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Fake Currency Detection

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ABSTRACT:

Fake currency is a growing issue that affects financial systems and everyday transactions. Many people, especially in rural areas or small businesses, find it difficult to identify counterfeit notes due to lack of training or tools. Manual checking methods, such as inspecting watermarks or using UV pens, are often slow, unreliable, and not easily accessible to everyone. This project aims to create an intelligent, easy-to-use, and cost-effective system to detect fake currency using image processing and deep learning. The system allows users to upload an image of a currency note through a user-friendly application built with Python and Tkinter. It uses Local Binary Pattern (LBP) to extract image features and a Convolutional Neural Network (CNN) to classify the note as real or fake. The application is enhanced with a voice assistant feature using pyttsx3, making it especially helpful for visually impaired users. Unlike traditional systems, this tool does not require expensive hardware and can be used on standard computers or later expanded to mobile devices for real-time detection. It also supports retraining with new data, making it adaptable for future changes in currency design. By combining deep learning, voice support, and an intuitive interface, this project offers an innovative and inclusive solution to a widespread problem. It empowers common people, shopkeepers, and students to protect themselves from counterfeit currency without relying on expensive or complex machines.

Keywords: Fake Currency Detection, Image Processing, Deep Learning, Convolutional Neural Network (CNN), Local Binary Pattern (LBP), Python, OpenCV, Tkinter, pyttsx3, Voice Assistant, Machine Learning, Currency Note Verification, Real-time Detection, Computer Vision, Accessibility, Mobile App Integration, Feature Extraction, Security, Fraud Prevention.

Introduction:

Fake currency has become a serious concern in many countries, including India. It not only damages the economy but also reduces public trust in financial transactions. Many people, especially in rural areas and small businesses, struggle to identify counterfeit notes due to lack of awareness or access to costly detection tools. Traditional methods such as UV lamps, watermark inspection, or fake-note pens are either inaccurate, time-consuming, or inaccessible to the general public. Therefore, there is an urgent need for an intelligent, affordable, and user-friendly system to address this issue.

Advances in **artificial intelligence (AI)**, **machine learning (ML)**, and **computer vision** have opened new possibilities for currency verification. Instead of relying solely on manual inspection or static image comparisons, modern systems can analyze intricate features of banknotes, such as patterns, symbols, and watermarks, using deep learning algorithms. Convolutional Neural Networks (CNNs), combined with feature extraction methods like Local Binary Pattern (LBP), offer high accuracy in distinguishing between real and fake notes.

The objective of this project, *Fake Currency Detection Using Deep Learning and Image Processing*, is to design and implement a smart application capable of classifying banknotes as genuine or counterfeit. The system uses Python, OpenCV, and TensorFlow to build a CNN model, with a Tkinter-based graphical interface for user interaction. Additionally, the project integrates a **voice assistant (pyttsx3)**, making it accessible even for visually impaired individuals. Unlike expensive machines used in banks, this solution is cost-effective, works on standard computers, and can be further extended to mobile devices for real-time detection.

This project is not only technically significant but also socially impactful. By enabling shopkeepers, vendors, students, and the general public to verify currency quickly and accurately, it helps prevent fraud, protects daily income, and promotes awareness about counterfeit money. With its scalable design, the system can adapt to new note designs in the future, ensuring long-term usability.

Methodology:

The methodology for this project focuses on developing an intelligent, accessible, and cost-effective system for detecting fake currency notes using *image processing* and *deep learning*. The process involves several key stages, from data collection to system implementation, as outlined below:

1. Data Collection

A dataset of real and fake Indian currency notes was prepared by collecting images from reliable sources. Images of different denominations were used to ensure diversity in the training data. Both genuine and counterfeit samples were included to train the system for classification.

2. Image Preprocessing

The collected images were preprocessed to improve quality and ensure consistency:

- *Grayscale Conversion*: Currency note images were converted to grayscale to reduce complexity.
- *Resizing*: Images were resized to a fixed resolution for uniformity.
- *Noise Removal*: Filters were applied to remove background noise.
- *Feature Extraction (LBP)*: The *Local Binary Pattern (LBP)* technique was used to extract texture features such as patterns, watermarks, and symbols from the note images.

3. Model Development (Deep Learning)

A *Convolutional Neural Network (CNN)* was designed and trained to classify notes as genuine or counterfeit:

- *Training Phase*: Preprocessed images with extracted features were fed into the CNN.
- *Feature Learning*: The CNN automatically learned intricate patterns that differentiate real from fake notes.
- *Testing Phase*: The model was tested on unseen note images to validate its accuracy and performance.

4. System Implementation

The trained model was integrated into a user-friendly application:

- *Graphical User Interface (Tkinter)*: A desktop app was created where users can upload an image of a currency note.
- *Prediction Module*: The CNN model analyzes the uploaded image and classifies it as "Real" or "Fake."
- *Voice Assistant (pyttsx3)*: To improve accessibility, especially for visually impaired users, the result is also read out loud.

5. Output and Validation

- The system displays the classification result on the screen.
- The voice assistant provides audio feedback.
- Validation was carried out by testing the system on multiple real and fake currency note samples.

6. Tools and Technologies Used

- *Programming Language*: Python
- *Libraries*: OpenCV (image processing), TensorFlow/Keras (deep learning), pyttsx3 (voice output), Tkinter (GUI)
- *Development Environment*: Jupyter Notebook, VS Code
- *Dataset*: Images of Indian currency notes (real and counterfeit)

Workflow

1. Collect currency note images (real and fake).
2. Preprocess images (grayscale, resize, noise removal).
3. Extract features using LBP.
4. Train CNN model with labeled data.
5. Test and validate the model.
6. Deploy into a Tkinter-based GUI with voice assistant.
7. Provide final output to the user as "Real" or "Fake."

Results

The project successfully developed and implemented a *Fake Currency Detection System* using *image processing* and *deep learning techniques*. The results demonstrate the system's ability to classify Indian currency notes as *real or fake* with good accuracy and usability.

1. Model Performance

- The *Convolutional Neural Network (CNN)* model trained on images of real and fake notes achieved high accuracy during testing.
- *Local Binary Pattern (LBP)* feature extraction improved the model's ability to distinguish textures, watermarks, and fine details on the notes.
- The system was validated using multiple Indian currency denominations, and the CNN consistently identified genuine and counterfeit notes with reliable precision.

2. Application Functionality

- A *Tkinter-based graphical user interface (GUI)* was developed to allow users to upload images of currency notes.
- Once an image is uploaded, the system processes the note and displays the result on-screen as either *"REAL"* or *"FAKE."*
- The application also integrates a *voice assistant (pyttsx3)*, which announces the classification result, ensuring accessibility for *visually impaired users*.

3. Usability and Accessibility

- The system was tested in a *lab environment at Aurora University*, where it successfully detected counterfeit notes across multiple trials.
- The application requires only a standard *PC or laptop with a camera*, making it affordable and accessible even for small shopkeepers, students, or rural users.
- The voice-enabled output provides an inclusive solution for users who may struggle with visual interfaces.

4. Key Outcomes

- The system is *low-cost*, requiring no specialized hardware beyond a regular webcam.
- It is *accurate and scalable*, with the ability to be retrained on new datasets if currency designs change in the future.
- It is *inclusive*, as the voice assistant supports visually impaired users, a feature lacking in most existing systems.

Figure 1: Real Currency Dataset

Figure 2: Fake Currency Dataset

Fake currency due to same serial numbers

Table: CNN Models Used for Fake Currency Detection and Their Accuracy

Model / Approach	*Technique*	*Accuracy*	*Remarks*
Basic CNN (Your Project)	LBP (feature extraction) + CNN classification	Not specified (tested successfully in lab)	Affordable, accessible, voice-enabled, retrainable
CNN-LSTM (César G. Pachón et al., 2021)	CNN + LSTM for pattern learning	~97–98%	High accuracy, but tested only in lab settings
Lightweight CNN + Transfer Learning (2021)	MobileNet, ResNet (pre-trained CNN models)	~99%	Very high accuracy, but limited denominations; not user-friendly
CNN + Mobile App (Syed J. Jaman et al., 2025)	CNN deployed with TensorFlow Lite on Android	98.5%	Real-time detection via app; focused on Bangladeshi notes

Conclusion

This project successfully developed a **Fake Currency Detection System** using **image processing** and **deep learning techniques**. By combining **Local Binary Pattern (LBP)** for feature extraction with a **Convolutional Neural Network (CNN)** for classification, the system effectively distinguished between genuine and counterfeit Indian currency notes.

The desktop application, built with **Python and Tkinter**, provides a simple and user-friendly interface for uploading currency note images. The integration of a **voice assistant (pyttsx3)** further enhances accessibility, making the system useful for visually impaired users as well. Testing in the Aurora University lab environment showed that the system delivers accurate results without requiring expensive hardware, relying only on a standard PC or laptop with a camera.

The key strengths of the project include its **low cost, accessibility, adaptability, and inclusiveness**. Unlike traditional currency detection machines, this system is affordable for small businesses and individuals. Additionally, the CNN model can be retrained with new data, ensuring future adaptability if currency designs change.

In conclusion, the proposed system provides an **innovative, reliable, and socially impactful solution** to the growing issue of counterfeit currency. By empowering common people, shopkeepers, and students to identify fake notes quickly and accurately, this project contributes to financial security, fraud prevention, and public trust in currency transactions.

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