FAKE CURRENCY DETECTION

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Abstract : Due to the progress of color printing technology, there has been large number of duplicate of counterfeit currency note printing. Printing can be done in the printing house some years ago, but now a typical laser printer can print currency notes with maximum accuracy using the printer. As a result, the problem of fake notes has increased greatly due to actual people. Unfortunately, India has been cursed unfortunately with problems like corruption and black money and the fabrication of currency notes is a major problem. This creates a system of fake currency notes in less time and more effective way. The proposed system gives an opportunity to check Indian currency notes. The invoice currency confirmation is done by the concept of image processing. This article describes the findings of various features of Indian currency notes. MATLAB software is used to extract the features of note. The proposed system has advantages like simplicity and high performance speed. They will tell you whether currency notes are fake or not.

Keywords: Image acquisition, gray scale conversion, edge detection, image segmentation, feature extraction.

1. Introduction:

Nowadays the pace of technology is increasing. The resultant banking sector is becoming increasingly modern day by day. This is an intensive requirement to recognize automatic counterfeit currency in automated teller machines and automatic goods seller machines. Many researchers have been encouraged to develop strong and efficient automatic currency detection devices. Automatic machines that can detect banknotes are now used in large quantities such as dispensers of modern products such as candies, a soft drink bottles to bus or a railway ticket. The currency identification technology is mainly aimed at identifying invisible features of currency notes and removing them. So far, there are several proposals for identifying currency notes. But the best way is to use visible features of the note. For example, color and size. But this note is not useful if bad or torn. If a note is dirty then its color feature is broadly replaced. That is why it is important that we apply the characteristic of currency note image and apply the correct algorithm to improve the accuracy to identify the note.

We apply a simple algorithm here that works properly. Currency is captured by a digital camera. The hidden features of the notes are highlighted in ultraviolet light. Image is being processed using concepts such as image segmentation, edge information of image and characteristics feature extraction. MATLAB is the best tool Computational work and analysis. Image feature extraction is a challenging task in digital image processing. This includes invisible and visible features of Indian currency notes. This approach includes various steps like image acquisition, edge detection, gray scale conversion, feature extraction, image segmentation and decision making. Acquisition of the image is a process of creating a digital image, from a physical perspective. Here, the image has been captured by a common digital camera in which all the features are highlighted. Then the images are stored for the next process.

2. Proposed Work:

In the proposed work, we will develop a system to detect fake currency for Indian Notes. First take the input of the given image and preprocessed the given image and convert the RGB image into the gray scale image. After preprocessing, apply sobel algorithm to detect the inner as well as outer edges of the image. Clustering will be done using k-means algorithm. In which it forms the clustering of feature one by one. After that recognized the input image as a 200, 500, or 2000 and compare the features of the image and classified it as original or fake with the help of SVM algorithm.

3. Methodology:

The system proposed here work here on the image of currency note under ultraviolet light acquired by a digital camera. The algorithm which is applied here is as follows:

1. Acquisition of image of note under ultraviolet light by simple digital camera or scanner.
2. The output of image acquisition is RGB image and now it is converted to gray scale image.
3. Now edge detection is performed on gray scale image .
4. Now features of the currency note will be cropped and segmented.
5. After segmentation, features of note are extracted.
6. Now we calculate intensity of each feature.
7. If the condition is satisfied, then the note is said as original otherwise fake.

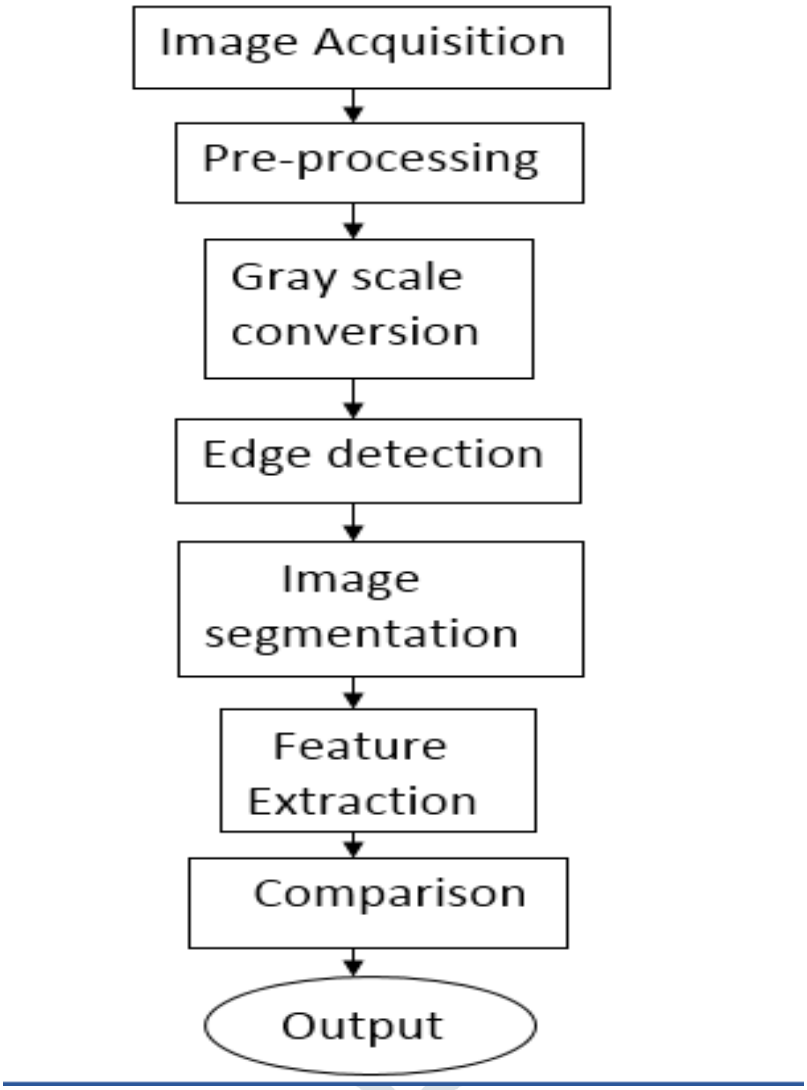

Fig: Flowchart

Steps:

3.1. Image Acquisition: The first stage of any vision system is the image acquisition step. After receiving the image, various methods of processing can be applied to image in a variety of perspectives. Image acquisition is always the first step in the workflow sequence, because without the image, it cannot be processed. There are many ways to get an image with a camera or scanner. All features must be preserved in the required image.

3.2. Preprocessing: The main purpose of the pre-processing is to enhance the visual appearance of the images and improve the dataset efficiency. Preprocessing of Images are operations that are generally required before major data analysis and removal of information. Image preprocessing, which is also said to be repaired, includes Improves lesions, reductions and improvements during the imaging process. The image enhances the reliability of pre-processing optical checks. Some filter operations make it easier or faster to make certain image detail sharper or lesser Evaluation is done with the help of image adjusting, Image Interpolation. Interpolation is used mostly for zooming, rotating, shrinking, and geometrical repairs. Removing noise is an important step in image processing. However may sound affect segmentation and pattern matching while performing smoothing process on a pixel, the neighbor of the pixel is used to do some transforming. After that a new value of the pixel is created.

3.3. Gray scale Conversion: The image acquired is in RGB color. It is converted into gray scale because it carries only the intensity information which is easy to process instead of processing three components R (Red), G(Green), B(Blue).To take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel :(R+B+C)/3. However, since the perceived
brightness is often dominated by the green component, a different, more "human oriented", method is to take a weighted average, e.g.: 0.3R + 0.59G +0.11B.

3.4. Edge Detection: Edge detection is the name for the set of mathematical methods, which means finding a dot in the digital image in which the image shifts intensely or breaks into a more formal form. Things that change the brightness are generally the same organized in a set of vertical segments. The same problem of detecting deviation in the 1D signal is known as step detection and the problem of detecting signal discontinuities from time to time is known change detection. Edge Detection is a fundamental tool in image processing, machine vision and computer vision, especially in the areas of feature detection and feature findings. Edge detection is the object processing technique to find the range of things inside the image. It works by detecting discontinuities by brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision and machine vision.
Based on one-dimensional analysis, the theory is accurate to calculate the two-dimensional image derivatives, as long as it can reach both the dimensions. Sobel operator measures the 2-D local gradient on the image. Generally, input is used to find the approximate total gradients of each point in gray scale image. The sobel edge detector has used a pair of 3x3 convolution masks, predicts the gradient in an X-direction (column) and predicts the gradient in Y-direction (rows). Usually convolution mask is much smaller than actual image. As a result, the mask is slid over the image, which can handle a square pixel at a time. The actual Sobel masks are shown below:

$$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

3.5. Image Segmentation: The process of image segmentation is partitioning the digital image into multiple segments (pixel set, also called super pixel). The purpose of image segmentation is to make it easier to represent an image and make it easier to interpret and / or change. Image segmentation is generally used to find objects and borders (lines, curves, etc.) in the images.

K-Means Algorithm: The K-Means Algorithm is an unsupervised clustering algorithm that categorizes input data points into multiple classes based on multiple distances. The purpose of the K-Means method is to minimize the sum of squared distances between all points and cluster centers. The algorithm has loose relationship to the related to k-nearest neighbor classifier, a popular machine learning technique for classification that is often confused with k-means because of the k in the name. You can apply 1-nearest neighbor classifier to the cluster centers received by K-means to classify new data in existing clusters. This is known as the nearest Centroid Classifier or Rocchio Algorithm.

3.6. Feature Extraction: Feature extraction is a special type of dimensional reduction. When the input data in the algorithm is too large to process and it is suspected to be unnecessary, less representation of the input data feature will be converted to a set of features. Conversion of input data into set of features is called as feature extraction. If the features that have been selected carefully, it is expected that the set of features will be reduced by removing the relevant information in the input data for the desired purpose using this reduced full size representation instead of full size input.
SVM Algorithm: In machine learning, support vector machines (supporting SVMs, vector networks) are supporting supervised learning models, which are relevant learning algorithms analyzing the data used for categorization and regression analysis. A set of training examples is given, each marked as belonging to one or two classes, and the SVM training algorithm creates a model that assigns new grades to one category or another, which makes it a non-potential binary linear classifier.

3.7. Comparision: In comparison, features extracted from the counterfeit currency notes play a very important role. Essentially, it is compared to those features that enable you to distinguish counterfeit notes from the genuine ones.

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

In this method, characteristics of currencies are employed which are used by common people for differentiating for different banknote denomination. The characteristics that can be used to check the authentication of currency note are-

A. See Through Register: The small floral design is printed in the middle of the vertical band and next to watermark. The floral designed on the front is hollow and in back is filled up. The floral design has back to back registration. The design will see as one floral design when seen against the light.

B. Watermarking: The portrait of Mahatma Gandhi, and multidirectional lines and a mark showing the denominational numeral appear which can be viewed when held against light.

C. Optically Variable Link: Optically variable ink is used for security feature; this type of feature is in the Rs.200, 500, and Rs.2000 bank note. Optically variable ink as security feature for bank note is introduced in Nov.2000. The denomination value is printed with the help of optical variable ink. The color of numerical 2000 or 500 appear green, when note is flat but change the color to blue when is held in an angle.

D. Security Thread: The security thread is in 2000 and 500 note, which appears on the left of the Mahatma Gandhi's portrait. In security thread the visible feature of ―RBI‖ and ―BHARAT‖. When note is held against the light, the security thread can be seen as one continuous line.

E. Intaglio Printing: The portrait of Mahatma Gandhi, Reserve bank seal, guarantee and promise clause Asoka pillar governor's signature all are printed in intaglio or raised prints.

F. Micro lettering: The micro letter's appears in between the portrait of Mahatma Gandhi and vertical band. Micro letter's contains the denomination value of bank note in micro letters. The denomination value can be seen well under magnifying glass.

G. Identification Mark: Each note has its special identification mark. There are different shapes of identification mark for different denomination (Rs.200-H, Rs.500-circle and Rs.2000- Square). The identification mark is present on the left of water mark.

H. Number Panel: Serial number panel with banknote number growing from small to big on the top left side and bottom right side.

I. Latent image: A vertical band on front side of denomination at right hand size. It contains latent image showing numeral of denomination when banknote is held horizontally at eye level.

4. Results:

Fig: Load and crop image

Fig: Contrast and gray scale conversion

Fig: Edge Detection

Fig: Image Segmentation

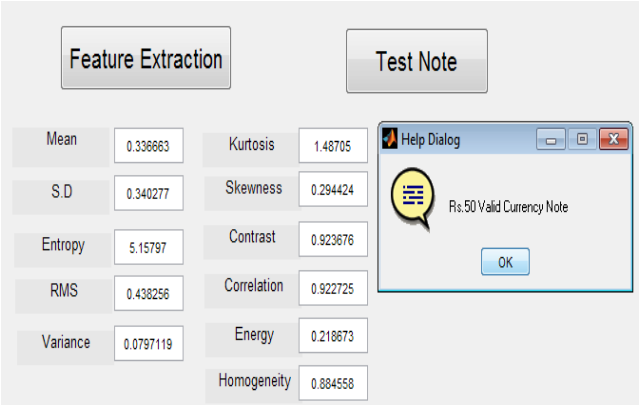

Fig: Feature Extraction and output

5. Conclusion and Future Scope:

By using digital image processing, analysis of note image is more accurate as well as this method is efficient in terms of cost and time consuming compared to existing techniques. MATLAB Software is used for this analysis. Day by day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate results. The proposed system is worked effectively for extracting features of Indian note images. Extracted features of currency image will be using for note value recognition as well as for its verification.

In Future, Application based system shall be designed to get proper result whether note image is fake or real. The same system can be developed for the remaining Indian currency notes and other country's currency notes. Also the app's interface can be further modified as per the user requirements.

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