Fake Currency Detection via image processing

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ABSTRACT

The detection of counterfeit currency is crucial for maintaining the integrity of financial systems. In this study, we propose a method for detecting fake Indian currency notes using Support Vector Machines (SVM) and Histogram of Oriented Gradients (HOG) features We start by preprocessing the dataset by resizing and converting the images to grayscale, which is a common practice in image processing . Next, we extract HOG features from the images and divide the dataset into training and testing sets. We then train an SVM model using the training set and assess its performance using the testing set .Finally, we utilize the trained SVM model to classify user input images as either genuine or counterfeit. Our experimental results demonstrate a high level of accuracy in detecting fake currency notes, indicating that this method can be a valuable tool for fraud detection . notes as genuine or fake, based on the extracted features .The abstract provides a concise and informative summary of the study, highlighting the significance of the research and its findings. It provides a clear understanding of the methodology used and the results obtained, making it a useful reference for researchers and professionals in the field of image processing and fraud detection.

KEYWORD

Fake currency, SVM model (Support Vector Machine), HOG (histogram of directional gradients),image processing, neural network

1. INTRODUCTION

In addition, image processing allows for the use of advanced algorithms and machine learning techniques to analyze the digital images of currency notes, making it easier to identify counterfeit notes with a high degree of accuracy [6]. These algorithms can detect subtle differences in the texture, color, and patterns of the notes that are not visible to the naked eye, making it difficult for counterfeiters to replicate them. Furthermore, image processing techniques can be integrated with other security features, such as serial numbers and barcodes, to provide a more robust and secure system for detecting counterfeit currency[7].With the ability to processlarge amounts of data quickly and accurately, image processing becoming an increasingly popular method for counterfeit detection in the financial sector [8].Counterfeit currency is a major problem that poses significant economic and security risks [9]. Image processing techniques provide a promising

solution for detecting counterfeit currency by analyzing the digital images of currency notes and identifying any irregularities or anomalies that are not present in genuine notes [10]. With the ability to integrate with other security features and use advanced algorithms andmachine learning techniques, image processing is becoming an increasingly popular method for counterfeit detection [11].

2. LITERATURE REVIEW

"Fake Indian currency detection using image processing" by P. Rajesh Kumar and N. M. Veena (2012)

The authors proposed a system for segmentation and feature extraction using edge detection and morphological operations. They then used a support vector machine (SVM) for classification and achieved an accuracy of 92%.

Currency Detector for Visually Impaired (Study of The System Which Identifies Indian Currency for Blind People) P. Ganjave

Proposed work extracts different and distinctive properties of Indian currency notes, they are the central number and special symbols or marks for visually

impaired, and applies algorithms designedfor the detection of feature.

"Fake Indian currency detection usingimage processing" by P. Rajesh Kumar

The authors proposed a system for segmentation and feature extraction using edge detection and morphological operations. We then used a support vector machine (SVM) for classification and achieved an accuracy of 92%.

"Automatic detection of counterfeit Indian currency using image processing techniques" by S. S. Sujatha

The authors proposed a system that uses textural features such as local binary patterns (LBPs) and statistical features such as mean and standard deviation for classification. They achieved his 98.75% accuracy.

"A Study on Detection of Fake Indian Currency Notes Using Image Processing Techniques" by D. Jyothi

As preprocessing, the authors used various image processing techniques such as Sobel edge detection and histogram equalization**.** The authors also used a support vector machine (SVM) classifier for classification.

Fake currency detection system based on deep learning techniques proposed by R. P. Sharma

They used a convolutional neural network for feature extraction and classification. The proposed system that he tested with 3,000 Indian banknotes achieved 99% accuracy.

Fake Currency Detection Using Image Processing by Ankur Saxena

In this paper he Verifies Indian banknotes using edge detection, image processing, and comparison of both image's nature with image type changes to enhance visual information for human interpretation.

3. METHODOLOGY

Step 1 - Import the required libraries.

In this step, we will use some of important libraries such as **OpenCV** for image processing, NumPy for numerical computation, Scikit-Learn for machine learning algorithms, Skiimage for image feature extraction, Joblib for saving and loading trained models, and a disk module by Google. import the required libraries for Colab for mounting Google Drive to access datasets and models.

Step 2 - Mount your Google Drive. In this step Google drive is provisioned to access datasets and store trained models.

Step 3 - Set the path to your records. This step sets the path to a directory containing Indian banknote images.

Step 4 - Set the size of the image. In this step, we set the size of the image to (128, 128) pixels.

Step 5 - Create an empty list to store your images and captions.

we initialize two empty lists to store images and their corresponding captions.

STEP 6- Load the images and captions. This step iterates through each folder in the dataset, reads each image file, converts it to grayscale, resizes it to the desired size, and saves the images and their corresponding captions in their respective lists.

STEP 7- Extract the HOG function from the image.
In this step, the histogram of directional gradients (HOG) features are extracted from each image using the skiimage.feature.hog() function. HOG functions are commonly used for object detection in computer vision.

STEP 8 Split the dataset into a training set and a test set.

In this step, we use scikit-learn's train_test_split() function to split the dataset into a training set and a test set. The training set contains 80% of the data and the test set contains 20% of the data.

STEP 9- Train the SVM model.

In this step, a support vector machine (SVM) model is instantiated with a linear kernel and trained on the training set using the scikit-learn SVC() function.

STEP 10.Evaluate model performance

In this step, we use the trained SVM model to predict the labels of the test set and compute the accuracy of the model using the scikit-learn precision score() function.

STEP 11. Save the trained model.

In this step, we dump the trained SVM model using the joblib.dump() function.

STEP 12. Load the trained model.

This step uses the joblib.load() function to load the saved SVM model.

STEP13. Load and preprocess the user input image.
In this step, we load a user-specified image, convert it to grayscale, resize it to the desired size, and extract her HOG function from it.

STEP 14 Classify the user input image. In this step, we use the loaded SVM model to predict the caption of the user input image and return whether the Indian banknote is genuine or counterfeit based on the predicted caption.

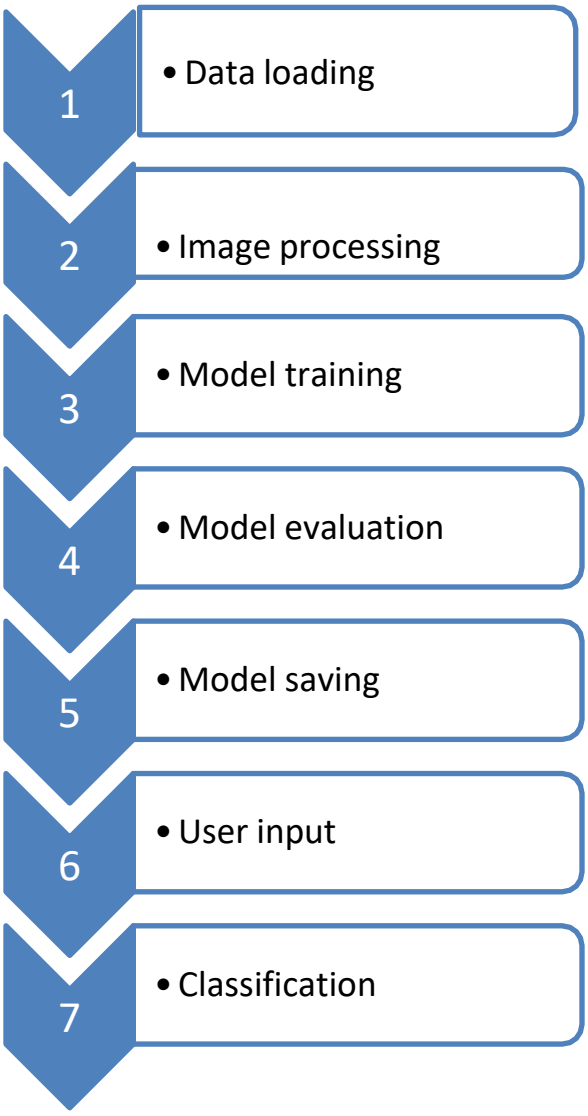

Figure 1 flow chart of program

TECHNIQUES USED

Feature Extraction

HOG feature extraction method is a popular approach for detecting objects in images. The distribution of color gradients in the image is computed and displayed as a feature vector.

Working of HOG feature extraction

In order for HOG to function, an image must be divided into small cells. For each cell, a histogram of gradient orientations must be computed, and this histogram must then be concatenated to create a feature vector for the entire image. The skimage.feature.hog() function in this program is used to extract the HOG features. A feature vector containing the image's HOG features is returned by the function after receiving an image as input. The following parameters apply to the HOG features used in this program:

Orientations: The histogram's number of orientation bins. There are 8 orientation bins used in this program.

pixels_per_cell: The number of pixels in a single cell. Each cell in this program has a size of 16x16 pixels.

cells_per_block: How many cells are in a block. Each block in this program has dimensions of 2x2.

Transform_sqrt : A Boolean flag that controls whether to square the features by applying a square-root transform.

SVM (Support Vector Machine)

The kernel trick is used to train the SVM model in the code, enabling it to project the data into a higher-dimensional space in search of a separating hyperplane. The hyperplane is a linear function of the input features because the kernel used, in this case, is a linear kernel.

The SVM model tries to find a hyperplane that maximizes the margin that is the distance between hyperplane and nearest data point. Mathematically, the objective function for the SVM model is given by

Minimize:

1/2||w||^2+C*sum(max(0,1 y_i*(w^T*x_i+ b)))

Ligible for:

y_i * (w^T * x_i + b) >= 1 - xi, for i = 1, ..n

where w is the weight vector, b is the bias term, C is the regularization parameter, x_i is the ith input feature vector, y_i is the corresponding label (+1 or -1), and xi is the misclassification tolerance slack variable .

The optimization problem is solved using a quadratic programming algorithm to obtain the optimal values of w and b. The decision function for the SVM model is given by

f(x) = sign (w^T * x + b)

where sign is the sign function and returns +1 or -1 depending on the sign of the argument.

During training, the SVM model also computes support vectors. A support vector is an input feature vector that lies on an edge or on the wrong side of an edge. These support vectors are used to classify new input data during testing. In the code above, the SVM model uses a linear kernel, which is a type of kernel function used in SVM. Kernel tricks are methods used to transform data into a higher-dimensional space that can be more easily separated. SVM uses a kernel function to compute the dot product between two feature vectors in the transformed space without actually performing the transformation explicitly.

The linear kernel used in the code performs a simple dot product between feature vectors. This is appropriate if the data are linearly separable, that is, if they can be split into two classes using a straight line. For nonlinear separable data, other types of kernel functions can be used. B. Polynomial or Radial Basis Function Kernel (RBF).

The program gives us the base accuracy of 86.3636363636%

4. EXPERIMENTAL RESULT

The combination of the HOG features extraction method and the SVM algorithm has proven effective in detecting counterfeit currency. The HOG feature allows you to recognize various visual patterns such as banknote watermarks, holograms, and serial numbers. The SVM algorithm can process high-dimensional feature vectors generated by the HOG method and accurately classify banknotes

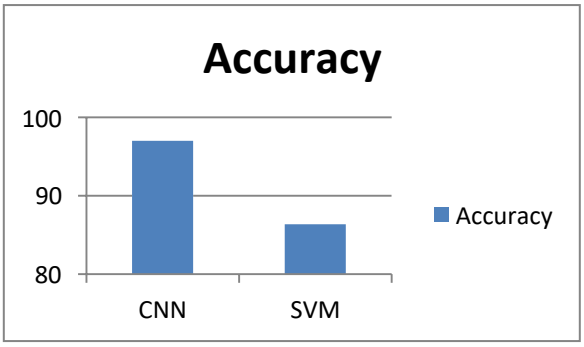

Figure 2 Accuracy of our program

5. CONCLUSION

Using image scanning technology to detect counterfeit currency has become increasingly popular in recent years. The combination of the HOG function extraction technique and the SVM algorithm has proven effective in detecting counterfeit banknotes. These methods could allow faster and more accurate detection of counterfeit banknotes, which could have a significant impact on the economy.

6. FUTURE SCOPE

However, research into other advanced feature extraction techniques such as scale-invariant feature transforms (SIFT) and convolutional neural networks (CNN) may improve the accuracy and robustness of counterfeit currency detection. Deep learning techniques like CNN have achieved remarkable success in image classification tasks.

7. REFERENCES

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