FAKE CURRENCY DETECTION USING MACHINE LEARNING

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Abstract: Great technological advancement in printing and scanning industry made counterfeiting problem to grow more vigorously. As a result, counterfeit currency affects the economy and reduces the value of original money. Thus it is most needed to detect the fake currency. Most of the former methods are based on hardware and image processing techniques. Finding counterfeit currencies with these methods is less efficient and time consuming. To overcome the above problem, we have proposed the detection of counterfeit currency using a deep convolution neural network. Our work identifies the fake currency by examining the currency images. The transfer learned convolutional neural network is trained with two thousand currency note data sets to learn the feature map of the currencies. Once the feature map is learnt the network is ready for identifying the fake currency in real time. The proposed approach efficiently identifies the forgery currencies of 2000 with less time consumption.
Keywords: Convolutional neural network, Currency detection, Deep learning, Feature extraction, Image processing.

I. INTRODUCTION

Fake Indian Currency Note (FICN) is a term used by officials and media to refer to counterfeit currency notes circulated in the Indian economy. In 2012, while responding to a question in parliament, the Finance Minister, P. Chidambaram, admitted that there is no confirmed estimate of fake currency in India. However, several central and state agencies are working together, and the Ministry of Home Affairs has constituted the Fake Indian Currency Notes Co-ordination Center (FCORD) to curb this menace. Automatic currency note recognition technology is specific to a country and can be generalized with standard banknotes of each country.If there is a system which can identify a currency note as fake through a camera image is one promising direction towards solving this problem. Convolutional neural network models have seen tremendous success in image classification tasks. And identifying a currency note as fake or real from its image is essentially a binary image classification task. Here we test the feasibility of CNN models for fake currency identification, which can be trained without manual feature extraction on raw images of currency notes with a simple, efficient and very accurate approach.

II. PROPOSED SYSTEM

In our approach we are using Deep Learning models like Deep Neural Network and Convolutional Neural Network (CNN). Deep Learning techniques are able to capture composite relations between millions of pixels. CNNs are generally used in computer vision, however
they've recently been applied to various image classification tasks CNN is composed of two major parts:

- Feature Extraction: In this part, the network will perform a series of convolutions and pooling operations during which the features are detected. If you had a picture of a zebra, this is the part where the network would recognize its stripes, two ears, and four legs
- Classification: Here, the fully connected layers will serve as a classifier on top of these extracted features. They will assign a probability for the object on the image being what the algorithm predicts it is.

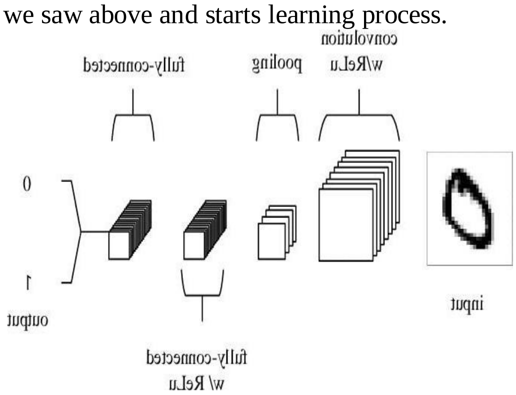
The proposed solution provides a fake currency detection system that understands the various features of currency like watermark, shape, alignment, picture of Mahatma Gandhi, a translucent feel and a security thread. The objective of system is to provide a better detection based on recorded information of currency. These systems use deep learning technique Convolutional Neural Network (CNN) to process information and provide the user with potentially more relevant prediction. Some of the main challenges in developing a system is to detect the fake currency and continuously update the system to adapt to the changes in the currency. The image processing techniques have some limitations, thus we are using Convolutional Neural Network (CNN) which has tremendous success in image classification tasks is used to overcome these limitations. The approach is as follows. Generate batches of tensor image data with real-time data augmentation by using the parameters like rotation range , width shift range , height shift range , rescale , horizontal flip etc. A binary classification sequential model is chosen. Deep Learning models Deep Neural Network and Convolutional Neural Network are constructed for training the model. The trained model will be tested and validated. Model will be fine-tuned for better performance.

III. IMPLEMENTATION

Data Pre-processing

Capture images of a 2000 INR note in different backgrounds exposed to different light conditions. Capture the images using different devices making sure the correlation of each pixel in terms of hex-ratio, z-index,… are above 95% confidence level. Run translation, rotation, and resolution algorithms setting a standard threshold factor to increase the volume of the dataset by a factor of 5X..Pick 50% of the dataset generated above and add a watermark in different coordinates of the image, remove or add additional lines at the edge using an image editor to mimic fake currency. Segregate the dataset in the ratio 90 : 5 : 5 for Training : Validation : Testing. Label the data manually as real or fake, the two possible classes. This would generate an exhaustive and a precise dataset suitable for training.

Model design
Series of layers to be implemented in the model are convolution, padding, pooling, flattening and full connection. In convolution operation there is a feature detector or filter. This filter detects edges or specific shapes. Filter is placed top left of image and multiplied with value on same indices. After that all results are summed and this result is written to output matrix. Then filter slips to right to do this whole process again and again. Usually filter slips one by one but it can be change according to your model and this slipping process is called ‘stride’. Bigger stride means smaller output. Sometimes stride value is increased to decrease output size and time. In Padding we have to keep as much information we can in early processes of CNN. But convolutional operations we mentioned above decrease size of image that’s why we apply padding to preserve our input size. Pooling is used reducing parameters and computation process. Also, by using this layer features invariant to scale or orientation changes are detected and it prevents overfitting. There are some pooling process like average pooling, max pooling etc. But mostly max pooling is used. Flattening is taking matrix that came from convolutional and pooling processes and turn it into one dimensional array. This is important because input of fully- connected layer consist of one- dimensional array. Full connection layer takes data from one-dimension array we saw above and starts learning process.



Learning Algorithm

Logistic Regression Classifier
The Logistic regression is named for the function used at the core of the method, the logistic function. It’s an S-shaped curve that can take any real-valued number and map it into a value between 0 and 1, but never exactly at those limitscontains the lung region, it also contains background, heart, liver and other organs areas. The main aim of this lung region extraction process is to detect the lung region and regions of interest (ROIs) from the CT scan image.

Hardware Requirement

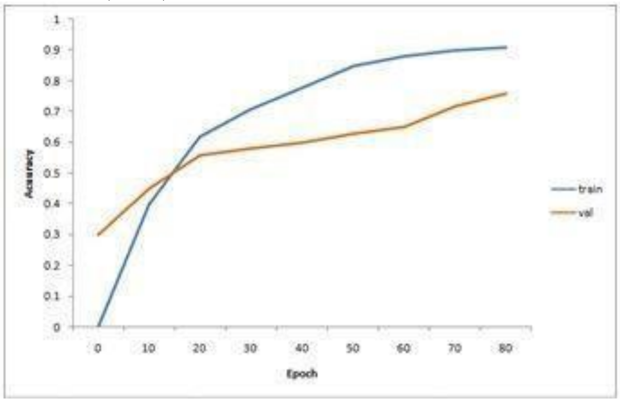
- Processor:Quad core Intel Core i7 Skylake or higher(Dual core is manageable)
- RAM: Minimum 6GB of RAM(16GB RAM is preferable)
- Storage: Minimum 500GB HDD(SDD is preferable for better performance)
- GPU:Premium Graphic cards like Nvidia 9x or 10x series(preferable to use graphic card that supports CUDA toolkit)

Software Requirement

- Operating System : Windows / Linux / MacOS
- Python 3+ : Programming language
- Keras 2.0+ : Library for neural network which uses TensorFlow as its backend
- TensorFlow 2.0+ : Deep learning library in python
- NumPy 1.18.2 : NumPy is the fundamental package for scientific computing with python.

IV. EXPERIMENTAL RESULTS

Fake currency detection has shown a good result. The neural network model for fake currency detection has gained training accuracy of 91% and validation accuracy of 76% with 80 epochs. The combined interface works without any delay and is a real time system that can be deployed.
Recall in this context is defined as the number of true positives divided by the total number of elements that actually belong to the positive class. In information retrieval, a perfect precision score of 1.0 means that every result retrieved by a search was relevant whereas a perfect recall score of 1.0 means that all relevant documents were retrieved by the search. In a classification task, a precision score of 1.0 for a class C means that every item labeled as belonging to class C does indeed belong to class C whereas a recall of 1.0 means that every item from class C was labeled as belonging to class C. Often, there is an inverse relationship between precision and recall, where it is possible to increase one at the cost of reducing the other. Our model achieved the precision of 0.936. In statistical analysis of binary classification, the F1 score (also F-score or Fmeasure) is a measure of a test's accuracy. It considers both the precision p and the recall r of the test to compute the score: p is the number of correct positive results divided by the number of all positive results returned by the classifier, and r is the number of correct positive results divided by the number of all relevant samples (all samples that should have been identified as positive). The F1 score is the harmonic mean of the precision and recall, where an F1 score reaches its best value at 1 (perfect precision and recall). The F1 score is also known as the Sørensen–Dice coefficient or Dice similarity coefficient (DSC).Our model achieved the f1 score of 0.84.



V. CONCLUSION AND FUTURE WORK

In this paper our model is performing the fake currency detection. The detection accuracy is most accurate since the currency characteristics features are learned through layer by layer. Here we have considered the whole currency image, but in future we will try to include all the security features of currency by employing suitable structural design and with suitable training data. Further, noise may be present in the captured image which has to be considered as a pre-processing step in currency detection process. The recognition and fake currency detection can also be extended by considering the patterns of currency surface as features for improving the detection accuracy.

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