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A Survey Paper on Currency Verification using Image Processing

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Abstract: Today in this world there are many different types of currency, every currency vary with each other i.e. they differ in their size of the banknotes, texture, color and so on, the people who are interested in the money exchange work have to differentiate between all the type of currencies. They have to keep on the top all the features of the all the notes from which they are differentiating as they can cause some minor as well as major problems, In short they require an effective, efficient and exact system to enhance their work. The main purpose of the developing system is to help the people who require recognizing or identifying different currencies or notes and with convinces and efficiency. The people who are working on currency recognition used many machines which help in their work. But for most of the staff who are working in money exchange have to keep a lot of different distinctive and anti-fakes label for different commonly-used currencies in their mind. In this paper it provides a detail review of different and various types of currency recognition systems.

Keywords: Currency Recognition, Neural Network, Pattern Recognition, Preprocessing, Feature Extraction

I. INTRODUCTION

The currency verification system which we are going to designed to identify the currency or notes by using and performing different techniques and methodology on a particular currency note. The currency verification system which is based on image processing must be capable to classify the paper currency to its correct class. The currency verification system which we are going to develop that must be able to detect the note immediately and rightly. The currency verification system should be able to identify currency note from any corner of the note. The currency notes are of various types in which some are old or new and some are noisy which creates a disturbance. Therefore, it is not possible that much simple to recognize and verify such types of notes.

To deal or to overcome with this problem we are going to develop a currency verification system. Currency verification system can be used in places such as shops, banks counter and automated teller machine, auto seller machines etc. It is not possible too much easy for the teller in the bank to recognize different types of notes so as to reduce human efforts currency verification system can be used. We have surveyed our system which can be used for various countries. So the welfare of this study for the proofreader are that by this study it will provide required data and information to the reader about this currency verification system for different countries. It is possible for them to distinguish verification system of different countries. Which techniques and tricks are applied to design these systems and at present which countries is having currency verification system using image processing.

II. LITERATURE REVIEW

In the base system we are going to use preprocessing technique to detect the note and remove the unwanted noise first, it is done by applying de-noising filter, image is converted into binary image using adaptive thresholding. The image is also resized for convenient and easy computation. Once the pre-processing is done the empty regions of the image can be identified. Identification of the empty region is done by grouping the image and finding out black to white pixels. Template matching is used to identify country of origin. Once the country has been identified, value of the note can be recognized [1].

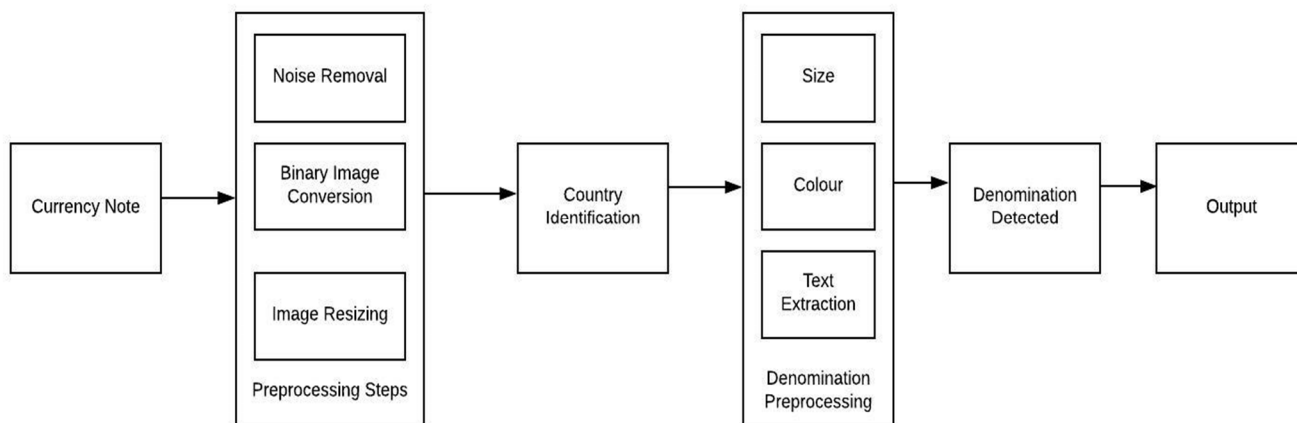
In the second reference the main requirement of the system is to provide the facility of fake currency detection. There are lots of machines available that help the people to identify different currencies. But they need to keep many features and anti-fakes for different currently used currency. About manual recognition of currency no one is 100 percent sure. So their purpose is to record currency with exact output without any interfere. This will also help in saving time period by detecting fake currency in comparatively less time [2]. In the third reference the system uses opt electric device to produce the signal from the light which will get refracted from the banknote. There are lots of currency recognition machine present so by using that currency recognition system currency can be identified which uses either image processing technique or neural network. In some of the system instead of sigmoid function they use function (Gaussian function) which describes hidden layer and output layer of NN. It is being

determined that Gaussian function is more beneficial than sigmoid function for the identification of known features and rejecting unknown patterns. [3] In the fourth reference the system is designed for fake currency detection which is implemented on MATLAB. The characteristics which are used to check the authentication of fake notes are Security thread, Serial number, Latent image, Watermark, Identification mark. The procedure with image acquisition proceeding towards Image pre-processing, Gray scale conversion and edge detection, image segmentation, and feature extraction. The system is capable of extracting feature even if there are scratch or scrawl on the note. The algorithm which is proposed here works perfectly for newly defined 500 to 2000 denomination (i.e. denomination is the value of the note). In order to increase the speed of the detection hardware implemented for the proposed system can be done using better processor. The automatic railway reservation can also be implemented which involves currency detection as one of its part. [4] In the fifth reference the system which is described is based on fraud detection of currency. So to reduce or to avoid the fraudulent notes they have taken some of the methods into consideration like water marking, optically variable ink, security thread, latent image, techniques like counterfeit detection pen and using MATLAB. The best counterfeit which can be used for currency is an ultraviolet counterfeit detection scanner; the UV detector present in it identifies the ultraviolet security features present in most the currency notes. It is done by simply placing the note into the detector, counterfeit currency is immediately identified. Among two different note which note is duplicate determine by comparing two various components of the notes if the note to be tested is original then at the place of number we only get variation. If the resulting image is blur than it indicates the fake note. [5] After going through all the five references about all the developed system we have decided to design such a system where multiple options for currency verification can be provided in one system. Our aim is to implement a system which is firstly able to identify the currency (i.e. currency of which country) after that rating of that currency in that country as compared to other countries. If there is fraud currency then to detect that type of currency we are going to develop such system which is having all these three facilities in one system. So it will become easy for the people in the market for identifying the value of currency in one country versus other country, also to detect or to catch if there is any fraud currency and so on.

III. SYSTEM OVERVIEW

The system overview contain of many automated machines available for currency recognition which has improved the importance of automated methods day by day. A well-planned currency recognition system is crucial for the automation in many sectors such as vending machine, railway ticket counter, banking system, shopping mall, currency exchange service and many others. Until now, there are many methodology considered for recognition of currency. The easiest technique is to make use of the features of the paper currency like the size and texture of the paper currency. Several founder and scientist have made definite contributions towards development or designing of system for currency denomination recognition. In this section we present an overview of such recent developments.

The method used is shown in below block diagram as fig. (1). Firstly each image is converted into usable input required for pre-processing steps. The system then extract the region of interest (ROI) based on properties of currency such as size, color, and text. By using this region of interest (ROI) the system first determines the country of origin of the currency. After this step the value of the note is identified by using alternate characteristics of each note.



Fig(1). Block diagram of proposed system

The currency can be differentiated based on two different parameters i.e. country of origin and value of the note. So the problem is distinguished into two segments:

- 1) Identify the country of origin.
- 2) Identify the denomination (value) of the note.

The reason of choosing this approach is that it is depend on the observation of the various note of different value (denomination) from the same country which can be discriminate based on the factors like size ratio, color, or text. The full method has been described in below section.

A. Pre-processing

- 1) *Noise Removal*: Pre-processing is done in order to remove the unwanted noise for that de-noising filter is applied. Although if there is background patterns left it can be effectively removed by de-noising. background patterns left it can be effectively removed by de-noising.
- 2) *Binary Image Conversion*: Then image is converted into binary image by using adaptive thresholding which allow us to identify the empty region with all black pixels. The regions which are empty are free of any foreground object in actual banknote. Although if there is background patterns left it can be effectively removed by de-noising which is followed by binary image.
- 3) *Image Resizing*: For easier computation the image can also be resized afterwards. Image resizing is necessary when you need to increase or decrease the total number of pixels, whereas remapping can occur when you are correcting for lens distortion or rotating an image.

B. Identify The Country Of Origin

- 1) *Identify the empty regions*: After preprocessing phase is completed, it can be identified which region is having black pixels on the note that is empty. This is performed by considering certain predefined areas. All the currency are classified into groups based on which regions are relatively empty. For that divide them into 3 groups: left side empty, right side empty, and center empty. Grouping is done based on finding out ratio of black to white pixels. Then classifying the note based on that ratio. If the is not having significant empty space then those don't fall into any of these groups, these are classified into another groups.
- 2) *Using Template Matching To Identify Country Of The Origin*: The image can be check against template for each country within that group once the banknote has been segregated into predefined groups. It requires relatively less comparison instead of checking every image against the template for every country in the system and this is the reason chosen for segregating the country into such groups. The template are chosen as they require less computational time but still capable of identify the country of the region. Templates are the uniform symbols such as country seal, name of the country itself with stylish fonts etc. suppose the location is similar for all the denomination for example the maple leaf symbol on the Canadian dollar can be used as a template, as its location will be similar for all Canadian notes. Hence we can template match for Canadian maple leaf in this section of the note. It will reduce the time for computation

C. Identify The Denominatioz

After the identification of the country is done in previous step, the value of the note can be identified. For this purpose there are three different approaches used:

- 1) *Size ratio*: The banknote of some countries can be differentiated easily by their size. Once the country of the origin is identified then the size of the banknote can be compare easily based on the denomination.
- 2) *Color*: In some of the countries the banknote are of same size so to differentiate based on the feature only in such situation we can try using difference in color for different denomination. K-mean clustering algorithm can be used for denomination value of note. It is performed on the image by LAB color space it contain 3 channels: L channel corresponds the lightness value, a* and b* channel the color value. For more accurate perception of color LAB color is used. After the value of the dominant color is obtained comparison of known color value of denomination of the country can be done.
- 3) *Text extraction*: The denomination indicate least square distance of a* and b* channel is the one with least color difference, and is selected as the actual denomination of that note. Suppose both the method implemented above fails then the value the

denomination can be extracted from the note using text extraction. This method is computationally intensive. So we can apply this in case of country such as USA, etc where both size and color does not vary too much in the denomination. If both the above method does not work then method is sure to work as value of the denomination is written on at least one place. Thus for taken banknote from the three methods any of the one method works.

IV. PROCEEDING METHODOLOGY

The algorithm for the proposed system has two algorithms

1) *Algorithm 1*: Identification using empty region (left, right or center region of the note).

In this algorithm we convert image into black and white format and calculate the ratio of black and white pixels.

Then according to ratio of black and white pixels we decide the country of currency.

- a) Convert the image to black and white.
- b) Extract the center region.
- c) Calculate r as the ratio of black to white pixels.
- d) If $r < 2\%$ then
 - 4.1) Output: Canada
 - 4.2) determine the denomination using text extraction.
- e) End if
- f) Extract the right most regions.
- g) Calculate r as the ratio of black to white pixels.
- h) If $r < 1\%$ then
 - 8.1): Output: Russia
 - 8.2): Determine the denomination value using template matching
- i) Else if $r < 3.7\%$ then
 - 9.1): Output: Philippine
 - 9.2): Determine the denomination using text extraction
- j) If $r < 4.1\%$ then
 - 10.1): Output: United Arab Emirates Dirham's
 - 10.2): Determine denomination based on color using K- means clustering algorithm
- k) End if

2) *Algorithm 2*: Identification using templates.

In this algorithm we identify the currency using k-means clustering and identify currency using templates present in the currency. we also determine the denomination value of currency.

- a) if '4 headed lion' template matches then
 - 1.1): Output: Indian Rupee
 - 1.2): Determine denomination using K-means clustering
- b) End if
- c) Extract the top left region
 - 3.1): if 'Canadian leaf' template matches then
 - 3.1.1): Output: Canadian Dollar
 - 3.1.2): Determine denomination using K-means clustering
- d) End if
- e) If 'Eagle logo' template matches then
 - 5.1): Output: USA Dollar
 - 5.2): Determine denomination using text extraction
- f) End if

- g) Extract the top right region
 - 7.1): if 'Kiwi leaf' template matches then
 - 7.1.1): Output: New Zealand Dollar
 - 7.1.2): Determine denomination using K-means clustering
- h) End if
- i) If 'Plus logo' template matches then
- j) Output: Swiss France
- k) Determine denomination using length-by-breadth ratio
- l) End if

V. CONCLUSION AND FUTURE SCOPE

In this paper we are going to propose a system which is capable to identify the country of origin and the denomination value of the given banknote. Our system which we are going to propose is able to identify twenty of the most common currency, but it can be extended easily to more countries by following the method described. Our system will be more accurate and take less time when compare with crude algorithm of pixel by pixel comparison. Our designed system will able to identify currency and denomination approximate in an average of 5.3 seconds, which is a considerable improvement over crude algorithm. This project will be helpful to the people, who travel in different countries and those who don't have any knowledge about currencies of different countries. This will also helpful for detecting fake currency. Our future work will be concentrated on fake currency recognition on coins.

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