ICFHR 2018 Competition on Multi-Script Writer Identification

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Abstract—This paper describes the ICFHR 2018 Competition on Multi-script Writer Identification with details on the competition tasks, databases employed, submitted systems, evaluation protocol and the reported results. The competition was aimed at exploring the traditional writer identification problem in a more challenging scenario of a multi-script environment where training and test samples of writers come from different scripts. Three different databases with handwriting samples in Arabic, French, English, Chinese and Farsi were employed in the six competition tasks. The realized results indicate that while high identification rates are reported in the literature by traditional writer identification systems, identifying writers in a multi-script environment is a much more challenging problem that requires significant investigations to extract effective handwriting representations that are able to characterize the writer across different scripts.

Problem and Motivation

Writer Identification Approaches

- Identification of writers from handwritten samples is a well-known behavioral biometric modality.
- Applications: forensic document analysis, authentication of documents and verification of the genuineness of historical manuscripts.
- Most of the research on writer identification has been carried out on handwritten texts in a single script.

Motivation and Objective

- Compare the performance of recent advances in multi-script writer identification.
- Investigate he performance of traditional script-dependent writer identification systems in a multi-script environment.

Challenges

- The present competition explores the traditional writer identification problem in a more challenging scenario of a multi-script environment where training and test samples of writers come from different scripts.
- Three different databases with handwriting samples in Arabic, French, English, Chinese and Farsi were employed.

Competition

Competitions Tasks

Task 1: Chinese samples in training and English samples in the test set.

Task 2: English samples in training and Chinese samples in the test set.

Task 3: Arabic samples in training and French samples in the test set.

Task 4: French samples in training and Arabic samples in the test set.

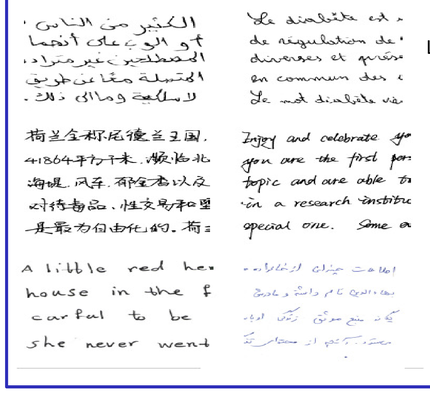
Task 5: Farsi samples in training and English samples in the test set.

Task 6: English samples in training and Farsi samples in the test set.

Evaluation Protocol

- The rankings of the submitted systems are calculated separately on each of the six tasks while the overall ranking of each system is calculated by accumulating the rankings on the individual tasks.
- If *R(i)* represents the rank of a system for task *i*. The accumulated rank (AR) of the system is computed by summing the rankings of the *m* sub-tasks where *m = 6*
- A ***smaller*** value of AR signifies better performance of the system

Databases



LAMIS-MSHD Database

CERUG Database

WDAD Database

System 1 (LIMPAF-I)
- Submitter: Abbas Faycel from Akli Mohand Oulhadj University of Bouira, Algeria
- Features: Complete Local Binary Patterns (CLBP)
- Classifier: Support Vector Machine (SVM)

System 2 (LIMPAF-II)
- Submitter: Abbas Faycel from Akli Mohand Oulhadj University of Bouira, Algeria
- Features: oriented Basic Image Features (oBIFs)
- Classifier: One-against-all multiclass SVM

System 3 (Tokyo)
- Submitters: Cuong Tuan Nguyen and Hung Tuan Nguyen from Tokyo University of Agriculture and Technology, Japan.
- Features: Convolutional Neural Networks (CNNs)
- Classifier: K-Nearest Neighbors (KNN)

System 4 (Nuremberg)
- Submitter: Vincent Christlein from Friedrich-Alexander University of Erlangen-Nuremberg, Germany
- Features: Convolutional Neural Network (ResNet-20) and VLAD encoding
- Classifier: Cosine distance.

Results

System	Task 1				Task 2				AR
	Top-1	Top-2	Top-5	Top-10	Top-1	Top-2	Top-5	Top-10	
LIMPAF-1	42.50 (2)	53.75 (2)	72.50 (2)	83.75 (2)	56.25 (1)	70.00 (1)	81.25 (1)	90.00 (1)	12
LIMPAF-2	57.50 (1)	67.50 (1)	80.00 (1)	86.25 (1)	46.25 (2)	55.00 (2)	71.25 (2)	80.00 (2)	12
Tokyo	23.75 (4)	42.50 (4)	60.00 (4)	68.75 (4)	16.25 (4)	28.75 (4)	46.25 (4)	57.50 (4)	32
Nuremberg	32.50 (3)	46.25 (3)	66.25 (3)	82.50 (3)	27.50 (3)	40.00 (3)	61.25 (3)	80.00 (2)	23

System	Task 3				Task 4				AR
	Top-1	Top-2	Top-5	Top-10	Top-1	Top-2	Top-5	Top-10	
LIMPAF-1	40.83 (1)	52.92 (1)	67.92 (2)	83.33 (1)	42.08 (1)	51.67 (1)	73.83 (1)	85.00 (1)	9
LIMPAF-2	37.50 (2)	50.00 (2)	68.75 (1)	80.83 (2)	40.00 (2)	47.50 (2)	68.75 (2)	79.58 (2)	15
Tokyo	30.00 (3)	40.42 (3)	56.67 (3)	71.25 (3)	17.08 (4)	29.17 (4)	51.25 (3)	60.83 (4)	27
Nuremberg	19.58 (4)	24.17 (4)	36.67 (4)	55.42 (4)	31.25 (3)	36.67 (3)	46.67 (4)	63.75 (3)	29

System	Task 5				Task 6				AR
	Top-1	Top-2	Top-5	Top-10	Top-1	Top-2	Top-5	Top-10	
LIMPAF-1	29.37 (1)	38.75 (1)	58.12 (1)	70.62 (1)	28.75 (1)	38.12 (1)	59.37 (1)	68.75 (1)	8
LIMPAF-2	26.25 (2)	36.87 (2)	49.37 (2)	64.37 (2)	24.37 (2)	33.75 (2)	47.50 (2)	64.37 (2)	16
Tokyo	9.37 (4)	16.87 (4)	31.25 (4)	50.62 (4)	6.87 (4)	17.50 (4)	33.12 (4)	47.50 (4)	32
Nuremberg	20.62 (3)	28.12 (3)	45.00 (3)	59.37 (3)	17.50 (3)	21.87 (3)	38.75 (3)	51.87 (3)	24

System	Task 1 & 2	Task 3 & 4	Task 5 & 6	Overall AR (Rank)
LIMPAF-1	12	9	8	**29 (1)**
LIMPAF-2	12	15	16	43 (2)
Tokyo	32	27	32	91 (4)
Nuremberg	23	29	24	76 (3)

Conclusion: The ICFHR 2018 Competition on Multi-script Writer Identification was aimed at reporting and objectively comparing the latest writer identification techniques under the same experimental protocols. The competition was carried out on three databases (LAMIS-MSHD, CERUG and WDAD) with writing samples in English, Arabic, French, Chinese & Farsi and comprised six tasks. In each of the tasks, the training and test sets contained writing samples in different scripts. The key idea was to investigate the performance evolution of the recent writer identification techniques when exposed to a multi-script experimental setup. Four systems were submitted to the competition, two of these (LIMPAF-1 & LIMPAF-2) were based on textural features while two employed Convolutional Neural Networks for feature extraction. While CNNs represent state-of-the-art feature extractors and classifiers, it was observed that in the given experimental scenarios, the traditional textural features outperformed automatic feature extractors. The system LIMPAF-1 realized the lowest average rank and was declared as the winner of the competition. The overall low identification rates (with respect to traditional writer identification systems) in all the four systems suggest the exploration of script independent features for this problem.