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| **Indian Currency Notes Classifier** |
| 06-03-2025 |

# Overview

## Abstract

We aim to develop a deep learning-based classifier for Indian currency notes to accurately identify their denominations. The proposed system will make use of convolutional neural networks (CNNs) using TensorFlow/Keras to classify various denominations of Indian banknotes. The methodology includes data collection, preprocessing, training a neural network model, and evaluating its performance. The expected outcome is a robust classification model that can be integrated into banking and financial applications for automatic denomination recognition.

## Introduction

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|  | **Currency denomination classification is a crucial task in banking, retail, and automated teller systems. Automated classification of currency notes can improve efficiency in cash handling processes and reduce manual errors. Deep learning offers an interesting approach to this problem by enabling accurate identification of currency denominations based on visual features.**  **Traditional image processing techniques often struggle with variations in lighting, orientation, and note wear. Deep learning models, particularly CNNs, can learn intricate patterns and textures that distinguish different denominations of banknotes.**   * **Can a deep learning model effectively classify Indian currency notes based on denomination?** * **What is the accuracy that can be achieved with a CNN-based approach?** * **How well does the model generalize to new currency note samples with real-world variations?** |

## Project Objectives

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|  | 1. ***Develop a deep learning-based classifier for Indian currency denominations using a CNN model.*** 2. ***Train and evaluate the model with a structured dataset containing different denominations.*** 3. ***Implement data augmentation techniques to improve model generalization.*** 4. ***Assess the model’s robustness against real-world variations such as wear, folds, and lighting conditions.*** |

## Methodology

**Neural Network Model and Architecture**

* The model will use a convolutional neural network (CNN) built with TensorFlow/Keras.
* The architecture includes convolutional layers, max pooling, flattening, and dense layers.
* The input image size is set to 224x224 pixels.

**Data Collection and Preprocessing**

* Dataset: Indian currency note images categorized into different denominations.
* Data Structure: Training and validation datasets stored in directories.
* Preprocessing: Image resizing, normalization, and augmentation (rotation, zoom, flipping) using Keras ImageDataGenerator.

**Data Visualization**

* Exploratory Data Analysis (EDA) using Matplotlib to visualize class distributions.
* Displaying feature maps from the CNN to interpret classification performance.

**Training and Testing Procedures**

* Using a training-validation split to ensure proper model evaluation.
* Training with an Adam optimizer, categorical cross-entropy loss, and softmax activation for multi-class classification.
* Model evaluation using accuracy, confusion matrices, and loss curves.

**Tools, Frameworks, and Libraries**

* Frameworks: TensorFlow/Keras
* Libraries: OpenCV, NumPy, Matplotlib, Pandas
* Tools: Jupyter Notebook

## Project Plan

**Timeline and Milestones**

1. **Week 1-2:** Data collection and preprocessing
2. **Week 3-4:** Model selection and initial training
3. **Week 5-6:** Hyperparameter tuning and model evaluation
4. **Week 7:** Testing with real-world images and robustness checks
5. **Week 8:** Finalizing results, documentation, and presentation

**Task Allocation**

* Data collection and preprocessing: Team Member 1
* Model development and training: Team Member 2
* Evaluation and testing: Team Member 3
* Documentation and report writing: Team Member 4

**Project Management Tool**

Jira (for tracking issues, tasks, and sprints)

## Expected Outcomes

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* A trained deep learning model capable of accurately classifying Indian currency denominations.
* A comparative analysis of different CNN architectures for classification performance.
* Potential applications in ATMs, vending machines, and automated cash-handling systems.
* Deployment possibilities for real-world financial automation.

## Evaluation Metrics

* **Accuracy:** Overall classification accuracy of the model.
* **Precision & Recall:** To assess model performance on different denominations.
* **Confusion Matrix:** To analyze misclassifications.
* **Loss and Learning Curves:** To evaluate training efficiency and detect overfitting.
* **F1-Score:** To balance precision and recall in cases of class imbalance.

## Conclusion

This project explores the use of deep learning for Indian currency denomination classification, addressing a crucial need in financial automation. The proposed CNN model will enable accurate and efficient recognition of banknotes, with potential real-world applications in ATMs, retail, and automated cash-handling systems. By leveraging advanced neural network techniques, this study aims to contribute to the growing field of AI-driven financial technology.

# Team Details

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| Roll Number | Name | Section |
| 322 | Jai | D |
| 346 | Yukesh | D |
| 355 | Mohit | D |
| 362 | Lakssan | D |

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