CURRENCY RECOGNITION SYSTEM

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Abstract : It is very difficult to count different denomination notes in a bunch. The system involves scanning of the images either with a camera or a scanner and then uses Pre-Processing technique for RGB to Gray Scale conversion.The ROI region is extracted with a Canny Edge Detection Algorithm which involves a Gaussian Filter for smoothing purpose. The images are then segmented based on color of images .The HSV and YCbCr values are calculated for the purpose of segmentation of images .The total number of each notes in the bunch and Grand Total of the bunch is given as a output.

IndexTerms **- Color Segmentation, Edge Detection, Feature Extraction, Gaussian Filter, Pre-Processing**

I. INTRODUCTION

Currencies in the world differ from one another based on their features which includes size of banknotes ,color ,texture and pattern .This system helps people in recognizing different currencies and allows them to work with convenience and efficiency .The variation in type of currencies even of single nation has made it difficult to correctly recognise them .For ease Digital Pre-Processing Technique of Image Processing Technique is used to find Region of Interest and Color Segmentation is used for segmentation purpose .It is very difficult to count different denomination notes in a bunch. This project proposes an image processing technique for paper currency recognition.

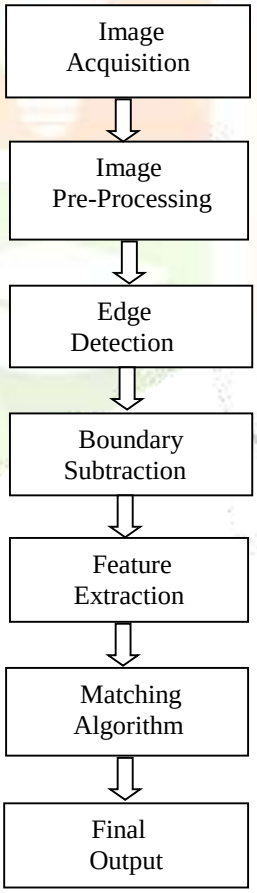

Figure: General Flow Diagram of Currency Recognition Syst**em**

1.1 Motivation

The techniques that were previously in use required a user to carry a machine to recognize currency notes.In order to overcome such a problem currency recognition technique was needed to be developed.This has been the ultimate motivation for the development of this system.

1.2 Problem Definition

The currency recognition techniques were initially using some pattern, or texture or any other feature to recognize currency notes. These techniques require a user to always carry a machine along with him/her. Also these machines consume a lot of power. Hence, some currency recognition technique was needed which can overcome these shortcomings. The recognition technique discussed in this report does not require the image to have the exact size as that of the currency note. It also takes a single image to determine the currency.

II. LITERATURE REVIEW

The literature survey for the project identifies the need of project. Also, any work done relating to project. Techniques used to guide the implementation project are also mentioned.

2.1 Placement Rules

Hideyuki Tamura et al. proposed the placement rules as in the past, there was some difficulty in texture analysis due to lack of adequate tools to characterize different scales of texture effectively. There are some texture based techniques. According to him, [3]a strict definition for visual texture is difficult .Its structure is simply attributed to the repetitive patterns in which elements or primitives are arranged according to a placement rule. Hence it can be written as f= R (e) Where R is denoting a placement rule (or relation) and e is denoting an element. There is a set of features by which all input patterns are measured and which give well-distributed results. For this purpose, it is required to have both extremes defines for each feature, e.g., coarse versus fine for coarseness.

2.2 Pattern based Recognition Techniques

Seth Mc NeillIn et al. [4] proposed the Pattern based recognition technique which is conclusions based on prior knowledge. A form of this is the classification of objects based on a set of images. There are number of techniques exist in the literature which Indian Currency Note Denomination Recognition in Color Images make use of pattern recognition as a feature to some of the good problems. These techniques are broadly focused on Vector quantization based histogram modelling. Vector quantization (VQ) is a method of sampling a d-dimensional space where each point, xj, in a set of data is replaced by one of L prototype points. RGB values of the coin and its background determine the Adobe Photoshop. Then a Segmentation program was applied to these images. After the data collection next step is Coin Segmentation and Cropping. In this step coins were segmented from their backgrounds using some modification. After completion of segmentation cropping program was implemented to locate the edges of coin. After this Features were extracted from the coins by convolving texture templates with each image, with edge detection templates. Next step was training, in these Five dimes, nickels, pennies, and quarters were used for training data. The result of this method is 94 percent accurate.

2.3 Color-based Recognition Techniques

The Wei-Ying Ma et al. in describes Color histogram (CH) method for an image. It is constructed by counting the number of pixels of each color. The global color distribution in an image describes the histogram. It is easy to compute and is insensitive to small changes in (VP) viewing position. The computation of color histogram just involves counting the number of pixels of specified color. Therefore in an image of resolution m*n, the time complexity of computing color histogram is O (mn). This method may suit the requirements when segregation is to done among almost similar colors. Color histograms also have some limitations. Color histograms describe which colors are present in the image and in what quantities; color histograms provide no spatial information. Color coherence vector is a refined approach of coherence histogram. In this approach, the local properties of images are taken into consideration as contrast to CH method that is a global one. In this method, regions are based upon the coherency. The work done in this area was also carried out by John R et al. in. They proposed the techniques of color image retrieval. Using color indexing through extract the color content of the images and videos. The technique proposed is to extract colors from images form a class of easily indexed metadata. The color-indexing algorithm uses the back-projection of binary color sets to extract color regions from images. Also both technique the automated extraction of regions and representation of their color content is extracted. All problems with color histogram techniques as high-dimensional feature vectors, spatial localization, indexing and distance computation.

III. RELATED WORK

For recognizing currencies automatically, a lot of work has been done. A distinctive point extraction method used a coordinate data extraction method from specific parts of a Euro banknote representing the same color. They used two key properties of banknotes face value and direction (front, rotated front, back, and rotated back) to recognize banknotes, for bill recognition and verification method neural-network based technique was used, for recognizing Italian Liras the learning vector quantization (LVQ) method was used, Robust and Effective Component-based method for Banknote Recognition by SURF Features. [3] In some of the research works a simple statistical test is used as the verification step, where univariate Gaussian distribution is employed, in some other technique for paper currency recognition, three characteristics of paper currencies including color, size and texture are used in the recognition. [4] We can see that most of these methods/algorithms use Artificial Neural Networks after studying the previously used methods for currency recognition.

IV. SYSTEM ARCHITECTURE

In India, Reserve Bank of India (RBI) holds the sole right to print currency notes. Currently, the Indian currency system has the denominations of Indian Currency Note Denomination Recognition in Color Rs. 10, Rs. 20, Rs. 50, Rs. 100, Rs. 500, and Rs. 2000. All the mentioned denominations are unique in one feature or the other. The features include color, size, identification mark among them color is most important feature for the development of currency notes recognition system. Currency notes have a variety of color and out of these, each currency note has one color is more prominent which we use to recognize currency note. There are many steps involved in the methodology of currency recognition system.

4.1 Image Acquisition

Image acquisition is the creation of digital image, typically from a physical scene. The co-ordinates of the pixels of the digital image in 2D form is given by 1st and 2nd index of an array and the 3rd index stores the RGB intensities for each co-ordinate. [6] Each array element then stores an unsigned 8-bit integer. Once the images are obtained, they were further processed using programs to extract whatever information is desired.

4.2 Image Pre-Processing

The undesired distortions are supressed with the help of Image Pre-Processing which also enhances some image features that are important for further processing or analysis. It includes Image adjusting. The size of the image is too big when an image is obtained from a digital scanner. For reducing the calculation, the size of the image as to be reduced. Image interpolation is used for image adjustment. While performing image transfers, some noise may appear on the image. Noise removal is an important step when image processing is being performed. Noise may affect segmentation and pattern matching. The degree of smoothening and reduction in noise can be determined with the help of mask values. Higher is the mask size, more is the smoothening.

4.3 Edge detection

The area of feature detection and extraction uses a fundamental tool of image processing which is Edge detection. The aim of it is to identify points in digital image at which the image brightness changes sharply. It reflects sharp intensity change in color of the images. It identifies object boundaries of an image. These algorithms include Sobel, Prewitt, Roberts, and Canny. The Canny method is more powerful because it can detect true weak edges, it has low error rate, and edge points are well localized and gives only one response to a single edge. So, at first the image should be converted to a binary image and then edge detection must be performed on that image using Canny edge detection technique to detect strong and weak edges.

4.4 Boundary Subtraction

In order to detect and recognize the note, it is preferred to remove irrelevant background first. After binarization, black pixels touching the boundary of the image were regarded as background, since the note had a white background that separated itself from the backgrounds. The image obtained from the camera may not be directly used for localization and requires enhancement. Next, generally background subtraction followed by RGB to Gray conversion was done. This was done because to localize a note, one must know whether a pixel is present in an image or not. After boundary subtraction, some noise may still exist. Usage of Breadth-First-Search (BFS) from the image centre removed the noise and so as the mask value.

4.5 Feature Extraction

The feature extraction includes the extraction of features of serial numbers of currency notes. It is a challenging work in digital image processing. During this process, the dimensionality of data was reduced. Feature extraction or selection effects on design and performance of the classifier intensively and was a pivotal procedure considerably for currency recognition. [2] If the differences of selected features were assumed to be too large, a classifier with good recognition performance could have been easily constructed. It was difficult to get it with the contrary situation. The essential task of feature extraction and selection is how to find the correspondingly effective features out of many pending features. Those features were extremely important both in recognition and authentication of notes. Basically, at first instance, people may not pay attention to the details and exact characteristics of banknotes for their recognition, rather they consider the common characteristics of banknotes such as the size, the color of background and texture present on the banknote.

4.6 Matching Algorithm

There are various algorithms that have been proposed by various researchers for reliable currency recognition. After getting features of currencies, it is essential to recognize the pattern of the currencies on the basis of these features, which should be practiced by an effective recognition system called classifier. In this method, the image acquired at first was RGB image and then it was being converted into Gray scale. Edge detection of the whole Gray scale image was then performed. After detecting edges, the four characteristics of the paper currency was cropped and segmented. It involves extraction of characteristics of the paper currency after segmentation and then comparing the characteristics of test image with the original pre-stored image in the system. If the match is found then the currency is genuine otherwise counterfeit.

V. SYSTEM ALGORITHM

Canny Edge Detection Algorithm: Canny edge detector is an advanced algorithm derived from the previous work of Marr and Hildreth. It provides clear response, good detection and good localization and thus it is an optimal edge detection technique. It is widely used in current image processing techniques with further improvements. These steps in Canny Edge Detection are as follows –

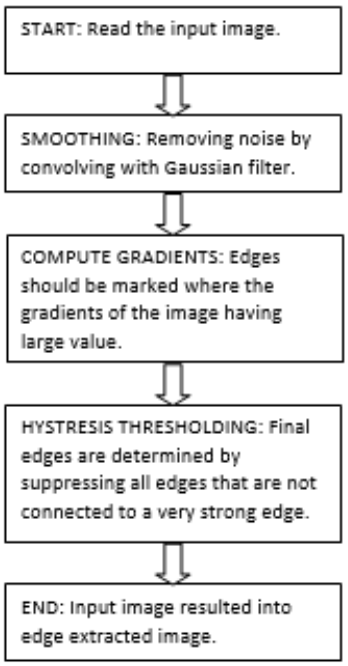

Figure: Steps for Canny Edge Detection Algorithm

VI. RESULT

Here are some of the images of the system that we have designed. In this, you can see different currencies are successfully recognized and also, we have added outputs of the difference Image processing stages along with output of total currency notes and grand total of the bunch.

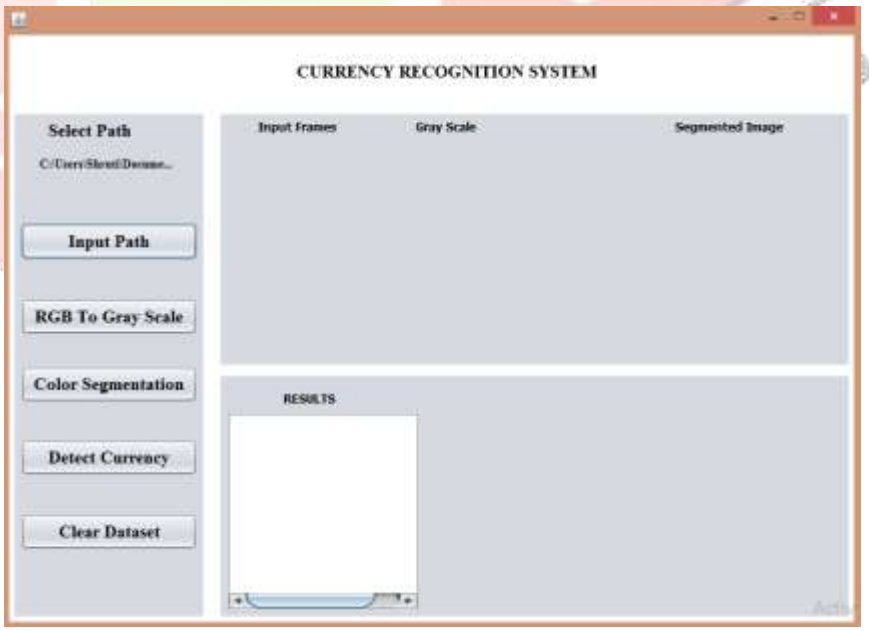

Figure above shows the image of system where Input Path is selected.

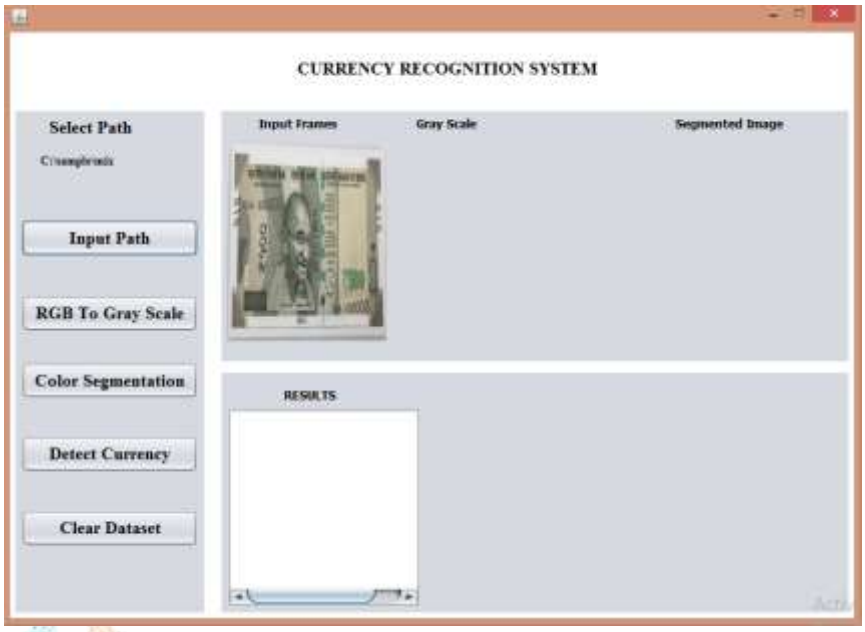

Figure above shows image where RGB to Gray Scale Conversion is carried out.

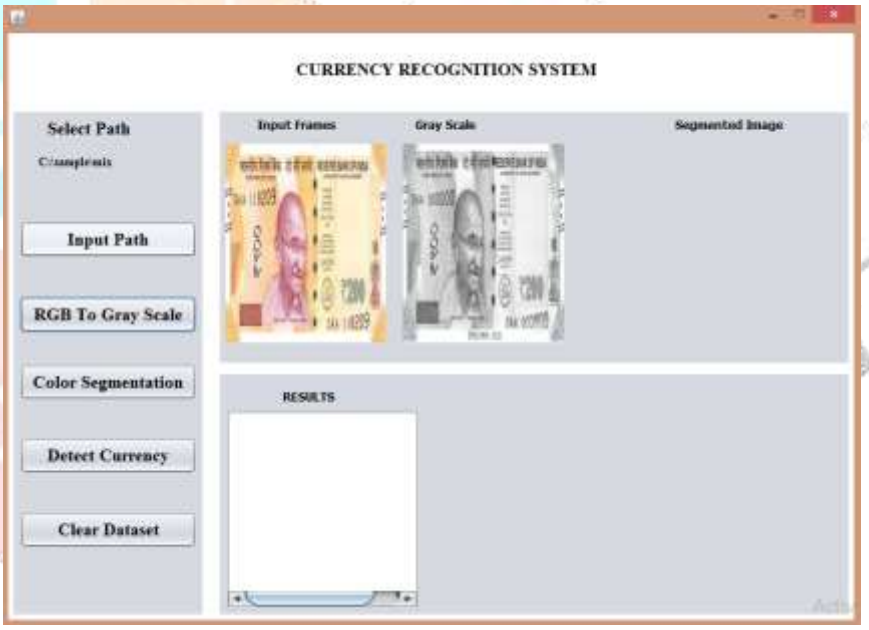

Figure above shows image of the system where Color Based Segmentation is carried out.

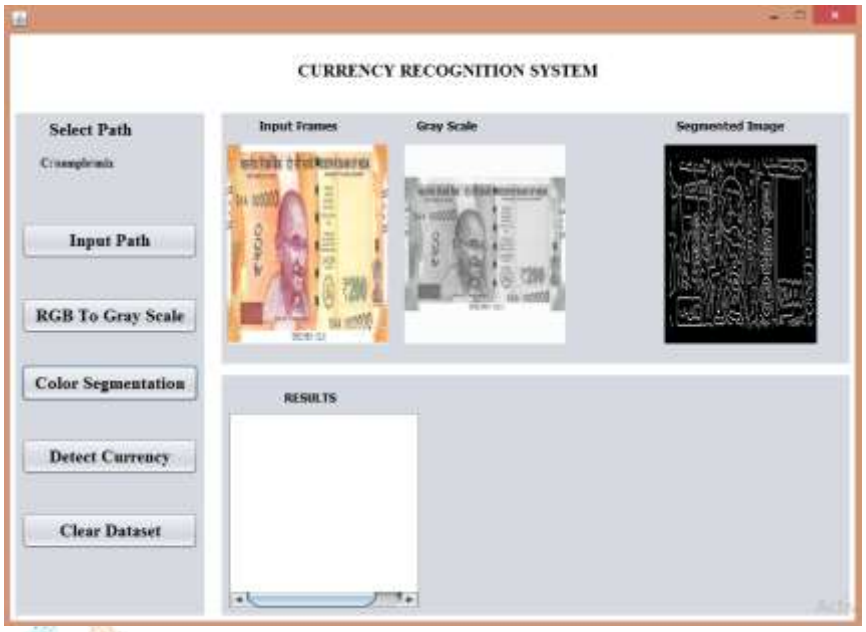

Figure above shows where the Detection of currency is done.

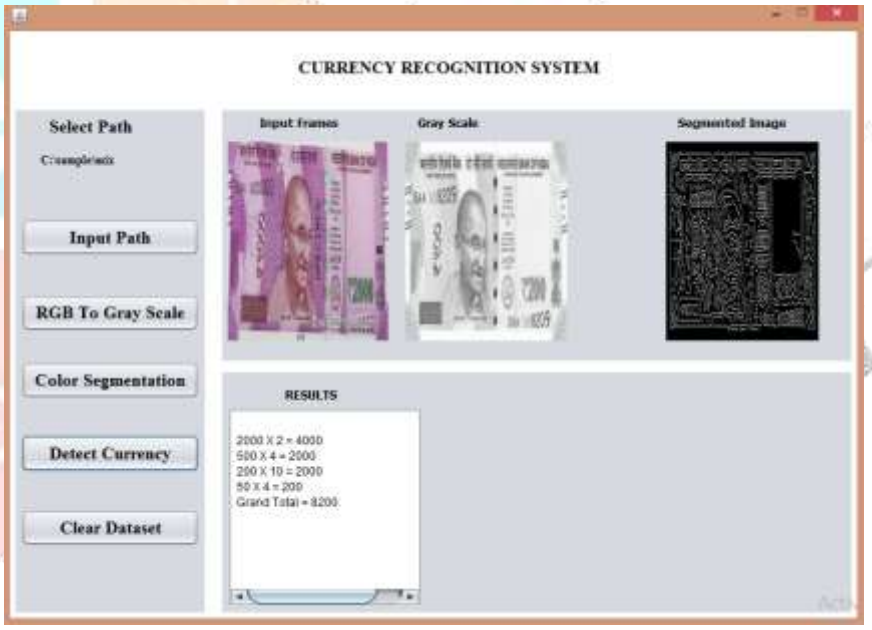

Figure above shows the final calculation of total notes in the bunch and their grand total.

VII. CONCLUSION

An image has been obtained through a Scanner then Pre-Processing technique has been applied to detect boundaries, cropping the ROI and calculating color features. The Boundary Detection and cropping is done to separate the background and the foreground and then Features Extraction is done to extract the HSV values and compare them with the values from the database. Thus, our proposed algorithm has enhanced our results and successfully obtained the desired results i.e. calculating the numbers of notes in a bunch and obtaining its Grand Total.

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