E-learning in Medical Diagnosis

Daniela Mayumi Ushizima and Marta Costa Rosatelli
Universidade Católica de Santos
Grupo de Sistemas Inteligentes
$\{usdani, rosatelli\}$ $@unisantos.br$

Abstract

The massive amount of data, required to learn how to diagnose, can be organized and turned into information to physicians using computers and Internet. In addition to atlases, the collaboration among professors, researchers, and students are decisive issues to consolidate the diagnostic knowledge. In order to tackle this problem, we propose a collaborative learning environment to support group activity, in the context of e-learning in the medical domain. The pedagogical approach of this environment is learning from case studies. The first step towards e-learning applied to diagnosis is to organize a blood image data base and their metadata available through a digital atlas (e-atlas). To accomplish this, we intend to: (1) collect a number of blood cell images organizing them into an e-atlas and (2) turn numerical measurements (real numbers) into medical reports, with suitable medical jargon.

1. Introduction

Physicians need to accumulate a vast background, based on previous cases of diseases, for more accurate diagnosis. This learning process requires observational grouping to evaluate several images and to relate them to their clinical data. The most acceptable learning method is to observe several high quality images from paper atlases, a heavy and expensive way of acquiring knowledge. Electronic atlases can substitute paper-made ones in most of cases, saving resources from educational institutions, learners, and the environment. Not ignoring atlases relevance, they are insufficient media in learning process, as it is mandatory students interact with experts.

Collaborative learning is an implicit feature in learning from case studies [1]. In the medical domain, particularly concerning blood diseases, this method requires that the cytologists collaborate in order to agree on a diagnosis. In this paper, we present the first step towards the development of a collaborative intelligent learning environment that supports group activity in distance learning, with particular application to cell description. We aim to use collaborative learning to help physician students to acquire background knowledge to diagnose unseen blood cell images, in the context of case-based diagnosis exercises. The system assists the learners during collaboration to agree on a diagnosis for a given case, as in [2].

The collaboration among users allows the registration of medical data, containing medical images with correspondent description of the cells for future processing. The collected data will permit to translate the output of a computer decision support system for leukemia diagnosis [3], which is currently numerical and meaningless to physicians, into meaningful medical reports. Both the e-atlas and e-learning environment project are based on the leukemia diagnosis system [4].

2. Material and methods

Our main purpose is to release an e-atlas, with the collected images, to researchers using the Internet. We already have an image database containing 1,439 classified blood smear images: 1,058 normal leukocytes and 381 abnormal cells. Digital images were captured manually from Leishman-stained blood smears slides, using a 2.1 Megapixel digital camera, attached to an optical microscope, set up to magnify 1,250x. Hematologists classified the cells manually into normal leukocytes - basophil, eosinophil, lymphocyte, monocyte, and neutrophil - and abnormal cases as chronic lymphocytic leukemic cells, prolymphocytes, hairy cells, mantle cells, and smudge cells.

We want to increase and make public the current database as well as to provide tools to deal with those images and to upload new ones. This auto-feed system must be capable of registering the metadata related to each image as (1) image id; (2) slide id; (3) patient id; (4) age; (5) sex; (6) filename; (7) number of cells in the slide; (8) type of the indicated cell; (9) status; (10) Hb (g/dL); (11) Ht (%); (12) WBC (x$10^3/\mu$l); (13) Plt (x$10^3/\mu$l); (14) Institution in charge; (15) microscope; (16) digital camera; (17) magnifi-

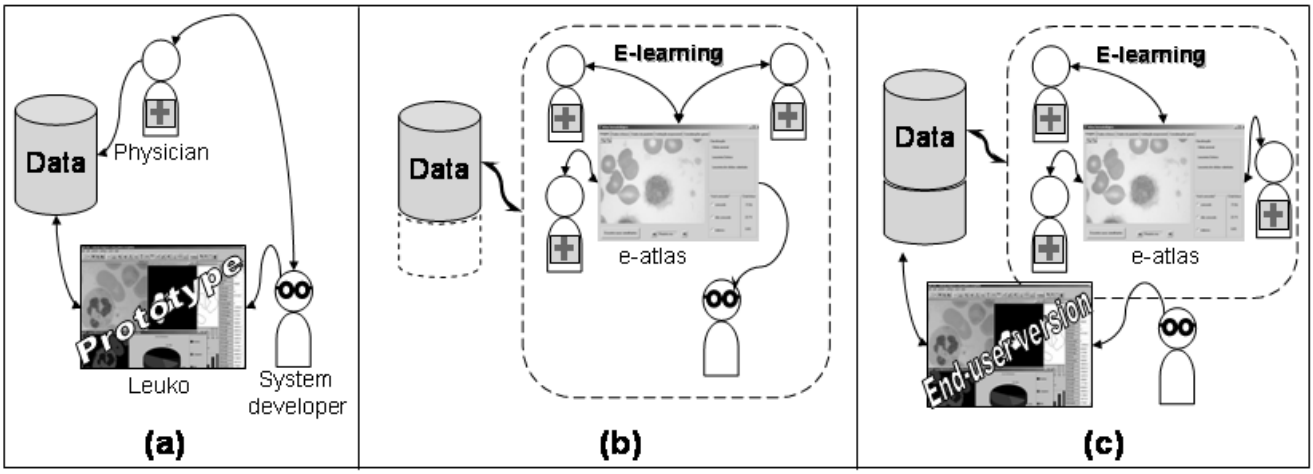

Figure 1. Knowledge organization toward leukemia diagnosis: (a) Leuko prototype concluded; (b) E-learning in medical diagnosis: information acquisition and exchange; (c) Future computer decision support system able to output anamnesis.

cation; (18) staining protocol; (19) blood smear preparation; (20) blood sample origin; (21) physician in charge; (22) hematologist in charge; (23) under treatment; (24) family background; (25) life expectancy; and (26) general remarks.

This research project (Fig.1.b) aims to accumulate knowledge from the e-atlas in terms of a collaborative learning environment to support health professionals in diagnosing blood diseases. We intend to publish the medical images, their measurements according to a computer decision support system based on acquired knowledge (Fig.1.a), including measurements and clinical data inserted by the users. From the provided database, we intend to connect numerical measurements to the meaningful biological description (Fig.1.c). Illustrating the idea, suppose that we use the entropy measure (E): a high value of E in the nuclear region provides the physician with a textual report that indicates nucleus containing heterochromatin, i.e. chromatin condensation in certain parts of the cell nucleus. Another possibility would be to interpret 2 or more measures to explain a typical medical observation, for example, a high value of E and preferential direction in which occurs the heterogeneity of the level of gray color in the image, which means chromatin color altered with the presence of scratches in the nucleus.

This enlarged database will allow carrying out data mining experiments for retrieving images based on context and knowledge discovery to aid *Leuko* development [4], toward an accurate system to support medical decisions when classifying leukocytes and malignancies related to these cells. The data mining will provide the most discriminative measurements related to the database. The biological meaning of the numerical measurements will come up via e-learning, such as the system can elaborate a pre-diagnostic report, formatted into an anamnesis, using the medical jargon from the collaborative discussions about the cases studies.

3. Conclusions

This paper presents an overview of the E-learning in Medical Diagnosis project. It aims supporting group activity of medical students working on a clinical case study. We propose the organization of an existent blood image database [3] and tools to load more images and their respective medical description, based on previous results on medical image database [1, 2]. The collaborative learning environment allows discussion about the case studies, including medical reports. These visual described properties of the images will be organized and made available through the e-atlas.

This work has been partially supported by FAPESP under projects 2003/08279-2 and 2005/52645-9.

References

[1] P. Dillenbourg. *Collaborative Learning: Cognitive and Computational Approaches*. Pergamon, 1999.

[2] M. C. Rosatelli and J. A. Self. A collaborative case study system for distance learning. *International Journal of Artificial Intelligence in Education*, 14:97–125, 2004.

[3] D. M. U. Sabino, L. da F Costa, E. G. Rizzatti, and M. A. Zago. A texture approach to leukocyte recognition. *Real-Time Imaging*, 10(4):205–216, 2004.

[4] D. M. U. Sabino, L. da F Costa, E. G. Rizzatti, and M. A. Zago. Toward leukocyte recognition using morphometry, texture and color. In *IEEE Intl Symp Biom Imag*, Apr 2004.