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# Optical Character Recognition Using Segmentation And Feature

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*Optical Character Recognition  
Using Segmentation And  
Feature*

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## MAXIMUS MCCARTHY

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*Segmentation of Touching Characters in Printed Devnagari and Bangla Scripts Using Fuzzy Multifactorial Analysis* GRIN Verlag

Optical character recognition and document image analysis have become very important areas with a fast growing number of researchers in the field. This comprehensive handbook with contributions by eminent experts, presents both the theoretical and practical aspects at an introductory level wherever possible.

### **Document Analysis Systems II**

Springer Science & Business Media  
 Technology Diffusion and Adoption: Global Complexity, Global Innovation discusses the emerging topics of

information technology and the IT based solutions in global and multi-cultural environments. This comprehensive collection addresses the aspects of innovation diffusion in the field of business computing technologies and is essential for researchers, practitioners, academicians and educators all over the world.

*Computer Vision in MATLAB. Object Detection, Motion Estimation and Tracking, Filters and Fixed Point Design* Springer Science & Business Media

Not always science and companies share the same objectives, however a company's need can be sometimes satisfied by applying science. Two of the common problems of a company that tries to work with data in the field of artificial intelligence are firstly how to

get the data itself and secondly how to label it. This thesis presents a real case where a company has to acquire data, label it and then create the best model that fits the data. After many experiments this thesis shows how a small number of training inputs and an Arachnid model, that combines 45 specialized CNNs and a classifier that finds the pattern behind the output of those CNNs, can improve the test accuracy of LeNet-5 from 93.85% to 99,00% when classifying 10 different classes of optical characters with a concrete dataset. 1.000 single characters were extracted randomly from around 10.000 images of receipts and 800 of them were used for the training and 200 for the test. The approach of this thesis is focused on a

real and concrete problem of a company, trying to find the best solution by using science and at the same time taking into account the company's need.

### Camera-Based Document Analysis and Recognition Springer

Optical Character Recognition (OCR) shows great potential for rapid data entry, but has limited success when applied to the Arabic language. Normal OCR problems are compounded by the right-to-left nature of Arabic and because the script is largely connected. This research investigates current approaches to the Arabic character recognition problem and innovates a new approach. The main work involves a Haar-Cascade Classifier (HCC) approach modified for the first time for Arabic character recognition. This technique

eliminates the problematic steps in the pre-processing and recognition phases in addition to the character segmentation stage. A classifier was produced for each of the 61 Arabic glyphs that exist after the removal of diacritical marks. These 61 classifiers were trained and tested on an average of about 2,000 images each. A Multi-Modal Arabic Corpus (MMAC) has also been developed to support this work. MMAC makes innovative use of the new concept of connected segments of Arabic words (PAWs) with and without diacritics marks. These new tokens have significance for linguistic as well as OCR research and applications and have been applied here in the post-processing phase. A complete Arabic OCR application has been developed to manipulate the scanned images and

extract a list of detected words. It consists of the HCC to extract glyphs, systems for parsing and correcting these glyphs and the MMAC to apply linguistic constraints. The HCC produces a recognition rate for Arabic glyphs of 87%. MMAC is based on 6 million words, is published on the web and has been applied and validated both in research and commercial use.

Inventing a Recognition System to Rotate, Scale and Translate Invariant Characters LAP Lambert Academic Publishing

Optical character recognition and document image analysis have become very important areas with a fast growing number of researchers in the field. This comprehensive handbook with contributions by eminent experts,

presents both the theoretical and practical aspects at an introductory level wherever possible. Contents: Pattern Classification Techniques Based on Function Approximation (U Kressel & J Schürmann) Combination of Multiple Classifier Decisions for Optical Character Recognition (L Lam et al.) Segmentation-Based Cursive Handwriting Recognition (M Shridhar & F Kimura) Handwritten Word Recognition Using Hidden Markov Models (A Kundu) Techniques for Improving OCR Results (A Dengel et al.) Multilingual Document Recognition (A L Spitz) Arabic Character Recognition (A Amin) Interpretation of Engineering Drawings (K Tombre & D Dori) Automatic Reading of Music Notation (D Bainbridge & N Carter) Algorithms for Automatic Signature Verification (G Dimauro et

al.) Automatic Reading of Braille Documents (A Antonacopoulos) Information Retrieval and OCR (K Taghva et al.) Benchmarking DIA Systems (T A Nartker et al.) and other papers Readership: Computer scientists and engineers. keywords: *Text Segmentation and Recognition for Enhanced Image Spam Detection* John Wiley & Sons  
Existence of touching characters in scanned documents is a major problem to design an effective character segmentation procedure for OCR systems. In this paper, new techniques are presented for identification and segmentation of touching characters. The techniques are based on fuzzy multifactorial analysis. A predictive algorithm is developed for effectively

selecting cut-points to segment touching characters. Initially, our proposed method has been applied for segmenting touching characters that appear in Devnagari (Hindi) and Bangla, two major scripts in Indian sub-continent. The results obtained from a test-set of considerable size show that a high recognition rate can be achieved with a reasonable amount of computations.

#### *Task Specific Image Text Recognition* World Scientific

Pattern recognition basically deals with the recognition of patterns, shapes, objects, things in images. Document image analysis was one of the very first applications of pattern recognition and even of computing. But until the 1980s, research in this field was mainly dealing with text-based documents, including

OCR (Optical Character Recognition) and page layout analysis. Only a few people were looking at more specific documents such as music sheet, bank cheques or forms. The community of graphics recognition became visible in the late 1980s. Their specific interest was to recognize high-level objects represented by line drawings and graphics. The specific pattern recognition problems they had to deal with was raster-to-graphics conversion (i.e., recognizing graphical primitives in a cluttered pixel image), text-graphics separation, and symbol recognition. The specific problem of symbol recognition in graphical documents has received a lot of attention. The symbols to be recognized can be musical notation, electrical symbols, architectural objects,

pictograms in maps, etc. At first glance, the symbol recognition problems seems to be very similar to that of character recognition; - ter all, characters are basically a subset of symbols. Therefore, the large know-how in OCR has been extensively used in graphical symbol recognition: starting with segmenting the document to extract the symbols, extracting features from the s- bols, and then recognizing them through classification or matching, with respect to a training/learning set.

*Information Systems for Indian Languages* LAP Lambert Academic Publishing

Research Paper (undergraduate) from the year 2018 in the subject Engineering - Computer Engineering, grade: 9.8, University of the Punjab (Guru Nanak

Dev Engineering College, Ludhiana), course: Masters of Technology, language: English, abstract: The traditional test extraction suffers from the drawback of size style and rotation of text arose on the images. Thus the scanning device needs to focus on the textual region of the images. Which is going to involve the person who is using the application software? This can be automated using algorithm which is written and designed in such a way so that the text area on the image will be easily identified either at some orientation or at variable sizes. In the presented work, the characters are segmented by using the pixel neighborhood technique and resized to a 32x32 block. The centre of gravity of the different characters is computed by

using the first order moments. The contour of the pixel is extracted by means of Robert's operator. The radii from centre of gravity to contour pixel and are arranged in descending order. If the same character is rotated about its centre of gravity by some angle, the same radii are extracted and are arranged in descending order. It is observed that the first few radii are same for the same character if rotated at any angle. This gives the rotation invariant character recognition. Further, the characters are normalized with respect to size by dividing the radii by mean radius. The location invariance is obtained by use of centre of gravity. In the proposed algorithm, the different invariances are considered into the features extraction process such that the

normalization of characters is done in all respect. Once the features of different characters are set and are constant for the same object in either form, then that features can be used for character identification purposes.

### **Advances in Information and Communication**

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#### Document Analysis and Recognition

Springer Nature

In the fall of 2006, the University of Maryland, along with various government and industrial sponsors, invited leading researchers from all over the world to a two-day Summit on Arabic and Chinese Handwriting Recognition (SACH 2006). The event acted as a complement to the biennial Symposium on Document Image Understanding

Technology (SDIUT), providing a focused glimpse into the state of the art in Arabic and Chinese handwriting recognition. It offered a forum for interaction with prominent researchers at the forefront of the scientific community and provided an opportunity for participants to help explore possible directions of the field. This book is a result of the expansion, peer review, and revision of selected papers presented at this meeting. Handwriting recognition remains the Holy Grail of document analysis, and Arabic and Chinese scripts embrace many of the most significant challenges. We are pleased to have 16 scientific papers covering the original topics of handwritten Arabic and Chinese, as well as 2 papers covering other handwritten scripts. We asked each author to not

only describe the techniques used in addressing the problem, but to attempt to identify the key research challenges and problems that the community faces. The result is an impressive collection of manuscripts that provide various detailed views of the state of research. In this book, six articles deal directly with Arabic handwriting. • Cheriet provides an overview of the problems of Arabic recognition and how systems can use natural language processing techniques to correct errors in lexicon-based systems. *Extending the Boundaries of Design Science Theory and Practice* Springer This thesis addresses the problem of reading image text, which we define here as a digital image of machine printed text. Images of license plates,

signs, and scanned documents fall into this category, whereas images of handwriting do not. Automatically reading image text is a very well researched problem, which falls into the broader category of Optical Character Recognition (OCR). Virtually all work in this domain begins by segmenting characters from the image and proceeds with a classification stage to identify each character. This conventional approach is not best suited for task specific recognition such as reading license plates, scanned documents, or freeway signs, which can often be blurry and poor quality. In this thesis, we apply a boosting framework to the character recognition problem, which allows us to avoid character segmentation altogether. This approach allows us to

read blurry, poor quality images that are difficult to segment. When there is a constrained domain, there is generally a large amount of training images available. Our approach benefits from this since it is entirely based on machine learning. We perform experiments on hand labeled datasets of low resolution license plate images and demonstrate highly encouraging results. In addition, we show that if enough domain knowledge is available, we can avoid the arduous task of hand-labeling examples by automatically synthesizing training data.

[Enhanced Segmentation and Feature Extraction for Sindhi Optical Character Recognition](#) Springer

The advancement and accessibility of digital computers and the introduction of

the Internet and World Wide Web resulted in massive information explosion all over the world. Large amount of handwritten, typewritten and printed documents contain numerous information and knowledge of different areas. To make the information and knowledge embedded in these documents accessible to the public, it is desirable to digitize, organize and develop retrieval systems for such kind of documents. In response to this need, researchers are moving towards recognition-free approach since optical character recognition OCR engines have various limitations.

*Technology Diffusion and Adoption: Global Complexity, Global Innovation*  
Springer

Segmentation of patterns of curves and

strokes associated with character shape geometry is a challenging task while developing Optical Character Recognition System for Indic scripts. Even though all Indic scripts are derived from a single entity, large amount of dissimilarities exist between northern and southern scripts. Complex conjunct formations add further complexity in the character shape description of the respective language. The complex properties among various scripts vary in terms of topology as well as geometry. The OCR efficiency of the these scripts depend on the effective mathematical representation with locale model as part of global features. An attempt is made in the present work in the form of extensive statistical evaluation on interrelations of isolated patterns of the

script while formulating segmentation model. The canonical syllable model is proposed in the present work. The concept of meaningful unit and its applicability in the segmentation processes is proposed with a specific reference to Telugu script. Touching character segmentation is attempted while emphasising shape description. *Optical Character Recognition Systems for Different Languages with Soft Computing* Springer Science & Business Media

1. This book constitutes the refereed proceedings of the 4th Workshop on Document Analysis and Recognition, DAR 2018, held in Conjunction with ICVGIP 2018, in Hyderabad, India, in December 2018. The 12 revised full papers and 2 short papers presented

were carefully reviewed and selected from 22 submissions. The papers are organized in topical sections: document layout analysis and understanding; handwriting recognition and symbol spotting; character and word segmentation; handwriting analysis; datasets and performance evaluation. *Advances in Digital Image Processing and Information Technology* World Scientific

Character recognition is one of the pattern recognition technologies that are most widely used in practical applications. This book presents recent advances that are relevant to character recognition, from technical topics such as image processing, feature extraction or classification, to new applications including human-computer interfaces.

The goal of this book is to provide a reference source for academic research and for professionals working in the character recognition field.

*Character Recognition Systems* IGI Global

This book constitutes the refereed proceedings of the 14th Pacific Rim Conference on Artificial Intelligence, PRICAI 2016, held in Phuket, Thailand, in August 2016. The 53 regular papers and 15 short papers presented in this volume were carefully reviewed and selected from 161 submissions. Pricai covers a wide range of topics such as AI foundations; applications of AI; semantic web; information retrieval; constraint satisfaction; multimodal interaction; knowledge representation; social networks; ad-hoc networks; algorithms;

software architecture; machine learning; and smart modeling and simulation.

*Symbol Spotting in Digital Libraries*  
Springer

This book constitutes the refereed proceedings of the 10th Iberoamerican Congress on Pattern Recognition, CIARP 2005, held in Havana, Cuba in November 2005. The 107 revised full papers presented together with 3 keynote articles were carefully reviewed and selected from more than 200 submissions. The papers cover ongoing research and mathematical methods for pattern recognition, image analysis, and applications in such diverse areas as computer vision, robotics, industry, health, entertainment, space exploration, telecommunications, data mining, document analysis, and natural

language processing and recognition.

**Offline Printed Arabic Character Recognition** CRC Press

This book develops algorithms, functions, and apps for designing and simulating computer vision and video processing systems. Algorithms are available as MATLAB functions, System objects, and Simulink blocks. You can perform feature detection, extraction, and matching, as well as object detection and tracking. Local features and their descriptors are the building blocks of many computer vision algorithms. Their applications include image registration, object detection and classification, tracking, and motion estimation. These algorithms use local features to better handle scale changes, rotation, and occlusion. Segmentation is

essential for image analysis tasks.

Semantic segmentation describes the process of associating each pixel of an image with a class label, (such as flower, person, road, sky, ocean, or car). Applications for semantic segmentation include: Autonomous driving, Industrial inspection, classification of terrain visible in satellite imagery and Medical imaging analysis. You can use the Image Labeler app to interactively label pixels and export the label data for training. The app can also be used to label rectangular regions of interest (ROIs) and scene labels for image classification. Image feature detection is a building block of many computer vision tasks, such as image registration, tracking, and object detection. The Computer Vision System Toolbox includes a variety of

functions for image feature detection. These functions return points objects that store information specific to particular types of features, including (x, y) coordinates (in the Location property). You can pass a points object from a detection function to a variety of other functions that require feature points as inputs. The algorithm that a detection function uses determines the type of points object it returns. The optical character recognition (OCR) app trains the ocr function to recognize a custom language or font. You can use this app to label character data interactively for OCR training and to generate an OCR language data file for use with the ocr function. Motion estimation and tracking are key activities in many computer vision applications, including activity

recognition, traffic monitoring, automotive safety, and surveillance. Tracking is the process of locating a moving object or multiple objects over time in a video stream. Tracking an object is not the same as object detection. Object detection is the process of locating an object of interest in a single frame. Tracking associates detections of an object across multiple frames. Tracking multiple objects requires detection, prediction, and data association. Detection detects objects of interest in a video frame, Prediction predicts the object locations in the next frame and Data association uses the predicted locations to associate detections across frames to form tracks. For rapid prototyping and embedded system design, the system toolbox



supports fixed-point arithmetic and C-code generation.

### Image Segmentation in Computer Vision

BoD – Books on Demand

This book highlights recent research on intelligent systems design and applications. It presents 100 selected papers from the 17th International Conference on Intelligent Systems Design and Applications (ISDA 2017), which was held in Delhi, India from December 14 to 16, 2017. The ISDA is a premier conference in the field of Computational Intelligence and brings together researchers, engineers and practitioners whose work involves intelligent systems and their applications in industry and the real world. Including contributions by authors from over 30 countries, the book offers a valuable

reference guide for all researchers, students and practitioners in the fields of Computer Science and Engineering.

### **Handbook of Document Image Processing and Recognition**

Createspace Independent Publishing Platform

"Much of pattern recognition theory and practice, including methods such as Support Vector Machines, has emerged in an attempt to solve the character recognition problem. This book is written by very well-known academics who have worked in the field for many years and have made significant and lasting contributions. The book will no doubt be of value to students and practitioners." - Sargur N. Srihari, SUNY Distinguished Professor, Department of Computer Science and Engineering, and Director,

Center of Excellence for Document Analysis and Recognition (CEDAR), University at Buffalo, The State University of New York "The disciplines of optical character recognition and document image analysis have a history of more than forty years. In the last decade, the importance and popularity of these areas have grown enormously. Surprisingly, however, the field is not well covered by any textbook. This book has been written by prominent leaders in the field. It includes all important topics in optical character recognition and document analysis, and is written in a very coherent and comprehensive style. This book satisfies an urgent need. It is a volume the community has been awaiting for a long time, and I can enthusiastically recommend it to

everybody working in the area." -Horst Bunke, Professor, Institute of Computer Science and Applied Mathematics (IAM), University of Bern, Switzerland In Character Recognition Systems, the authors provide practitioners and students with the fundamental principles and state-of-the-art computational methods of reading printed texts and handwritten materials. The information presented is analogous to the stages of a computer recognition system, helping readers master the theory and latest methodologies used in character recognition in a meaningful way. This book covers: \* Perspectives on the history, applications, and evolution of Optical Character Recognition (OCR) \* The most widely used pre-processing techniques, as well as methods for

extracting character contours and skeletons \* Evaluating extracted features, both structural and statistical \* Modern classification methods that are successful in character recognition, including statistical methods, Artificial Neural Networks (ANN), Support Vector Machines (SVM), structural methods, and multi-classifier methods \* An overview of word and string recognition methods and techniques \* Case studies that illustrate practical applications, with descriptions of the methods and theories behind the

experimental results Each chapter contains major steps and tricks to handle the tasks described at-hand. Researchers and graduate students in computer science and engineering will find this book useful for designing a concrete system in OCR technology, while practitioners will rely on it as a valuable resource for the latest advances and modern technologies that aren't covered elsewhere in a single book.