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Indian Currency Recognition and Verification using Transfer Learning

Rajiv Vincent[1], Prayag Bhatia,[1] M. Rajesh[1], Arun Kumar Sivaraman[1], Mohammed Said Sulaiman Al Bahri[2]

[1]School of Computer Science and Engineering
Vellore Institute of Technology
Chennai, Tamilnadu, India

[2]Information Technology
Higher College of Technology
Sultanate of Oman

email: rajiv.vincent@vit.ac.in, prayag.bhatia2015@vit.ac.in,
rajesh.m@vit.ac.in, arunkumar.sivaraman@vit.ac.in,
mohammed.albahri@hct.edu.om

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Abstract

One of the major setbacks to the economy of a country is the production of fake currency. In recent past due to advancements in technologies in color printing, duplicating newer ways of faking the currency are coming into the picture. The problem has even risen in larger scale after demonetization in India and many fake currencies have entered the market. According to recent data, the Reserve Bank of India has estimated nearly around 2 trillion worth currency as counterfeit currency. This increase in fake currency has been a major problem, especially for a common person, and now that even the banks and ATM's are disbursing fake currency. Almost everyone from a vegetable seller to a businessman is wary of accepting currencies in denominations of 500 and 2000 because they look almost exactly like a real note. The only solution to this problem is fake currency

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detector machines which are widely used and are mostly available in banks but which is not reachable every time by the average citizen. By building this system we hope to build an easy and efficient way to identify fake currencies which can be of great help to the common citizen. The application would be easily accessible to common people. Not only identifying if a note is fake or not, but our system is also even capable of recognizing the currency scanned. We have performed currency recognition and verification using Transfer Learning on AlexNet. The idea proposed by our system is to capture the image of currency notes of domination's 100, 200, 500, 2000 through mobile and after processing tell if the currency is fake or not and check its denomination value. Verifying the currency has many applications in banks as they have to deal with counterfeit currency every day. Our system would be extremely useful for a person with a mobile phone to check the authenticity of his currency note. Recognizing the currency note can be a useful feature for the visually impaired as there would also be a voice announcement on recognizing and verification of a currency note.

1 Introduction

The motivation behind this project was the lack of ways for people to find out whether a note they are dealing with is fake or real. Our most important target is the average citizen so that he/she can check a note for authenticity. There are Fake Currency Detector [8] machines available in the market but it is quite expensive for a normal citizen of India to spend. The proposed solution enables users to use their smartphones to detect if the currency note is fake or not and also detect its monetary value. The system is implemented using Transfer Learning on AlexNet on MATLAB. The system scans a currency note using a mobile phone and tells if it is a fake note or not and the currency value. The reason behind using Transfer Learning instead of building a deep neural network from scratch was the limited availability of data set. It is very difficult to gather a fake currency data set which looks similar to the real currency. Making a Convolutional Neural Network (CNN) from scratch would require a huge amount of image data.

2 Proposed Solution

The solution proposed consists of two parts: Currency Recognition and Currency Verification. The note is scanned from the mobile using IP Webcam application and captured. The currency note is then classified either as fake or real under currency verification and tells the currency denomination under currency recognition. There is also a voice announcement feature for the visually impaired using text to speech functionality. The system even sends a notification on a user's phone informing him/her of the result of currency detection and recognition.

2.1 Database Creation

Since it was difficult to gather fake currency which looks almost exactly as a real one, for the project implementation point of view we considered currency notes as real notes when the security features like Gandhi watermark image and thread were visible under light and the rest of all images are considered as fake notes. For recognition, around 40 images were captured for currency denominations of Rs 100, 200, 500 and 2000 under different lightning conditions. For verification between a real and fake note, 80 images of both fake notes and real notes were stored in the database. Under both sets that is verification and recognition, 70 percent of images were used for training and the remaining 30 percent of images were considered for testing.

2.2 Transfer Learning

Transfer learning is the process of reusing the pre-trained model already trained for our classification purposes [3]. The main idea behind transfer learning is to learn from the model where many data was used to train the model. It has vast importance in fields of Natural Language Processing and Computer Vision and can be very efficient as compared to building a CNN model from scratch. It works on a very basic idea. Usually in neural networks, they learn to detect very simple features like edges and shape the classification objects in middle layers. In the final layers our model becomes trained enough to classify objects as in computer vision. In Transfer Learning, we usually change the final layers so that model becomes capable of classifying our problem tasks. We try to use as much information as possible for our training purpose and try to bind them in our new classification models. Transfer learning is usually applied to models, which had been trained with

millions of images and can be used to classify many things. By just changing the final layers of the pre-trained model, we can save many resources and use it for our classification task. The main reason behind using transfer learning was the lack of data. Our project, which recognizes the currency note and verifies it to be fake or not, is built on limited data because it was impossible for us to gather a huge dataset of fake currency. Usually, in models which are built from scratch we require huge amounts of dataset. That is why we decided to go with transfer learning which uses the already defined knowledge from predefined models to classify our new tasks and even provides great accuracy.

2.3 Alexnet

The pre trained model used in transfer learning in our project is AlexNet which is the name of the CNN which was developed by Alex Krizhevsky and published with Ilya Sutskever and Krizhevsky's Ph.D advisor Geoffrey Hinton. On September 30, 2012, Alexnet competed in ImageNet Large Scale Visual Recognition Challenge and surprisingly it achieved a top-5 error of 15.3. AlexNet was originally written in CUDA language and it required GPU support to run. AlexNet is designed to recognize 1000 object categories and thereby even trained by millions of images. For our project, we had divided the image dataset into training and testing set in the ratio of 70 to 30 dataset are changed to the size of [227 227 3] which is the standard size of input in the AlexNet Neural Network. The final layers in the network were replaced to classify our new set of images. The rate of learning is slow in initial layers by keeping a very small learning rate, while to quickly recognize our dataset the rate of learning in final layers is kept high. An RGB image of size 227 X 227 is given as input to Alexnet. If the input image is not of that size it is cropped so that it becomes of size 227 X 227. If the input to AlexNet is a grayscale image, it needs to be converted to an RGB image by replacing the single channel to obtain a 3-channel RGB image. Random crops of size 227 X 227 are formed from inside the 256 X 256 images to feed the first layer of AlexNet.

3 System Deployment

1) Install IP Webcam and Pushbullet from the Playstore.
2) Log in to the Pushbullet application on both of your device.
3) Run the Graphical User Interface (GUI) in the MATLAB program.

4) Load the trained neural network in the workspace.
5) Make sure that the laptop and the mobile phone are connected on the same network.
6) Open the IP webcam application and start the server.
7) Focus the camera on the currency note to be verified.
8) Click capture image on GUI button and the image is displayed on the screen.
9) Click recognition button GUI to check the value of the note.
10) Click Verify note button GUI to check if the note is valid or not.
11) The result of the process would be displayed in the textbox provided in the GUI.
12) The voice announcement feature will announce the result and the user will also get a notification on his/her phone.

4 Results

The note is easily recognized and verified in real time without editing and the result of the system is displayed to the user in three ways which include the text box in the GUI, voice announcement and the notification on the mobile device. The implementation was successful even in improper lighting conditions, background disturbance and with a normal smartphone camera with basic specifications. The accuracy for currency recognition was found to be 93 % on test data whereas accuracy of 96 % in case of currency verification.

5 Conclusion

The above system has been implemented using MATLAB which uses Transfer Learning algorithm on AlexNet for the purpose of Recognition and Verification of the Indian currency. This program helps an average Indian citizen to recognize the value of the note and the authenticity of the note with utmost ease. The Voice announcement feature which makes a sound of the result helps the visually impaired. We have used a normal mobile phone camera in our program which will make sure people don't have to spend a single penny for using this system.

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