

# Multimedia and virtual reality assistance in medical systems

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## Abstract

**Purpose:** The aim of the paper is to present conceptions leading to improvement of communication between medical computer systems and users by multimedia and virtual reality applications based on the authors' experience in constructing and exploitation of medical expert systems.

**Material and methods:** The examples considered in the paper deal with problems being the subjects of the authors' investigation. They contain the cases of multimedia and virtual reality applications to computer systems destined for assistance of medical education and surgery operations. The systems in experimental version have been tested by physicians and student groups.

**Results:** The preliminary investigations give ground to confirm that the systems will be easier in use and very helpful as well for the surgeon as in educational processes.

**Conclusions:** The examples presented in the paper show beyond any doubt that contemporary medicine is inseparably connected with the latest information techniques, among which the system making use of the multimedia and virtual reality occupy a firmly established position.

**Key words:** computer medical system, multimedia, virtual reality.

## Introduction

The paper presents the main ideas of multimedia [1] and virtual reality [2] applications to medical computer systems or internet medical systems and shows how they can contribute to the improvement of its activity efficiency and of man-system communication. The work describes first of all the results of own authors investigations relating: 1) to patient simulator [3] assisting training in diagnosing; 2) to simulator of the radiotherapeutic equipment handling; 3) to surgery-assisting multimedia systems.

The presented patient simulator enables the student to make diagnosis on the basis conversation and it deals with the third multimedia version of training system, subsequently the described simulator of teletherapy based on virtual reality program enables training of teletherapy equipment manipulation for students or nurses and the proposed system for surgery consists of the three blocks: description, communication and expert. The key role of multimedia is to ensure communication comfort between the surgeon and the system as well as a group of physicians and nurses accompanying by the operation.

The paper presents also a concept of an experimental module designed to recognize spoken utterances that cover a limited range of words indispensable dialogs with computer medical systems. Research the recognition of spoken words by module based on artificial neural networks is described. Usefulness of the obtained results for multimedia health care systems and medical educational systems is also discussed.

## Material and methods

The third version of the patient simulator program has the software designed with the use of Visual Basic 5.0 and it makes possible to play files WAV and AVI due to which the simulated situations are more authentic. The patient simulator enables the student to make diagnosis on the basis conversation. The way in which a given history is taken, additional examinations

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suggested by the student, qualification of given examination results, and the final diagnosis are all evaluated with points by the system. The conversation with the simulator consists in selecting appropriate questions and medical examinations from a list presented by the system and answers to these questions provided by the simulator which chooses them randomly from the set of admissible answers for the unrevealed disease unit. The system traces the kind of questions asked by the student, their order, the choice of additional examinations suggested by the student as well as his qualification of given examination results, and assigns a suitable number of points to each decision of the student. Consequently, the system evaluates the quality of the history taking and the final diagnosis concerning both the general condition of the patient and identification of the disease unit. At the end of the procedure the student learns total score as well as the number of points for particular steps.

The virtual teletherapy simulator of the therapeutic equipment handling has been built according to the author's idea. Its software enables training in operating the equipment, i.e. enables making necessary adjustments before irradiation of the patient, entire visualisation of an operation, treatment planning and collecting data referring to given operations. The simulator works in the Windows environment and therefore it is operated by the system of dialog windows, menu and buttons of the toolbar. The exploitation of virtual reality in the software makes it possible to watch the devices and the patient during the operation in the 3D space with the possibility of easy change of viewpoint performed with the use of the mouse.

The system consists of three main blocks named: description, communication, and expert. The first block covers patient's personal data, records of patient's condition before operation (e.g. description, scanned roentgenogram, microphotogram, tomogram, electrocardiogram, etc.), brief description of the operation and of convalescence. The communication block includes a collection of statements and dialogues necessary for the operating surgeon's communication with the group assisting him in the operation as well as graphic signs and sounds needed in this communication. The third block is an expert system in the area of the surgeon's specialisation. The software of the mentioned blocks is immersed in a multimedia environment.

Experimental module of spoken language recognition, based on neural networks and applied to the described medical systems, was composed of the following two blocks [4]: a) classifying block; b) approximating block.

Speech recognition requires a variety of speech signal analyses and extraction of suitable parameters. What makes the process more difficult is the fact that each utterance can be pronounced differently, i.e. with different speed, sound intensity, accent or intonation.

The way an utterance is pronounced is partly an individual characteristic of a speaker, but it is also subject to a temporary emotional, psychological or physical condition of the speaker.

There are numerous external parameters on which an utterance depends. Thus it is clear that the choice of a suitable set of parameters that would describe speech is of essential importance.

In the investigations that have been carried out the following stages can be distinguished: experimental selection of structural model parameters close to optimal; creation of sets of one- or multi-word expressions; classification of the elements of the expression sets; analysis of the neural network learning and an expression recognition procedure; selection of parameters for recognition criteria.

## Discussion

Assessment of usefulness of the experimental module of spoken language recognition for the multimedia surgery-assisting system involved operations were preceded by numerous discussions with surgeons and the presented education system have been tested in student groups of Medical University of Łódź. The investigations and discussions give ground to confirm will be very helpful as well for surgeons as in education processes.

The patient simulator not only helps the student revise the acquired knowledge or catch up with the material but creates situations in which the student must take decisions by himself. This trains him in logical thinking and drawing conclusions, the skills whose value cannot be overestimated.

At present, the virtual reality technology is frequently used to assist many sorts of medical work. Due to special programming tools it is not very difficult to construct virtual reality computer systems or multimedia system carrying out educational tasks or assisting diagnosing, therapy or hospital management.

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