Neural network based currency recognition on an Android OS based mobile

Advisor : Dr. Amitabha Mukerjee
Advisor : Dr. Prithwijit Guha
Student : Rhushabh Bhandari (Y7356)
Index

• Aim
• Prior work
• Recognition Algorithm
• Database
• Android
• Application User Diagram
• Application Features
• System Requirements
• Results
• Applications
• Work Completion
AIM

• To recognize Indian currency denomination using low quality image.
• The image will be obtained by android based mobile camera.
• After the image analysis, the output image is passed through a neural network for recognition.
• Application type: Real-time output, low false positives, easy to extend for other currencies.
Prior work

• Multiple kinds of Paper Currency Recognition using Neural Network and application for Euro Currency
  – Fumiaki Takeda and Toshihiro Nishikage
  – Based on neuro-recognition using recognition patterns using axis-symmetrical mask and two image sensor.

• Smartphone Recognition of the U.S. Banknotes’ Denomination, for Visually Impaired People
  – Felipe Grijalva, J.C. Rodríguez, Julio Larco and Luis Orozco
  – Based on local feature (the left corner denomination) and neural network training to identify the number.

• ANN Based Currency Recognition System using Compressed Gray Scale and Application for Sri Lankan Currency Notes - SLCRec
  – D. A. K. S. Gunaratna, N. D. Kodikara, and H. L. Premaratne
  – Based on whole note features and neural network training to identify denomination.
Recognition Algorithm

- Pre-processing
  - Color Transformations
  - Edge Detection and Feature Extraction
  - 3 Layered Back Propagation Network
- Recognition
1. Color Transformation

• Conversion of the image into a gray scale format for reduction of computational costs.
• Linear transformation: \( f(x) = fa \times x + fb \);
• This gives the image a reappearance which is more refined for edge detection. By removal of the noise component (blurriness, intensity, etc.).
• The constant and scaling in the equation above is specific to a note system followed by a country and is obtained by heuristics.
2. Edge Detection and Feature Extraction

- Canny edge detection algorithm due to its low error rate and low time complexity.
- Image segmented into 10 rows, the edge based pixels in each row form the elements of a vector.
- Each row gives 4 vectors according to the edge orientation. (Horizontal, Vertical, Left tilt, Right tilt)
- This 40-dimensional vector is normalized and given as input to the neural network for classification
3. Neural Network

- Vector inputs.
- 3-layer back propagation network
- Trained on manually created database.
- Output Layer consists of 7 neurons while input layer consists of 41 neurons.
- Output: the denomination
Database

• Training for Neural Network
• The database will be created manually using the bank notes in daily usage.
• The dataset will contain Indian currency notes with black background.
• The analysis(training) will be carried on 10 bank notes with the denominations:
  1. Rs 1
  2. Rs 5
  3. Rs 10
  4. Rs 20
  5. Rs 100
  6. Rs 500
  7. Rs 1000
Android

- Android is a software stack for mobile devices that includes an operating system, middleware and key applications.
- The Android SDK provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.
Application Features

• Initial Screen
Application Features

• Capture Image
Application Features

• Output in Emulator
System Requirements

- Android based platform:
  - SDK version 2.1 and above
  - Camera enabled device
  - Internet connectivity.
  - J2ME support

- Server:
  - OpenCV support
  - Eclipse environment for Android SDK development.
Result

$Fa = 1.40, Fb = 160$
Applications

• Automated currency recognition in currency counter devices.
• Foreign currency Identification
• Recognition of banknote denomination for Visually impaired people.
• Extension : Serial number extraction of the note for authentication of note.
Work Completion

• Integration
  – The integration of android based implementation with the image analysis (neural network included)

• Training
  – Training the Neural Network.
  – 10 Indian banknotes of each denomination.

• Application layout
  – More options for refined image input.