PHYSIOLOGICAL SIGNAL ACQUISITION CABLE

The present invention relates to physiological monitoring of patients and, in particular, to physiological signal acquisition cable which provides real time and/or simultaneous transmission of the acquired signals via a serial RS232 port.

BACKGROUND TO THE INVENTION

Shifts in patient care, practices are changing the nature of monitoring. Increasingly, hospitals are attempting to lower costs by moving high-acuity patients as quickly as possible from intensive care units (ICU) to intermediate care and general ward areas.

This trend has dramatically reduced the need for the high end stationary, multi-parameter monitoring systems typically employed in the ICU. This has intensified demand for a more flexible, and therefore less expensive, systems that can easily be integrated into lower-acuity areas and configured to individual patient needs.

This is particularly the case in heart rate monitoring where the ECG is the well known form of monitoring.

In respect of foetal monitoring, the foetal heart rate (FHR) is the primary indicator of foetal viability. Current methods utilise FHR charts and are based on the detection of the mechanical activity of the heart via active ultrasound devices and interpretation by the clinician or nurse.

Foetal heart electrical activity has been analysed since the beginning of this century. However, problems associated with the small amplitude of the foetal signals and the influence of noise, have made the foetal ECG (FECG) difficult. FECG acquired from surface electrodes have a very low amplitude and the FECG data is masked by the maternal ECG (MECG). This problem results in the requirement of expensive ultrasound analysis systems for calculating the foetal heart rate.

Therefore it is seen that inexpensive monitoring technologies are needed to enable surveillance of all pregnancies during the second and the last trimester and, in particular, to

determine the appropriateness of intervention to minimise a potential risk to mother and foetus.

Therefore it would be advantageous to provide a physiological signal acquisition apparatus which provides real time and/or simultaneous transmission of the acquired signals which is simpler and therefore less expensive than known apparatus.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a physiological signal acquisition apparatus which substantially overcomes or ameliorates the above mentioned disadvantages. At the very least, the object of the invention is to provide an alternative to known physiological signal acquisition apparatus.

DISCLOSURE OF THE INVENTION

According to one aspect of the present invention there is disclosed a physiological signal acquisition monitoring apparatus having a bio sensor connected by cable means to an electrically isolated bio acquisition unit including a amplifying and control means which is serially connected by cable means to a display device for displaying in real time the resulting graphically representation of the physiological signal.

Preferably, the display device is a notebook PC, a palmtop PC and/or smart panel.

Preferably, the physiological signal acquisition cable monitor is used to acquire and display ECG, FECG, or to monitor blood pressure, asthma control, pacemaker monitoring, monitoring oxygen saturation, diabetes measurements, heart sounds and the like.

Preferably the bio sensor is electrodes or other pickup device.

Preferably the results are recorded by the display device as well as being shown in real time.

According to one aspect of the present invention there is disclosed a portable and multipurpose medical device for biological signals acquisition, display and biological data storage, said device comprising:

a display and storage device a display and storage device comprising:
a first housing;
a display screen being provided on the first housing for displaying the acquired data;
control means disposed within the first housing to control data acquisition options, storage of the acquired data, and other application specific functions of the medical device;

a biological signals acquisition module comprising:
a second housing;
a plurality of biological sensors;
an analog circuit to amplify and pre-condition biological signals from the plurality of the biological sensors;
a digital circuit for digitizing the biological signal and to send the biological data to said first housing; and

connector means connecting the first and second housings.

Preferably, the connector means is a cable means serially connecting the first and second housings.

Preferably, the display device is a notebook PC, a palmtop PC and/or smart panel.

Preferably, the physiological signal acquisition monitoring and display device is used to simultaneously acquire and physiological signals from a plurality of sensors measuring at least one of the group including multilead ECG, FECG, EEG, EMG, oximetry, blood pressure whether detected by invasive or non-invasive means, respiration, temperature, phonocardiogram, tokolytic, blood glucose, pCO2, pO2 and pacemaker pulses, and condition the signals and transmit data representing the signals in real time to an input/output port of the display device.

Preferably, the circuit means includes an isolated section, a non-isolated section with an isolation barrier therebetween, the isolated section being isolated from the input/output port of the display device. The isolated section receives the signals from the sensors and amplifies and preconditions the signals into data specific to the signal type prior to transmitting the data through the isolation barrier.

Preferably, the non-isolated section receives the data transmitted through the isolation barrier and prepares the data for transmission to input/output port of the display device via an input/output interface in the first housing and a cable means to the input/output port of the display device which is a second housing of the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be now be described with reference to the accompanying drawings in which:

Fig. 1 is a perspective view of a preferred embodiment of the the apparatus of the present invention,

Fig. 2 is a block diagram of the apparatus of Fig. 1, and

Fig. 3 is a block diagram of another preferred embodiment of the apparatus of the present invention.

BEST MODE OF CARRYING OUT THE INVENTION

One embodiment of a physiological signal acquisition cable monitoring apparatus 10 is illustrated in Figs. 1 and 2 of the drawings. The apparatus 10 preferably acquires an ECG and therefore includes electrodes or bio sensor 11 connected by cable 12 to an acquisition unit 13. The unit 13 includes a bio amplifier 14 and a control unit 15. The acquisition unit 13 is serially connected by cable 16 to a laptop display and storage device 17.

The acquisition unit 13 acquires the ECG while simultaneously displaying the ECG waveform on the display of the laptop in real time. The type of display and software of the display determine the level of cardiac information to be analysed, displayed and/or recorded.

The cable 16 includes access for a power supply line 18 to the acquisition unit 13 from the laptop, a serial control data line 19 and a output serial data line 20. The cable is connected to the laptop via a RS232 serial port 21 which allows the various signals to be acquired and displayed in real time.

The invention, however, is not limited to acquisition of ECG signals only. For example, FECG, EEG, EMG, oximetry, blood pressure whether detected by invasive or non-invasive means, respiration, temperature, phonocardiogram, tokolytic, blood glucose, pCO2, pO2 and pacemaker pulses.

A block diagram of another ECG acquisition module 30 is shown in Fig. 3. The ECG signal is collected via the sensors 31 and amplified by amplifier 32. The amplifier 32 is DC biased by the virtual ground potential produced by a virtual ground generator 33. The amplified analogue signal is fed to the input of analogue to digital converter (ADC) 34. The ADC 12 has two control inputs (-CS and CLK) and one output (DO). Control signals –CS and CLK are supplied by the display device 17 via its serial port 21, the connector and the cable 16 to a serial port interface 35 of the ECG acquisition module 30.

The amplified analogue signal is converted into digital ECG data (DO) and sent to the display device 17 via the serial port interface 35 of the ECG acquisition module 30, the cable 16, the connector and internal circuitry of the display and storage device 17.

Digital ECG data being stored in the display device 17 are accessible for displaying, calculations and overwriting. Control and data signals flow is defined by the display device 17.

Hardware Implementation

The ECG amplifier 32 is comprised of a high input impedance front stage voltage follower (U1a, U1b), instrumentation amplifier U2, high pass filter (C3, R4), second amplification stage U1d and a low pass anti-aliasing filter (R7, C4).

Front stage voltage followers use popular LMC6464 operational amplifier from National Semiconductors with input current less than 1nA.

It is believed that the preferred embodiment as described meets AAMI/ANSI ECG recommended safety standards which will include an electrical isolation barrier 36 as seen in Fig. 3.

All digital signals are transferred via digital optical isolators. A high pass filter defines the low end of the frequency band of the acquired ECG signal at 0.05Hz. A low pass filter removes high frequency noise on the input of ADC. Frequency response of the ECG amplifier for the selected filters values is 0.05Hz – 100Hz. 100Hz high end frequency is defined by the selected sample rate of 200Hz is in a compliance with the AAMI/ANSI ECG recommended frequency response standards.

Instrumentation amplifier INA126 from Burr-Brown Corporation is configured for a gain of 5. DC offset voltage is calculated as VCC/Gain, where VCC = 5V and Gain = 5. DC offset voltage Vdc = 5/5 = ±500mV is well above required by the AAMI/ANSI ECG standard of minimum of ±300mV.

The ECG acquisition module 30 uses single positive voltage derived from the display device 17 serial connector.

In order to amplify bipolar AC ECG signal without distortions, input stage voltage followers and instrumentation amplifier are referenced to AMP_REF voltage = VCC/2 generated by the virtual ground generator U1c.

Second stage of the amplifier is referenced to AMP_REF as well in order to bring the output signal to the half of ADC reference voltage.

The gain of second amplifier stage is defined by the values R5 and R6 and set to 151. Overall gain is 755.

The foregoing describes only some embodiments of the present invention, and modifications obvious to those skilled in the art can be made thereto without departing from the scope of the present invention.

CLAIMS

1. A physiological signal acquisition monitoring apparatus having a bio sensor connected by cable means to an electrically isolated bio acquisition unit including a amplifying and control means which is serially connected by cable means to a display device for displaying in real time the resulting graphically representation of the physiological signal.

2. The physiological signal acquisition monitoring apparatus according to claim 1, wherein the display device is a notebook PC, a palmtop PC and/or smart panel.

3. The physiological signal acquisition monitoring apparatus according to claim 1, wherein the physiological signal acquisition cable monitor is used to acquire and display ECG, FECG, or to monitor blood pressure, asthma control, pacemaker monitoring, monitoring oxygen saturation, diabetes measurements, heart sounds and the like.

4. The physiological signal acquisition monitoring apparatus according to claim 1, wherein the bio sensor is electrodes or another pickup device.

5. The physiological signal acquisition monitoring apparatus according to claim 1, wherein the results are recorded by the display device as well as being shown in real time.

6. A multipurpose medical device for biological signals acquisition, display and biological data storage, said device comprising:

a display and storage device a display and storage device comprising:
a first housing;
a display screen being provided on the first housing for displaying the acquired data;
control means disposed within the first housing to control data acquisition options, storage of the acquired data, and other application specific functions of the medical device;

a biological signals acquisition module comprising:
a second housing;

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a plurality of biological sensors;

an analog circuit to amplify and pre-condition biological signals from the plurality of the biological sensors;

a digital circuit for digitizing the biological signal and to send the biological data to said first housing; and

connector means connecting the first and second housings.

7. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 6, wherein the connector means is a cable means serially connecting the first and second housings.

8. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 6, wherein the display device is a notebook PC, a palmtop PC and/or smart panel.

9. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 6, wherein the physiological signal acquisition monitoring and display device is used to simultaneously acquire and physiological signals from a plurality of sensors measuring at least one of the group including multilead ECG, FECG, EEG, EMG, oximetry, blood pressure whether detected by invasive or non-invasive means, respiration, temperature, phonocardiogram, tokolytic, blood glucose, pCO2, pO2 and pacemaker pulses, and condition the signals and transmit data representing the signals in real time to an input/output port of the display device.

10. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 6, wherein the circuit means includes an isolated section, a non-isolated section with an isolation barrier therebetween, the isolated section being isolated from the input/output port of the display device.

11. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 10, wherein the isolated section receives the

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signals from the sensors and amplifies and preconditions the signals into data specific to the signal type prior to transmitting the data through the isolation barrier.

12. A multipurpose medical device for biological signals acquisition, display and biological data storage according to claim 11, wherein the non-isolated section receives the data transmitted through the isolation barrier and prepares the data for transmission to input/output port of the display device via an input/output interface in the first housing and a cable means to the input/output port of the display device which is a second housing of the apparatus.

