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A review of Fake Currency Recognition Methods

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Abstract – *The global economy is vulnerable to counterfeit currency. Advanced printing and scanning technologies have made it a common occurrence. For both people and corporations, fake currency recognition is a serious issue. The creation of counterfeit banknotes, which are barely distinguishable from legitimate currency, is a continuous process for counterfeiters. To detect fake notes, several traditional techniques and approaches are available based on colors, widths, and serial numbers. This paper discusses different methods of fake currency detection using image processing.*

Key Words*: *Fake Currency detection, Machine learning, Support Vector Machine, Convolutional neural network, AlexNet, K Nearest Neighbour (KNN), Support Vector Classifier(SVC), Gradient Boosting Classifier(GBC), ResNet50, DarkNet53, GoogleNet, Linear Discriminant Analysis(LDA), Canny Edge Detector

1. INTRODUCTION

Digitalization is bringing about a rapid acceleration in fraudulent activities, particularly in the financial sector. Technology has greatly facilitated the proliferation of fake money. Modern counterfeit money is very identical to real money [1]. Even though identifying counterfeit cash might be difficult, automated currency note recognition systems have advanced significantly in recent years. It thus attracts the interest of several modern research experts. Despite their usefulness, today's fake money detectors are too expensive to be used by the average person. Recent studies are concentrating on fake currency recognition based on image processing to resolve this problem [1][2].

This paper reviews various methods of fake currency detection based on image processing and machine learning. The different methods are presented in Chapter 3. Chapter 4 depicts the comparison of these methods. Chapter 5 includes the conclusion of the study.

2. LITERATURE REVIEW

AlexNet-based fake currency detection has been proposed in [3]. This transfer learned convolutional neural network is trained using data sets consisting of 50,200,500,2000 Indian rupee notes to obtain feature vectors. Here, the average accuracy for identifying real currency and counterfeit currency was 81.5 percent and 75%, respectively.A deep CNN model has been presented in [4] to detect counterfeit currency. It is intended to detect counterfeit notes on portable electronics like smartphones and tablets. A self-generated dataset of 10,000 images including 500 actuals, 500 fake, and 2000 real and 2000 fake notes was used to train and test the CNN model. Testing accuracy of 85.6% was obtained through this method.

An ensemble of classifiers has been used for the fake currency classification task in [5]. Moreover, this system is based on more than one security feature. DT, SVM, LDA, and KNN are the classifiers employed in this system. With an accuracy of 82.7 percent for all features, the SVM classifier outperforms all other classifiers. Four different CNN called Alexnet, Resnet50, Darknet53, and Google net have been used for Indian currency recognition in[6]. The findings demonstrated that each of the four preconfigured networks excels at one parameter while sacrificing the others.

KNN, SVC, and GBC have been used for fake money recognition in [7]. KNN is a suitable candidate for application in the computer vision job because of its excellent accuracy for smaller data sets. Machine learning algorithms and image processing techniques are used to obtain the desired outcome and accuracy. Here, KNN and GBC provide higher accuracy in the recognition task.

A fake cash detection technique that takes advantage of edge detection has been presented in [8]. A training dataset identical to the one that will be tested later is used by the detector. This edge detector-based system gives 90.45% accuracy in the fake currency detection system. A unique Optically Variable Device (OVD) patch was applied in [9] to help identify fake Philippine notes. Here, the Canny Edge algorithm identified counterfeit currency using OVD security features. It showed statistically significant detection rates under a threshold of significance of 5 percent for all four tests.

3. METHODOLOGY

3.1 AlexNet-based system

This system was implemented to classify fake Indian Currency. Transfer learned Alex network with Adam optimization has been used in the suggested technique [3]. Automatic feature extraction and fake currency classification from the input image of note is done by Alex Net, which is composed of 5 convolutional layers, 5 Max pooling layers, 2 Dropout layers, and 3 fully connected layers. The technique is examined in real-time using a webcam. Following the

acquisition of the picture, the network learns how the input currency note is constructed and compares it to its learned features to produce a "Real Note" (or "Fake Note") result.

3.2 Deep CNN model-based system

An image of the 'note' must be captured or uploaded by the user and is added to the real-time database Firebase in order to receive results immediately [4]. After feeding the image into the CNN model, the output appears on the screen shortly afterward. The CNN model receives an image from the database and predicts the outcomes, which are then returned to the database. The picture is pre-processed and converted to an 80 × 80-pixel size. CNN classifies whether the note is fake or not by extracting features from the image. The Deep CNN model has been implemented using 5 convolutional layers, 4 fully connected layers, and a single flattened layer.

3.3 Feature Ensemble Approach based system

Here, an ensemble of six classifiers has been used for currency recognition [5]. At first, the input image of the note is converted to a grayscale image. This image is segmented using ChanVese Segmentation which is a blend of the active contour model and Mumford Shah model. During Chan Vese segmentation, each pixel of the input image is assigned either a true or false value. In this system, 6 security features of notes are considered for fake currency recognition.

ROI can be calculated by partitioning the image of a note into 16 blocks and merging these blocks to create images that represent each security feature. Each of the security features is classified using different classifiers., SVM with linear kernel, LDA, KNN, and Decision trees (DT) are the classifiers employed in this system.

3.4 CNN-based System

Here, four different CNN architectures named AlexNet, Darknet-53, GoogleNet, and ResNet-50 have been used for detecting fake currency [6]. The dataset has been divided into training and testing sets, which consist of the two classes labeled Original and Fake Indian Note Currency. Utilizing predetermined convolutional neural networks, the training set and testing set attributes are retrieved. Support Vector Machine (SVM) is used to classify the test picture of the note as real or fake cash after characteristics have been extracted using CNN.

3.5 Machine Learning Algorithm and Image Processing-based system

In this system, due to the substantial variation in all the feature values, the dataset has been normalized. Then data has been divided utilizing the K-fold cross-validation technique. The prediction model has been trained using K-Nearest Neighbours, Support Vector Classifier, and Gradient Boosting Classifier. KNN categorizes a given data point by examining its nearest neighbors and giving each one a score based on the distance between them. The closest data points are given a greater weight based on the distance.

Determining the best-fitting hyper-plane for splitting the categorization is how SVM classification is carried out. Gradient boosting classifiers are built using a decision tree-like paradigm, where layers of yes-or-no inquiries are posed to produce a prediction model. In this system, all three classifiers provide more than 97% accuracy in the currency classification task.

3.6 Edge detector-based system

Here, a camera or other device has been used to take a picture of the currency [8]. Then the image is resized and converted to the grayscale format. Then the edges of the image have been detected using an edge detector. Then the image is segmented using various machine learning and clustering algorithms. Some dimensionality reduction approaches are then utilized to highlight the key elements of the image. The generated picture is then compared to the data set already in place as the last step to determine if the note is authentic or fraudulent (counterfeit).

3.7 Canny Edge detection Algorithm-based system

In the first step, the security attributes of the reference image are saved. The GUI software will evaluate the note under test with the reference note after the user clicks the "Compare" button [9]. The GUI clearly shows the difference between these two notes on the comparison. Here Canny edge detection algorithm is employed for image enhancement and sensing. It is a multiphase edge detection algorithm that consists of an upper and lower threshold as the parameters. Optically Variable Device (OVD) patches, a unique security feature that outperforms the conventional three-way recognition of notes, were added to some Philippine banknotes in order to recognize counterfeit notes.

4. COMPARISON

The comparison of various fake currency recognition techniques is shown in Table-1.

No	Title	Method	Dataset	Accuracy
1	Real time fake currency note detection using deep learning. [3]	AlexNet	Indian Currency (50,200,500,2000 notes)	87% for real 2000 note, 82% for fake note
2	Counterfeit Currency Detection using Deep Convolutional Neural Network [4]	Deep CNN	Indian Currency (500, 2000 notes)	85.6%
3	Indian Currency Classification and Fake Note Identification using Feature Ensemble Approach [5]	Chanvese Segmentation SVM, LDA, KNN, DT	Indian Currency (100,200,500,2000 notes)	88.5%
4	Identification of Fake Indian Currency using Convolutional Neural Network [6]	Darknet53 AlexNet ResNet-50 GoogleNet	Indian Currency (10, 20,50, 100, 200 and 1000 notes)	72.04% 65.15% 80.94% 64.64%
5	Fake Currency Detection with Machine Learning Algorithm and Image Processing [7]	KNN SVC GBC	Indian Currency	99.9% 97.5% 99.4%
6	Fake currency detection using Image processing [8]	Edge Detection, Segmentation	Indian Currency (500)	90.45%
7	Philippine currency paper bill counterfeit detection through image processing using Canny Edge Technology [9]	Canny Edge detection and OVD patch	Philippine currency Peso 500, 1000	95%

Table 1: Comparison

5. CONCLUSION

Finding the best approach to detect and recognize counterfeit money is a problem that is becoming worse for the scientific world. This review provides a summary of the identification of fake currency using non-conventional image processing techniques. Majority of the reviewed fake currency detection works are based on Indian Currency Notes. The use of image processing algorithms, CNN models, Machine learning algorithms make the counterfeit currency recognition task quick and easy. All these techniques gives more than eighty percentage accuracy in recognition task.

REFERENCES

[1] https://matlabsimulation.com/fake-currency-detection-using-matlab/

[2] https://www.ris-ai.com/fake-currency-detection-with-machine-learning

[3] Laavanya, M., & Vijayaraghavan, V. (2019). Real time fake currency note detection using deep learning. Int. J. Eng. Adv. Technol.(IJEAT), 9.

[4] K. Kamble, A. Bhansali, P. Satalgaonkar and S. Alagundgi, "Counterfeit Currency Detection using Deep Convolutional Neural Network," 2019 IEEE Pune Section International Conference (PuneCon), 2019, pp. 1-4, doi: 10.1109/PuneCon46936.2019.9105683.

[5] Narra, P., & Kirar, J. S. (2021, December). Indian Currency Classification and Fake Note Identification using Feature Ensemble Approach. In 2021 International Conference on Computational Performance Evaluation (ComPE) (pp. 022-029). IEEE.

[6] Sumalatha, R., Reddy, B. J., & Reddy, T. V. R. (2022, March). Identification of Fake Indian Currency using Convolutional Neural Network. In 2022 6th

International Conference on Computing Methodologies and Communication (ICCMC) (pp. 1619-1623). IEEE.

[7] 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.

[8] L. Latha, B. Raajshree and D. Nivetha, "Fake currency detection using Image processing," 2021 International Conference on Advancements in Electrical, Electronics, Communication, Computing and Automation (ICAECA), 2021, pp. 1-5, doi: 10.1109/ICAECA52838.2021.9675592.

[9] A. H. Ballado et al., "Philippine currency paper bill counterfeit detection through image processing using Canny Edge Technology," 2015 International Conference on Humanoid, Nanotechnology, Information Technology,Communication and Control, Environment and Management (HNICEM), 2015, pp. 1-4, doi: 10.1109/HNICEM.2015.7393184.

[10] https://www.researchgate.net/publication/346597498_Fake_currency_detection_A_survey

[11] Ding, L., & Goshtasby, A. (2001). On the Canny edge detector. *Pattern recognition*, *34*(3), 721-725.

[12] Yang, Y., Li, J., & Yang, Y. (2015, December). The research of the fast SVM classifier method. In 2015 12th international computer conference on wavelet active media technology and information processing (ICCWAMTIP) (pp. 121-124). IEEE.

[13] Shin, H. C., Roth, H. R., Gao, M., Lu, L., Xu, Z., Nogues, I., ... & Summers, R. M. (2016). Deep convolutional neural networks for computer-aided detection: CNN architectures, dataset characteristics and transfer learning. IEEE transactions on medical imaging, 35(5), 1285-1298.

[14] Yu, H., & Yang, J. (2001). A direct LDA algorithm for high-dimensional data—with application to face recognition. Pattern recognition, 34(10), 2067-2070.

[15] Guo, G., Wang, H., Bell, D., Bi, Y., & Greer, K. (2003, November). KNN model-based approach in classification. In OTM Confederated International Conferences" On the Move to Meaningful Internet Systems" (pp. 986-996). Springer, Berlin, Heidelberg.

[16] Rathee, N., Kadian, A., Sachdeva, R., Dalel, V., & Jaie, Y. (2016, March). Feature fusion for fake Indian currency detection. In 2016 3rd International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 1265-1270). IEEE.