International Conference on Document Analysis and Recognition (ICDAR 2011) – Competitions Overview

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Abstract—The great success and high number of participants in pattern recognition related competitions last years show an important improvement of recognition and classification approaches. This success is unconceivable without the availability of huge datasets of real world data. Within the scope of the 11th International Conference on Document Analysis and Recognition (ICDAR2011) a call for competitions was initiated. The aim of the competitions is the performance evaluation of algorithms and methods for a particular task of document analysis and recognition. 22 different teams have submitted their proposals. The subjects of these propositions cover the field of research of document analysis and recognition from pre-processing over document analysis to text recognition or writer identification. 16 competitions have received enough participants (we have defined the threshold to 3 systems) to present their evaluation at the ICDAR 2011.

Keywords-ICDAR2011; Competition; Benchmarking; Contest; Evaluation;

I. INTRODUCTION

Machines are still far from being able to read as humans can. Nevertheless, automatic reading of printed and handwritten text has reached a high level in many languages and applications, e.g. address reading and check reading. Powerful computers allow the execution of efficient recognition algorithms without special hardware. A big challenge are still languages that do not use Latin characters and unconstrained handwritten or/and historical manuscripts. An important aspect in the development of high performed handwriting recognition application is the availability of representative and well annotated data. Another crucial aspect for recognition system development is the discussion and competition of different approaches. Only the testing of different methods on identical datasets allows for informative comparison. Furthermore, objective quality measuring methods are necessary for ranking systems. This also constitutes a high motivation for developing advanced methods.

Three important reasons help recognition and classification approaches to make a veritable leap forward. The first reason is the availability of huge datasets for the research community, allowing the development of statistical methods for classification systems. A second important aspect is the development of methods for measuring and comparing the quality of recognition systems. Last but not least comparing different approaches during conferences is important to know about best performing methods. These are the main reasons for a call for competition within the scope of the ICDAR 2011 conference. 22 teams submitted a proposal and a call for participation, 20 proposals were accepted for presentation at ICDAR 2011 (Table I). Finally 16 competitions were carried out with at least 3 participants. This paper gives an overview about these competitions and is organized as follows: In each section (II to XVI) a short description of each competition is presented, including the organization teams, a short description of the objectives of the competition and a list of participating groups, if any.

II. ARABIC HANDWRITING RECOGNITION COMPETITION

The Arabic Handwriting Recognition Competition was organized by Volker Märgner and Haikal El Abed from the Technische Universitaet Braunschweig, Institute for Communications Technology (IfN), Braunschweig, Germany.

This fifth competition used the IfN/ENIT-database with Arabic handwritten Tunisian town names, used by more than 110 research groups from universities, research centers, and companies worldwide. This year, 4 groups (Table II) were participating in the competition. The systems were tested on known data (sets d and e) and on two data sets (f and s), unknown to the participants .

III. ARABIC RECOGNITION COMPETITION: MULTI-FONT MULTI-SIZE DIGITALLY REPRESENTED TEXT

The Arabic Recognition Competition; Multi-font Multi-size Digitally Represented Text; was organized by Fouad Slimane from the Document, Image and Voice Analysis research group (DIVA), Department of Informatics, University of Fribourg, Switzerland and from the REsearch Group on Intelligent Machines (REGIM), University of Sfax, National

Table I
OVERVIEW OF THE ACCEPTED COMPETITIONS FOR THE ICDAR 2011

Section	Competition	Organizer(s)
II	Arabic Handwriting Recognition Competition	Volker Märgner and Haikal El Abed
III	Arabic Recognition Competition: Multi-font Multi-size Digitally Represented Text	Fouad Slimane, Slim Kanoun, Haikal El Abed, Adel M. Alimi, Rolf Ingold, Jean Hennebert
IV	Online Arabic Handwriting Recognition Competition	Monji Kherallah, Adel M. Alimi, Haikal El Abed, and Volker Märgner
V	French Handwriting Recognition Competition	Emmanuèle Grosicki and Haikal El Abed
VI	ICDAR 2011 Chinese Handwriting Recognition Competition	Cheng-Lin Liu, Fei Yin, Qiu-Feng Wang and Da-Han Wang
VII	Arabic Writer Identification Contest	Abdelâali Hassaïne, Somaya Al-Ma'adeed, Jihad Mohamad Alja'am, Ali Mohamed Jaoua, and Ahmed Bouridane
VIII	ICDAR 2011 - Writer Identification Contest	Georgios Louloudis, Basilis Gatos, and Nikolaos Stamatopoulos
IX	Signature Verification Competition for On- and Offline Skilled Forgeries (SigComp2011)	Marcus Liwicki, Muhammad Imran Malik, Elisa van den Heuvel, Xiaohong Chen, Charles Berger, Reinoud Stoel, Michael Blumenstein, and Bryan Found
X-A	ICDAR 2011 Robust Reading Competition – Challenge 1: Reading Text in Born-Digital Images (Web and Email)	D. Karatzas, S. Robles Mestre, J. Mas, F. Nourbakhsh, and P. Pratim Roy
X-B	ICDAR 2011 Robust Reading Competition – Challenge 2: Reading Text in Scene Images	Asif Shahab, Faisal Shafait, and Andreas Dengel
XI	CROHME 2011: Competition on Recognition of Online Handwritten Mathematical Expressions	Harold Mouchre, Dae Hwan Kim, and Utpal Garain
XII	ICDAR 2011 Book Structure Extraction Competition	Antoine Doucet
XIII	DIBCO 2011 - Document Image Binarization Contest	Ioannis Pratikakis, Basilis Gatos, and Kostantinus Ntirogiannis
XIV	Music Scores: Writer Identification and Staff Removal	Alicia Forns, Anjan Dutta, Albert Gordo, and Josep Llads
XV	Historical Document Layout Analysis	Apostolos Antonacopoulos, Stefan Pletschacher, Christian Clausner, and Christos Papadopoulos
XVI	Document Analysis Algorithm Contributions in End-to-End Applications	Bart Lamiroy, Tao Sun, and Daniel Lopresti
Canceled Competitions		
XVII-A	ICDAR 2011 Page Dewarping Contest	Syed Saqib Bukhari, Faisal Shafait, and Thomas M. Breuel
XVII-B	Table competition at ICDAR 2011 - Establishing the physical model of a table: table location and/or segmentation	Ana Costa e Silva
XVII-C	Arabic Handwritten Textline Recognition (AHTR'11)	Mohammad Khorsheed, Ahmad Abdulkader, Abdulaziz Alobaid, Eman Bin Khunayn, Khalid AlFaifi, Basmah ALJedia, and Yaser ALmutairi
XVII-D	Interactive Handwriting Recognition	Nicolas Serrano, Adri Gimnez, and Alfons Juan

Table II
GROUPS PARTICIPATING IN THE ARABIC HANDWRITING RECOGNITION COMPETITION

S-ID	Group(s) (Corresponding Author(s))
[1]	University of Jordan, Jordan (Gheith Abandah and Fuad Jamour)
[2]	Computer Science and Software Engineering Department, Concordia University, Center for Pattern Recognition and Machine Intelligence (CENPARMI), Montreal, Quebec, Canada (Muna Khayyat, Louisa Lam, and Ching Y. Suen)
[3]	RWTH Aachen University, Human Language Technology and Pattern Recognition, Aachen, Germany (Patrick Doetsch, Philippe Dreuw, Mahdi Hamdani, Christian Plahl, and Hermann Ney)
[4]	Research Group on Intelligent Machines (REGIM) at the Ecole Nationale d'Ingénieurs de Sfax (ENIS), University of Sfax, Tunisia (Mahdi Hamdani, Tarek M. Hamdani, and Adel M. Alimi)

School of Engineers (ENIS), Tunisia, Slim Kanoun from ENIS, Haikal El Abed from Institute for Communications Technology (IfN), Braunschweig, Germany, Adel M. Alimi from REGIM, Rolf Ingold from DIVA, and Jean Hennebert from DIVA and Computer Science Department, EIAFR, HES-SO, Fribourg, Switzerland.

This first competition used the freely available Arabic Printed Text Image (APTI) database. The results of the participating systems (Table III) were compared using the recognition rates at the character and word levels.

IV. ONLINE ARABIC HANDWRITING RECOGNITION COMPETITION

The Online Arabic Handwriting Recognition Competition was organized by Monji Kherallah, Najiba Tagougui, and Adel M. Alimi from the University of Sfax, Research Group on Intelligent Machines (REGIM) Sfax, Tunisia, and Haikal

Table III
GROUPS PARTICIPATING IN THE ARABIC RECOGNITION COMPETITION:
MULTI-FONT MULTI-SIZE DIGITALLY REPRESENTED TEXT

S-ID	Group(s) (Corresponding Author(s))
[IPSAR]	Image Processing and Signal Analysis & Recognition (IPSAR) Group, KACST, Saudi Arabia (Mohammad Khorsheed and Samir Ouis)
[UPV-PRHLT]	Universitat Politecnica de Valencia (UPV), Spain (Ihab Alkhoury, Adria Gimenez, and Alfons Juan)
[DIVA-REGIM]	DIVA, Switzerland and REGIM, Tunisia (Fouad Slimane)

Table IV
GROUPS PARTICIPATING IN THE ONLINE ARABIC HANDWRITING
RECOGNITION COMPETITION

S-ID	Group(s) (Corresponding Author(s))
[AUC-HMM]	American University of Cairo (AUC), Cairo, Egypt (Hesham Eraqi, Hany Ahmed, and Sherif Abdelazeem)
[FCI-CU-HMM]	Faculty of Computers and Information, Cairo University, Cairo, Egypt (Ibrahim Hosney, Sherif Abdou, Aly Fahmy, and Mostafa Shahin)
[V-O]	Vision Objects Ltd., France (Zsolt Wimmer)

Table V
GROUPS PARTICIPATING IN THE FRENCH HANDWRITING RECOGNITION
COMPETITION

S-ID	Group
[ParisTech]	École d'Ingénieurs Télècom ParisTech, Paris, France
[IRISA]	Institut de Recherche en Informatique et Systèmes Aléatoires, Campus de Beaulieu, Rennes, France
[A2iA]	A2iA, Paris, France
[JOUVE]	JOUVE, Boulevard de Sébastopol, Paris, France

Table VI
GROUPS PARTICIPATING IN THE CHINESE HANDWRITING
RECOGNITION COMPETITION

S-ID	Group(s) (Corresponding Author(s))
[CASIA-CREC]	Character Recognition Engineering Center of CASIA (CASIA-CREC), China
[CASIA-CSIS]	Key Laboratory of Complex Systems and Intelligence Science of CASIA, China (Yunxue Shao and Chunheng Wang)
[HKU]	Department of Electrical and Electronic Engineering of University of Hong Kong, China (K.C. Leung and C.H. Leung)
[IDSIAnn]	Dalle Molle Institute for Artificial Intelligence (IDSIA), Switzerland (Ueli Meier and Dan Ciresan)
[SCUT-HCII]	Human-Computer Communication and Intelligent Interface Laboratory of SCUT, China (Yan Gao, Lingyu Liang, Kai Ding, and Lianwen Jin)
[THU]	Department of Electronic Engineering of Tsinghua University, China (Yanwei Wang, Xiaoqing Ding, and Changsong Liu)
[SCUT-IntSig]	Human Computer Intelligent Interaction Joint Lab of SCUT, China and IntSig Information Ltd., USA
[VO]	Vision Objects Ltd., France (Zsolt Wimmer)
[XD_IIPR]	Intelligent Information Processing and Pattern Recognition Lab of Xidian University, China (Chao Yao, Wei Hou, Shiyong Ma, and Zhaoyang Lu)

VI. ICDAR 2011 – CHINESE HANDWRITING RECOGNITION COMPETITION

The ICDAR 2011 Chinese Handwriting Recognition Competition was organized by Cheng-Lin Liu, Fei Yin, Qiu-Feng Wang and Da-Han Wang from the National Laboratory of Pattern Recognition (NLPR), Institute of Automation of Chinese Academy of Sciences, Beijing, China. In this competition 9 groups (Table VI) participated. Their systems were evaluated on four tasks: offline and online isolated character recognition, offline and online handwritten text recognition.

VII. ARABIC WRITER IDENTIFICATION CONTEST

The Arabic Writer Identification Contest was organized by Abdelâali Hassaïne, Somaya Al-Ma'adeed, Jihad Mohamad Alja'am, Ali Mohamed Jaoua, and Ahmed Bouridane from the University of Qatar, Qatar. This competition has attracted 30 participants, among those the 7 teams accepted to share their methodology and identity. A list of the participating systems is presented in Table VII.

VIII. ICDAR 2011 - WRITER IDENTIFICATION CONTEST

The ICDAR 2011 Writer Identification Contest was organized by Georgios Louloudis, Basilis Gatos, and Nikolaos Stamatopoulos from Computational Intelligence Laboratory, Institute of Informatics and Telecommunications, National Center for Scientific Research Demokritos, Athens, Greece. This contest is the first contest which is dedicated to record

El Abed, Volker Märgner from Technische Universitaet Braunschweig, Institute for Communications Technology (IfN), Braunschweig, Germany.

This competition with 3 participants (Table IV) aims to compare state-of-the-art approaches for online Arabic handwriting recognition.

V. FRENCH HANDWRITING RECOGNITION COMPETITION

The French Handwriting Recognition Competition was organized by Emmanuèle Grosicki from the DGA Ingnierie des Projets, Bagneux, France and Haikal El Abed from the Technische Universitaet Braunschweig, Institute for Communications Technology (IfN), Braunschweig, Germany. This competition is based on the RIMES-database of French written documents composed of letters sent by individuals to companies or administrations. Four participants (Table V) sent their systems to this competition.

S-ID	Group(s) (Corresponding Author(s))
[UCL]	University College London, UK (Andrew Newell and Lewis Griffin)
[Wride]	Delft University of Technology, The Netherlands (Laurens van der Maaten)
[Shasta]	G. Washington University, USA (Greg Werner)
[Eu Jin Lok]	Deloitte Inc., Australia (Eu Jin Lok)
[Intelligentia]	Knowledge Based Systems Group, Vienna University of Technology, Austria (Tri Kurniawan Wijaya) and CrimsonLogic, Singapore (Philips Kokoh Prasetyo)
[WIFAHD]	Department of Mathematics and Computer Science (Chawki Djeddi), Tebessi University, Tebessa, Algeria (Cheikh Larbi), and Department of Computer Science, LRI Laboratory, Badji Mokhtar University, Annaba, Algeria (Labiba Souici-Meslati)
[Robin]	University of Nottingham, UK (Enrico Glaab)

Table VIII
GROUPS PARTICIPATING IN THE WRITER IDENTIFICATION CONTEST

S-ID	Group(s) (Corresponding Author(s))
[ECNU]	Department of Computer Science and Technology, East China Normal University (ECNU), Shanghai, China (Hai Liu and Yue Lu)
[QUQA]	Pattern Recognition and Image Processing Research Group of Qatar University, Qatar (Abdelâali Hassaïne and Somaya Al-Ma'adeed) and Northumbria University, Newcastle, UK (Ahmed Bouridane)
[TSINGHUA]	State Key Laboratory of Intelligent Technology and Systems, Department of Electronic Engineering, Tsinghua University, Beijing, China (Lu Xu, Xiaoqing Ding and Liangrui Peng)
[GWU]	George Washington University, USA (Gregory J. Werner) and Qatar University, Qatar (Abdelâali Hassaïne)
[CS-UMD]	The University of Maryland, College Park, USA (Rajiv Jain)
[TEBESSA]	Department of Mathematics and Computer Science (Chawki Djeddi), Tebessi University, Tebessa, Algeria (Cheikh Larbi), and Department of Computer Science, LRI Laboratory, Badji Mokhtar University, Annaba, Algeria (Labiba Souici-Meslati)
[MCS-NUST]	National University of Sciences & Technology, MC-SNUST, Pakistan (Imran A. Siddiqi)

recent advances in the field of writer identification using established performance evaluation measures. Participants are listed in Table VIII.

IX. SIGNATURE VERIFICATION COMPETITION FOR ON- AND OFFLINE SKILLED FORGERIES (SIGCOMP2011)

The Signature Verification Competition for On- and Offline Skilled Forgeries (SigComp2011) was organized by Marcus Liwicki, Muhammad Imran Malik from the DFKI, Germany, Elisa van den Heuvel from the Netherlands Forensic Institute, The Hague, Netherlands, Xiaohong Chen from the Forensic Science Institute, Ministry of Justice, Shang-

Table IX
GROUPS PARTICIPATING IN THE SIGNATURE VERIFICATION
COMPETITION FOR ON- AND OFFLINE SKILLED FORGERIES CONTEST

S-ID	Group(s) (Corresponding Author(s))
[1]	Sabanci University
[2]	Anonymous
[3]	Hong Duc University
[4;5]	XYZMO
[6;7]	Qatar University and Northumbria University
[8]	German Research Center for Artificial Intelligence (DFKI)
[9]	Anonymous

hai, China, Charles Berger from the Netherlands Forensic Institute, The Hague, Netherlands, Reinoud Stoel from the Netherlands Forensic Institute, The Hague, Netherlands, Michael Blumenstein from the Griffith University, Gold Coast, Australia, and Bryan Found from the La Trobe University, Melbourne, Australia. A list of participating systems is given in Table IX.

X. ICDAR 2011 ROBUST READING COMPETITIONS

A. Challenge 1: Reading Text in Born-Digital Images (Web and Email)

This challenge was organized by D. Karatzas, S. Robles Mestre, J. Mas, F. Nourbakhsh from the Computer Vision Center, Universitat Autónoma de Barcelona, Barcelona, Spain, and P. Pratim Roy from the Laboratoire d'Informatique, Université Franois Rabelais, Tours, France. The challenge was organized in terms of three tasks of the whole reading process: text localization, text segmentation and word recognition. The list of participating systems is given in Table X.

B. Challenge 2: Reading Text in Scene Images

This challenge was organized by Asif Shahab, Faisal Shafait, and Andreas Dengel from the German Research Center for Artificial Intelligence (DFKI), Kaiserslautern, Germany. Challenge 2 of the competition dealt specifically with detecting/recognizing text in natural scene images (see Table XI for participants).

XI. CROHME 2011: COMPETITION ON RECOGNITION OF ONLINE HANDWRITTEN MATHEMATICAL EXPRESSIONS

This competition was organized by Harold Mouchère and Christian Viard-Gaudin from Ecole Polytechnique de l'Universitè de Nantes, Nantes, France, Dae Hwan Kim and Jin Hyung Kim from Division of Computer Science, Korea Advanced Institute of Science and Technology, Seongbuk-gu, Seoul, Korea, and Utpal Garain from Computer Vision and Pattern Recognition (CVPR) Unit, Indian Statistical Institute, Kolkata, India. The goal of this competition is to bring out a state of the art for the related research. Six groups have participated in this competition (Table XII).

S-ID	Group(s) (Corresponding Author(s))
[TH-TextLoc/ TH-OCR]	Department of Electronic Engineering, Tsinghua University Beijing, China (C. Yang, C. Liu and X. Ding)
[TDM_IACAS]	Institute of Automation, Chinese Academy of Sciences, Beijing, China (Y. Shao, C. Wang and Y. Zhang)
[OTCYMIST]	Medical Intelligence and Language Engineering Laboratory, Indian and Institute of Science, Bangalore, India (D. Kumar and A.G. Ramakrishnan)
[SASA]	Dept. of Computer Science, City Univ. of New York, USA and Dept. of Electrical Engineering, City University of New York, USA.(C. Yi and Y. Tian)
[TextHunter]	Univ. of Engineering and Technology, Lahore, Pakistan, Institut des Systèmes Intelligents et de Robotique (ISIR),CNRS, UPMC, Université Paris, France, and Laboratoire de Mathematiques Informatique et Applications (LAMIA), Université des Antilles et de la Guyane, France (M. Shehzad Hanif and L. Prevost)
[Textorter]	Military College of Signals, National University of Science and Technology, Pakistan (S. Tehsin and A. Masood)

S-ID	Group(s) (Corresponding Author(s))
[1]	City University of New York, U.S. (Chucai Yi and Yingli Tian)
[2]	Qualcomm Korea R&D Center, South Korea (Chunghoon Kim)
[3]	UET Lahore, Pakistan and Lionel Prevost, ISIR, Université Paris 06, France (Muhammad Shehzad Hanif)
[4]	Department of Computer Science, KAIST, South Korea (Seonghun Lee, Kyungmin Min, Jae-Hyun Seok and Jin Hyung Kim)
[5]	Faculty of Electrical Engineering, Czech Technical University, Czech Republic (Lukas Neumann and Jiri Matas)
[6]	LIP6, UPMC-Sorbonne Universités, France (Jonathan Guyomard, Frederic Precioso, Nicolas Thome, Matthieu Cord and Rodrigo Minetto)
[7]	Institute of Automation, Chinese Academy of Sciences, Beijing, China (Yunxue Shao, Chunheng Wang and Yang Zhang)
[8]	Department of Electronics Engineering, Tsinghua University, Beijing, China (Cheng Yang, Changsong Liu and Xiaoqing Ding)

XII. ICDAR 2011 BOOK STRUCTURE EXTRACTION COMPETITION

The Book Structure Extraction Competition was organized by Antoine Doucet, from the University of Caen, France, Gabriella Kazai, from Microsoft Research, Cambridge, UK, and Jean-Luc Meunier, from Xerox Research

S-ID	Group(s) (Corresponding Author(s))
[System-I]	Rochester Institute of Technology, NY, USA (Lei Hu, Richard Pospesel, Kevin Hart, and Richard Zanibbi)
[System-II]	Sabanci University, Turkey
[System-III]	Instituto Tecnológico de Informática. Universitat Politècnica de València, Spain (Francisco Álvaro, Joan-Andreu Sánchez and Josè-Miguel Benedí)
[System-IV]	Institute for Language and Speech Processing, Athena Research Center, Greece
[System-V]	IRCCyN-IVC, Universitè de Nantes, France

S-ID	Group(s) (Corresponding Author(s))
[MDCS]	Microsoft Development Center, Serbia
[Nankai]	Nankai University, China
[GREYC]	University of Caen, France
[XRCE]	Xerox Research Centre Europe, France

Center Europe.

The competition goal is to evaluate and compare automatic techniques for deriving structure information from digitized books, which could then be used to aid navigation inside the books. More specifically, the task that participants are faced with is to construct hyperlinked tables of contents for a collection of 1,000 digitized books. A list of participants is given in Table XIII.

XIII. DIBCO 2011 – DOCUMENT IMAGE BINARIZATION CONTEST

This competition was organized by Ioannis Pratikakis from the Department of Electrical and Computer Engineering, Democritus University of Thrace, Xanthi, Greece, Basilis Gatos from Computational Intelligence Laboratory, Institute of Informatics and Telecommunications, NCSR "Demokritos", Agia Paraskevi, Athens, Greece, and Konstantinos Ntirogiannis from Computational Intelligence Laboratory, Institute of Informatics and Telecommunications, NCSR "Demokritos", Agia, Greece and Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, Panepistimioupoli, Ilissia, Athens, Greece.

The general objective of the contest is to identify current advances in document image binarization for both machine-printed and handwritten document images using evaluation performance measures that conform to document image analysis and recognition. A list of participants is given in Table XIV.

Table XIV
GROUPS PARTICIPATING IN THE DOCUMENT IMAGE BINARIZATION CONTEST

S-ID	Group(s) (Corresponding Author(s))
[1]	Qatar University, Qatar and Northumbria University, UK (Abdelali Hassane, Larbi Boubchir Somaya Al-Maadeed and Ahmed Bouridane)
[2]	Houari Boumediene University of Sciences and Technologies, Algeria (M. Zayed)
[3]	Illinois Institute of Technology, USA (T. Obafemi-Ajayi and G. Agam)
[4]	Kobe University, Japan (N. Tanaka)
[5]	Institute for Language and Speech Processing (ILSP) of Athena - Research and Innovation Center in Information, Communication and Knowledge Technologies, Greece, & National Technical University of Athens (NTUA), Greece (V. Papavassiliou and F. Simistira)
[6]	University of Tunis, Tunisia & Technische Universitaet Braunschweig, Germany (I. Ben Messaoud, H. Amiri, H. El Abed, V. Märgner)
[7]	Federal University of Pernambuco, Brazil (R. Neves, C.A.B. Mello)
[8]	National University of Singapore and Institute for Infocomm Research, Singapore (B. Su, S. Lu and C-L. Tan)
[9]	Concordia University, Canada (T.H. Ngan Le, T.D.Bui and C.Y. Suen)
[10]	South University of Toulon-Var, France, (T. Lelore and F. Bouchara)
[11]	Smith College, USA (N. Howe)
[12]	SAIC-Frederick,Inc., USA (I. Filippov)
[13]	Vienna University of Technology, Austria and Fraunhofer-Institute for Production Systems and Design Technology (IPK), Germany (F. Kleber, M. Diem, R. Sablatnig)
[14]	Vienna University of Technology, Austria (F. Kleber, M. Diem, R. Sablatnig)
[15]	Indian Institute of Technology Kharagpur, India (S. Bag, P. Behera, and P. Bhowmick)
[16]	University of Guadalajara, Mexico and Freie Universitt Berlin, Germany (M.A. Ramrez-Ortegn, E. Cuevas, R. Rojas)
[17]	University of So Paulo, Brazil (W.A. Luz Alves, A. Morimitsu and R.F. Hashimoto)

Table XV
GROUPS PARTICIPATING IN THE MUSIC SCORES: WRITER IDENTIFICATION AND STAFF REMOVAL COMPETITION

S-ID	Group(s) (Corresponding Author(s))
[ISI01]	Computer Vision and Pattern Recognition Unit of the Indian Statistical Institute, Kolkata, India (Jit Ray Chowdhury and Umapada Pal)
[INP02]	The Institute for Systems and Computer Engineering of Porto, Portugal (Ana Rebelo and Jaime S. Cardoso)
[NUS03]	Bolan Su from the School of Computing of the National University of Singapore; Shijian Lu from the Institute for Infocomm Research, Singapure; Umapada Pal from the Computer Vision and Pattern Recognition Unit of the Indian Statistical Institute, Kolkata, India; and Chew-Lim Tan from the School of Computing of the National University of Singapore.
[NUG04]	Niederrhein University of Applied Sciences, Institute for Pattern Recognition (iPattern), Krefeld, Germany (Christoph Dalitz and Andreas Kitzig)

Table XVI
GROUPS PARTICIPATING IN THE DOCUMENT ANALYSIS ALGORITHM CONTRIBUTIONS IN END-TO-END APPLICATIONS COMPETITION

S-ID	Group(s) (Corresponding Author(s))
[1]	NIH NCI CADD group, USA (Igor Fillipov)
[2]	EPITA LRDE group, France (Guillaume Lazzara)

XIV. MUSIC SCORES: WRITER IDENTIFICATION AND STAFF REMOVAL

This competition was organized by Alicia Fornés, Anjan Dutta, Albert Gordo and Josep Lladós from the Computer Vision Center, Dept. of Computer Science, Universitat Autónoma de Barcelona, Bellaterra, Spain. This competition includes two contests: Staff removal and writer identification. Both contests have been tested on the CVC-MUSCIMA database: a ground-truth of handwritten music score images. A list of participating groups is given in Table XV.

XV. HISTORICAL DOCUMENT LAYOUT ANALYSIS

The Historical Document Layout Analysis Competition was organized by Apostolos Antonacopoulos, Stefan Pletschacher, Christian Clausner, and Christos Papadopoulos

from the Pattern Recognition and Image Analysis (PRImA) Research Lab, School of Computing, Science and Engineering, University of Salford, Greater Manchester, United Kingdom. This competition aims to give an objective comparative evaluation of layout analysis methods for scanned historical documents.

XVI. DOCUMENT ANALYSIS ALGORITHM CONTRIBUTIONS IN END-TO-END APPLICATIONS

This contest was organized by Bart Lamiroy from the Institut National Polytechnique de Lorraine, LORIA, Nancy Université, France, Tao Sun, and Daniel Lopresti from the Department of Computer Science and Engineering at Lehigh University, Bethlehem, USA. This contest aims to provide a metric giving indications on the influence of individual specific document analysis tools to end-to-end applications. There have been 2 contestants to the contest (Table XVI), providing a total of 5 contributions (2 binarizations and 3 text segmentations algorithms)

XVII. CANCELED COMPETITIONS

The following four competitions were canceled due to the lack of participants.

A. ICDAR 2011 Page Dewarping Contest

The Page Dewarping Contest was proposed by Syed Saqib Bukhari and Thomas Breuel from the Image Understanding

and Pattern Recognition Research (IUPR), Technical University of Kaiserslautern, Germany, and Faisal Shafait from the German Research Center for Artificial Intelligence (DFKI), Kaiserslautern, Germany.

B. Table Competition at ICDAR 2011 – Establishing the Physical Model of a Table: Table Location and/or Segmentation

This competition was proposed by Ana Costa e Silva from the Laboratory of Artificial Intelligence and Decision Support (LIAAD), Institute for Systems and Computer Engineering of Porto (INSEC), Universidade do Porto, Portugal.

C. Arabic Handwritten Textline Recognition (AHTR'11)

The Arabic Handwritten Textline Recognition (AHTR'11) Competition was proposed by Mohammad Khorsheed, Abdulaziz Alobaid, Eman Bin Khunayn, Khalid AlFaifi, Basmah ALJedia, and Yaser ALmutairi from the Computer Research Institute, King Abdulaziz City for Science and Technology (KACST), Riyadh, Kingdom of Saudi Arabia, and Ahmad Abdulkader from Microsoft Corp., USA.

D. Interactive Handwriting Recognition

This competition was proposed by Nicolás Serrano, Adrià Giménez, and Alfons Juan from the Pattern Recognition and Human Language Technology (PRHLT), Universitat Politècnica de València, Spain.

XVIII. Conclusion

Testing recognition systems on large identical datasets is crucial for performance evaluation. Another challenge comes from their complexity, because they consist of many specialized parts solving very diverse tasks. The competitions organized at the 11th International Conference on Document Analysis and Recognition (ICDAR 2011) show the importance of such evaluation contests to make an important improvement in a research field. Some of these research fields are well established, many groups are working on these topics, some other research fields are in the start phase and just a couple of groups are working on it.

Acknowledgment