Sri Lankan Currency Recognition for People with Visual Impairments using CNN

S. Laksana and S. Shriparen
Department of Computer Science, Faculty of Science, University of Jaffna
laksana.sriharan@gmail.com , shriparens@univ.jfn.ac.lk

Abstract

Visually impaired people find it extremely difficult to perform cash transactions in external surroundings. In order to assist the visually challenged individuals in our nation, a YOLOv10 based convolutional neural network was designed to detect image based currency denominations.This work presents a comprehensive approach to currency recognition, integrating state-of-the-art techniques for detection, classification, and user interaction. The initial phase involves capturing currency images using a mobile phone camera, setting the foundation for subsequent processing. A YOLOv10 model is used for detection, followed by an Ensemble CNN to enhance classification accuracy. To ensure accessibility, we have integrated the solution with a mobile application that provides a user-friendly interface. The developed mobile app incorporates language localization and audio feedback, ensuring accessibility for users across diverse linguistic backgrounds in Sri Lanka.

Keywords: Visually Impaired People, Sri Lankan currency notes, Convolutional Neural Network, YOLOv10, Ensemble Learning.

Introduction

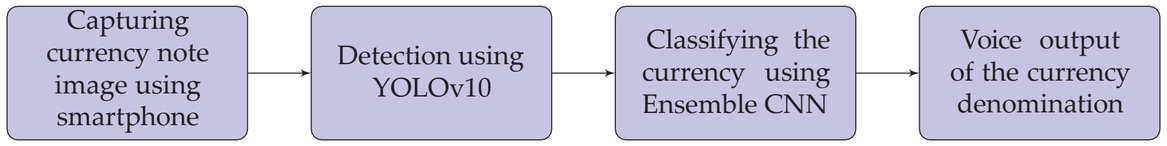
Currency recognition is crucial in various sectors like banking and retail for facilitating automated transactions, assisting the visually impaired, and enhancing security in financial systems. 1.7% of people over the age of forty are blind in Sri Lanka, while 1.6% of people have severe visual impairment. A visually impaired person(VIP) faces several challenges in their daily routine and often need to rely on others for help. Among them dealing with currency is a major issue at hand since currency is the base of society. Visually impaired people could get scammed. Despite the availability of digital payment methods, currency notes and coins remain a usual form of payment in our daily lives since cash remains a convenient payment method for majority of Sri Lankans.

Objective

The primary objective of this research is to develop a model that assists visually impaired individuals in recognizing six specific currency denominations (Rs.20, Rs.50, Rs.100, Rs.500, Rs.1000, and Rs.5000) through audio feedback.

Methodology

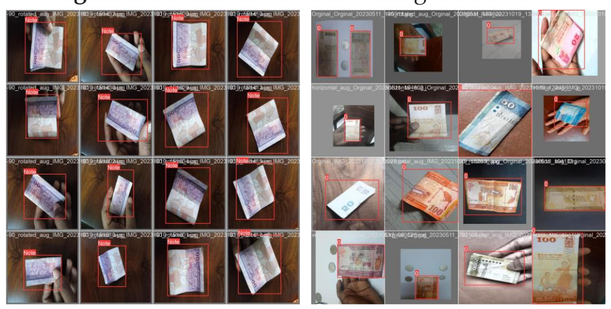
- Dataset: In addition to self-processed smartphone images, we utilized images from [5] to classify various Sri Lankan currency denominations (Rs.20, Rs.50, Rs.100, Rs.500, Rs.1000, Rs.5000).
- Preprocessing: The dataset was split into training, validation, and testing sets before applying any augmentation techniques. Augmentation was performed solely on the training data to increase its variability, while the validation and testing sets remained unaltered to ensure a fair evaluation of the model's performance on real-world, unseen images.
- Detection with YOLOv10: The process begins with the detection phase, where the input image is processed using the YOLOv10 (You Only Look Once) object detection system.
- Classification:-Stacking Ensemble CNN: For classification, we employed a Stacking Ensemble CNN approach. A Logistic Regression model serves as the meta-classifier, which learns to combine predictions from individual CNN models (MobileNetV2, EfficientNet, and ResNet50) to arrive at a final decision.
- Mobile App Development : We chose the Flutter framework for developing the mobile app, considering its cross-platform compatibility and efficient development capabilities.
- Audio Output and Language Localization : The app will provide users with the option to receive audio feedback in their preferred language, ensuring a locally accessible solution.



Results and Observations

The detection model, implemented using YOLOv10, achieved an impressive accuracy of 97.145%. This demonstrates the model's strong ability to accurately detect and localize various currency denominations in the test dataset, even under challenging conditions such as varying lighting and angles.

Figure 1: Results of detection using YOLOv10



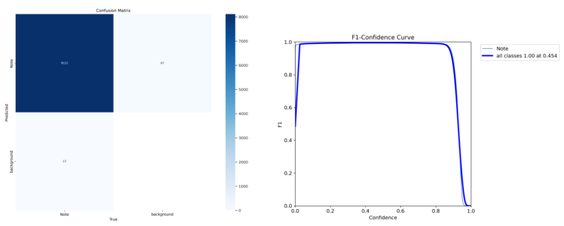


Figure 2: Graph and confusion matrix

On the classification side, the system employed a stacking ensemble technique, which combines the predictions of multiple individual classifiers. This approach resulted in an exceptional classification accuracy of 99.82% indicating that the ensemble model was highly effective at distinguishing between different currency denominations with near-perfect precision.

Conclusion

- This work uses YOLOv10 to detect currency notes in images. It recognizes different denominations in various light conditions, making it useful for real-world applications.
- The system uses ensemble learning with several CNN models to classify currency notes, but it may not detect notes that are folded more than two times

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