Handré: An Experimental Approach to Intelligent Character/Word Recognition using Support Vector Machines & Dynamic Time Warping

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Abstract

Optical Character Recognition (OCR) is the term used to describe the process of recognizing scanned images of text from documents, which may be handwritten manuscripts or printed text. An extension to OCR is Intelligent Character Recognition (ICR), which involves additional processing and recognition techniques in order to improve the accuracy of translating such documents by performing recognition on the level of words as opposed to individual characters. In this paper, we present an experimental system to outline the process of performing recognition of an entire handwritten document. Our approach outlines the feasibility of performing word recognition without having to collect hand-written samples for training. We make use of a windowed time-series method and pixel analysis to perform segmentation of the document invididual words and characters respectively. To perform individual character recognition, we used 2 different approaches – a kernel-based support vector machine (SVM) classifier and a dynamic time-warping (DTW) method which were both trained using a database of TrueType fonts. We then perform a committee based process of combining results from both models together with a probablistic spelling checker in order to perform the word recognition.

1 Introduction

2 Segmentation

2.1 Word Segmentation

2.1.1 Time-series Segmentation

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2.1.2 Post-processing

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2.2 Character Segmentation

2.2.1 Pre-processing

Hand-labeled Training Lorem ipsum dolor sit amet, consectetur adipiscing elit. Quisque posuere molestie metus. Suspendisse tellus urna, porta sit amet rutrum eu, tristique quis

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2.2.2 Pixel Analysis

Pixel Analysis Lorem ipsum dolor sit amet, consectetur adipiscing elit. Quisque posuere molestie metus. Suspendisse tellus urna, porta sit amet rutrum eu, tristique quis urna. Donec varius pharetra purus, eget mollis tortor ornare vel. Nullam sagittis tellus id dui placerat eget congue libero facilisis. Donec mattis sagittis lectus, eget porta quam facilisis vel. Vestibulum non urna ante, nec mattis mauris. Nulla sit amet interdum eros. Nam congue lacinia nulla, vitae aliquet nisl tincidunt vel. Morbi gravida bibendum ipsum, at accumsan nisl suscipit ac. Sed accumsan cursus tortor a faucibus. Phasellus tempus, orci ac lacinia hendrerit, dui justo accumsan mi, congue dapibus massa turpis at lectus. Cras a tellus nisi. Aliquam vitae dolor id nunc lacinia fermentum et sit amet metus. Nullam viverra ante eu mauris ultrices nec adipiscing lectus dapibus. Class aptent taciti sociosqu ad litora torquent per conubia nostra, per inceptos himenaeos. Nam mollis commodo lacus, eget bibendum risus lobortis nec.

3 Recognition

In this section, we describe how we approached the problem of recoginition. In section 3.1, we describe desribe support vector machines (SVM) and how they can be used for classification of the different alpha-numerical characer by training on a dataset in order to learn a model which generalizes well for all characters.. Section 3.2 covers dynamic time warping, and describes our approach to using it to classify alpha-numerical characters by minimising the distance of difference between the pixel-representations of the different characters. The method of which we combined both the classifers in order to make a committee or grouped decision on the final set of characters in a word is covered in section 3.3. Finally, we describe the use of a spelling checker which uses a probabalistic modelling of words which was used to perform the finalized word recognition.

3.1 Support Vector Machines for Character Classification

3.1.1 Mutliple Classes

3.2 K-means Clustering using Dynamic Time-Warping

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3.3 Combining Approaches for Word Recognition

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3.4 Dictionary Spelling Corrector

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4 Experiments

4.1 Multi-class Support Vector Machines

4.1.1 Cross-validation over training data

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4.1.2 Testing on handwritten text

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4.2 K-means Clustering using DTW

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4.3 Combined Character recognition

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4.4 Combined Word recognition

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5 Analysis

5.1 Multi-class Support Vector Machines

5.1.1 Optimal Tuning Parameters

5.2 K-means Clustering using DTW

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5.3 Combined Character recognition

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5.4 Combined Word recognition

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6 Conclusions & Future Work

6.1 Conclusions

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6.2 Future Work

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7 Acknowledgements

We would like to thank Dahua Lin for reviewing our initial project proposal, and subsequently taking time out of his busy schedule to meet with us and provide guidance, ideas and tips on approaches tp the project. Also, we thank Prof. Leslie Kaelbling for imparting her wisdom and stimulating our ethusiasm in the topics of machine learning.

A Data & Results

B Project Timeline

Week 1: 10/28 – 11/5

- Submit project proposal
- Narrow down choices to one for the project
- Read up on related papers/books

Week 2: 11/6 – 11/12

- Continue reading related works
- Word Segmentation investigation
- Numerical digit classification investigation

Week 3: 11/13 – 11/19

- Character segmentation
- Dynamic time-warping experiments
- Alphabet characters classification investigation

Week 4: 11/20 – 11/26

- Font database
- Dynamic time-warping for classification
- SVMs for training on fonts and classification

Week 5: 11/27 – 12/5

- Improving individual results
- Heuristics for combining both predictors
- Dictionary spell-correction
- Report writing

C Division of Labor