A SURVEY ON INDIAN CURRENCY NOTE DENOMINATION RECOGNITION SYSTEM

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ABSTRACT

At present the Currency denomination recognition is becomes dynamic topic for researchers in different potential applications. Financial exchange is an essential piece of our everyday activities. But for the visually impaired individuals especially suffer in financial exchanges. They are not ready to adequately recognize different denominations and are frequently betrayed by other individuals. Hence a reliable currency recognition system could be utilized as a part of any division wherever money related exchange is of concern. Accordingly, there is a vigorous need to outline a framework that is useful in recognition of paper money notes accurately. Currency denomination detection is an immeasurable area of exploration and huge advancement had been accomplished through the years. In this paper currency recognition explored and also presented a comprehensive review of the existing literature on techniques related to Indian Currency Note Denomination Recognition, the effort of survey promotes to give the effective system for visually impaired.

Keywords: Computer Vision, Feature Extraction, Image Processing

I. INTRODUCTION

Form the past many years the currency systems are most commonly used in India. In the 1861 the Government of India presented its first paper cash issuing 10 rupee notes ,further in1864; 20 rupee notes are introduced, in 1875 ;5 rupees notes in1899 ;10,000 rupees notes in 1900;100 rupee notes in 1905; 50 rupees notes in 1907; 500 rupees notes and similarly in 1909; 1000 rupees are developed . .The Reserve Bank of India (RBI) started note generation in 1938, issuing 1000, 100, 50,20,10,5,2 rupee notes, while the Government kept on issuing 1 rupee notes. At present the currency system in India has 1,2,5,10,50,100,500,1000 Rs but these are unique in one way are other. These characteristics may be shade, size or some distinguishing proof imprints and so on. It is not difficult to perceive these peculiarities for the common people but not for the visually impaired people .These visually impaired individuals can recognize in the two separate groups utilizing the distinctive size of notes, up till now the size variety alone is insufficient to faultlessly focus the cash note. In actuality, the almost no distinction between the sizes of continuous categories makes them mystified or confused not able to recognize the cash notes from each other. The cash notes are given few exceptional distinguishing proof stamps just for the visually impaired individuals with the goal that they might effectively perceive the category accurately. Each cash note has its section impressed at the upper right end which is delicate to touch, still this

imprint blurs away after the coin note goes available for use for quite a while. This again makes a trouble for the visually impaired individuals to accurately focus the category of the coin note.

A currency recognition framework for a visually impaired people is surveyed in this paper. And also the concentrated over the benefits of the currency recognition system using a color picture. And many techniques are used to recognize the image but in many cases neural networks are used to recognize the currency notes which contains the several steps namely some texture and pattern based .The identification of the object is nothing but the recognition. This procedure would presumably begin with picture handling methods, for example removal of the noise, emulated by (low-level) characteristic extraction to place lines, and certain texture contains the texture and the certain boundaries. The shrewd bit is to translate accumulations of these shapes as single articles, e.g. autos on a street, boxes on a carpet lift or carcinogenic cells on a magnifying image instrument slide. One explanation behind this is an AI issue that an item can seem altogether different when seen from distinctive points or under dissimilar lighting. An alternate issue is of choosing what features fit in with what item and which are foundations or shadows and so on. The human visual framework performs these undertakings inadvertently. But a machine obliges skilful programming and loads of handling force to approach human execution. The remaining section as arranged is as follows: II section describes the related work of the currency recognition system.III section describes the some major steps in the currency recognition system. IV section describes the evolution in the algorithms of the currency recognition system V section describes the techniques used in the image analyses of the currency recognition system.VI sections gives the conclusion of the survey in the currency recognition system.

II. RELATED WORK

The survey has proposed by Jain [1] an image processing method to extract paper currency quantity. The extracted ROI may be wormed with Pattern Recognition and Neural Networks matching method. First they obtain the image by easy flat scanner on glue dpi with an exacting size, the pixels level is place to attain image. A few filters are useful to extract denomination assessment of note. They employ dissimilar pixel levels in different quantity notes.

The paper was presented by Mirza and Nanda [2] a technique for validating paper currency of India. The technique employs four characteristics of paper currency plus identification mark, security thread, latent image and watermark. The scheme may extract the hidden features i.e. latent image and watermark of the paper currency. The anticipated work is an attempt to propose an approach for the characteristic extraction of Indian paper currency.

The review was presented by Chakraborty et al. [3] a widespread review of study on a assortment of developments in existing years in classification of currency denomination. A number of techniques applied by a diversity of researchers are proposed briefly in organize to evaluate the condition of art. In this paper the author also focusing primarily on currency detection system including different steps involved in it like image attainment, feature extraction and categorization system uses different algorithm.

The paper was demonstrated by Reel et al. [4] of the heuristic analysis of characters and a number of serial numbers of Indian currency notes to recognition of currency notes. To distinguish a character from a given currency image, there is require to extract feature descriptors of such image. As an extraction technique

significantly affects the quality of entire OCR process, it is very significant to extract features, which will be invariant towards the different light conditions, employ font type and deformations of characters caused by a distort of the image. Heuristic analysis of characters is complete for this reason to get the precise features of characters previous feature extraction in currency recognition.

The survey was focused by Pawade et al. [5] on existing techniques and systems for currency recognition stands on image processing. They have discussed both invent recognition and paper currency recognition techniques separately. Finally they summarized their work in tabular form which is very cooperative for study at a glance. Even though there is lot of research work done on this topic, still there are a number of issues related to the accuracy and efficiency of the method. Thus achieving maximum efficiency and getting 100% correctness for heterogeneous currency, when physical state of currency is not that much good, will always be a defy for researchers.

The review was demonstrated by Ali and Manzoor [6] of the technique for currency recognition using image processing. The proposition system employs the various features of the currency for recognition. Their experiment demonstrates that this is the squat cost machine to recognize the Pakistani paper currency notes. They had checked various notes on this system and the result is 100% which means that the system is working competently.

The paper was suggested by Krishan [7] an advances for the feature extraction of Indian currency notes. An Approach suggested from the beginning of scanning a document of converting it to binary image, thresholding, and morphological filtering and word segmentation has been successfully stated. One of the dispute facades in the character segmentation part is that two characters are sometimes joined together.

The review was conducted by Danti and Nayak [8] an important feature of Indian Currency Note are extracted and recognized. Currency features such as denomination, governor declaration, year of print etc. are segmented for recognition using 3×3 grid. Stands on geometrical shape, quantity of currency such as 100, 500, 1000 are determined with the help of Neural Network classifier. Year of publish of currency note is extracted using OCR techniques. Proposed method is experimented on a large dataset and demonstrated the efficiency of the approach.

The paper was proposed by Tanaka et al. [9] of the probability solidity formed by a multivariable Gaussian function, where the input data legroom is transferred to a lower dimensional subspace. Owing to the constitution of this model, they describe the total processing system as a hybrid neural network. While the calculation of the verification model is only to take internal product and square, the computational freight is very small.

The review was presented by Malik et al. [10] a reliable coin recognition system that is stands on a polar Fast Fourier Transform. Coins are regularly employed in each and everyday lives at a variety of places like in banks; grocery stores; supermarkets; automated weighing machines; vending machines etc. Thus, there is a fundamental require to mechanize the counting and sorting of coins. For this machines require to distinguish the coins very fast and precisely, as additional transaction processing depends on this gratitude.

The paper was discussed by Pathrabe and Bawane [11] a method for recognizing paper currencies of different countries. The technique uses three characteristics of paper currencies including size, color, and template. In this

technique the system can be trained for a new denomination banknote by just introducing one intact example of the banknote to it. In calculation the system may recognize the banknote on each side or any direction.

The review was illustrated by Sannakki and Gunjale [12] on their system intend to recognize and classify the currency notes by using dissimilar steps starting from image acquisition, preprocessing, testing, and training. Methodology used for feature extraction is Discrete Wavelet Transform (DWT) and estimated coefficient matrix of the currency image is derived. Statistical features are extracted using coefficient and stored in a vector.

The paper was demonstrated by Velu et al. [13] of the perfect image of a coin is employed for learning and appreciation. The correct classification of acceptance of a coin was achieved for 99.6% in a test sample of 10,000 coins. The Robert's, Laplacian and Canny edge detection methods gives 93%, 95% and 97.25% of the coin image. The planned ML-CPNN yields 99.47% recognition rate. By analyzing the experimental results, it is evident that, ML-CPNN yields the best result. This paper may be extended to categorize coins released during various time periods. Also, stands on the coin shape, notion on the coin, and metal of the coin etc, also, the categorization may be done depends on the similarity measure of a coin and based on the size and spatial location of peaks in the parameter space.

The review was proposed by Ravi and Ravi [14] to extort the surface features of exchange note images. To extort the features; they are using PCA Algorithm. It is exploiting on a currency note and the inexact coefficient-matrix of the distorted image is obtained. A set of coefficient statistical instants are removed from the approximate Co-efficient matrix. The extracted features are amassed in a feature vector. The extracted features may be employed for appreciation, categorization and retrieval of currency notes.

The paper was demonstrated by Bhavani and Karthikeyan [15] on the efficiency of SURF for banknote recognition. The scale-invariant and rotation-invariant attention point detector and descriptor provided by SURF is robust to handle the image rotation, scaling change and enlightenment change.

The review was presented by Sargano et al. [16] a new intelligent system for paper currency recognition. Pakistani paper currency has been considered as a case study, for intelligent recognition. This paper identifies, introduces, and extracts robust features from Pakistani banknotes. After extracting these features, the paper suggests to employ three layers of feed forward reverse promulgation Neural Network for classification. The planned method and system are simple and comparatively less time consuming which makes it suitable for real-time applications.

The paper was developed by Aggarwal and Kumar [17] an interactive system which produces Currency Recognition System using Localization and Color Recognition with the help of Matlab. The Indian currency notes have been properly recognized and the quantity has been found with a high level of accuracy. This system has much progression over the existing systems and they can confirm the following observations.

- It is probable to localize the currency note and subtract it from its background.
- The system accepts the interactive techniques of Currency Localization and Color Recognition.
- The system permits the user to identify the Currency note.
- The system is exclusive in its applications.
- The efficiency of their system is 96%.

III. IMPORTANCE OF CURRENCY RECOGNITION SYSTEM

There are some important steps in the currency Recognition system as shown in the figure1 and is stated as follows.

Image Acquisition: There are different approaches to procure picture, for example, with the assistance of cam or scanner. Acquired image have to hold all the features

Preprocessing: Preprocessing operations are ordinarily needed before the fundamental information examination and extraction of data. The point of picture preprocessing is to stifle undesired mutilations or upgrade some picture offers that are essential for further preparing or investigation. It incorporates

Image Adjusting: When we get the picture from a scanner, the extent of the picture is so huge. So as to diminish the count, we diminish the span of picture. Picture Adjusting is finished with the assistance of picture introduction. Addition is the method basically utilized for undertakings, for example, zooming, pivoting, contracting, and for geometric amendments

- Image Smoothening: At the point when utilizing a cam or a scanner and perform picture exchanges, were some will show up on the picture. Image noise is the illogical variety of brightness in pictures. Removal of the noise is an essential step when image processing is individually performed. However this noise may affect the pattern matching and segmentation. At the point when performing smoothing process on a pixel, the neighbor of the pixel is utilized to do some changing. After the steps the new value is formed the different pixels and they develop a framework, the extent of the grid is odd number, and the target pixel is spotted on the center of the matrix. Convolution is utilized to perform picture smoothing. Additionally picture smoothening could be possible with the assistance of average channel which more compelling than convolution when objective is to at the same time decrease the noise in the edges . Average channel replaces a pixel through the average pixel of every last one of neighborhoods.
- Gray-Scale Conversion: The picture gained is in RGB color. It is changed over into gray-scale on the intensity information that it conveys just the vigor data which is not difficult to process as opposed to usage of three parts R(red),G(green),B(blue).

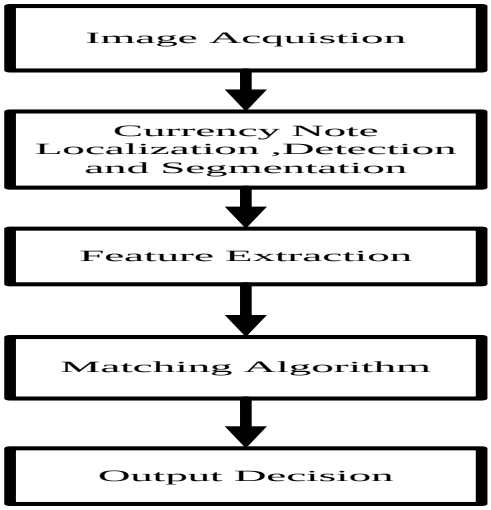

Fig 1: Steps In The Currency Recognition System

Edge detection: edge discovery is a crucial apparatus in picture preparing and machine vision, especially in the ranges of feature detection, extraction, which go for recognizing focuses in a digitized picture at which the picture splendor changes pointedly or, all the more formally, has discontinuities. Edge detection is one of the central steps in image processing, image pattern recognition, image analysis, and machine vision methods.

- Image segmentation: It divides into objects and regions. The level to which sub division is conveyed relies on upon the issue being illuminated. Division calculation for monochrome pictures by and large are focused around one of the two fundamental properties of intensity values is discontinuity, similarity.

- Feature Extraction: Feature extraction is the special form to reduce the dimensionality in image processing .It is the strategy for catching the visual substance of pictures for indexing and recovery. At the point when the data information to a calculation is so expansive there is no option be prepared and it is suspected to be famously recurring (much information though very little data) then the information will be changed into a diminished by representation set of the features. In the event that the characteristics concentrated are by the design chosen. It is normal that the properties set will extricate the applicable data from the information to carry out the desired task utilizing decreased representation rather than the full size input Characteristic extraction, includes improving the measure of assets needed to depict the vast set of information**.**

IV. EVALUATION IN THE ALGORITHMS'

Throughout the years, several algorithms have been anticipated by the various researchers for the consistent currency recognition. In the wake of getting peculiarities of economic standards, it is crucial to perceive the example of the currency on the basis of these features which have to be polished by a compelling successful recognition system called classifier. A standout amongst the most well-known grouping strategies that had been utilized as of late is Artificial Neural Network. A Neural system based recognition scheme was utilized used for The Neural Network comprised of three layers that are input, hidden, output layers. In this system, the picture procured right away was RGB picture and after that it was being changed over into gray scale. Edge detection of the entire gray scale picture was then performed. In the detecting edges, the four attributes of the paper money was edited and segmented. After segmentation, the qualities of the paper cash were extricated. The characteristics of experimental picture are contrasted and the first pre stored picture in the framework. In the event that it matches then the currency is bona fide generally with the counter feit. At that point they discovered the tone and immersion for imputing the picture and assessed the neural system for those characteristics On the off possibility that the tone and immersion limits from the neural system were not exactly the current picture thresholds limit, then the current picture was viewed as bona fide else the picture was announced as a fake one. And the next ,the comparative work is carried were they utilized picture histogram focused around which abundance of distinctive shades in a paper money was computed and contrasted and the one is used as reference for the currency[17]. They additionally utilized Markov affix idea to model surface of the paper currency as the monetary forms as an irregular procedure lastly utilized ensemble neural system (ENN) with negative relationship for alignment. The further work as carried out to give an alternate neural system based on the currency order framework utilizing negatively corresponded Ensemble Neural Network. In the evolution they concentrated more on the ROI by utilized with Pattern Recognition and Neural Networks matching procedure.

The Pattern Recognition and Neural Networks matcher strategy was utilized to match or discover cash value or denomination of paper. The work extended to the Neural Network based classification and these are utilized in the neural system that uses histogram based extraction and multilayer Perception model for order. The feed forward back propagation algorithms of the three layers are introduced for the currency note classification notes. The evolution is carried to increase the effective and less time consuming in the real time applications. And it is started to increase the heuristic characteristics of the contrast and brightness. The estimation of work depends on the extrinsic factors of the sensors several works are carried out in the color images .mainly Indian currency reformation are on the base of color. And further investigation is towards to locate the monetary order utilizing an arrangement of Light Dependent Resistor sensors; and Light Emitting Diode lights which are modified to sense the shade examples of the certified receipts next the further evolution is towards filters like wiener filter is used for the reduction of the drift and at the same time the histogram techniques are used in many currency identification techniques.

V. SOME IMPORTANT TECHNIQUES

5.1 Texture Based Recognition Techniques

Texture is an exceptionally valuable feature for Currency Recognition.. Textural features relating to human visual discernment are extremely helpful for ideal feature determination and surface analyzer plan. There are some situated of composition peculiarities that have been utilized regularly for picture recovery. Tamura characteristics such has directionality, coarseness, contrast, Tamura coarseness is characterized as the normal of coarseness measures at every pixel area inside a composition district. This sort of features can figure specifically from the whole picture without any homogeneity imperative. So the exhibitions of this peculiarity are not acceptable when all is said in done. Therefore, an enhanced variant of this peculiarity by speaking to the coarseness data utilizing a histogram should to be considered. Multi-determination synchronous auto-backward model watchful edge histogram, MRSAR features gives the results that are influential in recognizing distinctive surface examples. The Gabor features use channels to concentrate surface data at various scales and introductions With respect to composition characteristics, there is an examination of the execution of Tamura features, edge histogram, MRSAR, Gabor surface features, and pyramid-organized and tree-organized wavelet change characteristics. Nonetheless, to accomplish such a decent execution from MRSAR, separation focused around a picture subordinate Covariance framework must be utilized, and along these lines, it builds the extent of features and hunt complexity. Then again, the extraction of Gabor feature is much slower than other composition characteristics, which makes its utilization in expansive databases. Hence Tamura features are not tantamount to TWT, PWT, MRSAR, Gabor, characteristics.

5.2 Placement Rule

The previously, there was some trouble in composition investigation because of absence of satisfactory instruments to describe diverse scales of surface viably. There are some composition based methods. Many works are carried to give a strict definition for visual composition is troublesome .Its structure is just credited to the lifeless examples in which components or primitives are organized by a placement rule. Consequently it can be composed as f= R (e) Where R is indicating a placement rule or connection and e is the element. There is a

situated of peculiarities by which all data examples are measured and which give politely dispersed results. For this reason, it is obliged to have both extremes characterizes for each one features .Particularly, coarseness is a very key element in composition. With a specific end goal to enhance alternate features, the results should be well established. As for line-similarity, regregularity, and unpleasantness, and got significant correspondences in the middle of computational and mental estimations, but more effort is obliged to portray accurately for the texture elements on which it depends on the above mentioned three features.

The Pattern recognition is conclusions focused around earlier learning. A manifestation of this is the characterization of articles focused around a set of pictures. There are number of systems exist in the writing which make utilization of example recognition features to a portion of the great issues. These strategies are extensively centered on Vector quantization based histogram demonstrating. Vector quantization (VQ) is a system for testing a d-dimensional space where each one point, XJ, in a set of information is supplanted by one of L model focuses. The model focuses are picked such that the whole of the separations from every information point, XJ, to its closest model point is minimized. To start with he gathers the information, amid the information accumulation stage different foundation colors, including dark, white, red, and blue, were tried for segment ability. Adobe Photoshop was utilized to focus the RGB estimations of the coin and its experience. At that point a Segmentation system was connected to these pictures. After the information accumulation next step is Coin Segmentation and Cropping. In this step coins were sectioned from their experiences utilizing some adjustment .After completion of division editing system was executed to place the edges of coin. After this Features were extricated from the coins by convolving surface layouts with each one picture, with edge location formats. Next step was preparing, in these Five dimes, nickels, pennies, and quarters were utilized for preparing information.

The color based techniques mainly includes the histogram technique in the image. It is developed by numbering the quantity of pixels of each one color. Histogram depicts the worldwide color circulation in a picture. It is not difficult to register and is uncaring to little changes in the view position. The reckoning of shade histogram simply includes checking the quantity of pixels of determined color. Subsequently in a picture of determination m*n, the time intricacy of registering color histogram is O (mn). It is truly inhumane to little change in VP features is especially wanted in this task as the VP from which the picture of coin note will be procured can change. Color histogram system will suit when the isolation is to be carried out between a scope of shades and an unmistakable shade. This strategy may suit the prerequisites when isolation is to done among very nearly comparative colors. Shade histograms likewise have a few limits. Color histograms depict which colors are exhibit in the picture and in what amounts; shade histograms give no spatial data. Shade soundness vector is a refined methodology of cognizance histogram. In this approach, the neighborhood properties of pictures are mulled over as difference to CH system that is a worldwide one. In this system, areas are based upon the coherency. The color indexing calculation utilizes the back-projection of the two fold shade sets to concentrate shade districts from pictures. This procedure accommodates both the robotized extraction of districts and representation of their color substance. This overcomes the some of the problems such as spatial localization, and indexing and distance computation. as high-dimensional feature vectors etc.

VI. CONCLUSION

New advanced tools and development in the technology shows that the visually impaired individually issues can be hardened in today's reality. In this paper we have surveyed about technologies which are conceptualized on

the robustness and the computational for Indian Currency Note Denomination Recognition system especially for visually impaired ones. This paper presents a brief overview about the existing prior techniques and evolutions in the techniques.. The work gives more effective to understand the methods and algorithms involved in the system.

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