

# Recognition of the Old and Soiled Indian Paper Currency using Image Processing

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***Abstract:*** *In the paper, a system is proposed which is used to identify the old and soiled Indian paper currency notes. When the new currency notes are introduced and put into circulation, they get passed from person to person. As the time passes by, these notes get soiled, dirtier, and also get wrinkled. Identification and recognition of such notes inside the automated teller machines (ATMs) becomes difficult. Thus in the paper, a system is developed to handle such soiled, old and dirty Indian paper currency notes. The system works on three denominations of Indian paper currency which are 50, 200 and 500 Indian paper currency.*

***Keywords:*** *Indian Paper Currency, Old, Soiled, Image Processing.*

## 1. INTRODUCTION

Money has a vital role to play in the life of a human being. Money is most commonly used as a medium of exchange when it comes to buying and selling of commodities or service. Money has been a part of human life from a very long time from around 600 B.C. Before the use of the paper money or coins, barter system was used as a median of exchange for the buying and selling of commodities and service. Money by itself does not have any value as it is just a piece of paper or a metal coin. It gets its value by being a medium of exchange or a unit of measurement or by being a warehouse for wealth. Money was mainly used for the purpose of trade, that is, when buying and selling of commodities took place.

In barter system one commodities was exchanged for other commodities. Like five Bags of wheat for one cow. The issue with this system was that it was not fair trade sometimes and sometimes it was difficult to find the people to trade with commodity and services people wanted to exchange. Thus a common medium exchange was required. This lead to the usage of coins as a medium of exchange. The first coin was issued by lydia King Alyattes in 600 BC. The coins minted were mixture of silver and gold with some pictures on it which represented different denomination. Later in 700 BC the Chinese moved to using a different form of currency system which was the paper currency. Thus the paper currencies came into existence.

Now paper currencies have become a very important part where most of the people use paper currency to perform their commercial activities on daily bases. This lead to an ease for trading. As trading increased the standard of living of the people also increased the use of more currency as a medium of exchange. The need for more money to put into the circulation was required. As the need of money stated increasing people using some unauthorized ways of getting money. Counterfeiting of the currency notes started to take place. This lead to

adding many features and characteristics introduced into the paper currency which help to distinguish the original currency and the fake currency.

As the world is stepping into a new and advanced world, many different methods and ways of using the money has also changed. Now using machines for the purpose of money transactions have come into the picture. Humans are more dependent on machines rather than the human force. Vending machine are the future trading machines which are automatic machines used for buying commodities. Most common commodities are beverage, cigarette packs, snack, soft drinks and many more. ATM's (Automatic Teller Machines), CDM's (Cash Deposit Machines) are used for the withdrawal and depositing of money. These machines use the systems to identify the currency notes and determine if the note is fake or real. But there is a drawback in these systems. These system do not work well when it comes to dealing with the old, wrinkled or damaged paper currency.

As mentioned earlier, the paper currency is the most widely used medium of exchange. They travel from person to person and from one hand to another. As paper currency travels a lot, they tend to get dirtier, wrinkled and old with the passage of time. When such notes are put into the ATM's, CDM's or vending machines, the system do not work more efficiently in identifying them. So there is a need to develop system where such old, dirty and wrinkled notes can be identified.

## **2. LITERATURE SURVEY**

Many system have been developed by different researchers for identifying the Indian Paper Currencies, but during the literature survey conventional methodologies failed in identifying old, soiled and wrinkled currency notes. The systems worked well with the good quality of paper currency but did not work so well when it comes to identifying the old, soiled and wrinkled paper currencies. Many different method and techniques are used to identify the Indian paper currency. In the paper by Narayanan L et.al says, the currencies were identified based on their colors. The notes were identified as old currencies which were used before the demonetization and new currencies which were used after the demonetization [18]. Template matching was used for comparing the features of the currency which is the input with the currencies inside the database. Using the threshold currencies were identified as fake or original. These are many different security features of the paper currencies that distinguished are currency form other currency. In the paper by Singh M et.al says, such features are detected and are used to identify the currency [1]. Here two main features were considered which are the security thread and the latent image. As these two features have a very complicated design and these features are very difficult to replicate.

In the paper by Aggarwal H et.al says, localization method is first used to extract the currency [11]. Using scan line algorithm the edges of the notes are identified and the image of the note is cropped. Then the notes are identified based on the color matching. RGB color model is used to detect different countries. In the paper by Mirza R.says, the system used Sobel operations for the edge detection [19]. The foreground objects are separated form the background objects, feature extraction is performed then. The extracted features are compared to predict the output ie currencies are real or fake.

In the paper by K W et.al says, the proposed system worked on the Egyptian currency [7]. The texture and shape feature of the currency. GLCM matrix is used for texture feature extraction. For the shape feature extraction the image converted to binary image and labelled using 8-connectivity components. Properties of the labelled region is calculated mean value is calculated. Euclidean distance is calculated and compared to determine the currency is real or fake. In the paper by Zhang Q et.al says, K-means algorithm for feature extraction. The features are clustered and the currency is recognized using the SVM algorithm the images are

classified to predict the currency is real or fake [5]. The system showed 97% of accuracy. In the paper by Hassanpour H et.al says that CNN (Convolution Neural Networks) is used to recognize to currency is real or fake. CNN along with VGG Net is used to train the dataset. The proposed architecture provided a low error rate and also provided accurate results. A combined method of local and global thresholding aged historical document of agreement copy is detailed in Bipin et. Al [20]. Bipin et. Al also proposes enhanced approach of offline handwritten characters [21]. Bipin et. Al proposes reviewing folding mark using vertical line removal method [22].

### **3. DESIGN FLOW OF THE PROPOSED SYSTEM**

The proposed system involves seven steps to develop the system. They are: Image Acquisition, Grayscale Conversion, Binarization, Image Segmentation, Feature Extraction, Comparison and the Output. Figure 1 represents the systematic flow of the proposed system which help in achieving the objective of the paper.

### **4. IMPLEMENTATION OF THE PROPOSED SYSTEM**

The proposed system was built using the MATLAB software 2018 version. The proposed methodology helps in identifying the old and dirtier notes. The proposed system works on Rs.50, Rs.200 and Rs.500 Indian paper currency notes which were issued by the government of India after the demonetization. The first step of the proposed methodology was the image acquisition. The images which were taken by a camera or scanner are acquired into the system. The image are usually in RGB form.

The RGB image has 3 channels which are Red (R), Green (G) and Blue (B). The next step was converting the RGB image into a Grayscale image. This conversion was done because a grayscale image is easier to process as they have different intensities of gray. The next step is to convert the grayscale image to a binary image. This was done by using the 'imbinary ()' function. This step is called binarization. The function converted the whole image into a binary image where the image had only 2 values i.e. 0 or 1 which represents black or white. At this point a threshold was set. Now all the connected components that had fewer pixel than the threshold were eliminated from the binary image. Another binary image was obtained with all the remaining components excluding the less connected components eliminated.

Image segmentation was performed next. The segmentation process was done based on the region of the components. Here the components which were close to each other need to be considered as one segment. Firstly the properties of the image regions is measured. Then the number of pixels around were taken into consideration. If the region pixels were of same intensity it goes to the next pixel and if it was not the same intensity then boundary of the bounding box was identified.

Thus the boundaries of the regions on the four sides was identified and a bounding box was plotted around the region which was identified. Performing segmentation gave the numbers of the denomination part as different images. The denomination part of the currency has to be identified as a single unit. Thus to achieve this morphological close operation was performed. The regions which were nearer to each other would have less gap between them. A threshold value was considered. If the regions have a gap less than the threshold value, the gap would be filled thus connecting the components. By performing this the denomination part was obtained as a single region.

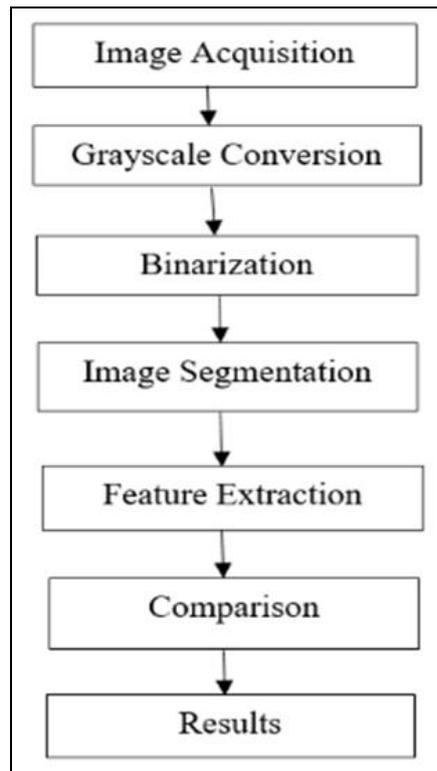


Figure 1 Systematic Flow of the Proposed System

Now the regions which were identified by the bounding boxed are called the features of the currency. These features need to be extracted. This was done based on the bounding boxes which were plotted during the segmentation process. The segmented image was scanned from top to bottom and from left to right. When a boundary of the bounding box was encountered then the corners of the boundary box were obtained. The four corners were to be obtained which were the top left, bottom left, top right, bottom right. All the pixels within these four corner were taken. The compliment of those pixels were taken and projected as another image.

It was observed that the denomination part of the currency was well segmented and also extracted successfully. The next step was taking the denomination part and identifying the part to predict which currency the input image belonged to.

## 5. RESULTS

1. **Image Acquisition:** the image was acquired into the system. Figure 2 shows the image of the old and soiled 200 Indian Paper Currency note is acquired.
2. **Grayscale Conversion:** the RGB image was converted to a grayscale image. Figure 3 shows the grayscale conversion.
3. **Binarization:** the grayscale image was converted to the binary image. Figure 4 shows the results obtained by binarization.
4. **Image Segmentation:** the binary image was filtered and the objects within the paper currency were identified. A bounding box was plotted around them. Figure 5 shows the image segmentation.
5. **Feature extraction:** the features which were identified during the segmentation are extracted. Figure 6, figure 7 and figure 8 shows some of the features which are extracted after the segmentation. Figure 9 shows the denomination part extracted as a single unit after performing the morphological close operation.

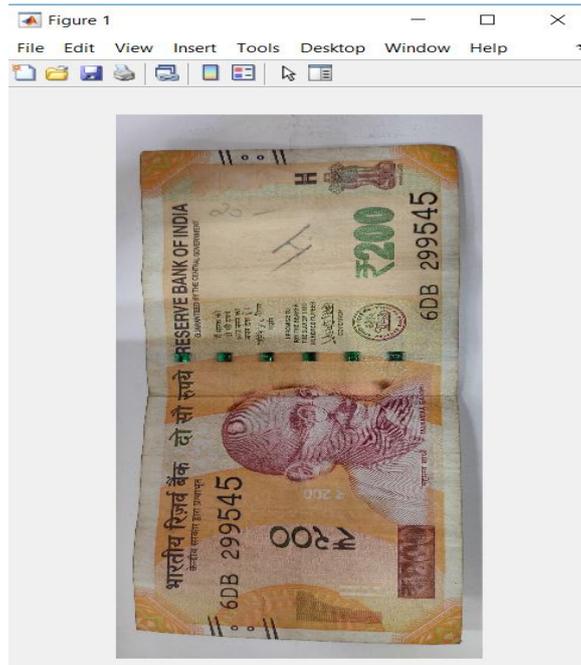


Figure 2 Image Acquisition



Figure 3 Grayscale Conversion



Figure 4 Binarization



Figure 5 Image Segmentation



Figure 6: Segmented Currency Extracted

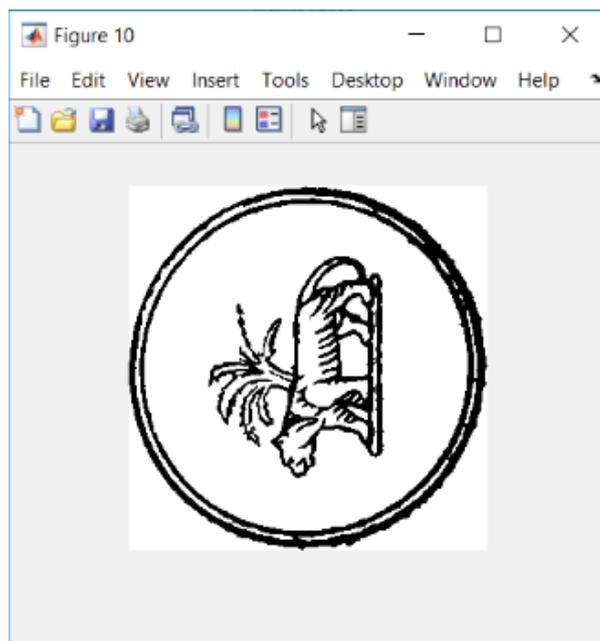


Figure 7 Intaglio Printing of RBI Seal Extracted

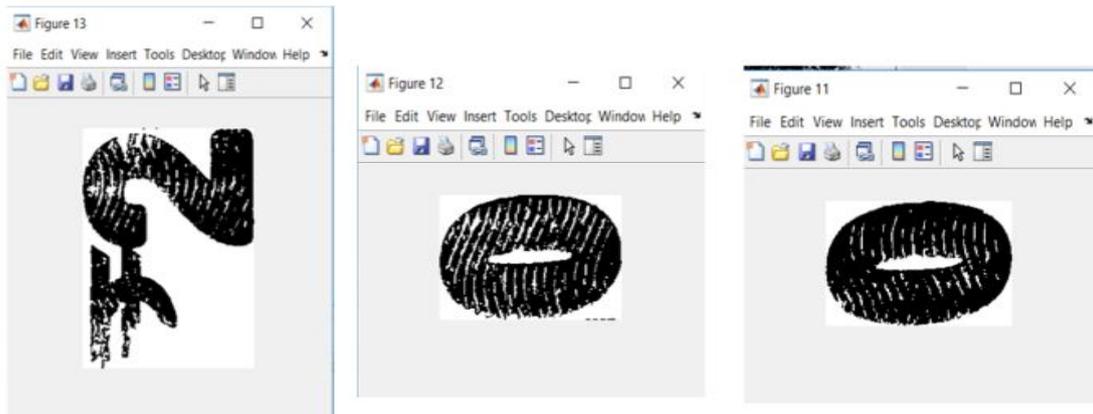


Figure 8 Denomination Part Extracted before Performing the Morphological Operation



Figure 9 Denomination Part Extracted after Performing the Morphological Operation

While performing the experiment no preprocessing methods or techniques were used in the process. It was observed that when no preprocessing operation was performed, the note part of the image could not be segmented easily i.e. only the note was able to be segmented removing the background of the whole image. This might have happened because when the preprocessing operation was performed, it smoothens out of image. When the image smoothens out then it merges with the background as their intensities are averaged.

## 6. CONCLUSION

In the paper, recognition of the old and soiled Indian paper currency detection system, a system has been developed to identify the Indian paper currency notes. The system mainly aims for working with the currency notes which became old and soiled with the passage of time and usage. It works for the denominations of 50, 200 and 500 Indian Currency notes. It was observed that the system provided accurate results in identifying the denomination part of the currency. The main advantage of the proposed system was that the system is very simple and also provides accurate results.

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