The distributed system for collecting and analysing selected medical data

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ABSTRACT

In this paper the structure of a three-tiered distributed system for collecting and analysing medical examination data is presented. The idea of this work is to make an assistant tool for urologists to diagnose the lower urinary track diseases and their symptoms easier. The data (which are processed from the files made in the uroflowmeters – devices for measuring urine flow rate) are presented in web browser. It has been done with the use of PHP scripts which are accessed through Apache web server.

Keywords: urine flow measurement, distributed computing, HTTP, PHP, database systems, Apache server.

1. INTRODUCTION

Computer measuring systems are used in medicine to improve quality and efficiency in health care processes. Personal computers have become inexpensive and relatively easy to use. The Internet technology for data exchange can be utilized from almost any office or doctor's surgery. This technical and socio-economic development has led to a situation when it appears to be appropriate to assume that a large number of doctors is able to access an Internet based information system and collect their medical data for their own usage. The doctors have a possibility to review and analyse their own medical data in theirs surgeries.

Described distributed system provides a concept to present some easy to understand graphical data on a web page from files generated by the uroflowmeters - the devices which are used by the urologists. The uroflowmetry database system can assist them in diagnostics of lower urinary track diseases as Benign Prostatic Hyperplasia (BPH) [1], Overactive Bladder (OAB) and other.

2. METROLOGICAL ASPECTS OF MEDICAL DATA ACHIEVING

The technique used to measure urine flow rate depends on the recording of the volume of urine passed with the derivative being flow rate (Fig. 1).

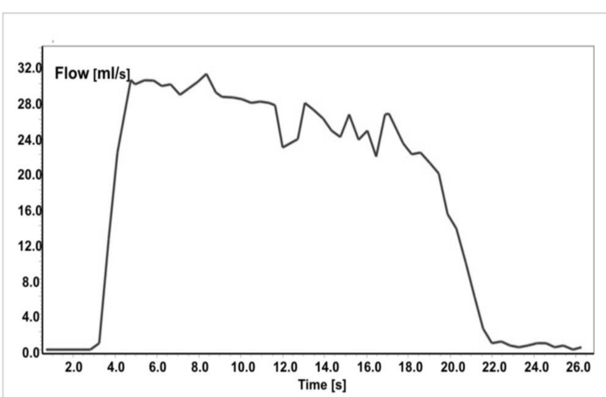

Fig. 1. Screenshot of the flow rate chart.

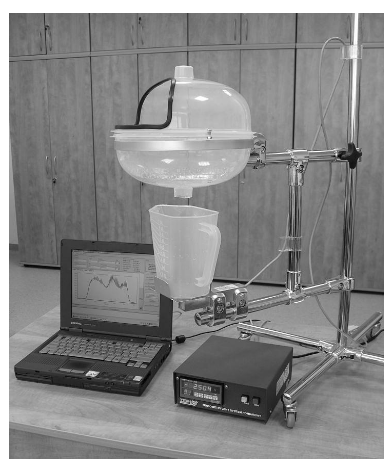

Fig. 2. Uroflowmeter Adalbertus.

It is the gravimetric method - passing the urine into a container which is continuously weighed [2]. This technique suffers from the amount of processing that is required to eliminate artefacts from vibration or movement during a miction and it is often implemented in uroflowmetry measuring systems.

Uroflowmeter Adalbertus, which has been made at Bialystok Technical University (Fig. 2), is an example of a device which works according to this principle of operation. It measures the parameters of miction such as: flow time, voided volume, maximum flow rate, average flow rate and flow rate after 1 second. The results of each examination and personal patient's data are stored in the data files. Considering that each doctor has many patients and each patient visits the doctor's surgery many times, there was a need to create a database system which would accumulate the data.

3. DATABASE SYSTEM ARCHITECTURE

The database contains:

- user (doctor) data which contains the doctor's ID, personal information, login and password, ID of the device which he uses;
- audit information about the user's access to the system (user's identity, actions taken);
- patient's data and status;
- examination records which consist of: flow chart, parameters of flow, doctor's diagnosis, date.

The entity-relationship diagram (Fig. 3) shows entities and how the entities are mutually related, e.g. entity *PATIENT* and entity *DOCTOR* are related through relationship *DOC_ PAT*. Mapping between entities is 1:N, which means that a patient can belong to one doctor and several patients can belong to one doctor [3]. In the same manner we can describe most of the other relations between entities. Entity *EXAMIN* means examination.

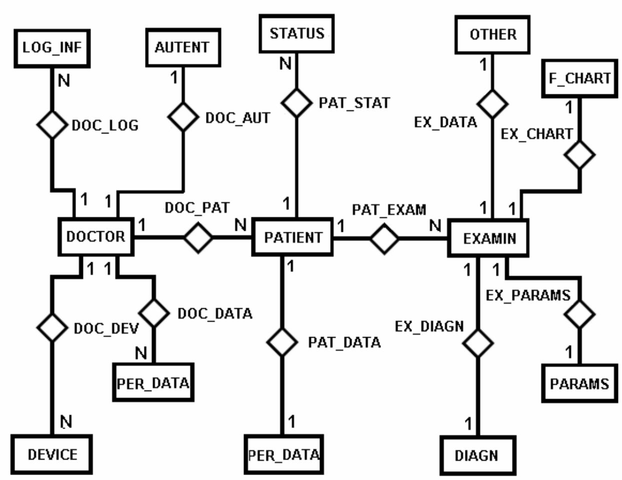

Fig. 3. Entity-relationship model.

4. DISTRIBUTED SYSTEM CONFIGURATION

One of the most important ideas of this project was to construct a distributed system of uroflowmeters connected to a centralized node. This node constitutes the server of the global database of achieved medical examination data and particular uroflowmeters play the source data role. Scattered throughout the country, uroflowmeters work then as

a Client terminal nodes with possibility of sending data to the Server and availability of reading stored data collected from other nodes. The system can be described as three-tiered client-server architecture. A Client in our architecture is implemented as thin-client, so presentation service works as a web browser. The process service (application service) is an interface between the presentation service (web browser) and data (database) and it is implemented in the system with the use of PHP [4].
MySQL [5] is a database management system and represents the data service. The system was implemented on Linux and Windows platforms. The architecture of the system is shown in Fig. 4.

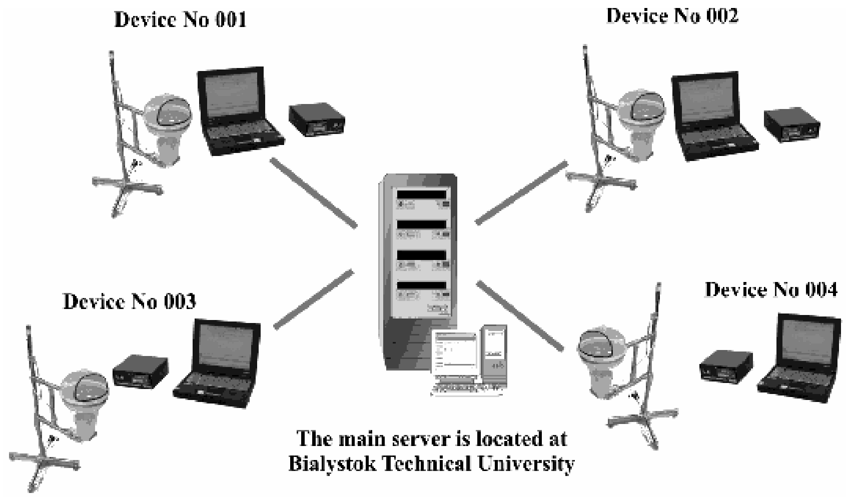

Fig. 4. Distributed system architecture.

A user can access web pages using SSL protocol (*Secure Socket Layer*) or plain HTTP (*Hypertext Transfer Protocol*). PHP scripts are called through an Apache web server [6]. These scripts help access the database management system as well as prevent it from unauthorized person. The received data is processed in the same way that XML data is formed [7].

4. DOCTOR INTERFACE

User's interface is currently based on HTML and CSS, so only an Internet browser is required to use the system. It is accessed by opening the initial web page where the user's authentication is performed.

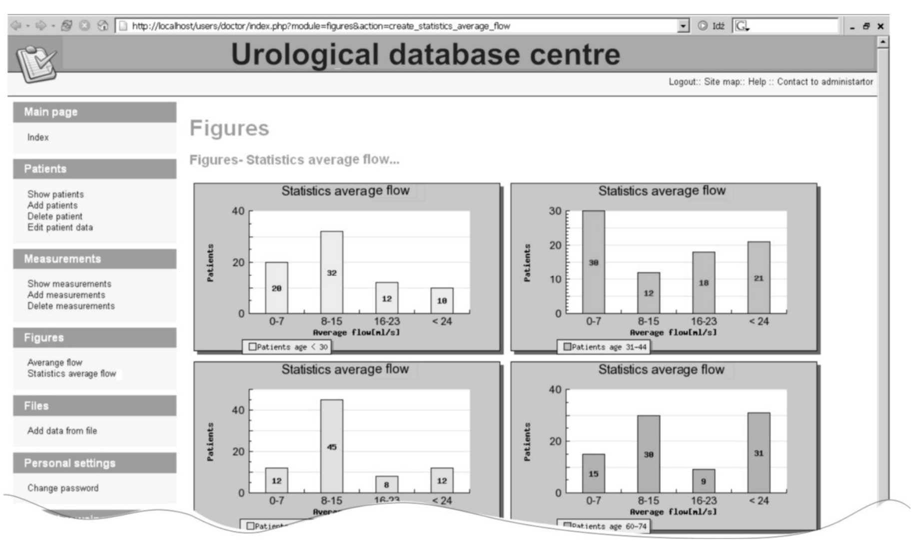

Fig. 5. Doctor's interface. Histograms of an average flow rate for groups of patients selected according to the age factor.

A user provides the password to access the following pages. This is achieved by using a session handle provided by PHP (PHP5.0). The session can be stored as cookies, if a browser is set not to accept cookies, the session is handled through URL.
After logging in, a doctor opens his/her profile. He/she can add a new patient and examination data by sending a data file made by the uroflowmeter to the database using a web browser.

It is also possible to look through the patients data (Fig. 5,6) and analyse his urine flow charts. The volume of urine and the values of maximum and average flows are compared to the values from Liverpool normograms made in a normal male population [8]. This enables the doctor to diagnose faster. He/she has a tool which save the time and allows to avoid the interpretations errors.

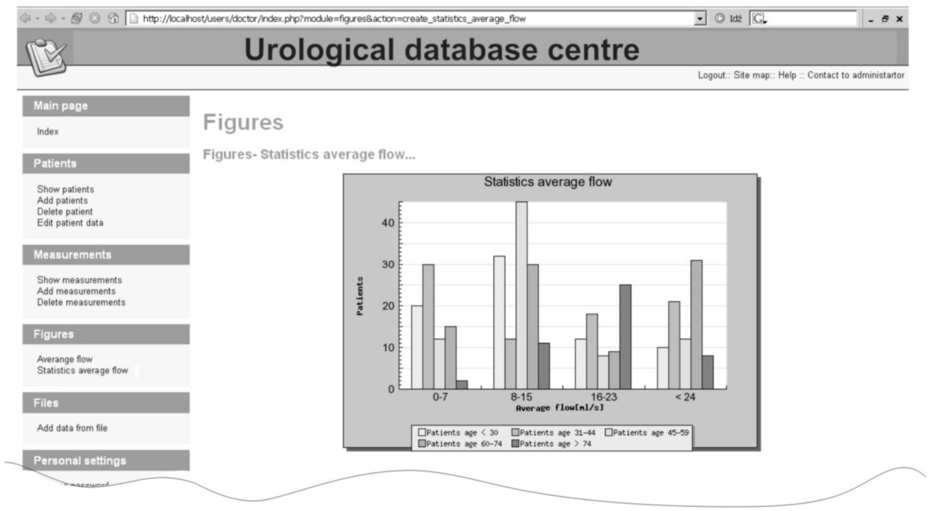

Fig. 6. Doctor’s interface. Statistics charts of data stored in urological database.

5. CONCLUSIONS AND FUTURE WORKS

Uroflowmetry is a preliminary examination in diagnosis of lower urinary track diseases as Benign Prostatic Hyperplasia (BPH) and other. Ther problem principally touches the people who are over 50 years old. Our system is a tool for every Polish urologist and can help store the results of examinations and present them on the background of normal male populations using Liverpool normograms. This service is a part of a great urological service containing not only data from uroflowmetry which is still at the developing and testing stage. In the nearest future this system can constitute a powerful tool for analyzing the uroflowmetry data of large populations in our country.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

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