Fake Currency Detection Using Image Processing

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I. INTRODUCTION

Different countries around the world use different types of currencies for the monetary exchange of some kinds of goods. One common problem faced by many countries related to currency is the inclusion of fake currency in the system[1]. Bangladesh is one of the countries that face a lot of problems and huge losses due to the fake currencies. Due to this there are losses in the overall economy of the country‘s currency value. Technological advancements have made a pathway for currencies to be duplicated such that they cannot be normally recognized [2]. Advanced printers and new editing computer softwares are used to create counterfeit currencies. Fake currencies can just be slipped into bundles of genuine currency which is how they are usually circulated in the market. Commercial areas like banks, malls, jewelry stores, etc have huge amount of transactions on a daily basis. Such places may be able to afford and find it feasible to buy machines that use UV light and other techniques to detect the authenticity of the

currency. But for common people it is very difficult to just detect whether the currency is fake or genuine and they may face losses especially during bank deposits or transactions. This system is designed such that any person can use it easily and detect the authenticity of the currency he has by using the visual features of the currency [3]. This system can further be converted into an app so that it is accessible to all the people. Furthermore, this system can be designed to detect currencies of other countries as well.

The system is based on Image processing where a number of steps are used to process the image of a currency and give the result to the user whether the currency is genuine or not.
The remainder of the paper mentions the following details. In section II, there is brief information on some related papers that are used for reviewing. In section III, the methodology is mentioned which specifies the different steps used in the entire process of currency detection. In section IV, the details of the proposed system are mentioned. Section V shows the result and conclusions. Section VI mentions the referred papers and links.

II. LITERATURE REVIEW

Various papers are available that contain information on Fake currency detection. Some referred papers are mentioned here. In [4], as mentioned, no one can be 100 percent sure of the manual recognition and so the system was proposed to compare images of currency with the stored data and detect whether the currency is fake or genuine. This system used MATLAB to run and perform the operations of the system. The feature extraction process mostly focuses on HSV values of the currency where the image is divided into blocks and the operations are performed on the ROI. In [5], the survey paper proposes a system to improve the currency detection system especially in commercial areas like banks, shopping malls, etc. Here some different pre-processing techniques were mentioned such as Radiometric corrections and Geometric corrections for correcting spectral errors or distortions due to sensor- Earth geometric variations etc. Different papers were compared and results were provided based on the accuracy rate obtained by using different methods. In [6], a system is proposed to detect fake currency based on different features that can be extracted for comparison. Various methods are used at different stages of histogram equalization, using feature vectors to store extracted features, etc. The features that were used for currency detection were security thread, RBI micro-print and serial number detection.

III. METHODOLOGY

The current systems that are present are only machine based i.e. it is only for commercial use. The systems that use image processing are performed on MATLAB [4], [7]. These machines are based on optical sensing or proximity detection. In optical detection , the currency is kept under the machine and the UV light is scanned over the currency and if the currency shines due to fluorescence then it is a genuine currency. In proxy detection the ink used to make the currency contains ferromagnetic properties, so when the currency is passed through a magnetic belt and if it shows some movement then it is concluded that it is a genuine currency [8].

Figure 1 is the flowchart that shows the general methods used to detect fake currency using image processing

A. Image Acquisition

The image of the currency that has to be checked or verified as a genuine currency is taken as an input for the system. The input image can be acquired using techniques like scanning the image or clicking a picture with the phone and then uploading it to the system.

B. Gray Scale Conversion

Conversion of a color image to a grayscale image requires more knowledge about the color image. A pixel color in an image is a combination of three colors Red, Green, and Blue (RGB).Similarly, A Grayscale image can be viewed as a single layered image. Different techniques can be used to convert a coloured image to grayscale image. [9]

C. Edge Detection

Edge detection is an image processing technique for finding the boundaries of objects within images [12]. It works by detecting discontinuities in brightness. Edge detection is used for image segmentation and data extraction in areas such as image processing, computer vision, and machine vision. The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. Edge detection helps to detect all the edges of the necessary ROI to perform various operations in the latter stages.

D. Segmentation

Image segmentation is the process of dividing an image into multiple parts. This is typically used to identify objects or other relevant information in digital images. [10] shows a few examples of the techniques that can be used to perform segmentation.

E. Feature Extraction

Feature extraction is 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. The features are extracted and then used for comparison in the further step.

F. Comparison

The features that are extracted from the previous step are used for comparison with the stored features and then the results are displayed as to the currency being genuine or fake.

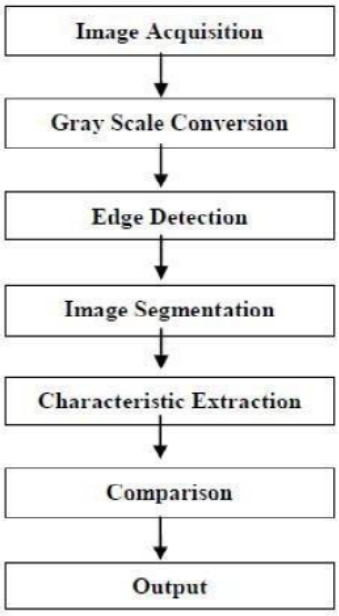


Fig. 1 Flowchart to Detect Fake Currency using Image Processing

The proposed system is using image processing to detect the currency. The input is a photographed or scanned image that is given to the system which can be of .png and the output tells whether the currency is genuine or not. The process contains techniques such as image pre-processing, gray scale conversion, edge detection, segmentation, feature extraction and comparison of features.

Figure 2 shows the architecture diagram for the proposed system.

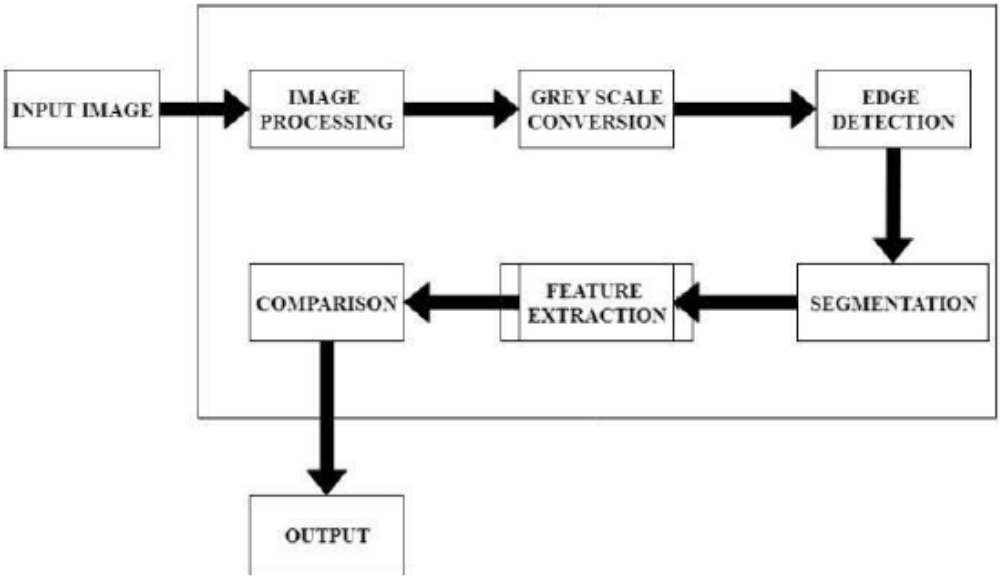


Fig. 2 Architecture diagram of proposed System

Step 1: Image Pre-processing
Pre-processing is a common name for operations with images at the lowest level of abstraction — both input and output are intensity images. The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing. In this system, noise filtration is done in image pre-processing [11]. Here, the salt and pepper type of noise is removed.

Step 2: Grey scale conversion
The image is converted to a grayscale image as it reduces the complexity of code. There are many methods that can be used to convert an RGB image to a grayscale image such as the averaging method, luminance method, desaturation method,etc. [15]. The system uses the luminance method to perform grayscale conversion.

Step 3: Edge Detection
The grayscale image is the input to this step. The system uses Canny Edge detection as it gives best results compared to the other techniques [13]. Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed.

Step 4: Segmentation
There are various methods like thresholding, clustering methods, region based segmentation, etc. to perform segmentation in image processing. Here the thresholding method is used to perform segmentation where threshold values which are obtained from the histogram of the edges of the original image are used. [14]

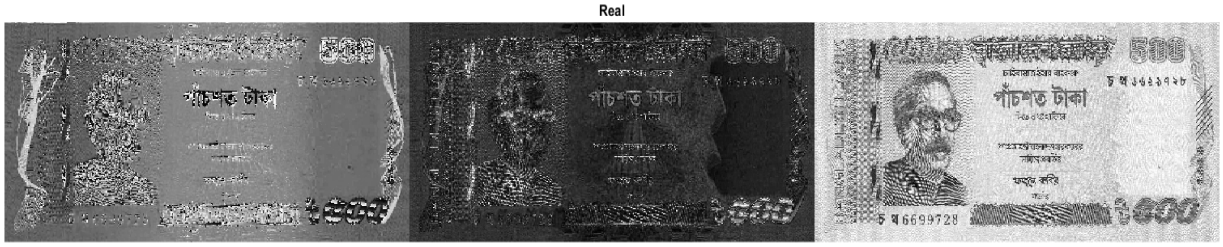
Step 5: Feature Extraction and Comparison
If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data. The system uses the SSIM (Structure Similarity Index Method) method for feature comparison.

Step 6: Output
The output shows the different features marked that are used for feature extraction and comparison. In the output, the system first asks the user to upload an image of the currency. The output shows four different types of images. The first image is that of the original image with which the uploaded currency is compared. Next the image is of the currency that is uploaded by the user. The third image is the overlapped images of the features in grayscale. This result

output helps to see the difference between the two images i.e. the original image and the uploaded image. The overlapping of these two images shows where exactly the changes are in the uploaded image if it is fake. The next image is of segmentation of the overlapped image. The overlapped image of the features is performed by thresholding on and is shown as a result to detect the difference in the images more clearly, if any. The system finally displays if the image is fake or genuine.

V. CONCLUSION

Currency use is a necessity for survival and hence it is always necessary to keep in track of its originality. Paper currencies are used much more in Bangladesh and hence a system to detect the fake currency is needed. As the new currencies are used in the market, the proposed system seems to be useful to detect whether the currency is genuine or not. This system compares more features for feature extraction than other proposed systems. It also shows where the differences are in the currencies instead of simply displaying the result. This system can be further implemented for foreign currencies like Dollars, Euros, Rupee, etc. as a future Scope.



Output from the system showing the comparison of features

```
correlevance of  mujib < 0.5
currency is fake
fx >>
```

Output showing the result if the currency is fake or genuine

Appendix:

```
A=imread('real.jpg');
P=imread('fake.png');

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



a2_tr = imcrop(a,[2218.5 204.5 535 521]);
b2_tr = imcrop(p,[2218.5 204.5 535 521]);


a2_str = imcrop(a,[1766.5 4.5 63 1096]);
p2_str = imcrop(p,[1666.5 4.5 63 1096]);




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');



croppedImageReal = imcrop(hsvImageReal,[1778.5 13.5 57 963]);
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');



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');



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');



[~,countReal] = bwlabel(areaopenReal);
[~,countFake] = bwlabel(areaopenFake);


co=corr2 (a2_str, p2_str);


if (co>=0.5 && countReal == 1 && countFake ~= 1 )
   disp ('correlevance of mujib > 0.5');
   if (countReal == 1 && countFake ~= 1 )
```

```
        disp ('currency is legitimate');
    else
        disp ('green strip is fake');
    end;
else
    disp ('correlevance of mujib < 0.5');
    disp ('currency is fake');

end;
```

Citations

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