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Fake Indian Currency Detection Using Machine Learning

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ABSTRACT: Fake Currency Detection is the biggest problem faced by many countries including India. The advancement of colour printing technology has increased the rate of fake currency note printing and duplicating the notes on a very large scale. So, it has become a necessity to develop a tool that detects the fake currency note in a less time and in a more efficient manner using Image processing.

KEYWORDS: Contrast enhancement, KNN Classifier, Image acquisition, Histogram Equalization, Image Processing.

I. INTRODUCTION

In recent years a lot of fake currency note is being printed which have caused great loss and damage towards society. With the production and circulation of fake notes, it becomes difficult for common people to differentiate whether the currency is real or fake as they differentiate on the basis of physical appearance that may fail many times. In this paper, we propose a system for Verification of currency note using image processing techniques and KNN Classifier. The proposed system has got advantages like simplicity and high performance speed. The result will predict whether the currency note is fake or real. The system has more efficient performance of and achieves good accuracy rate. [2][4]

II. METHODOLOGY

1. IMAGE PROCESSING TECHNIQUES USING MATLAB

Until now, many techniques have been proposed to identify the currency note. If a note is dirty, its color characteristics are changed widely. So it is important that how we can extract the features of the image of the currency note and apply proper algorithm to improve accuracy to recognize the note. Here, the image is captured by a simple digital camera such that all the features are highlighted. Image is then stored for further processing.

1. **DATA COLLECTION:** Input data can be collected by capturing the image using web camera. Web Camera is used to capture the image which is an input image given to Matlab for processing. A webcam captures and it sends the data to the computer.

2. IMAGE PREPROCESSING

Image Acquisition: the images are obtained through webcam or digital camera, they were further processed using MATLAB to extract the information required.

Image pre-processing: Image pre-processing is to suppress undesired distortions or enhance some image features that are important for further processing or analysis.

Image Adjusting : During image adjusting, after getting the image from a web camera, the size of the image should be reduced as per requirement and it is done with the help of image interpolation.

Image Smoothing: During Image Smoothing, it is necessary to remove the noise that may affect segmentation and pattern matching. Mask values can be used to determine the degree of smoothing.

RGB to Gray scale conversion: The image acquired is in RGB colour. This image is heavy and has more noise. By converting it into gray scale, reduces the size of the image and also the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue). Gray scale Images Representation is the way of representing an image only by using different shades of gray levels. Gray level image requires less information to be provided for each pixel.

Edge detection: It is a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. It is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.

Histogram Equalization: This is a technique used for adjusting image intensities to enhance contrast. To perform Histogram Equalization calculate probability mass function of all the pixels in the image. Then calculate Cumulative Distribution Function according to the gray levels. Then map the new gray levels to number of pixels.

IMPLEMENTATION OF THE SYSTEM

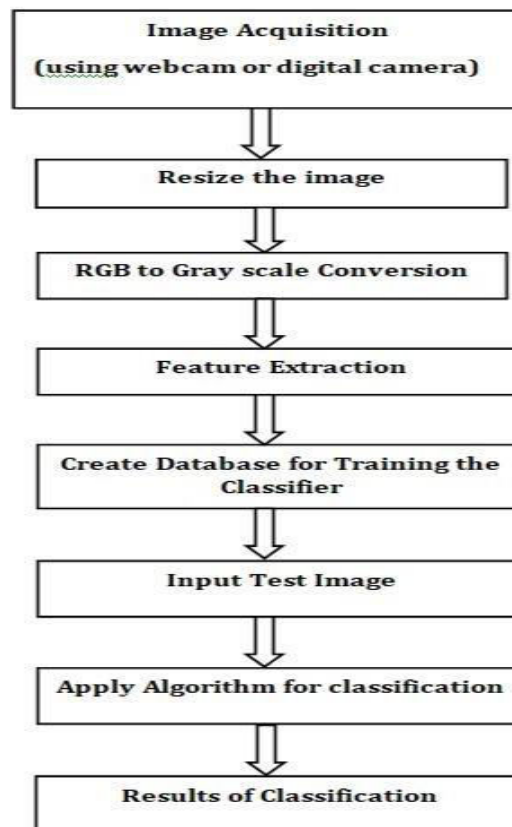


Fig. 1. Implementation of the system.

The algorithm automatically generates mask image without user interaction that contains only text regions to be inpainted.

TERMINOLOGIES USED IN THE PROPOSED SYSTEM

A. K-NEAREST NEIGHBOR (KNN) CLASSIFIER:

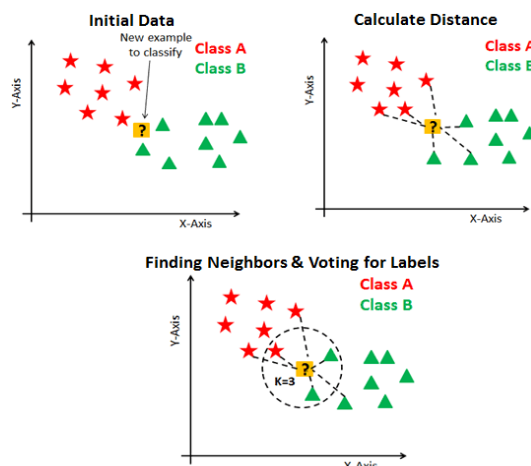


Fig. 2. KNN-Classification for two testing groups.

Figure 2 shows the classification of two groups using KNN classifier. K is a constant factor which is the value obtained by taking square root of number of samples taken for training.

KNN Algorithm uses feature similarity to predict the values of new data points which further means the new data point will be assigned a value based on how closely it matches the points in the training set. Working of the algorithm is explained by following steps:

Step 1- for implementation of algorithm, load the training as well as data set.

Step 2- Choose the K value, which is any integer value.

Step 3- For each point in the test data do the following:

3.1- calculate distance between test data and each row of training data using Euclidean distance method.

3.2- Now, based on the distance value, sort them in ascending order.

3.3- Next, it will choose the top K rows from the sorted array.

3.4- now, it will assign a class to the test point based on most frequent class of these rows.

Step 4- End.

A. **Gamma Correction:** Gamma correction controls the overall brightness of an image. Each pixel in an image has brightness level called luminance having the values between 0 to 1, where 0 means complete darkness (black) and 1 means brightest (white). Gamma correction is a technique to compensate for non-linear display characteristics of a device by mapping input values through a correction function corresponds to the characteristics of display device. It is done by sending signal through inverse function.

B. **Contrast Enhancement:** Contrast is defined as the difference in intensity between two objects in an image. Histogram represents the number of pixels for each intensity value considered. Histogram equalization is one of the contrast enhancement technique widely used in image processing because of its high efficiency and ease of use. This modifies dynamic range and contrast of an image so that the resulting image histogram has the desired shape.

C. **Log-Gabor Filter:** Log Gabor is a linear filter used for texture analysis. It is a logarithmic function, by varying the values of Gabor coefficients – x from 0 to 255 in the exponential value we need to create a matrix having the same order as that of input image matrix. The obtained matrix is known as Gabor filter which is to be convolved with the gray scale matrix to get the Gabor features of the input image. The obtained Gabor feature values are normalized in the range of 0-1. If the values are 0, it represent blue and if it is nearer to zero it represent green, if the

values are nearer to 1 it represent yellow and if the value is 1 then it represent red colour as seen and numbered as 1d and 2d in figure 3 & 4 respectively.

III. RESULTS AND DISCUSSION

120 images of fake and real Indian currency images of denomination Rs.10 and rs.20 are used for processing. After preprocessing, features coefficients are obtained by applying Log-gabor filter. These features are in turn given to KNN classifier for recognition. Satisfactory recognition rate is obtained after implementation. Results are given as below. Figure3 shows the outcomes of testing Real Rs.10 Note and Figure4 shows the outcomes of testing Fake Rs.10 Note.



Fig-3(a): Input image



Fig-3(b): Gamma corrected image



Fig-3(c): Contrast enhanced image

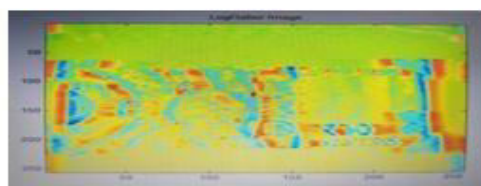


Fig-3(d): Log Gabour image

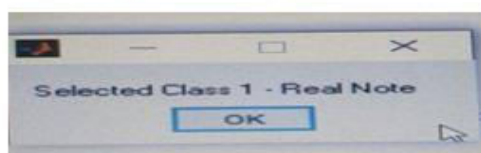


Fig-3(e): Result of given input



Fig-4(a): Input image



Fig-4(b): Gamma corrected image



Fig-4(c): Contrast enhanced image

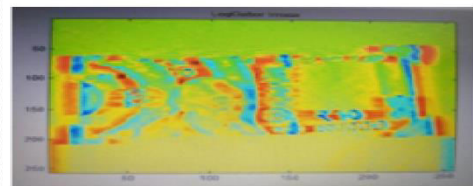


Fig-4(d): Log Gabor image

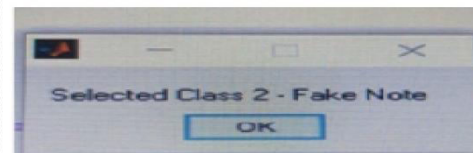


Fig-4(e): Result of given input

Fig. 3. Outcomes of testing Rs.10 Real note Fig. 4. Outcomes of testing Rs.10 Fake note

In this system of recognition of Indian currency notes, we have used 120 Images of real and fake Currency notes of denomination of Rs.10 and Rs.20 for Classification. Out of which 60 images (Rs.10 & Rs.20) are used for training the

system and 60 images (Rs.10 & Rs.20) are used for testing the system. For this process we have used KNN classifier. The obtained results are tabulated below

Table 1: Percentage of recognition rate of the system

Denomination		Images used for training	Images used for testing	Images classified correctly during testing	Images classified incorrectly during testing	%of recognition rate
Rs.10	Real images-15	15	15	14	1	93.3%
	Fake images-15	15	15	14	1	93.3%
Rs.20	Real images-15	15	15	13	2	86.6%
	Fake images-15	15	15	14	1	93.3%
Total average Recognition rate of the system : 92%						

IV. CONCLUSION

Indian currency notes of denomination Rs.10 and Rs.20 are used in our system for classification. After preprocessing these images, features are extracted by applying the Log-gabor filter. Filter coefficients are then given to KNN classifier for recognition purpose. The features are compared with trained dataset features Using KNN Classifier. We have used 120 Images of real and fake Indian Currency notes of denomination of Rs.10 and Rs.20 for Classification. For training the system we have used 60 images, that includes 30 images of denomination Rs.10 and 30 images denomination Rs.20. For testing the classifier we have used 60 images that also includes 30 images of denomination Rs.10 and 30 images denomination Rs.20. The percentage of recognition rate is calculated based on the rate of correct classification of test image as real and Fake Notes. The Table1 represents the percentage of recognition rate of the system . The average recognition rate of the system is 92%. Hence the proposed system is having more efficient performance and achieves good recognition rate.

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