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COUNTERFEIT CURRENCY DETECTION USING MACHINE LEARNING

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Abstract: Flow of money either virtually or physically creates opportunities for the malicious intenders to interrupt the normal functioning of the financial system. Due to the technological revolution, the widespread availability of printing technologies and duplication methods lead to the production of counterfeit notes. The production of fake notes hampers the proper functioning of the financial system. It greatly affects the economy of the nation and eventually the common man. This paper presents supervised machine learning algorithm for the detection of counterfeit notes. Simulation results certify that the machine learning model used provided accuracy better than the traditional methods.

IndexTerms **- machine learning, classification, supervised learning**

I. INTRODUCTION

Development is the process by which a nation improves the social and economic conditions of its citizens. Economic growth and development is one of the primary contributing factors for the development of the nation. Development of nation is reliant on its citizens as well as currency. The authority which issues currency notes is managed by Ministry of Finance and Reserve Bank of India (RBI). Counterfeit notes are the ones which are produced or created to mimic the government produced notes. With the advancement in printing technology, such as high-resolution devices and efficient color duplications, it has become quite easier to produce counterfeit notes. The number of counterfeit notes is increasing monotonously. The financial or the economic equilibrium is hampered by the detection of counterfeit notes commonly known as fake currency notes. Fake currency note production is a serious problem being faced by many nations including India, Malaysia and U.S.A as well. Detection of counterfeit notes is one of the prime concerns of every nation to be addressed at the earliest. Although the concept of digital economy is introduced prior, the use of paper currency is still in very much use in daily transactions. According to the Secret Service reports, nearly 70% of the $78 million was made using digital printing technologies [1].To handle the fake currency circulation, there should be proper mechanisms which could detect the counterfeit currency from the original ones. The available techniques usually rely on the sensors which help in detection of fake currencies. The sensors include infrared, ultraviolet, visible light as well as magnetic sensors. Sensor enabled machines find their best usage in banks, retail markets etc.

In this paper, detection of counterfeit currency using machine learning algorithms is proposed. The aim of the paper is to determine counterfeit Indian notes using machine learning algorithm. Section II discusses the related work done on the detection of counterfeit notes. Section III presents the proposed methodology. Section IV demonstrates the results and discussions. Section V presents conclusion.

II. RELATED WORK

There has been a lot of research conducted in the detection of counterfeit notes. In [2], Adaboost and voting ensemble model is used for the detection of counterfeit notes. Adaboost is used to increase the performance efficiency of ten machine learning algorithms. The voting ensemble is used to find out the best combinations of samples combinations of the ten machine learning algorithms. In [3] a technique of texture analysis known as Linear Binary Pattern (LBP) is used. In LBP, the grey value of the center pixel is used as a threshold to get an arrangement of all pixels with respect to the position of center pixel. The algorithm performs well on notes having low noise levels. The algorithmic performance decreases when currency with higher level of noise is inputted. In [4], an image processing technique of edge detection is used. Canny operator is used in the detection process. The operator detected all the watermarks embedded on the notes successfully. Many systems rely on sensor enabled machines. In [5], the detection of fake currencies is

accomplished through the ultra violet channels in U.S currencies. The fluorescence property of the paper substrate is exploited. A study of differences in the lifetime of fluorescence lifetime is made between original and fake currencies. The monetary cost of this technique interdicts its usage in banks and government organizations can be applied in forensic and science laboratories for the analysis purpose. In [6], a method of bit–plane slicing is applied on the currency notes to detect its originality. The original image of the bank note is decomposed into its 8 equivalent binary images. After bit plane slicing, it was observed that the image is clearer, edges are more accurate and detection is better than the original image. In [7], a method of X-ray fluorescence is used to detect the counterfeit notes. Raman spectroscopy is applied on the Brazilian currency notes followed by the multivariate analysis.

III. PROPOSED WORK

Figure 1 presents the flowchart of the proposed method for the classification problem. Task of classification is done using machine learning techniques. The dataset is obtained by taking the images of banknotes and obtaining the variance, symmetry, kurtosis and entropy. The first three characteristics of image are obtained in the form of wavelets. Wavelets are a kind of image cleaning procedure without any process of blurring the image. Using variance as one of the input characteristics gives an idea of the pixel layout of an image. Symmetry of an image gives the orientation values with respect to certain values or operations (translation, scaling and rotation). Kurtosis gives the frequency distribution of the image at its peak. Tailedness of the kurtosis graph provides the distribution of noise and image content within the image. Entropy gives the measure of randomness or uncertainty about the image content. Dataset comprises of these four image characteristics. To carry the binary classification task efficiently, the dataset should be fairly balanced. The first step of the proposed algorithm is data preprocessing. The task of data preprocessing is achieved by under sampling and over sampling methods. After the data is preprocessed, machine learning algorithm is applied on the dataset. In our approach, logistic regression is used. Logistic regression is a supervised machine learning algorithm which helps in the estimation of class label (original or fake) in our case using statistics. Supervised machine learning tasks can either be a classification or regression. Logistic regression unfolds the relationship between input characteristics and the probability of the desired target value. Cost function used in this case is the sigmoid function. After the model is selected, the selection of the training dataset is to be done. Usually 80 percent of the data instances are used as training instances. After the training data set is finalized, validation is to be done. Validation is carried out by running the data on test data or test data instances. If the model is valid i.e., it is producing desired output of whether the note is original or fake, then the process is done. If model is not producing desired results, it will reselect the training dataset and fine tune its parameters to get the correct classification result.

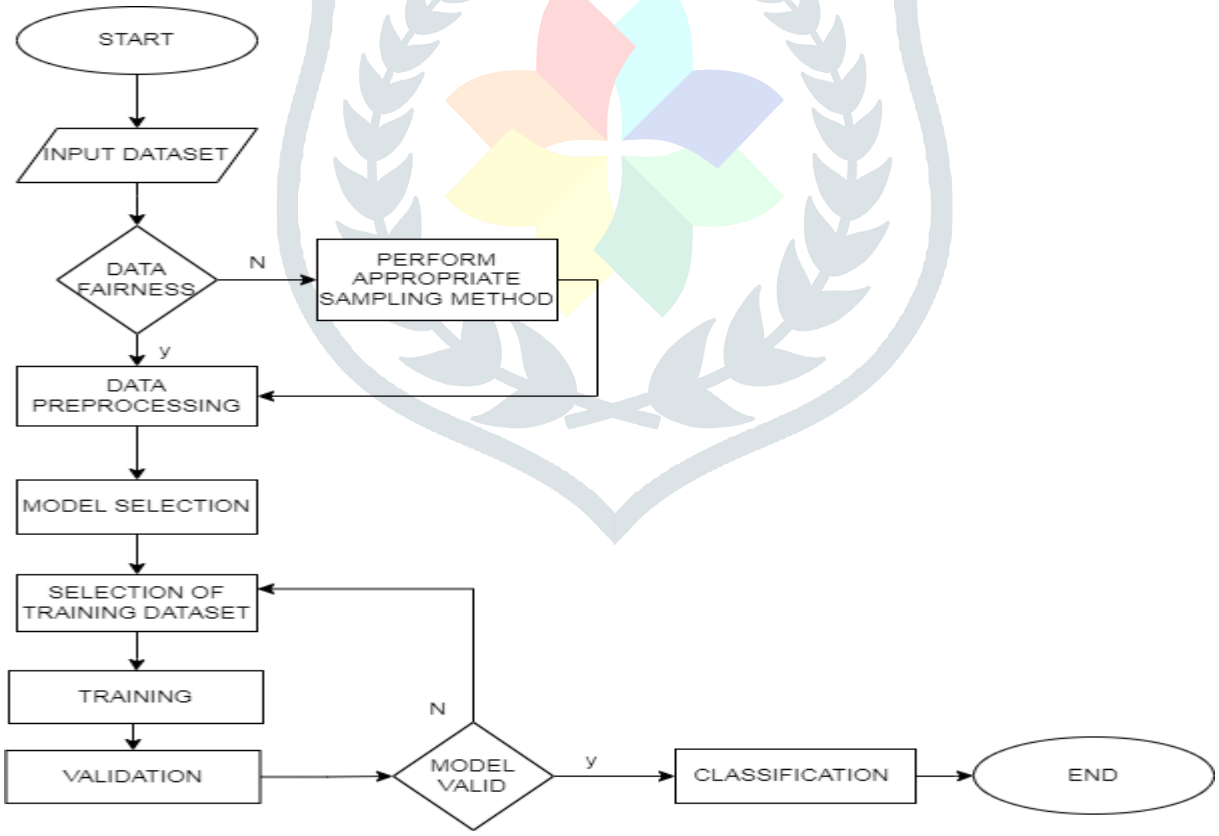

Figure 1 Flowchart of the proposed work

IV. RESULTS AND DISCUSSIONS

The experimental dataset used in this study consists of four image characteristics of fake and genuine banknote images from the Indian currency. After the validation of the model, the model is simulated. The simulations are conducted using 3.40GHz Intel® Core i7 Processor with 4GB of RAM. Dataset is explored and the fairness of data set is checked. To check whether the dataset is balanced or

not, we used pie chart distribution for the outcome variable as shown in Figure 2. Accuracy for our system means the model is correctly able to identify banknotes. It is the percentage of correctly identified banknotes. Accuracy is calculated by the formula given below:

$$\text{Accuracy} = \frac{retrieved\ correct\ notes}{total\ number\ of\ notes} * 100$$

The accuracy for our model is 98.36 %.

V. CONCLUSION

In this paper, the technique for counterfeit note detection is proposed as well as implemented. The input dataset comprises of variance, symmetry, kurtosis and entropy of image. These features are trained and fed to the logistic regression model. It is observed that the model performs. The model obtained an accuracy of 98.36%.

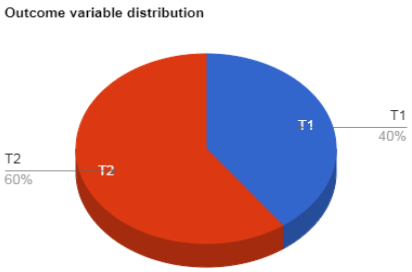

Figure 2: Distribution of dataset

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