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Currency Identification System for Different Countries

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Abstract: *There are many types 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 and etc. This system is currency recognition using image processing techniques. Only paper currencies have been considered. This system is identification of different currencies. The system deals with the image of currencies. The system removes noise from images of different currencies by using median filter and converts them into Luv color space by using texture feature to classify currency. MATLAB programming language is used as an easy and efficient tool to implement the proposed system.*

Keyword: *currency recognition, image processing, median filter, Luv.*

1. INTRODUCTION:

According to the survey conducted by the CIA, there are around 180+ currencies presently circulating in the world. Each of these currencies differs from their features such as size, color and texture. Unlike the olden times, the trade and commerce between countries has increased in all sorts of levels. The need for acquiring knowledge about all the currencies by the banks has been extremely important. However for any human teller to recognize each note correctly is something that is not feasible. Thus the need for an efficient system that helps in recognizing notes is pivotal for the future. 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 all banknotes that may cause some problems, so they need an efficient convinces and extract systems to help their work.

Monetary transaction is a complete part of our day to day activities. The strength of societies with regards to trading with other societies depends highly on the value held by their currency. There are nine different currencies notes, with each of them looking different. For instance, the size of the paper, color and pattern is different. People have to detect and recognize different types of currency denomination and that is not an easy job. They have to remember the symbol and other security features for each currency note. This may cause some problems, so they need an efficient and exact system to help them in this task.

Due to the recent developments in computer technologies, scanners and system helps business to protect themselves from money losses. Banks, retail stores, groceries, super market, money exchange sells and governmental organizations are the most affected of such deception while there are manual techniques that people can do to check the money but it take a while and not convenient for every occasion.

2. DIGITAL IMAGE PROCESSING:

Digital image processing is a developing technology which is help to enhance the quality of the image. The Image processing is performed to extract information from the image digitally by the use of computer algorithm. Digital image processing is a versatile method and also it is very cheaper. Filtering is also included in digital image processing which is helps to blur or sharpen the image. Digital image processing is depended upon the computer vision.

2.1. Resizing

Image resizing is used to increase or decrease the size of the input image acquired from digital interfaces. The image obtained from the internet is too big. In order to reduce the calculation complexity, the size of the image is reduced with the help of image interpolation. The input image is set to the same size which is 128×128 pixels.

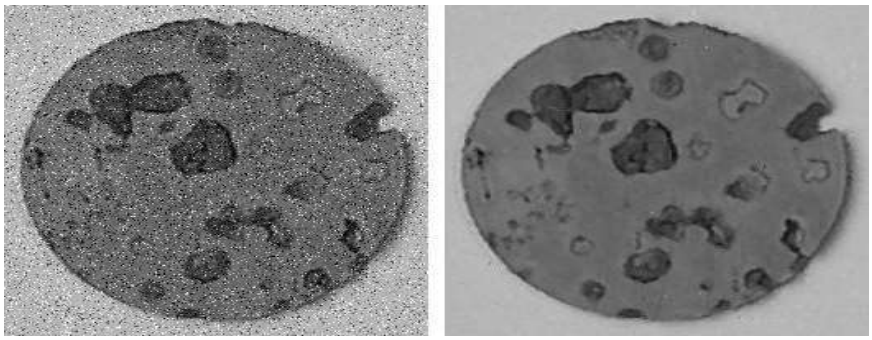
2.2. Noise Removing

The resized image also includes a number of noises according to the image type. Noise is defined as irregular substances that are caused by the lighting conditions and defects in the sensors and circuitry of the scanners, cameras and download from the internet. Image noise is and undesirable by-product of image capture that adds spurious and extraneous information.

There are two major categories of filtering: Linear filtering and Non-linear filtering. Moreover, each of these filter types can be parameterized to work one way under certain circumstances and another way under a different set of circumstances using adaptive filter rule generation. Conversely, if an image contains a low amount of noise but with relatively high magnitude, the median filter be more appropriate.

The salt and pepper noise can appear in a document image during the conversion process and is also caused by the dirt on the document. The noise can be composed of one or more pixels, by definition, they are assumed to be much smaller than the size of the text objects. Median filter removes isolated spikes and may destroy fine lines. The median filter is based upon moving a

window over an image, which computes the output pixels as the median value of the brightness within the input window. The median filter sometimes called and edge-preserving filter due to this property. It is useful in removing outliers such as impulse noise and retaining edges while suppressing the noise contamination. It can be concluded that the median filter can remove noises and also maintain the details of the image according to Fig.2.1.



(a)Image with salt and pepper noise (b) Image after median filter

Figure2.1. Comparison of Original Noisy Image and the Median Filtered Image

The median is the center of a rank-ordered distribution. The median value is usually taken from a template centered on the point of interest. The median operator is usually implemented using by a template. The common size of the template is 3 by 3 matrix. The nine pixels in a template centered on a point with coordinate (x, y) are arranged into a vector format and the vector is then sorted into ascending order. The central component of the sorted vector is the median value and replaced with value at coordinate (x, y). The median can be taken from larger template sizes but only for square matrices. The process of median filtering for noise is shown in figure 2.2.

Median filtering example using a 3 x 3 sampling window:

Sorted: 0, 0, 1, 1, 1, 2, 2, 4, 4

1	4	0	1	3	1
2	2	4	2	2	3
1	0	1	0	1	0
1	2	1	0	2	2
2	5	3	1	2	5
1	1	4	2	3	0

1	4	0	1	3	1
2	1	4	2	2	3
1	0	1	0	1	0
1	2	1	0	2	2
2	5	3	1	2	5
1	1	4	2	3	0

Figure2.2. Median Filtering Example using a 3 × 3 Window

2.3. Feature Extraction

A good classification scheme relies on feature extraction stage. Feature extraction is reducing the amount of data in the image to be classified or extracting the specific characteristics of the input data. The input data is too large to be processed and it is suspected to be redundant, then it can be transformed into a reduced set of features. The two types of feature extraction is shown in Fig. 2.3.

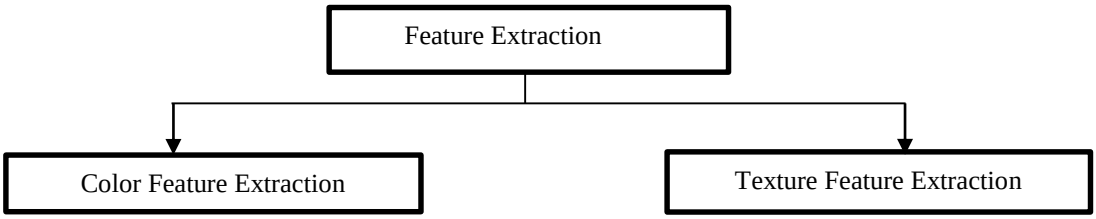


Figure2.3. Two Types of Feature Extraction

2.4. Color Feature Extraction

Color may be one of the most straight-forward features utilized by humans for visual recognition and discrimination. Color extraction by computer is performed without benefit of a context. Lack of knowledge also makes it difficult to cull the color information from the color distortion. The appearance of the color of real world objects is generally altered by surface texture, lighting and shading effects, and viewing conditions.

Color is the way the HVS (the human visual system) measures a part of the electromagnetic spectrum, approximately between 300 and 830 nm. Because of certain properties of the HVS we are not able to see all of the possible combinations of the visible spectrum hut we tend to group various spectra into colors.

A color space is a notation by which we can specify colors, i.e the human perception of the visible electromagnetic spectrum. Classification of colors paces are as follows:

- HVS based color spaces include the RGB color space, the opponent colors theory based color spaces and the phenomenal color spaces. These color spaces are motivated by the properties of the HVS.
- Application specific color spaces include the color spaces adopted from TV systems (YUK YIQ), photo systems (Kodak Photo YCC and printing systems (CMY(KJ).
- International Commission on Illumination (CIE) color spaces are spaces proposed by the CIE and have some properties of high importance like device-independency and perceptual linearity (CIE XYZ, Lab and Luv).

2.5. Texture Feature Extraction

Texture feature extraction is a major step in image classification, image recognition, image segmentation and image shape identification tasks. Image textures are complex visual patterns composed of entities or regions with sub-patterns with the characteristics of brightness, color, shape, size and so on. Texture analysis plays an important role in many image processing and pattern recognition tasks such as remote sensing, medical imaging, robot vision, and query by content in large image databases, curry recognition and verification and so on. Texture features can be extracted using several methods such as statistical based; structural based; model based and transform based information.

2.6. CIE Luv

The CIE, which stands for International Commission on Illumination (or Commission International de l'Eclairage), in 1931, defined three standard primaries (X, Y, and Z) to replace red, green, and blue. With this newly created X, Y, and Z primaries, all visible colors could be specified with only positive values of the primaries. The primary Y was intentionally defined to match closely to the quality of luminance of a color. Note that arbitrarily combining X, Y, and Z values can easily lead to a "color" outside the visible color spectrum. The picture to the left is taken from Computer Graphics, mentioned above, and shows the cone of visible colors, as well as the plane X+Y+Z=1 (discussed below).

Lowercase x, y, and z refer to the normalized X, Y, and Z values [normalized such that x + y + z = 1, so x = X/(X+Y+Z), y = Y/(X+Y+Z), and z=Z/(X+Y+Z)]. Thus, x, y and z are on the (X + Y + Z = 1) plane of the solid of visible colors in X,Y,Z space. These lowercase letters are called chromaticity values, and a projection onto the (X,Y) plane of the (X+Y+Z=1) plane of the figure to the left is called the chromaticity diagram. On this diagram, all perceivable colors with the same chromaticity but different luminances (brightness) map into the same point. This chromaticity diagram is shown to the right (it is also taken from Computer Graphics), with the dot marking the "C-illuminant" (or white point), and the numbers along the boundary correspond to wavelength in nanometers.

3. DESIGN AND IMPLEMENTATION OF THE SYSTEM:

Different Currencies Recognition (DCR) system consists of four main parts: Input Image, Image Preprocessing, Color Feature Extraction and Identification. Firstly, input image is taken from the internet. The input images are processed by using image processing techniques. Then features for identification are obtained from texture feature extraction for each Luv color space. The overall system design of currency identification system for different countries is shown in Fig. 3.1

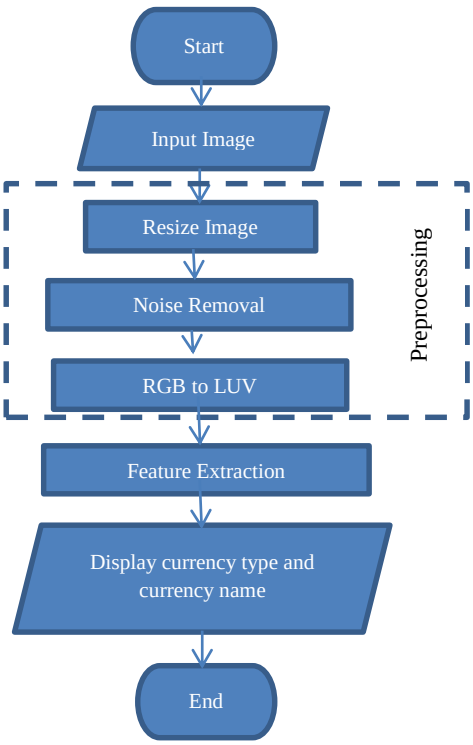


Figure 3.1 Flow Chart of the Different Currency Recognition System

3.1. Input Image

This system will classify different currencies from nine countries which are Myanmar kyats, Indian rupee, Korea won, American dollar, Australian dollar, Danish krone, Egyptian pound, Iceland krona and Indonesia Rupiah. Five kinds of bank note from each country are used in this system. There are various ways to acquire image such as with the help of camera, download and scanner. In this step, images of different types of currency are downloaded from the internet. So, file format of currencies are jpg,bmp and png, shown in Fig.3.2.

Figure3.2. Sample of Different Currencies

3.2. Implementation of the System

The proposed system is implemented by using MATLAB programming language. When the program run, the main interface of different currencies recognition system including six buttons such as Load Image, Resized Image, Noise Removing, Luv Image, Feature Extraction and Identification buttons will appear as shown in Fig. 3.3.

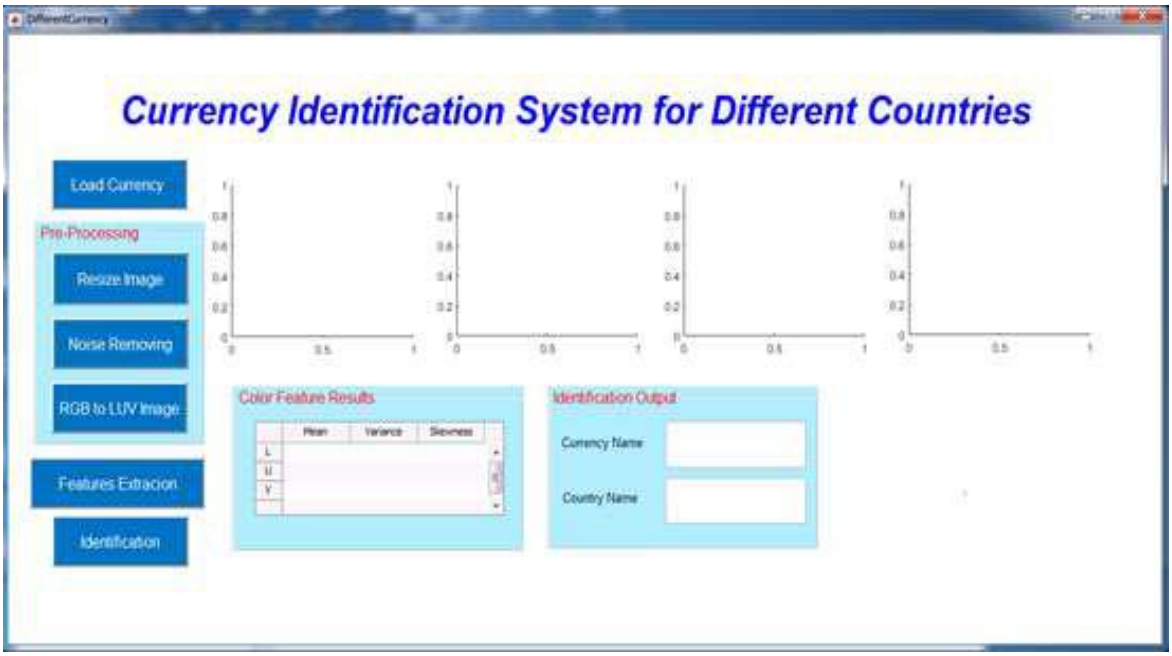


Figure3.3. Main Interface of Different Currency Recognition

Firstly, the input image is needed to load from the database by using 'Load Currency' button. After clicking the button, the open file dialog box will appear as shown in Fig. 3.4.

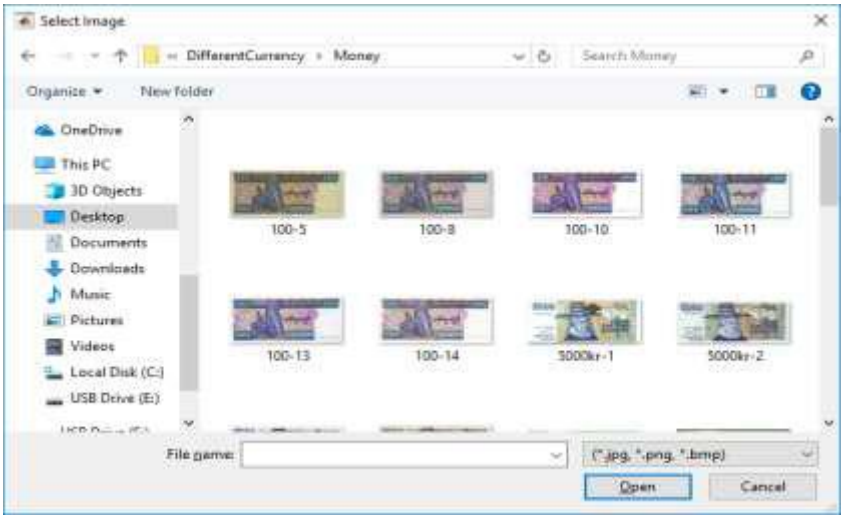


Figure3.4. Open File Dialog Box

Then, the user can select currency image from database. The selected banknote image will appear as shown in Fig. 3.5.

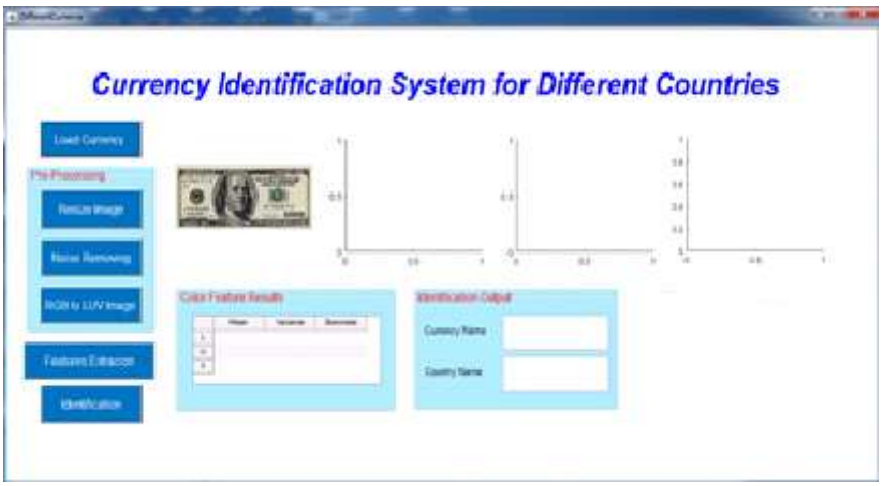


Figure3.5. Different Currency Recognition System with Load Image

After uploading the input image, there are two steps to perform for the selected image in preprocessing step including image resizing, noise removing and converting Luv image. The first process in preprocessing step and the result image is shown in Fig. 3.6.

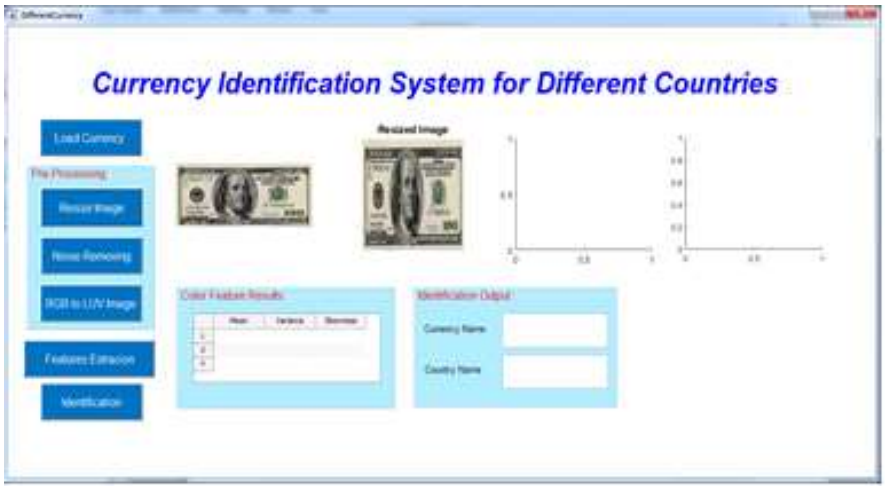


Figure3.6. Resizing Image of Currency

The second process of preprocessing step is noise removing by using median filter. If the user click ' Noise Removing' button, the result image will appear as shown in Fig. 3.7.

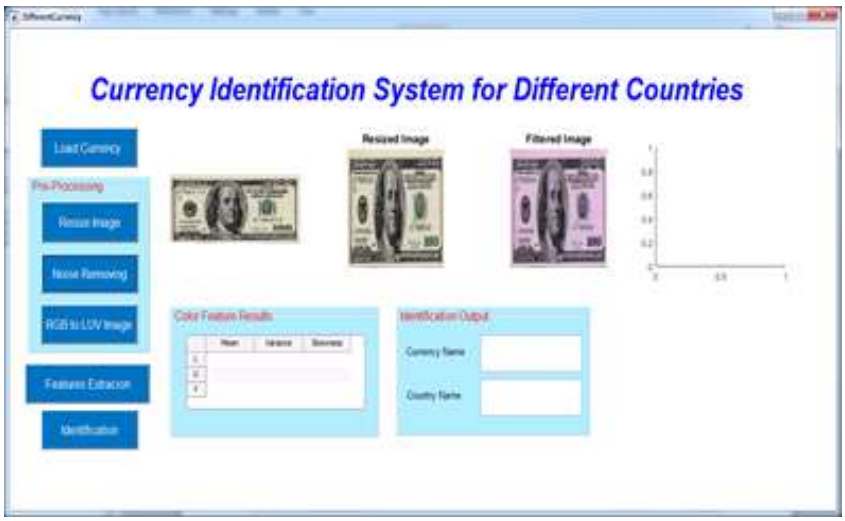


Figure3.7. Noise Removal using Median Filter

This system used Luv color space. By clicking the 'LUV Image' button, the image is transformed LUV image is shown in Fig. 3.8.

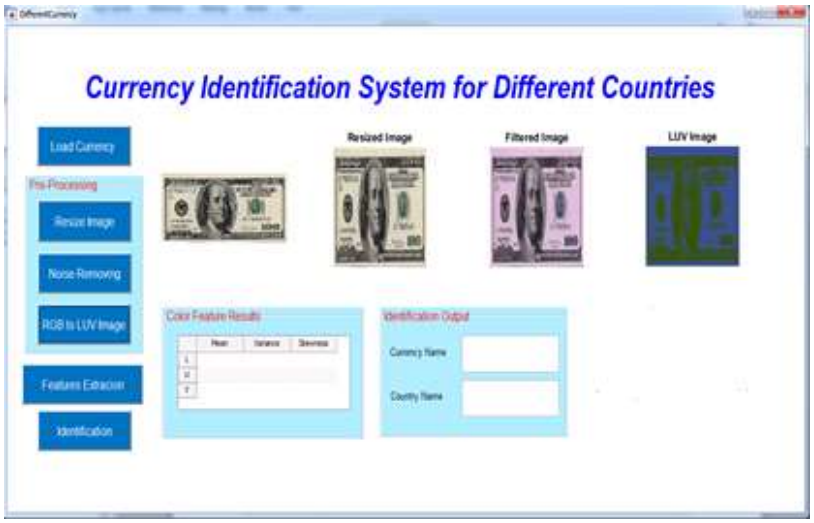


Figure3.8. Luv Image

By clicking the 'Feature Extraction' button, the feature such as mean, variance and skewness are extracted for each region Luv color space is shown in Fig. 3.9.

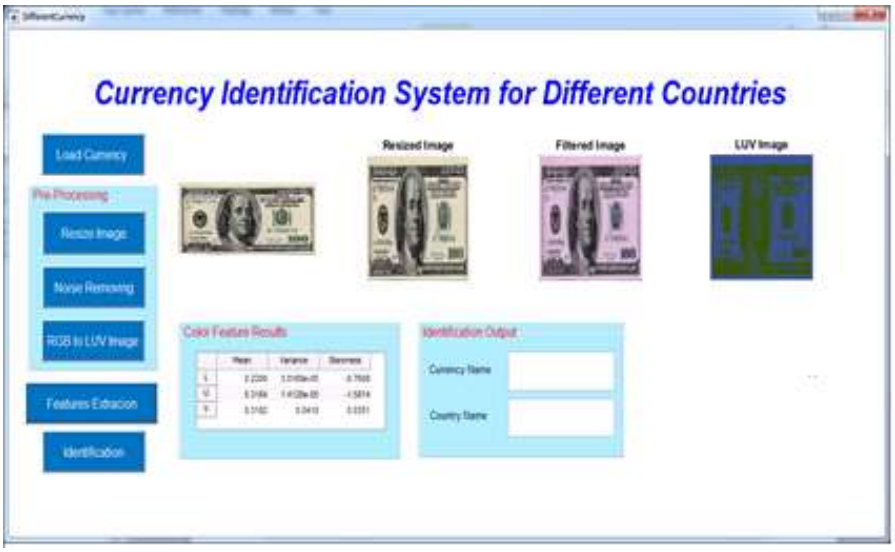


Figure3.9. Feature Extraction from Luv Color Space

The 'Identification' button is used to display currency name and country name. The final result of the system is shown in Fig. 3.10.

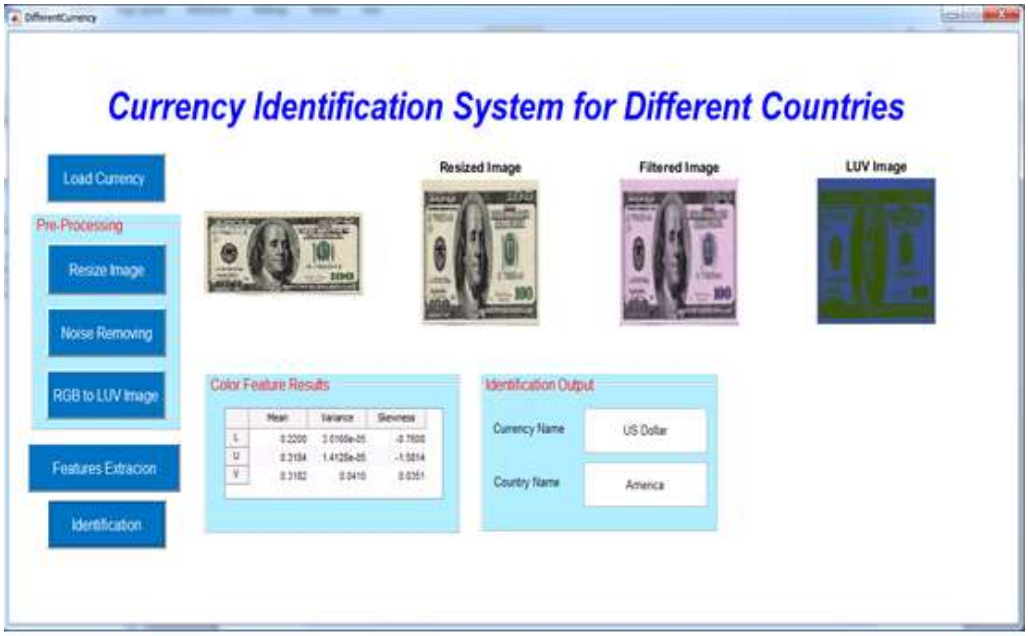


Figure3.10. Output Display of Currency Name and Country Name

4. DISCUSSION AND CONCLUSION

Nowadays, currency recognition systems are developing in many countries. This system is implemented for recognition of nine currencies for different countries. They are 100 kyat of Myanmar currency, 100 dollar of USD, 100 dollar of Australia, 2000 rupiah of Indo, 2000 rupee of India, 1000 won of Korea, 5000 krona of Danish, 50 pound of Egypt and 5000 krona of Iceland.

The image is acquired from the internet which is used as input image. The image is usually stored in jpg, bmp or png file format. Pre-processing consists of image resizing, removing noise and etc. The image is resized to standard size to all notes. Before extracting the color feature, noise removing must be located. Because most of currency are noisy and spots, so they are very old and dirty. The filtering can be done using various types of filters such as average filter, median filter or high pass filter. Out of these filters, the median filter is most commonly used to remove salt and pepper noise. Then, the image is transformed the Luv image.

After preprocessing the image, statistical features such as mean, variance and skew ness are extracted from Luv images. For each currency note, the extracted features are stored in a feature vector. The feature vectors of different currency notes can be used for classification, recognition and retrieval of currency notes. Currency Recognition system is to reduce the human effort and to avoid the purchase of expensive hardware. This system produces quite satisfactory results in terms of recognition and efficiency. The currency recognition system should be able to recognize the different currencies quickly and correctly. These systems use different color banknotes from nine countries because different color be proper to recognize banknotes basis Luv color space. And, use different amount to be evident.

4.1. Further Extensions

The system can recognize nine different kinds of banknote. It should be extended to be able to classify whether the banknote is real or fake. Although the system is implemented by using MATLAB programming language, it can be written with other programming language. Our future work includes recognizing also other types of currency, and getting same accuracy by using other classification methods.

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