

# Fake currency detection using smartphones and various image processing techniques

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## ABSTRACT

The imitation money produced without the legal sanction of the state intended to forgery or fraud can be termed as counterfeit money. Counterfeiting has been the second oldest profession in the world. This produced the need of a handy solution to recognize fake or counterfeit money circulation in the market. Several methods have been proposed before such as counterfeit detection pen, automatic currency detection machine NI-IMAQ, etc.

**Keywords:** Fake currency, Currency circulation, Currency detection.

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## I. INTRODUCTION

Recent enormous growth of technology, smart phone becomes a basic need, each & everyone now owns a smartphone. When one gets phone, question arrives what application phone should have? Currency note in India have denominations of rupees 5/-,10/-,20/-,50/-,100/-,500/-,2000/- respectively. This denomination differs with each other in some unique features.

Several works have been proposed before and lots of researchers are researching this domain for advent of best solution. Here, a robust note recognition android application is attempted. This can be used for recognition and detection of fake currency note and is very user-friendly in nature.

## II. LITERATURE SURVEY

Counterfeit Currency Detection Technique using Image Processing, Polarization Principle and Holographic Technique. (IEEE)

Here, in this paper, the author proposes the detection of counterfeit currency using spin coating, cellulose confirmation, polarization, holographic pattern and detection. The whole process is automated using NI- IMAQ (National Instruments-Image Acquisition).

Also, author proposes installing of a unique hologram for each denomination, thus making it easier to identify the denomination's genuineness. [1]

Automatic Indian Currency Denomination Recognition System based On Artificial Neural Network. (IEEE) Automatic detection and recognition of Indian currency is a trending research topic and has gained a lot of attention since the past decade. With this paper, the author proposes the recognition of Indian Currency using Image Processing. The methodology described goes as Follows-Extraction of dominant color, aspect ratio & then the image processing techniques such as edge detection, segmentation, dilation, erosion, cropping, Color space Conversion, etc. are carried out. Also, the author proposes the extraction & recognition of each unique ID-Mark using Fourier Descriptor and Artificial Neural Network respectively. [2]

Denomination	Dominant Color	Threshold Value of Aspect Ratio		
		Min.	Max.	Std.
Rs.20	RED	0.40	0.43	0.42
Rs.50	RED(PINK)	0.47	0.50	0.49
Rs.100	BLUE	0.45	0.48	0.46
Rs.500	GREEN	0.42	0.44	0.43
Rs.1000	RED	0.39	0.42	0.41

An automatic recognition of fake Indian currency note using MATLAB (IJESIT), Here an automation system to recognize the Indian currency note is proposed. the author discusses the MATLAB algorithm and other image processing techniques such as feature extraction, its color-space and etc. this paper discusses and embedded system application where the embedded system is connected to a computer using serial interface and the output is provided through the device camera to the computer system and output is generated on the LCD panel of the embedded system. [3]

Review of various image processing techniques for currency note authentication (IJCERT), In this application author proposes a system for currency note authentication using Open CV and use SIFT technique for feature matching. Author also discusses the short coming in the exiting MATLAB system and proposes used and Map-reduce platform using Hadoop as MATLAB does not provides open source platform using and cloud where internet connectivity is needed throughout the process. [4]

Features of Indian currency note: -

1)See Through Register: It is small floral design printed on the both face of the note in the middle of the vertical band next to water mark has an accurate back to back. the design appears as a floral when see against light.

2) Watermark: Each Indian currency note contains a portrait of Mahatma Gandhi with a light and shade effect and multidimensional lines in the watermark.

3)Optically Variable Ink: The numeral 1000 and 500 on the obverse and Rs1000 and Rs 500 respectively is printed in optically variable ink.

4)Fluorescence: Number panels are printed in Fluorescence ink. They also have optical fibers.

5)Security Thread: The security thread bears the inscription Bharat (in Hindi) and RBI (in English). the security thread appears to the left of mahatma portrait.

6)Intaglio Print: The portrait of Mahatma Gandhi, Reserve bank seal, guarantee and promise clause Asoka pillar governor's signature all are printed in intaglio or raised prints.

7)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 note. the higher denominational notes also contain denominational values of the notes in micro letters. This can be seen using a magnifying glass.

8)ID-Mark: Each denomination notes, ranging from Rs.20 to Rs.1000 has unique shape ID-Mark. This feature is for the visually impaired population to recognition the denomination. [5]

Denomination	ID-Mark Shape
Rs.20	Vertical Rectangle
Rs.50	Square
Rs.100	Triangle
Rs.500	Circle
Rs.1000	Diamond

### III. PROPOSED METHODOLOGY

The proposed work is implemented in android OS as number of smartphones users prefer android. Also it an open source thus, several additions to project can be done by researchers in the upcoming future. The proposed methodologies follows the process described in figure 1.

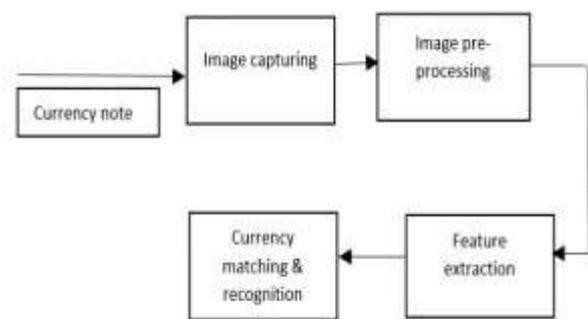


Figure 1: Process States

#### A. Image Capturing

The currency notes, firstly captured by the cellphone camera are subjected to be captured in better light condition and resolution. This captured image is then sent to the server over internet for matching and recognition. And another way to load currency note, is from gallery of cellphone, thus historical images too can be sent for recognition.

#### B. Image pre-processing:

After acquisition of image from camera or gallery it is subjected to pre-processing. Pre-processing is an essential step to be perform. It includes techniques such as noise reduction and generation of histogram.

For noise reduction, median filter is used. It is most simple noise removal technique & yet it is more efficient technique. The median filter follows moving window or sliding window principal similar to mean filter. A 3\*3, 5\*5 or 7\*7 kernel of pixel, is scanned over pixel matrices of the entire image. The median is then calculated and the center pixel of window is replaced with calculated median. [6]

This image is then enhanced by using histogram equalization technique. Here, we used LBPH (Low Binarization Pattern Histogram) technique. It increases the contrast of image and equalizes image histogram.

C. Feature extraction:

Several morphological functions are used for extraction of different features. There are total three primary morphological instructions – erosion, dilation and hit or miss. These operations can be performed only on grey scale or binary image.

After this, images are subjected to thinning and pruning. This can be often achieved by edge detection.

D. Matching and Recognition:

The matching of different extracted features is done by Euclidean matching. The images are subjected to match with number of images (image database).The formula for Euclidean matching goes as follows:

$$V^2(f1,f2) = \frac{\sum_{i=1}^N (f1(i) - f2(i))^2}{f1(i) + f2(i)}$$

E. Android application:

The android application is compatible with all versions above v2.3.4. The application also includes features of new currency notes of Rs.50/-, Rs.100/-, Rs.500/- and Rs.2000/- respectively.



Screenshot 2(b)



Screenshot 2(d)



Server-side Screenshot 1(a)



Screenshot 2(a)



Screenshot 2(c)



Screenshot 2(e)

#### IV. EQUATIONS

Let S be the solution of the given problem statement.

$S = \{s, e, i, l, p, o, x, fs, success, failure, fm\}$

Where,

$l = \text{login ID}$

$p = \text{password}$

$s = \text{initial state}$

$e = \text{end state}$

$i = \text{input}$

$\{ \text{Suspect note image} \}$

$x = \text{upload the image to server}$   $o = \text{output from server}$

$\{ \text{Detect the note is original or not} \}$

$fm = \text{main function}$

$\{ \text{Main function is to compare the suspect note image with original note image} \}$

$fs = \text{set of function } \{f1, f2, f3, f4, f5, f6, f7\}$  Where,

$f1 = \{ \text{pre-processing of suspect note} \}$

$f2 = \{ \text{binarization of suspect note image} \}$

$f3 = \{ \text{edge detection of suspect note image} \}$

$f4 = \{ \text{segmentation of image} \}$

$f5 = \{ \text{feature extraction of suspect note} \}$

$f6 = \{ \text{Convert security thread of suspect note into grey scale} \}$

$f7 = \{ \text{Verify the serial no. of suspect note with valid list} \}$

$success = \{ \text{It verify and compare all the parameters if all the parameters are satisfying then the suspect note is original} \}$

$o = f1Uf2Uf3Uf4Uf5Uf6Uf7$

failure = {network error, image not captured clearly, no internet connection then it goes into failure state.}

#### V. RESULT

The design technique was applied on image of Indian currency notes and different denominations. The capture note gets recognized successfully.

Advantages:

1. Unique system in it applications.
2. Allows user to identify currency note.
3. Display RBI note features.
4. Image taken from different orientation and distance.
5. Load from gallery.

#### IV. CONCLUSION

This paper gives an idea of developing currency recognition system for smartphones. Currency note captured are subjected to through different phases and finally the result is obtained. In future, audio output and offline processing added for the "dignity".

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