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MULTICRITERIA ANALYSIS AND CASE-BASED REASONING: APPLICATION TO THE TRAINING OF YOUNG DOCTORS IN THE CONTEXT OF BREAST MAMMOGRAM

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Abstract.

The detection of breast cancer is a priority for the Ministry of Health. That is why the objective is to give a more accurate diagnosis during a medical examination of patients. The diagnosis cannot be limited only to mammography ranked by the BI-RADS®, but should consider more and more patient history and clinical examination. The main goal of the present paper is to support the learning process, diagnosis and decision making of young doctors. Two approaches to diagnosis of this pathology stand, one will focus on reading mammography supplemented by medical records and palpation, and another approach will focus on breast palpation supplemented by reading mammograms.

1. Introduction

Faced with a growing number of breast cancer in women, routine screening is a necessity for the medical profession. Which leads improve the interpretation the set of elements: the patient history, mammograms and medical examination of the patient.

Offer a diagnosis to patients with accuracy is always risky for the doctor [1]. Only the doctor's experience over many years will strengthen his decisions. The diagnosis of breast cancer is present in ACR ranking by BI-RADS®.

Giving a diagnosis to a patient, requires several years of experience, and is based on three main elements: mammography of the breast (interpretation of radio), medical history (prior art study of patient and family) and a medical examination (breast palpation and exchanges between the doctor and his patient).

This imposes the young doctor to have a regular practice and support by a senior doctor. However, the learning time available to be an experienced doctor has been continually reduced as a consequence of medical institutions pressure to generalize medical prevention in society.

Many current researches concern diagnosis support systems, in the form of a likely proposal [2], [3], [4], [5], [6]. However the main problem is not the automatic decision tools but the need of adapted tools enabling young doctors to reduce the required learning time.

2. Learning support system for breast cancer diagnosis

The problem is to support a young doctor to acquire this experience through a process of self-learning supervised by a senior qualified doctor and an automatic system [7], [8]. The approach is as follows: the young learner doctor receives a complete package of information including a non-interpreted mammogram, a medical history and the results of a medical palpation (the new case to be solved). The learner must interpret the case, particularly the mammography, and give his diagnosis on the form of ACR ranking. In order to do this, the systems will select from a database two similar cases. These cases will be determined by a Case Based Reasoning methodology using the multicriteria decision aid tools as measure of similarity.

The proposed learning support system could be used in several ways as follows:

- *Learning is supervised by a qualified senior doctor*. In this case the new case to be solved is provided by the senior doctor. The learner must use the two cases proposed by the system in order to propose a diagnosis. The senior doctor evaluates this diagnosis and gives further explanations to the learner.

- *Learning is no longer monitored by a qualified doctor*. The learning support system will proposes a new case to be solved from the database, adapted to the individual former results of the learner. The system will then evaluate the proposed diagnosis.

- *Learning can also be limited to an interpretation of mammography* reading and image interpretation in relation to the ACR classification. The qualified medical doctor will follows the learner to discover the correct diagnosis.

- *Finally, the medical learner is free to build his own learning path* the learner will start the learning process by simple new cases to be solved and increase progressively the level of difficulty.

3. Proposed learning support system

The overall approach proposed in Figure 1.

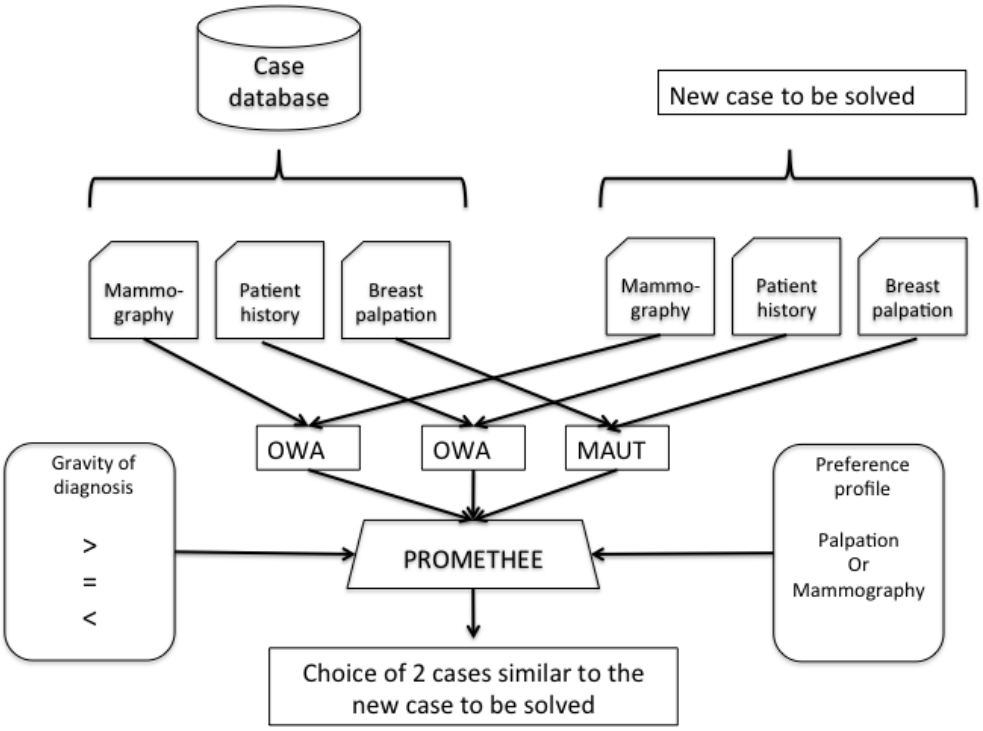

Figure 1. *Global proposed approach*

Tools, models and methods requested during the construction of this global approach will be several aspects:

- A case database must be available containing a number of independent cases validated by the senior doctors.

- A case is composed by three main elements: mammography and/or echography of the breast (interpretation of radio), medical history (prior art study of patient and family) and a medical examination (breast palpation and exchanges between the doctor and his patient).

    - Mammography is composed by the mammogram and a checklist grid of the set of diagnostic features, such as mass and calcifications for example. The learner analyses the image and fill the grid.

    - Patient history is composed by a set of answers to a number of questions as: former breast cancer and/or surgery within the patient family, ovary cancer in the family, patient age, menopause and/or hormonal treatment…

    - Breast palpation includes a checklist grid, previously defined by a set of senior doctors through the Delphi-Régnier methodology (consensus).

- Computation of similarity between a case of the data base and the new case to be solved, for each one of the three main elements above described.

  - Mammography similarity: aggregation of the distances of each attribute of the checklist (between a case of the data base and the new case to be solved) is made through an OWA (Ordered Weighted Average) [9] technique. It avoid to use an attribute hierarchical order.

  - Patient history similarity: aggregation of the distances of each attribute of the checklist (between a case of the data base and the new case to be solved) is made through an OWA (Ordered Weighted Average) technique. It avoid to use an attribute hierarchical order.

  - Breast palpation similarity: aggregation of the distances of each attribute of the checklist (between a case of the data base and the new case to be solved) is made through a MAUT (Multi Attribute Utility Theory) [10] technique. It allows to take into account the attribute hierarchical order defined by the senior doctors.

- Preference profile: two different profiles to diagnostic approach were selected, mammography and palpation oriented diagnosis.

- Gravity of diagnosis: the database of cases is decomposed in three sets regarding the ACR rank. A set contains the cases having equal value of ACR than the new case to be solved, and the two other sets contains the cases with lower and upper gravity (ACR).

- Global similarity aggregation through PROMETHEE [11]: Mammography, patient history and breast palpation similarities are aggregated taking into account both the preference profile and gravity of diagnosis.

For a given preference profile, PROMETHEE sort the cases of each one of the three main sets of gravity of diagnosis (ACR). Two cases of the database are selected randomly from the most similar of each sets of gravity. The comparison of these cases to the new case to be solved, will allow the learner to built his own reasoning of diagnosis.

4. Conclusion

The work presented in this paper are a continuation of earlier work "Case based reasoning and decision engineering: application to learning within the framework of breast mammography" presented at the last International Congress. We want to build a self-learning approach to the young doctors who wish to specialize in reading mammograms. This approach is based on methods and tools for multi-criteria analysis and reasoning from cases or experiences. This process of self-learning is treading new ground in its construction and its use through the integration of multi tools and experience gained in the various cases studied by the real experts.

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