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An Android Application for Indian Currency Recognition and Authentication for Blind

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Abstract - Indian currency note's higher denominations like □500 and □1000 have different colour, identification marks and different sizes for their recognition but still the normal people as well as blind people fails in recognition of authenticity of currency note. Due to the complications which the blind people as well as normal peoples are facing related the recognition and authentication, we have developed an android app for recognition and authentication of currency notes, which can be an assistive tool for a blind person and authenticity detector tool for normal person. This paper focuses on the recognition and authentication of the currency note. The recognition of the note is done by using the pre-processing techniques and the authentication of the note is done by applying OCR techniques and Serial number extraction and comparison of serial number with CSV file and an audio output is generated using TTS Speech Synthesizer.

Keywords - *Android, Currency recognition, Comma Separated Value(CSV), Image Preprocessing, Gray Scale, HSV(Hue Saturation Value), Optical Character Recognition(OCR), Speech synthesizer, Segmentation, TTS (Text To Speech).*

1. Introduction

Currency paper note is still a most commonly used mode of monetary transaction besides so many other ways of transaction. The appealing features of the paper currency include durability, privacy, simplicity and complete control. But it fails in case of value transaction because it lacks in intrinsic value and in case of repudiation, it fails in mechanism of reversal, except the credential support by the state. Image Processing is widely used in the field of currency recognition.

Automatic systems for currency note recognition holds importance in many applications such as automated teller machine and automated goods seller machines which our very costly. Our system is designed to recognize and verify the Indian paper currency. Our approach includes number of steps including image cropping, gray scale conversion, RGB, HSV, thresholding, Segmentation, Boundary detection, OCR of images. Firstly, large number of training samples is created which are used to avoid over fitting and poor generalization. Secondly, if the distribution of training sample is non-uniform, the result will probably converge to a local optimal or will even diverge unreasonably. Therefore, the selection of the training set is a crucial issue for the Image processing.

In currency circulation, the original information on paper currency may incur loss because paper currency may be worn, blurry, or even damaged. Furthermore, the complicated designs of different forms of paper currencies make automatic currency recognition difficult to work well. So therefore, it is difficult to extract the characteristic information from currency image and select proper pattern recognition algorithms to improve the accuracy of currency recognition. The method we present here has an excellent performance. In this paper, we have designed a first android app on currency which can recognize as well as authenticate the currency note. Preprocessing techniques are applied for recognition and OCR techniques are applied for Serial number extraction. Later, the extracted Serial number template is matched with fake serial number series templates in CSV file stored in Database. If matched, then fake note else original note.

2. Literature Survey

PAPER CURRENCY VERIFICATION SYSTEM BASED ON CHARACTERISTICS EXTRACTION USING IMAGE PROCESSING

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 Indian currency banknotes. 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. The image processing approach is discussed with MATLAB to detect the features of paper currency. Image processing involves changing the nature of an image in order to improve its pictorial information for human interpretation. The image processing software is a collection of functions that extends the capability of the MATLAB numeric computing environment. The result will be whether currency is genuine or counterfeit.

OPTICAL CHARACTER RECOGITION BY USING TEMPLATE MATCHING, March 2014.

The Optical Character Recognition is a mobile application. This uses smart mobile phones of android platform. This paper combines the functionality of Optical Character Recognition and the speech synthesizer. Its objective is to develop user friendly application which performs image to speech conversion system using android phones. The OCR takes image as the input, gets text from that image and then converts it into speech. OCR system can be useful in various applications like banking, legal industry, industries, home and office automation. It is mainly designed for people who are unable to read any type of text documents. The character recognition method is presented by using OCR technology and android phone with higher quality camera.

FAST COUNTRY CLASSIFICATION OF BANKNOTES.2166-0662/13 $26.00 © 2013 IEEE DOI 10.1109/ISMS.2013.34

In Fast Country Classification of Banknotes paper, a fast algorithm for country classification of banknotes is proposed. This algorithm can be used as an initial step for conventional country banknote classification methods developed for a single currency in a multi-country. We assume that the input image is a Contact Image Sensor (CIS) scan image with de-skewing and Region of Interest (ROI) extraction. In the training process, after size normalization extraction of image for a banknote group based on overall context similarity is done.

ROBUST AND EFFECTIVE COMPONENT-BASED BANKNOTE RECOGNITION BY SURF FEATURES

In this paper we propose a component-based framework for banknote recognition by using Speeded Up Robust Features (SURF). The component-based framework is effective in collecting more class-specific information and robust in dealing with partial occlusion and viewpoint changes. Furthermore, the evaluation of SURF demonstrates its effectiveness in handling background noise, image rotation, scale, and illumination changes. To authenticate the robustness and generalizability of the proposed approach, we have collected a large dataset of banknotes from a variety of conditions including occlusion, cluttered background, rotation, and changes of illumination, scaling, and viewpoints. The proposed algorithm achieves 100% recognition rate on our challenging dataset.

A STUDY OF COMPUTER VISION TECHNIQUES FOR CURRENCY RECOGNITION ON MOBILE PHONE FOR THE VISUALLY IMPAIRED.

In this paper a study of some recent computer vision techniques like BRIEF, ORB, FAST, AGAST, BRISK, FREAK and earlier techniques like SURF, SIFT. The mobile based currency recognition applications discussed here are meant to support visually impaired and blind users. Mobile devices are ubiquitous and come with a built in camera having a fair resolution. Currency note images captured by blind users can have several failings: images of the notes may not be ideally aligned/oriented; there can be scale changes due to variation of distance from camera; illumination changes can also lead to differences in images.

There is also the possibility of a cluttered background in the image, or the note being partially occluded, folded, worn and/or wrinkled, etc. This paper illustrates computer vision techniques employed till now and studies new improved techniques which can be used in their place. These new methods offer several advantages for efficient currency note recognition in mobile applications.

3. Architecture

I. Firstly, the real time camera captures the image or dynamically takes the image from gallery. Then image preprocessing techniques like grey scale, threshold, boundary detection, cropping are applied to the mage taken by real time camera or the image selected from gallery for the purpose of localization (make ready image for processing).

II. Secondly, the image which is ready for processing is loaded, further processing techniques like blurring and converting from RGB to HSV, Histogram calculation, Segmentation, finding aspect ratio and finally comparison is done using templates. This will give us the currency denomination.

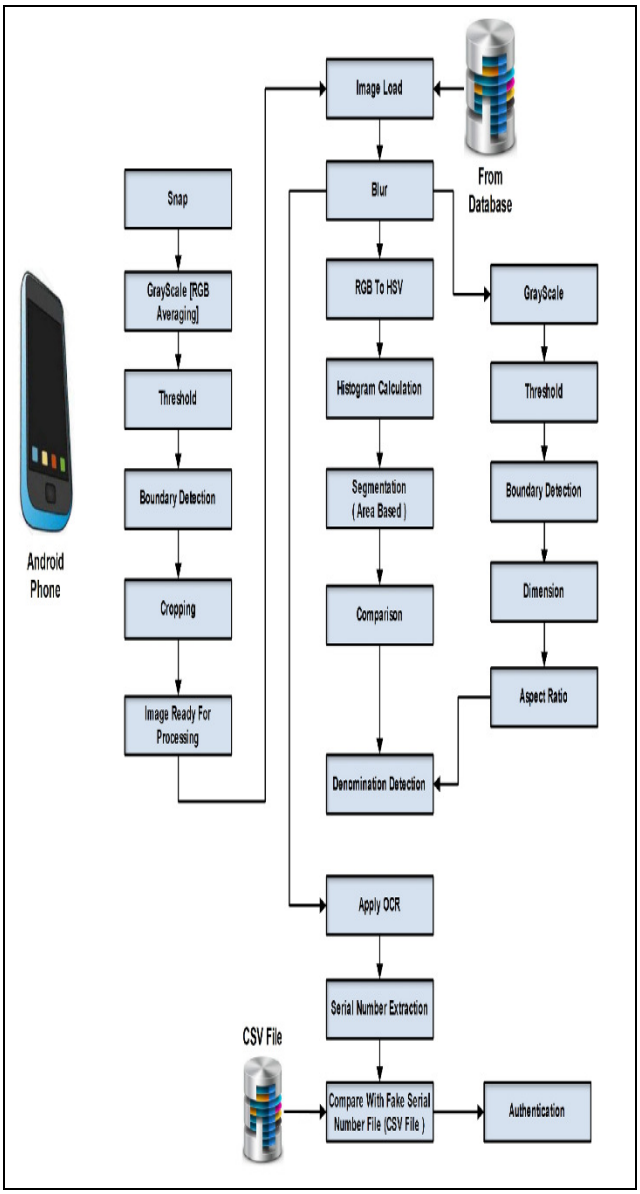


Fig1. Currency recognition and authentication

III. Lastly, the OCR technique is used for Serial number extraction and comparison is done between the extracted serial number template and template of the fake number series in CSV file which have been stored in the database. If matches found, the note is fake else the note is the original note.

IV. Blind user is supported by the audio note guidelines generated by the app. Results are generated as an audio clip using TTS Speech Synthesizer.

Our proposed system aims at dynamically taking the image by the user's camera or image is selected from gallery. This image is then converted to grey scale (RGB averaging).

- *Grey-scale conversion:*
  The image acquired is in RGB format. 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). Image is acquired in step 1 is large to continue process and color information is not needed, except the color index. First, image in RGB format is converted to pixel values and then to gray scale

- *Threshold:*
  HSV thresholding is applied. In this process, thresholding is used for isolating or removing image features which cannot be achieved by the RGB thresholding when the pixel color range is diverse.

- *Boundary Detection:*
  In image processing, an edge is the boundary between an object and its background. They represent the frontier for single objects. Therefore, if the edges of images objects can be identified with precision, all the objects can be located and their properties such as area, shape can be calculated.

- *Cropping:*
  Cropping refers to the removal of the outer parts of an image to improve framing, accentuate subject matter or change aspect ratio.

- *Blurring:*
  In image, terms blurring means that each pixel in the source image gets spread over and mixed into surrounding pixels. Blurring an image reduces the sharpening effect, this makes the detection more accurate. To increase the blur effect we can scan surrounding 5 pixel i.e. 5*5 window.

- *RGB to HSV:*
  Color vision can be processed using RGB color space or HSV color space. RGB defines color in terms of a combination of primary colors, whereas, HSV describes color using more familiar comparisons such as color, vibrancy and brightness.

- *Histogram Calculation:*
  It is possible to develop a transformation function that can automatically achieve this effect, based on the histogram of the input image. An image

histogram is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value.

- *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.

- *Output:*
  The output will be currency denomination and either "The note is Genuine" or "The note is fake" at a time will be generated as an audio output to the user.

3. Figures and Equations

3.1 Figures

Fig2. Original Image

Fig3. Image Preprocessing

Fig4. Serial number extraction

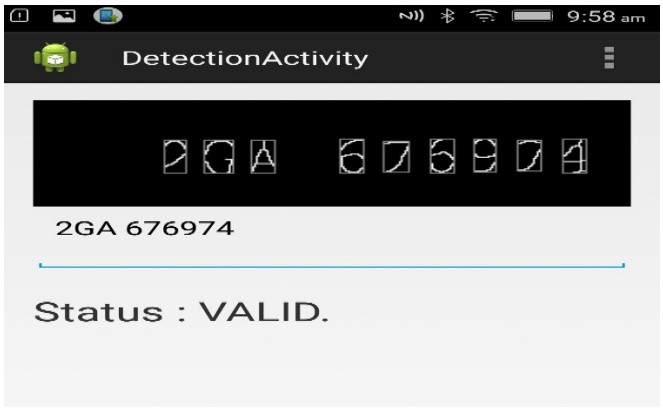


Fig5. Character template matching

3.2 Equations

a. S = {……
Let 'S' be the | Currency recognition system as the final set,

b. S= {U…}
U be the set of users
U= {U1, U2 …Un}

c. S= {U, I…..}
'I' be the set of Input Currency Image
I = {I1, I2…In}

d. S= {U, I, A…..}
'A' be the set of Algorithms
A = {A1, A2, A3……An}

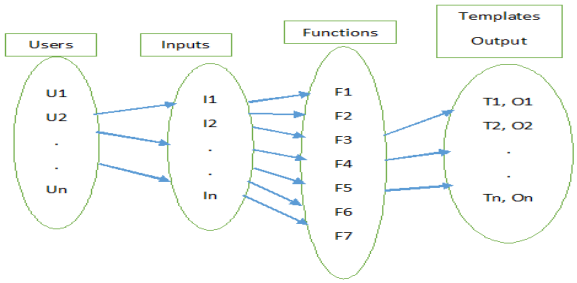
e. S= {U, I, A, T….}
'T' be the set of Templates generated

T= {T1, T2, T3……Tn}

f. S= {U, I, A, T, O…}
'O' be the set of Detected Characters
O = {O1, O2, O3…..On}

g. S= {U, I, A, T, O, F…}
Identify the functions as 'F'
F = {F1 (), F2 (), F3 (), F4 (), F5 (), F6 (), F7 ()}

F1 (): Blur ()
F2 (): RGBtoHSV ()
F3 (): HSVThresholding ()
F4 (): Thinning ()
F5 (): TemplateGeneration ()
F6 (): Segmentation ()
F7 (): CharacterDetection ()
Hence the functionality can be shown as,



a. Items will be punctuated as sentences where it is appropriate.

b. Items will be numbered, followed by a period.

4. Results

We have introduced a Currency recognition android app which can detect the fakeness of the note and let us know the denomination in the form of an audio output.

Effectiveness of our app is when it authenticates the note with the help of template matching and sends the audio note of the denomination of the notes (10 rupees, 20 rupees, 50 rupees, 100 rupees, 500 rupees, 1000 rupees) and the result will be shown as follows:

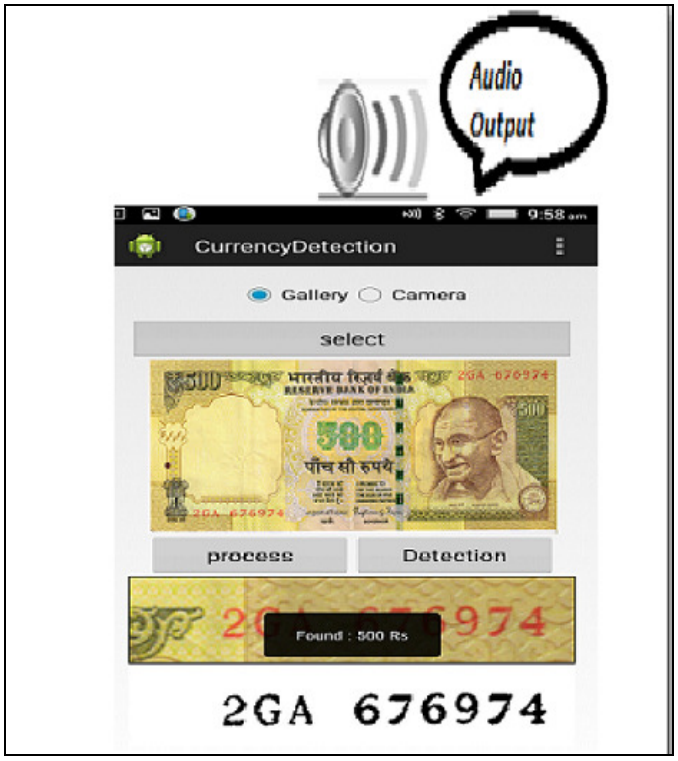


Fig 6. Output

5. Conclusion

This paper proposes the improvement in the existing system's which were very costly and robust in results. Our proposed work establishes a new approach of developing an android app as an assistive tool for Blind and a fakeness detector tool for normal people. This tool is implemented using Preprocessing techniques for recognition and OCR techniques for serial number extraction which will be compared with the fake serial number series stored in the database (CSV file) for detecting fakeness of the currency note and the Speech synthesizer (TTS) which speaks up the denomination of the different currency notes. Our proposed android application can also be used for different country currency notes by updating the trained database.

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