COUNTERFEIT CURRENCY DETECTION USING DEEP CONVOLUTIONAL NEURAL NETWORK

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ABSTRACT: The one important asset of our country is Bank currency and to create discrepancies of money miscreants introduce the fake notes which resembles to original note in the financial market. During demonetization time it is seen that so much of fake currency is floating in market. In general by a human being it is very difficult to identify forged note from the genuine not instead of various parameters designed for identification as many features of forged note are similar to original one. To discriminate between fake bank currency and original note is a challenging task. So, there must be an automated system that will be available in banks or in ATM machines. To design such an automated system there is need to design an efficient algorithm which is able to predict weather the banknote is genuine or forged bank currency as fake notes are designed with high precision. In this paper six supervised machine learning algorithms are applied on dataset available on UCI machine learning repository for detection of Bank currency authentication. To implement this we have applied Support Vector machine, Random Forest, Logistic Regression, Naïve Bayes, Decision Tree, K- Nearest Neighbor by considering three train test ratio 80:20, 70:30 and 60:40 and measured their performance on the basis various quantitative analysis parameter like Precision, Accuracy, Recall, MCC, F1-Score and others. And some of SML algorithm are giving 100 % accuracy for particular train test ratio.

1. INTRODUCTION

As many qualities of a fake note are identical to those of an authentic, it is generally exceedingly impossible for a human to distinguish between the two without the use of certain criteria. Differentiating between counterfeit bank notes and genuine notes is a difficult undertaking. Therefore, there must be an automated system accessible at banks or ATMs. To create such an automated system, an effective algorithm that can determine if a banknote is real or counterfeit is required since counterfeit banknotes are meticulously created. So, now a days it is required that bank or ATM machines must have some system that can identify the forged note from the genuine note. To determine the legitimacy of the banknote artificial intelligence and Machine learning(ML) can play a vital role to design such a system that ca identify forged note from the genuine bank currency. On a dataset from the UCI machine learning repository, six supervised machine learning algorithms are used in this research to determine the authenticity of bank cash. Using three train test ratios of 80:20, 70:30, and 60:40, we applied Support Vector Machine, Random Forest, Logistic Regression, Naive Bayes, Decision Tree, and K- Nearest Neighbor to implement this. We

then evaluated their performance using a variety of quantitative analysis parameters, including Precision, Accuracy, Recall, MCC, F1-Score, and others. To identify weather a note is genuine or fake we have to develop an automation system. Initially, the input is an image of note and from different image processing techniques we can extract the features of note. Further these images are given as an input to the SML algorithms to predict whether note is original or fake. In review we can see that not much of work is done on this side.

Fig.1: Example figure

Financial activities are carrying out in every second by many persons in which one most important asset of our country is Banknotes. Fake notes are introduced in the market to create discrepancies in the financial market, even they resemble to the original note. Basically they are illegally created to complete various task. In 1990 forgery issue is not much of concern but as in late 19th century forgery has been increasing drastically. In 20th century technology is increasing very vastly that will help the frauds to generate fake note whose resemblance is like genuine not and it is very difficult to discriminate them. This will lead to financial market to its lowest level. To stop this and to conduct smooth transaction circulation forged bank currency must be conserved. As a human being it is very difficult to identify between genuine and forged bank currency. Government have designed banknote with some features by which we can identify genuine. But frauds are creating fake note with almost same features with nice accuracy that make it very difficult to identify genuine note. So, now a days it is required that bank or ATM machines must have some system that can identify the forged note from the genuine note. To determine the legitimacy of the banknote artificial intelligence and Machine learning(ML) can play a vital role to design such a system that can identify forged note from the genuine bank currency.

2. LITERATURE REVIEW

Implementation of Multiple Kernel Support Vector Machine for Automatic Recognition and Classification of Counterfeit Notes

With the advance of digital imaging technologies, color scanners and laser printers make it increasingly easier to produce counterfeit banknotes with high resolution.Almost every country in the world face the problem of counterfeit currency notes.Even receiving Fake notes from ATM counters,vending machines and during elections have also been reported at some places.There is a need to design a system that is helpful in recognition of counterfeit notes. In this paper, we propose a system based on multiple-kernel support vector machines for counterfeit banknote recognition. Each banknote is divided into partitions and the luminance histograms of the partitions are taken as the input of the system. Linearly weighted

combination is adopted to combine multiple kernels into a combined matrix. Two strategies are adopted to reduce the amount of time and space required by the semidefinite programming (SDP) method. One strategy assumes the non-negativity of the kernel weights, and the other one is to set the sum of the weights to be unity.

Making classifier performance comparisons when ROC curves intersect

The ROC curve is one of the most common statistical tools useful to assess classifier performance. The selection of the best classifier when ROC curves intersect is quite challenging. A novel approach for model comparisons when ROC curves show intersections is proposed. In particular, the relationship between ROC orderings and stochastic dominance is investigated in a theoretical framework and a general class of indicators is proposed which is coherent with dominance criteria also when ROC curves cross. Furthermore, a simulation study and a real application to credit risk data are proposed to illustrate the use of the new methodological approach.

Credit rating analysis with support vector machines and neural network: a market comparative study

Corporate credit rating analysis has attracted lots of research interests in the literature. Recent studies have shown that Artificial Intelligence (AI) methods achieved better performance than traditional statistical methods. This article introduces a relatively new machine learning technique, support vector machines (SVM), to the problem in attempt to provide a model with better explanatory power. We used backpropagation neural network (BNN) as a benchmark and obtained prediction accuracy around 80% for both BNN and SVM methods for the United States and Taiwan markets. However, only slight improvement of SVM was observed. Another direction of the research is to improve the interpretability of the AI-based models. We applied recent research results in neural network model interpretation and obtained relative importance of the input financial variables from the neural network models. Based on these results, we conducted a market comparative analysis on the differences of determining factors in the United States and Taiwan markets.

Bank note authentication using decision tree rules and machine learning techniques

Banknotes are currencies used by any nation to carry-out financial activities and are every countries asset which every nation wants it (bank-note) to be genuine. Lot of miscreants induces fake notes into the market which resemble exactly the original note. Hence, there is a need for an efficient authentication system which predicts accurately whether the given note is genuine or not. Exhaustive experiments have been conducted using different machine learning techniques and found that Decision tree and MLP techniques are effective for banknote authentication which efficiently classifies a given banknote data. The rules given by Decision Tree are also tested and found that they are accurate enough to be used for prediction.

Comparison of Support Vector Machine and Back Propagation Neural Network in Evaluating the Enterprise Financial Distress

Recently, applying the novel data mining techniques for evaluating enterprise financial distress has

received much research alternation. Support Vector Machine (SVM) and back propagation neural (BPN) network has been applied successfully in many areas with excellent generalization results, such as rule extraction, classification and evaluation. In this paper, a model based on SVM with Gaussian RBF kernel is proposed here for enterprise financial distress evaluation. BPN network is considered one of the simplest and are most general methods used for supervised training of multilayered neural network. The comparative results show that through the difference between the performance measures is marginal; SVM gives higher precision and lower error rates.

3. IMPLEMENTATION

In general by a human being it is very difficult to identify forged note from the genuine not instead of various parameters designed for identification as many features of forged note are similar to original one. To discriminate between fake bank currency and original note is a challenging task. So, there must be an automated system that will be available in banks or in ATM machines. To design such an automated system there is need to design an efficient algorithm which is able to predict weather the banknote is genuine or forged bank currency as fake notes are designed with high precision.

Disadvantages:

- To discriminate between fake bank currency and original note is a challenging task.

In this paper six supervised machine learning algorithms are applied on dataset available on UCI machine learning repository for detection of Bank currency authentication. To implement this we have applied Support Vector machine, Random Forest, Logistic Regression, Naïve Bayes, Decision Tree, K-Nearest Neighbor by considering three train test ratio 80:20, 70:30 and 60:40 and measured their performance on the basis various quantitative analysis parameter like Precision, Accuracy, Recall, MCC, F1-Score and others. And some of SML algorithm are giving 100 % accuracy for particular train test ratio.

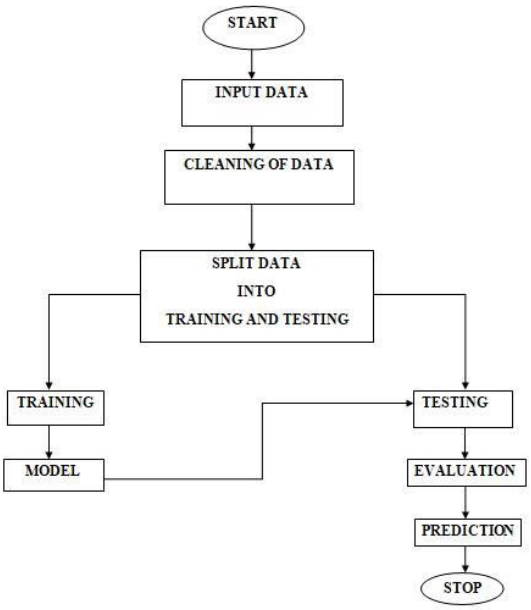

Fig.2: System architecture

MODULES:

- Data Exploration
- Data Preprocessing
- Feature Extraction
- Data Splitting
- Model Generation
- Build LR,RF,DT,KNN,SVM & NB Classifiers
- Model Build

- Create Flask Object
- Load Model
- Signup & Signin
- Upload Test Data
- Predict Fake or Not

4. METHODOLOGY

ALGORITHM USED:

SUPPORT VECTOR MACHINE(SVM):

"Support Vector Machine" (SVM) is a supervised machine learning algorithm which can be used for both classification or regression challenges. However, it is mostly used in classification problems. In this algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiate the two classes very well (look at the below snapshot). The SVM algorithm is implemented in practice using a kernel. The learning of the hyperplane in linear SVM is done by transforming the problem using some linear algebra, which is out of the scope of this introduction to SVM. A powerful insight is that the linear SVM can be rephrased using the inner product of any two given observations, rather than the observations themselves. The inner product between two vectors is the sum of the multiplication of each pair of input values.

Random Forest Algorithm

Random Forest algorithm is a supervised classification algorithm. We can see it from its name, which is to create a forest by some way and make it random. There is a direct relationship between the number of trees in the forest and the results it can get: the larger the number of trees, the more accurate the result. But one thing to note is that creating the forest is not the same as constructing the decision with information gain or gain index approach. The decision tree is a decision support tool. It uses a tree-like graph to show the possible consequences. If you input a training dataset with targets and features into the decision tree, it will formulate some set of rules. These rules can be used to perform predictions. When we have our dataset categorized into 3 category so now Random forest helps to make classes from the dataset. Random forest is clusters of decision trees all together, if you input a training dataset with features and labels into a decision tree, it will formulate some set of rules, which will be used to make the predictions.

Decision Tree Classifier:

Decision Tree is a supervised machine learning algorithm used to solve classification problems. The main objective of using Decision Tree in this research work is the prediction of target class using decision rule taken from prior data.It uses nodes and internodes for the prediction and classification. Root nodes classify the instances with differentfeatures. Root nodes can have two or more branches while the leaf nodes represent classification. In every stage, Decision tree chooses each node by evaluating the highest information gain among all the attributes.

K nearest neighbor algorithm:

K-Nearest Neighbors is one of the most basic yet essential classification algorithms in Machine Learning. It belongs to the supervised learning domain and finds intense application in pattern recognition, data mining and intrusion detection. It is widely disposable in real-life scenarios since it is

non-parametric, meaning, it does not make any underlying assumptions about the distribution of data (as opposed to other algorithms such as GMM, which assume a Gaussian distribution of the given data). We are given some prior data (also called training data), which classifies coordinates into groups identified by an attribute.

Naive Bayes Classifier:

Naive Bayes is a classification technique with a notion which defines all features are independent and unrelatedto each other. It defines that status of a specific feature in a class does not affect the status of another feature. Sinceit is based on conditional probability it is considered as a powerful algorithm employed for classification purpose.It works well for the data with imbalancing problems and missing values. Naive Bayes is a machine learningclassifier which employs the Bayes Theorem. Using Bayes theorem posterior probability.

Logistic Regression:

The logistic regression is a predictive analysis. Logistic regression is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variables.

Logistic regression is a statistical analysis method to predict a binary outcome, such as yes or no, based on prior observations of a data set. A logistic regression model predicts a dependent data variable by analyzing the relationship between one or more existing independent variables.

5. EXPERIMENTAL RESULTS

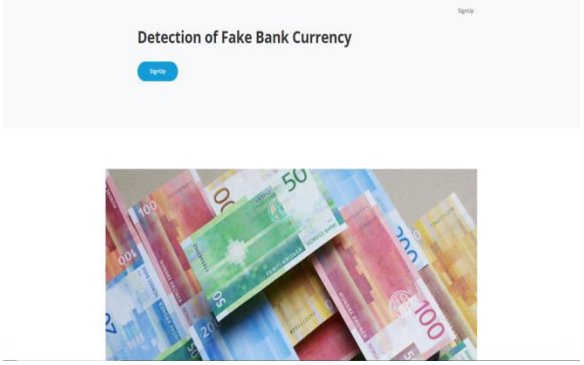

Fig.3: Home screen

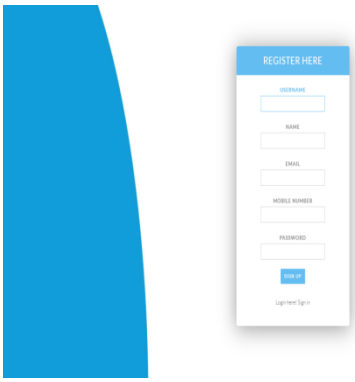

Fig.4: Signup

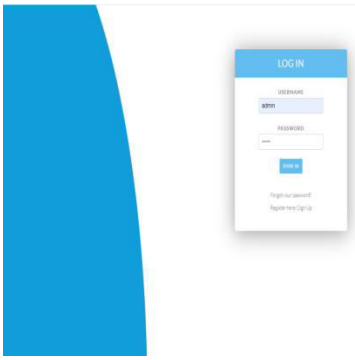

Fig.5: Login

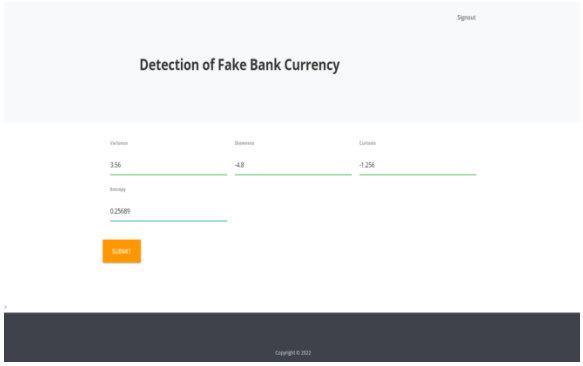

Fig.6: Give input

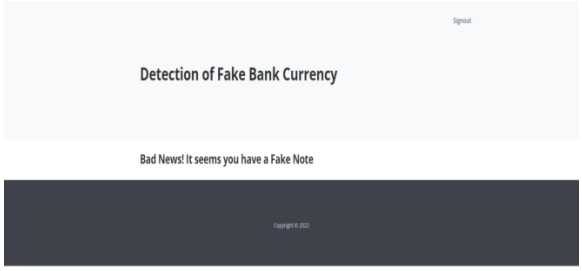

Fig.7: prediction result

6. CONCLUSION

In this paper, SML algorithm SVM, LR, NB, DT, RF and KNN are applied to the banknote authentication dataset taken from UCI ML repository on three different train test ratio 80:20, 60:40, 70:30. The dataset contain 1372 and 5 attributes and out of which 4 are the features and one is the target attribute that have value as genuine bank currency or forged note. Initially, we have visualized the data by KDE, Box plot and par plot to study the correlation between the features and the target class see Section III (See Fig. 1, 2 and 3). From this section it is concluded that all features are important and have relation with the target class as well as other features, so we have not dropped out any features. Further in Next section III we have analysed the performance of six SML algorithms based on the ROC curve and Learning curve on train test ratio 80:20. For the train test ratio 80:20 Accuracy of KNN is highest i.e., 100 % and NB is having lowest accuracy i.e., 84% see Fig. 4, 5, 6, 7 and 8. Further in Next section we have analysed the performance of SML algorithm SVM, LR, NB, DT, RF and KNN on the basis of standard quantitative analysis parameter like MCC, F1 Score, NPV, NDR, accuracy and others. For 80:20 and 70:30 train test ratio accuracy is highest in KNN. As MCC value is near +1 then it is perfect model and F1m is also1 for both train test ratio. And Naïve Bayes is having the lowest accuracy i.e., 84% in 80:20 and 86% in 70:30 and its MCC is lowest as well for both the train test ratio. For train test ratio 60:40 highest accuracy is seen in DT i.e., 100%, MCC value is also +1 that shows that decision tree is performing better than five SML algorithms. The lowest accuracy is seen in Naïve Bayes only that is same in 80:20 train test ratio see Table II, III, and IV. To visualize the evaluation parameter of SVM, LR, NB, DT, RF and KNN histogram is also drawn.

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