Benchmarking Optical Character Recognition Systems for the Tamil Language

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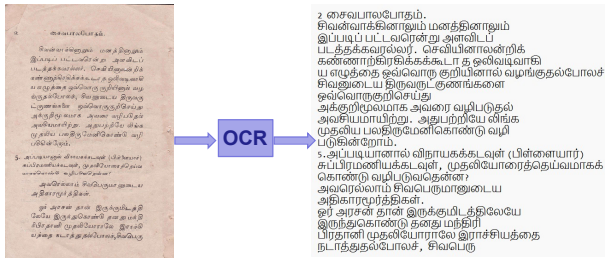
Introduction

- Natural Language Processing (NLP) aims to enable computers to comprehend, interpret, infer, and generate human language.
- Significant progress in high-resourced languages (e.g., English, Chinese).
- Limited resources (lexicons, annotation tools, etc) in low-resourced languages like Tamil.
- Rich text corpora are the key source to develop these computational resources/tools.
- Limitation in creating text corpora due to lack of good Optical Character Recognition (OCR) systems, specially to compile text from Tamil books.
- An OCR model for the Tamil language is planned to be developed, with the first step focusing on benchmarking existing OCR systems.



Input image OCR output text

Motivation

- There are several commercial and open-source OCR systems available for Tamil.
- No common benckmaking framework exists to evaluate these OCR systems.
- This research aims to create a benchmark dataset and evaluate existing OCR systems to identify the suitable OCR system for Tamil.

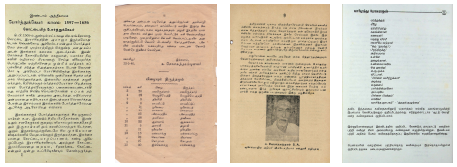
Existing Tamil OCR Systems

OCR Systems	Reported Evaluation
• Aharamariyi Tamil OCR (Not available)	• Character-Level Accuracy 81%
• Tamizhi-Net OCR (Not available)	• Reduced the character-level error rate of Tesseract to 2.61% for Tamil and to 4.74% for Sinhala. • Reduced the word-level error rate to 20.61% for Tamil and to 26.58% for Sinhala.
• OCR_Tamil (Available)	• Character-Level Accuracy 95% for newly printed Tamil books.
• Hybrid Decision Tree based OCR System (Not available)	• Character-Level Accuracy 98.80%

Methodology

Data Collection

- A total of 120 images from the Jaffna University Library and 50 images from the Noolaham Foundation were obtained from 1850, selected in 10-year gaps.
- Different types of pages: cover, imprint, table of contents, preface, plain text, tables, text with tables, text with images, and advertisements.
- Special Categorization: Image Condition (Good, Damaged, Noisy), Number of Languages (Monolingual, Multilingual), Printing Technology (Letterpress, Digital Print).



Examples of Diverse Page Format

Scanning the Images
- Sources: books, pamphlets, and newspapers.
- Resolution: 300 DPI (dots per inch)

Creating the Ground Truth Text
- Recognized texts from scanned images are OCRed using Tesseract and manually corrected.

Benchmarking the Existing OCR Systems

Benchmarking

1. Unicode codepoint-based Levenshtein distance.

$$D(i,j) = \begin{cases} 0, & i=0,\ j=0 \\ i, & j=0,\ i>0 \\ j, & i=0,\ j>0 \\ \min\{ & \\ \quad D(i,j-1)+1, & \\ \quad D(i-1,j)+1, & j>0,\ i>0 \\ \quad D(i-1,j-1)+\mathrm{m}(S_1[i],S_2[j]) & \\ \} & \end{cases}$$

S1, S2: The two strings being compared.

- D(i,j): The Levenshtein distance between the first i characters of S1 and the first j characters of S2.
- i, j: Indices in strings S1 and S2, respectively.
- m(S1[i], S2[j]): The cost of substituting the i-th character of S1 with the j-th character of S2.

2. Graphemes based (To be done)

- A grapheme-based evaluation checks how well the system recognizes Tamil letters, including consonants combined with vowel signs or diacritics.

Experiments

- Cloud Vision API, Google Docs API, and the open-source Tesseract OCR were evaluated with the collected data.

Results

- Overall, the Cloud Vision API produced better results than the others.

Challenges

- Misidentification of Tamil numerals. (0, க, உ, ங, ச, ஞ, சு, எ, அ, கூ)
- Confusion among similar-shaped characters. (வ, ல, க, சு, ன, ள, ஐ, ஜ)
- Complex layout.
- Quality of the image.
- Annotations and Catalog Labels.

Examples of Challenging Images

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