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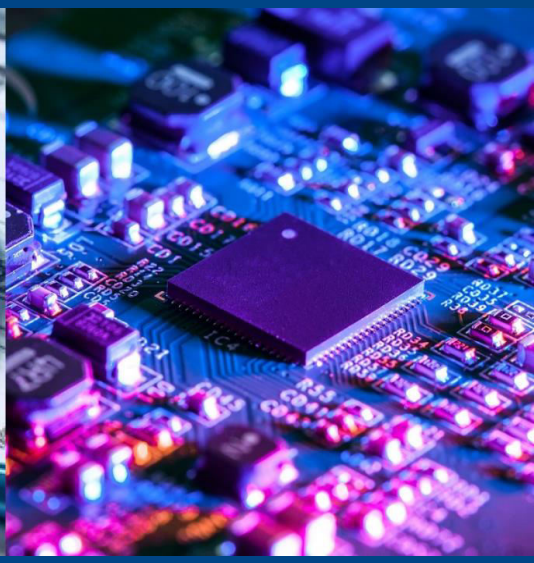

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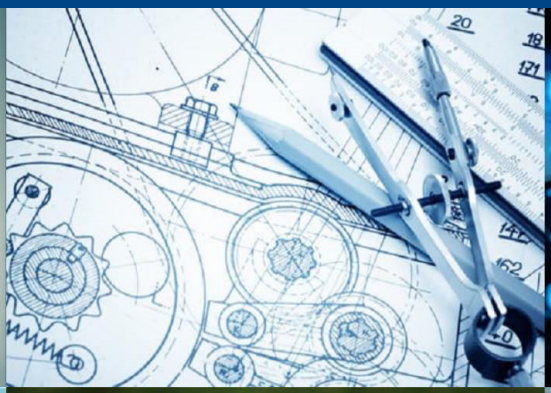

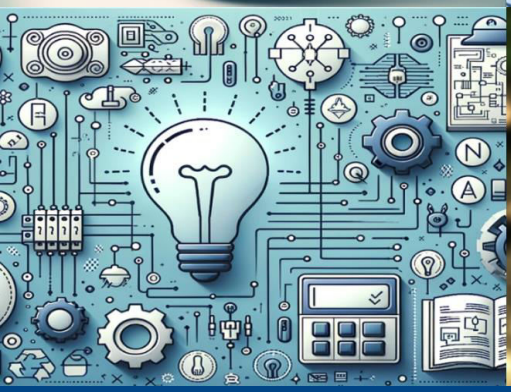

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Fake Currency Detection using Deep Learning

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ABSTRACT: The proliferation of counterfeit currency poses a significant threat to economies worldwide, necessitating advanced methods for detection. This project presents a **Fake Currency Detection System** specifically designed for Indian currency, utilizing Convolutional Neural Networks (CNN) to accurately distinguish between genuine and counterfeit notes. The system focuses on key security features such as the presence of Mahatma Gandhi's image, the serial number, and the security strip, which are essential indicators of authenticity. By analyzing images of currency notes, the CNN model identifies the absence or alteration of these features, thereby determining the currency's validity.

The system is implemented as a user-friendly web application, developed using Python and the Flask framework, ensuring accessibility and ease of use. It features a secure login system for users and an intuitive interface where users can upload images of currency notes for verification. Upon submission, the CNN model processes the image and classifies the note as either real or fake. To enhance accessibility, the system provides multilingual support, offering verbal feedback in three languages: English, Hindi, and Marathi. This feature ensures that the system can be effectively used across different linguistic demographics in India.

The system is implemented as a user-friendly web application, developed using Python and the Flask framework, ensuring accessibility and ease of use. It features a secure login system for users and an intuitive interface where users can upload images of currency notes for verification. Upon submission, the CNN model processes the image and classifies the note as either real or fake. To enhance accessibility, the system provides multilingual support, offering verbal feedback in three languages: English, Hindi, and Marathi. This feature ensures that the system can be effectively used across different linguistic demographics in India.

I. INTRODUCTION

The problem of counterfeit currency is becoming a menace in several countries across the globe, including India. This is due to the fact that fake notes, which are not easy to spot with the naked eye, can lead to losses for individuals, businesses, and banks. The risks associated with manual processes only complicate currency authentication as there is a high chance for mistakes and a relatively low efficiency rate when processing large amounts of currency. Thus, the aim of this project is to come up with an automated solution that has the capability of high accurate verification of counterfeit currency. In addition to assisting financial institutions, we expect our system which relies on deep learning, will be simple enough for the general public to use in confirming the authenticity of currency during transactions. Also, feedback in English, Hindi, and Marathi enhances the usability of the system for greater segments of the Indian market, including retailers and people who do not speak English. Because the system automatically detects and delivers immediate results, it could strengthen the economy and significantly aid in the battle against counterfeit money.

The goal of this project is to design and develop a web-based system that detects counterfeit Indian currency using deep learning techniques, specifically Convolutional Neural Networks (CNN). The system will analyze key features of currency notes such as Gandhi's image, the serial number, and security strips. After detection, it will provide audio feedback in three languages (English, Hindi, Marathi) to inform the user whether the currency is real or fake.This project aims to solve this problem by developing a web-based system using deep learning, specifically Convolutional Neural Networks (CNN), to detect counterfeit Indian currency. The system will analyze images of currency notes to identify missing or tampered features and provide real-time feedback in multiple languages (English, Hindi, Marathi), making it accessible to a broader audience.

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II. LITERATURE REVIEW

Several Techniques were proposed by various authors for Currency Identification, Forged Banknote Detection. In this scenario, a brief evaluation of some important contributors to existing literature is presented shortly.

1. Megha Thakur et al. (2014):

Presented the various fake currency detection techniques. Fake currency is imitation currency produced without the legal sanction of the state or government. Producing or using fake currency is a form of fraud or forgery. So they reviewed different fake currency detection systems. The systems are developed using different methods and algorithms. The benefits of this study for the reader are that this study will provide information about the different methods and algorithms used for fake currency detection system.

2. Komal Vora et al. (2015):

An algorithm based on the frequency domain feature extraction method is discussed for the detection of currency. This method efficiently utilizes the local spatial features in a currency image to recognize it. The entire system is pre-processed for the optimal and efficient implementation of two dimensional discrete wavelet transform (2D DWT) which is used to develop a currency recognition system. A set of coefficient statistical moments are then extracted from the approximate efficient matrix. The extracted features can be used for recognition, classification and retrieval of currency notes..

3. Spandan Sen Sarma (2016):

focused on detection of authenticity of Bank Notes using several machine learning techniques. Accurate separation of original notes from the forged one is a challenging job. In the present work Neural Network (NN) has been trained using Genetic algorithm (GA employed to detect authenticity of bank notes by classifying them into two separate classes. The initial weight vector to the input layer of the NN has been optimized gradually using the optimization techniques to enhance the performance of NN to a greater extent.

4. Nikita Bhatt et al. (2017):

deep neural networks have conquered research area in machine learning and pattern recognition. Deep learning is machine learning techniques that automatically learn hierarchical representations in deep architectures for classification. The goal is to find more important features by using neural networks. In the era of big data where for any real world application, large amount of data need to be processed, deep learning is proven to be the superior to other machine learning techniques.

5. Neha Sharma et al. (2018):

proposed an empirical analysis of the performance of popular convolutional neural networks (CNNs) for identifying objects in real time video feeds. The most popular convolution neural networks for object detection and object category classification from images are Alex Nets, GoogLeNet,and ResNet50. A variety of image data sets are available to test the performance of different types of CNN's. The commonly found benchmark datasets for evaluating the performance of a convolutional neural network are anImageNet dataset, and CIFAR10, CIFAR100,and MNIST image data sets.

6. Achal Kamble et al. (2018):

proposed a new approach to detect fake Indian notes using their images. A currency image is represented in the dissimilarity space, which is a vector space constructed by comparing the image with a set of prototypes. Each dimension measures the dissimilarity between the image under consideration and a prototype.

In order to obtain the dissimilarity between two images, the local key points on each image are detected and described. Based on the characteristics of the currency, the matched key points between the two images can be identified in an efficient manner. A post processing procedure is further proposed to remove mismatched key points.

Sr. No	System	Developed For	Remark

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1	Detection of fake Indian Currency	Counterfeit banknote detection of Indian Currency using Image Processing	Developed for only Indian Currency Only. Denomination Not Focused
2	Design and Implementation of Fake Currency Detection System	Counterfeit banknote detection of Indian Currency using Image Processing	Developed for Indian Currency Only. Denomination Not Focused
3	Banknote Authentication System	Counterfeit banknote detection of Indian Currency using Machine Learning	Developed for Indian Currency Only. Denomination Not Focused
4	Fake Indian Currency Detection	Counterfeit banknote detection of Indian Currency using Image Processing	Developed for Indian Currency Only
5	Currency Recognition System	Currency Recognition System using Image Processing	Only Currency Recognition done . No Detection of genuine or fake currency
			performed
6	Banknote Portrait Detection	Banknote Portrait Detection using Convolutional Neural Network	Banknote Portrait Detection for Indian Currency using CNN

III. METHODOLOGY

1. **Data Collection:**
   Gather a large dataset of both real and counterfeit Indian currency images. This dataset should cover multiple denominations (₹100, ₹500,) and include various counterfeit variations.

2. **Model Selection and Training:**
   Use CNN architecture to extract features from the currency images. CNNs are well-suited for image classification tasks as they can automatically learn spatial hierarchies of features from images.

3. **Currency Detection Pipeline:**

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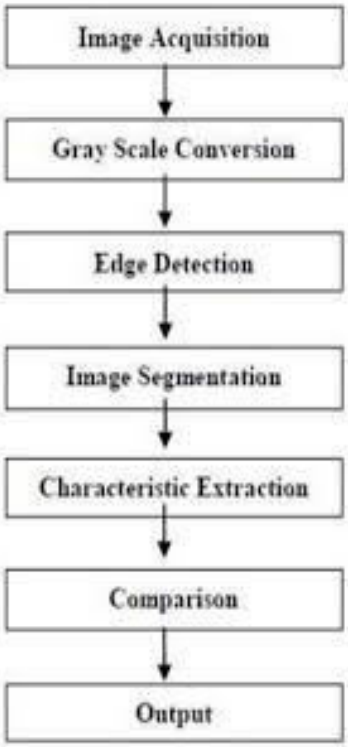
Upload Currency Image Implement a web interface using Flask, where users can upload images of currencynotes. Once uploaded, preprocess the image (resize, grayscale) before feeding it into the CNN model.

4. **Multilingual Feedback System:**
   Integrate a text-to-speech (TTS) system to provide voice feedback in three languages: English, Hindi, and Marathi.

5. **User Interface and Web Application:**
   Implement a user authentication system to allow users to securely log in and upload currency images. Design a user-friendly upload page where users can submit images for processing.

6. **Deployment:**
   Deploy the web application on a cloud platform (e.g., Heroku, AWS, or Azure) to make it accessible online.

7. **Testing and Validation:**
   Test the system using real and counterfeit currency under various conditions (e.g., different lighting, resolution, and quality).



IV. RESULTS

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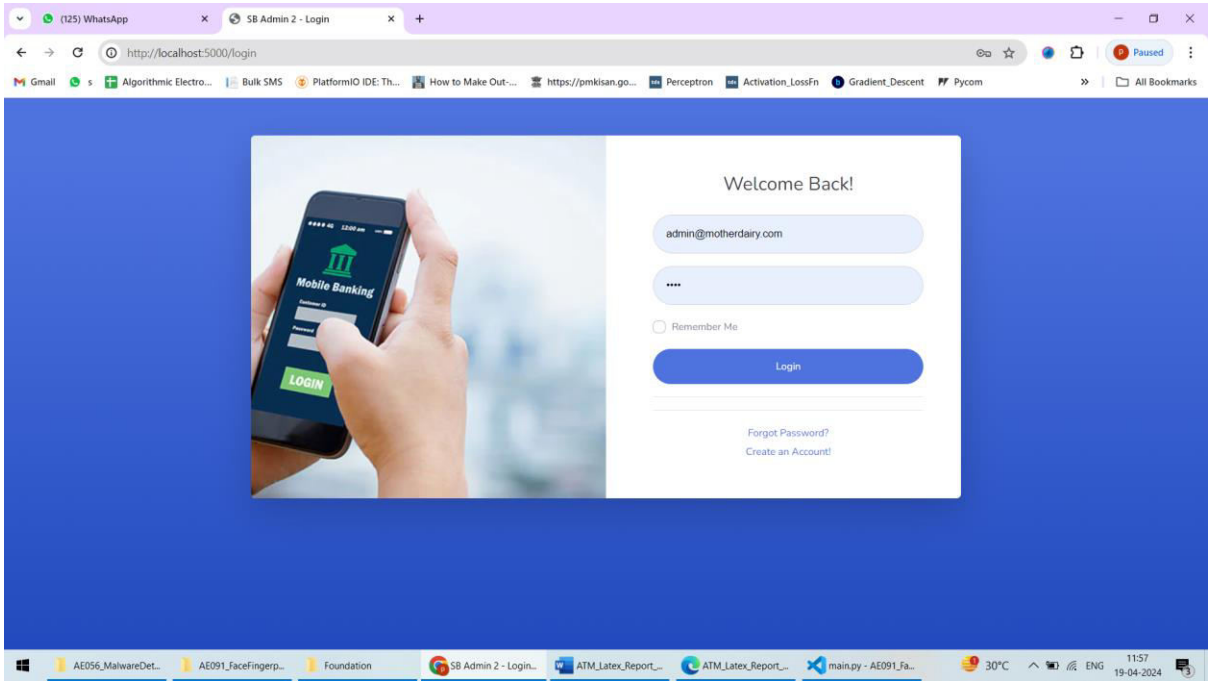

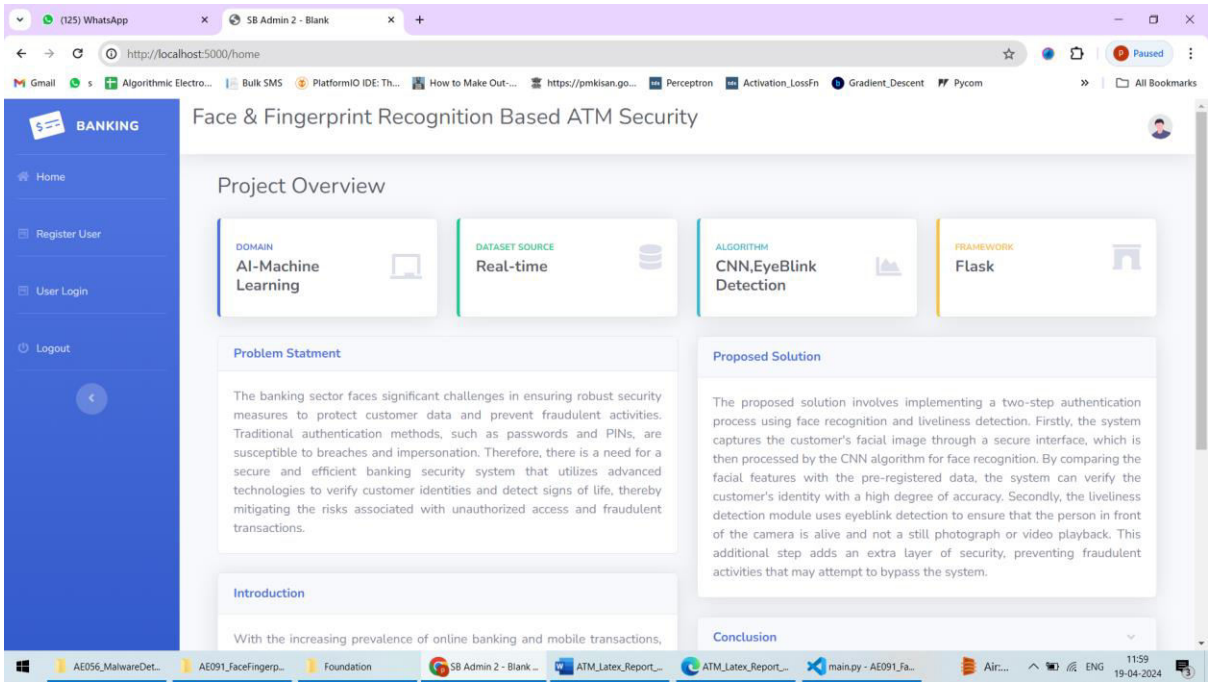

V. CONCLUSION AND FUTURE WORK

Conclusion:

The **Fake Currency Detection System** is designed to accurately detect counterfeit Indian currency notes using deep learning techniques, specifically the Convolutional Neural Network (CNN) algorithm. By analyzing key features such

as the image of Gandhiji, serial number, and security strip, the system can determine the authenticity of a currency note. Additionally, the system offers multilingual support, providing detection results in English, Hindi, and Marathi. The system is built as a web application using Python and Flask, allowing users to easily upload images for analysis. Through extensive testing, the system has demonstrated high accuracy and reliability in identifying fake currency. The integration of a user-friendly interface and multilingual speech output ensures that the system is accessible to a wide range of users.

Future Work:

1. **Increased Currency Support:** The system can be expanded to detect counterfeit currency for other countries by incorporating the unique features of their notes.
2. **Mobile Application Integration**: A mobile application could be developed to allow users to take pictures of currency notes in real time for instant verification, increasing the portability and convenience of the system.
3. **Enhanced Security Features Detection**: Future versions could incorporate advanced image processing techniques to detect more subtle security features such as watermarks, micro-printing, or holograms, improving detection accuracy..
4. **Blockchain Integration for Traceability**: Implementing blockchain for storing currency authentication records would provide an immutable, tamper-proof system, allowing the traceability of currency history and validation processes.
5. **AI Model Optimization:** Continuous improvement in the underlying deep learning models, including the use of more advanced neural network architectures like EfficientNet or ResNet, could further improve the speed and accuracy of the system.

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