ICTA'07, April 12-14, Hammamet, Tunisia

Performance Evaluation of the distributed Arabic cursive characters recognition using the DTW algorithm on the SRTG

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Abstract

Arabic printed cursive characters Recognition using the Dynamic Time Warping (DTW) algorithm provides very interesting results. Unfortunately, the big amount of computing to be achieved by this algorithm during the recognition process makes its execution time very slow. Grid computing presents a very interesting infrastructure that allow to support distributed applications in one hand and to take advantages of the underlying unutilized computing and/or the storage power in the other hand. Thus, we present in this paper the performance analysis of the distribution of the DTW algorithm on the Scientific Research Tunisian Grid (SRTG). Obtained preliminary results confirm that the Scientific Research Tunisian Grid gives an interesting framework to speedup greedy algorithms such as the DTW.

***Key Words**: Grid computing, SRTG, DTW algorithm, distributed Arabic cursive OCR, performance analysis.*

1. Introduction

The recognition of Arabic Printed cursive characters using the DTW algorithm provides a very interesting recognition rate. One of the advantages of the DTW algorithm is its ability to recognize words or connected characters without any need to their prior segmentation. In our previous studies achieved on high and medium quality documents [2], [3], [5] we obtained an average of more than 98% as recognition rate and more than 99% as segmentation rate. We found in particular that the recognition rate (consequently the segmentation rate) increases if the font size increases. The purpose of the DTW algorithm is to perform optimal time alignment between a reference pattern and an unknown pattern and evaluate their difference. The major problem of the DTW is the slowness of its response time because of the enormous amount of computing to be achieved [6], [7], [8].

Many solutions and approaches have been proposed to speedup the DTW algorithm, [1], [7], [8], [4], [9], [5].

We propose in this paper, another approach based on Grid technology especially the SRTG to speedup the execution time of Arabic printed cursive characters recognition by the DTW algorithm. Performance evaluation of the proposed approach has been achieved through an experimental study.

Section (2) describes the recognition of Arabic printed cursive characters using the DTW algorithm. Section (3), gives an overview on grid computing technology. The proposed approach and the corresponding performance evaluation are detailed in Section (4). Conclusion remarks and future investigation are presented in section (5).

2. Recognition of connected or cursive characters

Words in Arabic are inherently written in blocks of connected characters. Prior segmentation of these blocks into separated characters may consequently needed. Indeed many researchers have considered the segmentation of Arabic words into isolated characters before performing the recognition phase. The viability of the use of DTW technique, however, is its ability and efficiency to perform the recognition without prior segmentation [4].

Let constitute T a given connected sequence of Arabic characters to be recognized. T is then composed of sequence of feature vectors Tt that are actually representing the concatenation of some subsequences of feature vectors representing each an unknown character to be recognized. The objective is to detect simultaneously and dynamically the number of characters composing T. There surely exist a number k

and indices *(m1, m2, ..., mk)* such that $Cm1 \oplus Cm2 \oplus \ldots \oplus Cmk$ representing the optimal alignment to T where $\oplus$ denotes the concatenation operation [4].

3. Grid computing and the SRTG

3.1 Grid computing

Grid computing is an infrastructure that allows to many institutions (regardless their geographical locations) to interconnect a large collection of their heterogeneous computer networks and systems to share together a set of software and/or hardware resources, services, licences, ... [16]. This huge ability of sharing resources in various combinations will lead to many advantages such as:

- increase the efficiency of resource usage;
- facilitate the remote collaboration between: institutions, researchers,...
- give to users a huge computing power;
- give to users a huge storage capacity, etc.

3.2 Scientific Research Tunisian Grid (SRTG)

SRTG is developed by (l'Unité de recherche UTIC [11]). It is similar to the XtremWeb-CH [12] which is an improved version of XtremWeb [13]. The main goal of the SRTG is to provide to Tunisian researchers an effective experimental framework to achieve their different needs such as performance evaluation of distributed processing.

4. The proposed approach

The idea of the proposed approach is how to take advantages of the enough power provided by a given grid computing such as the SRTG to speedup the DTW algorithm?. We propose to split optimally the binary image of a given Arabic text to be recognized into a set of binary sub images and then assign them among some computers interconnected to the SRTG. Our Grid Computing is composed of several institutions heterogeneous computers interconnected trough the Internet. One of these computers is named the coordinator and the remaining one are named workers. The coordinator is responsible of the management of the recognition process and the coordination among workers. The coordinator is working as a web server service, for example it can provide instantaneously to users the number of available workers. Thus if we need to launch on the grid a distributed Arabic recognition process, we have first to log in to the coordinator, ask it about the number, the computing capacity and the Operating System of available workers. Then, we have to fix the target workers that will participate in the work and finally we have to prepare the different files (in XML format) [14], [15] required to achieve this task. These files which include the data to be processed (the binary sub image) and the code to be executed by every worker must be sent to the coordinator. After receiving these files, the coordinator assigns them to the target workers. Consequently, every worker of the grid previously selected and assigned must achieve the following tasks:

- the pre-processing and the segmentation of the binary sub image (they correspond to the second stage of an OCR system);
- the description and feature extraction of the segmented parts which correspond to connected characters (they correspond to the third stages of an OCR system);
- the recognition of these connected characters by the DTW procedure.

After achieving these tasks, every worker must turn back obtained results (recognized sub texts) to the coordinator. The coordinator must turn back to the user the totality of received results from workers.

A. Experimental Study

Figure 1. illustrates the first experimental results found. The linear curve of Figure 1. illustrates the sequential execution mode of the DTW algorithm. The other curve illustrates the distributed execution mode of the DTW algorithm. Experiment conditions are as follows:

- the totality of the studied application was implemented in "C sharp" language;
- the cursive Arabic text corpus used have the size of 277 characters. It was duplicated according to workers number, it means that every worker of the SRTG has computed only one Arabic text corpus;
- the reference library used is composed of 103 characters representing approximately the totality of the Arabic alphabet.

during conducted experiments, we have neglected the time needed to keep back the

final result from the coordinator because we have worked on a computer which is near to it;
all workers used in our conducted experiments have the same configuration which is 3GHZ as clock frequency, 512 Octets as RAM and Windows XP professional as Operating system.
Figure 1. shows that to speedup the Arabic printed cursive characters recognition by the DTW algorithm on the SRTG we need to use at least 5 workers. These results are very interesting and confirm our previous study [5].

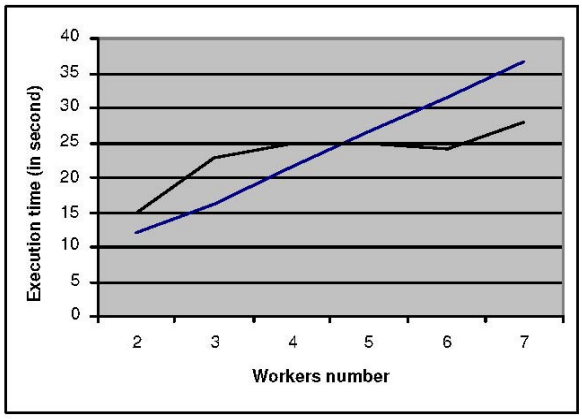

Figure 1.

5. Conclusion and perspective

We proposed in this paper a new approach based on grid technology to speedup the recognition process of Arabic printed cursive characters by the DTW algorithm.

Performance evaluation of the proposed approach on the SRTG confirms that grid computing can provide an effective framework to speedup greedy algorithms such as the DTW.

Many investigations are under studies, especially the automatic generation of the XML files describing the distributed application.

6. References

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