



Detection of Fake Currency

Comparison of Image Processing, Bag of Features and Deep Learning methods to detect Fake Currency

¹Purva Reshmi Rajesh, ²Sandhya M, ³Swarnashree T, ⁴K Sasikala M.E

¹Student, ²Student, ³Student, ⁴Assistant Professor

¹Electronics and Communication Engineering Department,
¹Meenakshi Sundararajan Engineering College, Chennai, India

Abstract: Fake currency is a big problem that affects our economic growth and it decreases the value of real money. The fake currency production has been growing erratically recently. So, to reduce the circulation of fake currency within real money, it must be detected and eradicated. Our model uses Image Processing, the Bag of Features Method, and Deep Learning. We will distinguish between real and fake currency using the above methods. Image processing is transforming an image into a digital form and performing certain operations to get useful information from it. Bag of Features is an Advanced Image Processing Technique that works by treating images as words. It serves as a bridge between Image Processing Techniques and Neural Networks. Deep learning is part of Machine Learning and is based on artificial neural networks.

Index Terms – Fake Currency Detection, Image Processing, Bag-of-Features Model, CNN

CHAPTER 1

1.1 INTRODUCTION

Ever since the invention of currency, we have had the concept of counterfeit currency. Even before we started using paper notes as currency, counterfeiters would make sure to find to gain more than the item's worth. Now, counterfeit money has evolved into a huge black market. It affects our society through the reduction in the value of real money, and inflation due to more money getting circulated in society, which in turn dampens our economy and growth. This unauthorized artificial increase in the money supply causes a decrease in the acceptability of paper money and losses to innocent people.

1.2 PROBLEM STATEMENT

We should not assume that counterfeit currency is no longer an issue due to advancements in security features and detection technology, but it has increased with the development of technology. Nowadays, we can use cheap inkjet printers to print money, and anyone can attempt counterfeiting. In 2016, 10 people in different areas of Dhaka and Narayanganj were arrested along with a huge supply of counterfeit notes. Bangladeshi counterfeit currency worth 6.6 million Taka, four laptops, and seven printers, two stacks of security threads used in 1,000 notes, and a haul of fake currency-making materials were detained from them. Therefore, we need to make the right kind of technological investments to find and root out money counterfeiting networks on a large scale.

1.3 EXISTING SYSTEM

Hardware Based Fake Currency Detection

I. UV Detection

II. Magnetic Detection

III. Infrared Detection

IV. Watermark Detection

V. Size, Microtext Detection

VI. CIS (Contact Image Sensor) - Scanned currency note is compared with the image saved in memory.

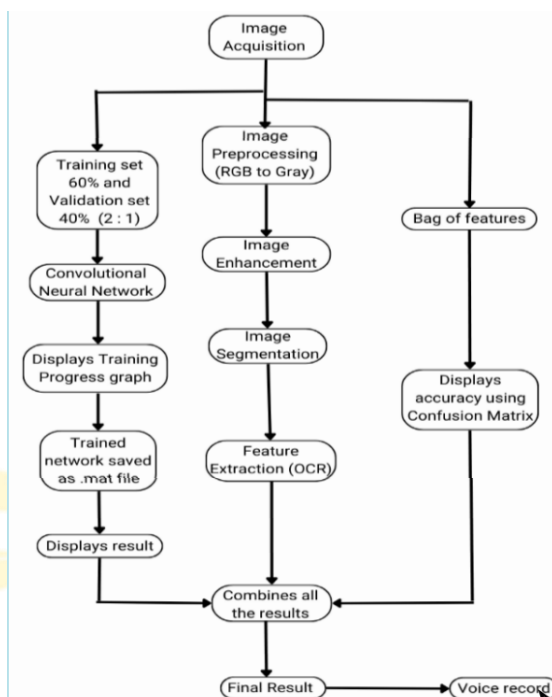
Disadvantage: Hardware Based and Costly

CHAPTER 2

2.1 BLOCK DIAGRAM

The block diagram in figure 1 consists of several stages that work together to detect fake currency. The first stage is the image acquisition stage, where a currency note is captured and pre-processed to remove any noise or artifacts. The pre-processed image is then passed through an OCR algorithm that extracts text and numerical values from the note. In the next stage, the extracted features

from the OCR algorithm are fed into a Bag of Features (BoF) model. This model extracts more sophisticated visual features from the currency note and generates a high-dimensional feature vector. Finally, the feature vector is fed into a Convolutional Neural Network (CNN) model, which classifies the currency note as real or fake. The CNN model learns to identify the subtle differences between real and fake currency notes based on the extracted features and provides a binary output indicating whether the currency note is genuine or counterfeit. Overall, the block diagram shows how the combination of OCR algorithm, Bag-of-Features, and CNN can be used to detect fake currency by extracting and analyzing visual features of currency notes.



2.2 HARDWARE REQUIREMENTS

- I. HDD: >90GB
- II. PROCESSOR: >Pentium IV 2.4GHz
- III. SYSTEM TYPE: 32 bit / 64 bit
- IV. RAM: >2GB
- V. OS: WINDOWS 7/8/8.1/10
- VI. PC / LAPTOP

2.3 SOFTWARE REQUIREMENTS

TOOL: MATLAB 2018a

2.4 PROPOSED SYSTEM

2.4.1 IMAGE PROCESSING STEPS

In the first stage, the testing image will be loaded from the disk. This image is the currency note which we want to check if it's fake or not. Then the image will be converted to gray to continue the next level of process. We can't process the RGB image in feature extraction, because it contains 3x3 matrices. So, we convert the Color image into gray. The next stage is the image enhancement. we need clear information about the image, we must enhance the image. In the next stage, a canny edge detection algorithm was used. It is used for sensing to extract the Optical Variable Detection feature of banknotes. Optical character recognition (OCR) is the classification of visual patterns contained in a digital image relating to alphanumeric or other characters. Character recognition is achieved through the steps of segmentation, feature extraction, and classification. Then we identify the realness of the currency.

2.4.2 BAG OF FEATURES STEPS

Bag-of-feature methods are used to find out the accuracy and confusion matrix of the data by analyzing the data. Bag-of-features model or bag-of-visual-words model comes from computer vision, where images are classified by treating them as words. In document classification, bag-of-words creates a sparse vector of occurrence counts of words; that is, a sparse histogram of the vocabulary.

2.4.3 DEEP LEARNING STEPS

Deep learning is part of Machine Learning and is based on artificial neural networks. Learning can be supervised, semi-supervised, or unsupervised. Here, we are using CNN.

CHAPTER 3

RESULT

Image Input is Chosen in the GUI from an Input Dataset of two folders named 'Fake' and 'Original' consisting of Fake and Original Currency notes respectively.

Name	Date modified	Type	Size
fake	19-03-2023 08:47	File folder	
original	19-03-2023 08:47	File folder	

Transform Techniques where Filters such as Matrix to Grayscale, Image to Binary, bwareaopen, Morphological close, Fill holes, Perimeter, Standard deviation grayscale, Range filter, Textured image and Color Separation are applied. This is used to analyze the various properties of the Input Currency.



- I. Matrix to Grayscale** - mat2gray - Converts matrix to grayscale image
- II. Image to Binary** - im2bw - Convert image to binary image, based on threshold
- III. Bwareopen** - bwareaopen - Remove small objects from binary image
- IV. Morphological close** - imclose - Morphologically close image



- V. Fill holes** - imfill - Fill image regions and holes
- VI. Perimeter** - bwperim - Find perimeter of objects in binary image
- VII. Standard Deviation + grayscale** - stdfilt - Local standard deviation of image
- VIII. Range filter** - rangefilt - Local range of image
- IX. Textured Image**

```
Textured_picture = im2bw(I, .6);
Textured_picture = bwareaopen(Textured_picture, 80);
```



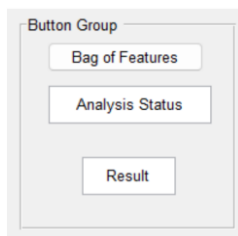
- X. Color Features** - Image is separated by colors and a Montage of Red, Green, Purple, Magenta, and Yellow Objects, and Background is Displayed.

Image Processing Techniques are applied, the various stages of the image during Image Processing are displayed such as RGB to Gray, Image Enhancement, Image Segmentation. Finally, a bounding box appears on the various features that are being compared after Image Processing.

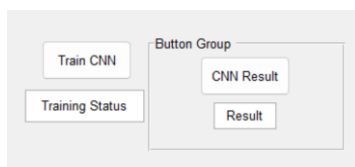


- XI. Bounding Box** - regionprops - Measure properties of image regions

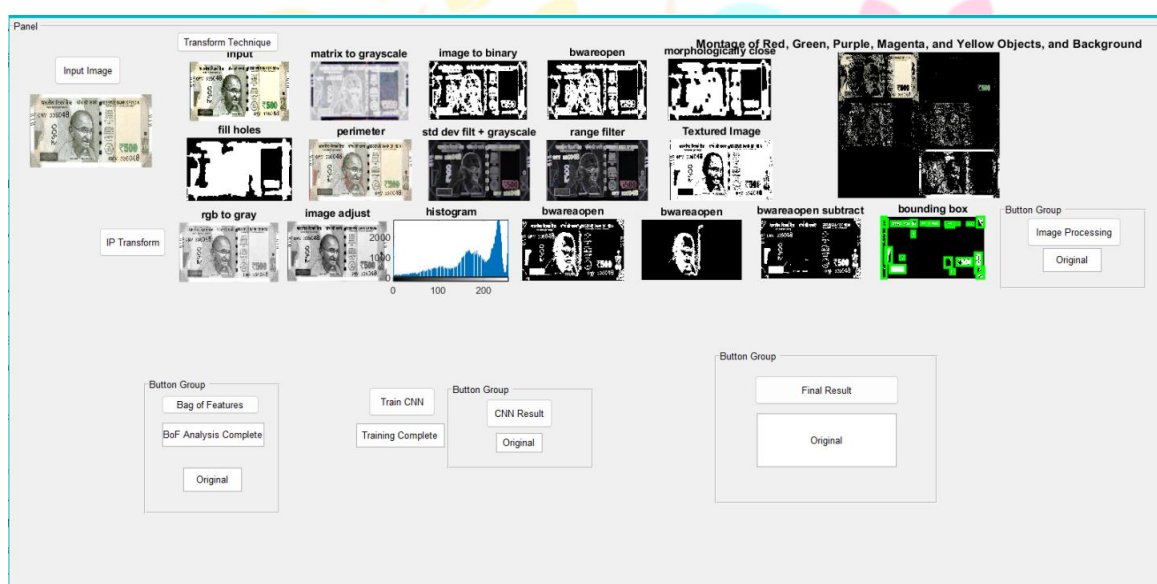
The Image is Determined as 'Original' or 'Fake' using Character Recognition of features.



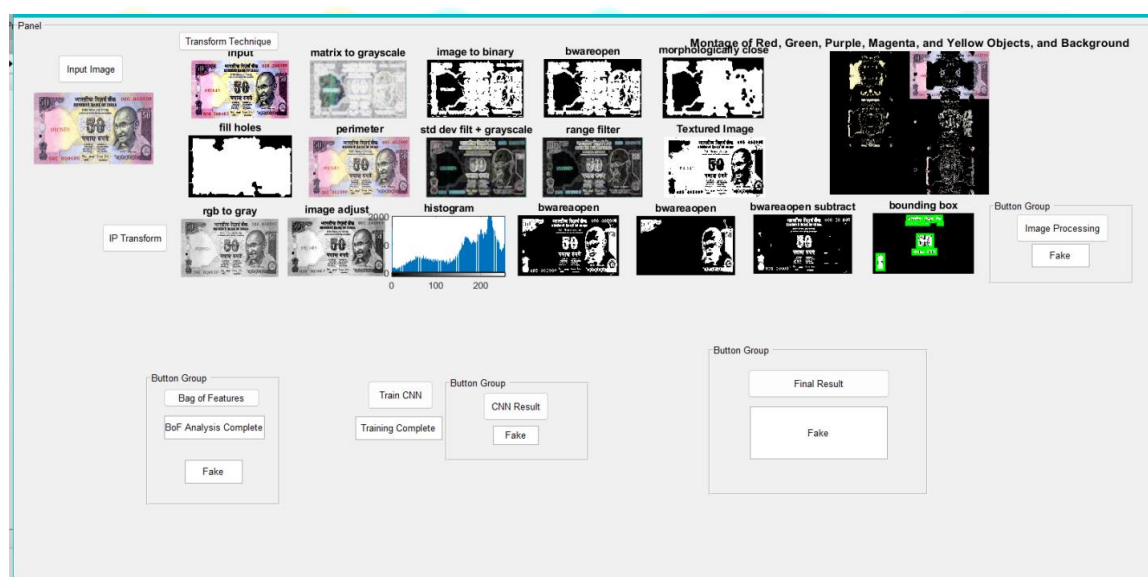
On clicking the 'Bag of Features' button on the GUI, the Bag of Features Algorithm is Performed and a Bag of Visual Words Model is created using K-Means Clustering. The Result of Bag of Features algorithm is displayed based on the Input dataset and the output is determined as 'Original' or 'Fake'.



On Clicking 'Train CNN' button, the CNN is trained and the training epoch is displayed. CNN result is determined as 'Original' or 'Fake'.



Original Currency Output



Fake Currency Output

The above FIGURES represents the complete output using Real Currency and Fake Currency Respectively.

CHAPTER 4**CONCLUSION & FUTURE WORK**

We have multiple fake currency detection machines available, that not only detect counterfeit notes but also count them. Our features can be integrated to give an additional layer of security and validation. This will result in a highly reliable counterfeit currency detector that would be helpful for banking purposes. This project discussed a technique for verifying Indian paper currency and an effort to suggest an approach to extract the features of Indian currency. In the Future, this software can be integrated into Mobile apps and be made useful for the visually impaired. Similarly, this system can be extended for the remaining Indian currency notes and other countries' currency notes. Additionally, this app's interface can be further modified as per the user requirements. This will increase its use and user network especially since India is going to establish the largest digital network in the world in the coming years.

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