INDIAN CURRENCY NOTE DETECTION

A MINIPROJECT REPORT

Submitted by

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in partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING IN

ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS ENGINEERING

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DATE:__/__/2022 **COURSE IN CHARGE**

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ABSTRACT

Indian is a developing country, Production and printing of Fake notes of Rs.100, 500 and 1000 are degrading economic growth of our country. From last few years due to technological advancement in color printing, duplicating, and scanning, counterfeiting problems are coming into picture. In this article, recognition of paper currency with the help of digital image processing techniques is described. Around eight characteristics of Indian paper currency is selected for counterfeit detection. The identification marks, optical variable link, see through register and currency color code decides the currency recognition. The security threads, water mark, Latent image and micro-lettering features are used for currency verification. The characteristics extraction is performed on the image of the currency and it is compared with the characteristics of the genuine currency. The currency will be verified by using image processing techniques. The approach consists of a number of components including image processing, edge detection, image segmentation and characteristic extraction and comparing images. The desired results shall verify with MATLAB software.

CHAPTER 1

INTRODUCTION

Fake currency detection is a serious issue worldwide, affecting the economy of almost every country including India. Currency duplication also known as counterfeit currency is a vulnerable threat on economy. It is now a common phenomenon due to advanced printing and scanning technology. The possible solutions are to use either chemical properties of the currency or to use its physical appearance. The approach presented in this
paper is based upon physical appearance of the Indian currency.Image processing algorithms have been adopted to extract the features such as security thread, intaglio printing (RBI logo) and identification mark, which have been adopted as security features of Indian currency.

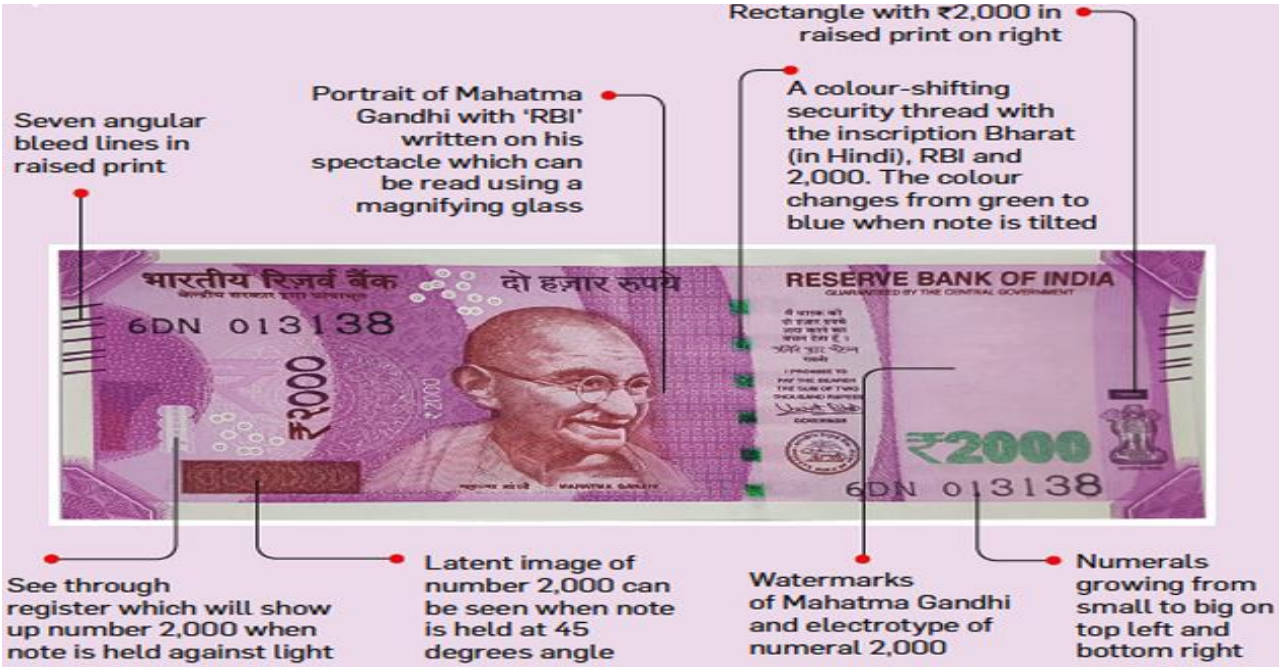

Fig 1.1

CHAPTER 2

OBJECTIVE AND MOTIVATION

2.1 OBJECTIVE

- To analyze the various security features of the currency note such as security thread, intaglio printing (RBI logo) and identification mark.
- To develp an automatic currency detection system with the real time currency detection algorithm and segmentation process.

2.2 MOTIVATION

In India Reserve Bank of India is only bank which has the full authority to issue bank notes. But some people are Counterfeiting currencies. The value of fake currency in circulation at any given time is Rs 400 crore, according to a study.Out Of the 90.26 billion Indian currency notes in circulation in 2015-16, no more than 0.63 million,That is seven in every million– were detected as fake, according to RBI data. The value of these fake notes in 2015-16 was Rs 29.64 crore of the Rs 16.41 lakh crore currency in circulation.Fake Indian Currency ofRs100, Rs500 andRs 2000 are injected into the system and there is no proper way to deal with them for a common Man. Common Man fall prey to this currencies. Manual testing of all notes are not efficient and it is difficult for anyone to identify the differences Fake Currency and Real Currency. Therefore Automatic methods for bank note recognition are required. Extracting sufficient monetary characteristics from the currency image is essential for accuracy and robustness of the automated system.

CHAPTER 3

FEATURES OF INDIAN CURRENCY

There are too many features present in Indian currencywhich is decided by Reserve Bank of India. Fig 3.1 gives the idea about currency features of 1000 Rs note.

3.1. SEE THROUGH REGISTER

The small floral design printed both on the front (hollow)and back (filled up) of the note in the middle of the verticalband next to the Watermark has an accurate back to back registration. The design will appear as floral design when seen against the light.

3.2. WATER MARKING

The Mahatma Gandhi Series of banknotes contain the Mahatma Gandhi watermark with a light and shade effect and multi-directional lines in the watermark.

FIG 3.1

3.3. OPTICALLY VARIABLE INK (OVL)

This is a new feature included in the Rs.1000 and Rs.500 notes with revised color scheme introduced in November 2000. The numeral 1000 and 500 on the obverse of Rs.1000 and Rs.500 notes respectively is printed in optically variable ink viz., a color-shifting ink.

3.4. FLUORESCENCE

Number panels of the notes are printed in fluorescent ink.The notes also have optical fibers. Both can be seen when the notes are exposed to ultra-violet lamp.

3.5. SECURITY THREAD

The Rs.500 and Rs.100 notes have a security thread with similar visible features and inscription ‘Bharat’ (in Hindi),and ‘RBI’. When held against the light, the security thread on Rs.1000, Rs.500 and Rs.100 can be seen as one continuous line.

3.6. INTAGLIO PRINTING

The portrait of Mahatma Gandhi, the Reserve Bank seal, guarantee and promise clause, Ashoka Pillar Emblem on the left, RBI Governor's signature are printed in intaglio i.e. in raised prints, which can be felt by touch.

3.7. LATENT IMAGE

On the obverse side of Rs.1000, Rs.500, Rs.100, Rs.50 and Rs.20 notes, a vertical band on the right side of the Mahatma Gandhi's portrait contains a latent image showing the respective denominational value in numeral

3.8. MICRO LETTERING

This feature appears between the vertical band and Mahatma Gandhi portrait. It always contains the word 'RBI' in Rs.5 and Rs.10. The notes of Rs.20 and above also contain the denominational value of the notes in micro letters. This feature can be seen well under a magnifying glass.

3.9. IDENTIFICATION MARK

Each note has a unique mark of it. A special feature in intaglio has been introduced on the left of the watermark window on all notes except Rs.10/- note. This feature is in different shapes for various denominations (Rs. 20-Vertical Rectangle, Rs.50- Square, Rs.100-Triangle, Rs.500-Circle and Rs.1000-Diamond).

CHAPTER 4

PROPOSED WORK

The system will work on two images, one is original image of the paper currency and other is the test image on which verification is to be performed.The proposed algorithm for the discussed paper currency verification system is presented as follows

- Image of paper currency will be acquired by simple scanner in .jpg extension.
- The image processing will be implemented on this image.
- The various characteristics of the paper currency will be cropped and segmented.
- After segmentation, the characteristics of the paper currency will be extracted.
- The extracted characteristic of test image then undergoes classification.
- On the basis of classification the result is generated .In the proposed method characteristics of paper currencies are employed that are used by people for Differentiating different banknote denominations. 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 background color (the basic color), and texture present on the banknotes. So we are implementing some different way or typical features of currency detection.

CHAPTER 5

BLOCK DIAGRAM

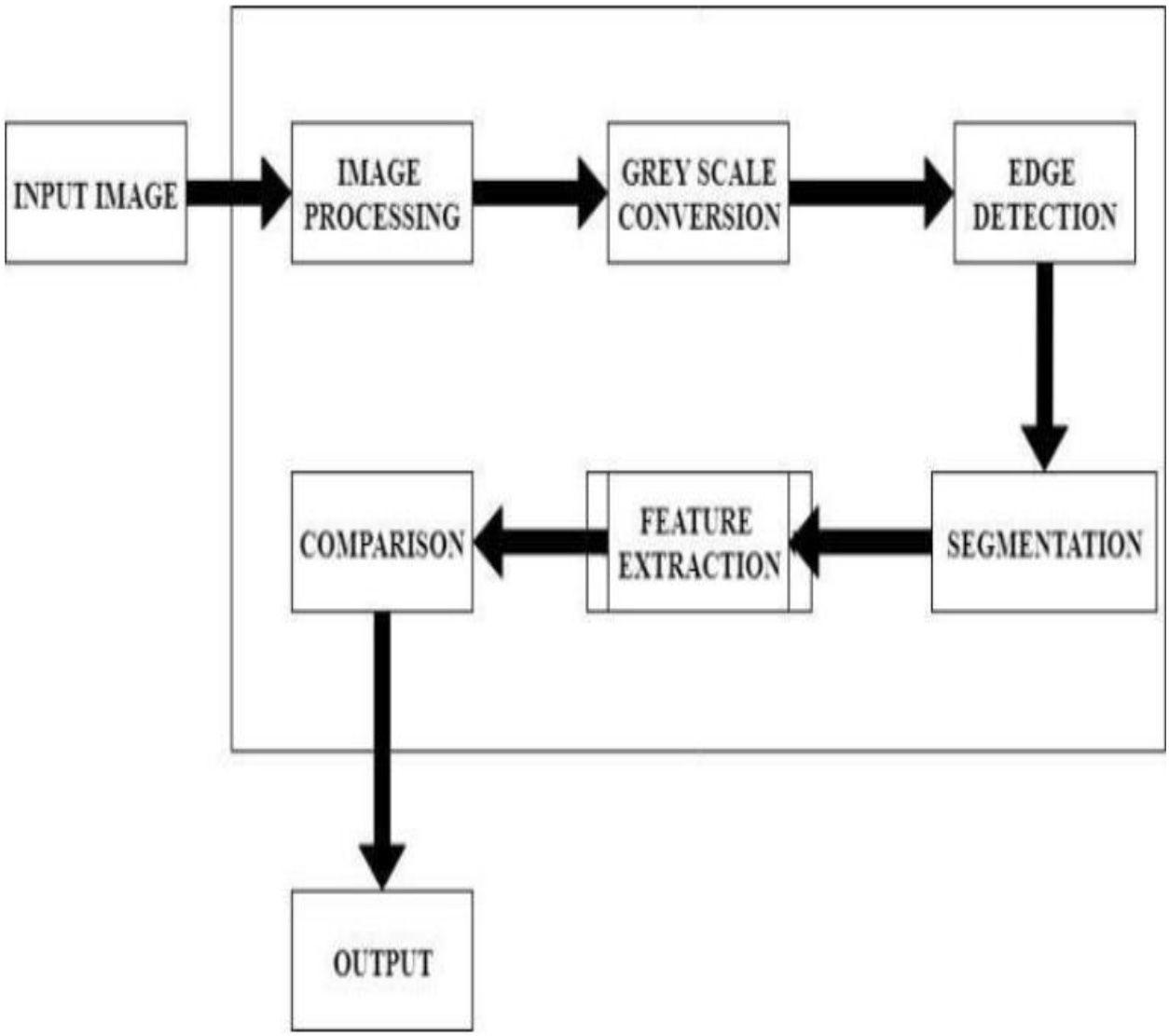

FIG 5.1

CHAPTER 6

SOFTWARE DESCRIPTION

MATLAB is a programming language developed by MathWorks. It started out as a matrix programming language where linear algebra programming was simple. It can be run both under interactive sessions and as a batch job. This tutorial gives you aggressively a gentle introduction of MATLAB programming language. It is designedto give students fluency in MATLAB programming language. Problem-based MATLAB examples have been given in simple and easy way to make your learning fast and effective.

Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building

FIG 6.1

CHAPTER 7

7.1 FLOWCHART

Image processing based currency recognition technique consists of few basic steps like image acquisition,its pre - processing and finally recognition of the currency.Image processing generally involves three steps:

1. Import an image with an optical scanner or directly through digital photography.
2. Manipulate or analyze the image in some way.
3. Output the result. The result might be the image altered in some way or it might be a report based on analysis ofthe image.

The Flowchart of the steps involved in methodology is as follows:

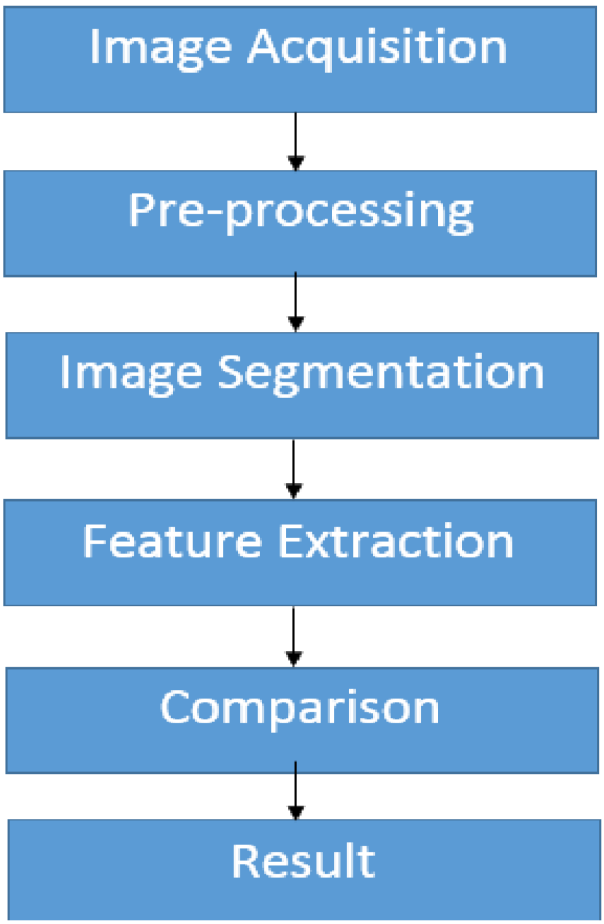

Fig 2. Design flow of fake currency detection

7.2 METHODOLOGY

7.2.1 IMAGE ACQUISITION (INPUT IMAGE)

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually it is a hardware-based source, so it can be passed through whatever processes need to occur afterward. Performing image acquisition in the process of image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is completely Unprocessed and is the result of scanner which was used to generate it, which can be very important in some fields to have a consistent baseline from which to work. One of the ultimate goals of this process is to have a source of input that operates within such controlled and measured guidelines that the same image can, if necessary, be nearly perfectly reproduced under the same conditions so anomalous factors are easier to locate and eliminate.

7.2.2 PRE-PROCESSING:

The main goal of the pre-processing to enhance the visual appearance of images and improve the manipulation of data sets. Image preprocessing, also called image restoration, involves the correction of distortion, degradation, and noise introduced during the imaging process. Interpolation is the technique mostly used for tasks such as zooming, rotating, shrinking, and for geometric corrections. Removing the noise is an important step when processing is being performed. However noise affects segmentation and pattern matching.

7.2.3 BINARIZATION:

The image acquired is in RGB color. It is converted into gray scale because it carries only the intensity information which is easy to process instead of processing three components R (Red), G (Green), B (Blue). To take theVRGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel: (R+B+C)/3. However, since the perceived brightness is often dominated by the green component, a different, more “human oriented”, method is to take a weighted average, e.g.:0.3R + 0.59G + 0.11B.

7.2.4 IMAGE SEGMENTATION

It determines region boundaries in an image. It can explore many different approaches to an image Segmentation& thresholding. Optimal Global Thresholding:

1.A threshold is said to be globally optimal if the number of misclassified pixels is minimum.

2.Histogram is bimodal (object and background).

3.Ground truth is known OR the histograms of the object and the background are known.

7.2.5 FEATURE EXTRACTION

Feature extraction a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. This approach is useful when image sizes are large and a reduced feature representation is required to quickly complete tasks such as image matching and retrieval. Some features of an image are: Size or Area. Every denomination differs from each other in the size parameter. Therefore size can be used as a feature for currency recognition. But the major limitation of this feature is that the size of the image varies depending on the distance from which photo of the image has been taken. To overcome this problem a new parameter named aspect ratio was used to classify the denominations.

7.2.6 COMPARISON

In our comparison the features extracted from the images of the currency notes plays a very crucial role. In facts, it is the comparison of the features that enables us to differentiate fake notes from the real ones. To compare the performance, we have segmented the image and then we remove from a binary image all connected components (objects) that have fewer than P pixels, producing another binary image. The above step is repeated three times to get the binary image which can be compared. Then we compare the two images and store the difference.

7.2.7 RESULT

The experiments were performed to identify the fake currency note of Rs 2000. The images were acquired using the camera and then features were extracted from the acquired images using the technique proposed in section IV. The identification between real and fake currency was done on the basis of dissimilarity and discontinuity between them.The extracted features were used for fake currency detection.The decision weather a note is fake or real was made by comparing
the values of the two notes.

CHAPTER 8

MATLAB PROGRAM

```
clc;
close all;
clear all;
A=imread('C:\Users\Hai\Desktop\Real.jpg');
P=imread('C:\Users\Hai\Desktop\duplicate.jpg');

a = rgb2gray(A);
p = rgb2gray(P);


%[I2, rect] = imcrop(a);
a2_tr = imcrop(a,[2218.5 204.5 535 521]);  %transparent
gandhi 1
b2_tr = imcrop(p,[2218.5 204.5 535 521]);  %transparent
gandhi 2


a2_str = imcrop(a,[1766.5 4.5 63 1096]);   %thin strip
1
p2_str = imcrop(p,[1666.5 4.5 63 1096]);   %thin strip
2



%decompose into hsv

hsvImageReal = rgb2hsv(A);
hsvImageFake = rgb2hsv(P);


figure('Name','real image hsv');
imshow([hsvImageReal(:,:,1) hsvImageReal(:,:,2)
hsvImageReal(:,:,3)]);
title('Real');
figure('Name','fake image hsv');
```

```
imshow([hsvImageFake(:,:,1) hsvImageFake(:,:,2)
hsvImageFake(:,:,3)]);
title('Fake');

%create black and white image

%croppedImageReal = imcrop(hsvImageReal,[1766.5 4.5 63
1096]);
croppedImageReal = imcrop(hsvImageReal,[1778.5 13.5 57
963]);
%croppedImageFake = imcrop(hsvImageFake,[1666.5 4.5 63
1096]);
croppedImageFake = imcrop(hsvImageFake,[1673.5 4.5 96
1096]);

satThresh = 0.3;
valThresh = 0.9;
BWImageReal = (croppedImageReal(:,:,2) > satThresh &
croppedImageReal(:,:,3) < valThresh);
figure('Name',' strips');
subplot(1,2,1);
imshow(BWImageReal);
title('Real');
BWImageFake = (croppedImageFake(:,:,2) > satThresh &
croppedImageFake(:,:,3) < valThresh);
subplot(1,2,2);
imshow(BWImageFake);
title('Fake');

%closing

se = strel('line', 200, 90);
BWImageCloseReal = imclose(BWImageReal, se);
BWImageCloseFake = imclose(BWImageFake, se);
figure('Name','closed  strips');
subplot(1,2,1);
imshow(BWImageCloseReal);
title('cReal');
subplot(1,2,2);
imshow(BWImageCloseFake);
```

```
title('cFake');

%cleanup

figure('Name','cleaned green strips');
areaopenReal = bwareaopen(BWImageCloseReal, 15);
subplot(1,2,1);
imshow(areaopenReal);
title('clReal');
areaopenFake = bwareaopen(BWImageCloseFake, 15);
subplot(1,2,2);
imshow(areaopenFake);
title('clFake');

%count black lines

[~,countReal] = bwlabel(areaopenReal);
[~,countFake] = bwlabel(areaopenFake);
%disp(['The total number of black lines for the real
note is: ' num2str(countReal)]);
%disp(['The total number of black lines for the fake
note is: ' num2str(countFake)]);

co=corr2 (a2_str, p2_str);

%display of conclusion

if (co>=0.5 && countReal == 1 && countFake ~= 1 )
    disp ('correlevance of transparent gandhi > 0.5');
    if (countReal == 1 && countFake ~= 1 )
        disp ('currency is legitimate');
    else
        disp ('green strip is fake');
    end;
else
    disp ('correlevance of transparent gandhi < 0.5');
    disp ('currency is fake');

end;
```

CHAPTER 9

EXPERIMENTAL RESULTS

FIG 9.1 REAL IMAGE

FIG.9.2DUPLICATE IMAGE

FIG.9.3.REAL IMAGE HSV

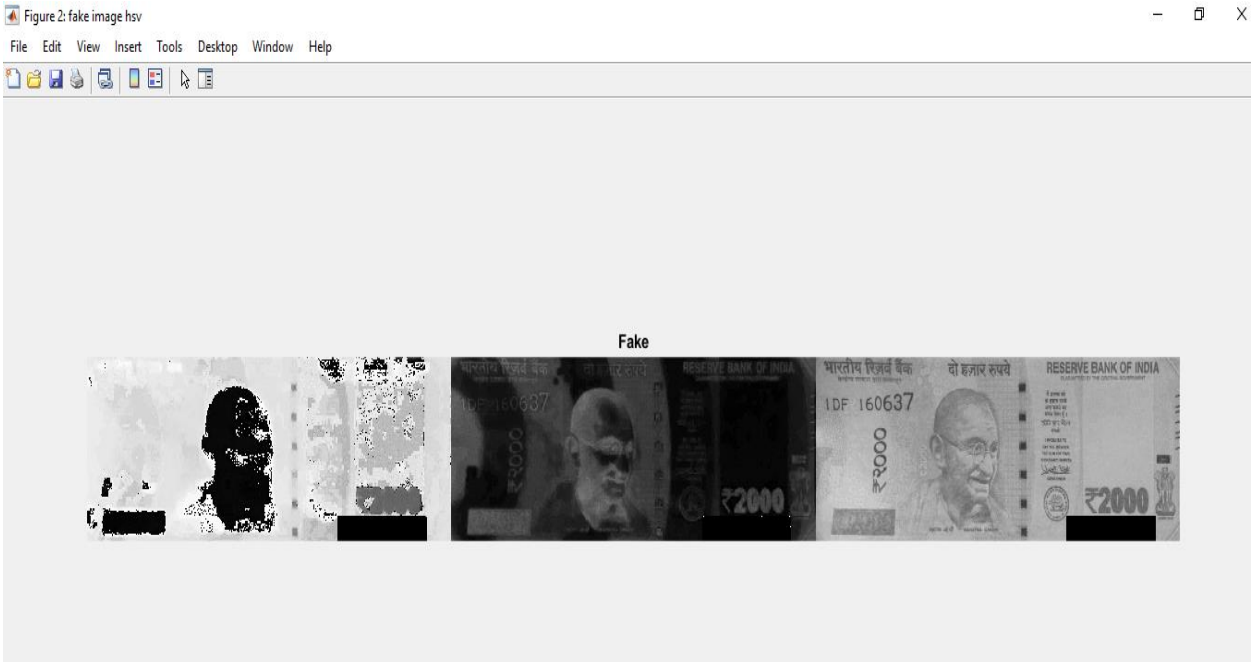

FIG.9.4. FAKE IMAGE HSV

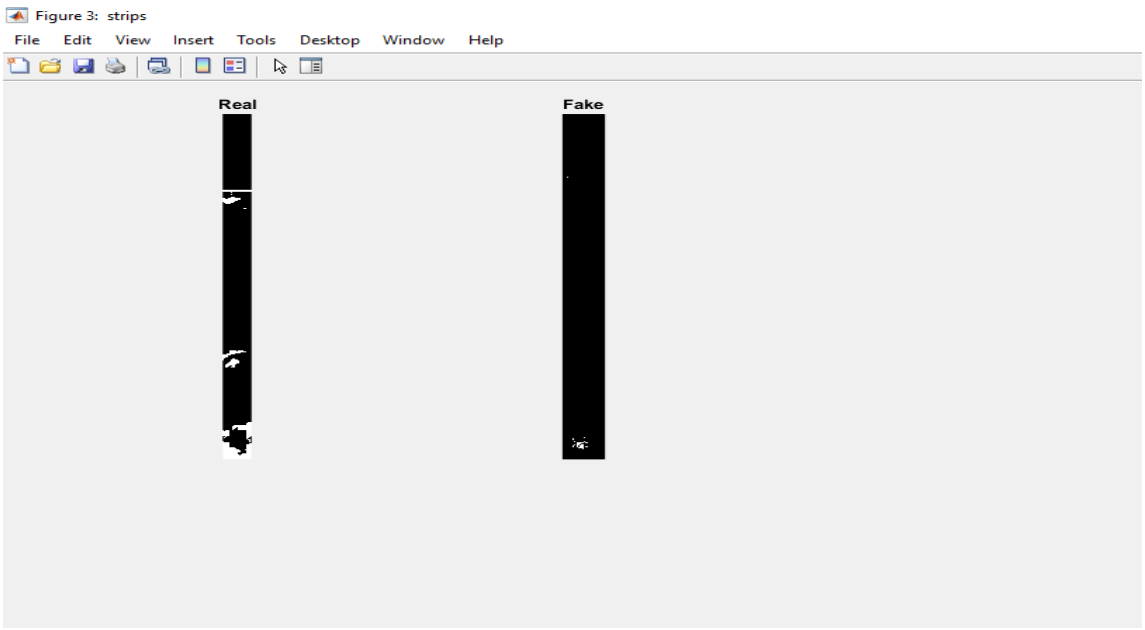

FIG.9.5. STRIPS

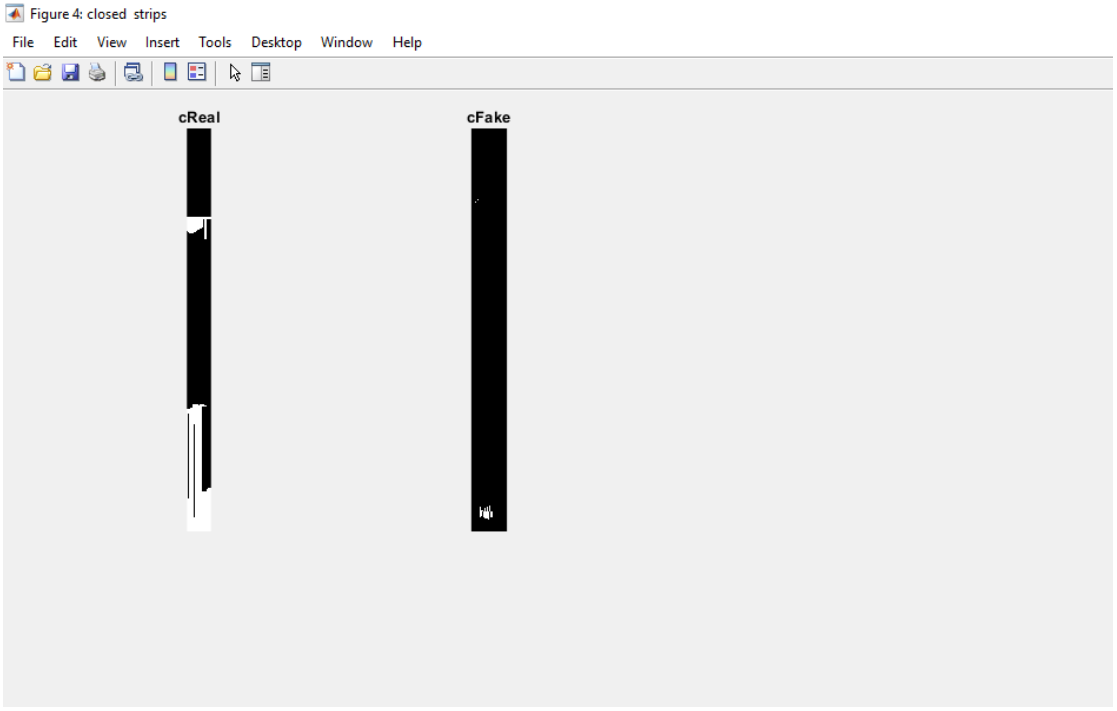

FIG.9.6. CLOSED STRIPS

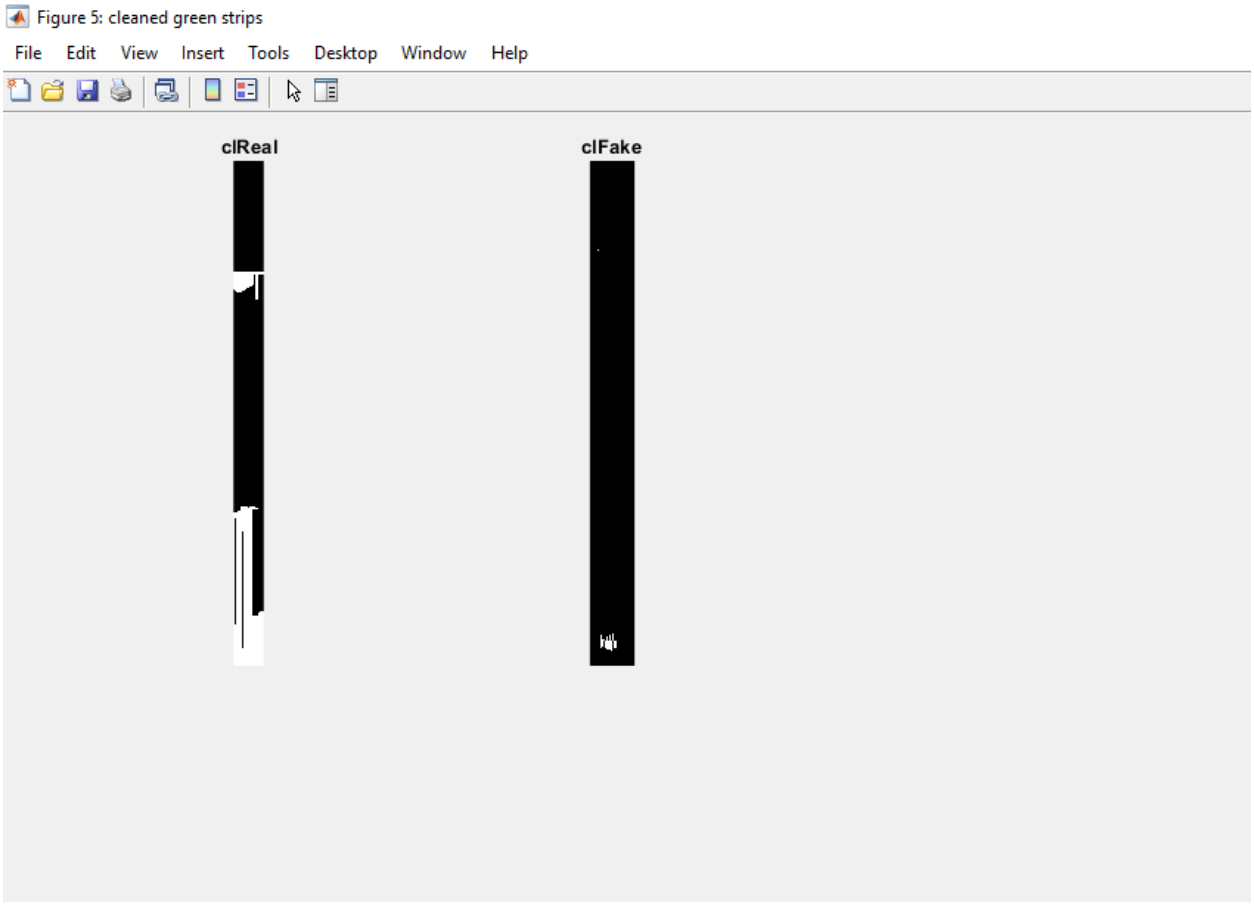

FIG.9.7. CLEANED GREEN STRIPS

CHAPTER 10

CONCLUSION AND FUTURE WORKS

By using digital image processing, analysis of Currency image is more accurate as well as this method is efficient in terms of cost and time consuming compared to existing techniques. MATLAB Software use for this analysis. Day by day research work is increasing in this field and various image processing techniques are implemented in order to get more accurate result. The proposed system is worked effectively for extracting feature of Indian currency images. Extracted features of currency image will be using for currency value recognition as well as for its verification. Application based system shall be designed to get proper result whether currency image is fake or its genuine.

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