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Currency Authentication for Visually Impaired Using Image Processing

Anjali Ranolia[1], Nupur[2], S Jaykumar[3]
[1,2] B. Tech(III) year Student of Department of Computer Science and Engineering,
SRM University, Ramapuram, Chennai, TN
[3,] Assistant Professor, Department of Computer Science and Engineering,
SRM University, Ramapuram, Chennai, TN
Email: anjaliranolia@gmail.com,nupur6060@gmail.com

Abstract- As in the past, only the printing house had the ability to make counterfeit paper currency, but at present it is possible for any person to print fake bank notes simply by using a computer and a laser printer at home. Counterfeit notes are a problem of almost every country. There is a need to design a system that is helpful in recognition of paper currency notes with fast speed and in less time. This proposed system describes an approach for verification of currency bank notes. The currency will be verified by using image processing techniques. The approach consists of a number of components including image processing, edge detection, image segmentation, characteristic extraction, comparing images. MATLAB is used to extract the characteristic features of paper currency. Also, a reliable currency recognition system could be used in any sector wherever monetary transaction is of concern, also this can be useful for visually impaired people. Currency denomination detection is a vast area of research and significant progress had been achieved over the years. This paper presents an extensive survey of research on various developments in recent years in identification of currency denomination. In this article, recognition of paper currency with the help of digital image processing techniques is described. The desired results shall verify with MATLAB software.

Keywords-Characteristic Feature Extraction, Currency recognition, , Image Processing

1. INTRODUCTION

As mentioned above, the aim of this system is to help people who need to recognize different currencies especially visually impaired. For bank staffs, there is a "Currency Sorting Machine" helps them to recognize different kinds of currencies. The main working processes of "Currency Sorting Machine" are image acquisition and recognition. It is a technique named "optical, mechanical and electronic integration", integrated with calculation, pattern recognition (high speed image processing), currency anti-fake technology, and lots of multidisciplinary techniques. It is accurate and highly-efficient. This system is based on image processing, techniques which include edge detection, segmentation, etc. In order to make the system more comprehensive, a small database is created for storing the characteristics of the currency. The system will be programmed based on MATLAB and include a user-friendly interface.

The main steps in the system are:

1. Read image, reading the image we get from scanner as well as the format of the image is JPEG.
2. Pre-processing, removing noise, smoothening image.
3. Image process, edge detection, segmentation, pattern matching.
4. Results printing.

Basically the images are read from different derivations. However, we delimit our system which can read the currency from scanner. The device that the system needs is very common in our daily life, so we do not need to buy an extra device to realize the system.

2. THEORITICAL BACKGROUND

The system is based on scanner, PC, and algorithm. The aid of the algorithm is located in the unique figure, RGB to Gray, image binarization, noise elimination, segmentation, pattern matching, etc. We realize there by programming with MATLAB.

2.1 Image Acquisition:

Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. After the image has been obtained, various methods of processing can be applied to the image to perform the many different vision tasks. There are various ways to acquire image such as with the help of camera or scanner. Acquired image should retain all the features.

2.2 Pre-processing:

The aim of image pre-processing is to suppress undesired distortions or enhance some image features that are important for further

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processing or analysis. It includes. Image adjusting -When an image is obtained from a digital camera, the size of the image is too big. In order to reduce the calculation, the size of the image should be reduced. Image adjusting is done with the help of image interpolation.

Image smoothening- While performing image transfers, some noise may appear on the image. Removing the noise is an important step when image processing is being performed. However noise may affect segmentation and pattern matching. Mask values can be used to determine the degree of smoothening and to reduce noise. Higher is the size of mask, more is the smoothening

2.3 Binarization:

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.

2.4 Edge Detection:

Edge detection is the name for 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 these continuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision.

2.5 Image Segmentation:

Image segmentation is the process of partitioning a digital image into multiple Segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful
and easier to analyze.
Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Segmentation algorithm for images generally are based on one of the two basic properties of image intensity values-

Discontinuity: Based on abrupt changes in intensity such as edges in an image.

Similarity: Based on partitioning an image into regions that are similar according to a set of predefined criteria.

2.6 Feature Extraction:

Feature extraction is a special 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. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input.

Here are the core codes for segmentation:
PY1= round ((PY2-PY1)*scale_y1)+PY1; % Set the boundary by proportional
PY2 = PY2 - round((PY2-PY1)* scale_y2);
PY1 = PY1 -10;
PY2 = PY2 +10;
PX1 = round ((PX2-PX1)* scale_x1)+PX1;
PX2 = PX2 - round((PX2-PX1)* scale_x2); %Set the boundary by proportional.

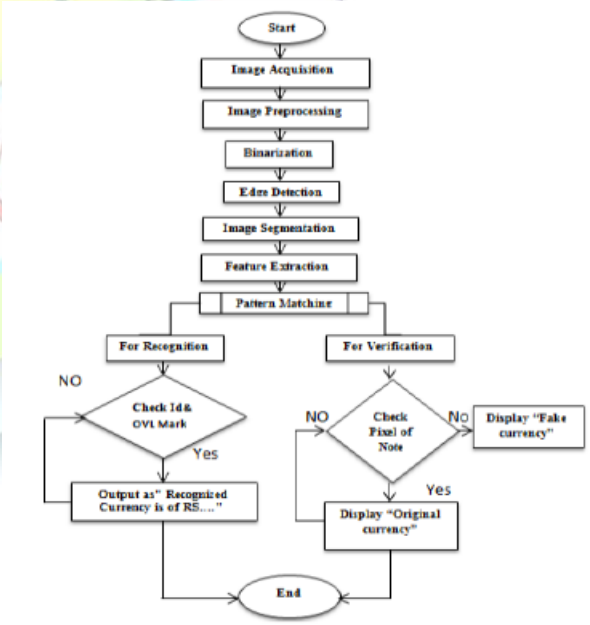

Fig. Currency Recognition and Verification System Flowchart

Actually PY1, PY2 is the boundary of top and bottom. PX1 and PX2 Is the boundary of left and right. After calculation, we get the new boundary of the pattern.

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3. POTENTIAL APPLICATIONS

Recent years have seen an increased interest in currency recognition system worldwide. And this is because of the various potential applications it has. Few of them are mentioned below:

Assisting visually impaired people:

There is a strong need for assisting visually impaired people because one specific difficulty that a blind person would encounter is to know the value of the currency or bill he or she is holding. Although these visually impaired people can distinguish between two different denominations using the different size of notes, but the size variation alone is not enough to flawlessly determine the currency note. In reality, the very little difference between the sizes of consecutive denominations makes them confused and unable to distinguish the currency notes from one another. The currency notes are provided with few special identification marks only for the blind people so that they may easily recognize the denomination correctly. Every currency note has its denomination engraved at the top right end which is sensitive to touch, but this mark fades away after the currency note goes in circulation for some time. This again creates a difficulty for the visually impaired people to correctly determine the denomination of the currency note. [5] proposed a system, this system has concentrated on finding a fast and interactive segmentation method for liver and tumor segmentation. In the pre-processing stage, Mean shift filter is applied to CT image process and statistical thresholding method is applied for reducing processing area with improving detections rate. In the Second stage, the liver region has been segmented using the algorithm of the proposed method. Next, the tumor region has been segmented using Geodesic Graph cut method. Results show that the proposed method is less prone to shortcutting than typical graph cut methods while being less sensitive to seed placement and better at edge localization than geodesic methods. This leads to increased segmentation accuracy and reduced effort on the part of the user. Finally Segmented Liver and Tumor Regions were shown from the abdominal Computed Tomographic image.

3.2 Distinguishing original note from fake currency:

Another important application is to distinguish original note from counterfeit currency so that it would be very helpful in encountering the counterfeit note that is flowing throughout Indian economy.

3.3 Automatic selling-goods:

The system must be very helpful for automatic selling goods. Vendors may sometimes get confuse when there is a huge crowd in a market. There is a possibility of being miscalculation on some of the goods. So the system will help vendors in keeping records of goods sold and the amount received.

3.4 Banking Applications:

The system should be very helpful in banking application such as counting of notes and its value during monetary transactions, detection of counterfeit notes, etc. Such a system will make the banking process a trustworthy and reliable process. As time is the important factor in today's world so such system will be helpful in saving time too.

4. PROPOSED SYSTEM

The proposed system of this article is divided into two parts such as:

(1) Currency Recognition

(2) Currency Verification

In Currency Recognition, Feature such as Identity Mark And optical variable link are used. Pixel value for each feature is calculated. Based on that pixel value histogram is plotted. Currency feature such as Id mark and Optical variable link will be using for recognition. Currency features such as watermark, security thread, Fluorescence and latent image will be using for currency verification.

In Currency Verification, Character from each segmented part is extracted. Pixel value for that extracted part can be calculated.

This section presents an approach to extract the features of currency notes. It is essential to describe a currency note by its attributes or properties in order to have better recognition, classification and retrieval of features. Several features like color, texture and size can be used to describe currency notes. Color is the most natural feature to describe currency notes. However, it fails to discriminate a number of the currency note having the same color. On the other hand each currency notes can uniquely be characterized by its texture. Therefore, the textures of the currency notes are considered as an important feature to describe and discriminate currency notes from each other. The proposed method begins with the pre-processing of currency notes via applying 2D adaptive noise removal to enhance the images.

The methodology is to apply the approximate coefficient of the transformed image is obtained. Next, the following statistical features such as mean, standard deviation, skewness and kurtosis are extracted from the approximate Coefficient matrix, Equation. For each currency note, the extracted features are stored in a feature vector. The feature vectors of different currency notes can be used for

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recognition, classification and retrieval of currency notes.

$$\text{Mean} = \frac{\sum_{i=1}^{N} F_i}{N} \quad \text{.....(1)}$$

$$\text{Standard Deviation} = \sqrt{\frac{\sum_{i=1}^{N}(F_i - \mu)^2}{N}} \quad \text{.....(2)}$$

Visual attributes of images are of two types-

1. Domain specific attributes which include fingerprints,
Human faces.
2. General attributes which include color, texture, and shape.

There are two types of attributes categorized under the
shape attribute extraction-
1. Global attributes include moment invariant, aspect ratio and circularity.
2. Local attributes include boundary segments.

In this approach the general attributes of the paper currency is extracted, that is shape including identification mark, security thread and watermark etc.. These features are extracted by detecting the edges and estimating the gradient of the image at every point to generate a gradient image and thresholding the gradient image to accomplish image segmentation.

4.1 Proposed Algorithms

4.1.1 Proposed Algorithm for Background Removal:

Input**:** Image with background
Output**:** Image with no background

Steps**:**
1. Get the width and height of the original image
2. Set a threshold value. Initialize two arrays horizontal
and vertical and left=0, down=0, top=0,right=0
3. Grayscale the original image.
4. Compare the pixel from top, left, right and bottom and calculate the difference in threshold in between the pixels in the following way
5. while i<wid do
   5.1. Top:
      5.1.1. While j=2 and j<ht/2-1 do
      5.1.2. P=gray value at i,j+1
      5.1.3. Q=gray value at i,j
      5.1.4. Diff=p-q
      5.1.5. if Diff>threshold then do
      5.1.6. Increment ver[j] , exit loop
      5.1.7. Increment j goto 5.1
   5.2. Bottom:
      5.2.1. while j=ht-2 and j<ht/2 do
      5.2.2. P=gray value at i,j-1
      5.2.3. Q=gray value at j,j
      5.2.4. Diff=p-q
      5.2.5. If Diff> threshold then do
      5.2.6. Increment ver[j] exit loop
      5.2.7. Decrement j goto 5.2
      5.2.8. Increment i goto 5

6. While J<ht
   6.1. Left:
      6.1.1. while i=2 and i<wid/2-1 do
      6.1.2. P=gray value at i+1,j
      6.1.3. Q=gray value at i,j
      6.1.4. Diff=p-q
      6.1.5. If Diff>threshold then do
      6.1.6. Increment hor[j] exit loop
      6.1.7. Increment i goto 6.1
   6.2. Right:
      6.2.1. while i=wid-2 and i>wid/2 do
      6.2.2. P=gray value at i-1,j
      6.2.3. Q=gray value at i,j
      6.2.4. Diff=p-q
      6.2.5. If Diff>threshold then do
      6.2.6. Increment hor[j] exit loop
      6.2.7. Decrement i goto 6.2
      6.2.8. Increment j goto 6
7. Assign to top and down new values by following
   7.1. Compare ver[current pixel] with ver[top]
      if greater than assign top=current pixel.
   7.2. Compare ver[current pixel] with ver[down]
      if greater than assign down=current pixel.
8. Assign to left and right new values by following
   8.1. Compare hor[current pixel] with hor[left]
      if greater than assign left=current pixel.
   8.2. Compare hor[current pixel] with hor[right]
      if greater than assign right=current pixel.
9. The dimensions of the new image are left, right, down and top.

4.1.2 Proposed Algorithm for Dominant Color Extraction:

Input**:** Image with background
Output**:** Dominant Color

Steps**:**
1.For each pixel in image get RGB value of pixel and store it integer variable P.
2.Extract Red, Green and Blue component from P and store in integer variables R, G and B respectively.
3.Convert this R, G and B components into HSV Components.

4.Keep track of Hue component from HSV of each pixel to determine dominant color of image.

5. RELATED WORK

As numerous researchers have made several contributions towards the system for currency recognition and verification. This paper presents an overview of such recent developments. Most of the work done in recent years have been successful in achieving 90% or more of accuracy and are mostly confined to one or two dimensions of currency recognition viz. color, texture and so on. The purpose of this paper is to study the techniques and methods implemented and applied by previous researchers and scholars. Unlike previous reviews, this paper concentrates on very recent developments, particularly in the field of currency recognition. This paper will also be focusing primarily on currency detection system including various steps involved in it like image acquisition, feature extraction and classification system using various algorithm.

CONCLUSION

The motivating insight of this research is, recognizing the notes manually becomes time-consuming and untidy process thus there is a need of automation techniques with which currency authentication process can be efficiently done. Using image processing techniques this process becomes more software oriented rather than depending on machines thus aiding a person to recognize and detect fake (counterfeit) notes at some extent. However, visually impaired people particularly suffer in monetary transactions. Such a system will help visually impaired people, finding it difficult to distinguish different currency denominations and also unable to recognize counterfeit currency. Current Systems implemented using Image processing techniques focuses more on extracting denomination value only. Thus this system focuses more on security features in Currency notes and using these security features the Currency is recognized. Experimental results show that the accuracy of the system proposed above is close to 90%. The future scope could be, to work with any note clicked with any orientation and to extend it to detecting currency denominations for various countries.

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