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Fake Currency Identification by Android Mobile Phone Using Digital Image Processing

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Abstract – This paper is based on Fake Currency Identification By Android Mobile Phone Using Digital Image Processing This is handy application of Hand Written Character Feature Extraction, the mobile phone device is used to capture image, it is available everywhere The image captured by android mobile phone live in form of video and it is saved there, again it is converted in gray scale format, binariesed image and some morphological operation performed on it, at last we found block of each character from complete images.

I. INTRODUCTION

The development of modern banking services, automatic methods for paper currency recognition become important in many applications such as in automated teller machines and automatic goods seller machines. The needs for automatic banknote recognition systems encouraged many researchers to develop corresponding robust and reliable techniques. Processing speed and recognition accuracy are generally two important targets in such systems. Modernization of the financial system is a milestone in protecting the economic prosperity, and maintaining social harmony. Automatic machines capable of recognizing banknotes are massively used in automatic dispensers of a number of different products, ranging from cigarettes to bus tickets, as well as in many automatic banking operations. The needs for automatic banknote recognition systems encouraged many researchers to develop corresponding robust and reliable techniques [1-5]. Processing speed and recognition accuracy are generally two important targets in such systems. The technology of currency recognition aims to search and extract the visible and hidden marks on paper currency for efficient classification. The method we present here is simple, less complex and efficient and can meet the high speed requirements in practical applications. Digital image processing is an area characterized by the need for extensive experimental work to establish the validity of proposed solutions to the given problem. It has become economical in many fields of research and in industrial and military applications. Digital image processing encompasses processes whose inputs and outputs are images and encompasses processes that extract attributes from images up to and including the recognition of individual objects. How to extract the hidden attributes of paper currency is a challenging task in image processing.

II. SYSTEM OVERVIEW

There are so many features in Indian currency can be seen easily. Some of features are show in figure below.



Fig 1 Features of Indian Currency

There are too many features present in Indian currency which is decided by Reserve Bank of India.

A. 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 vertical band next to the Watermark has an accurate back to back registration.

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B. 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.

C. Optically Variable Ink (OVL)

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.

D. 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.

E. 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.

F. 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

G. 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.

H. 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.

I. 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)

III. METHODOLOGY

The algorithm we apply here is very simple and works properly. The image of the paper currency is acquired through Android Mobile Phone . Such live image acquired by phone and phone connected to system in Matlab. The approach consists of a number of steps including image acquisition, gray scale conversion, edge detection, feature extraction, image segmentation and comparison of images. Image acquisition is the creation of digital images, typically from a physical scene.

The proposed system of this article is divided into two parts such as:

Currency Recognition

Currency Verification

In Currency Recognition, Feature such as Identity Mark And optical variable link are used. Pixel value for each feature is calculated. Based on that pixel value histogram is plotted. Currency feature such as Id mark and Optical variable link will be using for recognition. Currency features such as watermark, security thread, Fluorescence and latent image will be using for currency verification. In Currency Verification, Character from each segmented part is extracted. Pixel value for that extracted part can be calculated.

A. Image Acquisition

Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. After the image has been obtained, various methods of processing can be applied to the image to perform the

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many different vision tasks. There are various ways to acquire image such as with the help of camera or scanner. Here we are using Android Mobile Phone to acquire image. Android Phone connected with system and Matlab .



Fig.2: Acquiring image by Android Mobile Phone.



Fig.3.Original Indian 500 denomination

B. 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. Removing the noise is an important step when processing is being performed. However, noise affects segmentation and pattern matching.

The size of the image is reduced by using MATLAB function 'imresize'. • Removing noise: When image is captured there are chances that image get blurred and noise may be added to the image and it's necessary that this should be removed and image should be smoothened.



Fig.4 Indian 500 denomination after resizing the original image

C. 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).

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Fig.5 Gray Scale Image

D. Edge Detection

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has these continuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. Edge detection is an image processing technique for finding the boundaries of objects within images. 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. This can be achieved by using edge detection and scan line algorithms in MATLAB.



Fig.6. Edge Detection (Gradient magnitude of the image)

E. Image Segmentation

Image segmentation is the process of partitioning a digital image into multiple Segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.

Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images [15]. Segmentation algorithm for images generally are based on one of the two basic properties of image intensity values

1) Discontinuity: Based on abrupt changes in intensity such as edges in an image.

2) Similarity: Based on partitioning an image into regions that are similar according to a set of predefined criteria [16].

F. Feature Extraction

Feature extraction is a special form of dimensional reduction. When the input data to an algorithm is too large to be processed and it is suspected to be very redundant then the input data will be transformed into a reduced representation set of features. Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input



Fig.7: Edge based segmentation of Identification mark of 500 denomination

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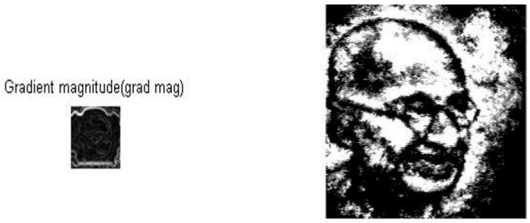


Fig.8: Edge based segmentation of Watermark of 500 denomination.

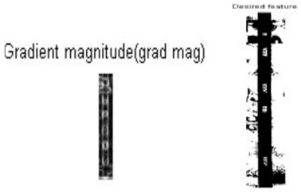


Fig.9. Edge based segmentation of Security Thread of 500 denomination.

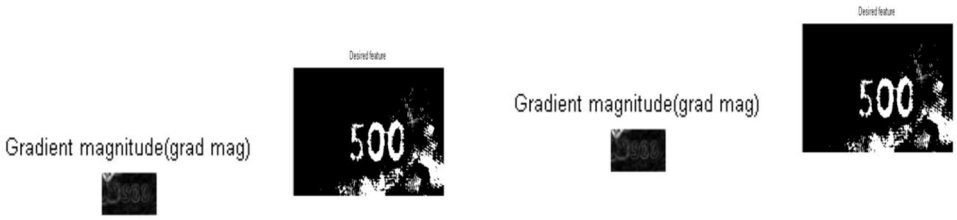


Fig.10. Edge based segmentation of Numeral watermark of 500 denomination.

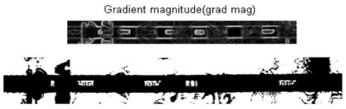


Fig.11: Edge based segmentation of micro lettering of 500 denomination

IV. MATLAB CODE

A. Capturing Image in Matlab by using Mobile Phone live

```
url = 'http://192.168.1.106:8080/shot.jpg';

ss  = imread(url);

fh = image(ss);

 while(1)
    ss  = imread(url);
    set(fh,'CData',ss);
    drawnow;
 end
```

B. Now Image is saved in Matlab

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C. Reading Images

```
[imname,impath]=uigetfile({'*.jpg;*.png'});
im=imread([impath,'/',imname]);
```

D. Preprocessing and Resizing Image

```
im=imresize(im,[128 128]);
```

E. Removing Noise and Separate Channels

```
r_channel=im(:,:,1);
b_channel=im(:,:,2);
g_channel=im(:,:,3);
```

F. Denoise Each Channel

```
r_channel=medfilt2(r_channel);
g_channel=medfilt2(g_channel);
b_channel=medfilt2(b_channel);
```

G. Restore Channels

```
rgbim(:,:,1)=r_channel;
rgbim(:,:,2)=g_channel;
rgbim(:,:,3)=b_channel;
```

H. Feature Extraction of an Image

```
fet=totalfeature(rgbim);
load db;
k=length(currency);
for j=1:k
D(j)=dist(fet',currency(j).feature);
end
[value,index]=min(D)
if value
currency_name=currency(index).name;
fprintf('recognized currency is : ');
disp(currency_name)
else
disp('no matches found');
end
```

V. CONCLUSION

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

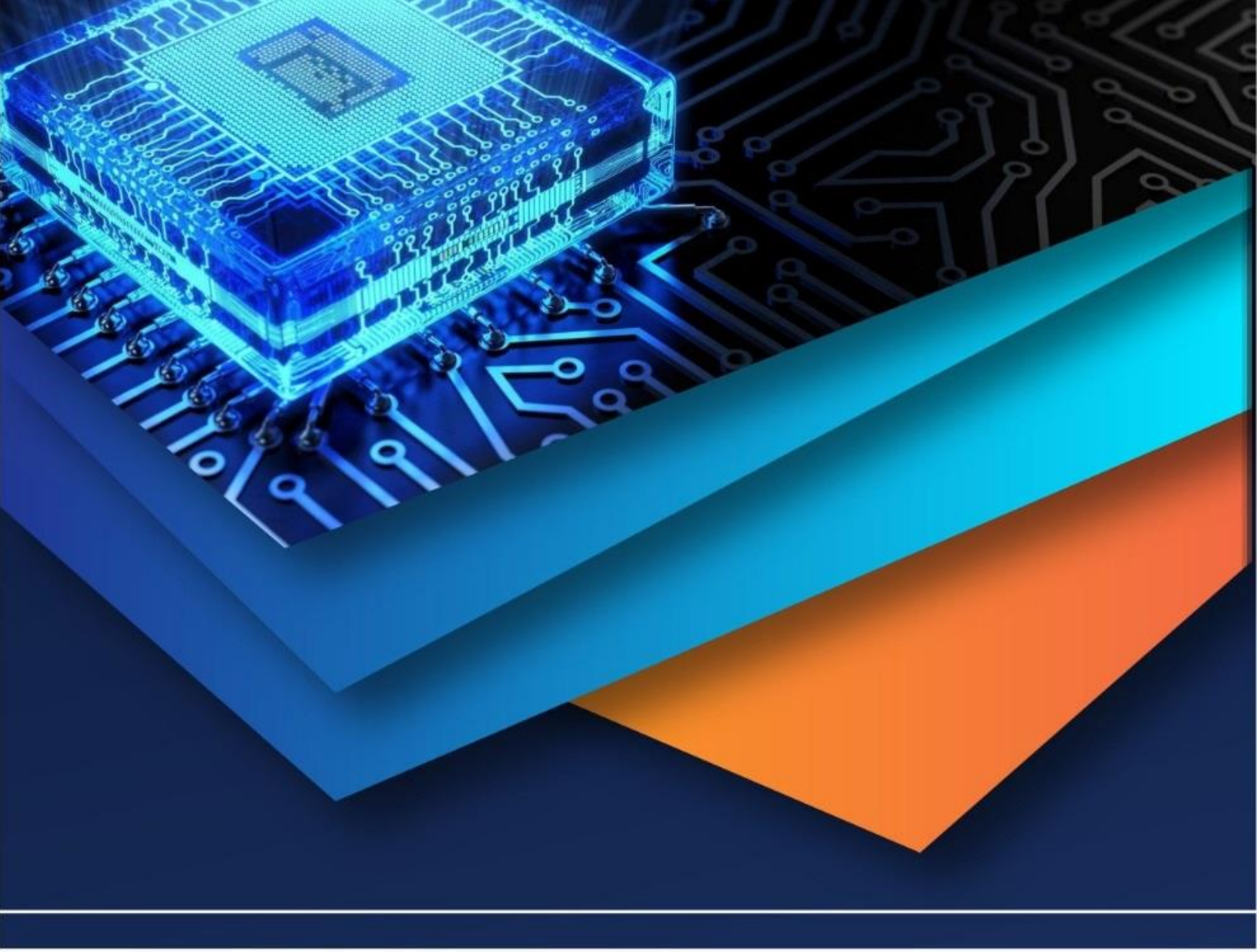
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increasing in this field and various image processing techniques are implemented in order to get more accurate result. The proposed system is worked effectively for extracting feature of Indian currency images. Extracted features of currency image 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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