Human Interface of Complex Electronic System for Monitoring and Diagnostics in Medicine

Șontea Victor, Iavorschi Anatolie, Lazari Eugen, Luchița Mihai, Arpentii Nicolae
Universitatea Tehnica a Moldovei
sontea@mail.utm.md

***Abstract* —Article presents the design and development of interface between complex system for diagnostics and medical monitoring, composed of modules and devices to collect biomedical parameters and signals from the human body and its operator**

***Index Terms* — patients database , interface , monitoring, signal processing, complex system.**

I. INTRODUCTION

Recent statistics show a marked increase of cardiovascular disease and therefore of brain sufferings worldwide. The existing monitoring systems, largely, are dedicated to monitoring the operation of central cardiovascular system.

Develop of new methods and complex systems to monitoring the main vital parameters of body through the implementation and optimization of existing methods and the latest technologies for processing data that would allow for analysis of vital parameters deviations from predetermined rules, is a vital concern of bioengineering.

II. SYSTEM DEVELOPMENT

Complex electronic system for monitoring and diagnosis in medicine developed by our team, is related to collect human biomedical signals , such as: signals corresponding to the operation of the human cardiovascular system, the electrical activity of the muscles of the eyes, neurons of the cortex, collecting signals characteristic for the abdominal and thoracic volume of air, also the measurement and determination of such parameters as blood pressure, blood oxygen concentration, heart rate variability parameters, and others.

The system is developed to work on a personal computer and consists of a device for collecting parameters and signals from the body, connected to the computer via USB universal serial interface The device is based on acquisition modules and analog processing of different biomedical signals and parameters also a signal acquisition module for resulted signals after their processing based on a high resolution analog to digital converter and a microprocessor..

III. DEVELOPMENT OF USER INTERFACE

The user interface is the connection of the monitoring system developed [1], and user. It aims to present the results of medical investigations into how more convenient form, intuitive and understandable by the user

Developed interface has the following functions:

- Receiving and decoding packet data from acquisition module of diagnostic and monitoring system;
- Display the time evolution of one or more of the collected signals from the human body as follows:
  - Electrocardiogram leads I, II and III
  - Photoplethysmogram
  - Horizontal Electrooculography
  - Vertical Electrooculography
  - Thoracic and abdominal breathing
  - The electroencephalogram
- Display biomedical parameters picked from the human body in the cells as follows:
  - Systolic and diastolic blood pressure;
  - The concentration of oxygen in the blood (SpO2).
- Signal processing for the purposes of extracting biological information and displaying it in the corresponding cells:
  - The frequency of the cardiac cycle from the ECG signal or from the photoplethysmography.
  - Respiratory cycle frequency from the abdominal or thoracic respiration signals
- Possibility to select signals which wish to be displayed and dividing the display field signals in fields of equal size for each signal;
- Possibility of transmitting commands to the core module of the system, such as switching cycle measuring blood pressure after the interval time set by the user;
- Storing signals and patients in a database for further processing or display them with other methods and software;
- Display of other useful information: the effective level signal of photoplethysmography, Name, Surname of investigated Patient, current date and time, the time from the beginning of the.

The user interface is visually divided into two areas: the left is for displaying the time evolution of the signals collected from the body, the right side is for displaying the measured parameters determined from the system or after signal.

Fig. 1 User Interface

The main window of the interface monitoring system adjusts easily to any screen resolution and can operate both in the FullScreen mode and in any size window, fields for signals and parameters , also used size of signals and fonts to display text data adapting to the size of the window and respecting the proportions for better visual perception of displayed information.

Each signal is displayed with inscription representing the name of the signal. Each category of signal is color-specific , such as for example: ECG and parameters extracted from the ECG signal is displayed in green color, photoplethysmography signal and parameters of the oxygen concentration in the blood is blue color, respiration and determined parameters – yellow.

The right side of the interface is normally divided into five cells that display certain parameters.

Upper Cell is for display frequency of the cardiac cycle which is measured in bpm (beats per minute). This is determined after processing ECG signals if they are viewed. If it only uses photoplethysmography signal frequency of the cardiac cycle will be determined from this signal, parameter is already displayed in blue color, specific color for display parameters and signal of photoplethysmography and SpO2.

A second cell is for display parameters of blood pressure measured by oscillometric method (noninvasive). In the middle cell is displayed systolic and diastolic blood pressure, unit of measure is mmHg (millimeters of mercury column). The top is displayed the last time when measurements was performed and the bottom is displayed time for the next measurement according with measuring range set by the user, or manual mode to start the measurement cycle.

Fig. 2 Display cell of parameters for blood pressure

The next cell is designed to display the oxygen concentration in the blood, parameter is the percentage of oxygenated hemoglobin from total hemoglobin in the blood. On the right side of the cell is displayed a bar indicating the signal level received from the SpO2 sensor. This information is to be welcomed for better positioning of the transducer on the investigated patient.

The cell below is for display respiratory cycle frequency which is determined from the corresponding signals of abdominal and thoracic air volume. This parameter is measured in rpm (breaths per minute).

Last cell is for representation of elapsed time from the start of monitoring. This parameter is not so relevant and in the case when is lowering the height of the interface window, this last cell disappears leaving more space to the other parameters, time is represented on the bottom bar. Menu of window for monitoring system has more tools and options for the operator, such as the introduction of new patients to the database system, the selection of signals for viewing and setting the system time intervals for starting blood pressure measurement cycles setting parameters for the communication port with the main module of the system, and others.

The functioning of developed software consists of several operations, such as sending commands to data acquisition module, also receive corresponding signals and parameters measured on the human body. The data packages received are then checked if correspond to protocol settings , are decoded, and information received are then processed, displayed and stored [2] [3].

IV. CONCLUSIONS

Interface for developed complex system for monitoring and diagnostics in medicine, was designed to run on any computer with Windows installed, to be more intuitive, ergonomic , informative and easily driven by the user . Separation of categories of signals and parameters in different areas and colors allows easy levying of the displayed information .

Storing data in a database allows their further display and the possibility of processing signals through other methods and specialized software.

V. ACKNOWLEDGMENT:

This work is financially supported by the Supreme Council for Research and Technological Development of the Academy of Sciences of Moldova, Project No. . 21/inst.U.

REFERENCES

[1] V. Sontea, A. Iavorschi, E. Lazari, M. Luchita, N. Arpentii, S. Railean, Complex Electronic System for Monitoring and Diagnostics in Medicine, 2nd Regional Workshop Health Technology Management (HTM), Chişinău, R. Moldova, 10 – 11 aprilie 2014.

[2] Rangaraj M. Rangayyan. Biomedical Signal Analysis, A Case-Study Approach, University of Calgary, Calgary, Alberta, Canada, 2002.

[3] Webster J. G. Medical Instrumentation: Application and Design. 3rd ed. New York, NY: Wiley, 1998.