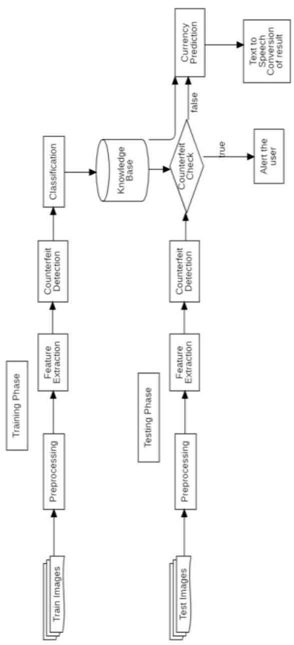

Fig: System Architecture

V. IMPLEMENTATION

This application encompasses several modules designed to handle and analyze currency through image processing and machine learning techniques. Initially, the currency dataset is uploaded into the application to set the foundation for further processing. The dataset preprocessing module handles the normalization, resizing, and splitting of the image data, allocating 80% of the images for training and reserving 20% for testing to evaluate the model's predictive accuracy. The DCNN (]Deep Convolutional Neural Network) algorithm is then employed, using the 80% of processed images to train the custom CNN (Convolutional Neural Network) prediction model. This trained model is subsequently applied to the test images to assess its accuracy in making predictions. In another module, OpenCV is utilized to capture live images of currency notes, which aids in predicting their denomination. Additionally, a feature extraction module analyzes these live-captured notes to determine if they are counterfeit. Finally, the application predicts the denomination and type of each currency note using the images processed from the live capture module, integrating all these functionalities to effectively identify and classify currency notes

VI. SYSTEM ARCHITECTURE

Training Phase:

- Feature Extraction: Utilize techniques such as image processing algorithms or statistical analysis to extract key features from the authentic parts. These features may include unique identifiers, manufacturing signatures, or physical characteristics.

- Model Training: Employ machine learning or statistical models to learn patterns and relationships within the extracted features. Train the model to distinguish between genuine and counterfeit parts based on the learned patterns.

Testing Phase:

- Data Acquisition: Obtain samples of parts to be tested for authenticity.

-Feature Extraction: Apply the same feature extraction techniques used during training to extract relevant features from the test parts.

-Counterfeit Detection: Utilize the trained model to classify the test parts as either genuine or counterfeit based on the extracted features.

-Verification Mechanism: Implement additional verification steps, such as cross-referencing with known counterfeit patterns or conducting physical inspections, to validate the detection results.

Reporting and Decision-Making:

- Result Analysis: Analyze the detection results to determine the authenticity of the tested parts.

- Decision Making: Based on the analysis, trigger appropriate actions such as rejecting suspected counterfeit parts, quarantining them for further investigation, or approving genuine parts for use.

- Alert System: Implement an alert mechanism to notify relevant stakeholders (e.g., manufacturers, distributors, or consumers) in case of counterfeit detection

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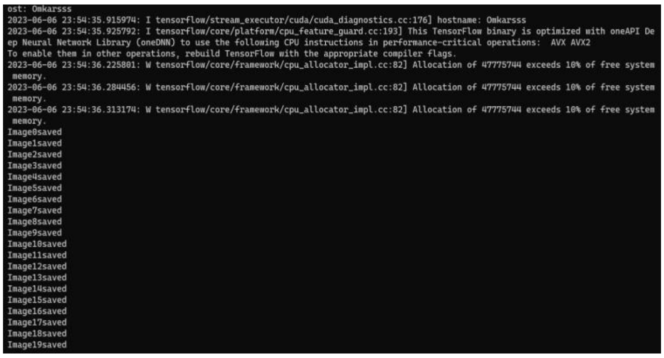
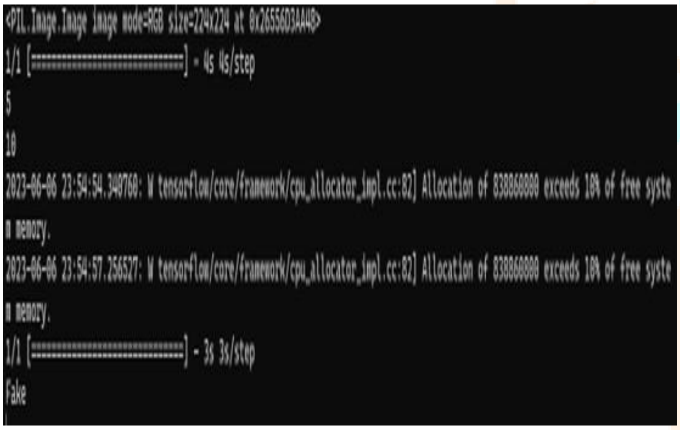
VII. RESULTS AND DISCUSSION

By Clicking, the camera becomes active and takes around 50 images.



Identifies whether captured image is real or fake



VII. CONCLUSION

The currency detection project signifies a remarkable advancement in financial security and accessibility. Through advanced machine learning and computer vision techniques, we've crafted a robust system adept at accurately recognizing currency denominations and identifying counterfeit notes. Notably, our integration of speech recognition technology empowers users, including those with visual impairments, to effortlessly determine banknote values through auditory prompts, promoting inclusivity in financial transactions. Additionally, the system's counterfeit detection capability adds a vital layer of security, mitigating potential fraud risks for individuals and businesses alike. By employing sophisticated algorithms and image processing methods, our solution swiftly distinguishes between genuine and fake banknotes, offering users real-time feedback for informed decision-making. Looking ahead, as financial transactions increasingly shift towards digital platforms, the demand for reliable currency detection systems will surge.

Our project lays the groundwork for future innovations in this domain, heralding more advanced technologies that bolster security, accessibility, and trust in global financial systems.

IX. FUTURE SCOPE

A potential future improvement to the currency detection project is the introduction of multicurrency support. By extending the system's capabilities, it can be trained to recognize multiple currencies from different countries. This improvement will make the system more versatile and applicable in different regions, meeting the needs of a wider user base. Users can use this system to identify and distinguish different types of banknotes, regardless of their origin. In addition, the development of a mobile application version of the currency recognition system will allow users to easily access its functionality on their smartphones. This increases flexibility and usability, allowing users to perform currency detection tasks on the go. In addition, by incorporating the ability to update the system's currency database in real time, users can be assured that they have access to the latest currency design and security features, ensuring that the currency detection system remains accurate and reliable over time.

Furthermore, exploring the integration of wearable devices, such as smart glasses, could offer a hands-free and immersive experience for visually impaired users. By leveraging the camera capabilities of the wearable device, the system could provide real-time feedback or auditory cues directly through the glasses, enhancing usability and mobility.

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