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Fake Currency Detection

Aniket Bhoyar[1], Aditya Sormare[2], Chirag Tabhane[3], Karan Tembhare[4], Prof. Shreya Bhanse[5]

[1,2,3,4]School of Science, G H Raisoni University, Amravati, Maharashtra, India
[5]Assistant Professor, G H Raisoni University, Amravati, Maharashtra, India

ABSTRACT

The creation and circulation of counterfeit notes are on the rise right now, as a result of advances in color printing technology. This is a serious issue that affects practically all of the nations. The economy is impacted. Such fake money fuels evil intentions, typically involving terrorist actions. According to the research, this has had a highly negative effect on developing nations like India. This research suggests a method for viewing the fake currency through its image. Pre-processing should be used after choosing an image. Then a conversion from RGB to GRAYSCALE is done. Banks and other trading places have equipment available to verify financial validity. Nevertheless, the normal individual does not have access to such tools, which is why fake money detecting software that is usable by regular people is required. We get at most 81% of accuracy considering 50 items of Indian Currency notes of 500-rupee. This project provides a thorough explanation of a fake note detector that can be used by the average person. The suggested system employs image processing to identify genuine currency from counterfeit money. The Python programming language has been used to create the software in its entirety.

KEYWORDS: *Fake Currency, Image Processing, Grayscale Conversion, Segmentation, pre-processing*

#Technologies
1)PYTHON-Python is an interpreter, object-oriented, high level, dynamically semantic programming language. 2)Python Libraries: OpenCV, NumPY, VS Code.

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I. 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 the economy, 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%.[51].

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 500- rupee 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.

Objective-

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.

II. RELATED WORK-

This project paper is based on Fake Currency Detection. At the first chapter it includes the introduction and objective part which mainly describe about our project topic, why this project is important and which methods are used in our project to make it successful. The second chapter includes literature review which mainly represents the summary of the different project paper related to our project topic, including of what they had achieved and by which process they had done their project etc. The third chapter includes the methodology part which mainly represents the information about the used dataset, software and hardware tools and tables the description of the process with the flow-chart diagram, features of the currency by following we did our project. The fourth chapter includes the conclusion part that includes result and discussion part, which represents what we have got from our project with the advantages of our project and also includes limitations of our project and the scope at which we can improve our project in the future.

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 500-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	Item	Type
Indian currency Note 500 rupee	kaggle	50	Image dataset

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

Software Specification-

Operating System	Windows 7,8,10
Programming language	Python
IDE (Integrated Development Environment)	VS code

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 a scripting 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's support for modules

and packages promotes the modularity and reuse of code in programs. On all 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 OpenCV array structure for analysis when it is integrated with different libraries, such as NumPy. We use vector space and apply mathematical operations to these features to identify visual patterns and their various features.

Features of Currency-

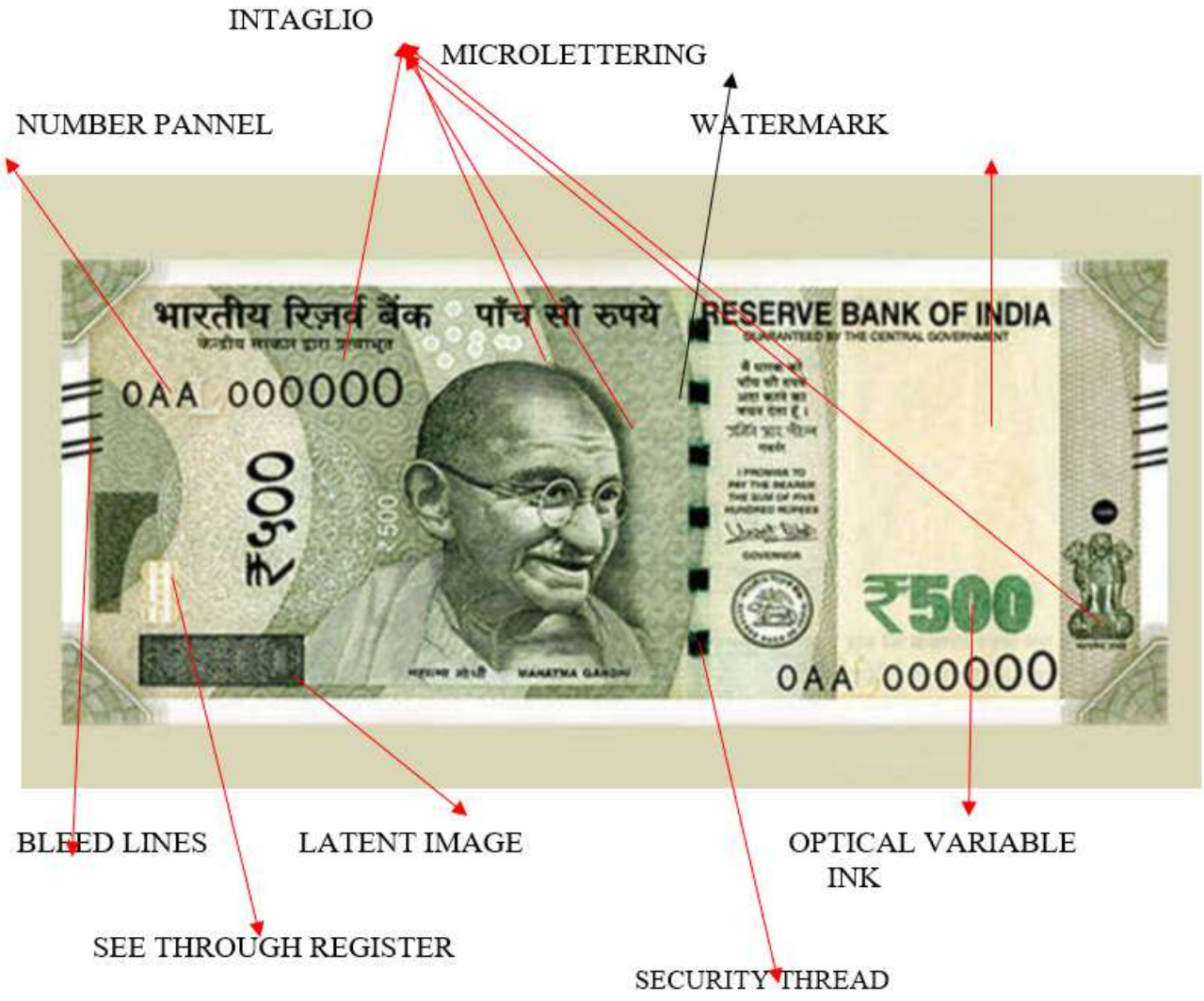
All features of Indian currency 500 showing in fig

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 editor Visual Studio Code. It tries to give developers only the tools they require for a short cycle of code-build-debugging and leaves more sophisticated processes to IDEs with more features, like Visual Studio IDE.

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

$$\text{Accuracy} = (TP+TN)/(TP+FP+TN+FN)$$



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

Fig: Portrait of Mahatma Gandhi

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-Security Thread

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: See through Register

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

Fig: Ashoka pillar

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

Fig: Identification mark

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: Guarantee Clause

Currency Numeral with the Rupees Symbol: Fluorescent ink will be used for printing. When viewed from different perspectives, the numerals change.

Fig: Currency Numeral with the Rupees Symbol

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

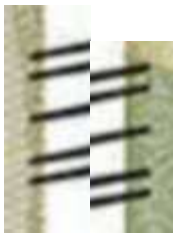


Fig: Bleed lines

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: Latent Image of Denomination Numeral

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.

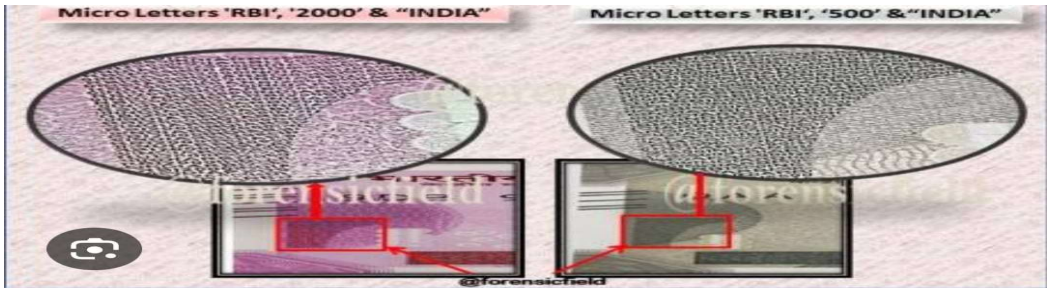


Fig: Micro Lettering

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: Government of India

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 one in which the camera can clearly see the object of interest.

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.

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

$$\text{Grayscale} = (R + G + B) / 3$$

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 pixels in 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.

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 where the 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.

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.

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.

Future Scope-

- This project cannot be able to detect the currencies of other countries except India. So in the future we can make this project possible to detect the currencies of other countries also.
- This project is only able to detect the currencies whether it is fake or not with denomination 2000 of Indian rupees. So in the future we can make it possible that it will detect the currencies with all denomination.
- In this project, we worked using a few features of the currencies. So in the future we can be able to work with all features of currencies to increase the accuracy of the project.

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