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A Review Paper on Currency Recognition System

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Abstract: ***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. 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. This paper provides review of different currency recognition systems***
Keywords: ***Currency Recognition, Neural Network, Pattern Recognition***

I. INTRODUCTION

The currency recognition system is developed to recognize the currency by applying different techniques and methods on currency note. The currency recognition system should be able to classify the paper currency to its correct class. The currency recognition system should be able to recognize the note quickly and correctly. The currency recognition system should be able to recognize currency note from any side. There are different types of currency notes some are old and some are noisy. Therefore, it is not easy to recognize such notes.

To overcome this problem currency recognition system is developed. Currency recognition system can be used in places such as shops, banks counter and automated teller machine, auto seller machines etc. It is not easy for the teller in the bank to recognize different notes so a currency recognition system in the bank can reduce human effort. We have reviewed currency recognition system developed for different countries. The systems are developed using different methods and algorithms. The benefits of this study for the reader are that this study will provide information to the reader about the currency recognition system of different countries. They can compare the recognition system of different countries. Which methods and algorithms are applied to develop these systems and which countries have currency recognition system.

II. LITERATURE REVIEW

Debnath et al. (2010) [1], they had used ensemble neural network for currency recognition. Negative correlation learning is used to train the individual Neural Networks (NNs) in an ENN. There are different types of notes such as noisy and old notes and the machine does not easily recognize such notes. Therefore, a system developed using ENN can identify them easily and correctly. For testing, they had used notes of different dominations, which are of 2, 5, 10, 20, 50, 100 and 500 TAKA. First, they convert the note image into gray scale and then the image is compressed. Then the compressed image is given to system as an input for recognition. The system developed using ENN can easily identify the currency with noise as well as old currency notes. With independent training, there are less chances of misclassification.

Qing and Xun (2010) [2], they had used two problem-solving techniques (Artificial Neural Networks and Gene Algorithm). Due to the slow convergence and indeterminate initial weights for Back Propagation Neural Networks, they had used Gene Algorithm. The purpose to use the Gene Algorithm is to get the appropriate result of connection weights and network connection. The GA-BP (Gene Algorithm: Back Propagation) takes short training time and a great recognition speed therefore it is used for image processing.

Jahangir and Raja (2007) [3], they had used neural network recognition method to recognize Bangladeshi currency. They had implemented this method on cheap hardware that can be used in different places. The system takes the image of banknote as an input. The notes are scanned using less expensive sensors. The notes are trained for recognition using Back Propagation algorithm. If the note is flipped, the correct recognition is guaranteed because the axis symmetric mask is used in preprocessing stage. For experiment notes, they used eight notes of TAKA, which were recognized successfully.

Guo et al. (2010) [4], they proposed Local Binary Pattern (LBP) algorithm for paper currency recognition. For recognition of currency notes, it is necessary to extract features with good quality. For characteristic extraction, they had proposed LBP algorithm, which is based on LBP method. The LBP method has advantage of simplicity and high speed. This method recognizes currency

successfully with a high ratio.

Lee and Kims (2003) [5], they had proposed a new point extraction and recognition algorithm for banknotes. For specific point extraction from the banknotes having same color, they had used coordinate data extraction method. For recognition, they trained five neural networks. One for inserting direction and remaining are for face value. The purpose of designing this algorithm is to reduce the time for recognition. The results from the experiment prove that the proposed method has excellent recognition rate and low training period.

Singh *et al*. (2011) [6], they represent the heuristic analysis of Indian currency notes and the digits of serial number of Indian currency notes to recognize them. To identify a character of currency image the features of that image should be extracted. It is very important to extract features from different notes. To extract correct features of character heuristic analysis are done before extracting features in currency recognition.

III. CURRENCY RECOGNITIONS TECHNIQUES

Due to development of automated systems the importance for automatic methods for currency recognition has increased day by day. An efficient currency recognition system is vital for the automation in many sectors such as vending machine, railway ticket counter, banking system, shopping mall, currency exchange service etc. Until now, there are many methods proposed for paper currency recognition. The simplest way is to make use of the visible features of the paper currency like the size and texture of the paper currency. A numerous researchers and scientist have made several contributions towards development or designing of system for currency denomination recognition. In this section we present an overview of such recent developments.

A. Texture based Recognition Technique

Texture based currency recognition is a very useful feature. The texture provides the measure of properties such as smoothness, coarseness and regularity. To describe the texture of a region the three principal approaches used in image processing are statistical, structural and spectral. Statistical approaches yield characterizations of textures as smooth, coarse, grainy and so on. Structural techniques deal with description of texture based on regularly spaced lines. Spectral techniques are based on properties of Fourier spectrum and are used primarily to detect global periodicity in an image [7].

Some texture features that have been used for image retrieval are Tamura features, MRSAR, edge histogram, Gabor texture feature, and pyramid-structured and tree-structured wavelet transform. Tamura features define the coarseness, directionality and contrast of an image. Tamura coarseness is the measure of average of coarseness at each pixel location inside the texture region. The performance of this feature is not good since it compute directly from image. So the performance can be improved by using histogram. MRSAR (Multi Resolution Simultaneous Auto Regressive) gives results which is helpful in distinguishing different texture patterns. Gabor feature extract information at multiples scales and orientation. According to author MRSAR and Gabor feature give better result than other feature [7].

B. Pattern based Recognition Techniques

Pattern based recognition is basically classification of objects based on some set of images. It requires experimenter to have some prior knowledge about the objects to come to a conclusion. It also requires a large collection of data. There are many techniques that make use of pattern recognition. All these techniques uses vector quantization based histogram modeling. Vector quantization is a sampling method where each point x_j in a set of data in d-dimensional space is replaced by L prototype points. The prototype points are picked in such a way that sum of the distances (called the distortion) from each data points x_j to its nearest prototype point is minimized.

Some work has been done in this area by Seth Mc Neillin for recognition of coin by pattern recognition. In this process first he collects the data by collecting coins with different background. Next the segmentation and cropping is done. In this step coins are segmented from background by using modified Nechba's code. Cropping of the image is done by locating the edges of the coin. Then features were extracted by convolving texture templates with each image. Next step is the training the program with as many data as possible to get high accuracy. Here the author uses five set and get 94% accuracy [7].

The work in this area is done by Vipin kumar Jain for Indian currency note. In this process he uses digital image processing techniques to find the region of interest and after that Neural Network and pattern recognition techniques is used for matching the pattern. From the experiment he found that recognition method of Indian currency note is quite simple, efficient and easy to be realized because denomination numerals are used for identification which can be extracted easily from paper currency. Then

extracted numerals are matched and are found exact match for identification. By using this recognition technique counting of different denomination note in a bunch can be done [6].

Dipti Pawade et al. (2013) made a comparative study on various currency recognition technique. In one of the paper by Kalyan Kumar Debnath et al proposed a method for currency recognition using ensemble neural network (ENN) particularly for Bangladesh currency. Ensemble neural network consist of number of neural network and each neural network is trained independently. Here each neural network is trained via negative correlation learning. The system is able to recognize highly noisy or old image and reduces the misclassification of notes [8].

Faiz M. Hasanuzzaman et al. proposed a component based framework for banknote recognition by using Speeded Up Robust Features (SURF). SURF feature divides the image into components and then matches test image with original image component. The SURF features are invariant to conditions of image occlusion, image rotation, changes of scaling, illumination and the viewpoint. The proposed algorithm achieves 100% accuracy [9].

In paper [10] the author proposed a method of currency recognition using Neural Network. Here they have used color, size and texture as three features that have used to recognize the currency note. In the experimentation they have achieved 97.34% accuracy.

C. Colour based Recognition Techniques

Variety of colors is used in each paper currency but there is only one or two dominant color present in each paper currency which can be used for distinguishing each paper currency. The image delivered from the digital camera is in RGB format. The electronic processing of these color signals (Red, Green and Blue) can take a number of different representation formats denoted as color spaces. There are variety of color spaces YIQ, HSV, YUV, HIS and YCrCb and each format has its own advantage. The choice of color space has a great influence on the performance of procedures such as segmentation. After taking the image from the digital camera the dimensionality of data is reduced. Then the image is converted from the RGB color space to a color space suitable for processing. After processing the features are extracted, matched and currency is detected as genuine or counterfeit.

In 2012 Pragati D. Pawar and Shrikant B. Kale converted image from RGB color space to HSV color space before feature extraction. They used HSV color space because it is close to human conceptual understanding of color. The feature extraction is done by analyzing color histogram, hue, saturation and intensity value. Then color histogram, hue, saturation and intensity value of input image is compared with the saved images. If the difference in threshold value is greater than the specified value then the currency is genuine otherwise counterfeit [11].

Histogram describes the global color distribution in an image by counting the number of pixels of each color. Color histogram method will suit when we have to segregate between the range of color and prominent color. The major limitation of color histogram is that color histogram describes which colors are present in the image and in what quantity but doesn't provide spatial information.

John R Smith and Shih Fu Chang has also done work in this area. They propose the techniques for color image retrieval. Here color indexing techniques is used by which images are extracted on the basis of color content of the image. The color indexing algorithm uses back-projection of binary color sets to extract color region from the image. It overcomes some of the problem with color histogram [12]

The major limitation of color based recognition techniques is to recognize an old note whose color become fading or changed due to rigorous circulation.

The three currency recognition techniques discussed above requires a user to always carry a machine along with him\her which consumes a lot of power. To overcome the problem a new technique has been developed known as currency localization technique.

D. Currency Localization Techniques

Currency localization technique is a mixed approach where first currency note in an image is localized and then various threshold based algorithm are applied to determine the denomination of currency note.

In this technique first image is taken by a mobile camera or a webcam. Then some enhancement of the image is required by applying some pre-processing technique such as noise reduction, normalization and contrast enhancement. Next background subtraction, RGB to gray conversion and edge detection is performed. Localization of currency note is done by applying scan line algorithm on the image after edge detection. The image is scanned from left to right and top to bottom line by line. The line is highlighted which contain number of pixels greater than the set threshold. With the intersection of these lines a rectangle is formed which surrounds the currency note. Then color matching technique is used for currency recognition.

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Hanish and Padam has done currency recognition in color images by applying currency localization technique. In this experiment they got 96% efficiency. The system can be enhanced by using template matching [13].

Parminder Sigh Reel, Gopal Krisnan and Smarti Kotwal has done some work on currency note recognition based on heuristic analysis of character and digits of serial number. Heuristic analysis is needed to filter non- character elements which are not reliably separated by traditional OCR method. Heuristic analysis of color separates character and non- character elements based on color basis [7].

Suriya Singh et al presented an application for Indian currency recognition on mobile. For this they have used visual Bag of Words (BoW) recognition method. Here they have used GrabCut algorithm to segment the foreground from background. This process of segmentation work so well that it can segment image from the cluttered background. After testing 2584 images they have got 96.7% accuracy [13].

In [14], the authors proposed a method for currency note recognition by using ANN. Here a special linear transformation function is adapted to wipe out the noise pattern from background without affecting the note original feature. The edge detection feature along with linear transformation is a better feature extraction technique and helps to keep notes look similar in varying conditions.

IV. CONCLUSION

In this study, we discussed recognition system of different countries like Bangladesh, China, India and recognition system for Euro currency. They have used different methods and algorithms to develop these systems like Bangladeshi Currency Recognition System using Negatively Correlated Neural Network, Bangladeshi Currency Recognition System Using Neural Network with Axis Symmetrical Masks and Chinese Currency Recognition System based on BP (Back Propagation) Neural Network Improved by Gene Algorithm, Chinese Currency Recognition by Neural Network, Chinese Currency Recognition based on LBP (Local Binary Pattern). Indian Currency Recognition System based on Heuristic Analysis and Recognition System for Euro using New Recognition Method. By using mentioned methods we have observe that good results can be obtained quickly and correctly. Same methods and algorithms could be used to develop the currency recognition system for other countries.

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