www.SeminarsTopics.com

TELEMEDICINE SYSTEMS

ABSTRACT

This project is used in hospitals, because the patients in the ICU need a constant monitoring of their body, Respiratory Temp, Saline Status and ECG. Our project is a working model that incorporates sensors to measure all these parameters and transfer it to the computer, so that the patient condition can be analyzed to by doctors in any part of the hospital wherever they are. thus it reduces doctor's work load and also gives more accurate results, wherever there is an abnormality fell by the patient, we have also incorporated saline monitoring system which gives an alarm when the saline bottle about to empty .

INTRODUCTION

Objectives

TELEMEDICINE refers to the utilization of telecommunication technology for medical diagnosis, treatment and patient care. It can be divided into two modes of operation (Lin 1999)

Real patient data are available at the remote terminal immediately after acquisition and time mode which is the store-and-forward mode which involves accessing the data at a later time (Craig 1999)

Recent technological advances have enabled the introduction of broad range of telemedicine application such as Tele-radiology (Shenng 1997, Takizawa 1998), Tele-consultation (Park 1998), and Tele-surgery (Huang 1999), Remote patient- monitoring (Stone 2001) and health care records management that are supported by computer network and wireless communication.

The mobile phone has been recognized as a possible tool for telemedicine since it became commercially available.

The aim of this project is to utilize computer systems as access terminals for general enquiry and patient monitoring services. We also utilize mobile phones for sending short messages to doctor, if patient is in distress.

With this system, authorized users, who can be doctor or patient's relatives, can view the patient's monitored physiological parameters on access terminals. The current and foreseen ageing of the world population has made patient-monitoring an attractive application because such services would enable early detection and diagnosis of pathological symptoms in elderly patients, who generally suffer from chronic diseases.

SYSTEM ARCHITECTURE

System specification

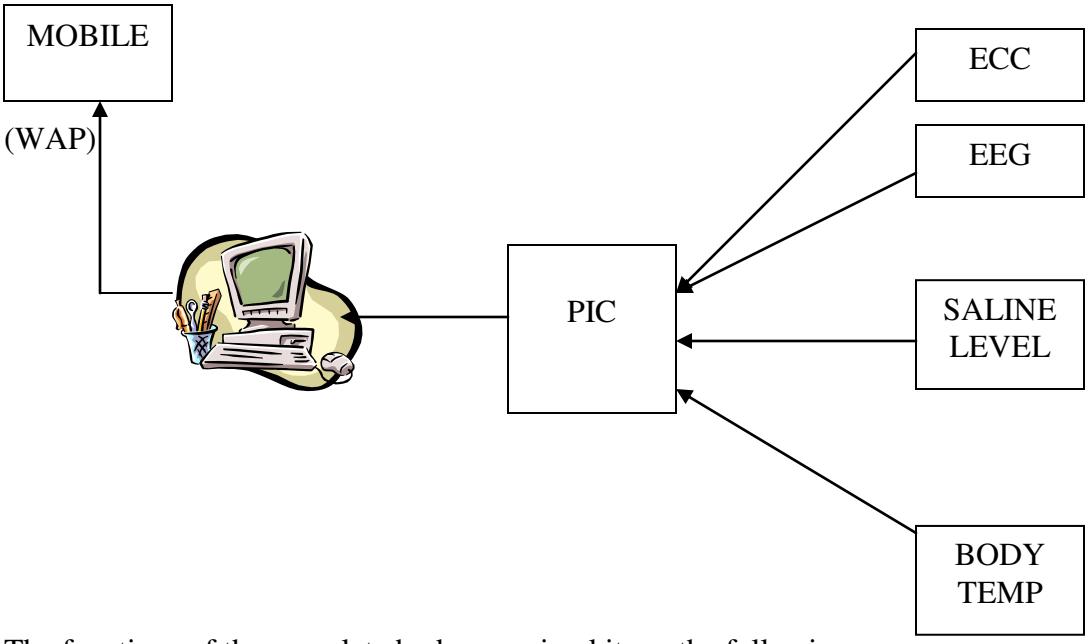
The system consists of a database server, access terminals, complete body scanning kit and the mobile phone, the access terminal communicates with the database server, which stores information and responds to the users' request. The mobile phone receives short messages alerting of the patients are in an emergency situation.

The above technical capabilities suggest that use of current mobile phones and access terminals in telemedicine is feasible in areas where the application operates in a client-server fashion

System architecture

This shows the architecture for the interface between the complete body scanning system, the database server, the access terminal and the mobile phone.

The user interface application at the front end, which is written in MS Visual Basic 6.0, will interface with the database server via ODBC. All data that the application accessed and manipulated with are stored in a relational database system is an MS access database system which is a repository to store the ECG, heart beat, respiratory temperature, body temperature, saline level, clinicians' attendance, in the case of abnormal readings form the patient, short messages are sent to clinicians mobile phone by using MS Outlook.



The functions of the complete body scanning kit are the following

ECG: This is a three lead ECG monitoring system voltages from two sensors kept at various parts of the body all signal conditioned by an external card and all given to the PC through an add on card.

Heartbeat: The heartbeat of the patient is measured by using the heartbeat sensor. The result will be sent to the PC.

Body & Respiratory Temperature: Thermistors are used to measure the body and respiratory temperature. The inputs are given to the Pc

Saline Level: The saline level monitor system used to monitor the saline level. Once the saline got exhaust the sensor will give an alert sound

Doctors' Attendance: This is used for doctors' attendance. Four LED sensors are used for this.

Patient Calling Switch: The switch is useful for the patient. Whenever he/she needs any help or emergency can use the switch, so that the duty doctor/nurse will attend the patient.

The above inputs are taken and given to the PC. These inputs are used for monitoring and analysis.

This module is responsible for communication with and control of the patient monitoring hardware, which includes the body temperature sensor, respiration temperature sensor, ECG, patient calling system and saline monitoring system.

It comprises of the PIC micro controller, a power supply unit, and filtering unit, rectifying unit, regulators, step-down transformers and op-amps.

The Thermistors are used for the measurement for the body temperature and respiratory temperature.

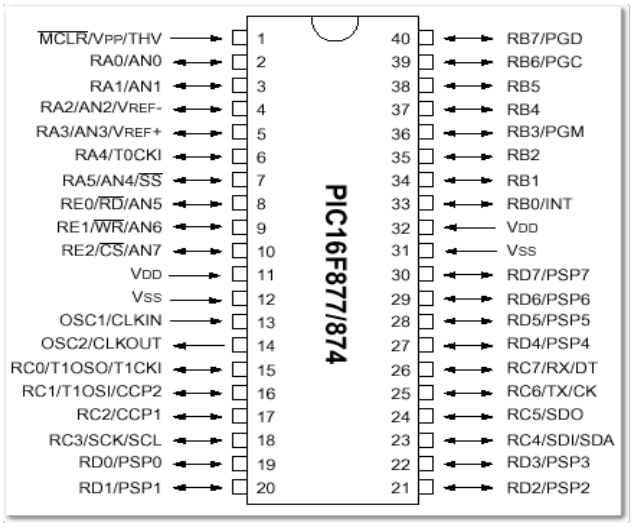
SYSTEM HARDWARE

Hardware architecture

The hardware architecture of the CBSS consists of four modules. They are PIC micro controller, RS232 interface, and power pack and acquisition devices. The detailed architectural design is illustrated below.

PIC MICROCONTROLLER BOARD DESCRIPTION

The pic micro controllers are supported with a full range of hardware and software development tolls. The used PIC16F877 device comes in 40pin package to communicate with the pic we are using rs232 port of the computer.



The PIC micro controller board consists of circuits necessary to operate a micro controller with PC interface. To have a PC interface for a heart beat rate-monitoring system we have used a PIC micro controller IC PIC16F877.

The board contains provisions for interfacing 8 analog inputs and 23 digital level signals.

Analog inputs: Pin no2 to 10 can be used to connect any analog signals of range 0-5v. In pic 6F877 port A and port E can be used as analog port.

Digital signals: As mentioned in the circuit the pin outs from the port is taken to a 26-pin FRC connector through which we can connect our Digital level signals 0 or 5 volts.

Clock: The PIC 16F877 can be operated in four different oscillator modes. The user can program two configuration bits FOSC1 and FOSC0 to select one of these four modes

MCLR/VPP: This is master clear input pin to the IC. A logic low signal will generate a reset signal to the micro controller. So we have tied this pic to VCC for the proper operation of the micro controller.

TXD and RXD: To communicate with the outside world the micro controller has an inbuilt USART. The output and input line from the USART is taken and given to a MAX 232 IC for having communication with the PC. Since we have used comport for interfacing the micro controller.

VCC and Ground: Pin no.32, 11 are tied to VCC and pin no 31, 12 are grounded to provide power supply to the chip.

RS232: The most common communication interface for short distance is Rs22. RS 232 defines a serial communication for one device to one computer communication port, with speeds up to 19200 baud. Typically 7 or 8 bits (on/off) signal is transmitted to represent a character or digit. The 9 in connector is used. The pin details are given below.

MAX 232: The MAX 232 is a dual RS 232 receiver / transmitter that meets all EIA RS232 specifications while using only a +5v power supply. It has 2 on board charges pump voltage converters, which generate 10v, and –10v power supplies from single 5v power supply. It has 4 level translators, two of which are RS232 transmitters that convert TTL/ CMOS input levels into +9v RS232 outputs. The other two level translators are Rs232 receivers that convert RS232 inputs to 5v.

TTL /CMOS output level. These revivers have a nominal threshold of 13v, a typical hysteresis of .5v and can operate up to +30v or –30v input

Transmitter section: Each of the 2 transmitters is a CMOS inverter powered by 10v internally generated supply. The input is TTL and CMOS compatible with a logic threshold of about 26% of VCC. The input I an unused transmitter section can be left unconnected: an internal 400 k ohms pull up resistor connected between the transistor input and Vcc will pull the input high forming the unused transistor output low.

The open circuit out put voltage swing is guaranteed to meet the RS232 specification 5v output swing under the worst of both transmitters driving the 3 k ohms.

Minimum load impedance, the Vcc input at 4.5-v and maximum allowable ambient temperature typical voltage with 5-kilo ohms and vcc-+. 9v

The slow rate at output is limited to less than 30v/ microsecond and the powered done output impedance will be a minimum of 300ohms with 2v applied to the output with Vcc=0v. The outputs re short circuit protected and can be short-circuited to ground indefinitely.

Receiver section: The two receivers fully conform to RS232 specifications. They re input impedance is between 3 k ohm either with or without 5v power applied and their switching threshold is within g the 3v of RS232 specification. To ensure compatibility with either RS232 IIP or TT1/CMODS input. The MAX 232ers have VIL of .8v and VIH of 2.4 v the revivers have .5v of hysterisis to improve noise rejection.

The TTL/CMOS compatible output of receiver will be low whenever the RS232 input is greater than 2.4v. The reviver output will be high when input is floating or driven between .8v to –30v.

POWER PACK

Power supply unit: As we all know any invention of latest technology cannot be activated without the source of power. So it this fast moving world we deliberately need a proper power source which will be apt for a particular requirement. All the electronic components starting from diode to Intel Ics only work with a dc supply ranging from 5v to 12v. We are utilizing for the same, the cheapest and commonly available energy source of 230v –50Hz and stepping down, rectifying, filtering and regulating the voltage. This will be dealt briefly in the forth-coming sections.

Step down transformer: When ac is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of dc needed. In our circuit the transformer of 230v / 15-0-15v is used to perform the step down operation

where as 230v ac appears as 15v ac across the secondary winding. One alteration of input causes the top of the transformer to be positive and the bottom negative. The next alteration will temporarily cause the reverse. The current rating of the transformer used in out project is 2A. Apart from stepping down ac voltages, it gives isolation between the power source and power supply circuitries.

Rectifier unit: In the power supply unit, rectification is normally achieved using a solid-state diode. Diode has the property that will let the electron flow easily in one direction at proper biasing condition. As ac is applied to the diode, electrons only flow when the anode and cathode is negative. Reversing the polarity of voltage will not permit electron flow.

A commonly used circuit for supplying large amounts of dc power is the bridge rectifier. A bridge rectifier of 4 diodes (4* IN4007) is used to achieve full wave rectification. Two diodes will conduct during the negative cycle and the other two will conduct during the positive half cycle. The dc voltage appearing across the output terminals of the bridge rectifier will be somewhat less than 90% of the applied rms value. Normally one alteration of the input voltage will reverse the polarities. Opposite ends of the transformer will therefore always be 180 degrees out of phase with each other.

For a positive cycle, two diodes are connected to the positive voltag4e at the top winding and only one diode conducts. At the4 same time one of the other two diodes conducts for the negative voltage that is applied from the bottom winding due to the forward bias for that diode. In this circuit due to positive half cycle D1 and D2 will conduct to give 10.8v pulsating dc. The dc output has a ripple frequency of 100Hz. Since each alteration produces a resulting output pulse, frequency=2*50 Hz. The output obtained is not a pure dc and therefore filtration has to be done.

Filtering unit: Filter circuits, which usually capacitor is acting as a surge arrester, always follow the rectifier unit. This capacitor is also called as a decoupling capacitor or a bypassing capacitor, is used not only to ‘short’ the ripple with frequency of 120Hz to ground but also to leave the frequency of the dc to appear at the output. A load resistor R1 is connected so that a reference to the ground is maintained. C1R1 is for bypassing ripples. C2R2 is used as a low pass filter, i.e., it passes only low frequency signals and bypasses high frequency signals. The load resistor should be 1% to 2.5% of the load.

ACQUISITION DEVICES

Temperature sensors: Thermistor is used for the measurement of body temperature. This Thermistor is a passive transducer where output depend son the excitation voltage applied to it. We have arranged the Thermistor in the form of potential driver in the circuit; this Thermistor exhibits a large change in resistance with a change in the body temperature. Initially hardware part is calibrated to room temperature. Later on the patient where temperature has to be measured, the Thermistor part is attached to him/her which changes the resistance value and thus the corresponding change in the temperature is displayed on the monitor. If the temperature exceeds the limit the alarm, indicates it. Here in our project we use bed Thermistor.

Electrocardiogram (ECG): This is a three lead ECG monitoring system voltages from two sensors kept at various parts of the body all signal conditioned by an external card and all given to the PC through an add on card, program in Visual Basic is developed to read the voltage signals and in a waveform pattern. The three lead used is silver electrode.

Saline monitoring system: For saline monitoring the infrared emitter and detector are placed in a portion such that the saline bottle passes between them. They are placed near the neck of the saline bottle. As long as saline is present. The infrared rays' path is blocked and the infrared detector is blocked from collecting infrared rays from the infrared emitter. And so the output will be logical low otherwise output is given to the PPI.

Saline level monitoring is most important compared with any other automation. This is one type of advanced and precious automation to avoid human errors and parallax errors. In our project we are monitoring the saline level as soon as the saline goes lower level [finishing stage] and information passes to the centralized computing center for further actions like changing to a new bottle or stop the flow permanently, otherwise if the bottle is empty due to body pressure blood may go up which is very dangerous because they are patients.

It is quite complex to differentiate the saline color and bottle color because both are sane only by viewing molecular density of the materials we can able to achieve the differentiation between them. For example if rays passed a glass material the o/p will be like beam, if the same rays passed to liquid whose viscosity is less than, I will be specter.

Patient calling system

Patient call switch is quite useful for total automation. The reason is while automating the body temperature acquiring ECG and BP the manpower is not at all required for acquiring. So people won't be aware of what is happening inside the patient room if in case of assistance required for the patient they can use the switch to call the hospital personals. We have forced four switches to logical high state through 1k resistor. So when the switch is not pressed, switch contact will be logical high. The other end of the switches the connected to the ground so whenever the switch is pressed, port will get a logical low.

We have designed the software in such ways that it will produce a call message whenever the port receives a low logic circuit. When two or more switches are simultaneously pressed all the messages will be displayed one after another and will be holded as long as the switch is pressed.

A warning alarm also raised while the switch is pressed. This enables easy understanding and annunciation. Annunciation means providing legible and audible o/p for the failure. (Providing a video is called animation and providing of audio is called enunciation)

The patient calling system in our project consists of four switches which when pressed gives on display on the screen and activates a buzzer indicating that a patient is calling. The circuit consists of a switch connected to port of PIC. When the patient presses the switch acts as a short and high input is given to the port to a buzzer, which gives an alarm sound.

Need to have span adj.

In general the output from the thermistors won't have a constant value always. The output may differ from one thermistor to another. Essentially you must have an adjustment circuits to keep all the outputs as constant as possible to provide legible information on the computer screen. We have provided 10 KΩ potentiometer in series with a 33 KΩ resistor, which provides gain between 20-30. What we want is 25 gains as per our calculation, which can be obtained by adjusting the span potentiometer. The span in instrumentation is called maximum operating point or upper threshold.

Zero adjustments are necessary to eliminate balancing errors a compensation error of the operational amplifier. In our circuit we have forced a 56KΩ resistor to the +12 and –12 along with a 2KΩ multi turn potentiometer. According to the calculation we may get +600mV to –600mV across the potentiometer.

The zeroing circuit gain is unity. The reason is finite adjustment required for this operation. Because the whole zeroing circuit source is driven by power supply which we are providing and it may have a good enough current and voltage.

Filtering

We have used 2 types of filters.

- Integrative Filter
- Low pass filter

Integrative Filter

In general the integrative filters are high-speed filters having fastest discharge rate like sweep signals. This provides high-speed noise filtering and different levels of harmonic and provides clear noise free output but with the constant frequency approximately 100 hertz which can be arrested by using our next circuit called low pass filter.

We have designed a low pass filter whose value is 10 UF. It is quite enough to arrest 100 Hz signed a produce 0 Hz signal.

In this stage of the 741 is noise free, ripple free, output if the input is constant.

SOFTWARE MODULE

Introduction

We have written the code in VB to show the ECG, body temperature, respiratory temperature, heartbeat and doctor's attendance obtained from the hardware kit in the computer screen and the database used in MS-Access to store the above data.

Software used:

Front end : Microsoft Visual Basic 6.0

Back end : MS-Access 2000

Operating system : Ms- Windows 98.

Front-end design:

In VB we designed 3 screens. Every screen is a from in VB. The first form is main menu form. It has the options to select which select which detail the user want to see. There are command buttons to select the appropriate link. If the user clicks one command button this form ends and the selected form appears.

The second form is body scans form. This is for displaying all the inputs obtained from the kit. There is separate text box control for every input. And there are two image controls. One is for display the temperature Vs time graph and another one is for display the ECG reading in graphical waveforms. Four select option controls re used. The user can select any one at a time and can view the appropriate reading in the text box control.

CONCLUSION AND FUTURE ENHANCEMENT

This project is a working model, which is used in IC unit to monitor the patient's body status. The various inputs taken from a patient and measured the body temperature, respiratory temperature, heartbeat and ECG. And also checked that if any abnormality in-patient it alerts doctor by gives beep sound and also send SMS to the doctor's mobile. By using the display we can check online parameters including body temperature, respiratory temperature, heart beat ad ECG.

Future enhancement

The main features of this project are:

- 8 independent analog channels available
- Annunciation 's systems are included for all this analog inputs
- Saline status is displayed in the monitor
- On-line graphics for selectable parameters
- On-line recording of all process parameters in the interval selectable by the user, which is most useful for future analysis and failure detection.