Indian Currency Recognition for Visually Impaired People

First-Level Project Presentation

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Introduction

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This project is designed to assist visually impaired individuals in recognizing and managing Indian currency notes independently. It provides a **voice-guided system with audio feedback**, enabling users to identify currency and track amounts without needing visual cues.

Problem Statement

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Visually impaired individuals struggle to recognize and manage currency due to lack of accessible tools. Existing solutions like tactile marks or note sizing are unreliable. There is a need for a simple, intelligent, and non-visual method to handle Indian currency independently.

Project Objective

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- Provide a reliable currency recognition service
- Enable real-time auditory feedback
- Maintain a digital virtual purse
- Offer an accessible, keyboard- and voice-driven interface
- Enhance financial independence and security

Goal: To develop an accessible system that empowers users to recognize and manage currency independently and securely.

Literature Survey (Part 1)

Paper Title	Methodology	Advantages	Disadvantages
A Robust System for Indian Paper Currency Recognition using Deep Learning	Fine-tuned VGG-16 CNN with transfer learning and image augmentation.	High accuracy, real-world robustness.	Computationally heavy; unsuitable for low-end devices.
Deep Learning Based Currency Recognition and Verification	Custom CNN trained on raw pixel inputs for denomination classification.	Good accuracy, fast inference with pre-trained layers.	Model size too large for real-time embedded applications.
SURF-Based Indian Currency Recognition	SURF feature extraction and keypoint matching with currency DB.	Low resource usage; fast detection.	Performance drops under varied lighting or distortion.

Literature Survey (Part 2)

Paper Title	Methodology	Advantages	Disadvantages
Automatic Counterfeit Currency Detection Using Hyperspectral Imaging	Snapshot Hyperspectral Imaging (HSI) capturing ROI; analysis via Mean Gray Value (MGV) in 400–500 nm range.	High accuracy; portable and affordable hardware.	Requires special sensors; not ideal for large-scale classification.
A Survey on Paper Currency Recognition Systems	Comprehensive review of classification, detection, and feature extraction methods across studies.	Broad coverage of technologies; comparative insights.	No original model or implementation details provided.

Existing System Limitations

Current System Issues

- Relies on faded tactile marks
- Depends on subtle differences in size and texture
- Limits user independence and privacy

Proposed System

Proposed System

- Deep learning model based on ResNet architecture
- Currency recognition via webcam or image upload
- Voice command integration using Web Speech API
- Keyboard-driven interface requiring no mouse
- Continuous audio feedback for seamless interaction
- Virtual purse to track total currency amount

Tech Stack:

TensorFlow, ResNet, HTML, CSS, JavaScript, Web Speech API, Flask

Methodology

Data Collection & Preprocessing

- **Dataset:** Collected from Kaggle; images under varied lighting, angles, backgrounds.
- **Image Standardization:** Resized to 224×224 pixels, normalized, RGB preserved.
- **Label Encoding:** Folder-based class extraction and one-hot encoding.
- **Data Augmentation:** Rotation, flipping, brightness variation, and shifting (training set only).

Methodology

Model Architecture

- **Base Model:** Pre-trained ResNet50 (ImageNet).
- **Custom Layers:** Dense output layers tailored for Indian currency.
- **Loss Function:** Categorical Cross-Entropy:

$$L = -\sum_{i=1}^{C} y_i \log(\hat{y}_i)$$

- **Optimizer:** Adam optimizer used for adaptive learning.

Methodology

Two-Phase Training Strategy

- **Phase 1 – Feature Extraction:** Freeze base layers, train top layers (7 epochs, LR $= 10^{-4}$).
- **Phase 2 – Fine-Tuning:** Unfreeze last 30 layers of ResNet50, fine-tune (8 epochs, LR $= 10^{-5}$).

  Dropout Layers: Dropout applied (rates 0.5, 0.3, 0.2) to prevent overfitting.

Methodology

Callbacks & Regularization

- **Early Stopping:** Stops training if validation loss doesn't improve for 5 epochs.
- **ReduceLROnPlateau:** Lowers learning rate on plateaued validation loss.
- **Model Checkpoint:** Saves model with highest validation accuracy.

Methodology

Evaluation Metrics

- **Test Accuracy:** Overall correct predictions.
- **Top-3 Accuracy:** True label in top 3 predictions.
- **Classification Report:** Shows per-class precision, recall, and F1-score.
- **Confusion Matrix:** Displays confusion between similar denominations.

Model Architecture

- **Base Model:** ResNet50 (pre-trained on ImageNet) used for transfer learning.
- **Custom Head:** Fully connected layers added for Indian currency classification.
- **Loss Function:** Categorical Cross-Entropy:

$$L = -\sum_{i=1}^{C} y_i \log(\hat{y}_i)$$

- **Optimizer:** Adam optimizer for adaptive learning.

Two-Phase Training

- **Phase 1:** Freeze ResNet base; train only top layers for 7 epochs at 10^{-4} learning rate.
- **Phase 2:** Unfreeze last 30 layers of ResNet; fine-tune for 8 epochs at 10^{-5} learning rate.

Dropout: Added at 0.5, 0.3, and 0.2 in custom layers to reduce overfitting.

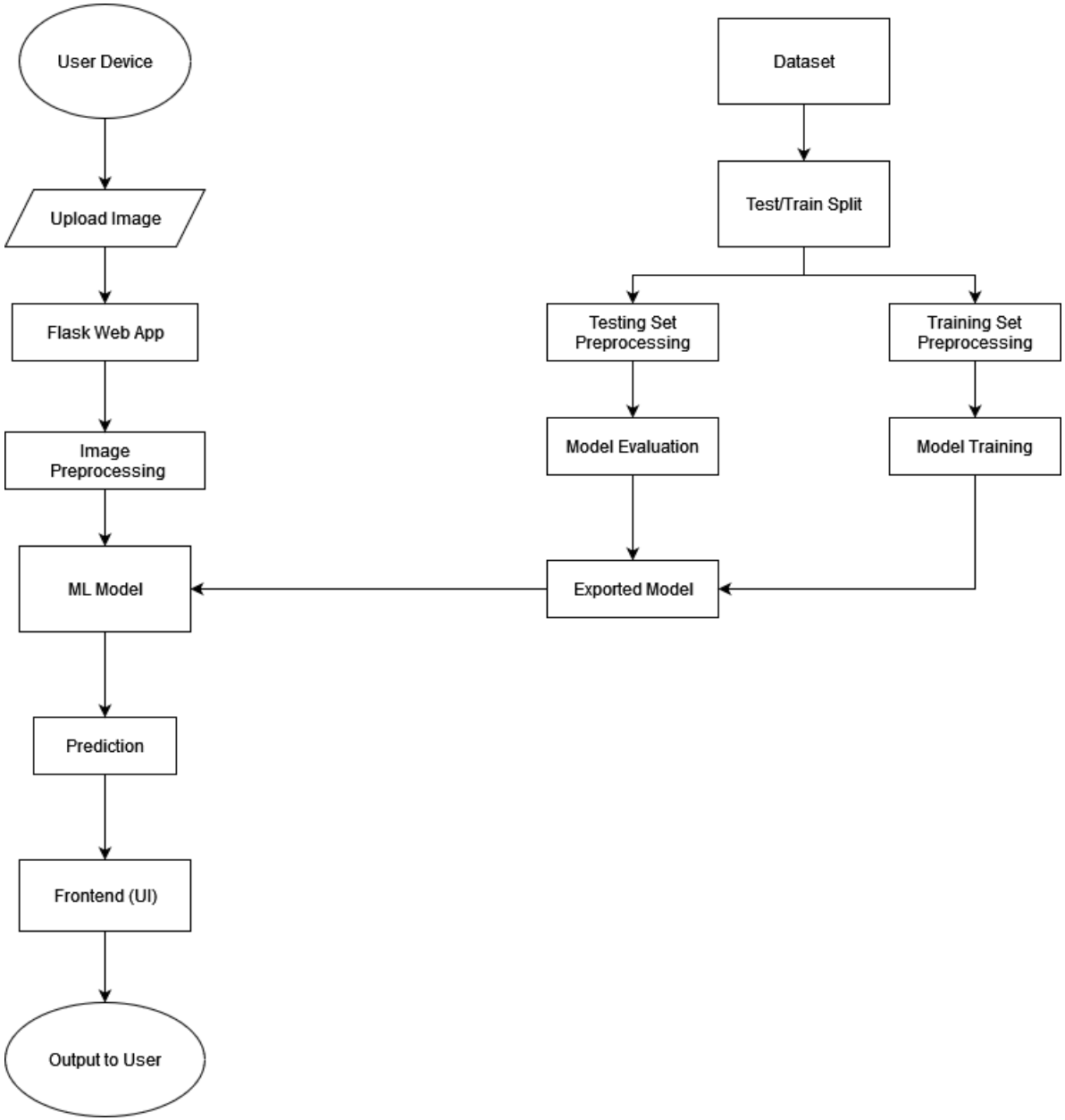
Callbacks & Regularization

- **Early Stopping:** Monitors validation loss, stops if no improvement in 5 epochs.
- **ReduceLROnPlateau:** Decreases learning rate on validation loss plateau.
- **Model Checkpoint:** Saves the best model based on validation accuracy.

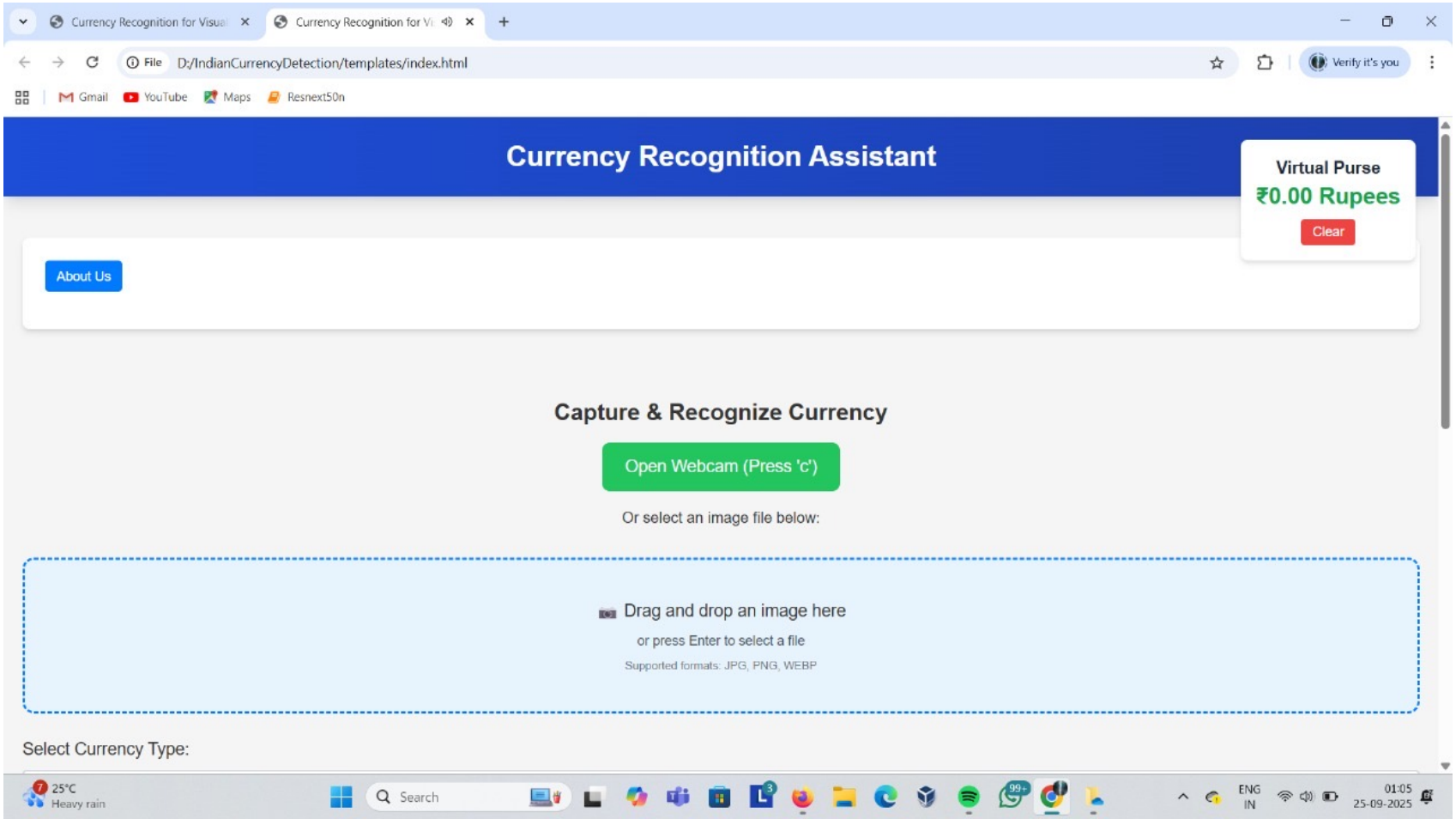
Evaluation Metrics

- **Test Accuracy:** Overall correct classifications on the test set.
- **Top-3 Accuracy:** Measures if correct label is in top 3 predictions.
- **Classification Report:** Includes precision, recall, and F1-score per class.
- **Confusion Matrix:** Shows misclassifications between denominations.

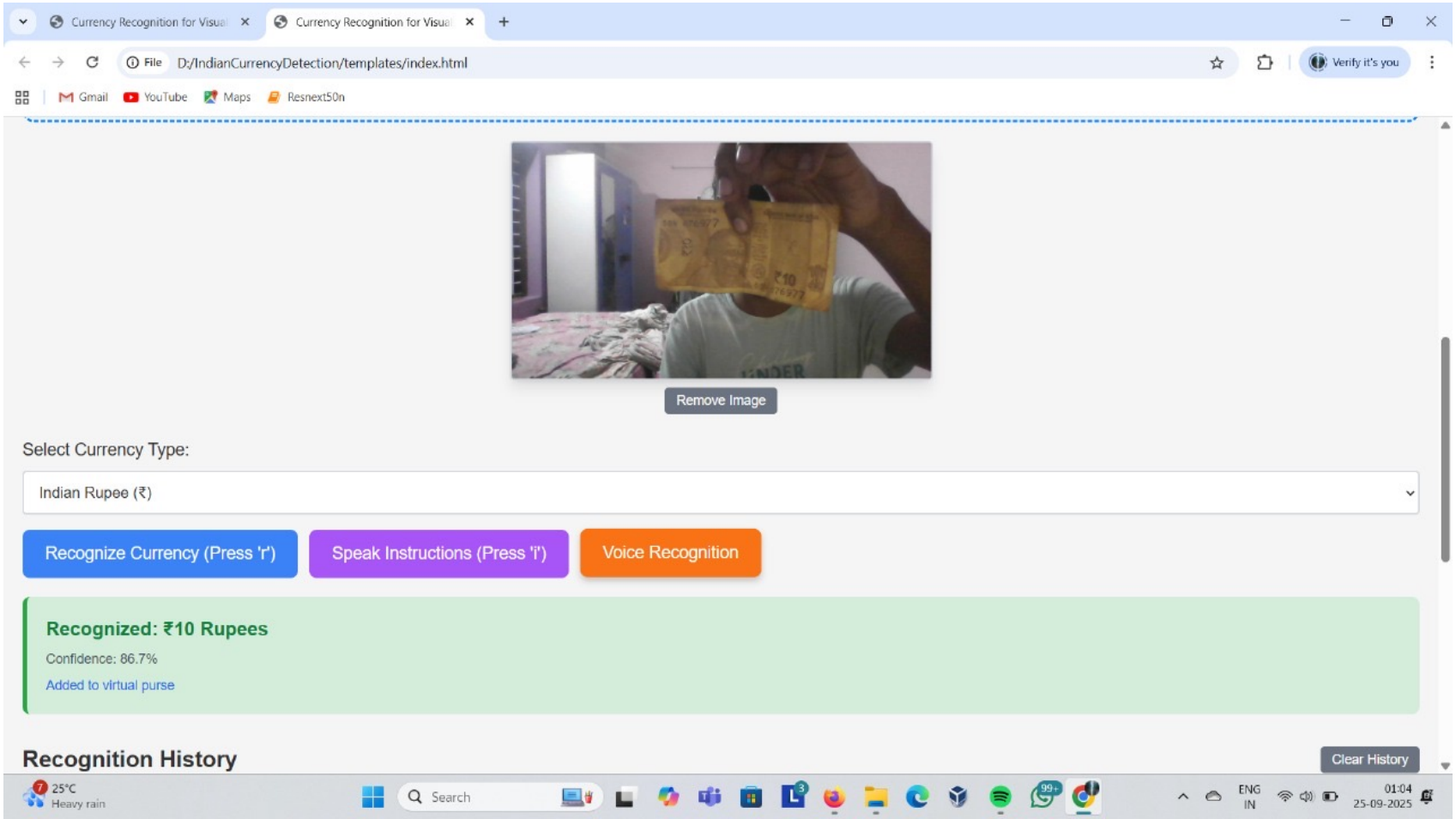
System Design / Architecture



Implementation - UI Screenshot 1



Implementation - UI Screenshot 2



System Configuration

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Hardware Configuration

- **Operating System:** Windows
- **Processor:** AMD Ryzen 5 5600H
- **Memory:** 8GB RAM

Software Configuration

- **Language:** Python
- **Machine Learning Library:** TensorFlow
- **Model Architecture:** ResNet (CNN)
- **Front End:** HTML, CSS3, JavaScript, Web Speech API
- **Back End:** Python Flask

Conclusion

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This project empowers visually impaired individuals to independently identify and manage currency, promoting financial autonomy and confidence. By prioritizing accessibility and inclusion, it supports a more equitable and dignified digital experience for all.

GitHub Repository

GitHub Link

github.com/Kevin-Monachan/CurrencyDetection

Thank You!