IDENTIFICATION OF CURRENCY VIA IMAGE PROCESSING TECHNIQUES AND ARTIFICIAL INTELLIGENCE

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ABSTRACT:

Paper currency counterfeiting is a serious problem all around the world. This has had a significant impact on almost every country, and it has now become a big issue. The primary purpose of this investigation is to identify Indian paper money. We obtained a dataset of currency notes from the internet, which included both authentic and bogus notes of various values. Using a feature extraction approach on the front side of the coin to determine whether it is genuine or counterfeit. For classification, we employed the Support Vector Machine (SVM) technique in this research. Determine whether something is genuine or not. The MATLAB image processing toolkit was utilised. Image processing is a technique for improving the visual information in an image for machine or hardware perception.

KEY WORDS:

Machine learning, SVM (Support Vector Machine) Algorithm, Brisk Features, CNN (Convolutional Neural Network) , Image Processing, Monetary Identification, A.I , Denomination, Currency Identification.

1. .11. INTRODUCTION:

Since the birth of the camera era, images have become an integral aspect of technology. Images not only preserve memories, but also contain a wealth of information. So, it's not surprising that science is interested in knowing more about these visuals. Image Processing is a solution that deals with comprehending images and applying them to daily tasks. To process an image, it must first be transformed to a digital format, after which the data extracted is extracted for further analysis. Digital and analogue processing techniques are the two types of processing techniques. As the name implies, there are additional advantages to digitally processing an image.

Various difficulties like an excessive noise and signal distortion can be avoided, and complicated algorithmic implementation is conceivable, which is not possible with analogue. The detection of counterfeit currency is necessary. Money is exchanged on a daily basis and it is an essential part of life. As a result, human mistake is common when large sums of money are exchanged. When the requirement for banknote verification arises, we employ image processing and classification techniques.

This is an automated system that uses a dataset of currencies and classifiers to sort them into predetermined categories. Destruction classes Although hurdles still exist, dealing with currency can be tough at times since one must focus on

distinct aspects such as lighting, size, colour, and different labels associated with a given currency.

The article's technique is as follows: Photograph analysis-based filtration of available aspects of notes and coins is displayed in particular to illustrate. Any moderate advancements, such as Photographic Component Identification, Facial Identification, Accelerated Comprehensive Features, Texture Study and transition of Canny Edge & Hough, High-performance algorithm, cross-platform and fully accessible algorithm, are included in the application. As a result, the program's core functions flawlessly, and the note identification rate looks to be 100 percent for each of the selected note characteristics.

2. LITERATURE REVIEW:

[2] Zhang, J., & Wu, L: - In this paper, an advanced GM (1, 1) version is proposed for facet detection. It makes use of the remaining factor of collection X (1) because the preliminary situation of GM (1, 1) version and predicts the pixel price on 8 directions. Then the expected picture is subtracted through the unique picture to discover the location factors with hopping gray values, which might be facet factors. Generally, the GM (1, 1) version makes use of the collection with duration identical to or large than four for modelling. As for a two-measurement picture, we are able to do not forget every row and every column as one-measurement, in which the adjoining pixels are relative to every other. So, for one-pixel withinside the picture, a number of its adjoining pixels may be used to set up the GM (1, 1) version for prediction. In the picture place with clean gray values, the prediction mistakes could be very small, so the gray version may be hooked up; however, at the picture facet, the gray values will range sharply, making the prediction mistakes very massive, for that reason the gray version can’t be hooked up normally. However, we are able to use this “not” to discover the region in which the gray values hop with the intention to understand facet detection.

Summary: - Gray Model first order one variable, picture facet detection, grey device theory

[3] Jing, L., & Jin, M. S: - In this paper, the binary coding is followed for the traditional GA. However, the non-stop weights and threshold values of the parameters and community nodes worried on this paper are actual numbers, for that reason the non-stop spatial discretization is needed for the duration of answer optimization. The mapping mistakes exist withinside the manner of spatial discretization, and it cannot without delay replicate the structural functions of the hassle itself. Thus, the coding with actual numbers is followed on this paper. During coding, the weights and threshold values of the neural community are taken because the gene of the genetic algorithms, which might be disbursed on one institution of weights and threshold values of the neural community at an c programming language of [-1,1], and those weights and threshold values are related for an extended string in order.

Summary: - About Genetic set of rules, synthetic neural community, identity of the numbers is mentioned on this paper.

[4] Guo, J., Zhao, Y., & Cai, A: - The approach we proposed on this paper is stimulated through the evaluation of picture texture. We can deal with distinct sorts of currencies as pictures with distinct textures, for that reason we are able to extract the feel functions for popularity. In this paper, we use LBP operator for function extraction, that's an effective device for texture description. The set of rules has low computational complexity, which could meet the excessive velocity requirement in realistic applications. The primary LBP operator is first added through Ojala. LBP is a effective device for texture description. In LBP, the community pixels are transformed to binary code zero or 1 through the use of the grey price of the middle pixel as threshold, after which a majority of these codes shape an ordered sample in line with their positions relative to the middle pixel. In order to focus on the exact facts of the paper forex, we phase the complete picture into M*N blocks. In every block, we calculate the LBP price

for each pixel, after which make the histogram of the block, that's referred to as block histogram.

In attention of the evaluation among distinct pictures, the block-histogram is normalized through the wide variety of pixels withinside the block.

Summary: - About paper forex detection, function extraction, LBP set of rules

[5] Sathisha, K: - In this paper, there may be a microcontroller primarily based totally device to mechanically perceive the serial numbers of the Indian forex. Image binarization method shall mechanically discover the brink of a picture, after which use that threshold to transform a gray picture into binary picture. Firstly, acquire the minimal and most grey price Tx and Ty and make the preliminary threshold TO.

The function to be extracted is the serial wide variety of the forex. Projection Profile set of rules is used to discover the serial wide variety region. The Segmentation module separates the string into character.

These characters are then identified through the Recognition module. Horizontal and Vertical Projection Profile technique is used to discover the gap among the characters at which they may be separated. The segmented characters are saved in separate matrices. It may be found from the binarized picture that the IDs are the primary non-clean non-stop picture region and accompanied entire clean line. This element is applied for in addition processing to reap the picture of the IDs.

Summary: - About Digit popularity, picture processing, binarize.

3. HISTORY:

Several trials for the identification of currency in the note sector have taken place over the years. Colour-based identification, patterns, access control, and other methods are currently the most widely utilised. There are various systems for detecting phoney currency that use a variety of strategies. A number of the methods have numerous processes, such as camera calibration, accessibility extract, and different algorithms' classification systems.

There are over 180 currencies in the world, necessitating the use of an autonomous currency mechanism. Recently, the demand for coin and note identification and recognition has risen dramatically. Characterizing distinct coins and notes, on the other hand, is quite difficult. As an example.

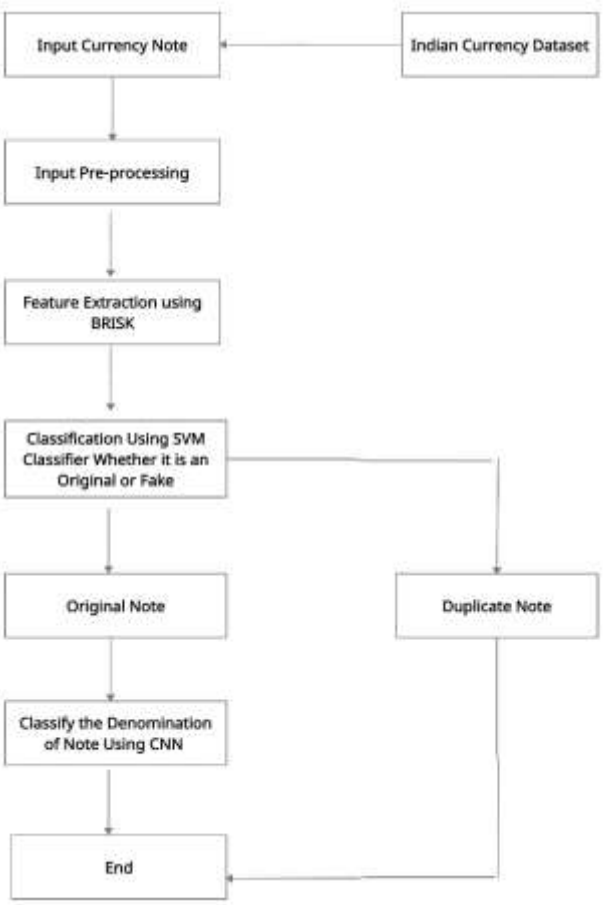
But all was for naught because none of the methods were trustworthy enough to be effective. As a result, this research question develops into a fascinating field of study.

1) Image analysis was one of the earliest methods of recognising the monetary system in the early 1990s. However, this technique makes no provision for note verification. The notes and photographs are expected to be in excellent condition. Then only can the desired outcome be achieved. It's worth noting that the suggested method relies on the capture of visual characteristics at predetermined angles and distances.

2) It uses two approaches to describe the photo mechanism: The smoothness of an image begins with noise reduction. It calculates the median of the surrounding pixels to create an exceptionally large kernel and a focus pixel, and then places a median filter in the centre of the pixel. Because the median filter is more efficient than other techniques, it is smoother.

4. PROPOSED SYSTEM:

The BRISK algorithm is a feature point detection and description algorithm with scale invariance and rotation invariance. It obtains the binary feature descriptor by constructing the feature descriptor of the local image using the grey scale relationship of random point pairs in the local image's neighbourhood.



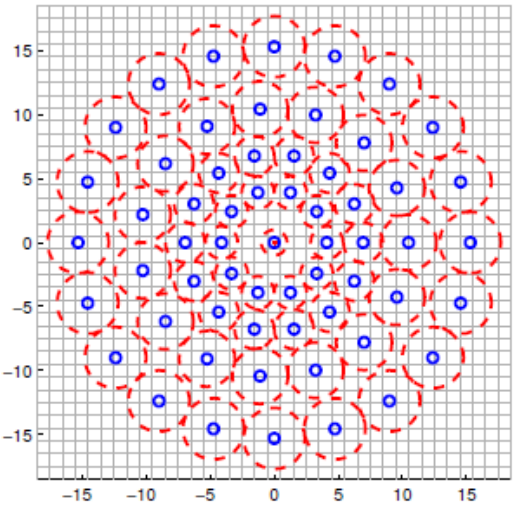
Unlike BRIEF or ORB, the BRISK descriptor contains a predetermined sampling pattern. Concentric rings are used to sample pixels. A tiny patch is evaluated surrounding each sampling site. The patch is smoothed with Gaussian smoothing before the process begins.

SVMs are a class of supervised learning methods for classification, regression, and outlier detection. However, it is mostly used in Machine Learning for Classification of difficulties. The SVM algorithm's purpose is to find the decision boundary for classifying n-dimensional space into classes so that additional data points can be readily placed in the correct category in the future.

BRISK FEATURES:

The BRISK algorithm is a point detection algorithm. It obtains the binary feature descriptor by constructing the feature descriptor of the local image using the grey scale relationship of random point pairs in the local image's neighbourhood. Unlike BRIEF or ORB, the BRISK descriptor contains a predetermined sampling pattern. Concentric rings are used to sample pixels. A tiny patch is evaluated surrounding each sampling site. The patch is smoothed with Gaussian smoothing before the process begins.

Short and long pairs are the two types of pairs used for sampling. Short pairs have a distance less



than or equal to distmax, whereas lengthy pairs have a distance greater than or equal to distmin. Short pairs are used to calculate the descriptor by comparing intensities and long pairs are utilised for orientation. BRISK accomplishes rotation invariance by attempting to rotate the sample pattern by the measure orientation of the key point. This is accomplished by first computing the local gradient g (pi, pj) between sample pairs (pi, pj), where I(pj, pj) is the smoothed intensity after gaussian smoothing.

$$g(p_i, p_j) = (p_i - p_j) \cdot I(p_j, j) - I(p_j, j)\, p_j - p_i 2$$

All local gradients between long pairs are then added, and the angle of the key point is

determined by the arctangent (gy/gx) between the y and x components of the sum. Now all we have to do is rotate the short pairs by that angle to make the descriptor more rotation invariant. Intensity comparisons are used to create the description. If the first point has a higher intensity than the second, 1 is written to the relevant bit of the descriptor, otherwise 0 is written.

CNN:

Artificial neural networks perform well in Machine Learning. Artificial Neural Networks are employed in picture, audio, and word categorization tasks. For example, we are utilising Recurrent Neural Networks, more exactly an LSTM, for predicting the sequence of words, and we use Convolution Neural Networks for image categorization. We will construct basic CNN building blocks in this section. One or more convolutional layers can make up a convolutional neural network. Let's review some Neural Network fundamentals before getting into the Convolution Neural Network. There are three types of layers in Neural Network.

1. Input Layers: This is the layer where we give our model input. The entire number of characteristics in our data is equal to the number of neurons in this layer (number of pixels in case of an image).

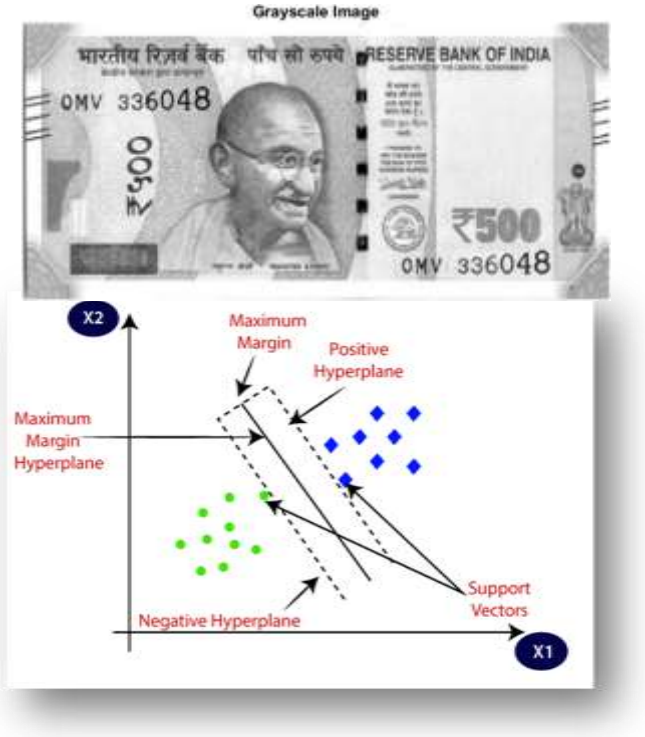
2. Hidden Layer: The hidden layer receives the input from the input layer. Depending on our model and data quantity, there could be a lot of hidden layers. The number of neurons in each hidden layer might vary, however they are usually more than the number of characteristics. The output from each layer is produced by matrix multiplication of the preceding layer's output with that layer's learnable weights,

3. then addition of learnable biases, and finally activation function, which makes the network nonlinear.

3. Output Layer: The hidden layer's output is then input into a logistic function like sigmoid SoftMax, which converts each class's output into a probability score.

SVM:

SVMs are one of the supervised learning methods which are used for classification, regression etc. It is widely used for Classification problems in Machine Learning. The SVM algorithm's purpose is to find the decision boundary for classifying n-dimensional space into classes. So, that additional data points can be



placed in the correct category in the future. A hyperplane is another name for the optimal choice boundary.

The extreme points that assist for creating the hyperplane are chosen via SVM. Support vectors are the extreme instances for the classification, and the algorithm is called a Support Vector Machine Algorithm.

5. RESULTS AND EVALUATION:

Fig. 1: INPUT IMAGE

Fig. 2: GRAY IMAGE

6. FUTURE & SCOPE:

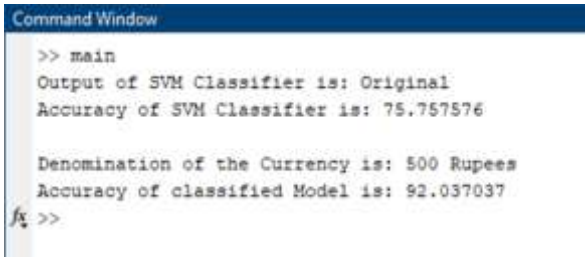
We've described the benefits of our approach, but it does have certain drawbacks, such as:

1. The characteristics in this recognition procedure are retrieved by calculating the BRISK features.

Fig. 3: TRAINING DETAILS

Fig. 4: ACCURACY DETAILS

Because each currency note is different in size, this



method does not precisely extract the supplied six currency security features. This issue can be handled by employing the suitable feature extraction method in the currency recognition system.

2. When we use an image from outside the testing folder as an input, it does not provide 100 percent accuracy. We can solve this problem by making improvements to the system.

3. The technology fails to distinguish hidden elements such as the paper currency's latent image and watermark. As a result, we may enhance the system by including these elements in the suggested system.

The recognition can be done for a variety of other countries as well. To improve the recognition process, we can include currency images from various angles such as front, back, front clock-wise, front anti-clockwise, back clock-wise, and back anti-clockwise. In addition to the above-mentioned factors, we may create a currency recognition-based application for mobile users to improve availability and make it more convenient, as well as the added features of GUI interface and portability.

7. CONCLUSION:

In this paper, we propose a method for determining whether currency is real or fake using a novel method called BRISK, which addresses the classic Computer Vision problem of detecting, describing, and matching image key points in cases where there is insufficient a priori knowledge of the scene and camera poses. The SVM technique is used to determine the currency is real or fake. When the currency is classified as original, a CNN network is trained on the data and it is tested to identify the denomination. With over 90% accuracy, then the trained convolutional neural network achieved a remarkably low training loss.

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