Fake Currency Detection Using Deep Learning

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Abstract: Fake currency is the money produced without the approval of the government, creation of it is considered as a great Offence. The elevation of color printing technology has increased the rate of fake currency note printing on a very large scale. Years before, the printing could be done in a print house, but now anyone can print a currency note with maximum accuracy using a simple laser printer. This results in the issue of fake notes instead of the genuine ones has been increased very largely. It is the biggest problem faced by many countries including India. Though Banks and other large organizations have installed Automatic machines to detect fake currency notes, it is really difficult for an average person to distinguish between the two.

***KeyWords*:** deep learning, oversampled, convolution neural network.

1. INTRODUCTION

Computers and mobile phones have become an unavoidable part of our lives. There are a lot of things which we can do with these technologies. With the rapid development of mobile phones and technologies come several services like application creation - (refers to the process of making application software for handheld and desktop devices such as personal computers and Personal Digital Assistants. Fake currency Detection is a system that can be used to overcome the limitations most of the people and our institutions of higher learning face with respect to making difference between counterfeit currencies- (is imitation currency produced without the legal sanction of the state or government, usually in a deliberate attempt to imitate that currency and so as to deceive its recipient) and real currencies. The project involves making use of Digital Image Processing Domain - Digital image processing is the use of computer algorithms to perform image processing on digital images.

This has led to the increase of corruption in our country hindering the country's growth. Some of the methods to detect fake currency are watermarking, optically variable ink, security thread, latent image, techniques like counterfeit detection pens. We hereby propose an application system for detecting fake currency where image processing is used to detect fake notes. We will find out dissimilarities between the image under consideration and the prototype. CNN classifiers will be used to detect fake currency. The proposed system for fake currency detection will be simple, accurate and easy to use.

2. LITERATURE SURYEY

I. Counterfeit currency detection using deep convolutional neural network. Author: Prof Kiran Kamble, Anuthi Bhansali, Pranali Satalgaonkar, Shruthi Alagundgi. **Year**: 2019.

In this relevant paper, many recognition techniques are implemented to recognize images, recognize faces, recognize car license plates, and recognize human behaviours. Currency is the primary average for circulation, and Various countries' currencies have different qualities. However, when the value of currency grows, there will be an increase in counterfeit currency. Counterfeit money might damage these nations' interests. As a result, one of the hottest subjects and a critical issue at the moment is how to use recognition technology to the genuine of money (Zhang, 2018). Visual examination was used in the past to identify and genuine money, particularly currency notes. Our eyesight cannot sense everything; sometimes, it is not easy for humans to distinguish genuine currency from

auth genuine entice currency without the aid of technology.

II. Fake currency Detection using Basic Python Programming and Web Framework Author: Prof Chetan More, Monu Kumar, Rupesh Chandra, Raushan Singh. **Year**: 2020.

Currency duplication also known as counterfeit currency is a vulnerable threat on economy. Although fake currency is being printed with precision, the Crime Investigation Department (CID) says that they can be detected with some effort. Currency printed by local racketeers can be detected easily as they use the photographic method, hand engraved blocks, lithographic processes and computer colour scanning. In counterfeit notes, the watermark is made by using opaque ink, painting with white solution, stamping with a dye engraved with the picture of Development of an analytic tool for software-based vehicle condition analysis for resales.

Mahatma Gandhi. Tourists are the most vulnerable people to fake currencies, because they don't know the proper and precise way of finding the difference between fake and real currencies note. So automatic identification of currencies using image processing technique will be helpful to these peoples.it is also be useful at other workplaces. . The system designed to check the Indian currency note with denominations 10, 20, 50, 100, 200, 500 and 2000. It will pre-process the digital pictures and organize the prepared arrangement of information and it will distinguish in monetary forms. This paper proposes a convenient and cheapest method for identifying Indian currencies. At the end of the process user can know whether the currency note is fake or real and its equivalent currency value into more than 150 counties

III. Hidden security features for the recognition of fake currency Author: - K Lavanya, T B Bhaskara Reddy. **Year:** 2018.

System proposed in this paper the note is checked by using image processing techniques like image acquisition, reprocessing, and image enhancement. The main objective of this is to specify about several security features of the highest denomination note introduced in year 2016. If the object is smaller than the pixel size then it cannot be applied.

IV. Identification of fake notes and denomination recognition. Author: Archana MR, Kalpitha C P, Prajwal S K, Pratiksha N. **Year**: 2018.

Image processing is a rapidly growing area of research with application to various aspects of business. Image processing is used to convert an image to digital as well as to obtain certain types of information from the same. The image processing and processing modes include analog and digital image processing. Digital image processing techniques helps to manipulate digital images with computers. The system uses computer algorithms for image processing which is better than analog processing and prevents various processing problems such as noise and signal distortion that provides more complex algorithms and implementation of methods that are not possible in analog design. Currency is used as the medium of exchange for goods and services. Human error is a huge concern in cases where large amounts of cash transactions are conducted, leading to a push for increase in automation of transactions in the banking sector. Indian paper currency consists of six major denominations, with each having distinguishing features, such as size, prominent color, identification mark. With the development of sophisticated printing techniques, counterfeit currency has become a significant concern. Some of the consequence of counterfeit notes on society are a reduction in the value of real money, increase in prices due to more money being circulated in the economy and decrease in acceptability of money. To prevent circulation of counterfeit notes, a system to detect fake notes must be developed. Notes with the legal sanction of the government possess certain security features such as intaglio printing, fluorescence and watermark. So far, many different approaches have been proposed to solve the problem of paper currency recognition and verification. The trade-off between accuracy, complexity and response time becomes the main hurdle to overcome.

3. METHODOLOGY

The main stages involved in this method are Data Collection-processing, Feature extraction, prediction model and evaluation

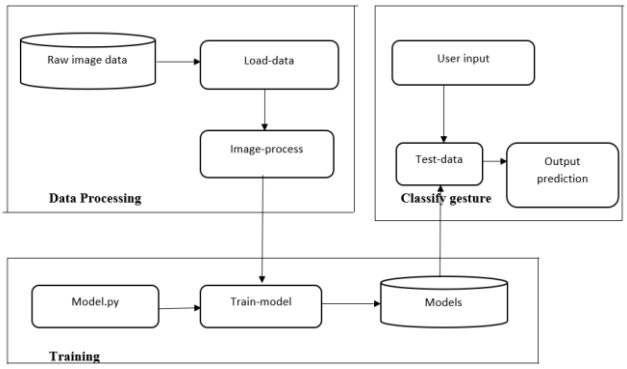


Figure 3.1: Methodology

STAGE 1: GATHER YOUR DATASET

The first component of building a deep learning network is to gather our initial dataset. We need the images themselves as well as the labels associated with each image. These labels should come from a finite set of categories, such as: categories=fake and real currency. Furthermore, the number of images for each category should be approximately uniform (i.e., the same number of examples per category) then our classifier will become naturally biased to overfitting into these heavily-represented categories. Class imbalance is a common problem in machine learning and there exist a number of ways to overcome it. We'll discuss some of these methods later, but keep in mind the best method to avoid learning problems due to class imbalance is to simply avoid class imbalance entirely. As our system is mainly focusing on detection of fake currency, we gathered our data as images. The dataset obtained consisted of several images in which tumor is present and in several images of fake and real currency.

STAGE 2: SPLIT YOUR DATASET AND PREPROCESSING

Now that we have our initial dataset, we need to split it into two parts:

1. A training set

2. A testing set

A training set is used by our classifier to "learn" what each category looks like by making predictions on the input data and then correct itself when predictions are wrong. After the classifier has been trained, we can evaluate the performing on a testing set. It's extremely important that the training set and testing set are independent of each other and do not overlap! If you use your testing set as part of your training data, then your classifier has an unfair advantage since it has already seen the testing examples before and "learned" from them. Instead, you must keep this testing set entirely separate from your training process and use it only to evaluate your network. Common split sizes for training and testing sets include 66:6%33:3%, 75%=25%, and 90%=10%, respectively.

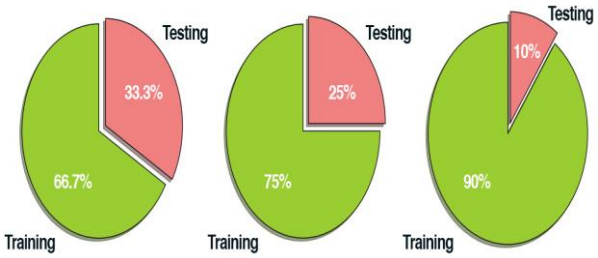


Figure 3.2: Examples of common training and testing data splits.

These data splits make sense, but what if you have parameters to tune? Neural networks have a number of knobs and levers (ex., learning rate, decay, regularization, etc.) that need to be tuned and dialed to obtain optimal performance. We'll call these types of parameters hyperparameters, and it's critical that they get set properly. In practice, we need to test a bunch of these hyperparameters and identify the set of parameters that works the best. You might be tempted to use your testing data to tweak these values, but again, this is a major no-no! The test set is only used in evaluating the performance of your network. Instead, you should create a third data split called the validation set. This set of the data (normally) comes from the training data and is used as "fake test data" so we can tune our hyperparameters. Only after have we determined the hyperparameter values using the validation set do we move on to

collecting final accuracy results in the testing data. We normally allocate roughly 10-20% of the training data for validation. If splitting your data into chunks sounds complicated, it's actually not.

Pre-processing

The primary target is to improve image highlights needed for additional processing. Here, the input image is converted into grayscale image for all the further preprocessing purposes. The image is then thresholded and further erosion and dilation is applied to the thresholded image. This image is used to extract the contours and extreme points.

STAGE 3: TRAIN YOUR NETWORK

Given our training set of images, we can now train our network. The goal here is for our network to learn how to recognize each of the categories in our labeled data. When the model makes a mistake, it learns from this mistake and improves itself. So, how does the actual "learning" work? In general, we apply a form of gradient descent.

. **STAGE 4**: EVALUATE

Last, we need to evaluate our trained network. For each of the images in our testing set, we present them to the network and ask it to predict what it thinks the label of the image is. We then tabulate the predictions of the model for an image in the testing set. Finally, these model predictions are compared to the ground-truth labels from our testing set. The ground-truth labels represent what the image category actually is. From there, we can compute the number of predictions our classifier got correct and compute aggregate reports such as precision, recall, and f-measure, which are used to quantify the performance of our network as a whole.

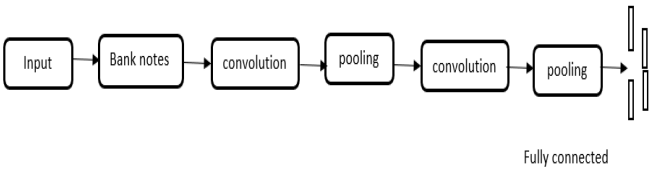


Fig 3.2 TRAINED MODEL

Convolutional Neural Network

CNN is utilized to get better result. The signal convolved with kernels to get include map. Past layers are interconnected with weights of the kernel. To upgrade the qualities of information image by back propagation calculation. Since feature maps of all units shared by the kernels. It will serve to reduces over fitting. Each data of neighborhood is taken by utilizing kernels. Kernel is a major source of context information. Activation function is applied to the output of neural network.

- Convolutional Layers

Objective of the convolution layer is to take or extract the features from the input [image], just the part of picture is link to the following convolution layer.

- Padding

Padding is incorporating a zero layer outside the input volume so the data on border won't be lost and we can get a similar dimension of output as input volume. Here we are using zero padding.

- Activation Function

Non- linear activation function ReLU (Rectifier Activation function) is used to provide accurate results than classical sigmoid function.

- Pooling Layer

It is used for combining spatially nearby features. Max-pooling is generally used to join features. It decreases the dimension of input image and controls over-fitting.

Algorithm used:

CNN Algorithm

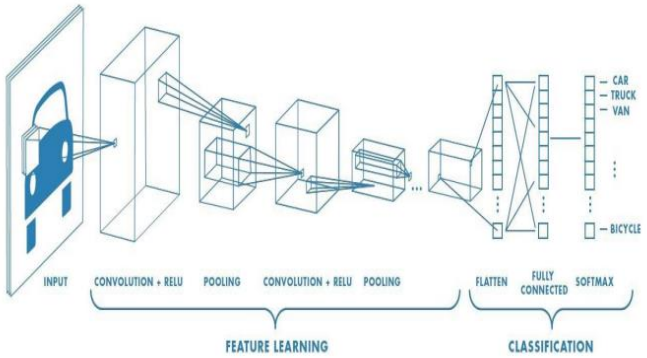


Figure3.3: External view of CNN

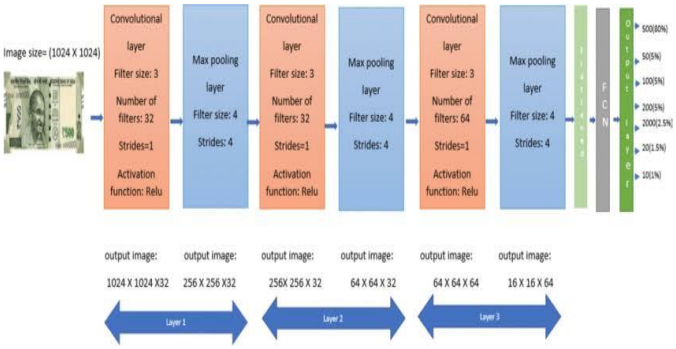


Figure 3.1 Functions of CNN

CNN works by extracting features from the images. Any CNN consists of the following:

1. The input layer which is a gray scale image

2. The Output layer which is a binary or multi-class labels

3. Hidden layers consisting of convolution layers, ReLU (rectified linear unit) layers, the pooling layers, and a fully connected Neural Network

It is very important to understand that ANN or Artificial Neural Networks, made up of multiple neurons is not capable of extracting features from the image. This is where a combination of convolution and pooling layers comes into the picture. Similarly, the convolution and pooling layers can't perform classification hence we need a fully Connected Neural Network.

The role of CNN is to reduce the images into a form that is easier to process, without losing features critical towards a good prediction. This is important when we need to make the algorithm scalable to massive datasets.

4. RESULTS

The proposed method uses convolutional neural network. The developed network is tested with a database of 100 images per currency, by taking fifty images as such as captured image and another 50 images are augmented images. The database image of Indian currency 50, 100, 200 and 500 real notes are shown in figures. The detection of real currency rate is shown in table 1. The scheme has been verified with the use of authentic Indian currencies and counterfeit currencies. The average accuracy for the real currency and counterfeiting was 81.5% and 75%, respectively. The total processing elapsed time of the model is 3 seconds. The proposed system is better by an approximate accuracy of 26% than VGG network. The performance is better but still it can be improved by increasing the database count.

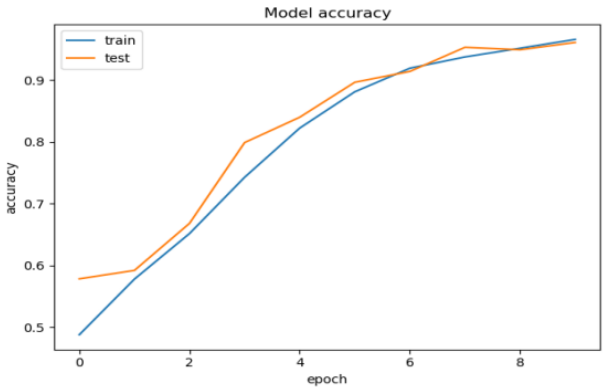
Figure 4. Database image of currency a) 50-rupee

b) 100-rupee

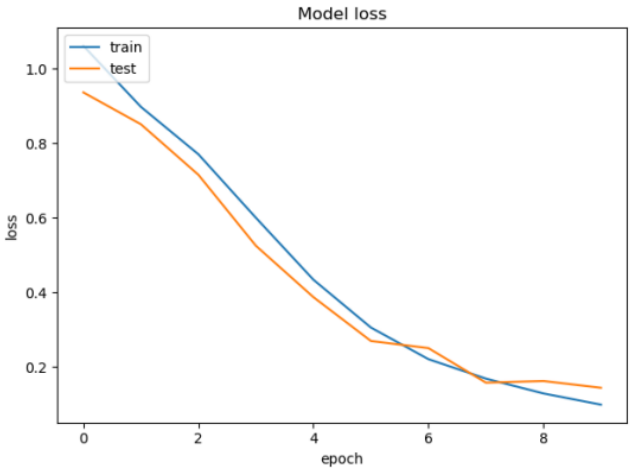
c) 200-rupee

d) 500-rupee

Accuracy v/s Epoch



Accuracy v/s Loss



5. CONCLUSION

Since the monetary property highlights are discovered layer by layer, the discovery precision is often great. We've looked at the whole image of money so far, but in the future, we'll try to include all of the security features of money by using a fair fundamental structure and providing sufficient preparation information. Furthermore, clamour may be present in the captured image, which must be taken into account as a pre-handling step in the money location procedure. It is also possible to achieve recognition and phone money recognition by using examples of cash surface as highlights for enhancing the finding precision. As a result, the various strategies presented in this research were effectively implemented and tested by experiments on the model. Using the modules, CNN was shown to be the optimal feature for performing the approach. By

doing model classification, we were able to attain a 95% accuracy rate. In addition, the detection of coins works effectively in this manner.

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