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Forgery Unveiled: Revealing and Halting the Spread of Fake Currency – A Review

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Abstract

The main goal of this study is to examine an existing system for detecting counterfeit currency. Numerous methods have been employed to detect counterfeit currency, yet their performance often lacks consistency and accuracy. Research studies aimed at detecting counterfeit currency have used various techniques and algorithms, including edge detection, image segmentation, the Support Vector Machine (SVM), Structural Similarity Index Metric (SSIM), Fast Discrete Wavelet Transform (FDWT), Gray Level Co-occurrence Matrix (GLCM), Artificial Neural Network (ANN), Dual-Tree Complex Wavelet Transforms (DTCWT), and others. The ultimate goal is to combine the most effective features from numerous research papers to achieve the highest level of precision. The combination of these features does not, however, ensure maximum effectiveness. The development of the ideal detection system has previously been attempted but have yielded limited success. As a result, it is crucial to promote collaboration and invest extensive research to identify techniques that, when combined with different detection strategies, promise the highest accuracy in counterfeit money detection. In order to identify the most promising strategies that have the potential to influence the future of counterfeit currency detection, this paper conducts a detailed examination of several related studies. The search for more effective identification techniques continues to be crucial in an environment where counterfeiters innovate rapidly, and this study aims to offer insightful information in this ongoing effort.

Keywords: Counterfeit currency, Authentic currency, Banknote verification, Counterfeit detection methods.

I. INTRODUCTION

In today's rapidly evolving technological environment, the financial industry is diligently keeping pace with this continual advancement. As a result, there is a growing demand for automatic counterfeit money detection technologies. In the past, secure printing factories were authorized to produce currency notes. However, the continuous advance of technology has resulted in an alarming expansion in the production of counterfeit money. Today, anyone with access to a modern color printer can produce counterfeit currency that is shockingly similar to real currency. In response to this growing threat, we have put in place a variety of advanced techniques that closely examine banknotes, differentiating between authentic currency and counterfeit reproductions. Nevertheless, the battle against counterfeit currency extends beyond technology alone. Numerous individuals engage in a variety of fraudulent activities across our nation, including the illegal production and distribution of counterfeit money, capturing citizens in their web of deceit. Undaunted, we stand at the forefront of innovation, tirelessly working on the development of an advanced system engineered to swiftly and accurately detect counterfeit currency. This groundbreaking system is a ray of hope in the ongoing struggle against counterfeit money-related fraud, as it has the potential to significantly reduce instances of this hideous act. In the ever-evolving intersection of technology and finance, this system serves as a stalwart guardian, preserving the integrity of our currency and upholding the trust of our citizens.

II. METHODOLOGY

The literature has suggested a number of methods for identifying counterfeit money. These methods primarily make use of advanced technologies like computer vision and machine learning.

Image processing techniques to analyze security features like watermarks, holograms, and microprinting.

Ultraviolet (UV) and infrared (IR) scanning reveal hidden security features that cannot be seen with the naked eye.
Deep learning models like convolutional neural networks (CNNs), to differentiate between genuine and counterfeit currency based on patterns and features extracted from images.
Pattern recognition techniques compare the test note's patterns with those of genuine notes to detect discrepancies.
Ultrasonic or magnetic sensors to detect the physical properties of the paper and ink used in genuine currency.

The 2014 study[10] emphasizes the importance of various methods for identifying fake currency notes. It illustrates how important it is to be cautious when detecting fake notes, highlighting how crucial this task is. It aims to empower citizens to spot fake currency in an effort to reduce corruption in the country. The suggested technique was developed in MATLAB and is designed to be applied to mobile phones with scanners or cameras. The system is designed to reduce the amount of counterfeit money that is circulated in the nation by making it simpler for common people to recognize fake currency notes. In contrast, the 2019 study[4] recommends a physical appearance-based fake currency detection system for Indian notes using a database of real Indian banknotes in various denominations and to overcome the Discrete Wavelet Transform's (DWT) limitations, we use the Dual Tree Complex Wavelet Transforms (DTCWT). The K-means segmentation algorithm is used to group input images (like 200 and 500) and classify them as either original or fake notes.

As compared to the 2020 study[1], the authors propose using OpenCV's ORB (Oriented FAST and Rotated BRIEF) and Brute-Force matcher to detect Indian currency and identify currency security features, the 2019 study[4] focuses on a physical appearance-based fake currency detection system for Indian notes using database of actual Indian currency notes in various denominations and uses the Dual-Tree Complex Wavelet Transforms (DTCWT) for feature extraction to overcome the Discrete Wavelet Transform (DWT). The 2020 study[1] highlights the system's effectiveness and speed, which may make it more suitable for real-time scenarios. It emphasizes the value of their methodology and claims that it can generate excellent results faster. The study's inclusion of detailed information about various Indian banknotes suggests an in-depth analysis and comprehension of monetary characteristics. The system, which is based on OpenCV, employs computer vision techniques and algorithms that are expected to deliver reliable and accurate results. The experiments use notes of different denominations, including the new Rs. 200 notes from the MG series, to show how adaptable the system is. The system had a 95.0% success rate, according to the reported results, demonstrating its high efficiency in identifying and detecting currencies. Another 2020[2] study presents a cost-effective and accurate system for detecting all Indian currency notes, with a focus on Rs. 2000 and Rs. 500 denominations, while the 2019 study[4] prioritizes addressing wavelet transform limitations.

Both the 2020 and 2022 studies seek to create simple-to-use tools for identifying fake money. However, they employ different approaches. The 2020 study[2] focuses on creating a quick, easy method that the average person can use to tell the difference between counterfeit and genuine Indian currency notes. The MATLAB-based system aims to automatically distinguish between genuine and fake Indian currency notes. The system is designed to be cost-effective and uses reliable image processing techniques to produce results. Experiments were conducted on a cloud server, and the outcomes demonstrate how well the system performs in terms of accuracy and throughput. The system is made to recognize all Indian banknotes, with a particular emphasis on the Rs 2000 and Rs 500 denominations for the purpose of identifying counterfeit notes. The study suggests that in the early stages of currency verification, hardware-based systems may not be necessary because image processing and supervised learning can achieve precision levels of more than 99%. The 2022 study[6], on the other hand, concentrates on classifying images using machine learning, specifically using an architecture built using a Machine Learning Convolutional Neural Network (ML-CNN). The ML-CNN architecture eliminates the need for laborious image processing and manual currency note security feature verification by acting as a feature extractor. A dataset has been made in order to run experiments and model real-world scenarios. The goal is to develop a user-friendly programme that makes it possible for common people to recognize fake currency notes. Future work on the model will involve experimenting with different ML-CNN architectures and expanding the dataset for better training. This study possibly offers increased precision and effectiveness.

Another study[7] in 2020, involves examining different currency detection algorithms, with a focus on SURF, SIFT, BRISK, and ORB in particular. It is well known that SURF, SIFT, and BRISK perform well when the currency images change significantly. We emphasize ORB and BRISK because of their affine change invariance. ORB is a well-known efficient algorithm that can identify a lot of features. ORB deserves praise for its quick image matching without sacrificing accuracy. It is determined that the ORB and Brute Force matcher combination is effective for real-time currency detection.

The Structural Similarity Index (SSI) method and machine learning for currency classification are the main topics of the

2021 study[3]. The objective is to distinguish genuine Indian rupees from counterfeit ones using the Structural Similarity Index (SSI) method. It classifies the types of genuine rupees using a number of techniques, including a Feature Selection algorithm (FDWT - Discrete Wavelet Transform) and a Feature Extraction algorithm (GLCM - Gray-Level Co-occurrence Matrix). A machine learning algorithm known as Artificial Neural Networks (ANN) is also used for classification. The 2022 study[6], in contrast, lessens the dependence on manual image processing by introducing a Machine Learning Convolutional Neural Network (ML-CNN) architecture as a feature extractor. While both studies make use of machine learning methods, the 2022 study's[6] strategy may result in more effective and user-friendly counterfeit detection.

The paper[1] presents future plans to develop an Android app for Indian currency detection in order to improve the system's usability and accessibility.

III. IMPACTS ON SOCIETY

Due to an increase in the money supply without a corresponding rise in goods and services, counterfeit money in circulation can cause inflation. The value of a nation's currency can gradually decline as a result of the acceptance of counterfeit money, which has an effect on the citizens' purchasing power. Unknowingly accepting counterfeit currency can result in financial losses for people and businesses, which can have an adverse effect on their bottom line. Following a transaction, the discovery of counterfeit money can result in disagreements and financial difficulties. The prevalence of counterfeit money can erode public confidence in the monetary system and the government's ability to protect the currency's integrity. Financial transactions among people might become less certain, which could slow down the economy. Money laundering schemes frequently make use of counterfeit money to legalize illicit gains. Money counterfeiting is linked to organized crime, the drug trade, and other illegal activities. Small businesses may experience financial hardship if they unintentionally accept counterfeit money and may lack the funds for sophisticated detection techniques. If a nation is known to have a problem with counterfeit money, it can damage its reputation in the international market and harm trade relations.

Effective detection systems keep counterfeit money out of circulation, maintaining the currency's value. By lowering the risk of accepting fake currency, these systems shield people and businesses from financial losses. Users of detection systems have greater faith in the legitimacy of transactions, promoting economic trust. Strong detection systems increase public confidence in the currency and give people peace of mind that their money is real. When banks and financial institutions make investments in counterfeit detection technologies, public trust in them is increased. Effective detection systems discourage counterfeiters by making it more challenging for them to create and distribute fake money. In its fight against crimes involving counterfeit money, it offers law enforcement agencies useful information and evidence. A nation's reputation on the international market is enhanced by successfully battling counterfeit money, which facilitates trade. Accessible and affordable detection tools enable small businesses to safeguard themselves against fake money, fostering a just and equitable marketplace.

IV. CONCLUSION

By identifying various security features on a currency note, we plan to implement the system to determine whether it is real or fake. Among the features that were extracted were security threads, an identification mark, a picture of Mahatma Gandhi, a watermark, microlettering, optical variable ink, a latent image, bleeding lines, and the Ashoka Piller logo[10]. We can examine these features to determine whether a currency note is genuine or counterfeit with the help of cutting-edge techniques and technology, which helps to decrease fraudulent activities involving counterfeit currency.

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