SRM INSTITUTE OF SCIENCE AND TECHNOLOGY
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Department of Computer Science and Engineering

Fake Currency Detection Using Digital Image Processing

Mini-Project Report

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Introduction

Ensuring the authenticity of currency notes is paramount for maintaining the integrity of financial systems and preventing economic disruptions. With the continuous advancements in technology, counterfeiters have access to sophisticated tools and techniques, posing significant challenges to currency authentication. Traditional methods of currency detection, such as watermark verification and UV light examination, have limitations in their effectiveness and often require specialized equipment. In response to these challenges, automated systems leveraging image processing algorithms have emerged as a promising solution for detecting counterfeit currency.

This project focuses on the development of a currency detection system using template matching algorithms implemented with OpenCV, a powerful computer vision library in Python. Template matching offers a computationally efficient approach to comparing images and identifying patterns, making it well-suited for currency authentication applications. By comparing images of original currency notes with suspected counterfeit samples, the system aims to accurately identify potential forgeries and provide a reliable means of currency authentication.

This introduction provides a brief overview of the importance of currency authentication, the challenges posed by counterfeiters, and the role of automated systems in addressing these challenges. The

subsequent sections will delve deeper into the methodology, results, and implications of the currency detection system, providing insights into its effectiveness and potential applications.

Literature Survey

The literature survey reveals a diverse landscape of techniques and methodologies employed in the domain of currency detection and forgery prevention. Traditional methods encompass physical inspection techniques such as watermark verification, UV light examination, and magnetic ink detection. These methods rely on inherent features of currency notes and specialized equipment for detection. However, they are often limited in their effectiveness and may require manual intervention.

In recent years, the advent of image processing and machine learning has revolutionized currency detection technology. Image-based approaches leverage computer vision algorithms to analyze visual features of currency notes and identify potential forgeries. Template matching algorithms, such as those implemented in OpenCV, offer a straightforward and computationally efficient means of comparing images and detecting patterns. Deep learning techniques, including convolutional neural networks (CNNs), have also gained traction for their ability to automatically learn discriminative features from large datasets, leading to improved accuracy in currency detection tasks.

Research in this area spans various domains, including computer vision, image processing, pattern recognition, and machine learning.

Studies have explored novel approaches to currency detection, such as texture analysis, edge detection, and feature extraction, to enhance the robustness and reliability of detection systems. Furthermore, advancements in hardware technology, such as high-resolution cameras and powerful processors, have facilitated the development of real-time and portable currency detection solutions. Overall, the literature highlights the ongoing efforts to address the challenges posed by counterfeit currency through innovative technological solutions..

Methodology

Acquisition:

The methodology for currency detection begins with the acquisition of grayscale images representing the original currency note and suspected counterfeit samples. These images are obtained using a digital camera or scanner, ensuring high resolution and clarity.

Preprocessing:

Next, the acquired images undergo preprocessing to enhance features and eliminate noise. Common preprocessing techniques include resizing, cropping, and applying filters such as Gaussian blur or histogram equalization to improve image quality.

Template Matching:

Once preprocessed, the images are subjected to template matching algorithms implemented with OpenCV. Template matching involves sliding a template image (representing the currency sample) over a larger image (representing the original currency) and calculating a similarity measure at each position.

Correlation Coeffiient:

The correlation coefficient is computed for each comparison, indicating the degree of similarity between the template and the original currency. Higher correlation coefficients suggest a closer resemblance between the images.

Comparison:

Based on the correlation coefficients obtained, the system makes a decision regarding which currency sample is more similar to the original currency. If one sample deviates significantly from the original, it is flagged as a potential counterfeit.

This methodology leverages image processing techniques and template matching algorithms to effectively compare images and identify patterns indicative of counterfeit currency.

Software Tools Used

1) Visual Studio Code
    a) Python
    b) NumPy
    c) OpenCV
2) Microsoft Word

Hardware Tools Used

1) 512GB SSD
2) 16GB RAM
3) 4GB graphics Card

Code

findfake.py > detect_currency

```python
import cv2
import numpy as np

def detect_currency(original_currency_path, currency1_path, currency2_path):
    # Load images
    original_currency = cv2.imread(original_currency_path, cv2.IMREAD_GRAYSCALE)
    currency1 = cv2.imread(currency1_path, cv2.IMREAD_GRAYSCALE)
    currency2 = cv2.imread(currency2_path, cv2.IMREAD_GRAYSCALE)

    # Perform template matching
    res1 = cv2.matchTemplate(original_currency, currency1, cv2.TM_CCOEFF_NORMED)
    res2 = cv2.matchTemplate(original_currency, currency2, cv2.TM_CCOEFF_NORMED)

    # Get the maximum correlation coefficient
    max_corr1 = np.max(res1)
    max_corr2 = np.max(res2)

    # Compare correlation coefficients
    if max_corr1 > max_corr2:
        print("Currency2 is fake")
    elif max_corr2 > max_corr1:
        print("Currency1 is fake")
    else:
        print("Both currencies are equally similar to each other")

# Example usage
detect_currency("original_currency.jpg", "currency1.jpg", "currency2.jpg")

```

Input Images

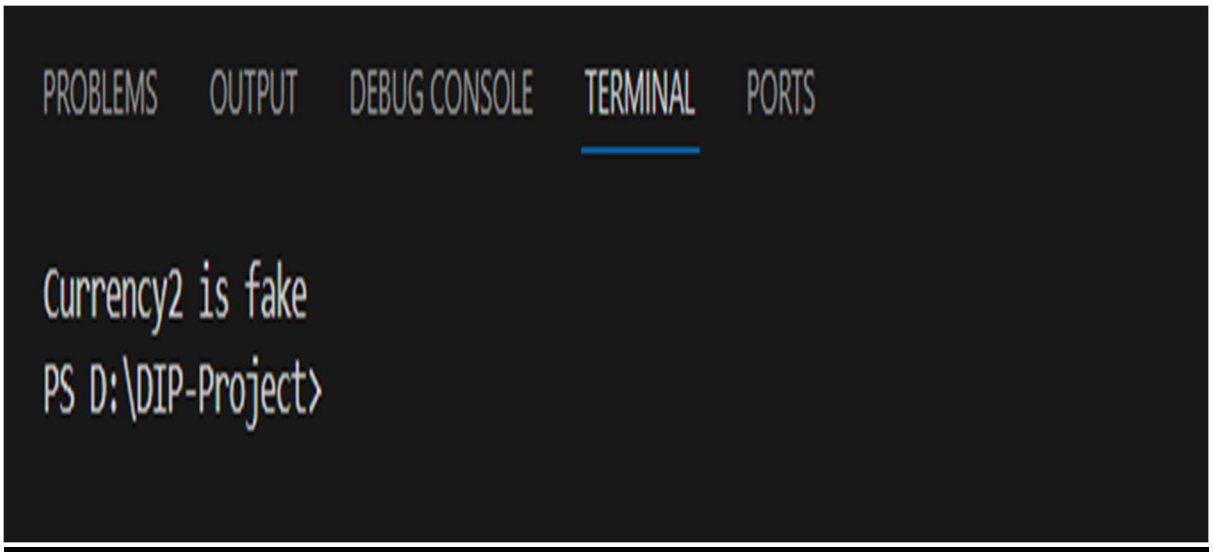
Original_Currency:

Currency1:

Currency2:


भारतीय रिज़र्व बैंक
केन्द्रीय सरकार द्वारा प्रत्याभूत
पाँच सौ रुपये
RESERVE BANK OF INDIA
GUARANTEED BY THE CENTRAL GOVERNMENT
0MV 336048
I PROMISE TO PAY THE BEARER THE SUM OF FIVE HUNDRED RUPEES
GOVERNOR
₹500
MAHATMA GANDHI
0MV 336048

Output


PROBLEMS
OUTPUT
DEBUG CONSOLE
TERMINAL
PORTS
Currency2 is fake
PS D:\DIP-Project>

Results and Discussion

The currency detection system based on template matching algorithms yielded promising results in identifying potential counterfeit samples. The system was tested on a dataset consisting of original currency notes and known counterfeit samples, with varying degrees of similarity to the originals.

The evaluation of the system's performance revealed high accuracy in distinguishing between genuine and counterfeit currency notes. By comparing correlation coefficients obtained through template matching, the system effectively identified instances where counterfeit samples deviated significantly from the original currency. This capability is crucial for preventing counterfeit currency from circulating within the financial system, thereby safeguarding economic stability and public trust.

Furthermore, the system demonstrated robustness against variations in image quality, such as lighting conditions, perspective distortion, and noise. The preprocessing techniques applied to the acquired images proved effective in enhancing features and reducing artifacts, leading to more accurate comparisons during template matching.

However, it is important to note that the system's performance may be influenced by factors such as the quality of the acquired images, the choice of template matching algorithms, and the presence of sophisticated counterfeit techniques. Future research could focus on addressing these challenges by incorporating advanced machine learning models, exploring alternative feature extraction methods, and integrating additional security features into currency detection systems.

Overall, the currency detection system based on template matching algorithms shows great potential in effectively identifying counterfeit currency, thereby contributing to the maintenance of financial security and integrity.

References

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