České vysoké učení technické v Praze
Fakulta jaderná a fyzikálně inženýrská

Katedra softwarového inženýrství

Obor: Aplikace informatiky v přírodních vědách

Optické rozpoznávání znaků na naskenovaných historických plakátech pomocí nejmodernějších metod

Optical Character Recognition on Scanned Historical Posters Using the State-of-the-Art Methods

VÝZKUMNÝ ÚKOL

Vypracoval:	Anna Gruberová
Vedoucí práce:	Ing. Adam Novozámský, Ph.D.
Rok:	2022

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Akademický rok 2021/2022

ZADÁNÍ VÝZKUMNÉHO ÚKOLU

Student:	**Bc. Anna Gruberová**
Studijní program:	**Aplikace informatiky v přírodních vědách**
Název práce česky:	**Optické rozpoznávání znaků na naskenovaných historických plakátech pomocí nejmodernějších metod**
Název práce anglicky:	**Optical Character Recognition on Scanned Historical Posters Using the State-of-the-Art Methods**

Pokyny pro vypracování:

1. Seznamte se s problematikou optického rozpoznávání znaků. Na základě rešerše vyberte několik metod, se kterými budete dále pracovat a vyhodnocovat úspěšnost jejich detekce.
2. Stáhněte několik volně dostupných datasetů, které jsou využívány v literatuře k porovnání jednotlivých metod na OCR. Dále vytvořte svůj vlastní dataset z obdržených dat.
3. Nastudujte techniky porovnání OCR výstupů s ground-truth.
4. U vybraných metod prostudujte jejich chování na jednotlivých datasetech při různém nastavení parametrů.
5. Navrhněte také možnosti filtrování výstupů jednotlivých metod za účelem snížení falešných detekcí.

Doporučená literatura:

[1] R. C. Gonzalez, R. E. Woods, Digital Image Processing (4th ed.). Pearson, 2018. ISBN 9353062985.
[2] GOODFELLOW, Ian, Yoshua BENGIO a Aaron COURVILLE. Deep learning. Cambridge, Massachusetts: The MIT Press, [2016]. ISBN 0262035618.
[3] SMITH, R. An Overview of the Tesseract OCR Engine. In: Ninth International Conference on Document Analysis and Recognition (ICDAR 2007) Vol 2 [online]. IEEE, 2007, 2007, s. 629-633. ISBN 0-7695-2822-8. ISSN 1520-5363. Dostupné z: doi:10.1109/ICDAR.2007.4376991
[4] CHEN, Xiaoxue, et al. Text Recognition in the Wild. ACM Computing Surveys [online]. 2021, 54(2), 1-35 [cit. 2021-10-2]. ISSN 0360-0300. Dostupné z: doi:10.1145/3440756

Jméno a pracoviště vedoucího práce:

Ing. Adam Novozámský, Ph.D.
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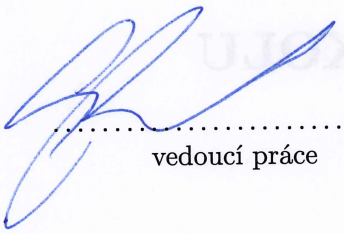
TU Wien - Faculty of Informatics

Datum zadání výzkumného úkolu: 15. 10. 2021

Termín odevzdání výzkumného úkolu: 31. 8. 2022

V Praze dne 15. 10. 2021



.....
vedoucí práce

.....
vedoucí katedry

Prohlášení

Prohlašuji, že jsem svou bakalářskou práci vypracovala samostatně a použila jsem pouze podklady (literaturu, projekty, SW atd.) uvedené v přiloženém seznamu.

V Praze dne ....

Anna Gruberová

Poděkování

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Anna Gruberová

Název práce:

Optické rozpoznávání znaků na naskenovaných historických plakátech pomocí nej

Autor: Anna Gruberová

Obor: Aplikace informatiky v přírodních vědách

Druh práce: Výzkumný úkol

Vedoucí práce: Ing. Adam Novozámský, Ph.D.
Computer Vision Lab, Institute of Visual Computing & Human-Centered Technology, TU Wien - Faculty of Informatics

Konzultant: –

Abstrakt: .

Klíčová slova: .

Title:

Optical Character Recognition on Scanned Historical Posters Using the State-of-t

Author: Anna Gruberová

Abstract: .

Key words: .

Contents

- What is OCR
- Datasets (types(synthetic, photos, scaned documents),problems(languages, noise, nonhorizontal text))
- Text detection
  - Description
  - Methods (CRAFT)
- Text recognition
  - Description
  - Methods
- End-to-end systems (Annotating tool)

  Reading scanned documents
  - EasyOCR
  - keras-ocr
  - Tesseract (PyTesseract)
  - (Google Cloud Vision free) paid
  - (AWS Recognition) paid
  - (Kili) paid
- Results evaluation
  - Comparison of output and ground-truth
  -
- Testing methods on free datasets

  Description of datasets
- Using methods on historical posters

  Description of dataset

0.1 Scene text detection

Methods

0.1.1 CRAFT

CRAFT is framework for scene text detection.

0.2 End-to-end systems

0.2.1 EasyOCR

EasyOCR is a product of Jaded AI for both image text detection and recognition. it supports over 80 languages and various scripts such as Latin, Chinese, Arabic etc. The company offers software with web interface for free and also prepaid version which enables usage of a new model for custom data. However, in addition to the web interface, the company also created a python package under the same name.[4]

The idea of EasyOCR package is to provide an easy-to-use tool where one can plug-in already created state-of-art models and use them for annotating. Pipeline of EasyOCR behavior is shown in the image 1. As it can be seen in this image, default detection model is CRAFT and for recognition is used CRNN (Convolutional Recurrent Neural Network) which model is composed of following components: feature extraction (Resnet is used) and VGG (Convolutional Neural Network), sequence labeling (LSTM is used) and decoding (CTC is used).[5]

EasyOCR package by default computes annotation on GPU, however there is a possibility for CPU computations (provided that the selected model supports it).

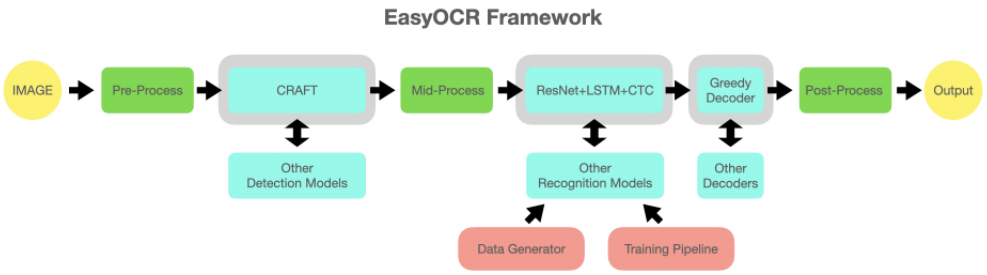

Figure 1: Diagram of EasyOCR pipeline. Grey slots are placeholders for models. The mentioned models are the ones used as default. [5]

0.2.2 Keras-ocr

keras-ocr is a python library used for detecting and recognizing text in images created by Fausto Morales. It works with variety of languages and with different writing scripts. It allows computing on CPU as well as on GPU. It unites the CRAFT text detection model[1] and an implementation in Keras python library of CRNN for recognizing text[2], worth mentioning this is a different implementation of CRNN than in EasyOCR.[1]

[1]hereinafter referred to as CRAFT
[2]hereinafter referred to as CRNN

On the official website[3] of the package there is a comparison of this method with two other OCR APIs – Google Cloud Vision and AWS Rekognition. Their performance was tested on 1,000 images from the COCO-Text validation set using a basic pretrained model of each method. None of the investigated methods Michalovice, 293 01 Mlada Boleslavperformed poorly; however, AWS Rekognition had the worst precision and recall results. Google's method and keras-ocr has similar results. It is important to mention that no tuning parameters were used in any of these methods. Another candidate for comparison was Tesseract but it performed on very badly on given data, most likely due to the fact that Tesseract is suitable for scanned documents rather than for photos of real life scenery and objects with text. [1]

CRAFT already provides a pretrained model which can be used directly without modification for text detection or it is used as initial model for training a new model on new data. This model was trained on three datasets (SynthText, IC13, IC17) and supports English and multi language text detection. [6] Similarly for recognition, CRNN also has a pretrained model This model was trained on the synthetic word dataset which consists of 9 million images with vocabulary of 90K English words. [3] To use these models in the keras-ocr library one either doesn't specify anything and use the defaults, or pass the value `clovaai-general` for the CRAFT pretrained model or `kurapan` for the CRNN model.

Keras-ocr offers preprocessing for four public datasets though any text image dataset can be examined using this tool. These four datasets are: BornDigital dataset, COCO-Text dataset, ICDAR 2013 dataset, ICDAR 2019 dataset (only Latin-only scripts).[2]

0.2.3 Tesseract

Tesseract is an open source text recognition engine. It supports over 160 languages. As it does not have a built-in GUI direct use is via command line. However, there exist a significant number of GUIs for Linux, Windows, Mac for computer usage and also for Android and iOS to use on mobile phones and few online OCR services. [7]

[3] `https://pypi.org/project/keras-ocr/`

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[3] **Text recognition data - Visual Geometry Group - University of Oxford**. Last accessed 2022. Available from: https://www.robots.ox.ac.uk/~vgg/data/text/#sec-synth.

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[5] Jaided AI. **Jaidedai/EasyOCR**. Available from: https://github.com/JaidedAI/EasyOCR.

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