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Fake Indian Currency Note Recognition

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Abstract - *In India, money transactions are increasing by the day. These increasing transactions become a cause to increase the currency traverse. Taking advantage of this, fake currency notes of Rs 50,100,500,1000 were being produced, and after demonetization the counterfeit notes of new Rs 50,200,500,2000 have increased a lot and this in time affects the economic growth of the country. Here, the recognition and verification of the paper currency is explained with the use of image processing techniques. The proposed approach consists of multiple element transactions like Image Acquisition, Feature extraction and comparison, Texture features, and Voice output. The desired results will be in text and voice output of the currency recognized and verified. Thus we can help in reducing the accumulation of counterfeit currency.*

Key Words: **Image processing, Edge detection , Image Acquisition, Feature extraction, Comparison.**

1. INTRODUCTION

Technology is growing very rapidly these days. Consequently, the banking sector is also getting up to date by the day. This brings a profound need of automatic currency recognition. Many researchers have been encouraged to develop tough and efficient automatic currency detection machine. Automated machines which can detect banknotes are now broadly used in dispensers of modern products like candies, cold drink bottle to bus or railway tickets. The technology of currency recognition essentially aims for identifying and extracting visible and invisible features of currency notes. Until now, a variety of techniques have been proposed to identify the currency note. But the best way is to use the visible features of the currency. For example, color and size. But this method is not useful if the note is dirty or torn. If a note is dirty, its color characteristics are changed extensively. So it is important how we extract the features of the image of the currency note and apply proper algorithm to improve accuracy to recognize the note.

The people who are mostly affected by these fake currency notes are the normal citizens, as it becomes very hard to identify these and it gets passed on from one hand to another's hand very quickly. From petrol stations to the local vegetable vendors, everybody is cautious of accepting banknotes in denominations of Rs. 50, 200, 500 and Rs. 2,000 (which was released after the demonetization) but a lot of these notes are almost impossible to tell from genuine ones. The common effect of counterfeit currency on economy is inflation.

The main solution that is currently available for common people to identify and recognize counterfeit currency is "Fake Note Detector Machine". This machine is mainly available only in banks which are not available to everyone. All these situations need a kind of solution for common people to judge a forged bank note and to prevent our Indian currency from losing its value.

We apply an easy algorithm here. The image of the note is captured through a camera. Processing on the image is done on that captured image using concepts like image segmentation, edge information of image and characteristics feature extraction. Python is an amazing tool for computational work, and analysis. The image formats supported by Python are JPEG, PCX, TIFF, PNG etc. Feature extraction of images is a very testing task in digital image processing. It involves extraction of all features, may it be invisible or visible, of Indian currency notes. This approach consists of various stages like image acquisition, edge detection, gray scale conversion, feature extraction, image segmentation and decision making. Acquisition of image is a way of creating digital images, from a physical thing. Here, the image is captured by a digital camera, that can be so easily available, such that all the features are highlighted. Image is then stored for additional processing.

2. LITERATURE REVIEW

A) Indian Banknote Recognition using Convolution Neural Network: Independent Scholar 2C-126, Vasundhara Ghaziabad, Uttar Pradesh

This paper presents a deep learning-based method for identification of denominations of Indian Currency Rupee notes from their colour images. A classification framework has been implemented using the concept of transfer learning where a large convolution neural network pre-trained on millions of natural images is employed for classification of images from new classes. An image dataset of four banknote denominations is prepared by preprocessing and augmentation of real-bank note images acquired in different viewpoints and lighting conditions via smartphone camera. A new top layer upon the convolutional base of a pre-trained MobileNet model is trained for a few epochs upon a portion of the dataset to achieve an agreeable accuracy upon validation subset.

B) Design and Implementation of Paper Currency Recognition with Counterfeit Detection: 2016-Online International Conference on Green Engineering and Technologies (IC-GET)

This paper proposes a system that can classify and subsequently verify Indian paper currency using fundamental image processing techniques. It uses the comparison between the input banknote and the calculated reference values for different parameters of original banknotes in a similar environment. This system maintains its simplicity while still having high accuracy of 100% for classification and 90% for validity verification.

C) Automatic Recognition of Fake Indian Currency Note: 2016 International Conference on Electrical Power and Energy Systems (ICEPES) Maulana Azad National Institute of Technology, Bhopal, India. Dec 14-16, 2016

In this paper, the automatic system is designed for identification of Indian currency notes and check whether it is fake or original. The automatic system is very useful in banking system and other field also. In India increase in the counterfeit currency notes of 100, 500 and 1000 rupees. As there are increases in the technology, like scanning, colour printing, and duplicating, there is increase in counterfeit problem. In this paper, recognition of fake Indian currency notes is done by using image processing technique. In this paper, recognition of fake Indian currency notes is done by using image processing technique. In this technique first the image acquisition is done and applies pre-processing to the image. In pre-processing crop, smooth and adjust then convert the image into grey colour after conversion apply the image segmentation then extract features and reduce, finally comparing image.

3. SYSTEM IMPLEMENTATION

In this section, working of the process of the system is described. The system is divided into two modules, namely,

1. Currency Recognition
2. Currency Verification

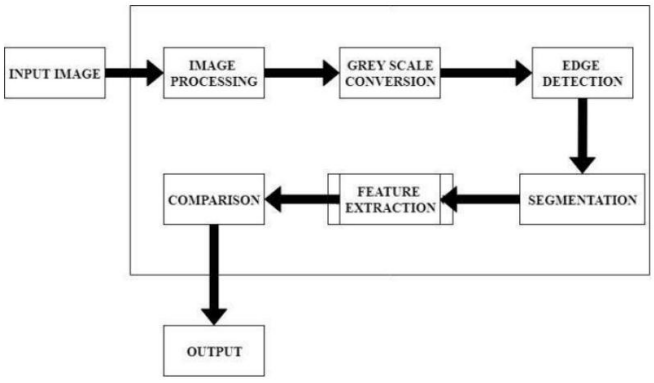

Fig -1: Architectural Diagram

3.1 Currency Recognition

In currency recognition we identify and isolate the denomination of the currency with the help of image processing and here we are extracting the features of the acquired image. We are using the steps that follow.

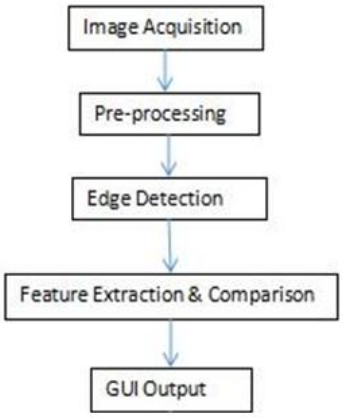

Fig -2: Flowchart Currency Recognition

Image Acquisition: Executing image acquisition in image processing is always the primary step in the work flow sequence because, without an image, processing is impossible. After the image has been obtained, many different methods of processing can be applied to the image to perform the many various vision tasks. There are various ways to obtain an image such as with the aid of a camera or scanner. Obtained image should preserve all the features.

Pre-processing: The main aim of the pre-processing is to improve the visual appearance of images and to enhance the management of data sets. Image pre-processing, also known as image restoration, and involves the alteration of distortion, degradation, and noises that are introduced through the imaging process. Interpolation is the technique usually used for tasks such as zooming, rotating, shrinking, and for geometric corrections. Removing the noise is a significant step when processing has to be performed. Nevertheless noise affects segmentation and pattern matching.

Edge Detection: Edge detection is the name for a set of mathematical processes that are intended to identify points in a digital image at which the image brightness changes sharply or, more properly, has these continuities. The points at which image brightness varies sharply are usually organized into a set of curved line segments termed edges. Edge detection is an image processing technique used for locating the boundaries of objects within these images. It works by identifying discontinuities in brightness. Edge detection is used for image segmentation and data extraction in methods such as image processing, computer vision, and machine vision.

Image Segmentation: Image segmentation is the process of dividing a digital image into many parts(groups of pixels, also known as super pixels). The aim of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to evaluate.

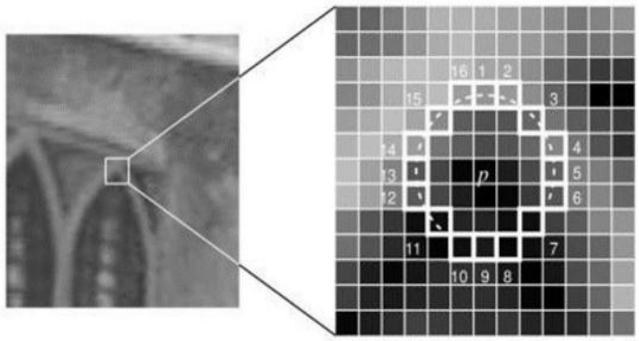

Fig -3: Image Segmentation

Feature Extraction and Comparison: Feature extraction is a particular form of dimensional reduction. When the input data to an algorithm is too large to be processed and it is suspected to be very redundant then the input data will be transformed into a reduced representation set of features. Changing the input data into the cluster of features is called feature extraction. If the features extracted are cautiously selected it is expected that the features cluster will extract the appropriate information from the input data in order to perform the desired task using this compact representation instead of the full size input.

3.2 Currency Verification

In currency verification we check or validate whether the currency is valid or not. Here we extract the texture features (HAAR) of the currency and compare it with the already stored HAAR features, then produce the output.

Haar Features Extraction: Haar-like features are digital imaging features which work only on image intensities (i.e) RGB values of each and every pixel in an image. A Haar-like feature considers neighboring rectangular regions, specifically at a definite location in a detection window, each region pixel intensities are added up also calculates the difference between these sums. Then it is used to sort out subsections of an image. In this work image databases of the currencies are used. For all currencies, the region of the denomination design is darker than the region of the see through part of Gandhi's portrait and is a common observation. So an ordinary haar feature for currency detection is a set of adjacent triangles that lie at plain regions. The area of these triangles is defined relative to a detection window that acts as a bounding box to the target object of the currency note.

Feature Comparison: The main goal is to put side by side the extracted features with the stored features which are stored in data sets which provide the result.

Output: The output of the currency recognition software will be given in the format of text. The test results will be given in a text box of the GUI.

Key Features of the Currency: The Fake currency detection system varies depending on specific features of banknotes of country. According to laws, Printing and circulation of forged notes are offences under section 489A to 489 E of Indian Penal Code (IPC) and are punishable by fine or imprisonment or both in the courts of law. Therefore, the currency has great significance in everyday life. Many researchers have become interested in the recognition of currencies and have proposed various approaches. According to literature, image processing is the best method in currency recognition area. A banknote has safety features mainly in the design and printing of paper. Some important security features of Indian currency are: - Watermark, Security thread, Latent Image, Intaglio Florescence Micro lettering, Identification Mark, Optically Variable Ink. The identification and examination of currency notes are mostly carried out by the following aspects:

(1) Physical dimension

(2) Paper quality

(3) Design

(4) Printing Technique

The physical dimension of the note depends on its cutting size, length, width, thickness and gram-mage. The paper on which currency note is printed has a high level of security. Watermark and Security thread are the most important components of currency note paper security. The reasons for selecting these features are because micro-printing is widely used for a robust feature of Indian banknotes. The advantage of micro-printing is that they cannot be visible without a magnifying glass or appropriate focus of the camera, this feature is very tough to replicate in fake notes by the normal printing process and actually require a very high cost and the other reason is Optically Variable Ink (OVI), which is very costlier ink and is impossible to forge through printer or ordinary printing machines. In real notes, the printing quality of watermark is very good. That is the reason why it is very hard to knock off for the counterfeits. The stitching technique of the security threads and the pattern around the security thread are clearly identifiable. A new dimension in stopping counterfeit notes is created by the presence of ultraviolet lines in the banknotes. Therefore, these features are used to perform forgery detection.

Features	Availability Among Note
Watermark	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Security Thread	All notes
Latent Image	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Intaglio Printing	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Fluorescence	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Micro Lettering	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Identification Mark	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000
Optically Variable Ink	Rs 5, Rs 10, Rs 100, Rs 500, Rs 1000, Rs 2000

Fig -4: Features in the Indian Currency

4. IMAGE CLASSIFICATION ALGORITHMS USED

Brute Force Classification is the algorithm that we use here. The descriptor of each feature in the first set is matched with each feature in second set by using a distance calculation and the closest ones are returned as the most matched one. For any two images it calculates the hamming distance using the descriptors and returns the point with minimum hamming distance and it was applied to the notes. The following key point/descriptor mapping was obtained:

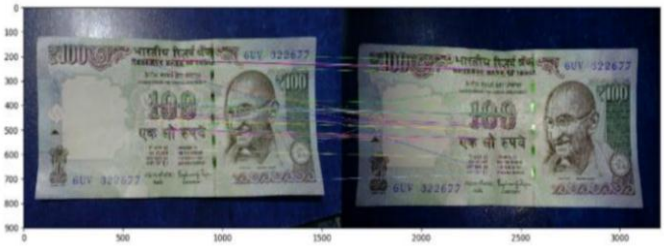

Fig -5: Matching notes using Brute Force Classification

5. METHODOLOGY

The system is divided into two parts. The first part is to identify the currency denomination through image processing. The second part is the oral output to notify the visually impaired person about the denomination of the note that he/she is currently having.

The development of this device is based on a webcam integrated with laptop with anaconda IDE for output. The real time bank notes are captured and processed through different image processing techniques like edge detection, segmentation, and feature extraction and classification.

Here, the laptop processor is used as a processor which processes the image of the currency note captured by the web camera. The controlling code for web camera is written and stored in processor. Captured image is stored in memory. Now system will process the image to identify the denomination of the currency. The processing algorithms and codes are written in PYTHON OpenCV. The reason for selection of the said hardware and software is that, this project intends to make this product as a cost efficient model using open source library such as OpenCV, so that it may favor future advanced improvements from people all over the world thus benefitting the end user.

CONCLUSION

By using image processing techniques, analysis of the currency image is more precise as well as this method is both cost and time efficient compared to existing techniques. Day by day research work is greater than ever in this field and many image processing techniques are implemented in order to get a more exact result.

The proposed system is supposed to work effectively for extracting and checking feature of Indian currency images.

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