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Currency Recognition for Blind

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Abstract: In this paper, we proposed a system for automated currency recognition using image processing techniques. The method proposed in this system can be used for recognizing both the country origin and denomination or value of a given currency note. Only paper currencies have been taken here. The proposed method will first work by identifying the country of origin using certain predefined areas of interest and then extracting features using characteristics such as size, color, or text on the note to find the denomination of the notes. Feature extraction depends on how much the notes within the same country differ. The output will be given in graphical user interface format and also in audio format. Our system is able to identify the test notes quickly and accurately.

Keywords: Image Processing, Feature extraction, Signal processing, Binarization, Denomination, Binary image, Origin, Currency recognition.

I. INTRODUCTION

There are around two hundred plus currencies presently circulating around the world. Each of these currencies unique features such as size, color and texture. Comparing to the olden times, the trade and commerce between other countries have increased in all sorts of levels. It has been extremely important for acquiring knowledge about all the currencies by the banks. However for any human to recognize each note correctly is not possible. Thus there is the need for an efficient automated system that helps in recognizing notes is important for the future.

We proposed an automated system for currency recognition using Image processing techniques. Our system works for 10 of the most commonly used currencies.

The method used in currency recognition system is shown in hierarchy in Fig. 1. Firstly the nature of each image is refined to convert it into a usable input to extract various pictorial information in pre-processing phase. Secondly system then extracts the region of interest based on features such as size, color and text. Using these regions of interest, the system first determines the country of origin of the currency note and then

the denomination of the currency note will be identified using the differentiating characteristics of each note within the same currency. The chosen characteristics would be size, color or text based on the country of origin of the currency note.

This paper consists of many sections as follows. Section 2 is about the previous works done in the field of currency recognition. Section 3 will explain about the method proposed with the various techniques used in detail. Section 4 presents conclusions of the paper. Section 5 contains the results. Finally, Section 6 consist the reference.

II. BACKGROUND

First the image input is scanned. Then the image is read using MATLAB. Image processing is performed by gray scale conversion and then by binary scale conversion. If any noise is introduced it is removed. Then feature extraction is performed. After performing these steps for both real currency and fake currency pattern matching is done considering unique characteristic like black strip [1]. The system can work for assisting visually impaired people to correctly determine denomination of the currency notes. It can help to distinguish original note from counterfeit note. If any damage occurs in middle of the process then the image need to be scanned again.

Radial bias function is used for classification. Saudi Arabian paper currency case method is used as a model. Here the bank notes are collected and scanned. The image is processed and noise or any disturbance if present is removed. Feature extraction is done based on weighted Euclidean distance [2]. Lastly the recognized results will be given. System takes almost 3 seconds per image in average for classification. System will not recognize other currencies other than Saudi currencies. The system is not concerned with verification of the validity of paper currencies. Image analysis and image processing are the main techniques in this system. Image processing is pre processing followed by signal processing. The output of the system can be either a set of characteristics or an image or the parameters related to the image.

The image is regarded as 2D signal generally and it applies some standard signal processing techniques in which image processing techniques are involved. Image analysis is necessary information from an image is extracted by means of digital image processing techniques. The process of partitioning of digital image into multiple segments is known as image segmentation. Feature extraction is simply transforming input data into the set of features. By this technique the number of lines on the real and fake images is found to make the real note pixels unique. System is time efficient and very accurate in results [3].

The System is implemented in MATLAB and connects it to a Raspberry Pi to make it helpful for the visually impaired persons. This is hard and very time consuming, if to be done manually. The project in the beginning is maintained in such a way that the currency note will be exposed to the UV LED in order make the water mark of Gandhi Visible along with the Security thread line. Image is sent through preprocessing stage after capture of image. After performing the entire image processing terminologies such as image acquisition, image binarization, edge detection, image segmentation, feature extraction and feature matching. The identified currency value is converted to text format and later the text is converted to speech and is speech synthesized in order to help the blind recognize the value correctly [4]. This helps blind person to detect the currency notes. It detects only Indian currency. Input the Indian Currency Image as the RGB. Convert the RGB to binary image. Apply three into three grids on each side of image and each block number from 1 to 18. Select the block 4 from the grid to detect denomination of the currency. To determine whether currency denomination is Rs. 100, Rs.500 or Rs. 1000 apply Neural Network Classifier. Select the block 8 from the grid to detect governor declaration. To locate governor declarations apply bounding boxes to all the regions. Select the block 17 from the grid to detect year of print. It has become very important to develop automated system to extract feature and recognize India currency note in different area such as bus station, railway station, shopping mall, and banking and ATM machines [5]. Identification of only old Indian currency note to be done. Fake currency cannot be detected. Only 100, 500, &1000 note can be recognized. The first step system is Image Acquisition. Give the image as input. After the image has been obtained, various methods of processing can be applied to the image to perform the different vision tasks. There are various ways to acquire images such as with the help of camera or scanner. The second step is Pre-processing. Pre-processing main goal is to enhance the visual appearance of images and improve the manipulation of data sets. Zooming, rotating, shrinking are used for geometric corrections and removing the noise. The next step is Edge Detection [6]. Edge detection is an image processing technique for finding the boundaries of objects within images. It works by detecting discontinuities in brightness. Image segmentation and data extraction in areas edge detection is used. The next step is Image Segmentation; image segmentation is the process partitioning a digital image into multiple Segments. The goal of segmentation is to simplify the representation of an image into the something that is more meaningful and easier to analyze. The overall disadvantage of the ideas are only particular notes can be detected, identifying the currencies of individual Countries have been implemented and audio features have not been used. The proposed idea will overcome all this drawbacks by adding up with audio and text feature, identifying the currencies of 10 countries along with their denomination and country.

III. METHOD

The high quality image has to be acquired from the input device. The similar images with size and quality are stored in the database. The system consists of following steps such as image acquisition, preprocessing including noise removal, feature extraction, classification and recognition. In Currency Recognition System the first stage is image Acquisition. Image Acquisition is the formation of digital images and is generally acquired by using digital camera. The image is then saving in order to be processed. Second stage of preprocessing is removal of undesired noise to be able to process. To remove noise from the images smoothing of image is applied using median filter. Median filter of 3*3 neighborhoods is applied to find the median. Next image enhancement stage is used to improve the images of low contrast. High level image is converted to binary image then binary image is converted to gray scale image.

Third Stage is Edge Detection. It aims at identifying points in digital image at which the image intensity changes strongly. The edge detection is used to restrict region of interest in the currency note.

Fourth stage is Image Segmentation. It subdivides the image into its ingredient regions. Segmentation algorithm for dull images generally is based on two properties:

A. Discontinuity

B. Similarity.

Image segmentation operation has been applied to marker the connected components in an image or part of an image. All set of pixels can be taken as connected group. Each connected component is given a sole label to be visualized in an image.

Once the preprocessing steps have done, identification of origin of country is done by using two methods that are by template matching and identifying empty regions. Identifying empty regions first identify black pixels in the binary image of the note that is relatively empty region. It is done by certain predefined areas. All the currencies have been clustered into groups based on which regions of the note are relatively empty. Divide them into 3 groups left side empty, right side empty, and center empty. If the number of currencies are larger use larger set of groups top empty, bottom empty, etc.. Grouping is done by finding out the ratio of black pixels to white pixels for the required region and then classifying the note based on this aspect ratio. The values chosen to classify the notes should be found experimentally. Some of the notes have no significant empty space, and therefore they don't fall into any of the groups. These notes are been classified into another group. Using template matching to identify country of origin is by segregating bank notes into one of the predefined groups, and then image is checked against templates for each of the countries within that group. The templates are chosen such that they are small thus requiring less computation but still uniquely identify the country of origin. Thus, the templates are chosen to be uniform symbols such as the country's seal, name of the country itself in stylized font, etc. Template matching can be done to banknote in only the region that we know a certain symbol will be, if the location is uniform across all denominations. This template matching reduces the amount of computation.

Fifth Stage is Feature Extraction. The 3 approaches those are

- 1) Size ratio
- 2) Color
- 3) Text extraction

Some country banknotes can be easily differentiated by the size. If the country of origin has been identified as one of these, then compare the size of the given banknote with the known sizes of all the denominations. Some of countries banknotes are of too similar in size and it are difficult to differentiate them based on this feature alone. In that case, color difference between the different denominations can be used. For differentiation based on color k-means clustering algorithm is run on the given banknote. If both size and color methods fail, then extract the value of the denomination from the note using text extraction. This is the most computationally intensive method, so it can only be applied in the countries such as USA, etc. where both color and size do not vary too much between the denominations. If both methods do not work, this text extraction method is sure to work, as all banknotes have the value of the denomination written on the note in at least one place. Therefore, any of these three methods works for every note in the set of currencies taken. Through the first stage, notice variations among images and this leads to enhance the recognition rate. Basic features are extracted including identification the paper-currency. The procedure begins from data acquisition and later compare between features. The edge detection is using sobel or canny operator which works well in the whole system with less computation time for segmentation.

The below given figure describes the hierarchy of currency recognition system.

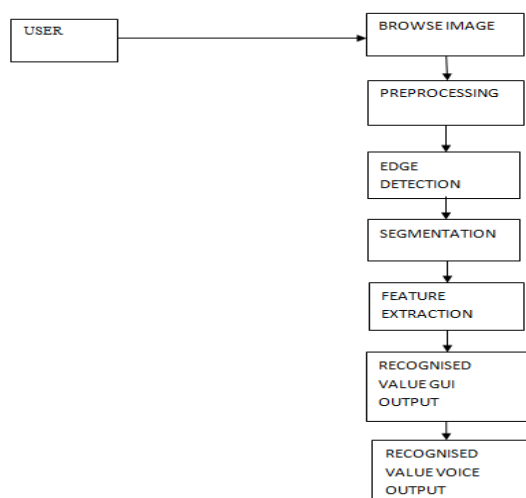


Fig 1. Hierarchy

IV. CONCLUSION AND FUTURE WORK

In conclusion, the designed system accurately identifies both the country of origin and the denomination of a banknote. This system currently supports ten of the most common currencies but it can easily be extended to more countries based on the method described. When compared to the previous algorithm, the algorithm proposed here is considerably more accurate and takes less time. The proposed algorithm is able to identify currency and denomination in an average of 45 seconds, which is a considerable improvement over the previous algorithms. The output will be displayed in GUI, the output will be converted to speech and give the output in audio which will be helpful for blind people. However, the proposed system only considers a limited number of currency notes and this system does not consider coins. There are more than one hundred and eight currencies that can be included in the system and we have chosen only 20 of the most common ones.

V. RESULTS

To identify the country of origin, first segment the note into a group based on presence or absence of empty regions in the certain pre-defined areas. Then classify the note by doing template matching with templates that characterize the banknotes from each of the countries in the group. Once the image has undergone preprocessing identify the country of origin by template matching it against the templates of all the countries within its group. Once the country has been determined, then the denomination should be identified. This can be done based on color, size, or text extraction. The color of the note can be used to differentiate notes such as Canadian Dollar, Mexican Pesos, etc., as they vary in color significantly between different denominations. Size can be a differentiating factor when the different denominations are of significantly different size. Resize and de-noise is done so that background noise is removed. It is essential to extract clean text. The image is then cropped to the area which holds the text. The text reads the denomination of the note in words. The output will be displayed in GUI, the output will be converted to speech and give the output in audio which will be helpful for blind people. Overall our system is able to accurately recognize most of the countries and denominations correctly. This result is much better result than that of the crude algorithm because it fails to recognize half of the given test images accurately.

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