
THE EXAMINATION SUPPORT IN SONOGRAPHIC INVESTIGATIONS

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Abstract: The principles of interface design for support decision systems in ultrasound diagnosis are examined and their implementation for a specific system oriented to the investigation of abdominal region is exposed.

Key words: diagnostic, ultrasound, investigation process.

INTRODUCTION

The problem of assuring an adequate medical assistance to the population depends both on training and qualification levels of doctors and performance of diagnostic equipment they use. Nowadays it is impossible to offer medical services, even at the most modest level, without using diverse instruments, apparatuses, devices and technical complexes.

Ultrasound equipment is much cheaper than the other equipment (MRI, CT, digital radiography etc), and its rational and efficient use could fill in many gaps in medical diagnosis. Technical progress of the last years in the field of ultrasound research allowed this method to come to a leading position among imagistic procedures.

On the other hand, it faces a lot of problems: the doctors subjectivity, a high degree of noise of the received images, the lack of qualified personnel etc. That is why a system of computerized assistance would be extremely useful. We still do not have too many ultrasound decision support systems, even though the attempts to elaborate such systems based on ultrasound research have been among the first ones.

Analyzing a number of systems destined to support sonographic investigations from the point of view of their functions one can divide them into the following categories:

1. Systems for creating protocols/standard reports (LookInside [1], Uzi [2], „The cabinet of ultrasound diagnosis” [3] etc.);
2. Educational systems (training of specialists in the corresponding domain);
3. Image storage systems (SONO-2000 [4]);
4. Tele-echography image transmission system (images transmission to obtain remote consultations);
5. Diagnosis expert systems (SonoConsult [5]).

EXAMINATION SUPPORT

The process of designing and implementing the examination support has been provided in three phases:

1. The formalization of the investigation process;
2. Developing the corresponding algorithm;
3. Algorithm implementation (interface).

FORMALIZATION OF THE INVESTIGATION PROCESS

To obtain a formalized expression of doctors experience it was necessary to involve a number of experts, which can explain step by step their actions and the corresponding logic. Often they act intuitively and this intuition should be detected, formulated and presented as a sequence of elementary operations.

DEVELOPING THE CORRESPONDING ALGORITHM

During this stage, the experts' knowledge has been analyzed more profoundly. Namely, it was taken into account that a part of information is purely subjective, another may be considered by experts (doctors) as already known (as for example the organ dimension depending on age, its location inside the abdomen etc.).

The examination process will end up with a general conclusion based on the rules from the knowledge basis. So, our main aim is to fill in the white sheet of report. The information to prepare the report is obtained from the attributes values collected during the examination. There are three kind of values: which should be included directly into the report (patient's name, age etc.); which are used in rules to deduce the conclusion, but are not included into the resulting description (for example, the detection of a shadow signaling the presence of some gall-stones); and values taking part in the conclusion computing and being also recorded in the report (for example, organ's characteristics). Moreover, if the fixed values respect a rule it might demand some additional questions to be asked in order to obtain more details necessary for the report drawing. For example, if the collected values correspond to a rule which leads us to the conclusion about the existence of gall-stones it might be necessary to know their additional characteristics: quantity, dimensions, structure etc.

ALGORITHM IMPLEMENTATION: INTERFACE

Our system contains a knowledge acquisition module, which formalizes the experts knowledge and presents them as a collection of rules, and a data base with annotated images, which is possible to access during examination. The system interface is intended to support the examination process.

The selected strategy for diagnosis establishment considerably influences the functional requirements of system.

The investigation process may be realized in two different ways:

- step by step, from the description of organ's anatomy to conclusion;
- from presumed pathologies to their asserting /confuting.

The ultrasound investigations, including the quality of the obtained images, are operator dependent. We will take into consideration that the operator may make some errors and confusions, the system being imposed to provide the control and to suggest some verification modalities, which can lead to the avoidance of such situations. The cases when a visualized organ is confused with a different one are not rare also, therefore before passing directly to inspection, it is necessary to request the checking of a possible confusion, for this purpose the criteria to determine a possible confusion are offered.

There are also cases when the organ is invisible (from obesity, out of place because of a pathology of the vicinal organ, eliminated organ, the insufficiency of preliminary preparation of the patient, lack of experience etc.)

Therefore, during the investigation process some adjacent problems will be solved, which will lead from the supposition of organ's confusion or non visualization to its confirmation/confuting.

On every stage of the investigation the decisions support will be ensured also by the comparison of obtained image with similar ones from database of images.

Each interface window is divided into three frames.

In the middle one the dialogue between the user and the system is displayed.

The left frame contains the history of investigation (the passed steps). This releases user from the necessity to memorize the information introduced or obtained on the previous steps.

Every time the passing way of investigation process is displayed for the user.

The third frame is placed on the right part of the screen. The information which will be contained here depends on the choice of the organ's investigation method.

For example, in the case when during the investigation process the necessity of comparing the obtained image with the similar images from the base appears, then in the right frame we will have the displayed image and its similar images, selected from the base.

If the examiner passes the way of investigation from organ's anatomy description to conclusion, then depending on the values introduced for each criterion of the investigated organ the right frame will contain the conclusion or the resulted diagnosis. We will mention that a declaration of impossibility to express an opinion about this case can be also a conclusion.

In the case of examination of supposed pathologies which are to be affirmed/rejected in the right part we will have the list of possible pathologies for the examined organ. In this case, the interface will be oriented to a concrete pathology, omitting some questions from the general process of examination and formulating others, specific to this case. It is not excluded, that during the system development in particular and medical knowledge in general, some new pathologies may appear or the knowledge about those existing may be modified, and as a result the interface components must be modified. So, we deal with the problem of dynamic generation of interface depending of the information contained in the knowledge base. For this we will have three lists: the pathologies list (the right frame), the criteria list (the middle frame), the rules list (this list is not visible for the user). After the supposed pathology selection from the rules base there will be inferred those attributes which characterize the selected pathology (or pathologies) and only the corresponding characteristics will be displayed, the other being inaccessible.

CONCLUSIONS

The stipulated results will serve so much in one's capacity of help to sonographer, how much for testing, auto testing and in doctor's training in purpose of raising their professional qualification.

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