An Implementation of Embedded Multi Parameter Monitoring System for Biomedical Engineering

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Abstract- In hospitals, the patients in ICU need a constant monitoring of their temperature, respiration and heart rate. This paper is a working model which incorporates sensors to measure patient's physiological parameters namely temperature, respiration rate, ECG, heart rate and evoked potential with the sensors interfaced to computer. Monitoring and control of all the specified parameters are done using particular sensor for each parameter. These sensors are sensitive to infrared rays, which are not harmful to human body. As, all the signals of the patients are interfaced to the computer the patient condition can be analyzed by doctors in any part of the hospital wherever they are. Thus, it reduces doctor's work load and also gives more accurate results. Whenever there is an abnormality felt by the patient, this system will give an alarm signal, by which the doctor rushes to the patient. This paper also incorporates some special features like online videography i.e. the doctor in charge of the patient can diagnose the patient from his cabin. All the results and diagnosis of the patient are stored in a secondary storage tool or in the computer itself as database for future reference. The results are represented in the desired forms as graphs, wave forms, statistics, picture etc., using graphics.

Keywords- Evoked potential, ECG monitoring, Temperature, Respiration, Heart rate.

1. INTRODUCTION

The main objective of the proposed system is to reduce the size and cost of the system. Since, an embedded module is used it provides smaller, faster and compact circuitry.

Electrocardiography known as an ECG is a designed tool to examine the function's of the heart. ECG is a recording device used to record the electrical activities of the heart. This system is used to study disorders that manifest changes in the electrical activity of the heart, for e.g. in condition like heart block. ECG provides valuable information about a wide range of cardiac disorders such as the presence of an inactive part (or) an enlargement of the heart muscle.

Heart rate measurement indicates the soundness of the human cardiovascular system. Heart rate is the number of heartbeats per unit time and is usually expressed in beats per minute (bpm). In adults, normal heart beat is about 60 to 100 times a minute during resting condition. The resting heart rate is directly related to the health and fitness of a person and hence is important to know. Measurement of heart rate can be done at any spot on the body where you can feel a pulse with your fingers. The most common places are wrist and neck.

Evoked potentials are used to measure the electrical activity in certain of the brain. To measure, test and record how quickly and completely the nerve signals reach the brain. Electrical activity is produced by simulation of specific sensory nerve pathways. These tests are used in combination with other diagnostic tests to assist in the diagnosis of neurological disorders.

Body temperature is a measure of the body's ability to generate and get rid of heat. Normal human body temperature depends upon the place in the body at which the measurement is made, and the time of day and level of activity of the person. Different parts of the body have different temperatures. The commonly accepted average core body temperature (taken internally) is 37.0 °C (98.6 °F). The typical oral (under the tongue) measurement is slightly cooler, at 36.8° ± 0.4°C (98.2° ± 0.7°F), and temperatures taken under the arm or in the ear produce different typical numbers.

Respiration rate is the number of breaths taken within a set amount of time, typically 60 seconds. Human respiration rate is measured when a person is at rest and involves counting the number of breaths for one minute by counting how many times the chest rises. When checking

respiration, it is important to also note whether a person has any difficulty in breathing.

Our multi parameter monitoring system is embedded based. Section II discusses the description about the electrodes and sensors used. Section III presents the proposed monitoring system. Section IV presents the description of the software used in the system. Section V presents the test results. Section VI concludes this paper.

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2. FUNCTION DESCRIPTION

Silver-silver chloride (AGCL) electrode

For the measurement of evoked potential, silver-silver chloride electrode is used. One of the important desirable characteristics of the electrodes designed to pick up signals from biological objects is that they should not polarize. This means that the electrode potential must not vary considerably even when current is passed through them.

Electrodes made of silver- silver chloride have been found to yield acceptable standards of performance. By properly preparing and selecting electrodes, pairs have been produced with potential differences between them of only fractions of milli volt. Standing voltage of not more than 0.1mv with a drift over 30 min of about 0.5 mV was achieved in properly selected silver-silver chloride. Silver-Silver chloride electrodes are also nontoxic and are preferred over other electrodes like Zinc-Zinc Sulphate which also produce low offset potential characteristics, but are highly toxic to exposed tissues. Silver-Silver chloride electrodes meet the demands of medical practice with their highly reproducible parameters and superior properties with regard to long-term stability.

Resistance Temperature Detector (RTD)

Resistance thermometers, also called resistance temperature detectors (RTDs), are sensors used to measure the respiratory rate by correlating the resistance of the RTD element with temperature. Most RTD elements consist of a length of fine coiled wire wrapped around a ceramic or glass core. The element is usually quite fragile, so it is often placed inside a sheathed probe to protect it. The RTD element is made from a pure material, platinum, nickel or copper. The material has a predictable change in resistance as the temperature changes; it is this predictable change that is used to determine temperature.

Thermistor

Thermistor is an input transducer (sensor) which converts temperature (heat) to resistance. Almost all thermistors have a negative temperature coefficient (NTC) which means their resistance decreases as their temperature increases. An NTC thermistor is a semiconductor made from metallic oxides, pressed into a small bead, disk, wafer, or other shape, sintered at high temperatures, and then coated with epoxy or glass. The resulting device exhibits an electrical resistance that has a very predictable change with temperature. They are extremely sensitive to temperature change, very accurate and interchangeable.

Blood oxy sensor

Used to measure heart rate, by sensing the changes in blood volume in a finger artery while, heart is pumping the blood. It consists of an infrared LED that transmits an IR signal through the fingertip of the subject, a part of which is reflected by the blood cells. The reflected signal is detected by a photo diode sensor. The intensity of reflected light depends upon the blood volume inside the fingertip. So, each heart beat slightly alters the amount of reflected infrared light that can be detected by the photodiode.

3. SYSTEM DESCRIPTION

The block diagram of the system is illustrated in figure 4.1. This system uses sensors to collect the signals from the user. These signals are then amplified by pre amplification and also to reduce noise. Their respective parameters are converted into digital values by an inbuilt module of the embedded microcontroller. An alarm circuitry is connected which produces an audible sound when there occurs any inconvenience during real time monitoring of the patient.

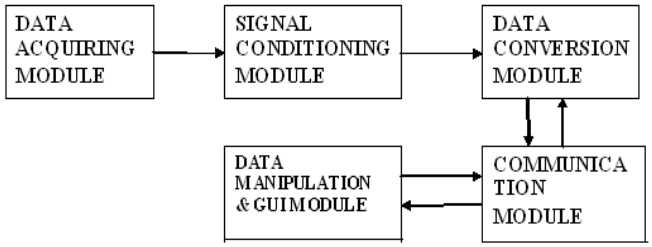

Figure 3.1Block Diagram of the System

Sensor

Data acquiring module consists of different sensors. A sensor (also called detector) is a converter that measures

a physical quantity and converts it into a signal which can be read by an observer or by an instrument. A sensor is a device which receives and responds to a signal when touched. A sensor's sensitivity indicates how much the sensor's output changes when the measured quantity changes. For accuracy, most sensors are calibrated against known standards.

Signal Conditioner

Signal conditioners are designed to isolate, transmit, convert, and amplify the analog signals in order to improve the reliability of the process. Signal conditioners are essential to improve field received signals. Signal conditioner job starts from simple amplification to protection. For our circuit input will be 0v to 1000mv and must be amplified to 5volts.It simply means manipulating an analog signal in such a way that it meets the requirements of the next stage processing.

Microcontroller Unit

Microchips peripheral interface controller PIC16F877A is used for signal processing. Peripheral Interface Controller (PIC) is enhanced version of microcontrollers. It is an embedded controller. It contains four ports port0, port1, port2, port3. Port0 is an external port and other three ports are internal ports. Microcontrollers are used to transmit and receive data.

RS 232

The most common communication interface for short distance is RS-232. RS-232 defines a serial communication for one device to one computer communication port, with speeds up to 19,200 baud. Typically 7 or 8 bit (on/off) signal is transmitted to represent a character or digit. The 9-pin connector is used.

Personal computer (PC)

In personal computer, data transfer takes place serially. PIC Micro controller is linked to PC through the RS-232 port. The PC displays the menu for selecting the calibrating equipment and all the calibration results graphically and in tabular form. The user can access the calibration data to get calibration reports, comparison graphs etc at any time using the menu offered in the PC. The PC will give the GUI for the system.

The hardware for the system is assembled and the snapshot for the hardware of this system is given in figure 3.2.

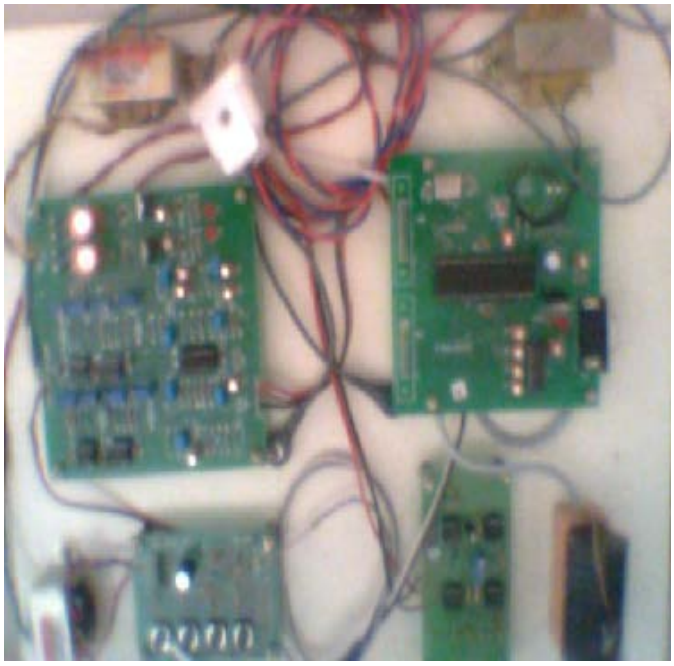

Figure: 3.2 Hardware of the system

4. SOFTWARE REQUIREMENTS

The Graphical User Interface (GUI) used for the system is Visual Basics 6.0.

Visual Basics 6.0

Visual Basic is a tool that allows you to develop Windows (Graphic User Interface - GUI) applications. Visual Basic is event-driven, meaning code remains idle until called upon to respond to some event (button pressing, menu selection). Visual Basic is governed by an event processor. Nothing happens until an event is detected. Once an event is detected, the code corresponding to that event (event procedure) is executed. Program control is then returned to the event processor.

Some Features of Visual Basic

- Full set of objects - you 'draw' the application
- Lots of icons and pictures for your use
- Response to mouse and keyboard actions
- Clipboard and printer access
- Full array of mathematical, string handling , and graphics functions
- Can handle fixed and dynamic variable and control arrays
- Sequential and random access files support
- Useful debugger and error-handling facilities
- Powerful database access tools

- ActiveX support
- Package & Deployment Wizard makes distributing your applications simple now

5. RESULTS AND DISCUSSIONS

The program for this system has been coded in visual basic. This code specifies the measurement of ECG, evoked potential, heart rate, respiration rate and temperature. A certain limit is specified in the program for all measurement of the physiological parameters of the patient. The code is then simulated and the program has been verified.

The output window of the system in visual basic screen is shown in Fig. 5.1.

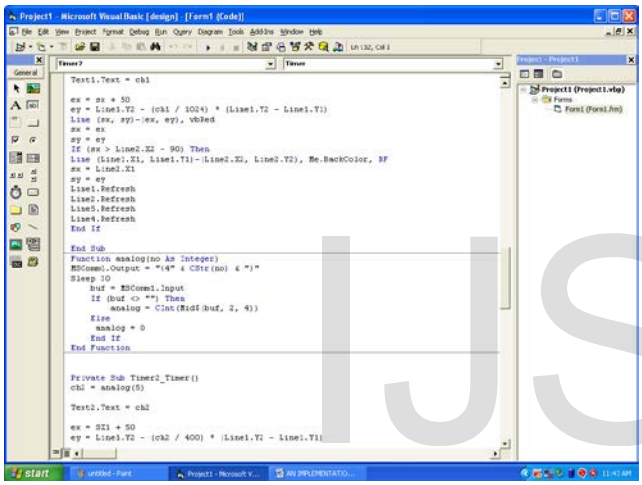

Figure 5.1 Output Window

6. CONCLUSION

In this paper, an embedded based multi parameter monitoring system based has been introduced. It has an inbuilt ADC which reduces the size of the hardware. Monitoring and control of all the specified parameters are done using particular sensor for each parameter. The patient's condition can be analyzed by doctors in any part of the hospital wherever they are. Thus, it reduces doctor's work load and also gives more accurate results. The proposed system has the following advantages namely System cost is reduced, reconfiguration is possible, size of the system is reduced and fine tuning is possible.

REFERENCES

[1] Chae.M and Yang.Z (2009) 'A 128-channel 6 mW wireless neural recording IC with spike feature extraction and UWB transmitter', IEEE Trans. Neural Syst. Rehab. Eng., vol. 17, no 4, pp. 312–321.

[2] Chestek.C and Gilja.V (2009) 'HermesC: Low-power wireless neural recording system for freely moving primates', IEEE Trans. Neural Syst. Rehab. Eng., vol. 17, no. 4, pp. 330–338.

[3] Elliot Greenwald and Mohsen Mollazadeh(2011). 'A VLSI Neural Monitoring System with Ultra-Wideband Telemetry for Awake Behaving Subjects', IEEE Trans. Biomedical circuits and systems, vol. 5, no. 21.

[4] Hamblen.J.O and Hall.T.S (2006) 'Using System-on-a-Programmable-Chip Technology to Design Embedded Systems', IJCA, Vol. 13, No. 3.

[5] Inman.V.Tand Ralston.H.J (1952) "Relation of human electromyogram to muscular tension," Electroencephalogr. Clin. Neurophysiol. vol. 4, no. 2, pp. 187–194.

[6] Neuman, M. R (2000) 'Biopotential Electrodes'The Biomedical Engineering Handbook: Second Edition.Ed. Joseph D. Bronzino Boca Raton: CRC Press LLC.

[7] Patil.M.V and Chavan.M.S (2007) 'GSM based remote patient monitoring system', Bharati Vidyapeeth University.

[8] Qijun Huang and Sheng Chang (2012) 'An Implementation of SOPC-Based Neural Monitoring System' , IEEE transactions on instrumentation and measurement.

[9] Santhanam.G and Linderman.M (2007) 'HermesB: A continuous neural recording system for freely behaving primates,' IEEE Trans. Biomed. Eng., vol. 54, no. 11, pp. 2037–2050.