EEG DATA ACQUISITION

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ABSTRACT

This paper copes with the development of the fully equipped sleeping laboratory in the department of biomedical engineering, Brno. The main topic consists in collecting the polysomnographic data into simple and appropriate form for further research. The paper is focused on the analogue multichannel data (EEG, ECG) which were measured and collected in the system with two personal computers.

1 INTRODUCTION

The research of our team consists in polysomnographic data processing. The methods we developed and discussed are summarized in our earlier work. We mainly focused on the processing of a huge databases of multichannel data, both analogue (EEG, ECG) and digital (data from CCD). Polysomnographic data consist of various biological signals, which are measured and collected when the patient sleeps. For this purpose the sleeping laboratories are designed. Cooperation with sleeping laboratory in Brno-Bohunice Hospital gained a lot of experiences for both sides. Nevertheless the methods, we develop, cope with various, multichannel data, whose gathering is not possible in the Brno-Bohunice sleeping laboratory. Thus, the design of a fully equipped sleeping laboratory in our department has begun.

In the beginning, two kind of data acquisition has been focused on. Analogue biological data, such as EEG and ECG, are measured by the electroencephalograph and using special measuring card and multiplexer are transformed to digital form and compressed. Image data are measured with CCD camera and transferred to PC. The collection and compression of the later data is beyond the scope of this article. Let us only mention this part of the system works properly and is designed in the PC_1.

2 POLYSOMNOGRAPHIC DATA ACQUISITION

The designed system uses two personal computers, which collect different types of data. The former image data, the later one-dimensional biological signals. As the main

condition of the proper functionality consist in gathering of synchronized data, the two computers have to be synchronized, as well. The synchronization using parallel port has been used. The common process of data acquisition consists of the "start recording" function on either computer. This function specifies the computer as "master" and sends the request to the other computer to "start recording" as the slave. For the further functionality of the system the role of each computer has been set. This allows us to record either both various data using both computers (master could be PC_1 or PC_2) or only image data (the former is master) or only one-dimensional data (the later is master) independently on software.

3 ANALOGUE DATA FROM EEG

3.1 HARDWARE SOLUTION

The EEG data acquisition are solved by the multifunctional measuring card TEDIA PCA-7408A. The main properties of the card are summarized below. In the figure 1 the measuring board TEDIA PCA-7408A is depicted.

analogue inputs	8 S.E.
analogue inputs resolution	14 bit
input ranges	$\pm$10V, $\pm$5V, $\pm$2.5V, $\pm$1.25V, $\pm$0.635V, $\pm$0.3125V
sample frequency	10 kHz
data buffer	256 B

The common EEG record consist of 21 channels, the external multiplexer must be used. Let us have at least 10 channels reserved for future biological signals, the system with 32 inputs must be used. The ideal solution is the multiplexer OPT-832.

3.2 SOFTWARE SOLUTION

As was introduced above, the system of two computers has been used. The application is variously designed for each part and might work either as master or as slave. The software solution is solved as a multi-thread application, whose core (thread No.1) deals with the communication with the other computer. The other threads look after the classic problem of data acquisition (2-D data for PC_1 and 1-D data for PC_2).

The figure 2 shows the basic software solution of the system. The meaning of each thread and its purpose is summarized below.

thread 1	communication and synchronization with the other PC
thread 2	collecting the measured data from the buffer and their compression
thread 3	waiting for the measuring board interrupt and transferring the measured sample into buffer

4 RESULT

The measuring system is very useful for designed sleeping laboratory. The sample of the EEG data and synchronized image data of the patient has been acquired. The appli-

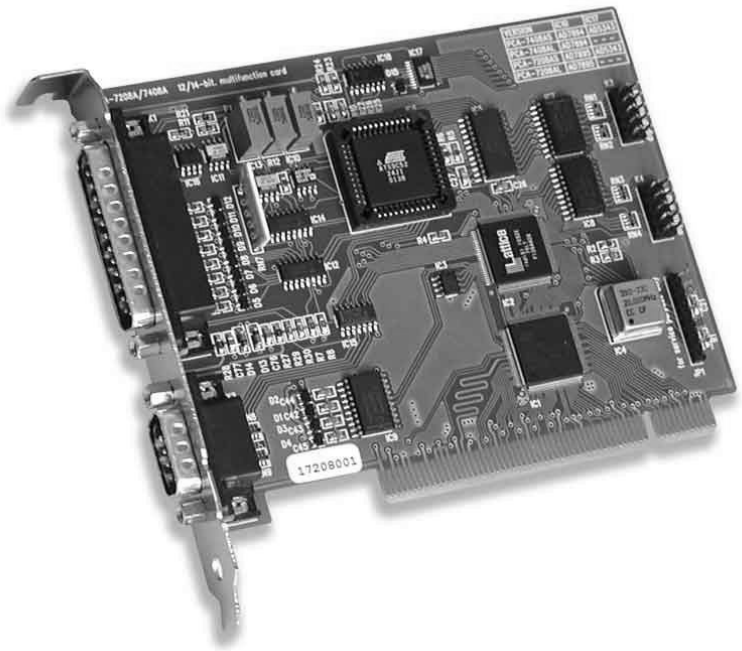

Figure 1: Measuring board PCA-7408A

cation window of the EEG data is shown in the figure 3. This data are perfectly suitable for further development of the methods for artifacts elimination and noise removal.

It is obvious, that the designed system works properly and allow us to measure and collect a huge amount of data for further research. Nevertheless it is also necessary to enlarge the number of channels and add some other biological signals. At the moment, the data obtained with the system are used for methods such as noise and artifacts removal. The measured data are suitable for this kind of task. On the other hand, (as the data are too noisy) it is not very appropriate to test some methods for pure EEG data association and processing of evoked potentials for example.

5 CONCLUSION

This paper dealt with EEG data acquisition, that is only a small part of our research of the polysomnographic data processing. As it was described above, we collected a valuable sample of the EEG data. Nevertheless (as obviously visible in figure 3), the measured EEG data are very noisy and containing many biological artifacts. It has also some benefits, e.g. denoising using our new methods and so on. On the other hand, our aim is to design a fully equipped sleeping laboratory, that is able to collect the data as well as the standard laboratory and using the mathematical methods, make the signal even more valuable.

However the presented system is able to measure a lot of data and collect them into huge databases. That's very useful for further research, but it's not a final status of the system. The further work upon the system is to be done, as well.

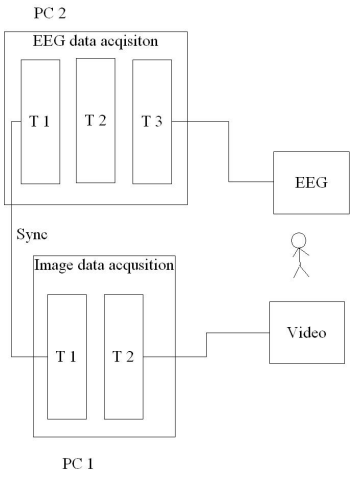

Figure 2: Model of the software solution of the system for polysomnographic data acquisition

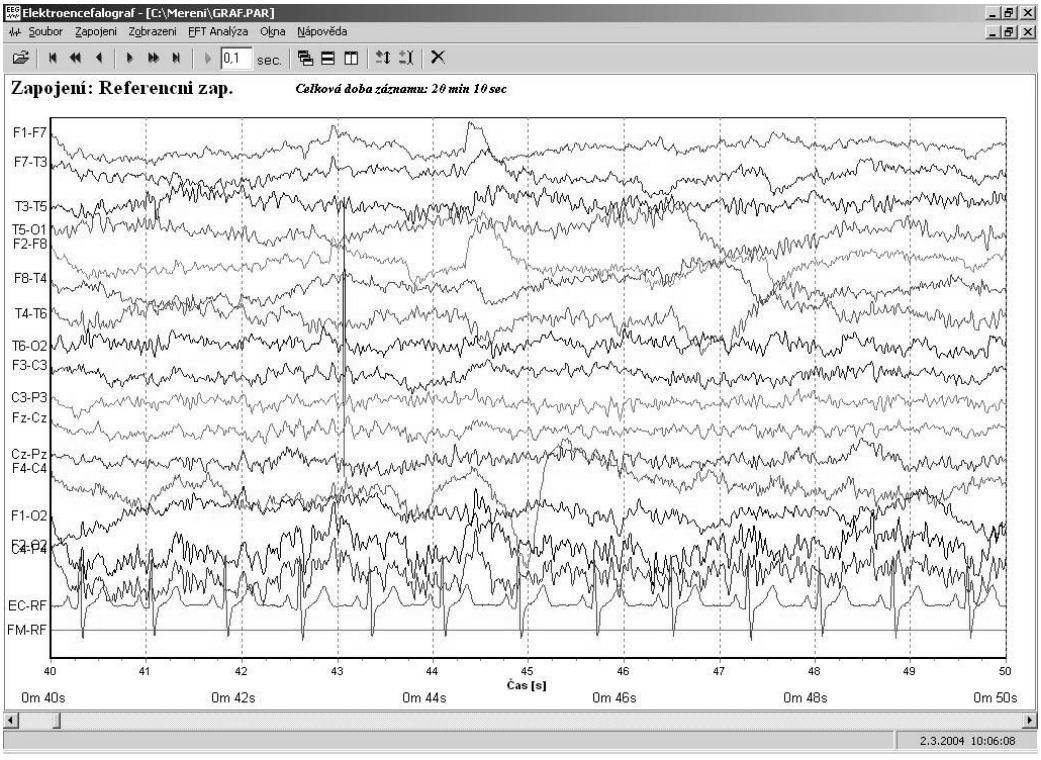

Figure 3: Measured EEG data