APPLICATIONS OF INFORMATION TECHNOLOGIES FOR RESEARCH IN CLINICAL OPHTHALMOLOGY

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This report covers the results of the research work performed in frame of the project “Information technologies for human health – clinical decision support “IT Health” during the period 2003-2006, financed by Lithuanian State Science and Studies Foundation.
The eHEALTH NETWORK for Integrated Support of Clinical Practice, Education and Research connecting KAUNAS eHEALTH CLUSTER created. The CLUSTER consists of Kaunas Medical University Hospital (http://www.kmu.lt), Telemedicine Center of Kaunas University of Medicine (http://tmc.kmu.lt), Telemedicine Support Center of Kaunas University of Technology (http://www.bmii.ktu.lt), Institute of Mathematics and Informatics (http://www.mii.lt)
Purpose

To create a portal for:

1. Clinical decision support for ophthalmologists including automatic and interactive eye fundus images parameterization and recognition;

2. Clinical decision support for family doctors including automatic and interactive signal and data parameterization and recognition;

3. CME – continuous medical education for ophthalmologists and family doctors;

4. Patients education.

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• The main targets of IT applications for research in clinical ophthalmology are images and signals (optical and ultrasound data) - the most informative sources for differential diagnosis.

The main activities:

• Registration and parameterization of diagnostic signals and images, selection of most informative parameters, creation of databases and interfaces;

• Data mining and clinical decision support using learning algorithms, remote access to services and expertise of physicians.

• Development of prognostic, diagnostic and treatment recommendations using the knowledge portals.
Materials and Methods

We have collected 7000 eye fundus images: healthy eyes, glaucoma and myopia.

The automatic and interactive image processing algorithms developed for analysis of digital images of the eye fundus.

Framework of the eye fundus image analysis consist of:
• **Estimation of the eye fundus image quality**

| IMG_1011.jpg | Optic nerve swelling (papilledema) of the right eye. Regression stadium. | Optic nerve changes. | Optic nerve head is swollen, pale (beginning of secondary optic nerve atrophy), with blurred elevated margins, deflection of vessels over edge of the disc. |

- Description table and grids for localization of the eye fundus changes and parametrization of retinal vessels.
Materials and Methods

- Localization of the main landmarks in the eye fundus

Optic nerve head
Materials and Methods

- Segmentation of the optic nerve head and vessels
Materials and Methods

- **Calculation of quantitative parameters of segmented objects.**

Ophthalmological image parametrisation, selection of diagnostic parameters

The example:

33 images of 4 different pathologies, described by the complex of 34 parameters (total: 1122 parameters)
Materials and Methods

For interactive parametrization of blood vessels created program based on Matlab.
Interactive image processing

Selection of blood vessels

The created program based on Matlab
Automatic image processing

Excluding of the network of blood vessels from fundus image

A grey level morphology scheme proposed by Mendel’s was used.
Results

• Methods and software for eye fundus images parametrization – including automatic recognition of optical nerve region, automatic outlining of this region and calculation of geometric parameters of the optical nerve, excavation and retinal vessels created.

• The set of parameters reflecting the diagnostically important eye fundus features calculated.

• The method of excluding of the network of blood vessels from fundus image was developed enabling to improve diagnosis of retinal damages.
Results

Created portal for:

• clinical decision support for ophthalmologists including automatic and interactive eye fundus image parameterization and recognition;

• clinical decision support for family doctors including automatic and interactive data parameterization and recognition;

• CME – continuous medical education for ophthalmologists and family doctors;
The architecture of the created system

Opthalmologist

- WEB interface
- MATLAB Application

Cardiologist

- WEB interface

IT Health server

- MATLAB Computing Engine
- MATLAB Application
- Database: text, images, signals
- MATLAB WEB SERVER
- PHP

Internet
• Complete framework for eye fundus image processing was implemented in eHealth diagnostic system using Web technologies.
Three CME courses developed in collaboration with Distance Learning Center:
• Diagnostic and Treatment of Eye Diseases
• New Diagnostic Methods in Ophthalmology
• Eye Diseases for General Practitioners
Conclusions

- Tools and services for eye fundus image analysis developed.

- Combination of IT and signal processing techniques into Web based services for health system can help with better diagnosis and even acquire new clinical knowledge.

- Web based tools give more flexibility for developers and medical practitioners: compatibility for different computer platforms, better service and response to needs, better access using available internet connection.
Thank You for Your attention!

http://tmc.kmu.lt