

Analyzing the Hyper Spectral Imaging and Utilization of Features Extractions to find the Difference between Fake and Original Indian Currency

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Abstract— Counterfeit notes are one of the predominant problems dealing with cash laundering. In a rustic like India, it becomes a prime obstacle. Thanks to advances in printing, scanning era makes it easy to print faux notes the usage of the modern-day hardware tools. Getting counterfeit notes in individual is a time-eating and hazardous method and this is why there's a want for computerized methods for use inside the manner of spotting the currency efficiently. Right here we've used our proposed idea in approaches: one by way of analysis the usage of hyper spectral imaging and the second one by means of subtracting extraordinary capabilities from counterfeit and real cash notes and by way of evaluating each other we can distinguish counterfeit notice from real word. In the photograph processing segment, the diverse functions gift within the take a look at enter are identified and as compared with the actual be aware and effects because the given note is inaccurate or now not. Entropy is measured in all factors. These are all modules used in MATLAB. We've got created a fake note detection unit with picture processing algorithms. Check results display that the outcomes obtained are nearly accurate, as the background of the text seems very complicated with similar ranges of intensity. The difficulty of the effective separation of counterfeit money from actual cash with alternate machines may be very essential. The proposed plan explains a way to at ease Indian banknotes. India counterfeit currency of a hundred, 500 and 1000 rupees appears to be full of the complete gadget and there may be no proper way to address it for the common person. The alert gadget is made up of two elements. The first is pre-processing, which includes finding edges, compressing statistics length, and output features. The second is to compare with the previously stored database. The end result is indicated by means of led mild. To be able to make the device whole, we want to maintain an internet site if you want to keep the economic functions [1]. The result may be actual or counterfeit money and the performance of our device is ready 95% which can be improved using the most advanced strategies. Further, a few applications related to extra paintings pointers are mentioned.

Keywords— Entropy, imaging hyper spectral, image acquisition, image processing, feature extraction and correlation.

I. INTRODUCTION

Guide checking out of all notes on sale could be very time ingesting and informal and there may be also the opportunity of tearing whilst giving notes. Computerized financial institution note recognition methods are consequently required in many systems together with computerized trading assets and trading devices. Extracting sufficient economic features from a currency model is vital for obtaining the accuracy and robustness of the default device. That is difficult issue for system designers. Every year the RBI (Reserve bank of India) offers with counterfeit notes or damaged notes. Managing big portions of fake notes poses extra troubles. Consequently, the combination of gadget (independently or as a professional human resource) makes the manner of notice recognition less complicated and extra efficient. The Reserve bank of India (RBI) has the only proper to issue monetary notes to India. Each 12 months the RBI faces the trouble of counterfeit money. The problem of inflation in India is a major hassle that desires to be addressed. In current years there has been a dramatic growth within the variety of counterfeit Indian rupee notes. Therefore, computerized banking note techniques are required for maximum structures which includes automated buying and selling - commodities and trading gadget. Extracting enough monetary features from a currency model is important for gaining gadget accuracy and durability. There are approximately 50 cash in the global, and everyone seems unique. For instance, the paper length is different; it's miles the same coloration and sample. Personnel running for Forex must classify special styles of currencies and that is not an easy undertaking. They ought to remember the value of every coin. This fraud is so popular that it is considered a 2d global service in in advance days. coins started within the Greek town of Lydia approximately six hundred B.C. previous to the introduction of paper money, the maximum commonplace method of counterfeiting involved blending basic metals with 24-karat gold or

silver[2]. A not unusual exercise became to “shy away” the cash and that is known as "CLIPPING". The default technique for acquiring counterfeit word could be very vital for all countries. In this venture we applied a faux be aware detection method and launched a coloration-coded HSV function and other picture processing programs figure 1.

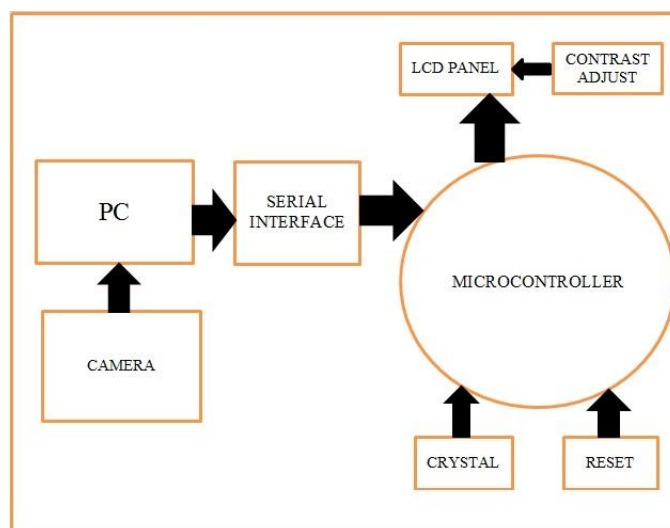


Fig 1 .Block diagram for automatic visual recognition of real and false notes

How is counterfeit money obtained?

1. Watermark
2. Security Thread
3. Identification Mark
4. Latent image
5. Fluorescence
6. Intaglio Printing
7. Micro lettering

1. Watermark:

The photograph of Mahatma Gandhi, the multidirectional traces and the electrolyte symbol indicating the program quantity appear in this section and this could be quality visible if the cash is held against the light [3].

2. Security Thread:

The notes of Rs.500 and Rs. A hundred have a series of protection capabilities with the identical visual characteristics. it is a 3.00 mm huge line marked “.art” and “RBI” with a change in color from green to blue when regarded from different angles [4].

3. Identity Mark:

Every note has its very own exclusive feature. A special function in intaglio is presented to the left of the watermark window. This option is in an exclusive format for distinctive denominations and enables the visually impaired to become aware of the denomination. In 500 variants the index is circular [5]. In 2000 versions the identification mark is a diamond.

4. Latent photograph:

It is a vertical band on front of the denomination at the proper. Incorporates an encrypted picture that shows the denominator number in which the coin is held horizontally at eye stage [6].

5. Fluorescence:

Numerical quantity panels are revealed in fluorescent ink. Both can be visible when notes are uncovered to extremely-violet mild. A portrait of Mahatma Gandhi, a symbol of the bank of history, a clause of warranty and promise, the Asoka Pillar logo on the left, the signature of the Governor of the RBI printed intaglio i.e. with raised prints, which may be felt via touch, for Rs.20, Rs.50, Rs. a hundred, Rs.500 and Rs.2000 notes [7].

6. Micro Lettering:

This seems among vertical band and Mahatma Gandhi portrait. It constantly incorporates the phrase “RBI” in Rs. Five and Rs.10.

• Hyper spectral Imaging:

With the fast development of printing and production device, the manufacturing and distribution of genuine currency notes has come to be increasingly complicated. despite the fact that there are advanced techniques for obtaining and studying counterfeit notes and technical gadgets, many require high priced high-stop laboratory

gadget that calls for large education, and they're frequently slow to accumulate and analyze information [8]. This technical finding provides a simple fluorescence-primarily based hyper spectral-imaging approach for obtaining and analyzing the exceptional or authenticity of economic and artifact notes the usage of the 365 nm Ultraviolet (UV) Bulb. All picture and spectral data are accrued with the aid of digital valid photofigure 2.

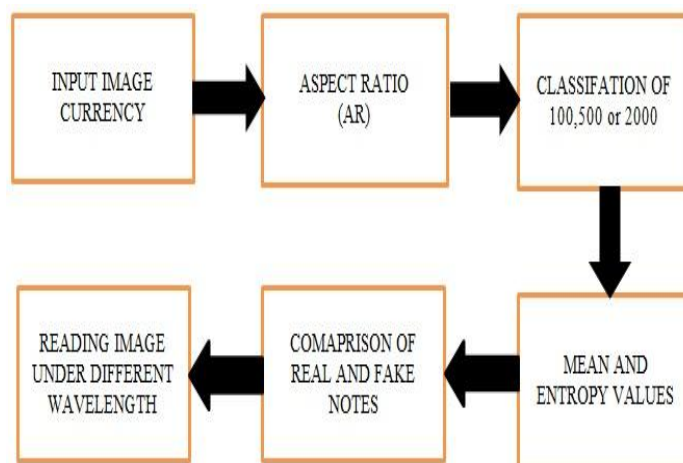


Fig 2: Block diagrams of the proposed hyper spectral imaging system

• **Purpose :**

The main objective of our proposed undertaking is to expand a financial word popularity device under hyper spectral imaging mode with special lights beneath exceptional lengths of prominence and function comparisons the use of picture processing algorithms.

II. RESEARCH GAPS

Right here is some software equipment for image processing applications. Yang proposed image processing for clinical engineering applications. He emphasized the significance of picture statistics in medical engineering as the principle supply of records change and said that despite the fact that the utility of virtual photo processing in medical engineering draws massive fees, it continually brings powerful consequences with the aid of minimizing noise effects and enhancing photo [9]. Inside the field of scientific engineering, processed pictures deliver numerous clinical and pathological statistics approximately a specific sickness. A software program simulation evaluation based approach is presented within the paper highlights a methodological approach displaying the implementation on image popularity evaluation software gadget [10].

A. Based totally on preliminary processing:

- RGB to gray scale conversion. It then performs a de-noising method.
- Median filtering is only a non-linear technique used to get rid of noise it could be processed by means of MATLAB [11].

B. Based totally on segmentation or thresh holding:

- Location of interest (ROI) extraction is genuinely a part of the picture to filter out and can create ROI in line with numerous shapes.
- Morphological segmentation: based on morphological operations [12].
- Photo cropping: center segmentation cropping.
- Block tile pictures: a way of dividing the image.
- OTSU thresh holding: is tritely a global adaptive thresh preserving photo segmentation algorithm, it became brought via Japanese OTSU researchers in 1979.
- Entropy minimization technique: hostile Entropy Minimization for domain edition in semantic segmentation [13].
- Side center segmentation.

C. Based on feature extraction set of rules:

- GLCM: grey stage Co-incidence Matrix.
- CNN: Deep learning Convolution Neural community architecture [14].
- RCNN: vicinity focused CNN

D. Based on characteristic matching algorithms:

- Naive Bayes Classifier: runs on a comparable technique to expect the possibility of different kinds focused on one of a kind attributes. This set of rules is mainly found in text classification and multi-class problems. A

Bayesian classifier is based at the concept that the location of a (natural) type is meant to count on feature values for individuals of that elegance guide [15] Vector gadget: is most effective a supervised system getting to know design with associated getting to know patterns that analyze the information used for classification and regression evaluation.

- KNN classifier is most effective ok-nearest Neighbor class algorithm and its miles best supervised gaining knowledge of set of rules continuously [16]. And it classifies new cases focusing on similarity measures.
- A decision tree with a tree design where instances are labeled according to their functional values.
- MLP or Multilayer Perceptron is only a feed forward neural community model that maps sets of input expertise to a hard and fast of accurate outputs [17].

PROPOSED SYSTEM AND ALGORITHM

We advise a gadget where currency popularity of notes can be carried out automatically based totally on a combination of enhancement, segmentation and feature removal technique beneath photograph processing. First we get pix below a hardware set that consists of adigital established within the box with a UV light system, standard LED light and multicolor LED's. Hardware setup is attached to a computer the usage of the USB port of the net digital camera [18]. Wecan consequently locate the price of the threshold that acts as a center among real notes and pretend notes. The use of pictures with low adjustment of cash notes acquired from the auto digital is monitored to make sure overall performance. Precise capabilities are detected and extracted based on the ROI output approach by using putting the width and duration of the ROI factor. The extracted capabilities are in comparison between a real note and a fake notice. Entropy is used and the quantity of entropy is compared among the two [19]. Through the difference in entropy values, we can distinguish whether or not a given observe is an actual note or a false notice figure 3.

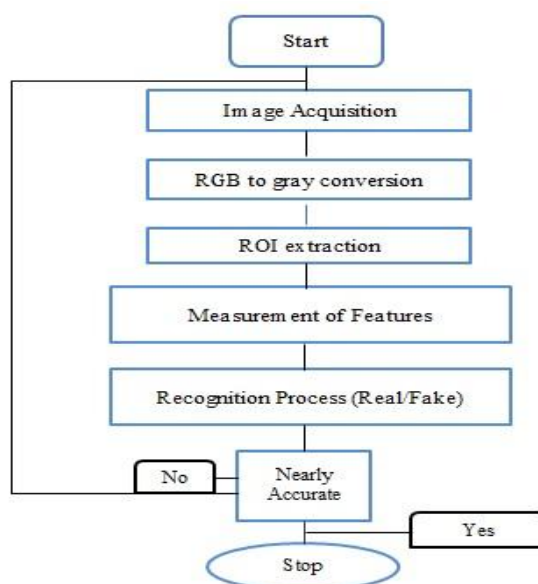


Fig 3: Flowchart for Proposed System

The HSV model is one of several color systems that people use to select colors from a color wheel or palette. This color model is significantly closer than the RGB model in the way people experience and describe color sensationsfigure 4.

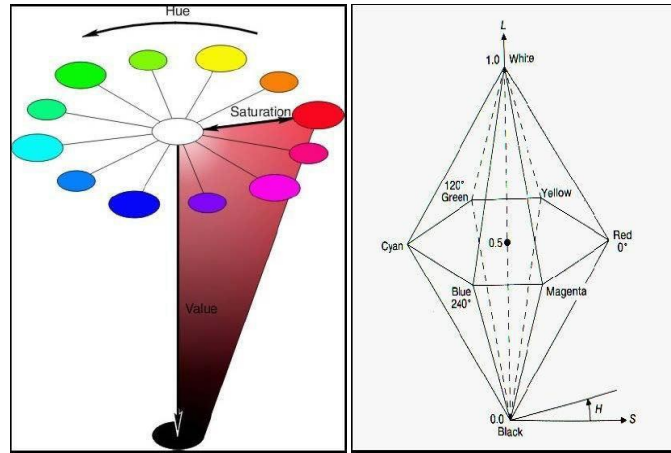


Fig 4. HSV model

Gaussian blurring is performed to remove noise from the image. Gaussian image convolution is performed using

$$\text{Mean} = \sum_{i=1/N}^N F i \quad (1)$$

$$\text{Standard Deviation} = \sqrt{\sum_{i=1/N}^N (f_i - \mu)^2} \quad (2)$$

ALGORITHM

Photograph Scaling the primary set of rules achieved in our program is photo scaling, which certainly takes an enter photograph and resizes it to 100 dpi (using a scale of s) to gain an extra suitable KNN for sorting. However, this pixel might not be a critical fee, so we use nearest neighbor interpolation to get the non-integral price of the pixel from the source photo basically the usage of the fee of the pixel closest to our non-integral source pixel [20]. Due to the way windows handles nearest-neighbor interpolation scaling, this may lead to a bad correlation result, as shown through our demonstration and facts evaluation. But, this step is important to finish our machine because our matching filters out isn't scale invariant; therefore, we need to ensure that the pictures we're reading have the identical decision as the photos in our reference facts set.

III. METHODOLOGY

A. Image Acquisition:

A real-time coin image taken with a camera is considered input. We can use the webcam with hardware settings to capture revenue [21]. A recently acquired image is converted to the appropriate RGB histogram.

B. RGB to GRAY conversion:

Real-time image of a coin taken with a camera is considered input. We can use the webcam with hardware settings to capture revenue.

C. FeatureMeasurement:

Entropy and Mean serve as the main extraction method used in all images and values are collected.

D. Classification:

We will find the result that the graph is arranged between the real note and the fake note under different wavelengths and wavelengths [22]. We can therefore find the value of the threshold that acts as a center between actual notes and fake notes.

IMPLEMENTATION

The degree of movement when it comes to work is that the whole motive is modified to cognizance at the functioning of the code. The purpose of the stage is to interpret the intention of attaining the first-rate result in the suitable dependent language. In this section, we cover the movement-associated action phase, providing details concerning the deliberate language and the improvement surroundings used [23]. It additionally gives a popular evaluation of the important thing sections about the work by using its path grade by grade.

The sensible segment consists of the following sports:

- 1) Careful planning.
- 2) Evaluation of shape and constraints.
- 4) Evaluation related to conversion approach.
- 5) Correct judgment concerning the selection of idea [24].

A. Used software program:

- 1) Windows 7 (64-bit) operating gadget.
- 2) MATLAB

B. picture Processing Toolbox:

The image processing toolbox allows for photograph enhancement; photograph blurring, function recognition, noise lower, and picture splitting statistical conversion [25]. The photograph processing tool supposed for the proposed strategies is unique below: -

- 1) Basic import and export
- 2) Display

IV. RESULTS AND ANALYSIS

- **Real2000RupeesNote:**

In this section, the results are obtained after performing the morphological image processing operation. The original image is loaded from the database [26]. The captured image has dimensions of 66 mm×166 mm figure 5,figure 6,figure 7,figure 8,figure 9,figure 10, and figure 11.

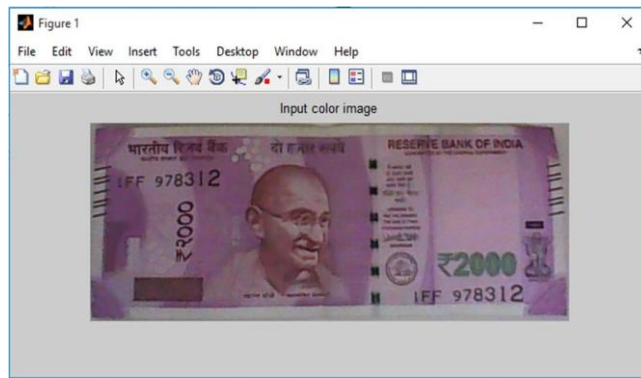


Fig 5. Inputofthereal 2000note

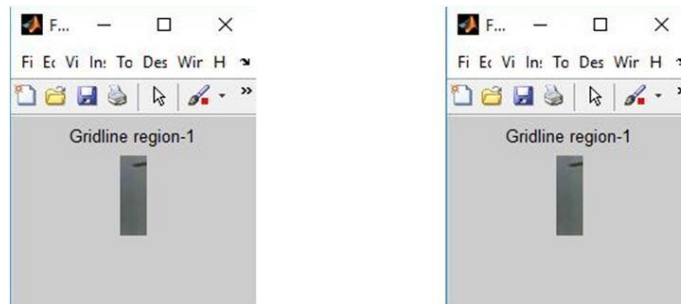


Fig 6. Gridlineofnote

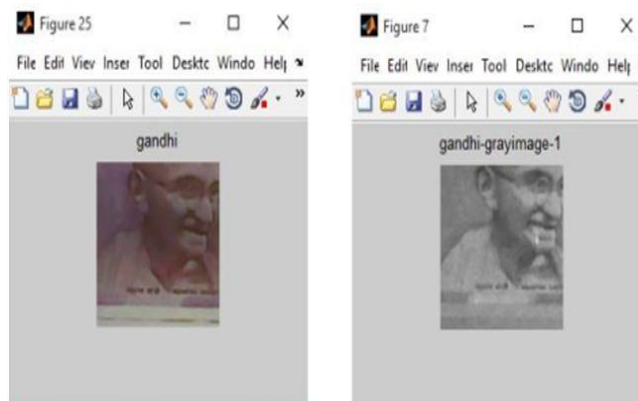


Fig 7. Gandhisecurityfeatureof thenote

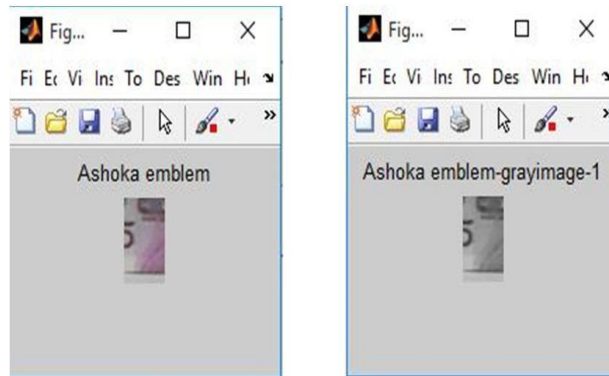


Fig 8. Asokaemblemfeatureofthenote

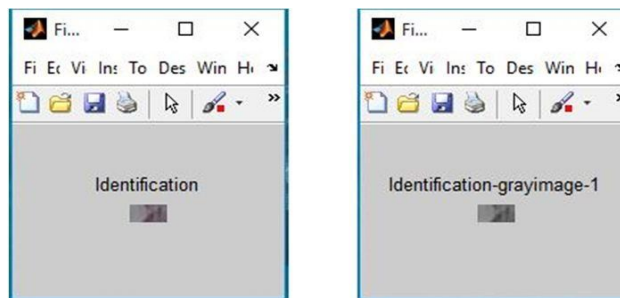


Fig 9. Identificationfeatureofthenote

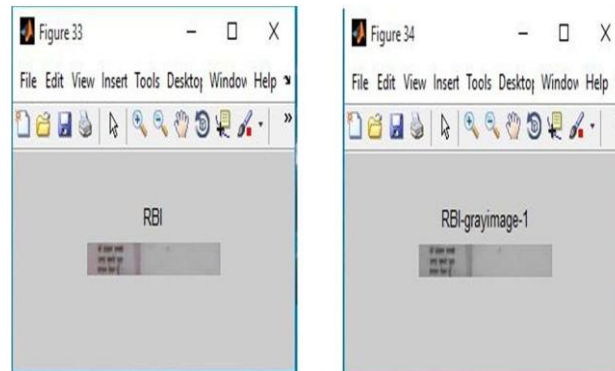


Fig 10. RBIfeatureofthenote

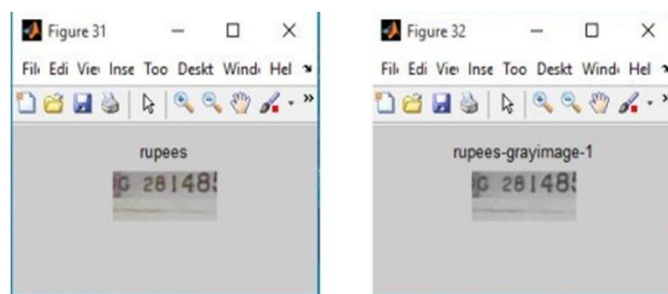


Fig 11. Rupeefeatureofthenote

Fake 2000Rupeesnotes:

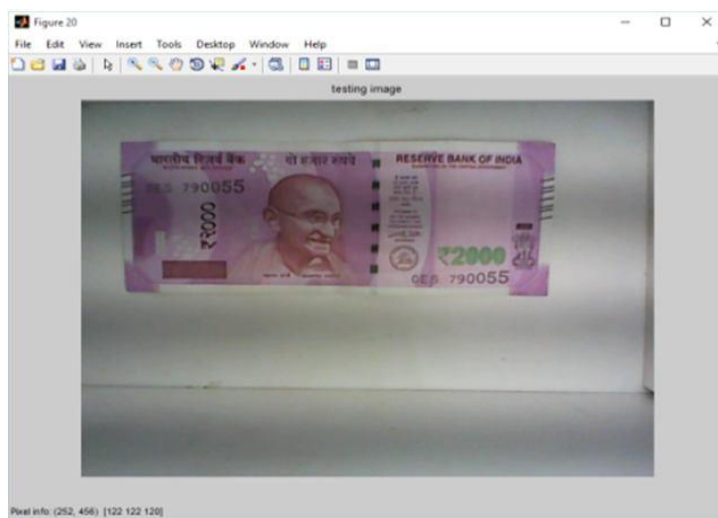


Fig 12.Input image of a fake 2000 note

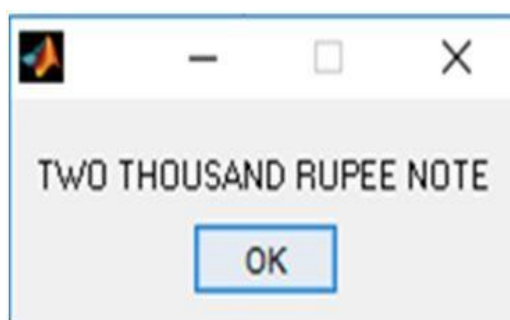


Fig 13 . Two Thousand Rupees Note

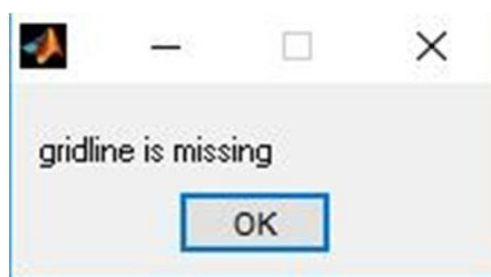


Fig 14. Missing gridline feature

- The execution section involves the following duties:
Careful scheduling.
- Exam concerning shape as well as constraints.
- Purpose for regarding the strategies towards undertaking the conversion [27].
- Evaluation on regarding the conversion technique.

Similarly, we performed some iteration, out of which were faulty and did not lead to the correct result. So the accuracy of our system is around 95%.

No. of Iterations	Percentage Accuracy(%)	Experimental result	Actual result
1	75.4%	REAL	REAL
2	54.5%	REAL	REAL
3	66.2%	REAL	REAL
4	78.2%	REAL	REAL
5	57.5%	REAL	REAL
6	56.2%	REAL	REAL
7	85.2%	REAL	REAL
8	79.3%	REAL	REAL
9	89.9%	REAL	REAL
10	85.2%	REAL	REAL
11	85.3%	REAL	FAKE
12	83.6%	REAL	REAL
13	65.3%	REAL	REAL
14	78.2%	REAL	REAL
15	65.9%	REAL	REAL
16	78.3%	REAL	FAKE
17	74.1%	REAL	REAL
18	78.2%	REAL	REAL
19	67.5%	REAL	REAL

V. CONCLUSION AND FUTURE WORK

We've carried out our proposed idea in ways: one with the aid of evaluation the use of hyper spectral imaging and the second one through extracting distinctive features from faux and actual cash notes and by using comparing each other we are able to distinguish a faux notice from an actual observe. We've blended those two strategic approaches to our proposed work [28]. Multi-colored lamps used for pictures with hyper spectral Ultraviolet (UV) mild, ordinary LED Bulb, crimson LED mild, inexperienced LED mild and Blue LED light range in variety from 360 nm to 800nm. in the photograph processing segment, the diverse functions gift inside the check input are identified and compared with the actual be aware and results as the given note is incorrect or now not. Entropy is measured in all factors. Thing Ratio is calculated first of all in enter notes to split the given a hundred, 500 or 2000. Those are all modules used in MATLAB. We've created a fake observe detection unit with image processing algorithms. Check results show that the outcomes obtained are nearly correct, because the background of the textual content seems very complicated with comparable stages of depth. The primary motivation for developing this mission turned into to create a system too easily and speedy acquire real and correct Indian foreign money notes. That is a MATLAB-based totally gadget for automatic reputation of the safety capabilities of Indian foreign money [29]. The method recommended from the beginning of the images to transform it to a grey scale to the removal of the function and contrast is referred to. This carrier presents a clean and cheaper way to acquire counterfeit money. It's going to be truly very beneficial in for decreasing counterfeit money.

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