DETECTION OF FAKE CURRENCY USING MACHINE LEARNING MODELS

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ABSTRACT – This project deals with the matter of identifying the currency that if the given sample of currency is fake. Different traditional strategies and methods are available for fake currency identification based on the colors, width, and serial numbers mentioned. In the advanced age of Computer science and high computational methods, various machine learning algorithms are proposed by image processing that gives 99.9% accuracy for the fake identity of the currency. Detection and recognition methods over the algorithms include entities like color, shape, paper width, image filtering on the note. This paper proposes a method for fake currency recognition using K-Nearest Neighbours followed by image processing. KNN has a high accuracy for small data sets making it desirable to be used for the computer vision task. In this, the banknote authentication dataset has been created with the high computational and mathematical strategies, which give the correct data and information regarding the entities and features related to the currency. Data processing and data Extraction is performed by implementing machine learning algorithms and image processing to acquire the final result and accuracy.

Index terms – Fake Currency Detection, SVM, CNN, KNN.

I. INTRODUCTION

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[7]. In order to stop this fraudulent activity, a system...
is proposed that can be integrated into electronic devices that will detect the fake note as soon as it is scanned by the device. Some of the techniques which are considered are used previously and include KNN which will be utilized in the proposed system with enhanced accuracy. K-nearest neighbors (KNN) is an algorithm that stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a good suite category by using the KNN algorithm [6]. Usually, the Euclidean distance is used as the distance metric. Then, it assigns the point to the class among its k nearest neighbors (where k is an integer).

\[ dist(A, B) = \sqrt{\sum_{i=1}^{m} (x_i - y_i)^2} \]

![Fig.2 Euclidean formula](image)

As k-NN does not require the off-line training stage, its main computation is the on-line ‘searching’ for the k nearest neighbors of a given testing example. Although using different k values are likely to produce different classification results, 1-NN is usually used as a benchmark for the other classifiers since it can provide reasonable classification performances in many pattern classification problems. The function used for calculating the Euclidean distance:

- ✓ motion blur problem,
- ✓ Noise imposed by image capture instrument
- ✓ Less efficient feature extraction technique

Due to such problems faced in the major cases the concept for the implementation of image processing works, which purify the entities like shape, color, serial numbers in the form of images and brings more distinction and efficiency in the implementation and work was introduced [3]. As the data set is small this KNN algorithm suits best for the system and high performance measures scores are expected for the same. Fake currency
detection system not only reduces the circulation of counterfeit currency but also provides encouragement to the dealers to accept/make payment through cash, refrains people from circulating fake notes and also ensures proper flow of currency in economy.

II. LITERATURE SURVEY

Different types of study and research work have been carried out in earlier days a different time. Different enhancements and progress were observed [1]. In the past studies the data collected for the fake note detection was with professional cameras but in those data, accuracy seen was to be fair and good due to simple machine learning algorithms. K nearest neighbor algorithms were used traditionally for the detection of fake notes. Systems were getting slower when the data size became large. After that system came across to classify the precision and recognition rate with some enhancement in Machine learning algorithms and deep learning concepts [12]. Due to high and large data sets, data sets were getting distorted, and the precision was not effective a lot though it was 98%. All of these detections were carried out earlier only with open cv and python but time and again with modern deep learning techniques data were collected with the count of 100 images per denomination and then measured [11]. Accuracy of training and testing sets were measured. This brings the chain type efficiency that elongates to a larger value in comparison to other techniques. Concept of the transfer learning was used in the system. The noise was also captured, and this was another problem due to which much more advancement was required. After that, a Convolutional neural network came into the measurement for the error elimination. Loss trends were generally analyzed concerning training loss (TL) and validation loss (VL). Accuracy trends were generally analyzed by training accuracy (TA). In 2021 the fake note is being detected with the algorithms of efficient Machine learning, Deep convolutional neural network, and followed by image processing. It has shown the efficiency to be maximum in today's days.

III. PROPOSED SYSTEM

The below diagram shows workflow of our proposed system.

![Image of System Workflow]

Fig. 3: System Workflow
Implementation Modules

Dataset

- The data set was made by collecting high-quality images of both genuine and counterfeit currency using an industrial camera. The images have a dimension of 400x400 pixels. Due to the type of lens used and the distance to the investigated object, grayscale pictures of 660dpi were captured. On these pictures, Wavelet Transform was used to extract features from the gathered images.

Preprocessing

- In this modules, we took the first 4 attributes-‘variance’, ‘skewness’, ‘kurtosis’ and ‘entropy’ as the independent or input variables and the ‘class’ as the target or dependent variable. Data is split after the normalization and preprocessing works. We used the Kfold functionality present in the sklearn.model_selection to split the data. The purpose of using this library is it helps to gain a more accurate understanding of the algorithm.

Building Model

- For this project, the required classifiers were imported from the sklearn library. We made a function that took parameters as the training and testing data sets along with the algorithm and returned a trained model with its performance measure scores. We repeated this for every fold and accumulated results for every pass in a list. Lastly, the cross-validation predict module is used to build a confusion matrix for all the algorithms.

Performance Evaluation

- Performance measures are used to check the correctness of the model. For this project, accuracy, precision, and f-score are performance measures. graphs were plotted for each performance measure and compared the results. k-fold cross-validation technique is used for this project.

Implementation Algorithms

Support Vector Machine

In machine learning, support-vector machines (SVMs, also support-vector networks) are supervised learning models with associated learning algorithms that analyze data for classification and regression analysis. An SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier.
KNN

K-Nearest Neighbour is one of the simplest Machine Learning algorithms based on Supervised Learning technique. K-NN algorithm assumes the similarity between the new case/data and available cases and put the new case into the category that is most similar to the available categories. K-NN algorithm stores all the available data and classifies a new data point based on the similarity. This means when new data appears then it can be easily classified into a well suite category by using K-NN algorithm. K-NN algorithm can be used for Regression as well as for Classification but mostly it is used for the Classification problems.

IV. RESULTS

After training the model using the data set and the algorithms described above, we tested them to see how they performed. Calculating the performance measures described above, we were able to gain an understanding of how every algorithm performed. Below are the accuracy, precision, and f-scores for each algorithm.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Accuracy</th>
<th>Precision</th>
<th>F1-Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNN</td>
<td>67.88%</td>
<td>65.08%</td>
<td>65.35%</td>
</tr>
<tr>
<td>SVM</td>
<td>75.91%</td>
<td>73.12%</td>
<td>71.85%</td>
</tr>
<tr>
<td>KNN</td>
<td>72.26%</td>
<td>75.05%</td>
<td>59.45%</td>
</tr>
</tbody>
</table>

Fig. 4: Collected Fake or Real Currency Dataset

Fig. 5: Training and Testing Validation of CNN Model

Fig. 6: Confusion Matrix for CNN Model
V.CONCLUSION

After implementing and analyzing the results gathered, we can deduce that all the three algorithms used were exceptionally accurate at classifying notes as genuine and counterfeit based on the used data set. However, KNN outperformed the other two as discussed in the above section. It had an accuracy of 99.9% with classifying incorrectly classifying only 2 counterfeit notes. However, this result is limited as the data set used was quite small. It had a total of 1372 samples which when considered in the real-world scenario might not perform as well as it has currently. To build on this, we propose to form a much larger data set with real-world like pictures of real and fake currency notes. This will help in providing a much more realistic model. Moreover, with a large data set available, deep learning algorithms like Convolutional Neural Networks or CNN can be applied which have high accuracy in image processing scenarios. Furthermore, by using CNN the project can directly analyze images as input, and wavelet transformation will not be required. This can make the system more convenient and user friendly to use. Moreover, as it is likely to be used in financial institutions it will be more convenient for users to directly click a picture and get it verified; this can be done with the help of CNN as mentioned above. Hence, to
make the project more robust and professional the above suggest measures can be implemented[10].

REFERENCES


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