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CS 419 Project Write-up
Fake Currency Detection using Computer Vision Techniques

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1 Introduction

Currency is an important innovation in human history and has made transactions of goods and services a global possibility. These notes are published for public use by the governments of respective nations in authorised printing centers. However, a few malignant sections of the society indulge in illegal dissemination of fake currency notes in the market. This further leads to loss to victims of these scams. As a counter measure, the real currency notes contain various security landmarks which are difficult to imitate and hence can be differentiated from their counterfeits. However, it is getting increasingly difficult to manually detect fake currency notes given the technological advancements accessible by the malignant scammers. Therefore, this situation leads to the need of a system which can detect fake currency notes with better accuracy than humans and which is also convenient enough to be used by common people in their day to day transactions. Hence, we have proposed to work upon the project of "Fake Currency Detection using Computer Vision Techniques". In the next section, we formally define our problem.

2 Problem Statement

Given an input image X of a currency note of a specific denomination and represented as a three dimensional matrix of size $m \times n \times 3$ where m & n represent the number of rows and columns of the image respectively and 3 represents the number of channels (Red, Green and Blue), we have to formulate a binary function $f(X)$ which outputs 1 if the image X corresponds to a fake currency note and 0 otherwise. Mathematically stating,

$$f(X) = \begin{cases} 1 & \text{if X is image of fake currency note} \\ 0 & \text{if X is image of real currency note} \end{cases}$$

3 Related Works

Pilania *et al.* [4] claimed that manual checking cannot result in 100% accuracy, therefore, any new note needed to be classified should be compared with an already existing images which we know certainly is genuine. This comparison was done using the HSV values. HSV stands for Hue Saturation Values wherein a color is described using its shade (amount of gray) and its brightness (value).

Nagpure *et al.* [2], Patil *et al.* [3] and many other prominent papers in this regard follow a similar approach. They first pre-process the image, wherein smoothing and noise removal happens. After this, an appropriate edge detection is selected and applied from which a sufficiently accurate boundary of the currency note is obtained. Post this, image segmentation happens wherein we locate the various entities of interest in our note like the serial number, emblem of the bank, etc. which aid the distinction between a genuine and a counterfeit note.

4 Our Approach

As proposed by Hritik *et al.* [1], a major paradigm shift in the domain of fake currency detection can be brought by Deep Learning techniques provided that there is sufficient amount of data in the domain. However, Deep Learning can also be used with lesser data points using Transfer Learning.

There are various Deep Convolutional Neural Networks (DCNNs) which are trained over millions of data points and are highly accurate in generating encodings of input images. The initial layers of DCNNs are responsible for analyzing basic features like edges, segments etc which are common for all the image analysis problems. The final layers are responsible for learning dataset specific features. This characteristic of DCNNs is exploited in Transfer Learning wherein only the last few layers of a DCNN are trained on a new dataset with lesser number of datapoints. Training of all layers of a DCNN is avoided for smaller datasets to avoid overfitting.

Therefore, following on similar lines, we propose our step-by-step approach to solve the problem of fake currency detection:

1. **Image Processing:** This step involves basic steps like noise removal, image size fitting etc.
2. **Deep Convolutional Neural Network:** This step involves feeding the processed image into a DCNN
3. **Classification:** From the features obtained from DCNN, a classifier can be applied to denote if the input image was of real or fake currency

5 Proposed Novelty

Hritik *et al.* [1] proposed to use VGG16 as the DCNN in the above proposed approach. Our proposed novelty which we would explore in our project are as follows:

1. We propose to explore other Convolutional and Attention based Deep Learning architectures for classification
2. We propose to combine image processing techniques used in earlier works with DCNNs in order to have better input features for DCNNs

References

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