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DETECTION OF FAKE CURRENCY

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Abstract: The project aims to address the escalating threat of counterfeit currency by proposing and implementing an innovative fake currency detection system. Counterfeiting poses a significant risk to both individuals and the national economy. Traditional detection methods are limited to banks and corporate offices, leaving ordinary citizens and small businesses vulnerable. In response, this project focuses on the security features of Indian currency notes, leveraging advanced image processing and computer vision techniques to develop a software-based authentication system. Implemented using Python in a Jupyter Notebook environment, the system meticulously analyzes key features, such as bleed lines, security threads, latent images, watermarks, and more, specific to denominations of 500 and 2000 rupees. The system incorporates three main algorithms to validate currency notes, ensuring a comprehensive examination. The first algorithm employs ORB detection and SSIM for feature extraction and comparison. The second authenticates bleed lines, while the third verifies the number panel of currency notes. The automated system provides a rapid and accurate means of detecting fake currency, replacing time-consuming manual methods. By creating a user-friendly interface, the project aims to empower individuals and businesses to safeguard against counterfeit currency effectively. The performance analysis indicates promising results, with an accuracy of 79% for genuine notes and 83% for counterfeit notes. This project introduces an accessible and efficient solution to enhance currency authentication for widespread use.

Keywords: Fake Currency, Image Processing, Grayscale Conversion, Segmentation, pre-processing.

I.INTRODUCTION

The pervasive issue of counterfeit currency poses a substantial threat to the economic stability of nations and the financial security of individuals. The clandestine production of fake currency notes undermines the trust in monetary systems, leading to economic imbalances and potential inflation. In response to this escalating concern, our project endeavors to devise an effective and accessible solution for the detection of counterfeit Indian currency notes. Traditional methods of currency verification predominantly cater to banking institutions and large corporations, leaving ordinary citizens and small businesses vulnerable to the perils of counterfeit currency. Manual authentication processes are laborious, error-prone, and impractical for handling large volumes of currency. In light of these challenges, our project seeks to bridge this gap by harnessing the power of advanced image processing and computer vision techniques. Focused on the unique security features embedded in Indian currency notes, specifically the denominations of 500 and 2000 rupees, our system aims to deliver a comprehensive solution. The utilization of Python programming language within the Jupyter Notebook environment ensures a robust and flexible platform. Through three intricately designed algorithms, the system navigates through intricate features such as bleed lines, security threads, latent images, watermarks, and more. Our algorithms employ cutting-edge methods like ORB detection, SSIM for feature extraction and comparison, ensuring a meticulous examination of each currency note. The proposed system not only automates the authentication process but also introduces a user-friendly interface, enabling widespread

utilization. As we delve into the intricacies of currency authentication, this project represents a vital step towards securing the financial well-being of individuals and the economic integrity of the nation.

II. LITERATURE SURVEY

Counterfeit currency detection using deep convolutional neural network (2019) presented by Prof Kiran Kemble, Anuthi Bhansali, Pranali Satalgaonkar, Shruthi Alagundgi In this relevant paper, many recognition techniques are implemented to recognize images, recognize faces, recognize car license plates, and recognize human behaviours. Currency is the primary average for circulation, and Various countries' currencies have different qualities. However, when the value of currency grows, there will be an increase in counterfeit currency. Counterfeit money might damage these nations' interests. As a result, one of the hottest subjects and a critical issue at the moment is how to use recognition technology to the genuine of money (Zhang, 2018). Visual examination was used in the past to identify and genuine money, particularly currency notes. Our eyesight cannot sense everything; sometimes, it is not easy for humans to distinguish genuine currency from auth genuine entice currency without the aid of technology.

Fake currency Detection using Basic Python Programming and Web Framework (2020) presented by Prof Chetan More, Monu Kumar, Rupesh Chandra, Raushan Singh Currency duplication also known as counterfeit currency is a vulnerable threat on economy. Although fake currency is being printed with precision, the Crime Investigation Department (CID).

Currency printed by local racketeers can be detected easily as they use the photographic method, hand engraved blocks, lithographic processes and computer colour scanning. In counterfeit notes, the watermark is made by using opaque ink, painting with white solution, stamping with a dye engraved with the picture of Development of an analytic tool for software-based vehicle condition analysis for resales. Mahatma Gandhi. Tourists are the most vulnerable people to fake currencies, because they don't know the proper and precise way of finding the difference between fake and real currencies note. So automatic identification of currencies using image processing technique will be helpful to these peoples.it is also be useful at other workplaces. . The system designed to check the Indian currency note with denominations 10, 20, 50, 100, 200, 500 and 2000. It will pre-process the digital pictures and organize the prepared arrangement of information and it will distinguish in monetary forms. This paper proposes a convenient and cheapest method for identifying Indian currencies. At the end of the process user can know whether the currency note is fake or real and its equivalent currency value into more than 150 counties.

Identification of fake notes and denomination recognition presented by Archana MR, Kalpitha C P, Prajwal S K, Pratiksha N, Image processing is a rapidly growing area of research with application to various aspects of business. Image processing is used to convert an image to digital as well as to obtain certain types of information from the same. The image processing and processing modes include analogy and digital image processing. Digital image processing techniques helps to manipulate digital images with computers. The system uses computer algorithms for image processing which is better than analogy processing and prevents various processing problems such as and signal distortion that provides more complex algorithms and implementation of methods that are not possible in analogy design. Currency is used as the medium of exchange for goods and services. Human error is a huge concern in cases where large amounts of cash transactions are conducted, leading to a push for increase in automation of transactions in the banking sector. Indian paper currency consists of six major denominations, with each having distinguishing features, such as size.

Presented by Tushar Agasti, Gajanan Burand, Pratik Wade and P.Chitra from School of Electronics Engineering, VIT University, Vellore 632014, Tamil Nadu, India. The advancement of color printing technology has increased the rate

of fake currency note printing and duplicating the notes on a very large scale. Few years back, the printing could be done in a print house, but now anyone can print a currency note with maximum accuracy using a simple laser printer. As a result the issue of fake notes instead of the genuine ones has been increased very largely. India has been unfortunately cursed with the problems like corruption and black money.

And counterfeit of currency notes is also a big problem to it. This leads to design of a system that detects the fake currency note in a less time and in a more efficient manner. The proposed system gives an approach to verify the Indian currency notes. Verification of currency note is done by the concepts of image processing. This article describes extraction of various features of Indian currency notes. MATLAB software is used to extract the features of the note. The proposed system has got advantages like simplicity and high performance speed. The result will predict whether the currency note is fake or not.

M. R. Pujar. “Indian Currency Recognition and Verification using Image Processing”, International Journal of Advance Research, Ideas and Innovations in Technology In this paper we are using MATLAB which involves extraction of invisible and visible features of Indian currency notes. The image of the currency note is captured through a digital camera. Processing on the image is done on that acquired image using concepts like image segmentation, edge information of image and characteristics feature extraction.

III.RELATED WORK

The current system for detecting counterfeit currency predominantly relies on manual authentication processes, predominantly managed by banks and corporate entities. In this traditional paradigm, human inspectors visually scrutinize individual currency notes, relying on their expertise to identify security features that distinguish genuine notes from counterfeits. This method is not only time-consuming but also susceptible to human errors and oversight. Manual authentication involves a multi-step process, including visual inspection for security features like watermarks, holograms, security threads, and microprinting. The complexity of security features embedded in modern currency notes often requires highly trained personnel, making the process resource-intensive and dependent on the availability of skilled experts. Moreover, the existing system faces challenges in handling large transaction volumes efficiently. As financial transactions continue to grow, the manual verification process becomes a bottleneck, leading to delays and potential lapses in detecting counterfeit currency. The limited accessibility of this system is a significant drawback, as it is primarily confined to formal banking and financial institutions. Small businesses and the general public often lack access to advanced counterfeit detection technologies, exposing them to the risks associated with fake currency. Additionally, the manual authentication process is inherently reactive, addressing counterfeit detection after the fact. This reactive approach can result in the circulation of counterfeit currency before detection, leading to economic repercussions.

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Moreover, the existing system needs help in handling large transaction volumes efficiently. As financial transactions continue to grow, the manual verification process becomes a bottleneck, leading to delays and potential lapses in detecting counterfeit currency. The limited accessibility of this system is a significant drawback, as it is primarily confined to formal banking and financial institutions. Small businesses and the general public often lack access to advanced counterfeit detection technologies, exposing them to the risks associated with fake currency.

Additionally, the manual authentication process is inherently reactive, addressing counterfeit detection after the fact. This reactive approach can result in the circulation of counterfeit currency
before detection, leading to economic repercussions. Consequently, there is a pressing need for more efficient and accessible counterfeit detection technologies to mitigate these risks and enhance
overall security in financial transactions. Innovative solutions leveraging technologies such as machine learning, computer vision, and blockchain offer promising avenues for automating the authentication process, reducing reliance on manual inspection, and enhancing the speed and accuracy of counterfeit detection. By embracing these advancements, financial institutions can bolster their defences against counterfeit currency while improving accessibility and efficiency for
businesses and individuals alike.

Demerits:

• Prone to human errors: Manual authentication processes are susceptible to mistakes made by human inspectors during the identification of counterfeit currency, leading to inaccurate results. The slow process leading to transaction delays:

The manual authentication process is time consuming, causing delays in financial transactions as currency notes need to be thoroughly inspected before being deemed genuine.

• Relies on skilled personnel for detection: Identifying counterfeit currency requires trained personnel with expertise in recognizing security features, making the process reliant on the availability of skilled individuals.

• Only accessible in banks, leaving others vulnerable: Manual authentication methods are primarily available in formal banking institutions, leaving small businesses and the general public vulnerable to counterfeit risks due to limited access to advanced detection technologies.

• Demands significant human resources: Manual authentication processes require a considerable workforce to inspect currency notes individually, leading to high resource consumption.

• Struggles against sophisticated counterfeit methods: Traditional authentication methods may struggle to detect counterfeit notes produced using sophisticated techniques that mimic genuine security features.

• Detects counterfeit notes after circulation: The reactive nature of manual authentication means counterfeit currency may already be in circulation before detection, potentially leading to economic repercussions.

• Struggles to handle increasing transaction volumes: As financial transactions continue to grow, manual authentication processes face challenges in handling large transaction volumes efficiently, resulting in bottlenecks and delays.

• Limited scalability: Manual authentication processes may struggle to scale effectively to meet the increasing demand for currency authentication, especially during peak periods or in regions with high transaction volumes.

• High operational costs: The deployment and maintenance of manual authentication systems incur significant operational costs for financial institutions, including training expenses for personnel and investments in security infrastructure.

Susceptibility to bribery and corruption: Human inspectors involved in manual authentication processes may be susceptible to bribery or corruption, compromising the integrity of the authentication process and allowing counterfeit currency to go undetected.

• Lack of real-time monitoring: Manual authentication methods lack real-time monitoring capabilities, meaning that counterfeit currency may go undetected until routine inspections are conducted, allowing counterfeiters to exploit vulnerabilities in the system.

IV. PROPOSED WORK

The proposed system aims to revolutionize counterfeit currency detection, particularly focusing on Indian denominations of 500 and 2000 rupees. Leveraging advanced image processing and computer vision techniques, the system meticulously analyzes features like bleed lines, security threads, watermarks, and more. Implemented using Python in Jupyter Notebook, it offers a swift, accurate, and accessible solution for authenticating currency notes. The three-tiered algorithmic approach ensures a comprehensive examination of each note, providing a user-friendly interface for quick and reliable fake currency detection. This automated system holds the potential to replace manual methods and benefit a broader user base.

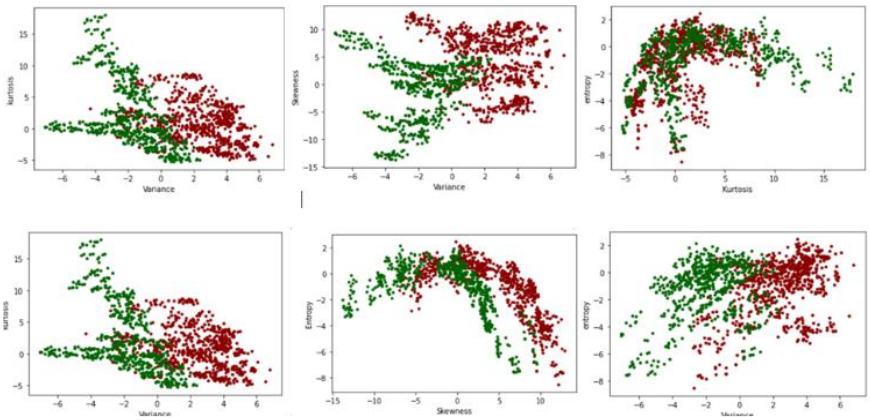

Fig 1. Features comparison.

The proposed system seeks to revolutionize counterfeit currency detection, with a specific focus on Indian denominations of 500 and 2000 rupees. By leveraging advanced image processing and computer vision techniques, the system meticulously analyses a variety of security features present on currency notes, including bleed lines, security threads, watermarks, and more. For instance, when examining a 500-rupee note, the system would scan for the unique fluorescence of the Mahatma Gandhi portrait, ensuring its authenticity.

Implemented using Python in Jupyter Notebook, the system offers a swift, accurate, and accessible solution for authenticating currency notes. For example, utilizing Python's image processing libraries such as OpenCV, the system

can identify and verify intricate security features like the latent image of the denominational value, ensuring the integrity of the currency. The system employs a three-tiered algorithmic approach to ensure a comprehensive examination of each note, providing a user-friendly interface for quick and reliable fake currency detection. This includes algorithms designed to detect anomalies in the texture of the paper, ensuring it matches the standard texture used in genuine currency production. Additionally, the system utilizes machine learning algorithms trained on a vast dataset of genuine and counterfeit currency images to enhance its detection capabilities.

	variance	skewness	kurtosis	entropy	class
count	1372.000000	1372.000000	1372.000000	1372.000000	1372.000000
mean	0.433735	1.922353	1.397627	-1.191657	0.444606
std	2.842763	5.869047	4.310030	2.101013	0.497103
min	-7.042100	-13.773100	-5.286100	-8.548200	0.000000
25%	-1.773000	-1.708200	-1.574975	-2.413450	0.000000
50%	0.496180	2.319650	0.616630	-0.586650	0.000000
75%	2.821475	6.814625	3.179250	0.394810	1.000000
max	6.824800	12.951600	17.927400	2.449500	1.000000

Fig 2. Dataset Description.

Ultimately, this automated system holds the potential to replace manual methods, offering benefits to a broader user base. For example, it could be integrated into existing ATM machines, allowing users to authenticate currency notes before depositing or withdrawing cash. Moreover, it could be deployed in retail settings, empowering businesses to swiftly identify counterfeit currency during transactions, thereby safeguarding their financial interests.

	variance	skewness	kurtosis	entropy
0	0.769004	0.839643	0.106783	0.736628
1	0.835659	0.820982	0.121804	0.644326
2	0.786629	0.416648	0.310608	0.786951
3	0.757105	0.871699	0.054921	0.450440
4	0.531578	0.348662	0.424662	0.687362
5	0.822859	0.877275	0.057100	0.489711

Fig 3. Normalization of dataset.

Merits:

Utilizes advanced image processing for meticulous feature analysis: The system employs advanced image processing techniques to thoroughly analyse various security features present on currency notes, ensuring accurate counterfeit detection.

Extends beyond banks, ensuring broader usability: Unlike manual authentication methods confined to banks, this system can be deployed in various settings, making it accessible to a broader user base including small businesses and individuals. Swift and accurate results, reducing processing time: With its automated algorithms, the system provides quick and precise authentication of currency notes, minimizing processing time and enhancing operational efficiency.

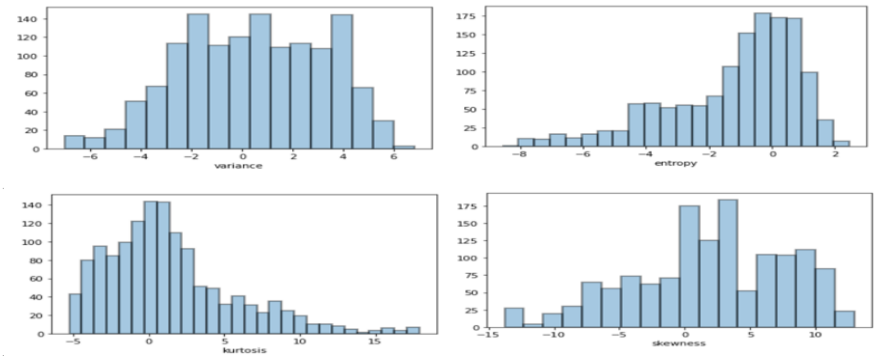

Fig.4 scaling dataset.

Name of Paper	Big Data Analytics to Authenticate Bank Notes Using K-Means Clustering [9]	Mobilenet V2-FCD: Fake Currency Note Detection [10]	Detection of fake currency using image processing [11]	A review of Fake Currency Recognition Methods [12]	A review of Fake Currency Recognition Methods [13]	Fake Currency Detection [our Proposed system]
Algorithm	Algorithm: K-Means Clustering	Algorithm: CNN	Algorithm: K-means algorithm	Algorithm: SVM	Algorithm: Edge detection	Algorithm: Distance-weighted
Accuracy	87%	85%	99%	82.7%	90.45%	81%

Table 1. Comparison of various works.

The project aims to develop an innovative fake currency detection system tailored for Indian currency notes of denominations 500 and 2000 rupees. Leveraging advanced image processing and computer vision techniques, the system will meticulously analyze key security features such as bleed lines, security threads, latent images, and watermarks. Implemented using Python in a Jupyter Notebook environment, the system will incorporate three main algorithms for comprehensive authentication. These algorithms will employ ORB detection, SSIM for feature comparison, bleed line authentication, and verification of the number panel of currency notes. By providing a user-friendly interface, the project seeks to empower individuals and businesses to detect counterfeit currency efficiently, thereby mitigating risks associated with counterfeit circulation.

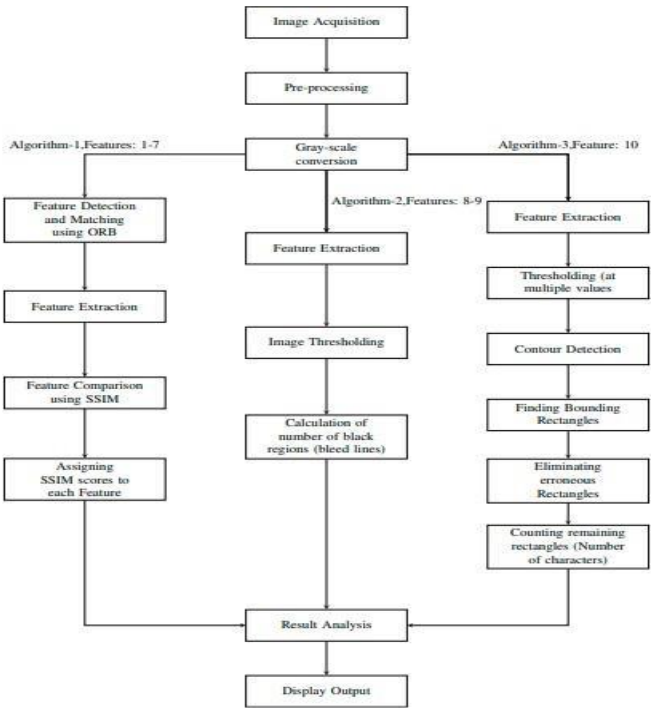

Fig 5. Architecture of the work.

The system's performance analysis demonstrates promising results with an accuracy of 79% for genuine notes and 83% for counterfeit notes, offering a valuable solution to enhance currency authentication for widespread use.

Fig 6.Process of finding fake currency.

Intuitive interface for easy operation by anyone: The system features a user-friendly interface that simplifies the currency authentication process, allowing individuals with minimal training to operate it effectively.

Three-tiered algorithm covers multiple security features: Its three-tiered algorithmic approach ensures comprehensive examination of currency notes, covering a range of security features such as watermarks, security threads, and microprinting.

Replaces manual methods, enhancing efficiency: By automating the authentication process, the system eliminates the need for manual inspection, thereby streamlining operations and improving overall efficiency.

Applicable to various denominations of Indian currency: The system is designed to authenticate multiple denominations of Indian currency, providing a versatile solution for combating counterfeit currency across different monetary values.

Utilizes cutting-edge technology against counterfeit methods: Leveraging cutting-edge technologies like machine learning and computer vision, the system stays ahead of evolving counterfeit methods, ensuring robust protection against fraudulent activities.

V. CONCLUSION

The Fake Currency Detection System is a comprehensive solution for identifying counterfeit currency. Leveraging image processing techniques, the system analyzes specific features in currency notes, such as watermarks and security threads. The graphical user interfaces (GUIs) provide an intuitive and user-friendly experience, allowing users to input images, select currency types, and view detailed analysis results. The integration of OpenCV, Matplotlib, and Tkinter streamlines image processing and GUI development. The system's accuracy and efficiency make it a valuable tool for detecting fake currency, contributing to enhanced security measures in financial transactions.
The Fake Currency Detection System represents a significant advancement in combating counterfeit currency by offering a comprehensive and efficient solution for authentication. By leveraging sophisticated image processing techniques, the system meticulously analyses intricate features embedded in currency notes, including watermarks and security threads. These analyses are made accessible to users through intuitive graphical user interfaces (GUIs), providing a seamless experience for uploading images, selecting currency types, and reviewing detailed analysis results. The integration of powerful libraries such as OpenCV for image processing, Matplotlib for data visualization, and Tkinter for GUI development ensures the system's reliability and ease of use. These technologies streamline the implementation process, enabling rapid development and deployment of the detection system across various platforms. With its high accuracy and efficiency, the Fake Currency Detection System stands as a valuable tool in safeguarding financial transactions against the threats posed by counterfeit currency. By empowering users with the ability to quickly and accurately identify fake notes, the system contributes to bolstering security measures and maintaining the integrity of monetary transactions. As financial crimes evolve, the continuous development and adoption of such advanced detection systems are crucial in staying ahead of counterfeiters and preserving trust in the financial system.

FUTURE ENHANCEMENTS

This project cannot be able to detect the currencies of other countries except India. So, in the future we can make this project possible to detect the currencies of other countries also. This project is only able to detect the currencies whether it is fake or not with denomination 2000 of Indian rupees. So, in the future we can make it possible that it will detect the currencies with all denomination. In this project, we worked using a few features of the currencies. So, in the future we can be able to work with all features of currencies to increase the accuracy of the project. Technology is advancing at a rapid pace these days. The proposed technique can be used to detect coins as well as recognize phone currencies. Other countries' currencies can be added, and a comparison between them can be made. When a picture is loaded into the training folder from the outside, it does not provide 100 percent accuracy. By optimizing the system, we can solve this problem. The scope for fake note detection using machine learning is quite promising, and there are several potential avenues for further development and improvement in this area.

Enhanced accuracy: One of the key areas of improvement for fake note detection using machine learning is accuracy. As machine learning algorithms continue to be refined and improved, it is likely that we will see even more accurate and effective models for detecting counterfeit currency.
Faster detection: Another area accurately identifies fake notes. detection. As technology continues to advance, it is likely that we will see faster and more efficient machine learning algorithms that can quickly and accurately identify the fake notes.

Automated detection: Automation is another promising area for future development. By integrating machine learning algorithms into automated counterfeit detection systems, we may be able to improve the speed and accuracy of detection even further.

Multi-modal detection: The use of multiple modes of detection, such as combining machine learning with other technologies like computer vision or spectroscopy, detection may also enhance the accuracy and speed of fake note.
Improved training data: The availability and quality of training data is critical for the effectiveness of machine learning algorithms. As more high quality data becomes available, it is likely that we will see even better performance from fake note detection models.

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