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An Automated Recognition of Fake or Destroyed Indian Currency Notes Using Image Processing

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Abstracts

In India Every year RBI (Reserve bank of India) face the problem on counterfeit currency notes. The bank staffs are specially trained to detect counterfeit notes but problem begins once such notes are mixed into the market and circulated through common people. Even receiving fake notes from ATM counters have also been reported at some places. Over the past few years, as a result of the great technology come advances in color printing, duplicating and scanning counterfeiting problems become increases.

In the previous, only the printing house has the ability to make counterfeit paper currency, but today it is possible for any person to print counterfeit bank notes simply by using a computer and a laser printer at house. Therefore to stop these issue The Indian currency notes recognition system is very useful .In order to deal with such type of problems, an automated Recognition of currency notes is introduced with the help of feature Extraction, classification based on Image processing .This technique is considered with the computer vision where all processing with the image is done by machine. The machine is fitted with a camera (scanner) which will scan the image of the currency note considering the dimensions of the banknote and software will process the image segments with the help of character recognition methods. To implement this design we are dealing with MATLAB Tool.

Keywords: character Recognition, Image Processing Tool, Bank Note and camera or Scanner.

Introduction

In India Every year RBI (Reserve bank of India) face the problem on counterfeit currency notes. The bank staffs are specially trained to detect counterfeit notes but problem begins once such notes are mixed into the market and circulated through common people. Even receiving fake notes from ATM counters have also been reported at some places. Over the past few years, as a result of the great technology come advances in color printing, duplicating and scanning counterfeiting problems become increases.

With development of modern banking services, automatic methods for paper currency recognition become important in many applications such as in automated teller machines and automatic goods seller machines. The needs for automatic banknote recognition systems encouraged many researchers to develop corresponding robust and reliable techniques. Processing speed and recognition accuracy are generally two important targets in such systems. A Digital Image processing is an area characterized by the need for extensive experimental work to establish the validity of proposed solutions to a given problem. It encompasses processes whose inputs and outputs are images encompasses processes that extract attributes from images up to and including the recognition of individual objects.

MATLAB is the computational tool of choice for research, development and analysis. The image formats supported by MATLAB are BMP, HDF, JPEG, PCX, TIFF, XWB, PNG etc. Characteristic extraction of images is challenging work in digital image processing. It involves extraction of visible and some invisible features of Indian currency notes. A good characteristic extraction scheme should maintain and enhance those characteristics of the input data which make distinct pattern classes separate from each other. The approach consists of a number of steps including image acquisition, gray scale conversion, edge detection, feature extraction, image segmentation and comparison of images.

Image acquisition is the creation of digital images, typically from a physical scene. In the proposed work, the image will be acquired by using simple digital camera by providing some backlighting so that all the features of the currency can appear on the image

properly. The image is then stored in the computer for further processing. Edge detection and image segmentation are the most important tasks performed on the images.

A. Edge detection
Edge detection is a fundamental tool in image processing and computer vision, particularly in the areas of feature detection and feature extraction, which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques.

B. Image segmentation
Image segmentation sub divides the image into its constituent regions or objects. The level to which sub division is carried depends on the problem being solved. Segmentation algorithm for monochrome images generally are based on one of the two basic properties of image intensity values-
1.) Discontinuity
2.) Similarity.
In the first category, the approach is to partition an image based on abrupt changes in intensity such as edges in an image. The approach in the second category is based on partitioning an image into regions that are similar according to a set of predefined criteria.

Security Features on Indian Banknote
There are various security features in Indian bank note but the most important features used in this paper as given below
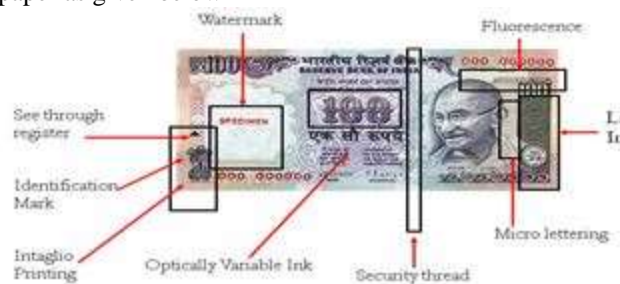
1. Watermark
The Mahatma Gandhi Series of banknotes contain the Mahatma Gandhi watermark with a light and shade effect and multi-directional lines in the watermark window.

2. Latent Image
On the obverse side of Rs.1000, Rs.500,Rs.100, Rs.50 and Rs.20 notes, a vertical band on the right side of the Mahatma Gandhi's portrait contains a latent image

showing the respective denominational value in numeral. The latent image is visible only when the note is held horizontally at eye level.

3. Fluorescence
Number panels of the notes are printed in fluorescent ink. The notes also have optical fibbers. Both can be seen when the notes are exposed to ultra-violet lamp.

4. Micro lettering-
This feature appears between the vertical band and Mahatma Gandhi portrait. It contains the word 'RBI' in Rs.5 and Rs.10. The notes of Rs.20 and above also contain the denominational value of the notes in micro letters. This feature can be seen better under a magnifying glass.

5. Optically Variable Ink
This is a new security feature incorporated in the Rs.1000 and Rs.500 notes with revised colour scheme introduced in November 2000. The numeral 1000 and 500 on the obverse of Rs.1000 and Rs.500 notes respectively is printed in optically variable ink viz., a colour-shifting ink. The colour of the numeral 1000/500 appears green when thenote is held flat but would change to blue when the note is held at an angle.

6. See through Register-
The small floral design printed both on the front (hollow) and back (filled up) of the note in the middle of the vertical band next to the Watermark has an accurate back to back registration. The design will appear as one floral design when seen against the light.

7. Serial Numbers
Every banknote has its own serial number, so it is more important to check whether the number is wrong or repeated.

There were the selected units that will help us to recognize the banknote. The counterfeit currency note first segmented into different parts containing these units and with the NNTOOL and appropriate algorithm processing and feature extraction will be applied with particular segment.

Related work
Currently, there are a number of methods for paper currency recognition [1][2][3][4]. Paper Currency Verification System Based on Character Extraction Using Image Processing in this paper they Proposed Paper Currency Verification System Based on Character Extraction Using Image Processing [1]and in 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 [2]. 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.

In another research work, a simple statistical test is used as the verification step, where univariate Gaussian distribution is employed [3]. The propose using the probability density formed by a multivariable Gaussian function, where the input data space is transferred to a lower dimensional subspace. Due to the structure of this model, the total processing system acts as a hybrid neural network. The method and the numerical experimental results are shown by using the real data and the recognition machine.

Another study describes an approach to digit recognition for the serial numbers on the Chinese currency banknotes [4]. It consists of a number of components including image preprocessing, image binarisation, morphological filtering, segmentation, feature extraction and digit recognition. The newly developed software Lab view which is based on the virtual instrument technique is used for image processing and recognition of the currency.

In another technique for paper currency recognition [5], three characteristics of paper currencies including size, color and texture are used in the recognition. By using image histogram, plenitude of different colors in a paper currency is computed and compared with the one in the reference paper currency. Based on the traditional local binary pattern (LBP) method, an improved LBP algorithm, called block-LBP algorithm, is used for characteristic extraction [6]. LBP is a powerful tool for texture description. This method has advantages of simplicity and high speed. A Neural Network based recognition scheme is used for Bangladeshi banknotes [7]. The scheme can efficiently be implemented in cheap hardware which may be very useful in many places. The recognition system takes scanned images of banknotes which are scanned by low cost optoelectronic sensors and then fed into a multilayer perceptron, trained by back propagation algorithm, for recognition.

In another study, three characteristics of paper currency are considered including size, color and texture [8]. The Marco chain concept is used to model the texture of paper currencies
As random process. Ensemble neural network (ENN) is used for the recognition system. The individual neural
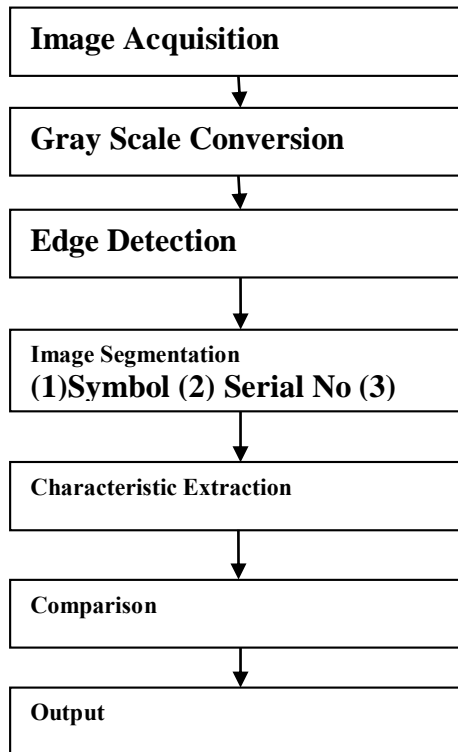
networks in an ENN are skilled via negative correlation learning. The purpose of using negative correlation learning is to skill the individuals in an ensemble on different parts or portion of input patterns. A new technique is proposed to improve the recognition ability and the transaction speed to classify the Japanese and U.S. paper currency [9]. This paper compare two types of data sets, time series data and Fourier power spectra, are used in this study. In both cases, they are directly used as inputs to the neural network. Still more we also refer a new evaluation method of recognition ability. Meanwhile; a technique is proposed to reduce the input scale of the neural network without preventing the growth of recognition. This paper applied the neural network to paper currency recognition and showed the effectiveness compared with a conventional manual method. Furthermore, it has proposed a structure reduction method of the neural network using random masks and showed its effectiveness for time series data and its Fourier power spectra.

Proposed work

The proposed system will work on two images, one is original image of the paper currency and other is the test image on which verification is to be performed. The proposed algorithm for the discussed paper currency verification system is presented as follows-
A. Image of paper currency will be acquired by simple scanner or digital camera.
B. The image acquired is RGB image and then it will be converted into gray scale.
C. Edge detection of the whole gray scale image will be performed.
D. After detecting edges, the four characteristics of the paper currency will be cropped and segmented.
E. After segmentation, the characteristics of the paper currency will be extracted.
F. The characteristics of test image are compared with the original pre-stored image in the system.
G. If it matches then the currency is genuine otherwise counterfeit.
The below diagram shows the step-by step process of this paper currency verification system-

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┌─────────────────────────────────┐
│      Image Acquisition          │
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               ▼
┌─────────────────────────────────┐
│      Gray Scale Conversion      │
└─────────────────────────────────┘
               │
               ▼
┌─────────────────────────────────┐
│      Edge Detection             │
└─────────────────────────────────┘
               │
               ▼
┌─────────────────────────────────┐
│  Image Segmentation             │
│  (1)Symbol (2) Serial No (3)    │
└─────────────────────────────────┘
               │
               ▼
┌─────────────────────────────────┐
│   Characteristic Extraction     │
└─────────────────────────────────┘
               │
               ▼
┌─────────────────────────────────┐
│        Comparison               │
└─────────────────────────────────┘
               │
               ▼
┌─────────────────────────────────┐
│         Output                  │
└─────────────────────────────────┘
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In the proposed method characteristics of paper currencies are employed that are used by people for differentiating different banknote denominations. Basically, at first instance, people may not pay attention to the details and exact characteristics of banknotes for their recognition, rather they consider the common characteristics of banknotes such as the size, the background color (the basic color), and texture present on the banknotes. In this method, these characteristics will be used to differentiate between different banknote denominations-

A. Identification mark
A symbol with intaglio prints which can be felt by touch, helps the visually impaired to identify the denomination. In 500 denominations the identification mark is a *circle*. In 1000 denominations the identification mark is a *diamond*.

B. Security thread
It is a 3.00 mm wide strip with inscriptions —.art— and —RBI‖ and color shift from green to blue when viewed from different angles. The thread is visible as a continuous line from behind when held up against light.

C. Number panels
Number panels of the notes are printed in fluorescent ink. The notes also have optical fibers. Both can be seen when the notes are exposed to ultra-violet lamp. This parameter we are find by using thresholding techniques.

All above result are calculated only in theoretical not in a practical when we will do practical then then resul will be in different manner

Main Result
1. First step of our to run your main.mat file then you see this window then you click on Snapshots Button

2. After that you select template image or your attached camera or scanner select Note image then you Observed Resized Image And segmented Image in our GUI

3. In step three you observed all three Parameter After that you select Process button and You will get result like in this way

This result we are performing in practical and this way we get it. In third step we get fake result because we are not saving bank fake number so that way it will show fake then in this way we perform some another notes and we will gets some result this in this way

Conclusion

Our main objective behind this project to present system base recognition of Indian currency notes to avoid frauds. In this project we applied fitting tool of image Processing, After extracting crucial features from Indian Notes (100,500,1000) by using image processing .This technique will surely very useful for minimizing the counterfeit currency note and efficiency of our system is 90%(camera),92%(scanner) and 92% (Template)

The technique uses three parameter of paper currency including identification mark, security thread, and Serial number. The system may extract the hidden features i.e. latent image and watermark of the paper currency. The proposed work is an effort to suggest an approach for the characteristic extraction of Indian paper currency. Approach suggested from the beginning of image acquisition to converting it to gray scale image and up to the word segmentation has been stated. The work will surely very useful for minimizing the counterfeit currency.

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