Automated Indian Currency Verification Using Convolutional Neural Networks and Image Processing

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Abstract: The progression of shading printing innovation has expanded the rate of Fake currency copying notes on a large scale. Albeit electronic monetary exchanges are turning out to be more popular and the utilization of paper cash has been diminishing as of late, banknotes still remain in distribution attributable to their dependability and straight forwardness in use. Few years ago, the printing should be possible in a printing-houses, yet presently anybody can print a money paper with most extreme exactness utilizing a straightforward laser printer. As an outcome, the issue of duplicate currency rather than the authentic ones has been increases generally. India had reviled the problems like defilement and dark cash and fake of money notes is likewise a big issue to it. To handle this problem, a deep learning-based framework is proposed to identify the fake Indian currency. The MATLAB tool has been used to identify the fake currency. The outcome will classify whether the Indian currency note is Real or Fake.

Index Terms: Fake currency, Fake Identification System, CNN

1. INTRODUCTION

In an era characterized by rapid globalization and the instantaneous flow of financial transactions across borders, the integrity of currency stands as a fundamental pillar of economic stability. However, this integrity is under constant threat from the proliferation of counterfeit currency, posing significant risks to the trust and functionality of financial systems worldwide [1].

The advent of advanced technological solutions, such as the Fake Currency Detection System (FCDS), represents a critical response to this pressing challenge. The FCDS stands as a sophisticated fusion of hardware and software meticulously designed to identify counterfeit currency with unprecedented precision and efficiency [2]. Central to its efficacy are Convolutional Neural Network (CNN) techniques,

which empower the system to scrutinize the intricate security features embedded within legitimate banknotes [3].

By analyzing elements like watermarks, security threads, and microprinting, the FCDS swiftly discerns between authentic and counterfeit currency, offering a formidable defense against fraudulent activities [4]. Beyond merely protecting financial institutions and businesses, the FCDS assumes a pivotal role in upholding public trust in currency, thereby ensuring the seamless operation of economies [5].

India serves as a poignant example of a nation grappling with the pervasive threat of counterfeit currency, which inflicts substantial losses on its economy [6]. The advancement of technology has facilitated the replication of currencies to such a degree that distinguishing between genuine and fake notes has become increasingly challenging [7]. Sophisticated printers and editing software enable the creation of counterfeit currencies that are virtually indistinguishable from genuine ones, perpetuating their circulation within the market.

However, the impact of counterfeit currency extends beyond commercial sectors to affect ordinary citizens, who may unknowingly fall victim to counterfeit notes during routine transactions or bank deposits [8]. While establishments like banks and malls can invest in specialized machines equipped with UV light and other detection techniques, such resources are often inaccessible to the general populace [9].

In response, the proposed system offers a user-friendly solution accessible to individuals from all walks of life. Leveraging visual features inherent to currency, this system empowers users to ascertain the authenticity of their notes with ease [10]. Moreover, its potential for conversion into a widely accessible mobile application holds promise for broadening its reach and effectiveness [11].

Furthermore, the adaptability of this system extends beyond domestic currencies, as it can be tailored to detect counterfeit notes from various countries, thereby bolstering its utility on a global scale [12]. In essence, this introduction underscores the pivotal role of the FCDS in the ongoing battle against counterfeit currency, highlighting its significance in safeguarding the integrity of financial systems worldwide.

2. LITERATURE SURVEY

Counterfeit currency detection has emerged as a critical area of focus in recent years, driven by the significant economic repercussions and threats to financial systems globally. Scholars and practitioners have delved into a plethora of approaches, spanning from conventional image processing methods to cutting-edge deep learning algorithms, in a bid to counter this pervasive menace. Through an extensive review of existing literature, a nuanced understanding of the landscape of counterfeit currency detection emerges, showcasing a diverse array of studies that contribute unique insights and methodologies to the field.

Vivek Sharan and Amandeep Kaur [1] proposed a methodology centered around image processing techniques for the detection of counterfeit Indian currency notes. Their research concentrated on the analysis of various security features inherent in legitimate banknotes, such as watermarks and security threads. By leveraging image processing

algorithms, they successfully developed algorithms capable of discerning between genuine and fake currency. This seminal work laid the groundwork for subsequent research endeavors in the domain.

Similarly, S. Atchaya et al. [2] explored the application of image processing in the realm of counterfeit currency detection. Their study focused on feature extraction from currency images and the utilization of pattern recognition algorithms for the classification of banknotes as genuine or counterfeit. Through empirical validation, they demonstrated the efficacy of their approach, underscoring the potential of image processing techniques in combating financial fraud.

In a related vein, M. Laavanya and V. Vijayaraghavan [3] proposed a real-time counterfeit currency detection system employing deep learning algorithms. Harnessing the capabilities of convolutional neural networks (CNNs), they developed a robust model capable of automatically identifying counterfeit currency notes with high accuracy. Their work showcased the effectiveness of deep learning techniques in addressing the intricate challenges associated with counterfeit currency detection, paving the way for more sophisticated solutions in the future.

Yadav et al. [4] delved into the realm of supervised machine learning algorithms for counterfeit currency detection. Their research explored the performance of various machine learning models, including decision trees and support vector machines, in classifying currency images. Through rigorous comparative analysis, they identified the most effective algorithms for detecting counterfeit currency, providing valuable

insights for future research and development endeavors in this field.

Aakash S Patel [5] proposed a methodology tailored for the detection of Indian paper currency using image processing techniques. By focusing on the unique features of Indian banknotes, their research yielded algorithms capable of accurately identifying counterfeit currency notes. This context-aware approach underscored the importance of tailoring detection methodologies to specific currency characteristics for optimal performance.

Anju Yadav et al. [6] conducted a comprehensive evaluation of machine learning algorithms for counterfeit currency detection, comparing the efficacy of various supervised learning models. Through extensive experimentation and analysis, they offered valuable insights into the strengths and limitations of different machine learning techniques in this domain, informing future research directions.

In a departure from conventional approaches, Kiran Kamble et al. [7] proposed a counterfeit currency detection system leveraging deep convolutional neural networks (CNNs). Their research capitalized on the hierarchical features learned by CNNs to automatically detect counterfeit currency notes with high precision. Through empirical validation using real-world currency images, they demonstrated the effectiveness of their approach in combating financial fraud, highlighting the potential of deep learning techniques in counterfeit currency detection.

Lastly, G. Hariharan and D. Elangovan [8] addressed the issue of proxy notes recognition and eradication as a means of combating counterfeit currency. Their research focused on the development of algorithms

capable of detecting proxy notes, which are often utilized as substitutes for genuine currency in fraudulent activities. Through innovative applications of image processing techniques, they proposed solutions for mitigating the impact of counterfeit currency on society.

In summary, the literature survey underscores the diverse approaches and methodologies employed in the field of counterfeit currency detection. From traditional image processing techniques to state-of-the-art deep learning algorithms, researchers have explored a wide range of methods aimed at identifying counterfeit currency notes with high accuracy and efficiency. Leveraging the latest advancements in technology and machine learning, these studies offer valuable insights and solutions for combating financial fraud and preserving the integrity of monetary systems worldwide.

3. METHODOLOGY

a) Proposed Work:

The proposed work in the paper is a deep learning-based framework to identify fake Indian currency using convolutional neural network (CNN). The authors have used MATLAB tool to identify the fake currency. The outcome of the proposed method will classify whether the Indian currency note is real or fake. The paper also discusses related work, Indian currency dataset, and experimental results. The authors have used four predefined networks (Alexnet, Resnet50, Darknet53, and Googlenet) in CNN to verify the accuracy of the created dataset. The results showed that the four predefined networks are good at one parameter and compromising on the other parameters. To overcome this problem in future

dataset verification, a novel CNN architecture will be used to obtain better results by considering all parameters.
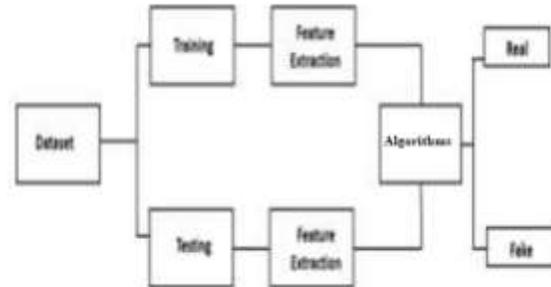
b) System Architecture:

Fig 1 Proposed Architecture

The image illustrates a general process for training and testing machine learning models, particularly for tasks like classifying real versus fake data. A dataset is split into two portions: training and testing. During training, relevant features are extracted from the training data. These features are then used to train the model using specific algorithms. This process allows the model to learn patterns and relationships within the data. Subsequently, the testing data undergoes the same feature extraction process. These extracted features are fed into the trained model to evaluate its performance. The model then classifies the test data as either "Real" or "Fake" based on what it learned during training. This comparison between predicted and actual labels determines the model's accuracy and effectiveness.

c) Dataset:

The dataset comprises images of both fake and real currency, specifically curated for the purpose of training and testing models aimed at fake detection. It

encompasses a diverse range of fake currency instances, simulating various techniques and characteristics employed in fraudulent replication. These images serve as the primary input for training machine learning and deep learning algorithms to distinguish between genuine and fake currency notes effectively. The dataset's composition ensures that the models are exposed to a wide array of counterfeit variations, enabling them to generalize well and accurately identify instances of fake currency in real-world scenarios.

d) Image Processing:

Image processing techniques play a pivotal role in extracting meaningful features from images, facilitating accurate classification tasks such as counterfeit currency detection. Leveraging Local Binary Patterns (LBP) and Gabor filters, functions like `getGaborKernel`, `filter2D`, and histogram calculation are employed to extract texture features essential for distinguishing between genuine and fake currency notes. Additionally, LBP-Gabor feature extraction methods are utilized to capture both local texture and frequency information, enhancing the discriminative power of the model. Further, employing Image Data Generator techniques like rescaling, shear transformation, zooming, horizontal flip, and reshaping aids in augmenting the dataset, thereby improving model robustness and generalization. Finally, feature extraction through Convolutional Neural Networks (CNN) and Histogram of Oriented Gradients (HOG) techniques enhances the representation of image features, facilitating more accurate classification of counterfeit currency instances.

e) Algorithms:

DarkNet53: DarkNet-53 is a convolutional neural network that is 53 layers deep. You can load a pretrained version of the network trained on more than a million images from the ImageNet database.

GoogleNet: GoogLeNet is a convolutional neural network that is 22 layers deep. You can load a pretrained version of the network trained on either the ImageNet [1] or Places365 [2] [3] data sets. The network trained on ImageNet classifies images into 1000 object categories, such as keyboard, mouse, pencil, and many animals.

ResNet50: ResNet-50 is a convolutional neural network that is 50 layers deep. You can load a pretrained version of the neural network trained on more than a million images from the ImageNet database [1].

SVM: Support Vector Machine (SVM) is a powerful machine learning algorithm used for linear or nonlinear classification, regression, and even outlier detection tasks. SVMs can be used for a variety of tasks, such as text classification, image classification, spam detection, handwriting identification, gene expression analysis, face detection, and anomaly detection. SVMs are adaptable and efficient in a variety of applications because they can manage high-dimensional data and nonlinear relationships.

Voting Classifier: A Voting Classifier is a machine learning model that trains on an ensemble of numerous models and predicts an output (class) based on their highest probability of chosen class as the output. It simply aggregates the findings of each classifier passed into Voting Classifier and predicts the output class based on the highest majority of voting. The idea is instead of creating separate

dedicated models and finding the accuracy for each them, we create a single model which trains by these models and predicts output based on their combined majority of voting for each output class.

4. EXPERIMENTAL RESULTS

Fig 2 Home Page

Fig 3 Signup Page

Fig 4 Login Page

Fig 5 Main Page

Fig 6 Upload Input Image

Fig 6 Result as Fake

Fig 7 Outcome as Real

5. CONCLUSION

Day by day the rate of fake notes in the market are increasing rapidly. Currently there are various technologies have been used to determine whether the note is real or fake currency. In this paper, a convolutional neural networks for detecting the fake Indian currency has been proposed. Four Predefined networks i.e Alexnet, Resnet50, Darknet53 and Googlenet have been used in CNN to verify the accuracy of created dataset. The results showed that the four predefined networks are good at one parameter and compromising on the other parameters. To overcome this problem in future dataset verification will be done using novel CNN architecture to obtain the better results by considering all parameters.

6. FUTURE SCOPE

Future scope lies in refining the system with larger and more diverse datasets to enhance its robustness and generalization capabilities. Additionally, exploration of advanced deep learning architectures and techniques could further improve detection accuracy and efficiency. Integration with real-time transactional systems and deployment in banking and retail sectors could expand its practical utility. Furthermore, continuous updates and adaptations to evolving counterfeit methods and technologies will be crucial to maintaining the system's effectiveness in combating counterfeit currency.

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