

Database for storing and organizing data of neurophysiological experiments: description and basic functionality

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Abstract—In present paper, we introduce a database containing multichannel experimental data of brain electrical activity (M/EEG signals) supplemented by necessary experimental protocols and additional characteristics of the subject (ECG, EOG, EMG, etc.), as well as the results of various processing methods application to the initial data. Data management and access is implemented with web-interface containing the toolkit for viewing and editing existing data and adding new items. Developed database provides increased level of data storage reliability and instant access to the neurophysiological data for analysis, processing and evaluation of accumulated experimental information.

Keywords—neurophysiological experiments, M/EEG, brain electrical activity, database

I. INTRODUCTION

Neurophysiological research is associated with a diverse analysis of large amount of experimental data, which may include a multichannel recordings of brain electrical activity and psychophysiological, cognitive and psychological information [1-15]. Dealing with such datasets requires well-systematised storage for the data with with the ability to instant access and effective data management [16-18]. In present paper, we introduce a unique database of experimental neurophysiological data including M/EEG recordings, experimental protocols, additional characteristics such as ECG, EOG, EMG etc., and the results of different preprocessing procedures applied to the initial data.

The main goal of developing the database is to organise the data according to the the most suitable pattern for the task in the course of current study. This includes the efficiency of preprocessing procedures, ease of processing due to the proper data organisation and the ability to evaluate statistically significant features depending on the current task [19-27]. Considering the diversity of experimental studies, the database is able to store and systematize experimental data of different nature.

II. MATERIALS AND METHODS

A. General requirements

The proposed database is intended for systematisation and processing automation of the data obtained during experimental studies performed at Neuroscience and cognitive technology laboratory (Innopolis University, Innopolis, Russia). Due to the various functions that the database should perform, such as organization of the information, uploading and maintaining data, web interface for viewing information, it is necessary to develop it as an informational system (set of

modules). Thus, the database includes the following functional modules:

- Database (DB);
- DB information management toolkit;
- Web interface for implementing DB management functions.

Each module satisfies the following requirements:

- Transparency for the user when working with data located not on a workstation, but on a server in a database;
- Scalability - the ability to change the number of users of software modules;
- Modularity - the system should provide for the possibility of expanding the set of software modules.

To ensure scalability and adaptation of the database functionality, the developed system is organized on the basis of a three-component structure.

The first layer, data storage, provides a physical storage service. It includes database servers, file storage and tape storage.

The second level - statistical data processing, provides functioning at the level of basic operations with data - systematization, creation of samples, reports.

The third level, data presentation, provides interfaces and services to the user.

Physically, the subsystems of each level can be either combined within one or distributed across different servers.

The database provides the ability to store data structures containing linked text fields, numerical values, text format files (files with initial experimental data, files with experimental data processing results, experiment protocol files, files describing the experiment, files with additional data specified by the user), as well as files of raster graphic formats containing digitized documentation (certificates of the equipment used and written consent of the subjects to participate in experimental studies). The database also provides the ability to display the stored data structure with the ability to quickly navigate through the structure files, download files, display data stored in attached files of graphic formats and containing.

B. Structure of the DB

In accordance with the requirements, the database was implemented on the basis of a three-component structure (see Fig. 1), including:

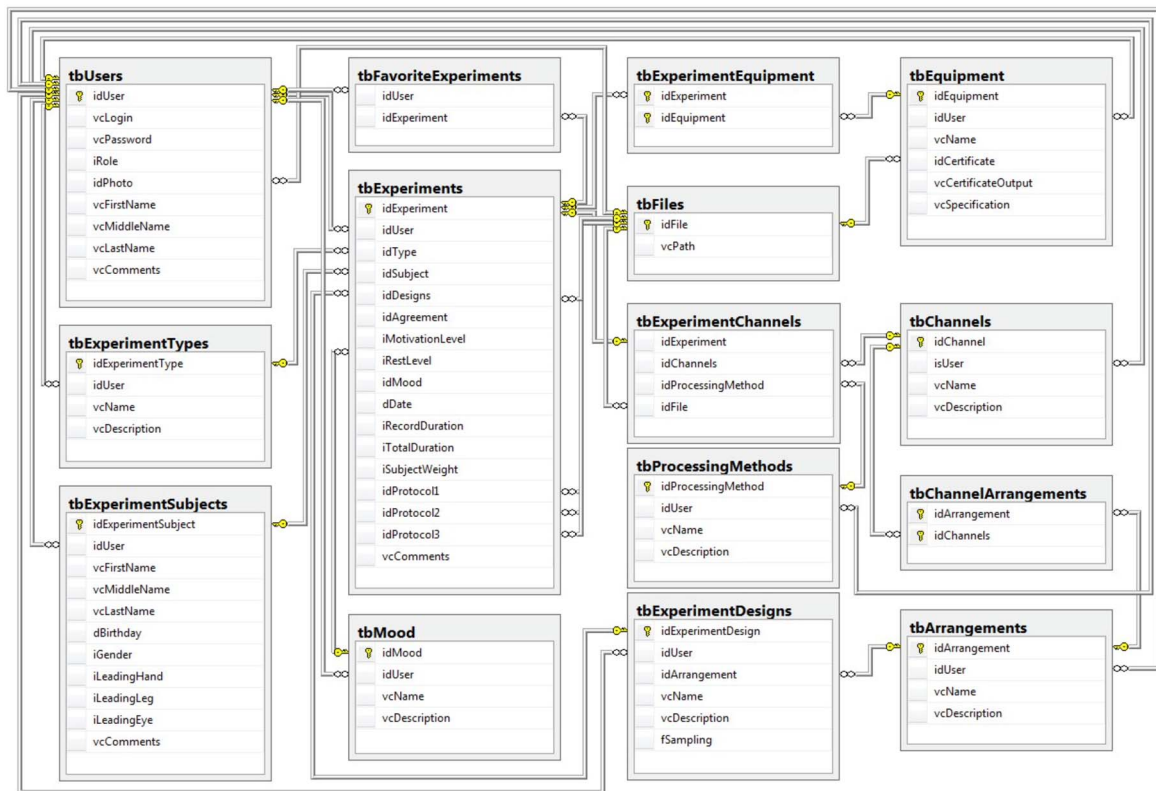


Fig. 1. The data structure diagram of the neurophysiological database

- Database server. This component provides data storage and is implemented by means of a database management system (DBMS). Microsoft SQL Server was chosen as the latter.
- Business logic server. This component provides functions for managing data in the database and was implemented in the C# programming language. When designing and developing the server, it was possible to expand the functionality of the system by adding new procedures and functions.
- Client software. This component was implemented as a web interface using Hypertext Markup Language (HTML), cascading style sheets (CSS) and JavaScript programming language.

The system was implemented using technology for creating web applications and web services from Microsoft.ASP.NET.

III. CONCLUSION

In the present paper, we introduced unique database for database for storing data of neurophysiological experiments. The main functionality, structure and capabilities were described. The data structure diagram was demonstrated. Presented system will be useful for proper organization of diverse experimental datasets, which include the experimental recordings itself as well as the supportive information about subject, equipment and another details.

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