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Detection of Fake Currency Using Machine Learning

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ABSTRACT

Counterfeit currency is a major issue affecting the economy of many countries. Traditional methods of detecting fake currency rely mainly on manual inspection or specialized hardware devices, which may not always be accurate or accessible. This project proposes a machine learning-based system to detect fake currency notes using image processing techniques. The system analyzes images of currency notes and extracts important features such as texture, color patterns, serial numbers, and security marks. Machine learning algorithms are then used to classify the currency as genuine or fake. By automating the detection process, the proposed system helps reduce human errors and improves the accuracy and efficiency of counterfeit currency identification.

INTRODUCTION

Fake currency detection is a serious issue worldwide, affecting the economy of almost every country including India. Currency duplication also known as counterfeit currency is a vulnerable threat on economy. It is now a common phenomenon due to advanced printing and scanning technology. The possible solutions are to use either chemical properties of the currency or to use its physical appearance. The approach presented in this paper is based upon physical appearance of the Indian currency. Image processing algorithms have been adopted to extract the features such as security thread, intaglio printing (RBI logo) and identification mark, which have been adopted as security features of Indian currency. Hence, we propose a more user friendly and portable solution to this problem in form of an mobile app coupled with cloud storage. Technology is growing very fast these days. Consequently the banking sector is also getting modern day by day. This brings a deep need of automatic fake currency detection in automatic teller machine and automatic goods seller machine. Many researchers have been encouraged to develop robust and efficient automatic currency detection machine [1-5]. Automatic machine which can detect banknotes are now widely used in dispensers of modern products like candies, soft drinks bottle to bus or railway tickets. The technology of currency recognition basically aims for identifying and extracting visible and invisible features of currency notes. Until now, many techniques have been proposed to identify the currency note. But the best way is to use the visible features of the note [1]. For example, color and size. But this way is not helpful if the note is dirty or torn. If a note is dirty, its color characteristic are changed widely. So it is important that how we extract the features of the image of the currency note and apply proper algorithm to improve accuracy to recognize the note. We apply here a simple algorithm which works properly. The image of the currency note is captured through a digital camera. The hidden features of the note are highlighted in the ultraviolet light. Nowprocessing on the image is done on that acquired image using concepts like image segmentation, edge information of image and characteristics feature extraction[2-3]. MATLAB is the perfect tool for computational work, and analysis. Feature extraction of images is challenging task in digital image processing. It involves extraction of invisible and visible features of Indian currency notes. This approach consists of different steps like image acquisition, edge detection, gray scale conversion, feature extraction, image

segmentation and decision making [4-5]. Acquisition of image is process of creating digital images, from a physical scene. Here, the image is captured by a simple digital camera such that all the features are highlighted. Image is then stored for further processing.

Fake Indian Currency Note is a term that refers to the counterfeit currency notes that rapidly circulated in the Indian economy. At the manufacturing time of real currency notes, the security thread is assimilated in to the paper, while in the fake currency notes, a line with gray ink is printed or an aluminum thread is used to paste two thin sheets of paper in order to imitate the security thread. It is difficult to reproduce the fake currency note with actual accuracy and to maintain the alignment of figures of real currency note. In this paper we have made fake currency note detection technique using the MATLAB algorithm. In the proposed method, acquired image of currency note through the camera is checked to real or not. To check the currency note is real or fake on the basis of counting the number of interruptions in the security thread. The camera pictures of notes are analysed by MATLAB program installed on computer. The proposed system is to check the Indian currency notes of 100, 500 and 2000 rupees. If the note is real, the respective message is appeared on the command window and vice-versa. Recently some fake currency detection techniques have been reported in the literature. Binod Prasad Yadav, C.S.Patil, R.R. Karhe, P.H Patil [1] presented Detecting Fake Currency it is very time consuming .The process is done by using feature extraction with HSV to detect the fake currency. Megha Thakur, AmritKaur [2] designing a system to identify the fake currency note by using various detection techniques and parameters on currency note. This methods can be used to efficiently and easily detecting the counterfeit currency notes. Kavya B R, Devendran B [3] proposed a system that recognize the fake currency note on the basis of extracted features of the currency note. Coherent matching of features, which helps in the SIFT techniques. Extracted features of currency notes, they are See Through register, Identification mark, thread, Governor's signature, Micro lettering, year of printing. W.K.El said [4] developed a feature extraction based system for detecting the fake Egyptian paper currency in efficient manner. In this process the extracted feature of currency is individually performed on original and sampled version of the currency note. On the basis of similarity measurements, independently acquiring the each side of the decision of currency detection. Tushar Agasti, Gajanan Burand, Pratik Wade P Chitra [5] proposed a system that recognise the fake currency note on the basis of accuracy. The extracted features of currency note is applied to the algorithm to improve the accuracy of note.

Counterfeiting money stands for the illegal replication of original currency; hence counterfeit currency is a fake currency that has not been authorized by the government.RBI is the only body which has sole responsibility to print currency notes in India. Every year RBI faces the problem of counterfeit currency notes once filtered and circulated in the market. Earlier fake currency detection was done by using chemical properties of the currency paper. With the advent of artificial intelligence and image processing, digital image processing is frequently used for fake currency detection by extracting attributes from images that represent the features of currency. Feature extraction is challenging work as it involves the extraction of directly or indirectly visible features of Indian currency. Security features of a currency are critical for determining real and fake currencies. Common security features include watermarks, latent images, security thread, intaglio, optically variable ink, micro lettering and fluorescence [1]. In the proposed work, an approach for fake currency detection is presented that extracts the general attributes such as shape, including the security thread, RBI logo and identification mark from the image of the paper currency. Digital Image Processing is a field that involves studying as well as processing of images by extracting attributes from images and includes the recognition of individual objects. Extracting attributes for images of currency

notes can get quite complex as it involves the extraction of some visible and invisible features of Indian currency.

In today's new digitalization environment, people are bounded by technology, and that technology is rapidly developing. Of course, such inventions make life much easier for us. People can now complete their tasks with minimal effort, which is possible due to technological advancements. However, some people are abusing the benefits of such technologies to achieve their nefarious goals. There are numerous examples of this kind all around us. One of the most prominent examples of this is a counterfeit note. Counterfeit currency is described as currency produced without the government's legal approval. To print counterfeit money, the dishonest people use the most up-to-date scanning and printing techniques. The development of such counterfeit money has an effect on any country's economy. Indian currency is also the portion of such unwanted things. So the common people face a huge problem in differentiating the real and fake currency [1]. Mr. NarendraModi, India's Prime Minister, declared in November 2016 that prevailing rupee notes of 500 and 1000 rupees would no longer be legitimate currency, and that steps would be engaged to combat black money and counterfeit currency in the world. The Prime Minister also announced the introduction of new rupee 500 and 2000 notes, as well as the discontinuation of existing rupee 500 and 1000 notes. According to Reserve Bank of India (RBI), the identification of fake currency notes decreased by 31.4 percent in 2017-18 compared to the previous year, owing to high-security features on notes that make forgery difficult [2]. Watermarking, latent picture, micro lettering, see through register optically variable connection, security threads, intaglio printing, fluorescence, identification mark and legal protections against counterfeiting are some of the techniques for identification implemented by many researchers. For detecting fake currency, there are also automated tools available. There is a need to build a reliable system that can identify currency with minimal processing time and accuracy. Many researchers use digital image processing for this purpose, in which authors extract various attributes after image acquisition and treat them as objects. These attributes may include watermarking, latent image, micro lettering, see-through register, optically variable connection, security threads, intaglio printing, fluorescence, identification mark and legal protections against counterfeiting. The authors used a variety of image extraction methods, but it must be a good and feasible image extraction in order to consider accurate data as input [3]. Both extrinsic and intrinsic properties are the paper currency. Scale, distance, colour etc. are dealt with by extrinsic properties while safety thread, I.D. label and panel number are dealt with intrinsically. Extrinsic properties are not sufficient to detect whether the note is original or false. During transportation or exchange currency can also be damaged. With the aid of image processing techniques the changes in image nature can be well understood and enhanced [4].

LITERATURE SURVEY

1. A Hybrid Fake Banknote Detection model using OCR, Face Recognition and Hough Features:

Authors: Adiba Zarin, Jia Uddin

Currency duplication remains an emergent concern among nations due to the advancement of printing and scanning technology. Many note detection systems are present in banks but they are very costly and often inaccurate. The fields of image processing, neural network and machine vision have potential to significantly overcome this issue. This paper proposes a model comprised of Optical Character recognition (OCR), Face Recognition and Hough

transformation algorithm. The microprinting, water-mark, and ultraviolet lines features of Bangladeshi notes are extracted for testing of genuine notes. The experimental results of the proposed model give accuracy as high as 93.33% which makes it suitable for deployment on a mobile application. Moreover, the obtained results are compared with the output from individual algorithm of OCR, Face Recognition and Hough transformation, to show that the proposed algorithm gives the highest accuracy.

2. Philippine Currency Paper Bill Counterfeit Detection through Image Processing using Canny Edge Technology:

Authors: Ballado, A. H. Jr., Dela Cruz, J. C., Avendaño, G. O., Echano, N. M., Ella, J. E., Medina, M.E.M., Paquiz, B.K.C.

Image edge information is essentially one of the most significant information in an image, which can describe the target outline, its relative position within the target area, and other important information. Edge detection is one of the most important process in image processing, and the detection results directly affects the image analysis. Traditional edge detection algorithms are accomplished through detecting the maximum value of the first derivative or zero crossing of the second derivative. Though it seems the representative first order differential operators have known advantages like simple computation, speed and ease of implementation, they are more sensitive to noise and their detection effect are not perfect in most engineering application. Schemes for counterfeit detection has been continuously evolving through various techniques and algorithms run on machines and devices. This paper presents image enhancement and image sensing through the use of Canny Edge Technology. Moreover, counterfeit detection on selected Philippine banknotes was achieved by incorporating a distinct security feature known as Optically Variable Device (OVD) patch, as an improvement to the traditional three-way detection of bills (watermark, security thread, see-through marks)A MATLAB GUI program was developed that acquired and processed the image through Canny Edge Technology. The Canny Edge algorithm proved a robust method in detecting fake bills through OVD security features, revealing statistically significant detection proportion under a 5% level of significant for the four cases under test.

3. Review on Detection of Fake Currency using Image processing Techniques:

Authors: Dr. S. V. Viraktamath, KshamaTallur, Rohan Bhadavankar, Vidya

Many countries are affected by the matter of fake notes. Indian is one among them. With the improved technology, anyone can print fake notes. These notes are produced without legal sanction of the state and continues production of such kinds of notes can degrade countries economy. When such counterfeited notes are produced and circulated, it becomes impossible for ordinary citizens to distinguish whether the money is real or fake because they differentiate according to physical appearance. The biggest challenge for many countries like India is the detection of fake currency. Even if banks and other big organizations have automatic machines designed to identify counterfeit currency notes, ordinary people can hardly differentiate between them. Nowadays recognition of fake currency has become challenging issue for many researchers. The identification involves many steps like edge detection, feature extraction, image segmentation, image acquisition, grayscale conversion, and comparison of images. This paper provides some related works of paper-currency recognition and has explained the spread of various currency recognition systems. Choosing the right feature would improve overall system performance. The goal of this work is to review previous papers and literature, identify the benefits and disadvantages of every method.

4. Feature Fusion for Fake Indian CurrencyDetection:

Authors: NeeruRathee, ArunKadian, RajatSachdeva

Fake currency detection is a serious issue worldwide, affecting the economy of almost every country including India.The possible solutions are to use either chemical properties of the currency or to use its physical appearance. The approach presented in this paper is based upon physical appearance of the Indian currency. Image processing algorithms have been adopted to extract the features such as security thread, intaglio printing(RBI logo) and identification mark, which have been adopted as security features of Indian currency. To make the system more robust and accurate, the decisive score of all the three features has been fused to differentiate between real and fake currencies. The fake currency detection accuracy of the proposed system is 100%. Another parameter used to measure the performance of the proposed system is mean square error, which is approximately 1%. It may be adopted by the common people as well, who quite often face the problem of differentiating between real and fake currencies.

5. FAKE CURRENCY DETECTION:

Authors: Arya S Dr.M.Sasikumar

Fake currency notes are increasing day by day, in order to overcome this we proposes a very helpful and efficient system to detect the fake currency. For detecting the fake currency note is done by counting the number of interruptions in the thread line. For predicting the note is real or fake on the basis of number of interruptions. If the number of interruption is zero, if it is real note otherwise it is fake. And also we calculate the entropy of the currency notes for the efficient detection of fake currency note. MATLAB software is used to detect the fake currency note.

SYSTEM ANALYSIS
EXISTING SYSTEM

In the existing system, counterfeit currency detection is mainly performed through manual verification and hardware-based methods. Banks and financial institutions use ultraviolet (UV) machines, magnetic ink detectors, and manual checking to verify the authenticity of currency notes.

Steps in Existing System

1. Visual inspection of the currency note.
2. Checking security features such as watermark, security thread, and microprinting.
3. Using UV light or currency detection machines.
4. Final verification by trained personnel.

Drawbacks of Existing System

- Manual inspection may lead to human errors.
- Requires trained professionals to detect fake notes.
- Specialized machines can be expensive.
- Time-consuming process when handling large amounts of currency.
- Difficult to detect highly sophisticated counterfeit notes.

PROPOSED SYSTEM

The proposed system uses Machine Learning and Image Processing techniques to

automatically detect fake currency notes. The system captures or uploads an image of a currency note and analyzes its features using machine learning algorithms. Features like texture, color distribution, patterns, and edges are extracted and compared with genuine currency data to classify the note.

Working of Proposed System

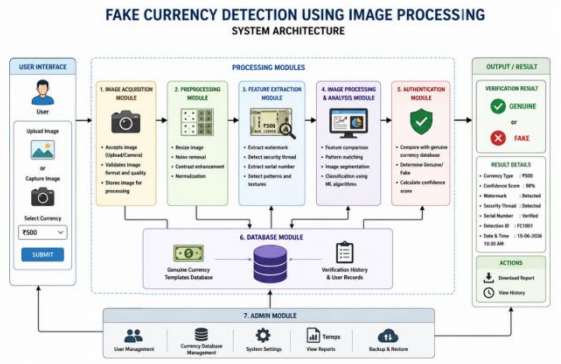
1. Image Acquisition – Capture or upload an image of the currency note.
2. Image Preprocessing – Remove noise, resize, and enhance the image.
3. Feature Extraction – Extract important features such as texture, color, and patterns.
4. Model Training – Train machine learning models using datasets of genuine and fake currency notes.
5. Classification – Classify the currency note as real or fake.
6. Result Display – Show the authenticity result to the user.

ADVANTAGES OF PROPOSED SYSTEM

- Higher accuracy using machine learning algorithms.
- Automated detection reduces human errors.
- Faster verification process.
- Cost-effective compared to specialized detection machines.
- Can process large numbers of currency notes quickly.
- Easy integration with mobile or web applications.

IMPLEMENTATION

1. Requirement Analysis



The implementation of the project **"Detection of Fake Currency Using Machine Learning"** begins with analyzing the increasing circulation of counterfeit currency and the need for an automated, accurate, and fast detection system. Traditional manual verification methods are time-consuming and error-prone. The proposed system uses machine learning and image processing techniques to identify fake currency based on visual features.

2. System Design

The system architecture is designed for automated currency authentication.

Main Modules

- Image Acquisition Module
- Preprocessing Module
- Feature Extraction Module

- Machine Learning Classification Module
- Result Display Module

3. Data Collection

The system collects datasets of real and fake currency images.

Data Sources

- Bank-issued currency datasets
- Image repositories
- Scanned currency notes
- Custom captured images

Currency Features

- Serial numbers
- Security thread
- Watermark
- Micro-text
- Color patterns

4. Image Acquisition

Currency images are captured using cameras or scanners.

Techniques

- High-resolution image capture
- Controlled lighting conditions
- Multiple angles for accuracy

5. Image Preprocessing

Captured images are processed before analysis.

Preprocessing Steps

- Image resizing
- Noise removal
- Grayscale conversion
- Contrast enhancement
- Background removal

6. Feature Extraction

Important features are extracted from currency images.

Extracted Features

- Texture patterns
- Color distribution
- Edge detection
- Security patterns
- Shape features

METHODOLOGY

1. Data Acquisition

The methodology begins with collecting images of genuine and counterfeit currency.

Data Collected

- High-resolution images
- Various denominations
- Different lighting conditions

2. Image Cleaning and Preparation

The collected images are processed for analysis.

Processing Steps

- Resize images
- Remove noise
- Normalize pixel values
- Enhance contrast

3. Feature Engineering

Relevant features are extracted from currency images.

Features

- Texture and patterns
- Security marks
- Edge and shape details
- Color distribution

4. Model Training

Machine learning models are trained using extracted features.

Training Workflow

1. Input dataset
2. Extract features
3. Train models
4. Optimize parameters
5. Validate performance

5. Classification Process

The trained model classifies currency.

Workflow

- Input image
- Extract features
- Apply classifier
- Predict result

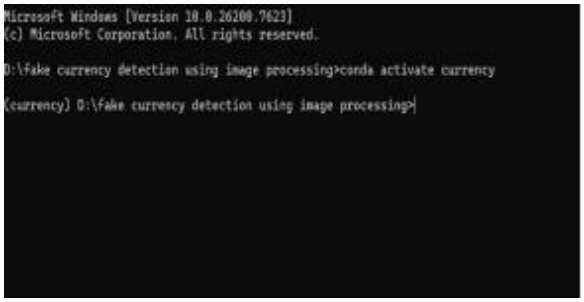
6. Real-Time Detection

The system processes live images for instant detection.

Steps

- Capture image
- Preprocess
- Classify
- Display result

RESULTS



CONCLUSION

The proposed system for **Detection of Fake Currency Using Machine Learning** demonstrates an efficient and reliable

approach to identifying counterfeit currency using image processing and intelligent algorithms. By leveraging machine learning models such as Support Vector Machine (SVM), Random Forest, and Convolutional Neural Networks (CNN), the system is capable of analyzing critical security features like texture, color patterns, watermark presence, and micro-printing with high accuracy.

The integration of automated feature extraction and classification significantly reduces human effort and minimizes errors associated with manual verification. The system performs well in real-time scenarios, making it suitable for applications in banks, retail environments, and financial institutions where quick and accurate currency validation is essential.

Furthermore, the use of advanced preprocessing techniques and optimized models enhances detection accuracy and robustness against variations in lighting, image quality, and currency condition. Overall, the proposed solution contributes to improving financial security and reducing the circulation of counterfeit currency.

In future work, the system can be enhanced by incorporating deep learning-based real-time mobile applications, expanding the dataset to include multiple currencies, and integrating advanced security feature detection such as ultraviolet (UV) and infrared (IR) analysis for even higher accuracy and reliability.

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