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An Automatic Detection of Counterfeit or Damaged Indian Rupee Notes

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***Abstract*— Every year in India, the Reserve Bank of India (RBI) deals with the issue of counterfeit currency notes. Bank employees are highly educated to detect counterfeit notes, however the trouble comes when such notes are used blended into the market and distributed via common channels folks. Receiving counterfeit notes from ATMs is also a possibility. Have also been observed in several locations . In the past, In the last few years, as a result of incredible technological**

***Index Terms*— RBI, Fake Currency**

I. INTRODUCTION

Many researchers were inspired to build corresponding robust and dependable solutions in response to the demand for automatic banknote recognition systems. Processing In general, speed and identification accuracy are two significant factors. Manual testing of all notes in such systems is a goal in such systems. Transactions are a time-consuming and disorderly procedure. while distributing notes theres also a chance of ripping consequently systems that automatically recognize bank notes are now being developmentit is necessary for many applications including advancements, colour printing, duplication, and scanning advancement The prevalence of counterfeiting is growing. Counterfeit Notes are one of the most serious cash- related issues transactions. It is increasingly significant for a country such as India Stumbling block, Because of advancements in printing and scanning .With today's technology, anyone can simply print false documents. notes made with the most recent hardware tools vending machines and mechanized merchandise sales. Extraction of sufficient monetary characteristics from the money picture is critical for the automated system's accuracy and robustness. This is a difficult problem for system designers to solve. Every year, the Reserve Bank of India (RBI) deals with counter feit or destroyed currency notes. Handling a large volume of counterfeit notes adds to the difficulties. As a result, using robots (either independently or as a supplement to human expertise) simplifies and expedites the note recognition process.
Feature Of Indian currency Notes.

- *Watermark:* The Mahatma Gandhi Series banknotes incorporate a watermark featuring Mahatma Gandhi's

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portrait. This watermark exhibits a play of light and shade, coupled with multidirectional lines within the watermark window.

- *Latent Image*: Positioned on the right side of Mahatma Gandhi's portrait on select denominations, a latent image reveals the numerical value of the note when held horizontally at eye level.
- *Fluorescence*: The banknotes utilize fluorescent ink for the number panels and are equipped with optical fibers. When exposed to ultraviolet light, both features become visible.
- *Micro Lettering*: Microscopic lettering, including the abbreviation "RBI" and the note's denomination, is integrated into the design. This detail becomes more discernible under magnification.
- *Ink with Optically Variable Properties*: Introduced in certain denominations since November 2000, the ink used for printing numerals like "1000" and "500" changes color when viewed from different angles, enhancing security.
- *See-through Register:* A floral pattern is printed on both sides of the note with precise alignment. When held against light, the design appears as a single, unified motif, indicating authenticity.
- *Serial Numbers*: Each banknote is assigned a unique serial number, crucial for verifying authenticity. Any irregularities or repetitions in these serial numbers serve as indicators of counterfeit notes.
- These features collectively contribute to the robust security of the Mahatma Gandhi Series banknotes,effectively deterring counterfeiting attempts.

II. Literature Survey

There are now several methods for recognising paper cash [1][2][3]. Using the properties of the HSV (Hue, Saturation, and Value) colour space, with a focus on the visual perception of variations in the Hue, Saturation,andIntensityvalues of an image pixel [1].

Althoughtheprintingfirmhasthecapability of producing counterfeit paper currency, anyone with a computer and a laser printer at home may produce counterfeit bank notes. As a result, the challenge of effectively detecting counterfeit banknotes from genuine ones using automatic machinery has become increasingly critical. Trupti Pathrabe and Swapnili Karmore introduced a new method [3] focused on enhancing the accuracy of recognition and speed of transactions in categorizing Japanese and US paper currencies. Their study utilizes time series data and Fourier power spectra for comparing two different datasets. These datasets are directly inputted into the neural network in both cases. Additionally, they propose a fresh approach to evaluating recognition ability.

Mirza and Nanda's research [4] outlines a technique for identifying denominations from paper currency. They locate the region of interest (ROI), which can be matched using Pattern Recognition and Neural Networks. Initially, the image is obtained using a standard flat scanner at a fixed resolution and size, with pixel levels chosen for image acquisition. Several filters are applied to extract the denomination value, with different pixel levels used for various denomination notes. Pattern Recognition and Neural Networks are then employed for matching or determining the monetary value/denomination of paper currency.

Sai Prasanthi and Rajesh Setty present a methodology for validating Indian rupee banknotes in their study [6]. They utilize image processing techniques to extract six distinct characteristics. These characteristics include picture processing, edge detection, image segmentation, and image comparison. They utilize the Sobel operator with gradient magnitude for characteristic extraction. Accurate and fast paper currency recognition is vital for the financial system.

Recognition of paper currency is based on three primary features: size, color, and texture. An image histogram is utilized to compute and compare the abundance of different hues in a paper currency with a reference paper currency. Moreover, an upgraded LBP technique named block-LBP, based on the standard local binary pattern (LBP) method, is used for characteristic extraction. This system can be implemented efficiently in low-cost hardware, providing versatility in various situations. Scanned images of banknotes captured by low-cost optoelectronic sensors are used, and a multilayer perceptron trained with a backpropagation algorithm is employed for recognition.

Another study focuses on three properties of paper currency: size, color, and texture [7]. The texture of paper money is simulated as a random process using the Markov chain concept. An ensemble neural network (ENN) is employed for recognition, using negative correlation learning to train 20 networks in the ensemble. This technique involves training ensemble members on various parts or portions of input patterns. Overall, these studies contribute to enhancing the recognition ability and transaction speed of classifying Japanese and US paper currencies.

III. Steps In Fake Note Recognition System

In currency recognition systems, achieving high processing speed and accurate identification are fundamental objectives. Digital image processing requires extensive experimental validation to ensure the effectiveness of proposed solutions for specific challenges. This field encompasses processes where images serve as both inputs and outputs, involving property extraction and object recognition. MATLAB is commonly utilized as the preferred computational tool, supporting various image formats such as BMP, JPEG, PNG, HDF, PCX, TIFF, and XWB.

Extracting image characteristics, particularly from Indian currency notes, presents a significant challenge due to the need to remove both obvious and subtle elements. A successful extraction strategy aims to enhance the distinction among different pattern classes. This process involves multiple steps, including image acquisition, grayscale conversion, edge detection, feature extraction, segmentation, and comparison.

Image acquisition entails capturing digital images from real-world scenes using a digital camera with suitable backlighting to ensure accurate representation of currency details. Subsequently, these images undergo further processing, such as grayscale transformation and edge detection, which are crucial for identifying areas of sharp brightness change or discontinuities.

Image segmentation divides an image into constituent regions or objects based on characteristics like intensity inconsistency or similarity. Effective segmentation is essential for accurate feature extraction, which is vital for distinguishing currency denominations.

A proposed algorithm for currency verification includes steps such as image capture, grayscale transformation, edge detection, region cropping, segmentation, feature extraction, and comparison with pre-stored reference images. This verification process determines currency authenticity based on feature matching.

The recognition method utilizes four key aspects of paper currency: identification marks, security threads, latent pictures, and watermarks. These features play a critical role in distinguishing between different denominations and identifying counterfeit notes.

Automatic currency identification systems heavily rely on feature extraction and recognition algorithms. Existing challenges include issues like motion blur, image noise, variations in note types, and inefficient feature extraction methods. Addressing these challenges is crucial for improving real-note recognition rates and system efficiency.

The proposed algorithm for the previously discussed paper currency verification system is as follows.

- A simple scanner or digital camera will be used to capture an image of paper cash.
- The acquired image is an RGB image that will be transformed to grayscale.
- The entire grayscale image's edges will be detected.
- Once the edges have been detected, the four features of the paper currency will be cropped and subdivided.
- Following segmentation, the paper currency's properties will be extracted.
- The features of the test image are compared to the system's original pre-stored image.
- If it matches, the currency is authentic; otherwise, it is counterfeit.

The diagram provided below illustrates the stepwise procedure for verifying paper currency. This method relies on four key elements of paper currency: its identification mark, security thread, latent picture, and watermark. Utilizing advanced technology, this approach enables the extraction of concealed properties of paper currency, such as latent pictures and watermarks.

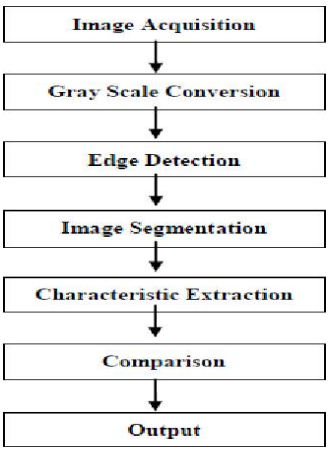

Figure 1: Indian Currency Recognition System

This proposed method capitalizes on the innate characteristics of paper currency that individuals typically utilize to differentiate between different denominations. Rather than solely depending on precise details, individuals often consider common attributes like size, primary color backdrop, and texture when identifying banknotes. These characteristics serve as distinguishing factors for various denominations of banknotes.
The detection of counterfeit notes and the establishment of a paper currency identification system are pivotal in banking systems and other financial sectors. Automated currency note identification heavily relies on the inherent features of currency notes. The efficiency of recognizing specific currencies and accurately extracting features is directly impacted by the effectiveness of the feature extraction process.
Upon reviewing existing approaches, it becomes apparent that certain challenges impede the efficiency of currency recognition systems. These challenges encompass issues such as motion blur, noise from image capture devices, variations in note types, and less effective feature extraction strategies. Addressing these challenges is imperative for enhancing the recognition rate of genuine notes and improving the overall efficacy of currency verification systems.

IV. Expected And Otherprevious Research Results

To implement the proposed technique for detecting counterfeit notes, we use MATLAB to simulate image processing activities. The presented graphic depicts two sorts of services: real and fake. The image is segmented as follows. After the image has been acquired and segmented, it will be converted to grayscale format. The grey scale conversion diagram is as follows:
what the system uses to recognise it. The image's edge detection displays sharp intensity shifts in the colours. The identified edge information is then retrieved and organised in the network's needed format. The detection of edges to extract features is shown in the diagram below. Pattern matching is a set of methods for locating related objects in a collection. many resources Pattern matching is a technique used in image processing. Pattern matching is a set of tools for locating things that are similar. Objects from various sources The pattern is used in image processing. Matching is a technique for finding a small image (called model) from a larger source (called target image). The following is a list of resources. The matching images of the comparison are shown in figure. There are fake and real notes.

Fig. 2 Front panel of software before image is selected Note Value

Fig. 3 Front panel of software after image is selected Note Value

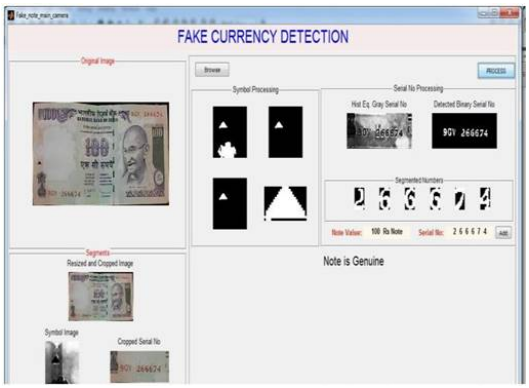

Fig. 4 Front panel of software after image is processed and results is “Note is Genuine”

V. CONCLUSION

The RGB colour scheme is used in the original input image. It is converted to grey scale because it simply contains intensity information, which is easier to comprehend than three different types of information R (Red), G (Green), and B (Blue) are the components (Blue). The image in this case is from the file ,the currency notes are converted to grey scale to convert to pixel values converting to grayscale has no effect on the quality of the image. The minimum degree of information required on currency notes then a new one appeared. From the original grey scale pixel, a series of values has been constructed. By using a linear combination of the previous values edge detection is used to extract data after the transformation .The identity of the image is

In this work ,we did a survey by reading various literature that discusses several strategies for detecting false notes. This is a MATLAB-based system for recognizing the security characteristics of Indian currency automatically. Experimental results reveal that the low-cost system produces accurate and consistent results at a high throughput employing effective and efficient image processing approaches and algorithms. The created method is compatible with Indian banknote denominations of 100, 500, and 1000 rupees.

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