AUTOMATED DETECTION OF COUNTERFEIT INDIAN CURRENCY NOTES THROUGH IMAGE PROCESSING ANALYSIS

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ABSTRACT

The prevalence of counterfeit currency notes is on the rise, necessitating advanced detection methods. One approach involves counting interruptions in the thread line, where the absence of interruptions indicates a genuine note, while any interruptions suggest a fake one. Additionally, the system assesses the entropy of currency notes to enhance the efficiency of fake note detection. The advent of sophisticated color printing technology has exacerbated the problem, enabling widespread replication of notes. Unlike the past when printing was confined to specialized facilities, the current ease of printing, even with a basic laser printer, has led to a significant surge in fake notes. To address this challenge, the proposed system utilizes image processing concepts for Indian currency note verification. Various features of the currency notes are extracted using MATLAB software, ensuring simplicity and high-speed performance. The system's outcome serves to predict whether a currency note is genuine or counterfeit.

Keyword : *Image processing, Currency, Authenticity verification, Classification, Feature extraction*

1.1 INTRODUCTION

Counterfeit currency detection poses a significant global concern, impacting the economies of various countries, including India. Currency duplication, facilitated by advanced printing and scanning technology, has become a prevalent threat to economic stability. In addressing this issue, potential solutions involve leveraging either the chemical properties or the physical appearance of the currency. This paper focuses on the latter, employing image processing algorithms to analyse the physical characteristics of Indian currency for counterfeit detection. Hence, we propose a more user friendly and portable solution to this problem in form of a mobile app coupled with cloud storage. The Reserve bank is only one which has the sole authority to issue bank notes in India. Reserve bank, like other central banks the world over, changes the design of bank notes from time to time. Traditionally, anticounter

feiting measures involved including fine detail with raised intaglio printing on bills which allows non experts to easily spot forgeries

Coins with milled or marked edges, displaying parallel grooves, serve as a safeguard to indicate that none of the precious metal has been scraped off. The Reserve Bank employs various techniques to detect counterfeit currency. However, manual testing of all notes in transactions proves to be a time-consuming and messy process, with the added risk of tearing notes. In the rapidly evolving landscape of technology, the banking sector is continually embracing modernization. This trend underscores the need for automatic counterfeit currency detection in both ATMs and automated product vending machines. Numerous researchers are motivated to develop robust and cost-effective automatic currency detection machines, now widely employed in dispensers for modern products such as candies, soft drinks, and even bus or railway tickets. The primary objective of currency recognition technology is to identify and extract both visible and invisible features of currency notes.

While several techniques have been proposed for currency note identification, the most effective approach involves utilizing the visible features of the note, such as color and size. However, this method may prove less effective if the note is dirty or torn, altering its color characteristics significantly. To address these challenges, it is crucial to extract features from the currency image accurately and apply appropriate algorithms to enhance recognition accuracy. Here, we employ a straightforward algorithm that demonstrates effective performance. The manual testing of notes in transactions is not only time-consuming and messy but also carries the risk of tearing notes. Therefore, the implementation of automatic methods for banknote recognition becomes imperative in applications like automatic goods vending machines. Extracting sufficient monetary characteristics from the currency image is essential for the accuracy and robustness of automated systems, presenting a significant challenge for system designers. Annually, the Reserve Bank of India grapples with the issue of counterfeit currency notes and destroyed notes, posing additional challenges due to the handling of large volumes of counterfeit notes. The concealed features of the note become apparent under ultraviolet light. Subsequently, image processing is carried out on the captured image using techniques such as image segmentation, edge information extraction, and feature extraction. MATLAB proves to be an ideal tool for processing and analyzing these images.

1.2 LITERATURE SURVEY

Zahid Ahmed [1] et.al introduced a method that isolates distinct features from Indian currency, utilizing them for detecting counterfeit money. The image was captured using a picture acquisition device, and security features were extracted through various image processing algorithms. Template matching was then employed to identify counterfeit money. Overcoming this challenge involves leveraging diverse parameters, sufficient to distinguish between fake and genuine currency notes, through the application of advanced image processing techniques.

Hariri [2] et.al demonstrated the identification of Iranian banknotes by employing wavelet transformation and neural networks. This method utilizes wavelet transformation to extract image features and operates in two stages. In the initial phase, the image undergoes preprocessing with size reduction, resulting in a grayscale RGB image. The extracted information serves as inputs for the neural network.

Hassanpour [3] et.al focus on India, a developing country, and discuss the production and printing of counterfeit money. The article explores the recognition of paper currency using digital image processing techniques, selecting eight characteristics for detecting counterfeit Indian paper currency. Currency recognition is determined by identification marks, optical variable link, see-through register, and currency color code. Security threads, watermarks, latent image, and micro lettering features are employed for currency verification, involving the extraction of characteristics from the currency image and subsequent comparison with genuine currency features.

R.C. Gonzalez [4] et.al highlight the expanding need for modern banking services, driving the demand for an automated money recognition and verification system. This encourages numerous researchers to develop precise, reliable, and high-speed methods. Two techniques for verifying the authenticity of currency notes are employed: the first-line inspection method and the second-line review technique. The first line involves varied thickness watermarks, UV fluorescence, intaglio printing, microtext, and holography, while the second line encompasses isocheck/isogram, fiber-based authenticity certificates, color, and feature analysis.

Mriganka Gogoi [5] et.al emphasize the significance of money in our daily needs, stressing its vital role. The circulation of counterfeit currency poses a threat to the economic development of our nation, causing considerable distress to individuals. Many people remain unaware of how to identify fake notes and the precautions to take. The focus is on developing an advanced mobile-based application dedicated to detecting counterfeit money, aiming to empower the common man with an easily accessible tool for swift identification. Unlike existing bank indicators,

Counterfeit: Currency Detector offers a user friendly and convenient application for promptly identifying forged banknotes.

1.3 METHODOLOGY

Existing systems are predominantly machine based and tailored for commercial applications, particularly those utilizing image processing on MATLAB. These machines commonly rely on optical sensing or proximity detection mechanisms. In optical detection, the currency is placed beneath the machine, and UV light is systematically scanned across it. If the currency exhibits fluorescence, it is deemed genuine. In proximity detection, the ink used in currency production possesses ferromagnetic properties. As the currency is passed through a magnetic belt, any observable movement indicates its authenticity. Figure 1 illustrates a flowchart depicting the general methods employed for detecting counterfeit currency through image processing.

1.3.1 Image Acquisition

The system takes an image of the currency intended for verification as input. The input image can be obtained through various methods, such as scanning the currency or capturing a photograph using a mobile phone, which can then be uploaded to the system.

1.3.2 Grayscale Conversion

Transforming a colour image into a grayscale image involves understanding the colour composition of the image. In a colour image, each pixel's colour is a blend of three colours: Red, Green, and Blue (RGB). Conversely, a grayscale image is represented as a single layered image. Various techniques can be employed to convert a colour image into a grayscale image.

1.3.3 Edge Detection

Edge detection is an image processing technique employed to identify the boundaries of objects within images. It operates by identifying discontinuities in brightness, a method widely utilized for image segmentation and data extraction in fields such as image processing, computer vision, and machine vision. The goal is to pinpoint abrupt changes in image brightness, capturing significant events and alterations in the properties of the visual scene. The application of edge detection is crucial for identifying all edges within the Region of Interest (ROI), facilitating various operations in subsequent stages.

1.3.4 Segmentation

Image segmentation refers to the process of dividing an image into multiple parts, commonly utilized to identify objects or extract pertinent information from digital images.

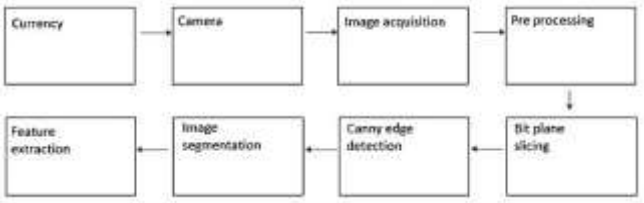

Fig-1: Block diagram

Fig-2: Real Note image

1.3.5 Image Preprocessing:

Image preprocessing involves the essential steps taken to format images before they are utilized for model training and inference. This encompasses tasks such as resizing, orienting, and colour corrections. These operations are crucial prior to data analysis and information extraction, with resizing being a primary example. In addition, grayscale conversion is performed during this stage.

1.3.6 Gray Scale Conversion and Edge Detection:

The acquired image, initially in RGB format, is converted into a grayscale image to retain intensity information. Grayscale images are further processed to detect edges. The luminance of a pixel in a grayscale image ranges from 0 to 255, involving the conversion of RGB values (24- bit) to grayscale values (8bit). Various image processing techniques and software applications facilitate this conversion. Edge detection, an image processing technique focused on finding object boundaries, operates by identifying discontinuities in brightness. This method is essential for image segmentation and data extraction in areas like image processing, computer vision, and machine vision. The primary purpose is to identify sharp changes in image brightness, capturing significant events and alterations in the properties of the visual scene. Edge detection aids in detecting all edges within the necessary Region of Interest (ROI), enabling diverse operations in subsequent stages.

Fig-3: Gray scale image

1.4 IMPLEMENTATION

The execution phase of the task involves transforming the overall objective into executable code, aiming to achieve the best possible outcome in a suitable programming language. This section focuses on detailing the execution phase, providing information about the programming language and development environment utilized.

The execution phase encompasses several tasks:

1.4.1Careful Planning:

Definition: Planning involves outlining the steps, resources, and timelines required to accomplish the project goals.

Importance: Careful planning is essential to ensure that all aspects of the conversion process are considered. It helps in allocating resources effectively, managing time efficiently, and addressing potential challenges.

1.4.2.Analysis of Structure and Constraints:

Definition: This task involves a thorough examination of the existing structure and any constraints that might impact the conversion process.

Importance: Analyzing the structure and constraints helps in understanding the limitations and opportunities of the project. It ensures that the conversion process aligns with the existing framework and identifies potential challenges that need to be addressed.

1.4.3.Defining Techniques for Achieving the Conversion:

Definition: In this step, specific techniques and methods are identified and defined for achieving the conversion of the project.

Importance: Defining techniques involves selecting the most suitable approaches for the conversion process. It ensures that the chosen methods align with project requirements, standards, and best practices.

1.4.4Evaluation of the Chosen Conversion Technique:

Definition: After selecting a conversion technique, it's important to evaluate its feasibility, effectiveness, and potential impact on the project.

Importance: Evaluation helps in ensuring that the chosen technique is viable and aligns with project goals. It allows for adjustments if the selected method is found to be inadequate or if there are unforeseen challenges.

1.4.5 Precise Decision-Making Regarding the Proposed Approach:

Definition: This task involves making well informed and precise decisions regarding the overall approach to the conversion process based on the analysis and evaluation.

Importance: Precise decision-making ensures that the project team is aligned on the chosen approach. It helps in setting clear expectations, responsibilities, and milestones for the execution phase.

1.5 RESULTS AND DISCUSSION

When merging components from two different images, if the note being tested is genuine, variations only appear at the number's location. However, when using a counterfeit note in this instance and applying the same code, it becomes evident that the image overlay is inaccurate. Additionally, the resulting image is blurred, a clear indicator of a fake note, confirming its inauthenticity.

Fig-4.1: real black strip **Fig-4.2:** scanned strip

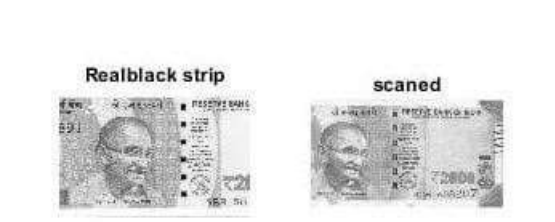

Fig 5: Gray scale image

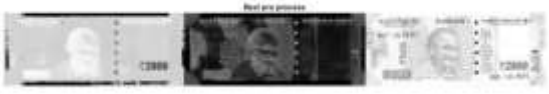

Fig 6: Edge detection

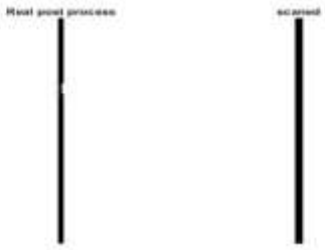

Fig 7: Feature extraction or segmentation

Fig 8: Merging of two components to verify real currency

1.6 FUTURE SCOPE

The primary objective of this project was to create a user-friendly and efficient system accessible to the common man. Built on MATLAB, the system focuses on automatic recognition of fake and genuine Indian currency. Being a cost-effective solution, it employs highly effective image processing techniques, delivering accurate and reliable results with a commendable throughput, as demonstrated by server-end experimental results. The developed MATLAB Code is designed to detect all Indian currencies, with a specific focus on fake detection for Rs 2000 and Rs 500 notes. In the initial stages, our proposed system could potentially replace the hardware system in currency verification processes. This system is designed to assist individuals who may not be technically inclined, streamlining background processes through the utilization of Image Processing Techniques, ensuring ease of use and accurate identification.

1.7 CONCLUSION

The implementation of fake currency detection using image processing involves extracting features from the currency note, such as the serial number, security thread, identification mark, and Mahatma Gandhi portrait. The process spans from image acquisition to the calculation of the intensity of each extracted feature. Notably, the system demonstrates capability in extracting features even from notes with scribbles. The algorithm presented here is well-suited for the newly introduced 500 and 2000 denomination notes.

Additionally, this technology could be integrated into an automatic railway ticket booking system, making currency detection a pivotal component. The utilization of computerized image processing enhances the accuracy of currency image examination, and this method proves cost effective and less time-consuming compared to existing procedures.

1.8 REFERENCES

[1] Zahid Ahmed, Sabina Yasmin, Md Nahidul Islam, Raihan Uddin Ahmed “Image Processing Based Feature Extraction of Bangladesh Banknotes”.

[2] Hariri, Elham. Hariri,Mahdi. "Persian Banknote detection methods and its imperfections identifies."

[3] Hassanpour,H., Yaseri, A. and Ardeshir G.: “Feature extraction for paper currency Recognition” In International Symposium on Signal Processing and its Application (ISSPA) Sharjah.

[4] R.C.Gonzalez and R.E.Woods, Digital Image Processing,2nd ed.,Prentie Hall,2002 B.Manjunath and W.Ma,"texture features for browsing and retrieval of image data,"IEEE Trans.Pattern Anal .

[5] Mriganka Gogoi "Automatic Indian Currency Denomination Recognition System based on Artificial Neural Network"