International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Enhancing Currency Security-Counterfeit Detection with SVM Based Machine Learning Technique

Nunna Tarun Venkata Sai[1]

B.Tech Student, Department of IT, GMR Institute of Technology, Rajam-532127, Andhra Pradesh, India
Email: 21341A1287@gmrit.edu.in[1]

A B S T R A C T

Currency is crucial in every country, but nowadays every country is facing the problem of currency identification due to technological improvements in color printing, duplicating and scanning. The problem of counterfeiting mostly affects the economic and financial development of the country. Circulation of large amounts of counterfeit currency increases the amount of money in circulation, which can lead to high demand for goods. Security is a race between counterfeiters and banks. To overcome these problems we will use machine learning algorithms to detect fake currency. Processes like watermarking, optically factor ink, string, inert picture, counterfeit identification pen are part of the strategies for distinguishing counterfeit money. Using this machine learning technique, we create a counterfeit currency detection system that detects fake and genuine currencies. This technique is implemented using CNN (Convolution Neural Network), SVM (Support Vector Machine) and Logistic Regression. The goal is to create a system that can accurately distinguish between genuine and counterfeit notes.

Keywords: Counterfeit currency, Machine learning, convolution Neural Network, Support Vector Machine, Logistic regression, duplicating, banks.

Introduction

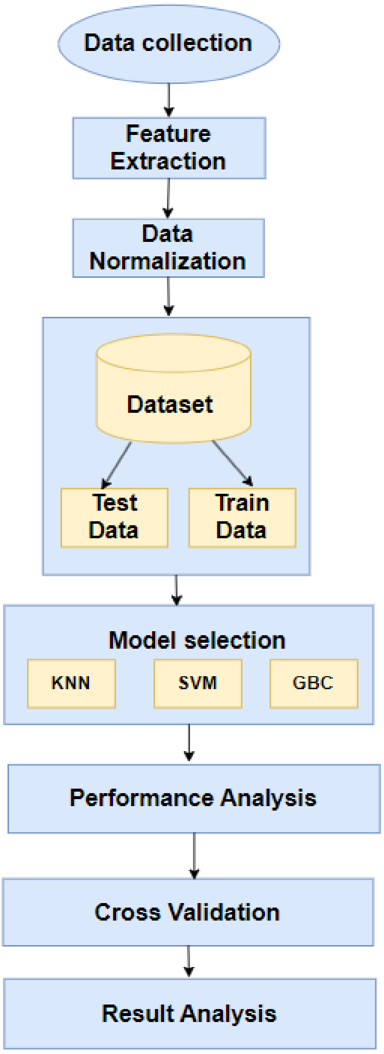
The contemporary landscape of the banking sector and cash trading underscores the critical importance of automatic recognition in the fight against counterfeit currency. While recent demonetization efforts in India have taken strides towards eliminating corruption and black money, they have inadvertently highlighted a persistent challenge—counterfeit currency remains a formidable threat. Despite the commendable objectives of the demonetization drive, the existing measures have proven insufficient in effectively tackling the proliferation of fake banknotes. Alarming statistics from Indian banks further underscore the urgency of addressing this issue. A record peak in the prevalence of counterfeit currency has been acknowledged, accompanied by an astonishing 480% surge in doubtful transactions following the demonetization initiative. This alarming uptick necessitates a proactive and innovative approach to counterfeit currency detection, beyond the constraints of current techniques.

To surmount the limitations inherent in existing methods, this research proposes a novel solution— an efficient and cost-effective counterfeit currency detection system. In essence, this research endeavors to contribute a pivotal tool in the ongoing battle against counterfeit currency, aligning with the broader objectives of ensuring the integrity and security of financial systems in the aftermath of significant economic reforms.

Literature Review

In this century where the majority of people are aware of technology and how it works, many of them indulge in unlawful activities. One of such activities is the production of fake currency which is practiced to deceive people. In this proposal, it is focused on this illegitimate practice and try to bring forward a solution for it. According to a survey, the maximum number of cases of counterfeit in India still relate to fake currency, There were 132 cases of counterfeit currency in 2018, which shot up 37 percent to 181 in 2019. This paper discusses the evolution of detection of bank notes from using professional cameras to modern deep learning techniques, and the challenges faced due to high and large data sets . Earlier studies used traditional machine learning algorithms like K nearest neighbor (KNN) for fake note detection, but accuracy was limited due to large data sets and slower systems. Modern techniques involve deep learning concepts and convolutional neural networks (CNN) for higher accuracy in image processing. The implementation of image processing techniques helps purify entities like shape, color, and serial numbers, improving efficiency. KNN algorithm is suitable for small data sets and provides high-performance measures for fake currency detection. The proposed system using KNN achieved an accuracy of 99.9% in classifying genuine and counterfeit notes, outperforming other algorithms. Future work includes building a larger data set with real-world images and applying CNN for even higher accuracy in image processing.Overall, the literature survey highlights the evolution of fake currency detection techniques from traditional algorithms to modern machine learning and deep learning approaches, emphasizing the importance of image processing and the potential of CNN for accuracy.

Methodology



Step1:The first step is to prepare the source data.

Step 2: Feature Extraction Wavelet Transform was used to extract features from the gathered images. The attributes gathered after the Wavelet Transformation were Variance, Skewness, Kurtosis , Entropy , Class of the currency. First, four of the five derived attributes are continuous and describe the features of the note where-as the fifth attribute- 'Class', classifies the currency into fake by giving it a value of 0 and genuine by giving it a value of 1.

Step 3: Normalization of Data After exploration of the data set, It is observed that the data needs to be scaled so that the model is not biassed towards a particular feature. For this, it has been decided to keep the range of each feature between 0 and 1. To do so, the following formula is used

$$X_{norm} = \frac{X_{current} - X_{min}}{X_{max} - X_{min}}$$

Step 4: Training and Testing data The process of dividing the data into these sets is crucial to building a model that generalizes well to new, unseen data. Overfitting occurs when a model learns the training data too well but fails to perform well on new, unseen data. The testing set provides a measure of how well the model is expected to perform in real-world scenarios.

Step 5: Model Selection The K-Nearest Neighbors (KNN) algorithm, Support Vector Classifier (SVC), and Gradient Boosting Classifier(GBC) were chosen as the machine learning algorithms for the study.

KNN: K-Nearest Neighbour algorithm is a supervised machine learning algorithm. It is mostly used for classification predictive problems. The way the algorithm works is that it classifies a given data point by looking at its closest neighbour and assigns a weight to them based on the distance. The distance can be Euclidian, and it gives more weightage to the closer data points.

SVM: Support Vector Machine is an supervised machine Learning Algorithm. It is mostly used for classification and regression problems. In this algorithm Each point is plot in a n-dimensional plane with the value of the point being the data point of the sample. Then the classification is performed by finding a hyper-plane that is the best fit for dividing the classification.

GBC: Gradient Boosting Classifier a powerful boosting algorithm that combines several weak into strong learners, in which each new model is trained to minimize the loss function such as mean squared error or cross-entropy of the previous model using gradient descent.

Step 6: Performance Analysis Performance measures such as accuracy, precision, and f-score were used to evaluate the models. Accuracy: Accuracy, a fundamental metric in model evaluation, reflects the overall correctness of predictions. While simple to interpret, it may not be sufficient when dealing with imbalanced datasets, emphasizing the need for a holistic view considering precision and recall.

Precision: Precision, a key performance indicator, gauges the model's ability to make accurate positive predictions. It is crucial in scenarios where false positives have substantial consequences, providing a focused insight into the reliability of positive classifications.

F-Score: The F-score, harmonizing precision and recall, presents a balanced assessment of a model's performance. Particularly useful in situations where striking a balance between false positives and false negatives is imperative, the F-score aids in capturing nuanced aspects of model effectiveness.

Step 7: Cross-validation is a technique used in machine learning to assess the performance and generalizability of a predictive model. It is particularly useful when you have a limited amount of data, and you want to make the most out of it for both training and testing. The basic idea is to split the dataset into multiple subsets, train the model on some of these subsets, and then evaluate it on the remaining subset. This process is repeated several times, and the performance measures are averaged over all the runs.

Step 8: Result Analysis The results were analyzed and compared, with KNN performing consistently well and outperforming the other algorithms in terms of accuracy and prediction.

Results

Algorithm	Accuracy	Precision	F-Score
KNN	99.9%	99.9%	99.9%
SVC	97.5%	99.7%	98.6%
GBC	99.4%	99.9%	99.7%

Conclusion

The quest for enhancing currency security through counterfeit detection has yielded significant strides. Leveraging advanced technologies and machine learning algorithms, particularly exemplified by methods like Support Vector Machines, Decision Trees, and image feature extraction, has proven instrumental. Notably, the system's robust performance in accurately identifying security features on a diverse set of Indian banknotes showcases its efficacy. With a commendable average accuracy of 95.0%, this approach holds promise for fortifying the integrity of currency systems and safeguarding against counterfeit threats. The continuous refinement of such methodologies remains pivotal for staying ahead in the ongoing battle against illicit currency reproduction, ensuring the trustworthiness of financial transactions and upholding the stability of economic systems.

References

[1]. Bhatia, A., Kedia, V., Shroff, A., Kumar, M., & Shah, B. K. (2021, May). Fake currency detection with machine learning algorithm and image processing. In 2021 5th international conference on intelligent computing and control systems (ICICCS) (pp. 755-760). IEEE.

[2]. Gopane, S., & Kotecha, R. (2020, April). Indian counterfeit banknote detection using support vector machine. In Proceedings of the 3rd International Conference on Advances in Science & Technology (ICAST).

[3]. Yadav, A., Jain, T., Verma, V. K., & Pal, V. (2021, January). Evaluation of machine learning algorithms for the detection of fake bank currency. In 2021 11th International Conference on Cloud Computing, Data Science & Engineering (Confluence) (pp. 810-815). IEEE.

[4]. Kumar, D., & Chauhan, S. (2020). Indian fake Currency Detection using computer vision. International Research Journal of Engineering and Technology, 7(5), 2870-2874.

[5]. Antonius, F., Ramu, J., Sasikala, P., Sekhar, J. C., & Mary, S. S. C. (2023). DeepCyberDetect: Hybrid AI for Counterfeit Currency Detection with GAN-CNN-RNN using African Buffalo Optimization. International Journal of Advanced Computer Science and Applications, 14(7).

[6]. Counterfeit Currency Note Detection using Machine Learning PRAJWAL EM1, SUNITHA2 , PRITHVI3 , SRIKANTH4 , Dr. KIRAN A. GUPTA, SMIEEE.

[7]. Shilpa, B., Student, N. S., Student, P. B., Student, A. P., & Student, A. U. Fake Currency Detection Using Machine Learning.

[8]. Pallavi, S., Pooja, N., Yashaswini, H. R., & Varsha, N. (2022). FAKE CURRENCY DETECTION. International Research Journal of Modernization in Engineering Technology and Science (4076-4081), 4(06).

[9]. Patil,P., Patil, A., Sawant, H., & Patil, N. FAKE CURRENCY DETECTION USING MACHINE LEARNING AND IMAGE PROCESSING TECHNIQUES.

[10]. LAKSHMI, B. N., & KUMAR, G. S. (2022). FAKE CURRENCY DETECTION USING MACHINE LEARNING. Journal of Engineering Sciences, 13(12).

[11]. M. N. Rathore and J. Sagar, "A Review on Fake currency detection using feature extraction," vol. 10, no. 11, pp. 407–411, 2019.

[12]. M. A. Gaikwad, V. V Bhosle, and V. D. Patil, "Automatic Indian New Fake Currency Detection Technique," Int. J. Eng. Res. Technol., vol. 6, no. 11, pp. 84–87, 2017.

[13]. M. N. Shende and P. P. Patil, "A Review on Fake Currency Detection using Image Processing," Int. J. Futur. Revolut. Comput. Sci. Commun. Eng., vol. 4, no. 1, pp. 391–393, 2018.

[14]. A. Saxena, P. K. Singh, G. P. Pal, and R. K. Tewari, 'Fake currency detection using image processing', Int. J. Eng. Technol., vol. 7, pp. 199–205, Jan. 2018, doi: 10.17577/IJERTV8IS120143.

[15]. C. G. Pachon, D. M. Ballesteros, and D. Renza, 'Fake Banknote Recognition Using Deep Learning', Appl. Sci., vol. 11, no. 3, p. 1281, Jan. 2021, doi: 10.3390/app11031281.

[16]. J. D'cruz, M. Jose, M. Eldhose, and B. Jose, 'FAKE INDIAN CURRENCY DETECTION USING DEEP LEARNING'.

[17]. M. Laavanya and V. Vijayaraghavan, 'Real time fake currency note detection using deep learning', Int J Eng Adv TechnolIJEAT, vol. 9, 2019.

[18]. C. Kumar and A. K. Dudyala, "Banknote Authentication using Decision Tree rules and Machine Learning Techniques", International Conference on Advances in Computer Engineering and Applications(ICACEA), 2015.

[19]. M. Gogoi, S. E. Ali and S. Mukherjee "Automatic Indian Currency Denomination Recognition System Based on Artificial Neural Network", IEEE, pp. 553-558, 2015.

[20]. S. Mahajan and K. P. Rane, "A Survey on Counterfeit Paper Currency Recognition and Detection," ICIAC, pp. 54-61, 2015.