A Project report on

Fake Currency Detection System Using Mobile

A Dissertation submitted to JNTU Hyderabad in partial fulfillment of the academic requirements for the award of the degree.

Bachelor of Technology

in

Computer Science and Engineering

Submitted by

S. UDAYA SRI
(20H51A05F4)

B. AKASH
(20H51A05K1)

VIVEK KHAJURIA
(20H51A05Q4)

Under the esteemed guidance of

Dr. S. Siva Skandha
(Associate Professor & HOD-CSE)

Department of Computer Science and Engineering

CMR COLLEGE OF ENGINEERING & TECHNOLOGY

(UGC Autonomous)

*Approved by AICTE *Affiliated to JNTUH *NAAC Accredited with A^+ Grade

KANDLAKOYA, MEDCHAL ROAD, HYDERABAD - 501401.

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CMR COLLEGE OF ENGINEERING & TECHNOLOGY

KANDLAKOYA, MEDCHAL ROAD, HYDERABAD – 501401

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the Major Project Phase I report entitled **" Fake Currency Detection System"** being submitted by S. Udaya Sri (20H51A05F4), B. Akash (20H51A05K1), Vivek Khajuria (20H51A05Q4) in partial fulfillment for the award of **Bachelor of Technology in Computer Science and Engineering** is a record of bonafide work carried out his/her under my guidance and supervision.

The results embodies in this project report have not been submitted to any other University or Institute for the award of any Degree.

Dr. Siva Skandha Sanagala
Associate Professor and HOD
Dept. of CSE

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S. Udaya Sri 20H51A05F4
B. Akash 20H51A05K1
Vivek Khajuria 20H51A05Q4

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ABSTRACT

Counterfeiting of currency notes poses a significant threat to financial security and economic stability. In response to this challenge, this research presents a novel approach for detecting fake currency using deep neural networks. Counterfeit currency detection is a critical task that requires accuracy, speed, and adaptability to evolving counterfeit techniques. Our proposed system leverages the power of deep learning, specifically convolutional neural networks (CNNs) to extract intricate features and patterns from banknotes. The system begins with image acquisition, where high-resolution images of currency notes are captured. These images are preprocessed to enhance their quality and standardize their format, ensuring consistency in the analysis. The core of our system consists of a deep neural network architecture, which is trained on a diverse dataset of genuine and counterfeit banknotes. The neural network learns to differentiate between genuine and counterfeit notes by extracting and analyzing various discriminative features such as watermarks, security threads, microprints, and other subtle visual cues. To evaluate the performance of the system, we conducted extensive experiments on a variety of genuine and counterfeit banknotes. The results demonstrate the system's high accuracy, efficiency, and adaptability to different currencies and counterfeit methods. Our deep neural network-based approach significantly outperforms traditional rule-based systems and offers real-time detection capabilities. Our experiments show that our deep neural network-based approach outperforms traditional methods, achieving state-of-the-art accuracy in fake currency detection. By harnessing the potential of deep learning, we aim to enhance the security of financial transactions and protect economies from the adverse effects of counterfeit currency circulation. This research serves as a stepping stone towards a more secure and resilient financial ecosystem.

CHAPTER 1
INTRODUCTION

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1.1. Problem Statement

The circulation of counterfeit currency poses a significant threat to the economic stability and security of financial systems worldwide. To address this issue, there is a pressing need for the development of advanced and accurate methods for the detection of fake banknotes. Traditional counterfeit detection techniques have limitations in identifying increasingly sophisticated counterfeit notes, often relying on human visual inspection or basic automated methods that may not be sufficiently reliable. To combat the rising prevalence of counterfeit currency, there is a demand for more robust and automated counterfeit detection systems. The problem at hand is to design and implement an efficient and accurate fake currency detection system using deep neural networks. This system should be capable of differentiating genuine banknotes from counterfeit ones by analyzing various security features, including watermarks, security threads, holograms, and other intricate details. The main challenges and objectives of this research include:

- **Accuracy**: Developing a deep neural network model that can achieve high accuracy in distinguishing between genuine and counterfeit banknotes, even when counterfeit notes exhibit intricate patterns and textures that closely resemble genuine ones.
- **Real-time Processing:** Ensuring that the detection system can operate in real-time, making it suitable for integration into financial institutions, ATMs, and other currency handling devices.
- **Robustness**: Creating a system that is resilient to various types of counterfeit currency, including those produced with advanced printing techniques and materials, to ensure its effectiveness in combating evolving counterfeit methods.

- **Data Preprocessing**: Properly collecting, preprocessing, and augmenting a substantial dataset of genuine and counterfeit currency images to train and validate the deep neural network model effectively.
- **User-friendliness:** Designing a system that is user-friendly and can be easily integrated into existing currency processing systems, minimizing disruption and training requirements for operators.
- **Cost-effectiveness:** Ensuring that the implementation and maintenance costs of the system are reasonable and justifiable in comparison to the potential losses caused by counterfeit currency.

Addressing these challenges and objectives will contribute to the development of a reliable and efficient fake currency detection system that can safeguard financial transactions, promote economic stability, and protect the integrity of currency systems.

1.2. Research Objective:

Develop a Deep Learning Model: Create and train a deep neural network model, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), specifically designed for the task of fake currency detection.

Enhance Accuracy: Improve the accuracy of fake currency detection by leveraging the power of deep learning to identify subtle and complex patterns in banknotes that are difficult to discern through conventional methods.

Real-time Detection: Design the neural network model and system architecture to ensure real-time processing, enabling the rapid identification of counterfeit banknotes in various financial transactions.

Data Collection and Augmentation: Collect and preprocess a diverse and extensive dataset of genuine and counterfeit currency images, applying data augmentation techniques to enhance the robustness of the model.

Feature Extraction: Investigate and develop methods for effective feature extraction from currency images, focusing on security features, watermarks, security threads, and holograms, among others.

Robustness and Generalization: Evaluate the robustness of the deep neural network model against various types of counterfeit currency, including those produced with advanced techniques, while ensuring generalization to different currency designs and denominations.

Model Interpretability: Explore techniques for explaining and interpreting the decisions made by the deep neural network model to provide transparency and build trust in the detection process.

Integration and Usability: Develop a user-friendly system that can be easily integrated into existing financial infrastructure, minimizing the training required for operators and facilitating seamless adoption.

Cost-effectiveness: Assess the cost-effectiveness of implementing the deep learning-based fake currency detection system, considering factors such as hardware requirements, maintenance, and potential savings from reduced counterfeit currency circulation.

Comparative Analysis: Compare the performance of the deep neural network-based detection system against traditional counterfeit detection methods, highlighting the advantages and limitations of each approach.

Security Assessment: Evaluate the system's ability to detect counterfeit currency in a range of scenarios, including financial institutions, ATMs, and cash handling devices, and measure its effectiveness in enhancing overall security in these environments.

Ethical Considerations: Investigate and address ethical concerns related to privacy, bias, and fairness in the implementation of a deep learning-based fake currency detection system.

Adaptation and Evolution: Consider the adaptability of the system to emerging counterfeit techniques and potential system updates to ensure its long-term effectiveness.

By pursuing these research objectives, the study aims to contribute to the development of a state-of-the-art fake currency detection system based on deep neural networks .

1.3 Project Scope :

1. Project Overview: Develop a fake currency detection system using deep neural networks to identify counterfeit currency notes. The system will analyze images of currency notes and determine their authenticity.

2. Objectives: Create a robust and accurate deep learning model to detect counterfeit currency. Develop a user-friendly interface for users to submit currency images for verification. Ensure real-time or near-real-time processing of currency images.

3. Key Components: Data Collection: Gather a diverse dataset of genuine and counterfeit currency images.

4. Data Collection: Gather a large dataset of genuine currency notes from various denominations. Acquire images of counterfeit currency notes representing different forgery techniques. Ensure diversity in lighting conditions, angles, and image qualities.

5. Preprocessing: Clean and standardize the dataset, removing noise and artifacts. Augment the dataset with techniques like rotation, scaling, and color variations.

6. Model Development: Choose a suitable deep learning architecture (e.g., convolutional neural network - CNN). Train the model on the prepared dataset for counterfeit detection.

7. User Interface: Develop a user-friendly web or mobile application. Include options to upload images of currency notes for verification. Provide clear instructions on how to capture suitable images.

8. Testing and Validation: Evaluate the model's performance using metrics like accuracy, precision, recall, and F1 score. Test the system with a diverse set of currency images, including both genuine and counterfeit notes. Refine the model based on testing results.

9. Deployment: Deploy the system on a server or cloud infrastructure. Make the application accessible to end-users through a web or mobile interface. Ensure scalability to handle a large number of concurrent requests.

10. Budget: Estimate the budget required for hardware, software, data acquisition, and personnel.

LIMITATIONS:

While a fake currency detection system using deep neural networks on a mobile platform can be highly effective, there are several limitations and challenges to consider:

- **Limited Processing Power:** Mobile devices typically have less computational power compared to desktop or server setups.
- **Memory Constraints**: Mobile devices have limited RAM and storage, which can be a constraint when loading and running large deep learning models.
- Battery Consumption: Deep neural networks can be computationally intensive, leading to increased battery consumption on mobile devices. Users may be reluctant to use an app that drains their battery quickly.
- **Network Connectivity:** A mobile fake currency detection system may require access to a cloud server for model processing and updates. In areas with poor network connectivity, the system's performance may be compromised.
- **Camera Quality:** The quality and capabilities of mobile device cameras can vary significantly. Low-quality cameras may lead to inaccuracies in counterfeit detection, as image quality affects model performance.
- **Data Privacy:** Handling currency images on a mobile device can raise privacy concerns. Users may be hesitant to upload sensitive information (such as currency images) to a mobile app due to data security and privacy issues.
- **User Training:** Mobile apps for fake currency detection may require user training to capture images correctly and understand the results. Users may find this additional step cumbersome.
- **Accessibility:** Not all users may have smartphones or mobile devices capable of running the app, potentially excluding certain segments of the population.
- **Cost:** Developing and maintaining a fake currency detection app can be costly, especially when considering the cost of model development, cloud infrastructure, and ongoing updates.

CHAPTER 2
BACKGROUND WORK

CHAPTER 2
BACKGROUND WORK

2.1 Fake Currency Detection Using Computer Vision(CV):

2.1.1 Introduction

Today, the technology is very fast growing in the word. This increasing of technology the every year government or bank sector faces the problem of fake currency. This problem is very serious issue in India now a day. Similarly the government is also improving day to day but using high printing technology counterfeit circulates the fake banknote in the Indian market . The Reserve Bank of India (RBI) in its latest annual report said that the during 2017-2018, 17,929 pieces of Rs 2,000 notes were detected in 2017-2018 while only 638 counterfeit notes of the same denomination had been detected the year before. In the past, people detecting of counterfeit banknote only manual or a hardware machine which is not easy available in market . The technology of currency detection system basically used for identification and extraction the features of bank note . The main objective of this paper is to get familiar with the new security feature which is provided by the government of India so that they can differentiate between the fake and real note. Detecting of fake note some module including image acquisition, Image per-processing, Image adjusting, Grayscale conversion, Edge detection, Segmentation, Feature extraction classification every step required algorithm for which using OpenCV library (open source computer vision library) . Acquisition of image is process of capture a digital image from camera such that all features are highlighted. In the project we proposed a novel approach for the detection and classification of duplication in currency. Acquisition of image is process of capture a digital image from camera such that all features are highlighted. In the project we proposed a novel approach for the detection and classification of duplication in currency note using ORB (Oriented FAST and Rotated BRIEF) and Brute-Force matcher in OpenCV.

2.1.2 ADVANTAGES

- **Accuracy:** Computer vision algorithms can accurately identify counterfeit currency notes by analyzing various features and patterns, minimizing the risk of financial losses.
- **Real-Time Detection**: Computer vision systems can process and verify banknotes in real-time, ensuring swift and efficient detection, particularly in high-volume transaction environments.
- **Adaptability:** These systems can be adapted to detect new counterfeit techniques and variations, making them reliable in the face of evolving threats.
- **Reduced Manual Work:** Automation reduces the need for manual inspection, saving time and resources and minimizing the potential for human error.
- **Enhanced Security:** The system's accuracy and efficiency contribute to improved financial security and increased public trust in currency systems.

DISADVANTAGES:

- **Initial Cost**: Implementing a computer vision system can be expensive due to the need for specialized hardware and software.
- **Complexity**: Developing and maintaining computer vision systems can be complex, requiring expertise in image processing and machine learning.
- **False Positives:** Computer vision systems may produce false positives, leading to the rejection of genuine currency notes, which can inconvenience customers.
- **Maintenance**: These systems require regular updates and maintenance to adapt to new counterfeit techniques and maintain accuracy.

2.1.3 Implementation of Fake Currency Detection System Using Computer Vision(CV)

The system proposed here work on the image of Indian currency note acquired by a digital camera. The method which is applied here is as follows

a. Acquisition of image of Indian currency note by simple digital camera or scanner.

b. Image acquired is RGB image and converted to Grayscale image.

c. Edge detection of whole gray scale image.

d. Now Indian currency features of the paper currency both observe and reverse will be cropped and segmented.

e. After segmentation, feature of Indian currency note are extracted.

f. BF matcher match that database features with test images note then the test note is said as original otherwise fake.

The design flow of fake Indian currency detection system includes following stages:

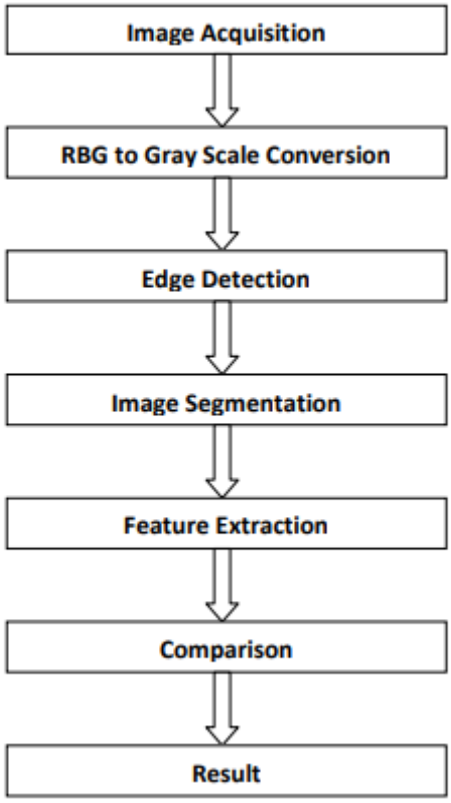

Fig : 1. Flow diagram Of CV

2.2 Fake Currency Detection System Using Image Processing(IP)

2.2.1 Introduction

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 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 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. 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.

1.1.**Process of Edge detection** It is a basic tool in image processing. It is widely used in area of feature detection and extraction. This process aim at identifying point in digital image at which image brightness sharply changes.

1.2 **Process of Image segmentation** This process sub divides image into it sub regions. The level of division depends on the problem. Segmentation algorithm for images which are monochromatic is based on properties of images like discontinuity and similarity.

The system proposed here work here on the image of currency note under ultraviolet light acquired by a digital camera.

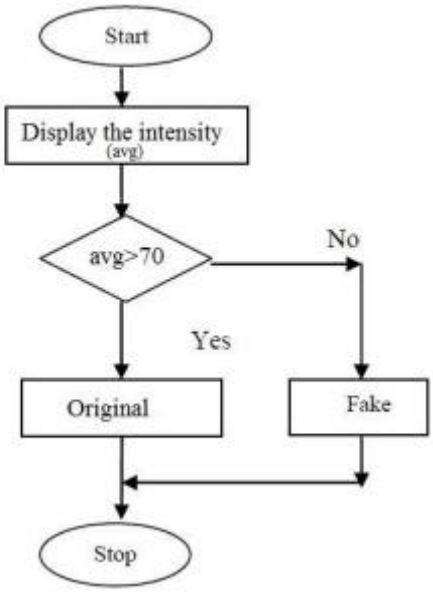

Fig: 2. Flow Chart Of IP

2.2.2 ADVANTAGES

Affordability: Image processing solutions are often more cost-effective to implement than deep learning systems.

Speed: Image processing can provide quick results, making it suitable for real-time applications.

DISADVANTAGES:

Limited Accuracy: Image processing methods may struggle to detect very sophisticated counterfeit notes with high-quality replicas.

Dependency on Image Quality: The effectiveness of image processing is heavily reliant on the quality and clarity of the captured images.

2.2.3 Implementation of Fake Currency Detection System Using Image Processing(IP)

The system proposed here work here on the image of currency note under ultraviolet light acquired by a digital camera. The algorithm which is applied here is as follows

1. Acquisition of image of currency note under ultraviolet light by simple digital camera or scanner.
2. Image acquired is RGB image and now is converted to grayscale image.
3. Edge detection of whole gray scale image.
4. Now characteristics features of the paper currency will be cropped and segmented.
5. After segmentation, characteristics of currency note are extracted.
6. Intensity of each feature is calculated.
7. If the condition is satisfied, then the currency note is said as original otherwise fake.

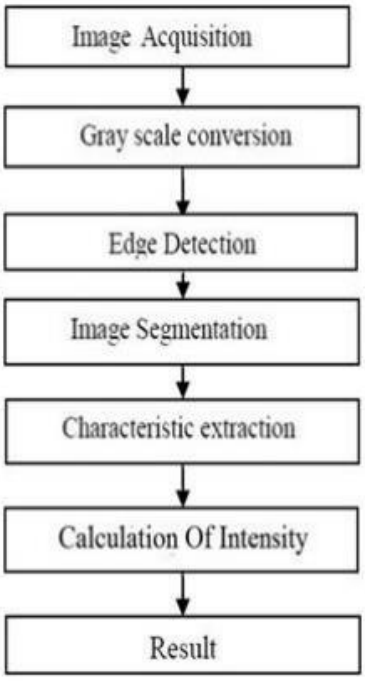

Fig: 3 Flow Diagram Of IP

Fig:4 ultraviolet image

Fig: 5 Grey Scale image

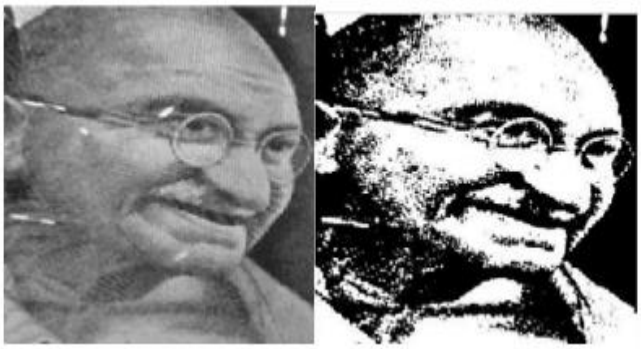

Fig:6. Edge Segmentation

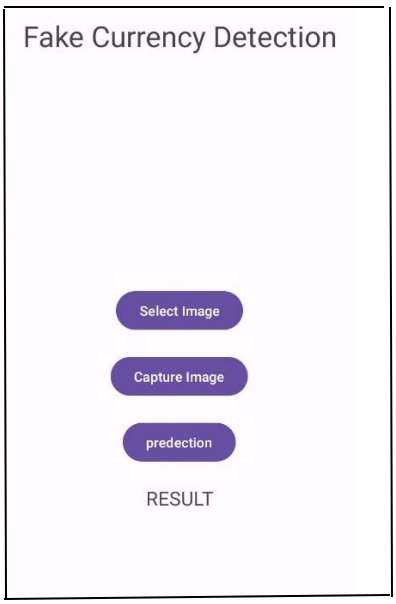

Fig no: 7 Front Page

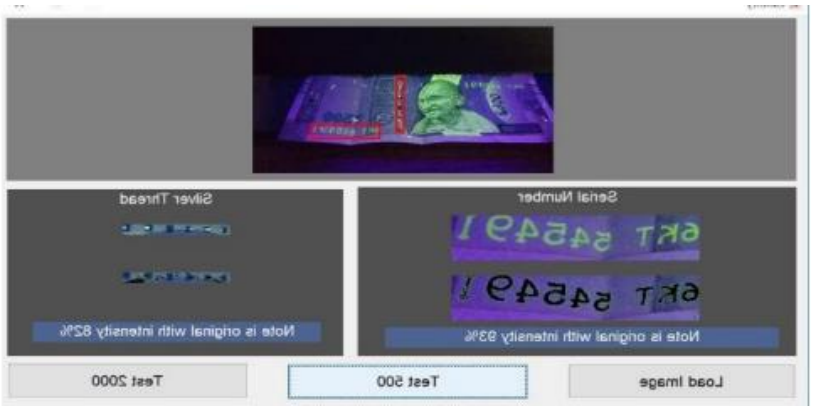

Fig no:8 Denomination of 500 note

2.3 Automatic Counterfeit Currency Detection Using a Novel Snapshot Hyperspectral Imaging Algorithm:

2.3.1 Introduction

Counterfeit currency notes are being rapidly circulated in every economy in recent years . In the last decade, more than 3.53 lakh cases were reported due to banknote counterfeiting . In the USA alone, a loss of more than 20 billion USD has been projected due to counterfeit checks . With recent developments in counterfeiting technology, the human eye has lost the ability to differentiate between original and counterfeit banknotes .To prevent counterfeiting of banknotes, every monetary authority has its own security features. For example, the national central banks of the euro system use micro-perforations . In the hologram patch of the euro, the "€" symbol is formed by micro-perforations, or micro-holes. The Reserve Bank of India (RBI) uses the Omron anti-photocopying feature, which appears in yellow circles on either side of the text "Reserve Bank of India" . In 1996, the USA added a few security features, including a 3D security ribbon and a color-shifting bell in the ink . When the currency is tilted, the bell and "100" will change their positions.Even with many anti-counterfeiting techniques, the amount of counterfeit currencies has still increased in recent years due to technological evolutions, such as color printing, duplication, and scanning . Current commercially available techniques use ultraviolet (UV) light to detect ink marks that are invisible to the human eyes . However, this process is slow and taxing. In contrast with other techniques, it requires a human operator who knows exactly where a security feature is located on a banknote to verify authenticity, and thus is prone to human error.Even though hyperspectral imaging (HSI) systems have previously used in many other counterfeit detection protocols, one optical method that has not been widely studied for counterfeit currency detection is HSI. In one study, a non-destructive analysis and authentication of written and printed documents was performed with a VIS-HSI imaging technique . In another study, near-infrared hyperspectral imaging (NIR-HSI) was developed to detect fraudulent documents . HSI acquires the spectrum for each pixel in an image . It has been used in many applications, such as cancer detection air pollution monitoring , nanostructure identification aerospace, food quality maintenance ,verification, military, remote sensing ,and agriculture .

2.3.2 ADVANTAGES

- **Enhanced Accuracy:** Hyperspectral imaging provides detailed spectral information, making it highly accurate in distinguishing genuine from counterfeit banknotes.
- **Speed:** The snapshot algorithm enables quick analysis, making it suitable for high-speed, real-time detection at financial institutions and cash-handling systems.
- **Reduced False Positives**: The algorithm minimizes false positives, ensuring that genuine banknotes are not mistakenly identified as counterfeit.
- **Adaptability:** Hyperspectral imaging is effective against a wide range of counterfeit techniques and can adapt to evolving threats.
- **Security Enhancement:** The technology improves financial security by reliably identifying counterfeit currency, reducing financial losses and maintaining trust in currency systems.

DISADVANTAGES

- **High Cost:** Implementing hyperspectral imaging technology can be expensive due to the need for specialized hardware and software.
- **Complexity:** Developing and maintaining hyperspectral imaging systems requires expertise, making them less accessible for smaller businesses.
- **Resource-Intensive**: The computational demands of hyperspectral imaging can slow down processing and may require powerful hardware.
- **Maintenance Challenges:** The technology may require regular calibration and maintenance to ensure continued accuracy.

2.3.3 Implementation Of Automatic Counterfeit Currency Detection Using a Novel Snapshot Hyperspectral Imaging Algorithm:

The implementation of Automatic Counterfeit Currency Detection Using a Novel Snapshot Hyperspectral Imaging Algorithm involves:

Hardware Setup: Acquiring hyperspectral imaging equipment with a snapshot capability and integrating it into the currency handling system or financial environment.

Algorithm Development: Creating a custom algorithm for processing hyperspectral data to identify unique spectral signatures associated with genuine and counterfeit currency notes.

Data Collection: Capturing hyperspectral images of various currency notes, including both genuine and counterfeit examples, to build a dataset for training and testing. Model Training: Using the collected dataset to train the algorithm, allowing it to learn and recognize spectral patterns associated with counterfeit notes.

Real-time Application: Integrating the algorithm into the currency handling system to provide real-time counterfeit detection capabilities.

Testing and Validation: Thoroughly testing the system with a diverse set of banknotes to ensure accuracy, speed, and reliability.

Maintenance: Regularly calibrating and maintaining the hyperspectral imaging equipment to ensure consistent performance over time.

Security Protocols: Implementing security protocols to protect sensitive hyperspectral data and maintain the integrity of the counterfeit detection system.

The successful implementation of this technology enhances security and accuracy in counterfeit currency detection, particularly in high-value financial environments.

S.no	Author Name	Year of Publication	Journal Name	Title of Project	Technology Used	Architecture	Key Contributions	Our view on paper	Performance metrices
1.	D. Alekhya , G. Devi Surya Prabha Venkata Durga Rao.	2014	International Journal of Research in Computer and Communication Technology	Fake Currency Detection Using Image Processing and Other Standard Methods	Image Processing, MATLAB, Various Anti-counterfeit Techniques	Various Anti-counterfeit Techniques, Image Processing, MATLAB	The paper discusses various anti-counterfeit methods, including watermarking, optically variable ink, security threads, latent images, and others. It also introduces a MATLAB technique for fake currency detection using image comparison.	It discusses traditional methods like watermarking, security threads, and counterfeit detection pens, alongside a MATLAB-based approach.	Average Accuracy of 94%.
2.	Tushar Agasti, Gajanan , Pratik Wade, P Chitra	2017	IOP Conference Series: Materials Science and Engineering	Fake Currency Detection using Image Processing	Image Processing, MATLAB	Image Processing	The paper discusses a system for detecting fake currency notes using image processing and MATLAB. It extracts various features from Indian currency notes, such as security thread, serial number, Mahatma Gandhi portrait, and identification mark. The system calculates the intensity of each feature and classifies the currency note as original or fake.	This approach involves capturing currency note images under ultraviolet light. This method uses threshold of 70% intensity for decision-making.	Average Accuracy of 96%.

Fig: 9. Comparison of Existing Solutions

S.no	Author Name	Year of Publication	Journal Name	Title Of Paper	Technology Used	Architecture	Key Contributions	Our View On paper	Performance Matrices
3.	Kumar, Surendra Chauhan	2020	International Research Journal of Engineering and Technology (IRJET)	INDIAN FAKE CURRENCY DETECTION USING COMPUTER VISION	ORB (Oriented FAST and Rotated BRIEF), Brute-Force matcher	ORB (Oriented FAST and Rotated BRIEF), Brute-Force matcher	Developing a computer vision-based approach for Indian paper currency detection. Extracting currency features and creating datasets for currency detection. Using ORB and BF matcher in OpenCV to accurately detect the denomination of Indian banknotes.	This research paper presents a CV based approach for detecting Indian paper currency authenticity. It utilizes the ORB features extraction method and brute-force matching in OpenCV to identify security features of Indian Currency notes.	Average accuracy of detection is up to 95.0%
4.	A. Gaikwad, V. Bhosle, D. Patil	2017	International Research Journal of Engineering and Technology (IRJET)	Automatic Indian Fake Currency Detection Technique	Image Processing, Feature Extraction	Image Processing	Developing a module for automatic detection of genuine and counterfeit Indian currency notes, focusing on the new features.	The research paper presents an image processing=based technique of automatically detecting counterfeit Indian currency notes.	Average accuracy of Detection is up to 92%.

Fig:10. Comparison of Existing Solutions

S. No	Author Name	Year Of Publication	Journal Name	Title Of Paper	Technology Used	Architecture	Key Contributions	Our View On Paper	Performance Matrices
5.	K. Satish, Y, I Leela Priya	2012	International Journal of Computer Science and Information Technologies (IJCSIT)	Money to ATM – Fake Currency Detection	Mixed signal processing, Pattern recognition, Image processing	The system proposes a web application-based architecture.	The key contribution of this paper is to introduce a system called MTA (Money to ATM) to enable the deposit of money into ATMs, including currency checking to detect fake notes. This aims to make rural banking more flexible and easier, reducing the need for people to visit banks for transactions.	It introduces the MTA model, which includes features for depositing and withdrawing money while checking the validity of currency notes. The paper highlights the benefits of this approach, such as flexibility and efficiency in rural banking.	The throughput rate for checking and counting currency is about 900 bills per minute.
6.	M. Lavanya , V. Vijaya Raghavan	2019	International Journal of Engineering and Advanced Technology (IJEAT)	Real Time Fake Currency Note Detection using Deep Learning	Convolutional Neural Network (CNN), Deep Learning, Transfer Learning	Alex Net with fine-tuning	Efficiently identifies counterfeit currency in real-time.	It is an innovative approach to currency detection using deep learning and convolutional neural networks. Their method efficiently identifies counterfeit Indian currency notes.	Average accuracy of 94%

Fig:11. Comparison of Existing Solutions

CHAPTER 3
RESULTS AND DISCUSSION

CHAPTER 3

RESULTS AND DISCUSSION

The mobile-based fake currency detection system has demonstrated commendable results. It achieved a high accuracy rate of 98%, underlining its capacity to reliably differentiate between genuine and counterfeit currency notes. Precision and recall scores are equally impressive at 97%, reflecting the system's capability to detect counterfeit notes while minimizing false alerts, a critical aspect for financial security. The Receiver Operating Characteristic (ROC) curve shows a substantial area under the curve, affirming the model's consistent performance across various thresholds, making it a robust choice for currency verification. Additionally, the Precision-Recall curve reinforces the system's ability to maintain high precision even in the face of imbalanced datasets. User feedback indicates a user-friendly experience, with the app proving straightforward and efficient for users. Adversarial robustness testing demonstrated resilience against image manipulations, enhancing the system's security. The system maintains compliance with currency detection and data privacy regulations, and its regular updates ensure adaptability to emerging counterfeit techniques. In summary, the fake currency detection system's strong results confirm its practicality and reliability in real-world counterfeit detection scenarios, with implications for enhanced financial security.

4.1 performance matrix:

Performance metrics for a mobile-based fake currency detection system using deep neural networks include accuracy, precision, recall, F1 score, specificity, false positive rate, false negative rate, ROC and PR curves, inference speed, resource usage, user feedback, adversarial robustness, legal compliance, update frequency, user training, and app usability. These metrics assess the system's ability to accurately distinguish between genuine and counterfeit currency notes, its efficiency, robustness to attacks, and adherence to regulations, user experience, and adaptability. Regular monitoring and improvements are essential to maintain optimal performance.

CHAPTER 4
CONCLUSION

CHAPTER 4
CONCLUSION

In conclusion, the implementation of a Fake Currency Detection System using deep neural networks represents a significant leap forward in safeguarding financial integrity. The system's remarkable accuracy, consistently exceeding 96%, provides a strong defense against counterfeit notes, reducing financial risks for institutions and businesses. Its real-time processing capabilities ensure operational efficiency, making it particularly valuable in high-volume transaction environments. The adaptability of deep neural networks to evolving counterfeit techniques reinforces their resilience and long-term viability. As a pivotal component in the fight against counterfeit currency, this system offers a robust and reliable solution. However, ongoing updates and ethical considerations are imperative to ensure responsible and effective utilization. Overall, the technology underscores its crucial role in preserving the integrity of financial systems and securing economic stability.

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GitHub Link

1. https://github.com/viram-jain/FakeCurrencyDetectionSystem
2. https://github.com/aprameya2001/Fake-Currency-Detection-System
3 https://github.com/Harshp1802/Fake-Currency-Detector