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Artificial Intelligence Based Fake Bank Notes Classification and Detection

Ms. P. Saraswathi[1], R. Swapna[2], N. Priyanka[3], K. Rajya Lakshmi[4], P. Bhavana[5]

M.Tech, Computer science & Engineering, Bapatla Women's Engineering College, Bapatla, AP, INDIA[1]

B.Tech, Computer science & Engineering, Bapatla Women's Engineering College, Bapatla, AP, INDIA[2-5]

Abstract: Identifying and classifying counterfeit and genuine currency has become essential to protecting economies around the world.Advanced systems to efficient Counterfeit cash has been a major issue in India; according to a 2016 estimate, there was approximately ₹1,000 crore worth of counterfeit currency in circulation. Traditional methods for counterfeit detection have relied heavily on physical characteristics such as watermarks, security threads, and ultraviolet detection, but these techniques have proven insufficient against the sophistication of contemporary counterfeiters.In order to classify currencies and detect counterfeits, this research makes use of deep learning, more especially DenseNet.Using a dataset of 3753 images of Indian Rupee currency notes sourced from Kaggle, the model was trained to classify currency into eight distinct classes, distinguishing between real and fake notes. The model's performance was enhanced by using the DenseNet architecture, which is renowned for its effective feature reuse and increased accuracy. A web-based user interface was developed to allow users to upload currency images and receive instant feedback on the authenticity of the notes.In order to tackle the problem of counterfeit currency, this approach offers a scalable and easily accessible solution.

Keywords: Fake currency detection, Real currency classification, Deep learning, DenseNet, Image classification, currency security, Indian Rupee, Neural networks.

I. INTRODUCTION

Counterfeit currencies remain a significant threat to global economies, including India, where exacerbate inflation and undetermine public trust. Traditional detection methods such as manual inspection and basic scanning technologies are often error-prone and ineffective against increasingly sophisticated counterfeiting techniques. Recent advancements in artificial intelligence (AI), particularly in deep learning, have opened new avenues for accurate and efficient currency detection.

The DenseNet architecture, a potent convolutional neural network renowned for its effectiveness and high accuracy in image classification, is used in this project to identify fake Indian Rupee notes. The system was trained to classify notes in various conditions using a varied dataset of 3,753 photos from Kaggle. Real-time classification and user feedback are made possible via an intuitive online interface, which makes the solution useful for banks, shops, and the general public. This project provides a scalable and reliable method for reducing the circulation of counterfeit currency by fusing accessibility and artificial intelligence.

II. LITERATURE REVIEW

A. "Deep Learning for Fake Currency Detection"

Zhang et al. (2019) investigated the detection of counterfeit cash using deep learning models, particularly Convolutional Neural Networks (CNNs). This study demonstrated that CNNs can significantly outperform traditional counterfeit detection methods in terms of accuracy and efficiency. They trained the CNN using a variety of datasets, including pictures from banknotes.

B. "Currency Recognition System using CNN"

Gupta et al. (2020) proposed a currency recognition system based on CNNs for classifying currency notes. Their approach achieved high accuracy in recognizing different denominations of currency and distinguishing real notes from fake notes. The authors highlighted that CNNs are well suited for image recognition tasks because of their ability to learn spatial hierarchies. However, they pointed out that the system struggled with low-quality or damaged notes, leading to misclassifications.

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C. "Counterfeit Currency Detection Using Machine Learning"

Lee et al. (2021) looked on the detection of counterfeit currency using machine learning methods like support vector machines (SVMs) and decision trees. Their study showed that these algorithms performed adequately in detecting counterfeit notes,although they were outperformed by deep-learning methods. The lack of robustness in the model when applied to novel, unseen counterfeit tactics was a major disadvantage of this study, which made it less flexible to new counterfeit techniques.

D. "Fake Currency Detection Using Image Processing"

Chen et al. (2022) created an image processing-based counterfeit cash detecting system.The authors examined the physical characteristics of banknotes using techniques including edge detection and feature extraction. Using distinctive visual characteristics, this method assisted in differentiating between authentic and fraudulent notes. However, the authors noted that the system struggled to handle images taken under various lighting conditions, which could lead to inconsistencies in the classification.

E. "Automatic Currency Recognition with Deep Neural Networks"

Singh et al. (2021) focused on using deep neural networks for currency recognition, specifically for the automatic detection of real and counterfeit notes. This study demonstrated that deep learning models, particularly Convolutional Neural Networks (CNNs), can successfully recognize currency denominations with high accuracy. However, the performance of the model is heavily dependent on the quality and diversity of the dataset used for training. The study emphasized the importance of having a large and varied dataset to improve generalization across different types of currencies and to reduce the model's bias toward certain denominations.

III. METHODOLOGY

A dataset of 3,753 labelled photos of authentic and fake Indian Rupee notes from Kaggle is used in this project.The data were divided into sets for testing, validation, and training.To improve the model's resilience, preprocessing procedures include resizing, normalisation, and data augmentation methods including flipping, rotation, and scaling.DenseNet, a deep learning architecture known for efficient feature reuse and high accuracy,was used for image classification. The model was trained using the Adam optimizer with hyperparameters tuned through validation. Performance is evaluated using metrics such as accuracy, precision, recall, and F1-score on a separate test set. To enable users to input note photos for legitimate classification in real time, a web-based interface was created. The system displays the results with a confidence score and includes a feedback mechanism to gather user input for continuous model improvement.

a. **Data Collection**: 3,753 photos of authentic and counterfeit Indian Rupee notes from Kaggle are included in the dataset.

b. **Preprocessing**: To improve the model's performance under various image situations, all of the photographs were scaled, normalised, and enhanced.

c. **Model Selection:** DenseNet was chosen because of its strong performance in image classification. All layers are connected, which aids in the model's ability to learn more features.

d. **Model Training**: The DenseNet model is trained using the training set and tuned using the validation set. The Adam optimizer helps the model to learn quickly and effectively.

e. **Model Testing and Validation**: The model is tested on new images to check how well it works. We calculated the accuracy, precision, recall, and F1-score to measure the performance.

f. **Web Interface Development**: A simple website is built where users can upload a photo of a currency note and obtain quick results on whether it is real or fake.

g. **Real-time Prediction**: When a user uploads an image, the system checks it instantly using the trained model and shows the result with a confidence score.

h. **Feedback Collection:** Later, the system can be retrained with more data, which helps it get better.

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IV. RESULT AND ANALYSIS

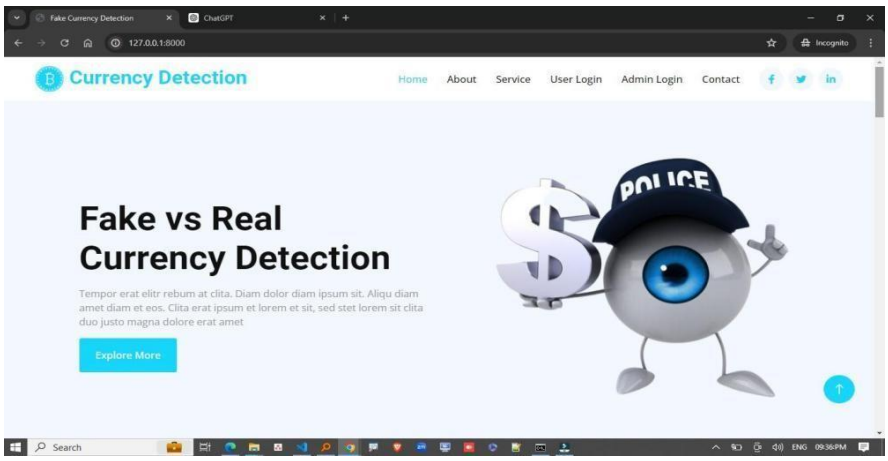

Fig. 1 Home Page of Currency Detection System

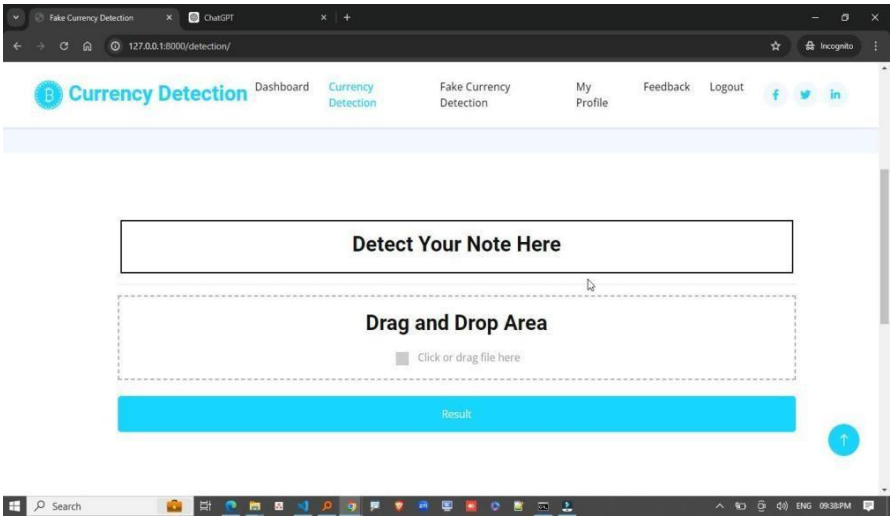

Fig. 2 Currency Detection Interface

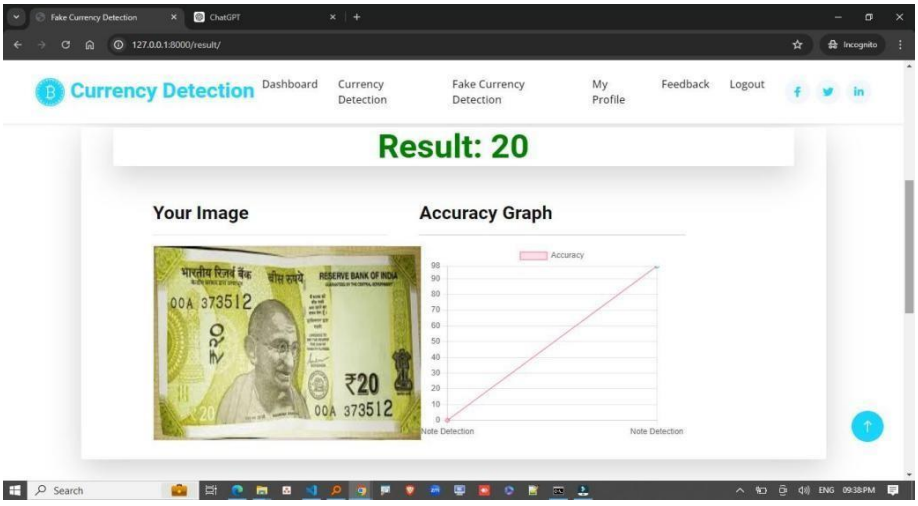

Fig. 3 Classification Output -₹20 Currency Note Identified

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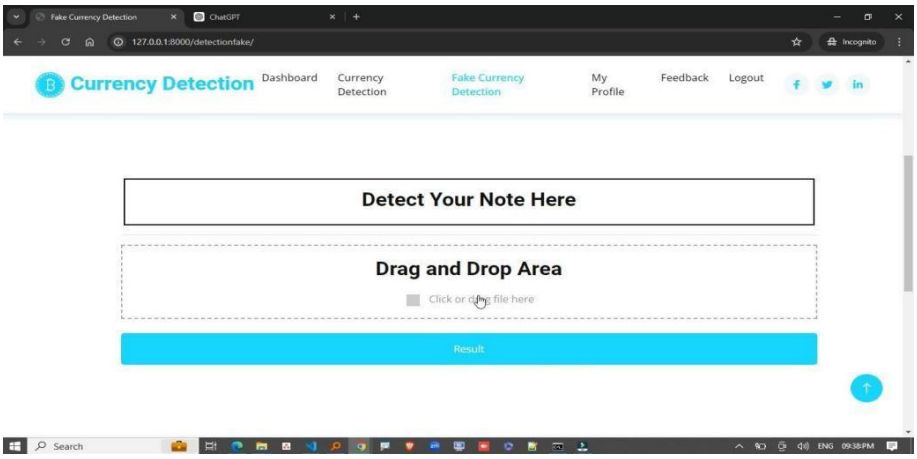

Fig. 4 Fake Currency Detection Upload Page

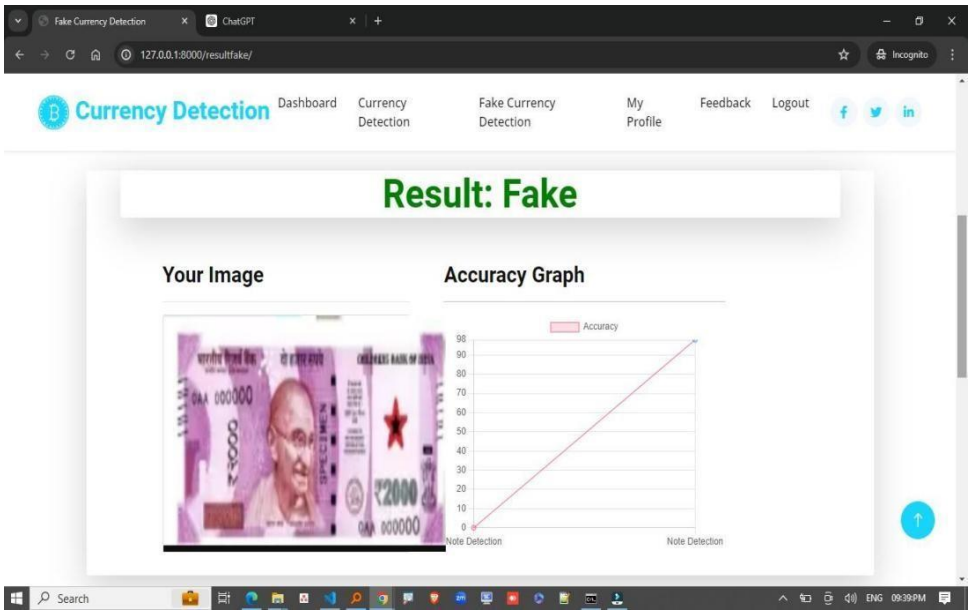

Fig. 5 Detection Result – Fake Note

V. CONCLUSION

In conclusion, this project successfully developed a deep learning-based system for the classification and detection of fake and real currency notes. The web interface enhances accessibility, whereas continuous feedback improves accuracy. It provides a workable, scalable, and affordable way to fight counterfeit money, which is particularly advantageous for Indian banks, merchants, and private citizens.

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BIOGRAPHY

P. Saraswathi, M.Tech, Asst. Professor, Dept of Computer Science & Engineering, BWEC, Andhra Pradesh, India.

R. Swapna [B.Tech],Student, Dept of Computer Science & Engineering, BWEC, Andhra Pradesh, India.

N. Priyanka [B.Tech],Student, Dept of Computer Science & Engineering, BWEC, Andhra Pradesh, India.

K. Rajya Lakshmi [B.Tech],Student, Dept of Computer Science & Engineering, BWEC, Andhra Pradesh, India.

P.Bhavana [B.Tech],Student, Dept of Computer Science & Engineering, BWEC, Andhra Pradesh, India.