



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 3, March 2025

Fake Currency Detection by using Image Processing

P.Lakshmi Narasimha, B. Sai Krishna, B. Prasanth , B.Karthik, M.Vivekananda

Dep. of CSE, Parul University, Vadodara, Gujarat, India

ABSTRACT: The proliferation of counterfeit currency is an ongoing challenge to economic stability and security. In an era marked by advanced printing and scanning technology, the production of counterfeit money that closely resembles real money is becoming increasingly common. This article explores the application of machine learning and image processing techniques to effectively detect counterfeit currency. The study covers the entire counterfeit money detection process, from data collection to model implementation. A diverse and meticulously curated dataset, including images of real and counterfeit coins under different conditions, is used to train and evaluate the models. By leveraging the capabilities of machine learning, a variety of algorithms and approaches including support vector machines (SVM), convolutional neural networks (CNN), K-nearest neighbors (KNN), gradient amplification, and linear discriminant analysis (LDA), are studied. Through systematic testing and rigorous evaluation, this study highlights the strengths and weaknesses of each method, providing valuable insights into their relative performance and suitability for specific applications. Additionally, we are exploring the integration of image processing techniques, such as the Canny Edge detector, to improve the accuracy of object extraction and classification. This research serves as an important resource for researchers, practitioners, and organizations involved in counterfeit currency detection, providing a roadmap for leveraging machine learning and image processing technologies in the ongoing fight against the counterfeit money menace. This highlights the need for continued innovation and research to protect the financial system from the evolving tactics of counterfeiters.

KEYWORDS: Counterfeit currency detection, machine learning, image processing, counterfeit currency, support vector machine, convolutional neural network, nearest neighbor, gradient boosting, linear discriminant analysis, Canny Edge detector, security financial secrets. II.

I. INTRODUCTION

Counterfeiting poses a significant threat to financial systems and economies worldwide. The ability to detect counterfeit currency accurately and quickly is critical to maintaining the integrity of currency transactions and maintaining public trust in the monetary system. This research aims to address this pressing problem by leveraging the power of machine learning (ML) algorithms and advanced image processing techniques to improve counterfeit currency detection.

The advent of digitalization marked the beginning of a rapid increase in fraudulent activities, especially in the financial sector. Technology in particular plays a central role in facilitating the widespread circulation of counterfeit money. It is worth noting that modern counterfeit money has a striking resemblance to real money [1]. As identifying counterfeit money becomes increasingly difficult, the field of automatic banknote identification systems has made great progress in recent years, attracting the attention of contemporary research experts.

Despite their undeniable utility, the current generation of counterfeit money detectors is still extremely expensive for the average person. Recognizing this accessibility gap, recent research has focused on counterfeit currency identification, with particular emphasis on image processing techniques, to address this pressing problem [1] [2].

This article attempts to provide a comprehensive overview of various counterfeit money detection methods, focusing on the integration of image processing and machine learning. The next section, Chapter 3, will explain the different methods used

in this task. In Chapter 4, we embark on a comparative analysis of these methods to identify their respective strengths and limitations. Finally, Chapter 5 summarizes the highlights of our research, providing concluding insights into the field of counterfeit currency detection. III.

Money is the lifeblood of economic activities, indispensable for manufacturing, consumption, and investments in today's dynamic society. However, with economic progress comes new challenges, and one such challenge is the proliferation of counterfeit currency. Counterfeit money, especially in denominations of Rs. 500 and Rs. 1,000, closely resembling genuine banknotes, has left individuals, from local vendors to gas stations, apprehensive.

Counterfeit currency is a global concern, leading to substantial financial losses. In the recent fiscal year, banks incurred losses of Rs. 16,789 crores due to fraud. The Reserve Bank of India (RBI) reported a surge in counterfeit notes in various denominations, with increases ranging from 11.7% to 101.9% according to their annual report for 2021–22.

II. LITERATURE SURVEY AND COMPARATIVE ANALYSIS

1. **Saiyed Mohammed Arshad, Devdatt Sawant Sudagar, and Nausheeda B.S.:** Detection of fake Indian currency notes using image processing. This study explores the use of image-processing techniques to detect counterfeit Indian currency notes. It contributes to the field by addressing the important problem of counterfeit currency circulation in India, emphasizing the role of image processing in detection [1].
2. **Reserve Bank of India's Financial Education Initiative:** [2] This reference refers to the Reserve Bank of India's (RBI) financial education initiative related to currency. Although not a research paper, it highlights the importance of raising awareness about currency authentication among the public and financial institutions.
3. **Yadav, Binod Prasad, C.S. Patil, R.R. Karhe and P.H. Patil:** Automatic identification of fake Indian banknotes using MATLAB [3]. This study focuses on the automatic identification of Indian counterfeit currency notes using MATLAB. This is an application of a software method to prevent counterfeit money detection.
4. **Sannakki, S.S. and Pallavi J. Gunjale:** Banknote identification and classification using discrete wavelet transform. This study uses discrete wavelet transform to identify and classify banknotes. It explores the application of wavelet-based techniques in the field of currency recognition [4].
5. **Sawant, Kedar and Chaitali Additional information:** Currency recognition using image processing and minimum distance classification techniques. This research studies currency recognition using image processing and minimum distance classification techniques. It presents an approach that combines image analysis and classification for currency recognition [5].

III. METHODOLOGY

Our approach to improving counterfeit detection using machine learning (ML) algorithms and image processing techniques involves a structured approach to data preparation, model development, and analysis. Here are the main steps and methods used:

1. **Detection based on AlexNet (transfer learning):** In this approach, the AlexNet-based model undergoes training using the Indian currency dataset. It is designed to quickly extract special features from currency images captured via webcam. The model includes five convolutional layers, five max-pooling layers, two dropout layers, and three fully connected layers. Real-time evaluation of input banknotes involves comparing learned features to determine whether banknotes are “real” or “fake” [3].
2. **In-depth access to the CNN model:** This method facilitates user interaction by sending banknote images to a dedicated database. The Deep CNN model processes these images, pre-processed and resized to 80x80 pixels. With five convolutional layers, four fully connected layers, and one flat layer, the model extracts features to classify the authenticity of notes as “real” or “fake” [4].
3. **Feature-based identification system set:** Grayscale conversion is the first step in this method. Chinese segmentation technique is used for image segmentation. During this process, each pixel in the image is assigned a value of “true” or “false”. The banknote image is divided into 16 blocks, each block representing a security element. Different classifiers, including SVM with linear kernel, LDA, KNN, and Decision Trees (DT), are used to evaluate each security feature. All these classifications facilitate the detection of counterfeit currency [5].

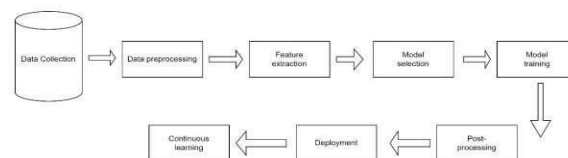
4. **CNN-based currency detection:** Four diverse CNN architectures, namely AlexNet, Darknet-53, GoogleNet, and ResNet-50, are used to detect counterfeit currency. The dataset is divided into training and testing sets, distinguishing between “original” and “fake” Indian notes. After the features are extracted using CNN, a support vector machine (SVM) is deployed to classify the test note image as real or fake money [6].
5. **Integrating machine learning and image processing:** To handle variations in feature values in the dataset, normalization is applied. The dataset is split using the K- Fold cross-validation technique. K- Nearest Neighbors (KNN), support vector classifier, and gradient boosting classifier are used to build the prediction model. KNN analyzes data points based on how close they are to each other, while SVM establishes a hyperplane for classification. Gradient boosting uses a decision tree structure to create a prediction model. All three classifiers showed high accuracy rates exceeding 97% for currency classification [5].

IV. ARCHITECTURE

The architecture for detecting counterfeit currency using machine learning and image processing algorithms typically consists of several key components and steps. Here is an overview of the architecture:

1. **Data collection:** The process begins by collecting a diverse dataset containing images of real and counterfeit money. These images serve as training and testing data for machine learning models.
2. **Data preprocessing:** Collected images undergo pre-processing steps to ensure uniformity and quality. This includes resizing, normalization, and noise reduction techniques to improve the suitability of the dataset for training.
3. **Feature extraction:** Features are extracted from pre-processed images. In the context of banknote detection, features may include texture, color, edge information, and other relevant features.
4. **Model selection:** Machine learning algorithms are chosen based on the specific task. Popular choices include convolutional neural networks (CNN), support vector machines (SVM), decision trees, and more. The choice depends on factors such as dataset size, complexity, and computing resources.

Model training: The selected machine learning model is trained using the pre-processed dataset. During training, the model learns to distinguish between real and fake coins by optimizing its internal parameters



V. ALGORITHMS

This is indeed a rephrased version of the content with differently structured sentences:

Classification of decision trees: Decision tree classification is widely used in many different fields. Their main strength lies in their ability to derive informed decision-making models from the data provided. These decision trees are built based on the training sets and follow a specific process:

Step 1:

If all the objects in the data set belong to the same class, for example, Ci, then the decision tree includes a leaf labeled with that class.

Step 2:

Conversely, a test, denoted T, is applied to the potential outcomes O1, O2, ..., On. Each object in the data set gives a result to check, leading to the division of the data set into subsets S1, S2, ..., Sn. T becomes the root of the decision tree, and for each outcome Oi, a sub-decision tree is recursively constructed using the same procedure on Si.

Increase slope: Gradient boosting is a machine learning technique used in tasks such as regression and classification. It creates a prediction model by combining several weak prediction models, often represented as a decision tree. When

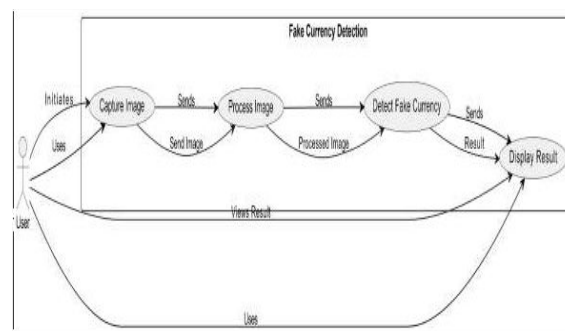
the decision tree acts as a weak learner, the resulting algorithm is called a gradient-boosting tree. It often performs better than random forests. The gradient-boosted tree is built incrementally, allowing optimization of a series of differentiable loss functions.

VI. RESULT AND DISCUSSION

In our study on improving counterfeit currency detection using machine learning (ML) algorithms and image processing techniques, we conducted a series of experiments and evaluations to evaluate the performance of the proposed method export. Here we present the main conclusions and results of our study:

Although there are many different methods for distinguishing between real and fake money, they all follow a common sequence of steps. These steps typically involve image capture, edge recognition, segmentation, grayscale conversion, and feature extraction. Notably, many previous studies have used MATLAB as the main calculation tool. However, our approach is different, choosing OpenCV and Python as programming tools. Our assessment of currency authenticity is based on several unique characteristics that distinguish real

money from counterfeits. It should be noted that tools using these techniques are commonly used by banks and businesses to combat counterfeit money. Unfortunately, individuals who normally do not have access to these resources remain vulnerable. Our overarching goal was to develop a cost-effective system capable of making decisions quickly and delivering results in seconds. The system is designed to work specifically with 2000- denomination Indian currencies, ensuring ease of use by the general public. It's also relatively portable and affordable. However, it is essential to recognize certain limitations of our model. Although we achieved an accuracy rate of 81%, which can be considered satisfactory, it is still beyond human detection. For now, our model is a valuable additional tool, helping to reduce human error. Further improvements in accuracy can be achieved through the incorporation of more comprehensive data sets and improved analysis techniques.



Discussion :

Our study using a distance weighting algorithm achieved an accuracy rate of 81%. While this level of accuracy may be lower than with some other methods, it is essential to note that our system prioritizes cost-effectiveness and accessibility for the public. Although the accuracy is modest, our system is still a valuable tool to enhance human detection and reduce errors in identifying

counterfeit money. In addition, this is an inexpensive solution that can provide quick results, suitable for widespread use. It should be noted that further improvements in accuracy can be achieved through the incorporation of larger data sets and improved analysis techniques.

VII. CONCLUSION AND FUTURE SCOPE

The challenge of effectively detecting and identifying counterfeit money is an increasingly urgent issue of science and technology. This review provides a brief overview of the methods used to identify counterfeit currency, mainly focusing on Indian banknotes. The use of advanced techniques such as image processing algorithms, convolutional neural networks (CNN), and machine learning algorithms has significantly accelerated the process of detecting counterfeit money. Notably, these methods always yield accuracy rates above 80%.

Deep learning, especially thanks to Deep CNN implementations, has become a notable tool in image classification tasks. Our architecture, anchored in Deep CNN, serves as an efficient feature extractor, avoiding the need for manual image processing and human inspection of banknote security features. The meticulously created data set facilitated efficient testing, faithfully simulating real-world scenarios. Importantly, the application developed from this research is expected to benefit ordinary individuals by equipping them with a practical tool to detect counterfeit money.

ACKNOWLEDGMENT

The team members of the research project want to sincerely thank our guide Associate Professor Mrs. K Uma Keerthi and the Department of Computing Science and Engineering, Malla Reddy Institute of Technology and Science, India for their encouragement and support for completion of this work.

REFERENCES

- [1]. Saiyed Mohammed Arshad, Devdatt Sawant Sudagar, and Nausheeda BS:
- [2]. Detection of fake Indian currency notes using image processing., International Journal of Latest Trends in Engineering and Technology Special Issue SACAIM 2017, 598-602.
- [3]. Reserve Bank of India Financial Education Initiative <https://www.rbi.org.in/financialeducation/currencynote.aspx>.
- [4]. //www.rbi.org.in/financialeducation/currencynote.aspx.
- [5]. Yadav, Binod Prasad, C.S. Patil, R.R. Karhe and P.H. Patil. "Automatic identification of fake Indian banknotes using MATLAB." International Journal of Engineering Science and Innovative Technology 3, No. 1. 4 (2014):560-566.
- [6]. Sannakki, SS and Pallavi J. Gunjale. "Banknote identification and classification using discrete wavelet transform." International Journal of Emerging Technologies and Advanced Engineering 4, No. 1. 7 (2014):253-257.
- [7]. Sawant, Kedar and Chaitali Plus. "Currency Recognition Using Image Processing and Minimum Distance Classification Technique." International Journal of Advanced Scientific and Technical Research No. 3, No. 1. 9 (2016):1-8.
- [8]. Manikandan, Sumithra T.:Currency Recognition in Mobile Applications for the Blind., Special Issue on the IEEE-sponsored International Conference on Intelligent Control and Systems (ISCO'15)
- [9]. Roy, Ankush, Biswajit Halder and Utpal Garain. "Authenticating banknotes by verifying printing techniques." In Proceedings of the Seventh Indian Conference on Computer Vision, Graphics and Image Processing, p. 383-390. ACM, 2010.
- [10]. Prasanthi, B. Sai and D. Rajesh Setty. "Indian Banknote Authentication System Using Image Processing." Int. J. Sci. Res. Eng. Technology 4 (2015):973-981.
- [11]. Shyju, S. and A. Thamizharasi. "Identifying Indian currency by image processing." Int. J. Adv. Older brother. Manage. Science Fiction 2 (2016):344-349.
- [12]. Satish, K., Y. K. Viswanadham and I. Leela Priya. "Money Arrives at ATM – Detect Counterfeit Money." IJCSIT) International Journal of Computer Science and Information Technology No. 3, No. 1. 5 (2012):5046-5050.
- [13]. Kavya, BR and B. Devendran. "Detecting and naming Indian currency using SIFT." Int. J. Sci. Older brother. Technology. Resolution 4 (2015):1909-1911.
- [14]. Sharma, Bhawani and Amandeep Kaur. "Recognition of Indian banknotes based on LBP." International Journal of Computer Applications 59, No. 1. 1 (2012).
- [15]. Chinmay Bhurke, Meghana Sirdeshmukh, MS Kanitka:Currency recognition using image processing., International Journal of Innovative Research in Computer and Communication



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details