2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)
Department of Electrical & Electronics Engineering, Galgotias College of Engineering and Technology, Gr. Noida, India

# Identification of Currency via Image Recognition

Sarthak Bhardwaj
Department EEE, GCET Gr. Noida, India
Sarthakbhardwaj2 603@gmail.com

Shivam Vishwakarma
Department EEE, GCET Gr. Noida, India
coolshivam1616@ gmail.com

Suneel Kumar
Department EEE, GCET Gr. Noida, India
ksunil7742@gmai l.com

Sagar Jaiswal
Department EEE, GCET Gr. Noida, India
sagarjaiswal543@ gmail.com

Gauri Katiyar
Professor
EEE Department GCET,Gr. Noida,
gaurikatiyar@galg otiacollege.edu

2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE) | 978-1-7281-7741-0/20/$31.00 ©2021 IEEE | DOI: 10.1109/ICACITE51222.2021.9404760

***ABSTRACT*- The primary objective of this report is to identify currency with such a centralized system that is compact, and also which is highly portable. In this review, the characteristics of the idealized currency will be processed and analyzed in mat files, and so these stored features will be matched to the sample currency. Perceive whether something is real or false. With this structure, it's easy to illustrate this concept everywhere, at any moment. We have used the MATLAB toolbox for data recognition the rendering of the image is a way to enhance the image's pictorial details for the sake of computer or hardware vision. Currency recognition has significant problems, such as steganographic recognition, currency note resolution, dirty notes, etc. This approach is working. First, to classify the nationality to use certain predefined rules. Areas of significance, and then derive the denomination value. Using features such as scale, color, or script on a note, based on how distinctive the notes are in the same region. We listed 20 of the most traded currencies, as well as their denomination.**

***Keywords- Comprehensive Monetary Identification, Image Processing, denomination, currency identification, extracted characteristic.***

## I. INTRODUCTION

Images have become a significant part of technology since the dawn of the age of cameras. Images not only capture memories but also hold an extensive amount of information. So, it would not be odd for science to take a deep interest in learning what these images hold. Image Processing is the solution that talks about the understanding of images and apply them to daily activities. To process an image, it is first converted into a digital format and then the information extracted is brought out for further studies. There are two types of processing techniques including digital and analog. As the name suggests there are more advantages to process an image digitally.

Various issues like unnecessary noise and signal distortion can be avoided, and it also allows for complex algorithmic implementation which is not possible if we try it using analog.

A fundamental application of such technology is identifying fake currency. The exchange of money happens daily, and it is an imperative part of life. Hence, human error becomes common when an enormous amount of money transaction is done. When the need arises for verification of banknotes, then we make use of image processing and classification techniques. This method is an automated solution that makes use of a dataset of currency and classifiers, which segregates them into predefined classes of demolition. Although there's still a possibility of obstacles, dealing with currency can be difficult sometimes as one needs to focus on unique characteristics like lighting, size, color, and different labels related to a specific currency.

The approach of this article: Photograph analysis based filtration of features available of the notes and coins are displayed particularly to illustrate. The program incorporated includes any moderate innovations like the Photographic Component Identification [1], Facial Identification, Accelerated Comprehensive Features, Texture Study and transition of Canny Edge & Hough, High-performance algorithm, cross-platform and fully accessible algorithm. As a result, the program core works perfectly and the identification rate appears to be 100% for each chosen characteristics of the notes.

## II. HISTORICAL EVOLUTION:

There have been several trials over the decades for the identification of the currency in the note sector. As of now, the most commonly used are color-based identification, pattern, access control, etc. There are several recognition systems available to identify fake currencies with many techniques. A lot of the methods use multiple steps, including camera calibration and accessibility extract and classifying system of different algorithms.

There are about 180+ currencies worldwide and the necessity for an automatic currency mechanism [2]. Lately, that urge in the identification and recognition of coins and notes have increased tremendously; the requirement was crucial for implementing technology that manages notes beyond human interference for different purposes. However, it is exceptionally challenging to characterize different coins and notes. For example. Frosini et al. [3] employed an external controlling algorithm for operating multilayer perceptions which are used for classification and verification of banknotes. Leelasantitham et al. [4] inspected watermarks for currency recognition using neural networks and correlational mapping. It recommended methods like implementing a framework that was in trend for all currencies. But it proved out to be worthless as none of the approaches were reliable enough to be effective. Hence, this research question becomes a fascinating field of study for growth.

1) Among the first ways of identifying the monetary system in the early 90s, they used image analysis. Yet this technique includes no part in incorporating verification of notes. It is supposed that the notes and pictures should be in excellent

condition and only then will it get the desired result. We should note that the proposed system uses the taking of image features in the angle and distances are pre-defined. While this technique attempts to suggest an overall solution, this method is not productive for all currencies.

2) It characterizes the photo mechanism with two methods: Noise reduction is the essential step in the image's smoothness. It places a median filter in the center of the pixel by measuring the median of the surrounding pixels that compile an unusually large kernel and a focus pixel. The median filter is more efficient and therefore it is smoother than some other approaches.

## III. METHODOLOGY

A. Various parameters (republic and region of residence), we have two steps to categorize the problem:

- First, it identifies the country of origin
- aim of identifying the note's name (value)

The basis of our choice of method recognizes that distinct notes of various values (denomination) that can normally be used in the same region are usually distinguished by certain characteristics, such as the overall size and letter extraction to get the significance.

We have developed this software development tool under MATLAB Establish, a Graphical User Interface (GUI). A method that comprises the LBP and the PCA, is implemented. Statistical analysis methodology that has been used in the disciplines: face-recognition and image analysis processing to determine high-dimensional and corresponding data. The dataset comprises all the photographs used to acknowledge the different currencies. The instructional dataset comprises all the currency visuals we have prepared for evaluation for identification or verification and all the image data of currency we must test.

Method of analysis- Important Points:

There are several approaches to the Identification of currency.

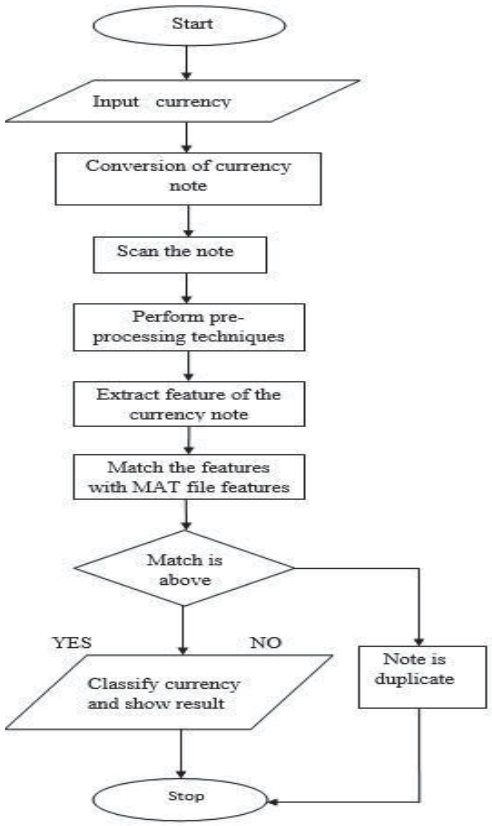
1. Procurement of the image by scanning the image at the base of experimentation.
2. Technology for image pre-processing including RGB to Gray Scale transformation.
3. For safety reasons, use the PCA algorithm.
4. Using extracted features via correlation techniques. For matching purposes, it uses LBP and Euclidian distance. For example, an Indian currency note takes the following characteristics: the left flower, numbers on the top right, the left hidden Gandhi Ji, 500 in the middle, the right vertically 500, and the vertical strip.

Methodology-I: PCA algorithm:

- Get all the information. Calculate the mean and eliminate the mean of the data.
- Find out more about the matrix of data coefficients.
- Now pick one element and construct the matrix of the function.
- Calculate the Eigenvectors from the covariance matrix and Eigenvalues now.

Methodology-II: LBP algorithm:

- It divides the images into several cells. Cells compose pixels, compare these pixels to pixels of the neighbor. It either follows the pixel direction in an anti-clockwise direction.
- It bases the labeling on the scale of the pixel, if it will be less than central in the neighbor, they assign it as 1, otherwise 0.
- It builds the histogram based on each numeration frequency measurement.
- Legitimize the histogram and preprocess all cells with the normalized histogram. It provides a vector of features.




Methodology-III: Euclidian Distance:

- In the analysis, Euclidean distance is determined among the Central training pictures and it completes the simulation of test images.
- Sample picture is often used to assume the lowest possible length estimate between the graphic of the experiment and the related pictures in the Training file.
- After currency identification, it concludes the related currency type.

Methodology-IV (LBP, PCA, and Euclidian Distance)

The range for combining is PCA, LBP, and Euclidean. It follows the preceding procedures for this purpose:

- Using Key Part Teaching Research
- Break the noted frame into sections.
- In the cell, every pixel is used to equate a 360 angle to its peers and follow the pixel direction.
- Marking depends on the dimension of the pixel. If the neighbor is not key, they rate it as 1, otherwise 0.

## IV. RESULT AND EXPLANATION

**DATA ACCUSATION:**

Amongst the most common systems for currency, note classification is investigated and is continuously developing image recognition research areas today. The need to consider the provenance and composition of currencies in implementations including the identification framework for currencies is increasing day by day. A secure id for the banknotes device identifies the

ethnic origin and a paper currency by the study of some salient features of the note [5]. The core attribute of a comprehensive monetary identification scheme by its specificity, to classify effectively, whether notes are ripped and creased and new notes, are not influenced by specific surrounding attributes such as light gradient, regression, and differences in viewpoint.

A summary of the Indian rupee is analyzed in this part of the report characteristics included in the classification of banknotes used in this technique has been proposed:

- The Central Numeral (A),
- Ashoka Pillar Emblem (B),
- Identification Mark (C)
- The Color Band (D)


Indian currency's economic value is printed in both statistics and words. The central number is most extensive, this characteristic is unique as the valuation of the cash for each denomination. They used the Ashoka Pillar emblem on the bottom left corner of the note for all Indian monetary faiths. This is the difference between the rupee and other commodities.

- Central Numeral:

The central numeral is what can become an exact alternative in which any denomination in the Indian currency can be specified and defined. The model can distinguish currency denominations according to their central number in a bag of characteristics. It must take some steps to construct a language for visual word and classification comprising binary support vectors (SVM).

1. It is important to render a methodology that was adopted for 144 central numeral images from banknotes.

=Using to derive functions from SURF descriptors data set for instruction. Information development for SURF methods invariants and efficient points of rotation and size controls light and shadow curve.

2. A characteristic histogram of character limit vs Visual Word Index generates a Dataframe instruction. The histogram contains an expanded dependent on the descriptor's proximity to the middle of the cluster (visual word). The histogram is this function used to prepare a binary classification (SVM).Ashoka Pillar Emblem Recognition:

The logo is a hallmark of the Indian capital. The average diameter is almost unchanged.

The picture of the bill is then quantized using the local threshold that binaries the image with the required functionality.

- Color Recognition:

For the color interpretation of currency notes, it uses the CIE LAB spatial domain template. This CIE specified color space model has two color features and a singular chrominance canal that makes it an adversary color scheme device.

**PRE- PROCESSING :**

It must analyze the currency notes graphic in advance to delete all noise from overseas. This is achieved by the operation of a simple filter to eliminate noise. That's why we should define all the currency notes regions. Notice that these empty areas are free of all preliminary items in the current Banknote. Although certain context trends may be present, these are de-noised and transformed to de-noise a binary image. The picture is also re-dimensioned for better evaluation.

**EDGE DETECTION:**

It uses this methodology for extracting edge points in the graphic, examining and detecting persistence in luminance to extract characteristics and details from the banknotes.

## V. FEATURE EXTRACTION :

A. Identify the country of origin:

Identification of vacant areas: pre-processing steps where we can define which areas the note is fairly empty in. It achieves this based on certain pre-defined areas. It categorizes any currency into classes that are based on the empty note regions.

B. To Classify the Place Of Origin, Using Prototype Matching:

Once you have split the banknote into two, we can search the picture for the state of a system for each nation in that category. Note that it needs fewer correlations to review the picture with any template nation, which is why we have picked independent nations into classes like these.

C. Determine the initials:

Once it's defined the nation correctly, we define the note value in the preceding phase. For this function, there are a few major approaches:

- Ratio of scale
- Retrieval of text

**CLASSIFICATION:**

Production recognition: it contains the hybrid algorithm, LBP and PCA are based upon. It also uses width from Euclid for the object to match. After it finishes this phase, it shows the corresponding currency with its message box category to which includes the currency category. For example, 5%, 10%, 20%, 50%, use two thousand different methods for classification.

K-NN is added to the derived method in the first method Functionality. Indian banknotes' pre-compiled pictures are immediately used in the second classification process, CNN.

- K-NN: it attempts to calculate a neighbor for the closest Functional verification of the training package. It measures the closest neighbor with the distance with the Euclidean method. The vector for this training classes the colors and texture properties to which they are nearest to the vector of the evaluation function.
- CNN: it interconnects each picture with some co-evolutionary kernels for the first convolutionary layer c1 to construct feature vectors. It then transports these functionality maps through a linear transfer unit (relu)– and initialization mechanism that transforms all negatives to zero making the remaining values unchangeable. The provided function RELU is to sub-specify the character maps for the first sub-samples layer s1 with matrix multiplication. Then it is fed onto the next filter sheet. The final feature charts are moved to the identification component, a completely integrated or thick surface, with a Softmax role is enabled identification as multi- class.

**PICTURE SEGMENTATION:**

This stage aims to separate the image into various fragments to promote an impassioned analysis.

## VI. AUTHENTICATION:

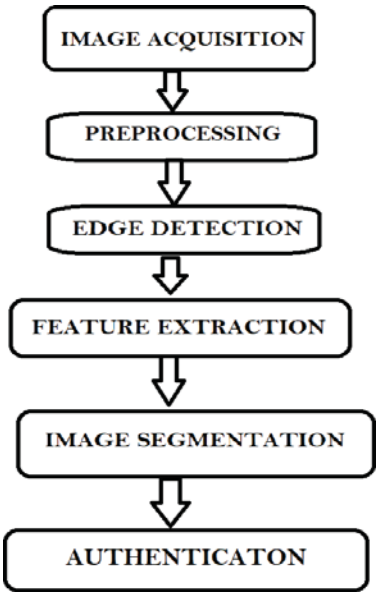
The last step in the selection process. The image is evaluated by specific methodologies and then compared with the broad range of characteristics.

**PICTORIAL REPRESENTATION**

## VII. RELATED TECHNIQUES

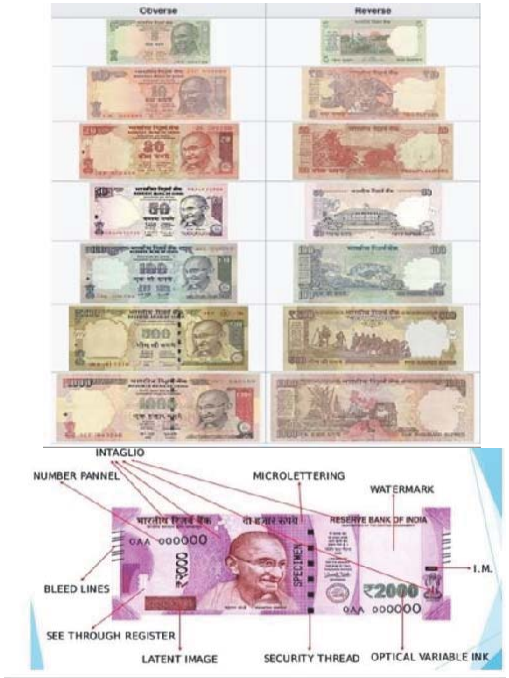
Even though banknotes are constantly recreated there has been a requirement to differentiate between false and actual banknotes. So it would not take long to conclude that it solves the currency identification dilemma in multiple directions and attempts.

- Singh [6] suggested a system in which key points were located from features extracted and defined by SIFT or SURF. Then a sequence of characteristics with k-means was acquired. It collects a histogram of word representations during the extraction process. Besides, it has implemented a voting system for classifying the relevant features existing in a banknote, in which each image recovered contributes votes to their image class depending on a set of temporally compatible key points.
- Verma [6] selected those regions of interest for their work from photographs of currencies such as RBI seal and central numeral, and the face of Mahatma Gandhi, and pulled them out with the help of a classification algorithm. In several cases, processes require the compilation of characteristics to establish the specific registry to authenticate it. For certain banknotes, a significant amount of these characteristics also become repetitive. In comparison, these types of evaluation techniques can only be used but cannot be tested to the observation page where the attributes are gained because of the opposite sides of the notes.
- A strategy that helps blind individuals understand the banknote is provided by Faiz M. Hasanuzzaman et al.[7]. This approach uses the Speed Up Robust Function (SURF) based structure for components. SURF is an efficient tool for controlling changes in lighting, background noise, rotation of an image, scale, etc. It developed features using SURF descriptive terms that are unobservable in the rotation and irreducible. For a group of characteristics, it evaluates the focal points of the source images and the target output at the point and regional levels. We eventually identified all characteristics of the test currencies with 100% precision.
- A system based on PCA is used by Eigen's face to detect currency characteristics. This machine also creates audio signals that tell the blind people what the money is. They had 99,135 percent acceptance in measuring [6]conditions for indoor environment, 99.835 percent for optimal conditions.
- Different neural network[6] frameworks for the identification and authentication of paper money have been applied. For the process of multi-layers of impressions used for identification and testing banknotes, Frosini used quite an external optimization method. Leelasantitham examined watermark information using neural mapping networks to detect money. For the identification and verification of world currencies, Tanaka used a single Gaussian distribution and hybrid neural network. For the precision of up to 99 percent in validating paper currency, Zhang [9] used the mapping function of the gray photo, edge detection, and neural network.




- Methods of information processing focused on point picture analysis were analyzed by the companies of Nevliudov, Novoselov, and Sychova. This showed that validity confirmation could use the association identification tool to improve the performance of automatic banknotes. By studying current image processing models, it has established a model to assess the validity of banknotes. This method required the precise automatic detection to be increased.
- Due to the selective specification of the magnification type and the status of the banknote, the dilemma of removing feature image elements from the background sound could be overcome by implementing an anisotropic Filtration Process.
- The validity of the Indian banknotes is checked by Sonali R. Darade[10], an automated identification device. It achieves this through the manipulation of the image. The built framework gains an image and transfers it to the central processor. The Interface will take the photo to choose the corresponding denomination, and then a control button is used. The picture of the text is translated to gray and is compartmentalized and ultimately sliced and re-dimensioned.
- Then the picture in the server is matched with the image. The authentication of various banknotes with simple processing methods is discussed by Shahbaz Khan. For fast preprocessing, it transforms the image from RGB to Grayscale. It identifies the boundaries using the Sobel operator, and it segments the image with the edge. The functionality is derived by the ORB detector. Functionality derived includes safety thread, intaglio printing, etc.
- The note could be found by silver bromide thread by Sushma R G. The genuine note is in the English and Hindi languages 'RBI.' Mobile Webcam program for the capturing of an image is used in this article. [10]
- Mitsukura [11] et al. presented the technique of assessing in 2000, integrating neural network approaches with the virtual annealing approach, based on synaptic methods and

with optimum efficiency. The governing equations were obtained by the author that shows that the creation of the small neural currency identification system is low costs with a rate of 99,68%[12-13] by application of dynamic and synchronized annealing and coin recognition systems.




## VIII. CONCLUSION

This paper discusses different ways to recognize bogus banknotes with different evaluation standards and outcomes. Some use a structured method for deducting and identifying characteristics. Features including central numeral, RBI seal, color strip, and visually disabled recognition symbol are extracted and recognized with implementations tailored for a specific purpose. Different denominations and human and physical conditions, including fresh notes, wrinkles, and uniform lighting, have been measured. This approach gave a 95.11 percent accuracy score.

It addressed it to maximize performance, by delivering more detailed outcomes and increasing the clinical outcomes, creative currency identification systems by digital image processing [10]. Several approaches were used to construct an appropriate recognition scheme for image processing. The solvent extraction of ORB features is faster than SURF but SURF shows better results. We should also assume that consistency is very critical when designing an assessment method. A variety of approaches are currently available that deliver decent results but more development will lead to much more effective methods and improved goals in terms of precision.

There are also several concerns, which remain unaffected amid intensive study in currency identification

The Indian currency notes were all operated with (5, 10, 20, 50, 50,...) and collect the six standard features of the note for further identification.

- The note should be highly defined.
- The photos must be the same size as the money.
- An improved picture with the featured upgrade.
- In this post, the hybrid PCA and LBP algorithm

Techniques that profoundly improve identification precision with the right identification by 100 percent. The base of knowledge of the pictures should be big enough i.e. samples, including a clean image of various currency types should be there. This will boost the precision. The benefits and disadvantages of each method are also present. We discussed the benefits of our system, but this system has thresholds such as:

- It can extract the features during this identification by calculating the length of the features. In this way, the six currency features are not exactly extracted since every currency note has different dimensions.
- The right method for the extraction of functions in the money recognition method will work to ease this problem. If it takes the input image from the outside of the training folder, the accuracy of the image is not 100 percent.

The other countries earn acknowledgment too. We may add photos of the currency with the various corners such as front and back and front clockwise, front anti-clockwise, back and back anti-clockwise, and rear left to right to boost the feature extraction. Besides the above points, we can implement currency identification services for mobile consumers so that the availability is improved and makes the added features user friendly. For the picture training phase, we may also consider a neural network.

## B. REFERENCES

[1] Prof. Renuka Nagpure, Shreya Sheety, Trupti Ghotkar, "Currency Recognition and Fake Note Detection", IJIRCCE, Vol-4,2016.

[2] Binod Prasad Yadav. “Indian Currency Recognition and Verification System Using Image Processing”. In: International Journal of Advanced Research in Computer Science and Software Engineering 4.12 (2014).

[3] Mirza, R., & Nanda, V. (2012). Design and implementation of Indian paper currency authentication system based on feature extraction by edge based segmentation using Sobel operator. International Journal of Engineering Research and Development, 3(2), 41-46.

[4] Verma, Singh B.K, Agarwal A, Indian Currency Recognition based on Texture Analysis, Nirma University International Conference on Engineering (NUiCONE 2011), pp. 1-5, December 2011.

[5] Hasanuzzaman F.M, Xiaodong Yang, YingLiTian, Robust and Effective Component-Based Banknote Recognition for the Blind, Systems, Man, and Cybernetics, Part C: Applications and Reviews, IEEE Transactions on, vol.42, no.6, pp.1021,1030, Nov 2012.

[6] Grijalva F, Rodriguez J.C, Larco J, Orozco L, Smartphone Recognition of the U.S. Banknotes Denomination for Visually Impaired People, IEEE ANDESCON 2010, pp.1-6,15-17 Sept 2010.

[7] Cao Bu-Qing, Liu Jian-xun, Currency Recognition Modeling Research Based on BP Neural Network Improved by Gene Algorithm, In Proceedings of Second International Conference on Computer Modeling and Simulation 2010 (ICCMS ’10), Vol. 2, pp. 246-250, January 2010.

[8] S Surya and G Thailambal, “Comparative study on currency recognition system using image processing”, IJECS, vol. 3, issue 8, August 2014, pp. 7723-7726.

[9] Y. Mitsukura, M. 'Takumi, N. Akamatsu, “Design and Evaluation of Neural Networks for Coin Recognition by Using GA and SA” in proceedings of the EEE-INNS-ENNS International Joint Conference on Neural Networks, Vol. 5, pp. 178 –183, 2000, IJCNN 2000.

[10] R. Bremananth, B. Balaji, M. Sankari and A. Ch0itra, ”A new approach to coin recognition using neural pattern analysis” IEEE Indicon 2005 Conference, Chennai, India, 11- 13 Dec. 2005.

[11] A. A., S. B. And D. K., “Intelligent Coin Identification System”, Proceedings of the IEEE.International Symposium on Intelligent Control (ISIC’06), Munich, Germany, 4-6 October 2006.