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Automatic Indian New Fake Currency Detection Using Deep Learning

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Abstract: ***In India,' currency' is the means of Transaction so there is more value for currency in our social and economic development. Here, currency exists in the form of coins, banknotes and electronic data. Fake money or counterfeit notes is the dangerous or acute problem in front of whole world, and India is also a part of this fake currency. Modernization in the financial system is a milestone in protecting the economic development and now a days Indian government has become conscious about this so demonetization of Rs 1000 and Rs 500 notes is the latest example of it. But again we have Rs 2000 as a new currency in market. so as the highest value note there is a chance that corrupt people will try to make it as a counterfeit. we have used our dataset with real and fake currency notes and then trained InceptionV3, VGG16, Resnet50 and Custom CNN on that dataset. After training VGG16 and Custom CNN giving more than 90% validation accuracy and InceptionV3 and Resnet50 shown poor performance. We have coded this project using JUPYTER notebook.***

General Terms - Image Processing, feature extraction, detection.

Keywords - Segmenting feature of currency, canny, financial system, and genuine note.

I. INTRODUCTION

Economic development of every nation is mostly dependent on its currency and every person is the part of Economy but some of the unsocial group of people damage this process and unbalances the social harmony of the nation. For ex. Now a days, in process of demonetization, there are long queues in front of banks and ATM Machines of those common people who contribute to our economy by paying taxes but on the other hand many corrupted people are issuing the money directly by evil sources and it is directly effecting on economic status of India.

As we know, in India, Ministry Of Finance and RBI(Reserve Bank Of India are authorized to issue currency notes and coins. But corrupt people take the advantage of high printing and scanning technologies to print fake notes by using latest hardware tools and techniques. Fake currency detection means finding the fake currency from the original one. Generally, currency recognition system is mostly used in banks, business firms, shopping malls, railway stations, government sector, organizations etc.[1] But common people do not have any source of currency detection and they are unable to identify the real original currency. That's why the malpractice of fake currency is carried out openly in our economy. [2]

Till date, many researchers have given their contribution in finding the technique of identifying the genuine currency notes from the fake notes.

Feature extraction of images is challenging work in digital image processing. The meaning of the feature extraction phase is most conveniently defined referring to the purpose it serves. Feature extraction is that of extracting from the raw data the information which is most relevant for classification purposes, in the sense of minimizing the within-class pattern variability while enhancing the between-class pattern variability. During the feature extraction process the dimensionality of data is reduced. This is almost always necessary, due to the technical limits in memory and computation time.

Automatic method for detection of fake currency note is very important in every country. In this project we have made fake currency note detection technique and other applications of image processing. In the project setup, note is placed in front of camera to check whether it is fake or genuine. The camera pictures of notes are analyzed by program installed on computer. The project is meant to check Indian currency notes of 100, 500 and 1000 rupees. If the note is genuine, the respective message is appeared on GUI screen and by the glow of green LED. Currently, there are a number of methods for paper currency recognition

[1], [4], [6]. Using the properties of the HSV (Hue, Saturation and Value) color space with emphasis on the visual perception of the variation in Hue, Saturation and Intensity values of an image pixel [1]. In this technique, Fitting tool of Neural Network is used for the purpose of paper currency verification and recognition. Crucial features from Indian banknotes were extracted by image processing and experimented on Neural Network classifier. But this method is not sufficient as the rapid advancement in printing today could easily fool the system.

Another technique [2], used just three security features, latent image, security thread and identification mark for fake currency identification. The comparison between the features of test currency to a pre stored currency is done to get the result. Another technique [3], is to use a fake note detection unit using UV LED and photodiode. The concept used is that genuine currency notes are made of cotton based fabric but the fake currencies are made of polished paper , thus, genuine currency reflects UV light while fake currency absorbs it. But this technique could not be relied upon as it is not efficient enough for accurate result.

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

Digital image processing allows the use of much more complex algorithms, and hence, can offer both more sophisticated performance at simple tasks, and the implementation of methods which would be impossible by analog means. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

II. LITEARTURE SURVEY

[1] Sagar S. Lawade et al.

The authors proposed a fake currency detection system using **image processing in Python**, focusing on Indian notes. Features like serial number, watermark, identification mark, and Mahatma Gandhi's portrait were extracted for verification. The system could detect fake ₹500 and ₹2000 denominations even with scribbles, ensuring robustness and high-speed performance. It demonstrated the viability of feature-based verification for fast and cost-effective counterfeit detection [1].

[2] Mohammad H. Alshayeji et al.

This paper introduced a **bit-plane slicing technique** combined with the **Canny edge detection** algorithm to enhance counterfeit detection in banknotes. By analyzing the significance of higher-order bit-planes and comparing extracted features with genuine notes, the authors achieved faster and more accurate detection than traditional methods. Their approach proved particularly effective on **Kuwaiti currency** and demonstrated strong edge localization and noise resistance [2].

[3] Binod Prasad Yadav et al.

This work implemented an **automatic recognition system for fake Indian currency** using MATLAB. The system employed **HSV color space** and basic image processing to identify key features of notes. Supporting denominations of ₹100, ₹500, and ₹1000, the algorithm achieved good throughput and accuracy. A **CCD camera** and **LCD display** were integrated for real-time testing, aiming for a cost-effective and automated currency verification unit [3].

[4] B. Sai Prasanthi and D. Rajesh Setty

The authors designed a **quick authentication system** for Indian paper currency using image processing techniques. Six features including watermark, security thread, and micro-lettering

were extracted and compared to reference images using black pixel analysis. The system, tested on denominations from ₹20 to ₹1000, could handle scribbled and variably-sized notes, offering fast and reliable feature extraction within one second [4].

[5] Kavya B. R. and Devendran B.

This study proposed a system using the **SIFT (Scale Invariant Feature Transform)** algorithm to extract key features from Indian currency notes. The extracted features were used to validate authenticity and recognize denomination. A 3×3 grid was used for segmentation, ensuring feature robustness. The model successfully differentiated between genuine and counterfeit notes and highlighted the role of **SIFT in precise pattern matching** [5].

[6] W. K. ElSaid

The paper presented a fake currency detection system for **Egyptian banknotes** using **texture and shape characteristics**. Texture was analyzed via the Gray-Level Co-occurrence Matrix (GLCM) and shape features through region-based properties. Each side of the note was processed independently, and the final decision was based on **similarity measurement**. The system achieved high accuracy and efficiency, and was suggested for financial institutions and accessibility for the visually impaired [6].

[7] Komal Vora et al.

This review paper discussed a currency recognition approach using **2D Discrete Wavelet Transform (2D DWT)** for feature extraction in the frequency domain. By applying OCR for serial number detection and classification techniques, the authors focused on improving both **currency recognition and counterfeit detection**. Their future vision includes expanding recognition to multi-country currency notes and automatic denomination conversion systems [7].

III. PROPOSED METHOD

A Flow of fake Currency detection technique

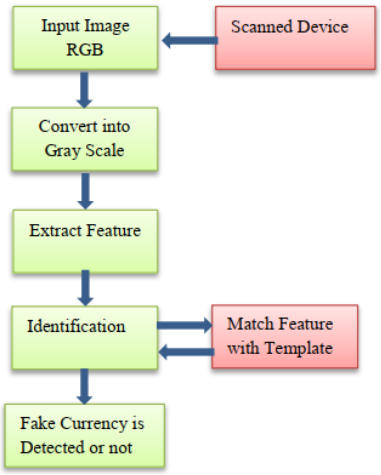


Figure.4.1 Block diagram of A flow of fake Currency detection technique

For example, we have new Rs 500 and Rs 2000 notes. We will discuss their feature one by one

First image is of Rs500.

Second image is of Rs 2000.

B Front –side features. (These are the obverse features)

Rs 500 denomination bank notes are released in new series with inset letter ‘E’ in both the number panels and it also has the image of Mahatma Gandhi and signature of Governor Dr. Urjit R.Patel.

First of all we will discuss the features of Rs 500 notes.

Color

The color of Rs 500 note is stone gray.

Size

The new Rs 500 note is smaller than previous note (size of at 63mm x 150 mm).

Bleed lines

There are seven "bleed lines" on the side of Rs.2000 notes, and five lines on Rs 500 notes.

Latent image

In Rs 500 note there is latent image of the denomination in numeral.

Denomination numeral in Devnagari font.

Devnagari font is also used on the currency of Rs.500.

Orientation

In previous notes of Rs 500 and current notes there are some changes in orientation and relative position of Mahatma Gandhi.

Windowed security thread

Rs.500 notes contain a readable, fully embedded windowed security thread with the inscription "Bharat" (in Hindi), and "RBI". Which changes color from green to blue when note is tilted. Guarantee clause, Governor's signature with promise clause and RBI emblem shifted towards right

. Portrait

The portrait has been changed in raised manner. The orientation and the portrait of Mahatma Gandhi has been changed and we can see the electrotype watermark also.

Numerals

In new currency notes numerals are mentioned in the increasing order of their size from top-left side to bottom right side.

Ashoka pillar emblem

On the right side Ashoka pillar emblem is present.

Special Features of New Currency

1. Swachh Bharat slogan with logo.

2. At the center there is a language panel.

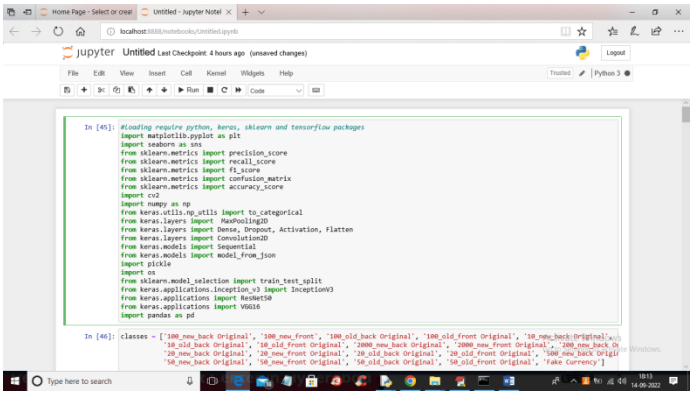
3. Red fort with Indian tri-color(flag)

4. At the right side denomination numeral in Devnagri

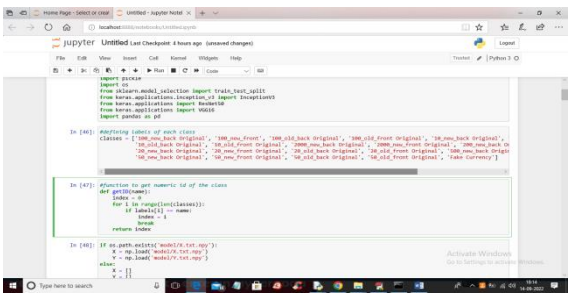
C key features of Rs 2000 notes

IV. RESULTS

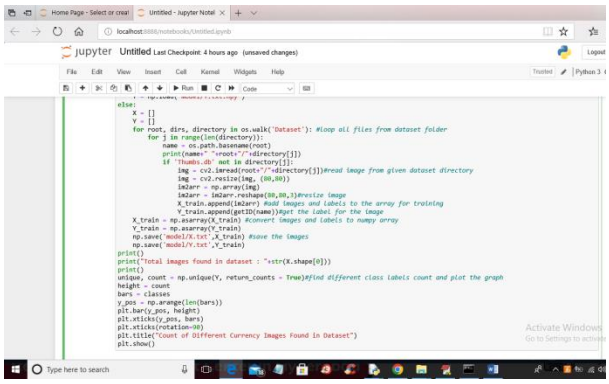
As per your request we have used our dataset with real and fake currency notes and then trained InceptionV3, VGG16, Resnet50 and Custom CNN on that dataset. After training VGG16 and Custom CNN giving more than 90% validation accuracy and InceptionV3 and Resnet50 shown poor performance. We have coded this project using JUPYTER notebook and below are the output screens.



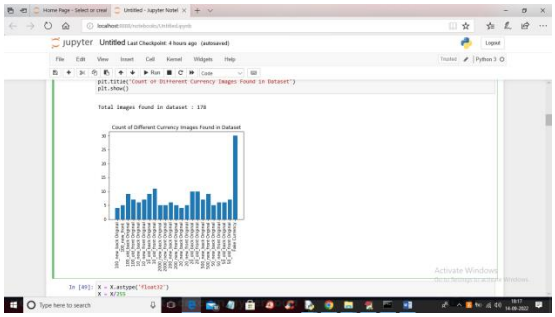
In above screen we are loading require python packages and you can read blue colour comments starting with '#' symbol to know about coding



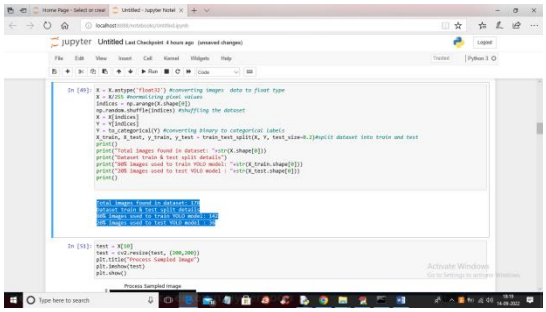
In above screen we are defining names of each class labels



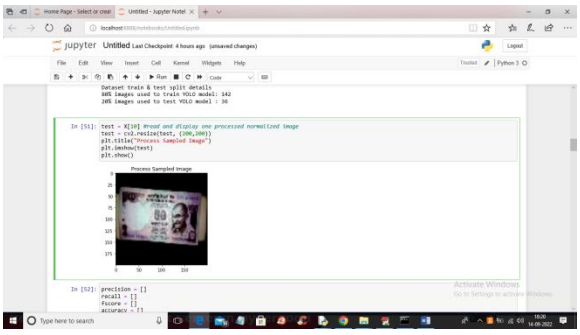
In above graph we are reading all images and then adding to array variables and then plotting graph with different currency and their counts and in below screen we can see the graph



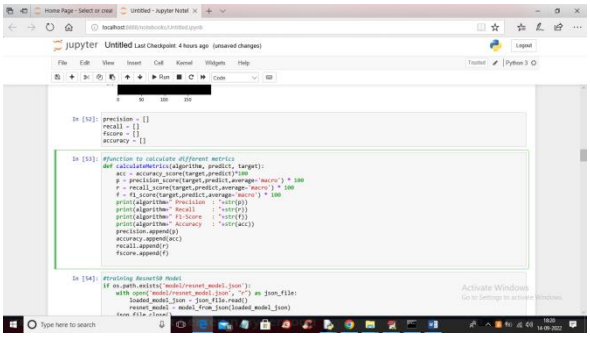
In above screen x-axis represents names of currency and y-axis represents counts of images for that currency



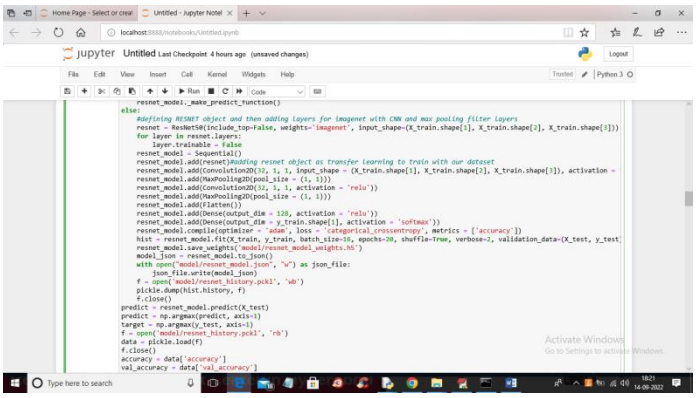
In above screen we are normalizing image pixels and then splitting dataset into train and test and in blue colour text we can see size of training and testing images



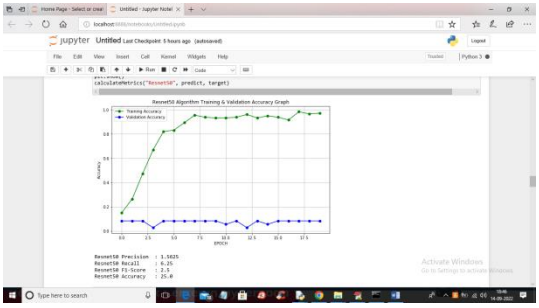
In above screen displaying sample processed image



In above screen we have defined function to calculate accuracy and other metrics

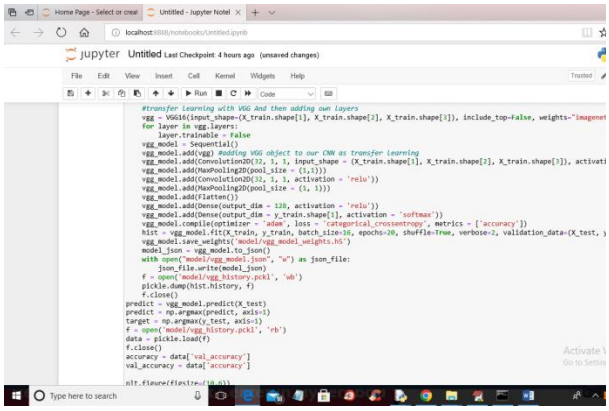


In above screen we are training Resnet50 and after training will get below output

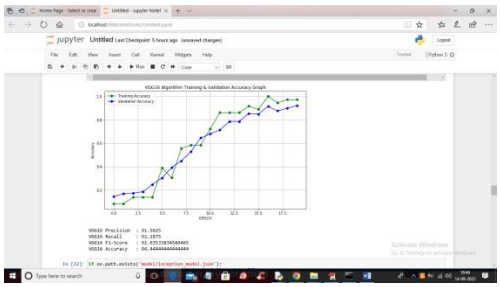


In above graph we can see Resnet50 training and validation graph and then we got Restnet50

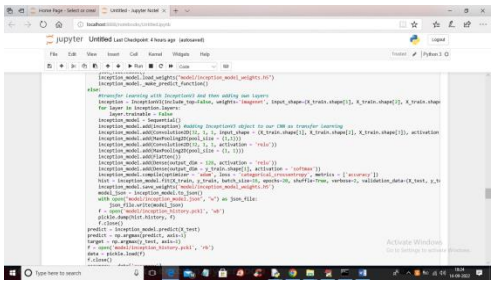
accuracy as 25% on test data so its performance is not good. In below screen we can see VGG16 output



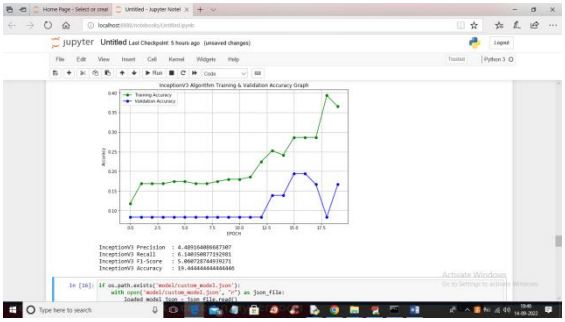
In above screen we are training VGG16 on currency dataset and below is the output screen



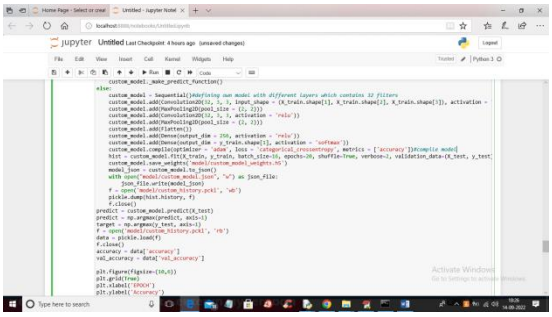
In above graph we can see VGG16 training and validation accuracy and we got its accuracy as 94%. In below screen we can see InceptionV3 training



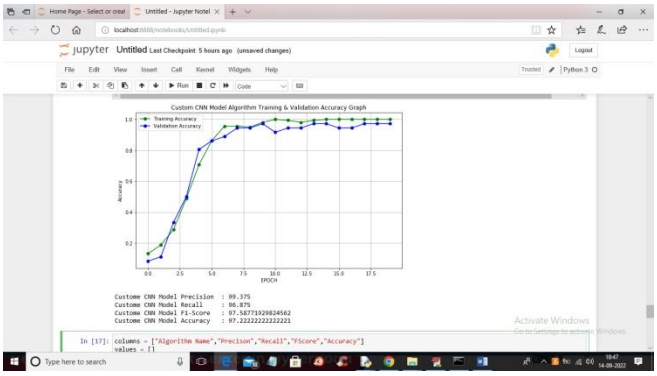
In above screen we are training inception and after training will get below output



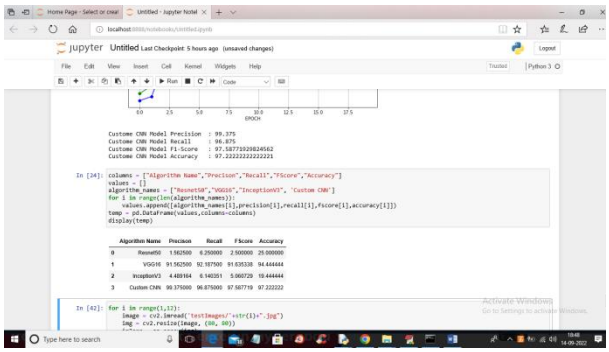
In above screen we can see InceptionV3 training and validation graph and we got its accuracy as 19% and its performance is not good and in below screen we can see custom CNN training



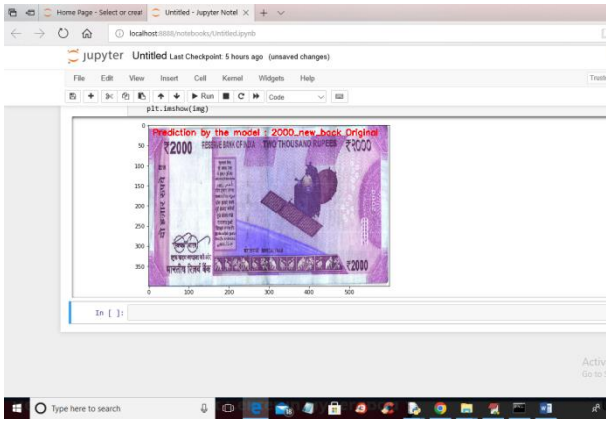
In above screen we are training custom CNN and after training we got below output



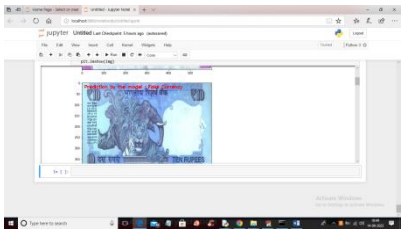
In above screen with Custom CNN we got 97% accuracy and below is the performance table of all algorithms



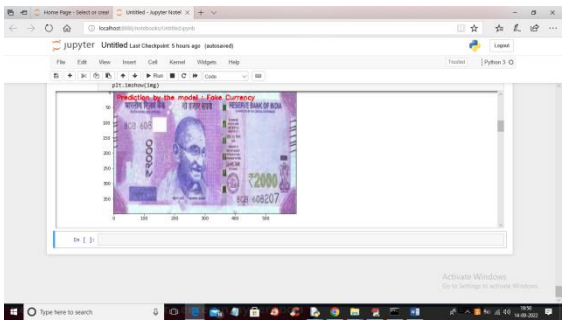
In above table we can see VGG16 and Custom CNN got accuracy of more than 90% and below is the predictions of all test images

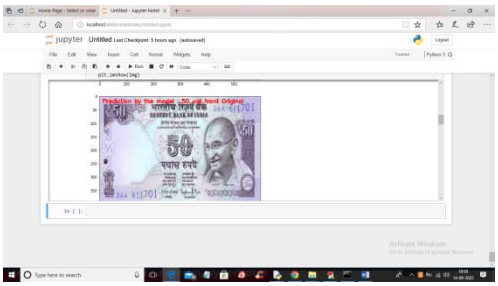


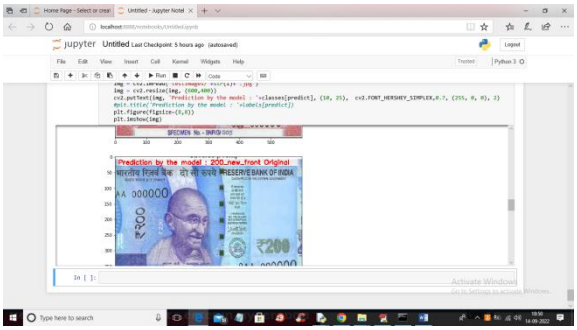
In above screen after prediction we can see red colour text as “Original” and below are the other prediction



In above screen predicted output is Fake currency







V. CONCLUSION

We have used our dataset with real and fake currency notes and then trained InceptionV3, VGG16, Resnet50 and Custom CNN on that dataset. After training VGG16 and Custom CNN giving more than 90% validation accuracy and InceptionV3 and Resnet50 shown poor performance. We have coded this project using JUPYTER notebook.

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