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Comparative Study on Currency Recognition System Using Image Processing

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ABSTRACT

In the world, currency is the main role as medium of exchange where government of many countries introduces as banknotes and coins that is. Indian rupees, dollar, Yuan, dinar etc. in different appearance such as picture of our leaders, different color, size, serial numbers, watermarks. At same time people handled difficult to recognize currencies from different countries. The purpose of the paper is to help people solve these difficulties by comparing with another methodology. However, currency recognition system that are based on image analysis entirely are not sufficient. Our system is based on image processing and makes the process easy and user friendly to recognize all kind of banknotes. In this paper we have use Indian currency i.e. Rupees

Keywords: Currency recognition, Image processing

I. INTRODUCTION

There are many type of currencies in the world, with each of them looking different with their features i.e. differ in the size of the banknotes, color, texture etc. the people who work in the money exchange have to differentiates all the type of currencies. They have to keep all the features of the all the banknotes that may cause some problems, so they need an efficient and exact system to help their work. As mentioned early, the aim of system is to help the people who need to recognize different currencies and with convinces and efficiency.

There are machines helps the people to recognize different kinds of currencies. But for most working staff in money exchange have to keep a lot of different characteristics and anti-fakes label for different commonly-used currencies in their mind. However, everyone has a handbook that about the characteristics and anti-fakes labels of come commonly-used currencies. No one can ever be 100 percent confident about the manual recognition.

Our system is based on image processing which include many techniques to recognize the currency. In order to make system complete, we need to maintain a database for storing the characteristics of the currencies. In this system, we take Indian currency as example. The system will be programmed based on MATLAB which is user-friendly interface.

II. SYSTEM ARCHITECTURE OF PAPER CURRENCYRECOGNITION

The architecture of currency recognition system is designed in Fig 1

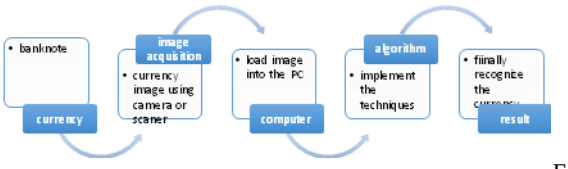

Figure 1.Architecture of this system

III. METHODLOGY

The system is based on digital camera and load image on the pc and implement with algorithm. Once the image loads on

the computer we applied technique and also image compares have been done. We realize there by programming with MATLAB. The process of the system is described in the flowchart below Fig 2

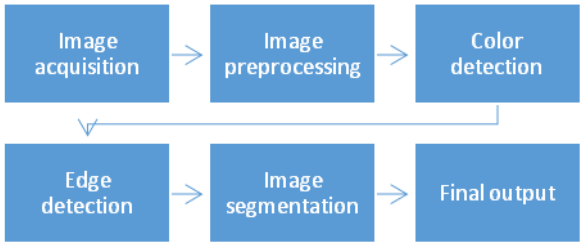

Fig 2 – Process of the System

a. IMAGE ACQUISITION

There are various ways to acquire image such as with the help of camera or scanner. Acquired image should retain all the features. You can choose any one to process. We have used digital camera image. The image we capture it should be in format by JPEG i.e. Joint Photographic Experts Group and should not be png/gif etc. after we get the currency image, the basic distribution is similar, a white area in the left side and a head portrait in the right side. There are some more important characteristics to distinguish the different of currencies. This data is then processed with some proprietary algorithm to correct for different exposure conditions and sent to the computer via the device's input/output interface. Below image acquisition Fig 3 (a) & Fig 3(b)

Fig 3(a) Indian rupee back

view

Fig 3(b) Front view of the 100 rupee

b. IMAGE PRE-PROCESSING

The aim of image pre-processing is to destroy undesired distortions or enhance some image features that are important for further processing or analysis.
In our work, image pre-processing includes these parts:

- Image smoothening (removing noise).
- Image adjusting

1) Image Smoothening

When using a digital camera or a scanner and perform image transfers, some noise will appear on the image. Image noise is the random variation of brightness in images. Removing the noise is an important step when image processing is being performed. However noise may affect segmentation and pattern matching. When 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. The neighbor of the pixel is consisting with some other pixels and they build up a matrix, the size of the matrix is odd number, the target pixel is located on the middle of the matrix.
And this perform is often used in image processing to reduce "salt and pepper" noise. Besides the median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. After processing with median filter, the noise is removed so well, and some detail is described so well on the image. The pattern which is the most important thing that we want to find is also clear.
Median filter replaces a pixel via the median pixel of all the neighborhoods:
$y[m, n] = median\{x\ [i, j], (i, j) \in w\ \}$
Where w represents a neighborhood centered on location.

2) *Image Adjusting*

After removing the noises, the next step is to cut off some useless area. Sometimes, for some reasons, some black lines will appear on the edge of the original image, which will affect the next operation. To avoid this problem, we cropped the white space of the image. Fig 4(a) & Fig 4(b) describe the adjustment of the image.

Fig 4(a) – Captured Image using camera

Compared with an A4 size paper, the currency is so small. However, when we get the image from the camera, the image

we get is a picture like an A4 paper.

Fig 4(b) Cropped Image from original picture

So after capturing the image will have lots of white area surrounding the currency. Actually this is useless part for recognition. In order to make the system efficient, the white area part will be cut entirely. Figure 16 shows before cutting and after cutting. Because the light condition, when getting the image from digital camera, we need to perform histogram equalization.

Histogram is used to adjust the contras and brightness of the image, because some part of the recognition based on color processing. Histograms chart has pixel value (0-255) on the X axis and number of pixels (0-image size) corresponding to that color value on the Y axis. Using histograms, we can filter pixels with those values out of the image leaving the desired object in view.

If R<R_min_thres or R>R_max_thres then R=0
If G<G_min_thres or G>G_max_thres then G=0
If B<B_min_thres or B>B_max_thres then B=0

Here the min_thres and max_thres for the three RGB components is the minimum and maximum threshold limit present in any currency note and is determined by experimenting on various different values.

c) COLOUR DETECTION

There are too many types of color model we can use, like RGB, HSV, and GREY. We use RGB model because we need to calculate the mean of the color. The image is presented as x by y by 3 matrix (here x is the width of the image, y is the height of the image), iteration each pixel and store the value of R, G, and B. After that, the mean of each channel will be calculated. We do not calculate the whole primary color of the currency. We cut half of the Currency, because most of the currencies are dividing into two parts. And the left partis mostly white area, while the right part has some patterns or portrait.The primary color of the image is used to check what this currency is and this isone of the important characters for recognizing the currency.

d) EDGE DETECTION

It is the fundamental tool in image processing, which aim at identifying points in digital image at which the image brightness changes sharply or has discontinuities.

The next step is performing edge detection. There is some way to perform edge detection, Sobel, Canny, Prewitt and so on.

Sobel is used for edge detection in our system. It computes an approximation of the gradient in the image. Sobel operator is the operator in image processing, one mainly used for edge detection. It is used for computing the gradient of image brightness function approximation. Any point in the image using this operator will have a corresponding gradient vector or the vector of its law.

There are two Sobel operators, one is used to detect the x direction and the other is used to detect the y direction.

$$Gx = \begin{matrix}-1 & 0 & 1\\ -2 & 0 & 2\\ -1 & 0 & 1\end{matrix} \times a$$

$$Gy = \begin{matrix}1 & 2 & 1\\ 0 & 0 & 0\\ -1 & -2 & -1\end{matrix} \times a$$

Where a is the image, Gx and Gy are the image that after detected.

COMPARASION OF SOBEL AND ROBERT CROSS OPERATOR

SOBEL OPERATOR	ROBERT CROSS OPERATOR
Consists of pair of 3x3 convolution kernel	Consists of pair of 2x2 convolution kernel
Edges are more thicker when increase smoothing of Sobel operator	Edges are not much thicker
Sobel operator is not as sensitive to noise and it amplifies high frequency.	Robert operator is sensitive to noise.
$Gx = \begin{matrix}-1 & 0 & 1\\ -2 & 0 & 2\\ -1 & 0 & 1\end{matrix} \times a$ $Gy = \begin{matrix}1 & 2 & 1\\ 0 & 0 & 0\\ -1 & -2 & -1\end{matrix} \times a$	$Gx = \begin{matrix}1 & 0\\ 0 & -1\end{matrix} \times a$ $Gy = \begin{matrix}0 & 1\\ -1 & 0\end{matrix} \times a$

e) IMAGE SEGMENTATION

It sub divides the image into its constituent regions. We need to store the feature of the currency as part by part and make image comparison using the following techniques.

i) Classic image check

Description

The classic - or default - image check compares the color value of every single expected and actual pixel. If at least one expected pixel differs from the actual pixel the check

fails. The option Tolerance for checking images defines the tolerance for comparing pixel values.

Purpose

This pixel based check is suitable if you expect an exact image match with minimal tolerances or any deviations. Whenever your application renders the component not fully deterministically, this algorithm is not suitable. Image-in-image search

a) Using this image-in-image search, we can able to compare images if you don't know the exact position and thus cannot define an offset. The search can be combined with any algorithm and is thus valuable for any purpose.

It uses to find an expected image within a (larger) image. The check is successful when the expected image can be found anywhere using the defined algorithm.
There are some techniques used on image processing such as image-in-image search, Pixel-based identity check etc.

IV CONCLUSION

A lot of images of currency notes were taken from their front as well as back in different positions with the help of a camera. The designed algorithm was then applied on these acquired images of Indian currency notes to find the denomination of the currency note. After we follow the above mentioned design steps of the proposed recognition scheme, the currency note in the image gets recognized.

V FUTURE ENHANCEMENT

We have developed an interactive system that generates Currency Recognition System using some different technique with the help of MATLAB. The Indian currency notes have been recognized. The future study will be done by applying different filters. In this thesis the images were scanned horizontally in the future the images will be scanned with different angles using all the methodology. Different currencies could be used for recognition like dinar, US dollar, EURO etc. Similarly different features can be used for recognition.

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