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# Counterfeit Currency Note Detection using Machine Learning

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**ABSTRACT:** In the modern-day world, automation playsa vitalrole in various aspects such as industrial work process, object detection and exploration of complex algorithms. This is extremely useful for enhancing the efficiency of achieving a particulartask,atthesametimeminimizinghumanpower consumption.In this work,a currency note detectormodel has been developed which can performfake currency note detectioninaworking environmentusingconcepts ofmachine learning.The Raspberry Pimodeldetectsvariousfeatures present on currency notes and identifies the type of extracted features using a Feature-based Registration algorithm by training the test samples. It then detects the genuine and fake currency notes with a certain distance and various calculations. The modeltakes information from the environment through a pi camera such as various currency notes and with the help of various image processing techniques provides the appropriate output.

**KEY WORDS: Artificial intelligence, automation, Fake currency, algorithm, Raspberry Pi, Image Processing**

## I. INTRODUCTION

Automatic recognition of fake Indian currency is very important in major domains like banking sector and cash trading nowadays. This system is used to detect whether the currency is fake or original through the automated system which is through a convolution neural network, in deep learning. Deep learning excels in the task of recognition and classification of images over large data sets, which is also primarily used in object category recognition. In the recent demonetization drive may be a step towards eradication of corruption and black money, but it fails to address the problem of counterfeit currency.

The first step iscapturing of currency notes with the help of a PI-Camera that is linked to the raspberry pi. The Next step is the pre-processing of the image taken through the RPI-camera and performing of the basic concepts of image processing such as segmenting, edge detection and feature extraction. The next challenging task in image processing is feature extraction. This leads to the extraction of invisible as well as visible features from the Indian currency. This approachconsists of different techniques included such as acquisition, edge detection, image segmentation, feature extraction and feature matching.

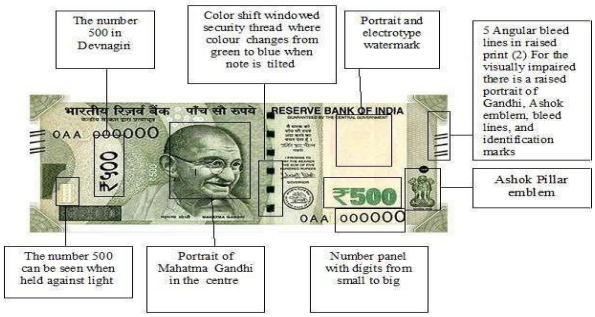


**Fig-1**: Security Features.

Notes with the legal sanction of the government possess certain security features such as intaglio printing, fluorescence and watermark, as shown in **Fig-1**.

### 1.1 PROSOPOSED SYSTEM

The image captured consists of the currency note on a whitebackground. To increase the efficiency of both detectionalgorithms, the image is subjected to a preprocessing system,which extracts the regions of interest and converts them into abinary form. For example, to analyze parameters such as huecalculation, the RGB image is converted into HSV formatwhile mean pixel intensity is calculated over a greyscaleimage [5].

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## II. LITERATURESURVEY

1. According to this[1], Single Shot MultiBox Detector (SSD) model based on deep learning as the framework, employ Convolutional Neural Network (CNN) model to extract the features of paper currency, so that we can more accurately recognize the denomination of the currency, both front and l used for feature
2. l anking services have been discussed, automatic schemes for paper currency recognition thatare significant in many applications. An Automated paper currency recognition system can be a very good utility in banking systems and another field of commerce.
3. The Sobel operator[3] with gradient magnitudehas been explained which is used for characteristic extraction. The process begins with image acquisition and ends at a comparison of features. The features are extracted using edge-based segmentation by Sobel operator and work well in the whole process with less computation time.
4. The framework[4] for feature matching and object detection has been addressed. In the first step of the framework design, four algorithms for feature detection and extraction are implemented. Then, the brute-force matchers are used with certain optimizations and settings for the feature matching.

$$Likelihood = L(d) = \sum_{i=1}^{n} l(i,d)$$

## III. CLASSIFICATION BASED ON DENOMINATION

The Indian currency notes consist of various salient features indicating denomination, the most prominent ones being size, color, identification mark and pixel intensity. First, the typical parameter values for each denomination are calculated using the images from the created standard database. These are set as the reference values for classification. To determine the denomination of the input note, it undergoes the same scanning procedure and preprocessing technique. The parameter values for the input are determined and then compared to the reference values. As each parameter is measured differently, it is necessary to normalizethem.

$$F(i,d) = \left| \frac{F_{input}(i) - F_{reference}(i,d)}{F_{reference}(i,d)} \right| \quad (1)$$

In (1), $F_{input}(i)$ is the value of the $i^{th}$ parameter for the input image, $F_{reference}(i, d)$ is the value of the $i^{th}$ parameter for the $d^{th}$ denomination determined from the reference database, andF(i,d) is the normalized parameter value. A likelihood factor is formed, which shows the relative likelihood of an input note belonging to a particular denomination. Each parameter contributes to the likelihood factor, increasing or decreasing its value based on the similarity to the denominationreference.

$$l(i,d) = \frac{1}{F(i,d)} \quad (2)$$

(3)

In (2) and (3), l(i, d) is the likelihood factor contributed by the $i^{th}$ parameter for the $d^{th}$ denomination, and it is denoted by the inverse of F(i,d). The likelihood L(d) of each denomination is finally calculated as the sum of the likelihood factors. Finally, the denomination with the highest cumulative value of likelihood is selected and the note is classified.

## IV. BLOCKDIAGRAM

The machine is controlled usinga Raspberry Picontroller, which is interfaced with a camera, LCD display.The results are displayed on theconsole.

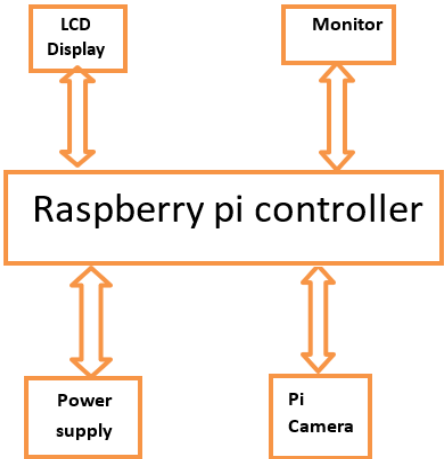


**Fig -2**: Block diagram of the model.

In designing this system one challenging case is to design a system that is theextraction of characteristics from currency image foraccuracy of the automated system.

Raspberry Pi

The control of the process is done by the Raspberry Pi controller. Thework of the controller is to clarify data from fake note detectionunit to check whether currency is fake or genuine. Also, control and synchronization of note feeding mechanism is done by microcontroller. This instructs PC to capture images using a camera andinterpret the data from PC.

PC

In PC the SPYDER software is used for this system. This is used for image processing and to apply User Interface

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which runs on the PC. Communication with the microcontroller is done using serial communication.

Pi Camera
It is used to capture the environment of the robot in video mode and send it to the raspberry pi controller.

LCD Display
It is used to display the output of the project that is whether the currency is fake or genuine.

## V. DESIGN FLOW OF THE PROPOSED MODEL

Design Flow of Automatic Recognition of Genuine and Fake Indian Notes.The design flow of fake currency etection system consists of eight stages. This system works on two images one is the original currency image and other is image of currencyused for authentication purposes.

1) Image Acquisition

The camera or scanner is used for image acquisition. The acquired image should consist of all the features.

2) Pre-processing

In pre-processing the operations normally initial to maindata analysis and extraction of information. In this unwanteddistortion are suppressed and enhance some image featuresthat are important to further processing. It includes imageadjusting and image smoothening.

In image adjusting, when the image obtained from scannerthe size of image is large therefore to reduce the size ofimage, image adjusting is used. In this for image adjustinginterpolation is used [6].

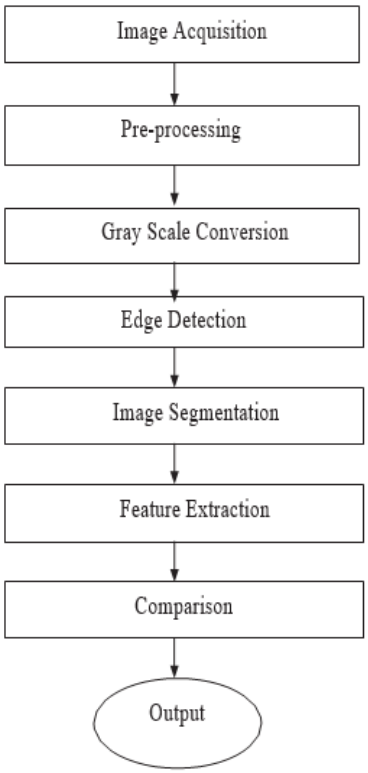


**Fig -3**: Flow Chart of Digital Image Processing

Method to DetectFake Note.
In image smoothening, while using camera or scanner and perform image transfer, some noise will appear on the image. The important step of removing noise is done by image smoothening. For image smoothening convolution is used.

3) Gray ScaleConversion

The image obtained is in RGB color. It is transformed into grayscale because it takes only the intensity information which is easy to process than the processing of three components RGB [7].

4) Edge Detection

Edge detection is a basic tool in image analysis, image processing, image pattern recognition and computer vision techniques. Edge detection is basic tool particularly in the area of feature detection and feature extraction [8].

5) Image Segmentation

In image segmentation, the image is divided into regions or objects depending on problem the segmentation is done. Segmentation algorithms for a monochrome image are based on two basic properties of image intensity.

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6) Feature Extraction

Feature extraction is a specific form of dimensionality reduction. It is the method of capturing the visual content of image for retrieval and indexing. When input to the algorithm is too large to be proceeding and it is having much data but not more information. Then input data will be converted into reduced representation set of features.Feature extraction makes simple the number of resources required to describe the large set of data [9].

7) Comparision

In comparison, the extracted feature of the input image and extracted feature of the original image is compared.

8) Output

The output is displayed on LCD. The output is currency denomination or currency is fake or original.

## VI. RESULTS

In this section, the result is obtained by performing image processing Operations. In the system, image acquisition is done by using the camera and the acquired image is sent to the processing unit. As shown in the GUI the acquired image is the test image. After that the test image is then converted into grayscale image, segmented image, cropped image and resized image.

The fake currency detection using image processing was implemented on SPYDER. Features of currency note like serial number, security thread, Identification mark, Mahatma Gandhi portrait were extracted. The process starts from image acquisition to calculation of intensity of each extracted feature. The system is capable of extracting features even if the note has scribbles on it. The algorithm processed here works accurately for genuine and fake currency notes.

Then comparison of cropped and resized image with the images saved in the database is done. Then the result is displayed in theresultpanel. The various security features for each denomination were analyzed. If the values of the input note do not match with the expected value of real note, then the note is determined to be counterfeit. Using this algorithm, the success rate of counterfeit identification is 90%. The Pi camera gets capture rate of around 38fps that is just above 0.025s per picture on with overclocking set to 900Mhz.

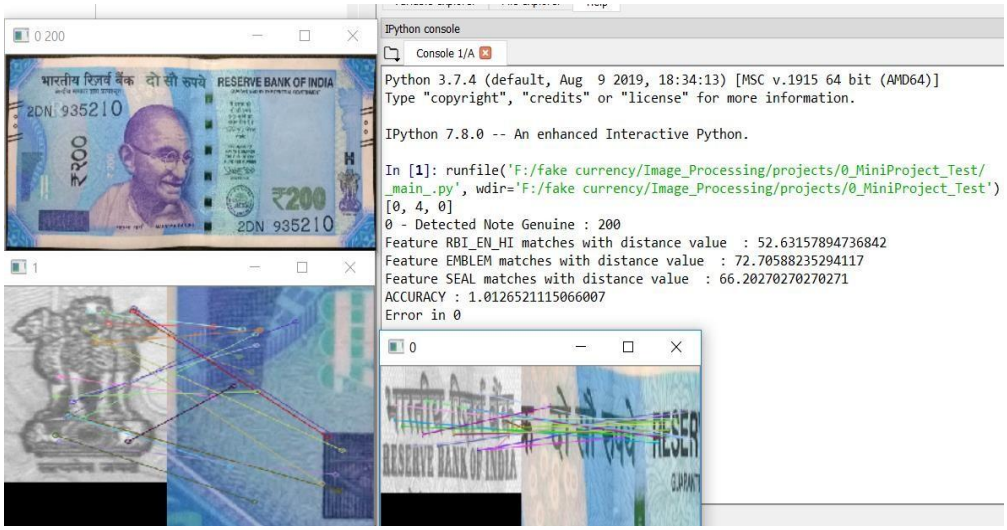


**Fig-4**: The currency is detected as "Genuine" in real-timesimulation.

## VII. CONCLUSION

Budget-friendly:- as most of the task is achieved using software and hardware components used are low in cost this entire project is budget friendly and affordable

Compared to object detection using hardcoding, this artificial intelligence-based objectdetectionwhich involves deep-learning is more efficient in a wide range of applications.

Eco-friendly as it does not involve the use of any harmful materials.

In this project, the detection of fake Indian currency note is done by using image processing principle. This is a low-cost system. The system works for denomination of 100,200,500 and 2000 for Indian currency. The system also provides accurate and valid results. The process ofdetection of fake notes is quick and easy. In this system input is taken by Pi camera and output is displayed on

LCD.

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