A FIELD PROJECT REPORT ON

“FAKE CURRENCY DETECTION USING IMAGE PROCESSING”

Submitted in partial fulfilment of the requirements for the award of the degree

**BACHELOR OF TECHNOLOGY**

in

**COMPUTER SCIENCE AND ENGINEERING**

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# CERTIFICATE

This is to certify that the field project entitled “FAKE CURRENCY DETECTION USING IMAGE PROCESSING” being submitted by T.Harshitha(231FA04285),E.Nikhitha-(231FA04287),B.Divya sree-(231FA04459)and A.Ram charan-(231FA04479) in partial fulfilment of Bachelor of Technology in the Department of Computer Science Engineering, Vignan’s Foundation For Science Technology & Research (Deemed to be University), Vadlamudi, Guntur District, Andhra Pradesh, India, is a bonafide work carried out by them under my guidance and supervision.

|  |  |
| --- | --- |
| **Head of the Department** | **Guide** |

# DECLARATION

We hereby declare that our project work described in the field project titled “FAKE CURRENCY DETECTION USING IMAGE PROCESSING” which is being submitted by us for the partial fulfilment in the department of Computer Science Engineering, Vignan’s Foundation for Science, Technology and Research (Deemed to be University), Vadlamudi, Guntur, Andhra Pradesh, and the result of investigations are carried out by us under the guidance of Dr. O. Bhaskar

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CHAPTER-1

INTRODUCTION

# 1.INTRODUCTION

Money can serve as the driving force behind any economic activity associated with manufacturing, circulation, consumption, etc. Capital information can be used to save money and make investments. Money is essential for everything in today's dynamic culture. There are also other factors that are shrinking the economy as it advances. One of those things is the creation and use of counterfeit currency. Due to the widespread use of counterfeit currency in theeconomy, the typical person is the group most negatively impacted by this activity. Everyone is afraid of accepting banknotes in the denominations of Rs. 500 and Rs. 1,000 because the bulk of them are nearly hard to distinguish from genuine banknotes, from gas stations to the neighborhood vegetable seller.

The issue of counterfeit money is one that is discussed and debated throughout the world. Banks lost Rs. 16,789 crores in the most recent fiscal year due to frauds. The Reserve Bank reported that "the amount that has been lost on account of frauds in the year 2016–17 was Rs. 16,789 crores," which was in accordance with the fraud monitoring report made by various banks and financial institutions. According to the RBI's (Reserve Bank of India) annual report for 2021–22, there was an increase in the number of counterfeit notes found in the denominations of Rs. 10,

Rs. 20, Rs. 200, Rs. 500 (new design), and Rs. 2,000, respectively, of 16.4%, 16.5%, 11.7%, 101.9%, and 54.6%.

Inflation is the typical impact of counterfeiting on the economy. The only tool now available to the average person to identify fake money is the Fake Note Detection Machine. The majority of the time, this machine is only found in banks, which are not always accessible to the regular person. In order to prove the viability of suggested solutions to a particular problem, a lot of experimental work is required in the field of digital image processing.

It includes operations whose inputs and outputs are images and operations that extract properties from photos, including the identification of specific objects. The watermark on fake currency is created using opaque ink, white solution, and stamping with a dye that has a picture of Mahatma Gandhi engraved on it. Visitors are the most susceptible to phony currency because they lack the knowledge necessary to distinguish between fake and genuine currency notes.

These people will benefit from automatic currency identification using image processing techniques. Also, it can be helpful in other workplaces. The devised system to verify the 2000rupee Indian currency notes. It will organize the predetermined arrangement of information and pre-process the digital images before differentiating in monetary forms. The approach for detecting Indian currencies suggested in this article is practical and affordable. The user can determine whether the cash note is authentic or phony at the conclusion of the process.

### 1.1 Problem Definition

Counterfeit currency is a significant threat to the economy, leading to inflation, financial losses, and a lack of trust in cash transactions. The increasing sophistication of fake currency makes it difficult for the general public to distinguish between genuine and counterfeit banknotes, especially for denominations such as Rs. 500 and Rs. 1,000. Currently, Fake Note Detection Machines are primarily available in banks, limiting accessibility for the common person.

To address this issue, an automated counterfeit currency detection system using digital image processing is required. This system will analyze digital images of currency notes, extract key features, and compare them against predefined characteristics of authentic banknotes. By implementing image processing techniques, the system can identify counterfeit notes based on watermarks, color patterns, and security features.

The proposed solution aims to provide a cost-effective and efficient way for individuals, businesses, and vendors to verify the authenticity of currency without relying solely on banks. This will help reduce financial fraud and ensure safer transactions in everyday economic activities.

**1.2** Existing System

Currently, counterfeit currency detection is done using traditional methods, which have several limitations. The existing system relies on **manual inspection** or **Fake Note Detection Machines**, both of which are not widely accessible to the general public.

### ****Methods in the Existing System:****

1. **Manual Verification by Individuals**
   * People check security features such as **watermarks, color shifting ink, micro-text, and serial numbers** manually.
   * This method is unreliable as **counterfeit notes have become highly sophisticated** and difficult to distinguish from genuine ones.
2. **Fake Note Detection Machines**
   * Banks and large financial institutions use **UV light scanners, magnetic sensors, and infrared detection** to identify counterfeit notes.
   * These machines analyze specific security elements like the **security thread, watermark, and ink composition.**
   * **Limitations:**
     + These machines are **expensive** and not accessible to small businesses and individuals.
     + They are **not portable** and are mostly found in banks or large retail stores.

**1.3** Proposed System

The proposed system is an **automated counterfeit currency detection system** that uses **digital image processing techniques** to verify the authenticity of Indian currency notes. It will provide an easy-to-use, fast, and cost-effective solution for individuals, businesses, and financial institutions to detect fake banknotes without relying on expensive machines or manual verification.

#### **Working of the Proposed System:**

##### **Image Acquisition**

* + A high-resolution **camera or scanner** captures the image of the currency note.
  + The captured image is then pre-processed to remove noise and enhance clarity.

##### **Pre-processing**

* + The image is **converted to grayscale** for better analysis.
  + Techniques like **edge detection, contrast adjustment, and noise removal** are applied.

##### **Feature Extraction**

* + Important security features of the currency are extracted, such as:
    - **Watermarks**
    - **Security thread**
    - **Micro-lettering and serial number**
    - **Optically variable ink (color-changing ink)**
    - **See-through register**
    - **Raised printing (intaglio print)**
  + These features are detected using **pattern recognition, edge detection, and texture analysis techniques.**

##### **Comparison & Analysis**

* + The extracted features are **compared with a database of genuine currency notes** stored in the system.
  + **Machine learning or deep learning algorithms** may be used to improve accuracy.

##### **Decision & Output**

* + The system determines whether the note is **genuine or counterfeit** based on the analysis.
  + The result is displayed on a **screen, mobile app, or notification system**.

### Objectives

* 1. To examine the various security components of Indian currency notes.
  2. Using a scanner or camera to gather paper money.
  3. To extract characteristics from the captured image by cropping and segmenting it.
  4. Creating a feature localization algorithm.
  5. Designing an extraction and recognition of features.
  6. To determine the right money denomination.
  7. To distinguish between authentic and fake money note.

## 1.4 Literature Survey

Colaco, Rencita Maria et al. chose to use the programming language Python and OpenCV for their project using Canny Edge Detection algorithm. To make comparisons and determine the outcome, a number of characteristics that define genuine currency apart from counterfeit ones were taken into account. Identification marks, see-through registers, optical variable ink, currency color codes, security threads, watermarks, latent images, and micro-lettering were a fewof these features. The accuracy of the proposed system was close to 80%. The goal of this research was to create a low-cost system with quick computations so that even the average person, who is unable to use more advanced resources, can identify counterfeit money. [1]

In this project, Vadnere, Koneri et al. used digital image processing algorithms to make currency authentication. In essence, some features were extracted using image-based segmentation and template matching, which worked well throughout the entire process and required little computation time. The technique was incredibly easy & simple to use. Using this method in the real world is highly adaptable. The folks who are unfamiliar with currencies will be benefitted from this effort. [2]

In this experiment, Jamkhandikar, Dayanand et al.used two different currencies, and it was discovered that the suggested method based on color and feature analysis is effective for currencies. This project was done using image processing algorithm. The accuracy found in this system was 70%. Doing this project allowed them to identify counterfeit money, which is particularly helpful in preventing high-order counterfeiting that makes use of low-cost but highquality machinery. [3]

Sangogi, Mrs Jyoti et al. made it possible for someone who is blind to tell whether money is real or phony. Based on the parameters of the HSV values of the currency note, the Python technique, which was implemented in a Raspberry Pi with a scanner, could capture the currency note and carried out the image processing techniques mandated in the project to determine whether the currency is genuine or counterfeit. [4]

Shiby, Ashik et al. used image processing, this project aided in the acquisition of fake currency. In certain ways, this can stop the propagation of fraudulent notes in the system. It can provide theuser with the opportunity to ascertain the note's legitimacy without having to visit a bank using machine learning algorithms.The accuracy of this proposed system is approximately 80%. The initiative covered the acquisition of Indian paper money. [5]

Warke, Kanthi et al. compared their project with other previous methodologies, image processing techniques allow for more accurate examination of the currency image while also saving time and money. The suggested method was designed to efficiently extract and check features from photos of Indian cash using so many algorithms like fluorescence detection algorithm, dimension detection algorithm, color composition algorithm etc. [6]

Aditya Sharma, Shweta Poojary et al. worked using the help of the Tensorflow and Keras libraries, this system primarily focused on the picture categorization part of deep learning using deep learning network algorithms, deep neural network algorithms, and convolutional neural network algorithms. The detection of currency tooks only a few seconds, and currency recognition was simple. The system has an excellent overall accuracy level for differentiating between real and fraudulent cash. [7]

Kudalkar et al. proposed a technique which was appeared to be effective in determining whether the currency is real or fake using image acquisition, noise removal, gray scale conversion, edge detection, segmentation, feature extraction, comparison, supervised learning algorithm. According to the project's findings, the primary security features—bleed lines, security thread, and micro lettering—were needed to be precisely computed. [8]

Pallavi, S. et al. detect and identify banknotes of different denominations. This study presented a system that use convolutional neural networks with deep training using CNN (Convolutional Neural Network) model training, currency pre-processing algorithm. By acting as a feature extractor, their ML-CNN (Machine Learning Convolutional Neural Network) based project eliminated the need for image processing and the need for manually confirming the existence of security characteristics in the note. The project's audio output, which will also be useful to blind people, will be its final product. Further experiments with different ML-CNN (Machine Learning Convolutional Neural Network) architectures will increase the model's accuracy. [9]

Potluri, Jahnavi et al. suggested an approach which offered a more effective way to spot a phony banknote using data augmentation, transfer learning. This CNN (Convolutional Neural Network) model (Mobilenetv2-FCD) was developed for a mobile application after being trained on a realtime dataset. With smart phones, this mobile application can be used to detect counterfeit money notes. This suggested network had an accuracy of 85% in identifying counterfeit notes. Any currency can be used with the network after it has been trained for it. [10]

Khan, Mudassir and Mahtab Alam showed how machine learning can be used to accurately identify fake currency. It is possible to distinguish between real and fake banknotes quickly by using the K-Means algorithm with many clusters of size two. A third group of banknotes that could be subject to additional analysis, such as genuine banknotes in poor condition that could be mistaken for forgeries, can aid when there are three clusters instead of two. The model had some flaws. In this point, an accuracy of 87% might be sufficient. Yet, it is still more precise than human detection. Additionally, the model's accuracy can be increased any further with more dataand better analysis. [11]

Vidhate, Shah et al. examined all relevant existing architectures, and by studying how they functioned, they found certain problems with the system that was in place at the time. With some of the extra features in their suggested system being implemented utilizing KNN (K-Nearest Neighbors Algorithm) algorithms or sophisticated machine learning techniques, they had preserved all the key aspects of the existing systems as their primary focus. [12]

Kumar, Akhila et al. used three supervised machine learning (SML) methods were used in this project to authenticate banknotes. The three methods that were used are the Decision Tree (DT), KNN (K-Nearest Neighbors Algorithm), and SVM (Support Vector Machine) algorithms. [13]

NR, Deepak proposed an efficient method for extracting and identifying the characteristics of Indian rupee notes was given in this study. Using digital image processing methods, the study also included the recognition and classification of counterfeit money. [14]

Siddiki, Marjuk Ahmed et al. had created a system for spotting counterfeit money using a convolutional neural network (CNN) model and certain deep learning techniques with image processing algorithms. These were really accurate and very useful for spotting counterfeit money. [15]

Naseem, Syeda Aimen et al. proposed an innovative method for distinguishing real banknotes from fake ones by applying an image processing methodology that was implemented in MATLAB. A image watermark, security thread, and serial number extraction are among the features of the banknote. The algorithm, which is based on image processing, was used in the proposed technique, which made use of regular RGB images to authenticate banknotes. [16]

Saxena, Ankur et al. presented a document which can give a person the ability to spot a phony note using digital image processing algorithms, which can play a vital role in reducing corruption. In order to detect false notes, MATLAB techniques were implemented in mobile phones with scanners or cameras, giving average person the ability to tell if a piece of currency isreal or not.

[17]

Kanojia, Mahendra, Niketa Gandhi and Amruta Rane focused on two different currencies and used color and feature analysis to evaluate whether the given currency was real or false utilizing image processing algorithms such image acquisition, gray scale conversion, edge detection, image segmentation, and feature extraction etc. [18]

Shah, Raj, Mayank Champneri and Pujan Sheth employed two methods to detect fraudulent currency notes: UV LEDs (Ultraviolet light-emitting diodes) and image analysis. To determine if a note was false or real, a UV LED (Ultraviolet light-emitting diodes) effect (a fake note detection unit) was positioned in front of the camera. In any country, automatic methods for counterfeit money note detection are essential. [19]

Gaikwad, Mayadevi et al. conduct an experiment where pattern matching was used to separate authentic notes from false notes. It was explained that various denominations have distinct templates; if the templates match the value, the note is authentic otherwise it is counterfeit. The input photos were preprocessed, which involved eliminating noise from the photographs and performing a feature extraction technique to determine the denomination. The original note and the phony note were then compared using pattern matching. [20]

Agasti, Tushar et al. researched a method for identifying counterfeit money began with the image acquisition and continued with the computation of each extracted feature's intensity. Even if the memo has scribbles on it, the algorithm can still extract features from it. This research suggested a method for determining whether a certain frequency is real or not. [21]

CHAPTER-2

SYSTEM REQUIREMENTS

# 2. System Requirements

#### Data Description:

The banknote-authentication dataset is used to distinguish between genuine and counterfeit banknotes. Images of real and fake banknote-like specimens were used to extract data from the photos. These photos were processed and number of lines on a thin strip are measured. A compressed version of the dataset from Kaggle was used in this experiment. There are 100 samples total. The model has been trained using 2000-rupee notes of cash from India**.**

To determine the dataset's input/output behavior for the system, an experiment was run. The sample dataset utilized in the experiment is named and provided below:

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset | Source | Items | Type |
| Indian Currency notes of 2000-rupee | Kaggle | 50 | Image dataset |

Table 3.1: Dataset[Accessed 05 February 2023]

**2.1** Requirement Analysis:

The implementation requirement details are given in this section.

Requirement Analysis method is intended in such a way that it takes fewer resources to figure out work correctly. The minimum needs that we’d like to take care of: The system would require a minimum of 4 GB (Gigabyte) of RAM (Random Access memory) to run all the options sleek and unforeseen. It wants a minimum of 2 GHz (Gigahertz) processor to run the system smoothly.

The system can be operated by common people as well as commercial people.

**Hardware Specification:**

|  |  |
| --- | --- |
| Processor | 2 GHz Intel |
| Storage | 512GB |
| Ram | 4GB |

Table 3.2: Hardware Requirements

**Software Specification:**

|  |  |
| --- | --- |
| Operating System | Windows 7,8,10 |
| Programming Language | Python |
| IDE(Integrated Development Environment) | VS Code |

Table 3.3: Software Requirements

**2.2** Software Requirements Specifications(SRS)

##### Python:

Python is an interpreter, object-oriented, high-level, dynamically semantic programming language. It is particularly desirable for Rapid Application Development as well as for usage as ascripting or glue language to tie existing components together due to its high-level built-in data structures, dynamic typing, and dynamic binding. Python's straightforward syntax prioritizes readability and makes it simple to learn, which lowers the cost of program maintenance. Python'ssupport for modules and packages promotes the modularity and reuse of code in programs. Onall popular platforms, the Python interpreter and the comprehensive standard library are freely distributable and available in source or binary form.

#### Python Libraries:

##### OpenCV:

OpenCV is a sizable open-source library for image processing, machine learning, and computer vision. It now plays a significant part in real-time operation, which is crucial in modern systems. With it, one may analyze pictures and movies to find faces, objects, and even human handwriting.

To install OpenCV run the command - pip install opencv-python. Python is able to handle the O as NumPy. We use vector space and apply mathematical operations to these features to identify visual patterns and their various features.

##### NumPy:

Many mathematical operations can be carried out on arrays with NumPy. It provides a vast library of high-level mathematical functions that work on these arrays and matrices, as well as strong data structures that ensure efficient calculations with arrays and matrices. To install NumPy run the command - pip install numpy.

##### VS Code:

Debugging, task execution, and version control are supported by the simplified code editorVisual Studio Code. It tries to give developers only the tools they require for a short cycle of code-builddebugging and leaves more sophisticated processes to IDEs with more features, like Visual Studio IDE.

Features of Currency

All features of Indian currency 2000 showing in fig

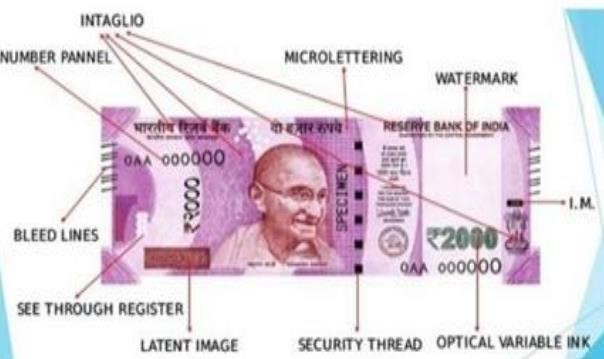


Fig 3.1: All security features of Indian currency 2000[3]

**Portrait of Mahatma Gandhi at the Center:**

The intaglio printing of portrait of Mahatma Gandhi at the center of the currency.



Fig 3.2: Portrait of Mahatma Gandhi[1]

**Security Thread:**

When held up to the light, the security thread, which has "RBI" and "Bharat" inscribed on it continually, can be seen at the left side of the watermark. The photo of the Mahatma has a security thread on one side.



Fig 3.3: Security Thread[1]

**See through Register:**

The denomination numeral is displayed in the see-through register. Both sides of this register are printed. One side of the two sides is hollow, and the other side is filled with material. The micro lettering has been written horizontally along this register. The note has a latent image on the left side. Moreover, this register is shown above the latent image. When viewed in contrast to the light, this register appears as a single design.



Fig 3.4: See through Register[1]

**Ashoka Pillar**:

On the right side of the coin there is a picture of the Ashoka pillar.



Fig 3.5: Ashoka Pillar[1]

**Identification Mark:**

Just over the Ashoka's pillar symbol, there is an identification mark.



Fig 3.6: Identification Mark[1]

**Guarantee Clause:**

Located to the right of Mahatma Gandhi's image, the guarantee clause is signed by the governor and includes a promise clause that is printed in intaglio.

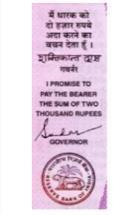


Fig 3.7: Guarantee Clause[1]

**Currency Numeral with the Rupees Symbol:**

Fluorescent ink will be used for printing. When viewed from different perspectives, the numerals change.



Fig 3.8: Currency Numeral with the Rupees Symbol[1]

**Bleed Lines:**

The oblique lines that protrude from the sides of banknotes are known as bleed lines.

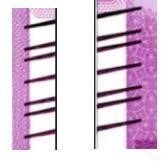


Fig 3.9: Bleed Lines[1]

**Latent Image of Denomination Numeral:**

The right side of Mahatma Gandhi's portrait is bordered by a vertical band on the opposite side of the denomination. A latent image of the corresponding denominational value is present in it. Its denominational value is represented by a numerical value. The latent picture can be seen when the coin is held horizontally, and it should also be held at eye level. While using counterfeit money, it is not noticeable.



Fig 3.10: Latent Image of Denomination Numeral[1]

**Micro Lettering:**

Between the vertical band and the image of Mahatma Gandhi, micro lettering is visible. The term "RBI" and the denominational value are written in tiny letters. The micro letters on counterfeit money are incorrectly printed.

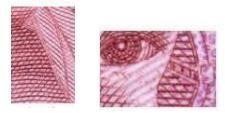


Fig 3.11. Micro Lettering[1]

**Government of India:**

The words "Government of India" are printed at the top of the one rupee note, directly over the Devanagari-scripted number one. The smallest currency note now in use in India is 1 rupee, and it is the only one that was produced by the Government of India rather than the Reserve Bank of India like the others. Because of this, it is the only one with the Finance Secretary's signature rather than the RBI Governor's.



Fig 3.12. Government of India[1]

CHAPTER-3

MODULES OF SYSTEM

# 3.Modules of System

**3.1** Modules of System

#### **Image Acquisition Module**

* Captures an image of the currency note using a camera or scanner.
* Ensures high-resolution images for accurate analysis.

#### **Preprocessing Module**

* Converts the image to grayscale or binary format.
* Enhances the image by noise reduction and contrast adjustment.
* Normalizes the image to a standard size for further processing.

#### **Feature Extraction Module**

* Extracts key features such as:
  + **Watermarks** (opacity, texture, position).
  + **Security thread** (metallic strip presence).
  + **Micro-lettering** (hidden text verification).
  + **Color and pattern analysis.**
  + **Holograms and color-shifting ink detection.**

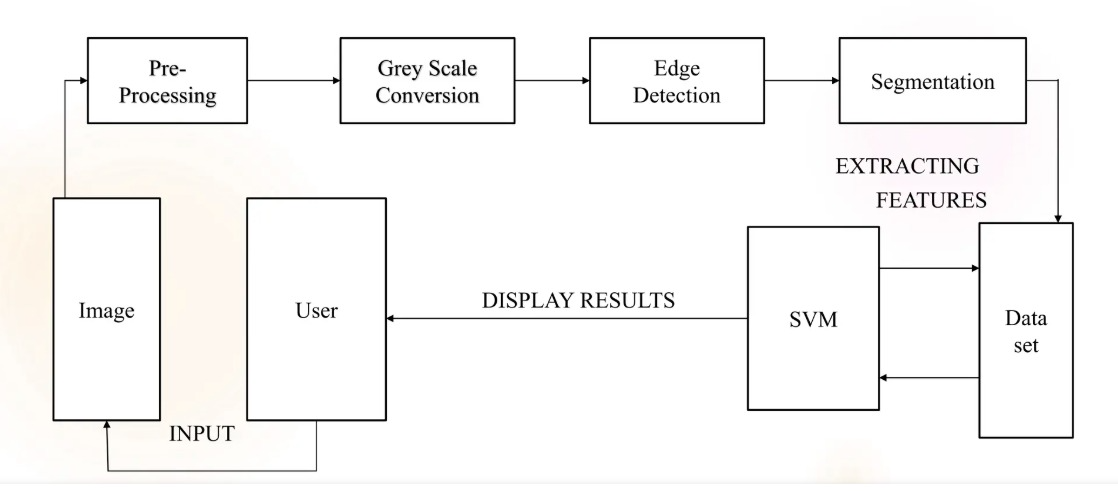
#### **Classification & Authentication Module**

* Compares extracted features with a database of genuine currency.
* Uses machine learning or deep learning models to classify as **genuine or counterfeit.**
* Applies pattern recognition and edge detection techniques.

#### **Result & User Interface Module**

* Displays the verification result to the user.
* Can include a **mobile app** or **desktop software** for real-time processing.
* Provides alerts if counterfeit currency is detected.

**3.2** UML Diagrams



CHAPTER-4

IMPLEMENTATION

# 4.Implementation

**4.1** Sample Code

#### Required Algorithm:

**Image acquisition:**

The act of obtaining an image from sources is known as image acquisition. Hardware systems like cameras, encoders, sensors, etc. can be used to do this. It is without a doubt the most important phase in the MV (Machine Version) workflow because a bad image would make the workflow ineffective as a whole. As machine vision systems don't study the acquired digital image of the object and not the object itself, acquiring an image with the proper clarity and contrast is crucial. A set of photo-sensitive sensors turn an object's incoming light wave into an electrical signal during the image acquisition step. These little components provide the function of accurately describing the object to your machine vision algorithms. It's a frequent fallacy that with an MV system, choosing the correct colors is crucial. However it's not always the case. Colors frequently increase noise and make detection more challenging. The main objective of an image acquisition system is to increase contrast for the important features. The ideal image is onein which the camera can clearly see the object of interest. [45]

The major image acquisition components have been mentioned below:

1. Trigger
2. Camera
3. Optics
4. Illumination

**RGB to Grayscale:**

Taking the average of the red, green, and blue pixel values for each pixel to obtain the grayscale value is a straightforward technique to convert a color image's 3D array to a grayscale image's 2D array. This creates an approximate gray color by combining the lightness or brightness contributions from each color band. [46]

The Average method takes the average value of R, G, and B as the grayscale value. [47]

Grayscale = (R + G + B ) / 3

The weighted method, also called the luminosity method, weighs red, green, and blue according to their wavelengths. The improved formula is as follows:

Grayscale = 0.299R + 0.587G + 0.114B

**Image Segmentation:**

Image segmentation is a technique for breaking up a digital image into smaller groupings called image segments, which reduces the complexity of the image and makes each segment more easily processed or analyzed. Technically, segmentation is the process of giving labels to pixelsin an image in order to distinguish between objects, persons, or other significant aspects. Object detection is a frequent use of image segmentation. It is usual practice to first apply an image segmentation method to discover things of interest in the image before processing the complete image. The object detector can then work with a bounding box that the segmentation algorithm has previously established. By stopping the detector from processing the entire image, accuracy is increased and inference time is decreased. A crucial component of computer vision technologies

and algorithms is image segmentation. It is employed in a variety of real-world

contexts, including as face identification and recognition in video surveillance, medical image analysis, computer vision for autonomous cars, and satellite image analysis.[48]

**Feature Measurement:**

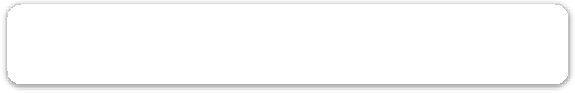
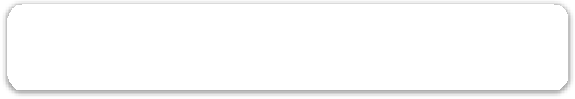
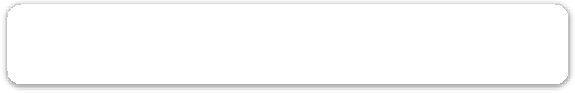
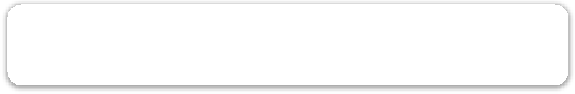
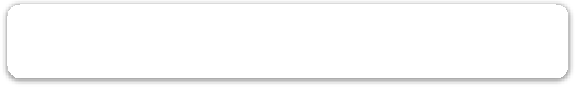
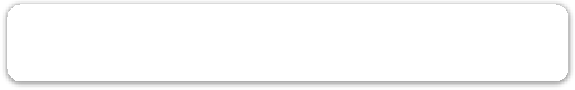
The process of "feature detection" involves computing abstractions of image data and locally determining whether or not each image point contains an image feature of a specific type. A fundamental aspect of image processing is feature detection. This means that it is typically done as the initial operation on an image and checks each pixel to see if a feature is present there. If this is a component of a bigger algorithm, the algorithm will usually just look at the image wherethe features are. The term "feature description" refers to a technique for describing the local attributes of an image at identified key points in an image. These algorithms take advantage of key points discovered in the image data to extract interesting information. The information produced by these feature description techniques is frequently organized by encoding it as the constituent parts of a single vector, or feature vector. A feature space is the collection of all feasible feature vectors. [49]

**Finding Correlation:**

For finding Correlation of two images we have to follow this steps:

1. Load two images and extract their pixel-by-pixel information
2. Normalize and down sample the pixel information
3. Calculate cross-correlation using the processed pixel information
4. Generate visual summaries of cross-correlation, highlighting areas of maximum image overlap.

#### Flowchart:



Image

Acquisition

RGB

to

Grayscale

Image

Feature

Finding

Correlation

Classification

Fig 3.13: Block Diagram of Fake Currency Detection

#### Workflow

1. Image Acquisition: The model receives the image. Images should be present: the note you're trying to identify and its real-world counterpart. Picture capture of an Indian banknote with a basic digital camera or scanner.
2. RGB to GRAYSCALE: Acquired picture is A GRAYSCALE image is created by converting an RGB image. The RGB image is dense and noisier. Instead of processing three components R (Red), G (Green), and B, the image is reduced in size and gains easyto-process intensity information when it is converted to gray scale (Blue).
3. Segmentation: Gandhi Ji's image and a narrow strip image are cropped from the original image. The observe and reverse aspects of the Indian paper currency will be clipped and split. The technique of segmenting an image into separate segments and sets of pixels is done digitally. It is also known as "picture thresholding," where a threshold is set and, if a specific pixel's value exceeds it, the pixel turns white; otherwise, it turns black.
4. Feature Measurement: Feature measurement is done to measure the number of lines on a thin strip. This is a really lengthy process.
5. Finding Correlation: We find correlation between Gandhi Ji’s image on the real note & fake note using distance-weighted algorithm. If the outcome is greater than 0.5 then we will consider it legitimate otherwise the currency is fake.
6. Classification: Finally, we will classify the image as real or fake

#### Implementation Steps

1. At first, OpenCV was used to read the real and fake photos after importing the Modules.
2. The colorful image was then changed to black and white because a black and white image makes it simpler to identify key aspects.
3. Then Gandhi Ji's picture was being taken from the original note. The coordinates must be changed each time Gandhi Ji's image is extracted. The same thing also be done for fake notes.
4. Then the thin strip was extracted from the real and fake notes.
5. Then the image was being converted to HSV (Hue Saturation Value). Simple terms, the format is different. A numerical evaluation of the color in the photograph is called HSV.
6. Then, the thin strip was extracted from the HSV images and fake images.
7. Then, the thresh value was specified in this case, and only values more than the specified values were extracted from the cropped image. The '&' of both values will then be taken. The goal of the entire procedure was to extract the thin strip's lines from the thin strip image.
8. Bwareaopen is a function that will find the connectivity in a picture. It will be used to determine how many lines there are in a short strip. It will be employed later on in the procedure.
9. Then, the code for morphologically extracting the thin strip image can be seen. This is a crucial step in determining the amount of lines in an image.
10. Then Bwareaopen function for the thin strip was used.
11. In next step, final counting of the number of lines in real and fake note was made.
12. A correlation function was being defined. This correlation function to our Gandhi Ji image was applied. Simply said, we were looking to compare Gandhi Ji's image on the real and false photos. This will accept two two-dimensional matrices as input and return aresult in the form of a number between 0 and 1. Gandhi Ji's photo on a fake note is legalif the outcome is larger than 0.5; otherwise, it is not.
13. Lastly the correlation function was being used. Also, we were building our code to determine whether or not the correlation value is greater than 0.5. If it is larger than 0.5, then we were determining whether or not there are an equal number of lines.

**4.2** Test Cases

|  |  |  |
| --- | --- | --- |
| **Test Case ID** | **Test Scenario** | **Expected Output** |
| TC\_FD\_01 | Scan a genuine Rs. 500 note | System verifies it as "Genuine" |
| TC\_FD\_02 | Scan a counterfeit Rs. 500 note | System detects "Fake Currency" |
| TC\_FD\_03 | |  | | --- | |  |  |  | | --- | | Scan a torn/damaged note | | |  | | --- | |  |  |  | | --- | | System provides a warning message | |
| TC\_FD\_04 | Scan a different denomination (Rs. 10, Rs. 100, etc.) | System correctly identifies the denomination |
| TC\_FD\_05 | Scan a foreign currency (USD, EUR, etc.) | System rejects the note with an "Invalid Currency" alert |

CHAPTER-5

RESULTS

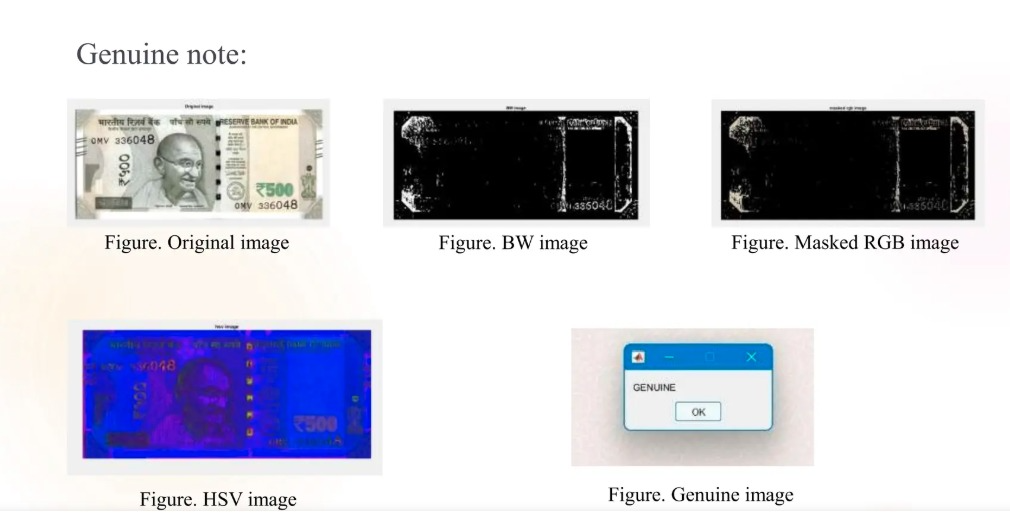
# 5. Results

There are other ways to detect if the money is phony or not, but they all follow the same basic stages. Image capture, edge recognition, segmentation, grayscale conversion, and feature extraction are among them. Most of the articles use MATLAB as their computation tool, however we ultimately used OpenCV and Python as our programming language. To perform comparisons and determine the outcome, a number of characteristics that identify genuine currency apart from counterfeit ones are taken into account.

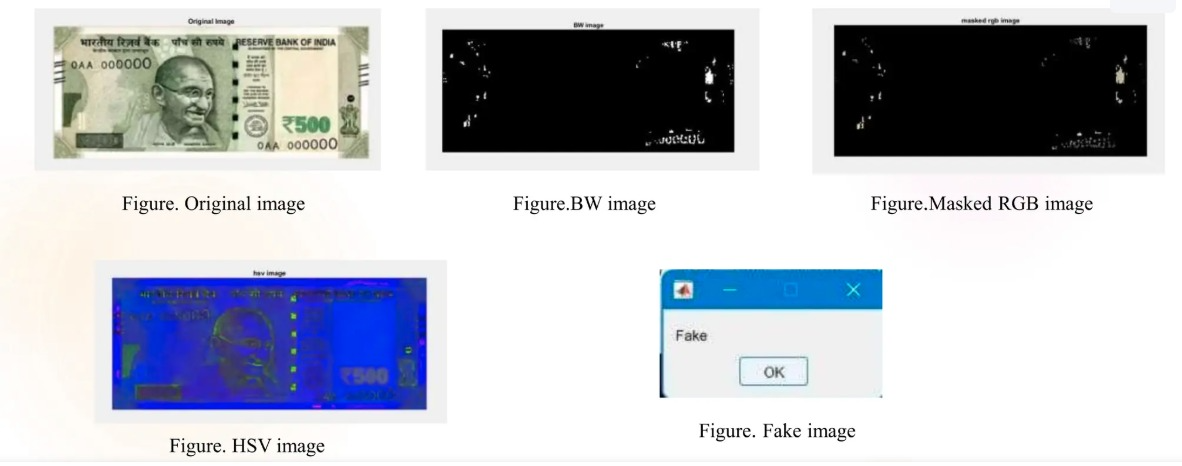
We are aware that these tools are used at banks and businesses to help identify counterfeit money, but the average person who lacks these resources is susceptible to this. Our goal is to offer a lowcost system with quick computations that can make decisions in a matter of seconds. The entire process ought to function for Indian denomination 2000. It would be simple for the general public to use, relatively portable, and reasonably priced. The model has some limitations.We can get at most 81% of accuracy which may be sufficient. However, it is still more precise than human detection. It can currently be utilized as an additional tool to lessen human mistake. Additionally, the model's accuracy can be increased any further with more data and better analysis.

Accuracy: The percentage of accurately classified data samples over all the data is known as accuracy. Accuracy can be calculated by the following equation. [52]

Accuracy = (TP+TN)/(TP+FP+TN+FN)



Fake Note:



CHAPTER-6

CONCLUSION

# 6. Conclusion

#### Advantages

* The application will be very helpful in identifying counterfeit money.
* The software is simple to use and accessible.
* It will lessen the user's effort and save time.
* It provides the user methods that are more affordable, accurate, and give accurate recognition of money notes.

#### Restriction:

* This project cannot be able to detect the currencies whether it is fake or not, of other countries except India.
* This project is only able to detect the currencies whether it is fake or not with denomination 2000 of Indian rupees.

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