Detection of Fake Currency Using Machine Learning

Mr. Y. Vamsi Krishna Teja[1], Guvvala Likhita Reddy[2],

Battula Venkata Sai[3], Aratikatla Varshavardhani[4], Bandarupalli Vijaya Sagar[5]

[1]Assistant Professor, Department of Computer Science and Engineering, Tirumala Engineering College
[2,3,4,5]Student, Department of Computer Science and Engineering, Tirumala Engineering College

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Abstract - Counterfeiting of currency is a growing problem due to advancements in color printing technology, impacting economies worldwide. Fake money is often used for criminal activities, including terrorism. Research indicates that developing countries, like India, are particularly affected. One solution proposed involves analyzing the image of counterfeit currency through pre-processing steps such as converting from RGB to grayscale. This approach aims to tackle the issue of counterfeit currency circulation effectively. After converting the text, the image is divided into sections, its characteristics are assessed, relationships are identified, and a decision is made to determine if the image is authentic or counterfeit. Counterfeit currency continues to be a notable problem. Financial institutions and other establishments have the necessary resources to confirm the legitimacy of money. However, the average person does not have access to such equipment, making it essential to have counterfeit money detection software that can be used by anyone. This study achieves a maximum accuracy of 81% when analyzing 50 Indian currency notes with a denomination of 2000 rupees. This initiative offers a comprehensive overview of a counterfeit detection system that is accessible to the general public. The proposed system uses image processing to distinguish real currency from counterfeit money. The entire software has been developed using the Python programming language.

Key Words: Fake Currency, Counterfeit, Denomination, Python, Machine Learning,

1.INTRODUCTION

In today's tech-savvy age, there are unfortunately a significant number of individuals who engage in illegal activities, such as the production of counterfeit currency to deceive others. This proposal aims to address this unlawful practice and offer a solution to combat it. Recent surveys have revealed that India continues to face a high number of counterfeit currency cases, with 132 cases reported in 2018 and a 37% increase to 181 cases in 2019. To prevent fraudulent activity, a new system is suggested for integration into electronic devices. This system will be able to identify counterfeit currency as soon as it is scanned. Utilizing techniques such as K-nearest neighbors (KNN) will improve the accuracy of the system. KNN is able to classify new data based on similarity to existing data, making it easier to detect fake currency. However, some errors and inefficiencies were identified in the current method of fake currency detection. The issue of motion blur and noise from image capture devices, as well as less effective feature extraction techniques, have led to challenges in image processing. These challenges have prompted the development of techniques to enhance the quality and efficiency of image processing tasks, such as refining shapes, colors, and serial numbers in images. These improvements have been introduced to enhance the overall effectiveness of image processing tasks. Given the small size of the data set, the KNN algorithm is a great fit for the system and is expected to achieve high performance scores. The fake currency detection system plays a crucial role in reducing the circulation of counterfeit currency, encouraging dealers to transact in cash, discouraging the circulation of fake notes among people, and ensuring a smooth flow of currency.

2. RELATED WORK

A study conducted by A.A. Mandankandy and K.E. Kannammal on fake currency detection reveals that the issue of counterfeit currency remains a significant threat in the banking sector. Despite the availability of numerous detection methods, the use of easily accessible image manipulation tools poses a serious challenge in the industry. The identification of key features present in currencies is crucial for evaluation purposes. Classifiers play a vital role in determining whether the extracted features belong to genuine or fake currency notes. In the absence of classifiers, comparisons can be made between the original note's features and the segmented currency image. However, simply focusing on alignment and edges is insufficient for accurately authenticating a specific image. There are instances where segmented important portions do not match up, leading to fake currency notes being mistaken for genuine ones. To prevent this, extracted features must undergo processing by classifiers to improve accuracy. This paper conducts a comparative analysis of image segmentation, thresholding, feature extraction, classification, and selection methods. Additionally, it includes analysis work based on existing approaches.

Sandeep Arya and Manoj Sasikumar presented their research on fake currency detection at the 2019 International Conference on Recent Advances in Energy-Efficient Computing and Communication (ICRAECC) in February 2020. The prevalence of fake currency notes is on the rise, prompting the need for an effective detection system to come up with a solution. Their proposed system focuses on counting interruptions in the thread line of currency notes to determine their authenticity. By analyzing the number of interruptions, the system can classify a note as either real or fake. Additionally, the researchers leverage entropy calculations to enhance the

efficiency of fake currency detection. MATLAB software is employed for this purpose.

Singh, Bhoyar, Pandey, Mankani, and Tekriwal worked together on a research study that was published in 2019 in the International Journal of Engineering Research and Technology. The study explored the use of image processing to detect counterfeit currency. The team highlighted the growing issue of fake money affecting society and stressed the urgent need for a solution. Their project aims to create a tool that can accurately identify counterfeit currency through image analysis, offering a practical and precise method for detecting fake notes across different users.

Researchers S. Shaker and M.G. Alawan have conducted a comprehensive review paper on image processing techniques for paper currency detection. The significance of currency in daily life has sparked a high level of interest in currency recognition among researchers. Through a thorough literature review, it has been determined that image processing is the most commonly used and efficient method for currency recognition. The paper explores various related works in the field of paper currency recognition and discusses different systems used for this purpose. These applications leverage computational power to accurately distinguish between different types of currencies. The primary objective of this study is to analyze and evaluate existing research and literature by assessing their strengths and weaknesses. The findings are compiled in a comparative table that showcases various approaches to evaluating the technology utilized in image processing for distinguishing currency papers.

In 2018, A. Upadhyaya, V. Shokeen, and G. Srivastava conducted research on detecting counterfeit currency. Counterfeit money is a major threat to an economy and has global impacts on growth. Making fake money or tampering with real money is against the law and is considered a criminal offense under economic laws. Recently, various methods have been developed by researchers to identify fake money, such as hardware-based techniques, image processing, and machine learning approaches.

Authors M. Laavanya and V. Vijayaraghavan discuss in their paper published in the International Journal of Engineering and Advanced Technology (IJEAT) a novel approach to detecting fake currency notes in real-time using deep learning. They point out that advancements in printing and scanning technologies have made the issue of counterfeiting more prevalent, leading to negative impacts on the economy and the devaluation of legitimate currency. Traditional methods of counterfeit detection rely on hardware and image processing, which can be inefficient and time-consuming. In response to this, the authors propose a solution that utilizes a deep convolutional neural network for more efficient and accurate detection of counterfeit currency.

3. EXISTING SYSTEM

Current technology for detecting counterfeit money through artificial intelligence is made with the aim of using cutting-edge tools to fight the spread of fake currency. These systems usually use a mix of image processing methods and machine learning algorithms to examine the security features found on bills. Here is a brief rundown of the process:

1. Image Capture:

The system takes high-quality pictures of banknotes, capturing all the intricate details and security elements.

2. Pre-processing:

The images are then put through steps like reducing noise, enhancing the image, and normalizing it to guarantee the best quality for analysis.

3. Feature Extraction:

When processing images of currency notes, algorithms extract important features like watermarks, security threads, microtext, and other identifying characteristics.

4. Classification:

Machine learning models are then used to classify currency notes as either genuine or counterfeit by analyzing these extracted features.

Techniques Used:

Here are some methods that were employed:

- Breaking down the image into distinct sections to focus on certain characteristics.
- Spotting patterns and irregularities in money bills to tell apart real ones from counterfeits.
- Making use of various algorithms such as Support Vector Machines, Random Forest, or Convolutional Neural Networks for sorting tasks.

4. PROPOSED SYSTEM:

The proposed system aims to enhance the accuracy and efficiency of fake currency detection through the integration of deep learning techniques and real-time processing capabilities.

Key Features:

- **Deep Convolutional Neural Networks (CNN):** Implementing CNN architectures to learn intricate patterns and features from currency images for improved detection accuracy.
- **Real-time Detection:** Optimizing the system for quick and efficient identification of counterfeit currency notes during transactions or inspections.
- **Training Data:** Utilizing large datasets of currency images, including the latest INR 2000 and INR 500 series notes, to train the model effectively.
- **Enhanced Security Features:** Our security measures are top-notch, including cutting-edge methods like optically variable ink, holograms, and microprinting to prevent counterfeit currency.

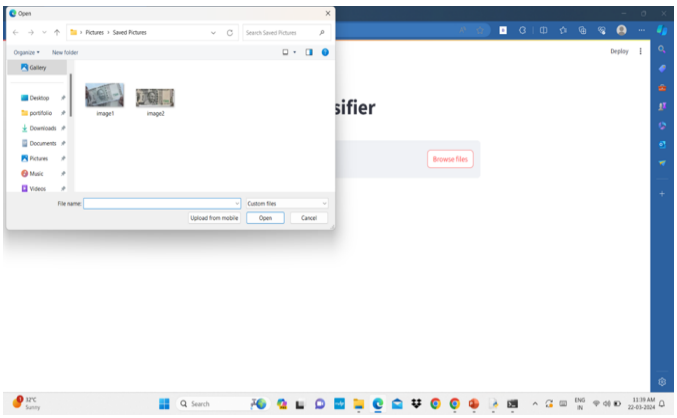
Implementation Steps:

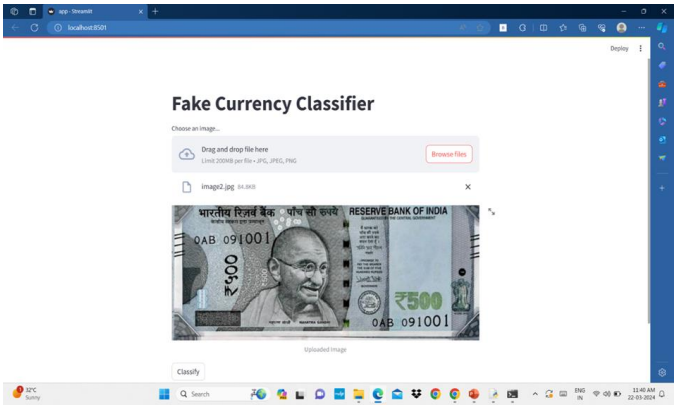
- **Data Collection:**
  We gather a wide range of currency images, both real and counterfeit, to teach our deep learning model. Model Training: Our CNN model is trained on this dataset to distinguish between real and fake currency notes.
- **Validation and Testing:**
  We test the model's accuracy and reliability using unseen data.
- **Deployment:** We integrate the model into a real-time system to detect counterfeit currency in practical use cases. Putting the trained model into a real-time detection system to detect fake money.

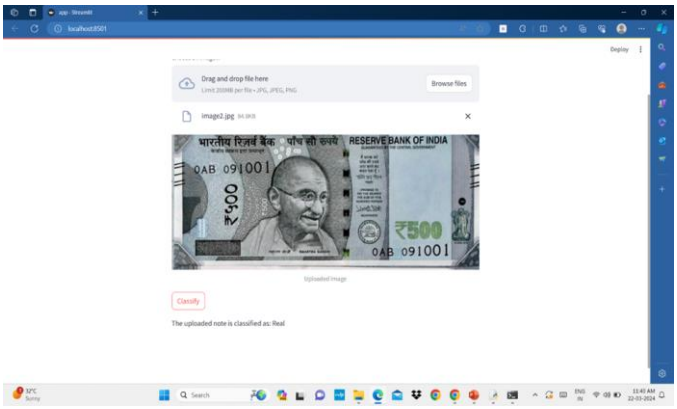
By using these advanced methods, the system will improve security against fake money and protect financial systems from fraud.

5. RESULTS AND SAMPLE OUTPUT SCREENS

There are various methods to determine the authenticity of money, all of which involve similar steps. This includes capturing images, recognizing edges, segmenting, converting to grayscale, and extracting features. While many resources utilize MATLAB for computations, we opted to use OpenCV and Python for programming. In order to make comparisons and make a final determination, certain characteristics that distinguish real currency from counterfeit ones are considered. We understand that these tools are typically used by banks and businesses to help detect counterfeit money, leaving the average person vulnerable. Our aim is to provide an affordable system with fast calculations that can make quick decisions. The system should be compatible with Indian currency notes of 2000 denomination, user-friendly, portable, and cost-effective. Although the model has its limitations with a maximum accuracy of 81%, it still outperforms human detection. Currently, it can be used as a supplementary tool to reduce human errors.







6. FUTURE ENHANCEMENTS

In the future, advancements in detecting counterfeit money using machine learning will prioritize improving accuracy, efficiency, and security. An important aspect of this progress is the integration of deep learning algorithms such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) to more effectively identify features and categorize fake money. By leveraging the power of deep learning, these systems have the potential to achieve greater precision in differentiating between genuine and counterfeit currency. It will be important to improve real-time detection systems that can quickly and accurately spot fake money during transactions or inspections. These systems will enhance security measures, especially in busy environments where fast verification is crucial. Using a variety of detection techniques, such as analyzing watermarks, holograms, and microprinting, will strengthen the ability of machine learning-based systems to detect counterfeit currency.

The development of portable devices for verifying currency on-the-go is a promising opportunity for future improvements. By designing easy-to-use and portable devices with machine learning algorithms, people and businesses can conveniently confirm the legitimacy of currency notes in different situations. Additionally, incorporating blockchain technology with machine learning currency detection systems could offer secure and tamper-proof verification processes, guaranteeing the trustworthiness of financial transactions.

In order to make AI systems more effective, it is crucial to improve the quality and variety of datasets used to train machine learning models. Having strong datasets allows models to learn from a diverse set of counterfeit currency examples, which in turn improves their accuracy and adaptability. Implementing dynamic learning algorithms that

can adjust to new patterns of counterfeit currency would also boost the detection capabilities of these systems. Furthermore, collaborative learning techniques, where systems exchange and learn from each other's experiences, could lead to major advancements in counterfeit currency detection.

In the future, it is important to focus on integrating advanced security measures like optically variable ink, holograms, and microprinting to improve counterfeit detection capabilities. Additionally, it is crucial to address regulatory compliance and ethical concerns in order to responsibly develop and use machine learning-based currency detection systems. By adopting these enhancements, the field of fake currency detection through machine learning can greatly enhance the protection of financial systems and transactions from fraudulent activities.

7. CONCLUSION

The study titled "Detection Of Fake Currency Using Machine Learning" offers a thorough examination of the method for detecting fake banknotes. The paper explains the procedures for gathering data, preparing it for analysis, and extracting features. It also presents a detailed look at the structure and application of Convolutional Neural Networks (CNN) and how well the model performed. The findings of the study show that employing CNNs for identifying counterfeit currency can be quite successful. The CNN model that was trained on the dataset achieved impressive accuracy, highlighting its promise as a dependable tool for flagging fake money.

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