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Improving the Real Time Performance of Sensor Networks for Monitoring the Healthcare System Using Wireless Devices

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Abstract: ***To monitor the health condition of patients and provide a wide range of effective, comprehensive, and convenient health condition services the wireless networks combined with IP techniques. A minimum power embedded wearable sensor network can be used to measures the health parameters effective, and is connected according to the concept of (IP over low-power wireless personal area network). Sensor-network-based home monitoring system for elderly activity behavior involves functional assessment of daily activities. The large amount of biomedical signals can be sent through the extended wireless network combining IP technique and mobile technology for daily lifestyle to users appropriately. A visualization module of the Microcontroller function displays the recording biomedical signals. The opportunity for cardiac patients and child have constantly be monitored their health stage at any place. Patient information stored in the System within help of Wireless devices. Server system will get patient information from Ethernet card via Hub. In Case of emergency, the Ambulance is automatically called with the help of the IP Address and the Patient is also informed about the abnormality prevailing in health condition.***

Keywords-health condition, healthcare application, sensors, Ethernet, system, wireless devices, emergency condition

I. INTRODUCTION

A real time monitoring the health condition of patients that utilizes sensor wireless devices, collect, analyses and record patients' health status. They are many cool sensors available now a days, ranging from small and large distance sensor modules[1-2],[4],[11],[16],[19], accelerometers, EEG sensors, temperature sensors, ECG sensors, Respiration sensors, pulse sensors, Blood pressure sensors and many more(chemical sensors, sound sensor, pressure sensors, touch screens). Many of these are analog in nature.

The wireless links allow the design of lightweight, low-power sensors at low cost for sensor networks. ADC is connect to the PIC Microcontroller by 3 control register and 2 data register. The control registers are used to display commands to the ADC. They also give the status of ADC. The two data registers contain the ten bit of converted data. Since each resister in PIC Microcontroller is of 8 bits therefore 2 registers are required to hold the 10bit data.

The LCD's are connected from PIC Microcontroller. All bio-signal values are displaying LCD Module. Incase of emergency condition it is indicate the abnormal status.

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In particular, the continuous recording of bio signals is critical for the advancement of diagnosis as well as treatment by using wearable sensors [1-2], [4]. In addition, it is conceivable that further automated analysis of recorded biomedical signals could support doctors in their daily practices and allow the development of warning systems. This would bring several benefits increase in the health observability, collaboration among doctors, and doctor-to-patient efficiency and thereby decrease medical costs [11], [13]. Moreover, such continuous monitoring would increase early detection of abnormal health conditions and bio signal values and therefore provide a great potential to improve the quality of life [2], of patients.

II. RELATED WORKS

A . ECG Sensor

The heart is —in simple terms— the blood pump of the body made up of muscle tissue. Its regular contraction is controlled by the sinus node which generates the electrical stimulus every time the heart beats. This special area is located in the right upper chamber (atrium) of the heart, and is connected to the lower chambers (ventricles) by conduction pathways. Its generated energy travels down and causes these lower chambers to pump out blood. A healthy person's sine node generates roundabout 60 – 80 heartbeats in repose [2], [14], [17]. A typical ECG tracing [16], of a normal heartbeat consists of a P wave, a QRS complex and a T wave. (Klabunde, 2004) A small U wave is normally visible in 50 to 75% of ECGs. The baseline voltage of the electrocardiogram is called the isoelectric line. Figure 1 beneath is the schematic of a normal ECG.

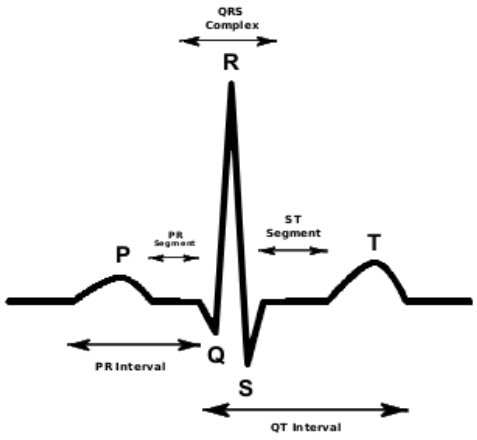

Figure 1 ECG Tracing

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Most people have seen this curve, but only a few know what it means. The first little bump is called the "P wave". It indicates that the atria are electrically stimulated to pump blood to the ventricles. The following part is a short downward section connected to a tall upward section. This is called the "QRS complex" [1]. It indicates that the ventricles are electrically stimulated to pump out blood. The next short flat segment is called the "ST segment". The ST segment indicates the amount of time from the end of the contraction of the ventricles until the beginning of the "T wave". Finally the T wave indicates the recovery period of the ventricles.

B. Pulse Sensor

The Heart Beat Sensor provides a simple way to study the heart's function. This sensor monitors the flow of blood through ear lobe. As the heart forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. The sensor shines a light lobe (small incandescent lamp) through the ear and measures the light that is transmitted. The clip can also be used on a fingertip or on the web of skin between the thumb and index finger. The signal is amplified, inverted and filtered, in the box. By graphing this signal, the heart rate can be determined [8], [14].

Heart rate varies between individuals. At rest, an adult man has an average pulse of 72 Per Minute. Athletes normally have a lower pulse rate than less active people. Children have a higher heart rate (approx. 90 beats per minute), but also show large variations. The heart rate rises during exercise and returns slowly to the rest frequency after exercise. The rate at which the pulse returns to normal can be used as an indication of fitness.

C. Respiration Sensor

The respiration signal is a relative measure of abdomen expansion. The respiration sensor [17], is fixed to a long hook and loop strap that is placed around the chest or abdomen. For most applications, placing one sensor around the abdomen is necessary. Optionally, you can place a second respiration sensor around the chest. Using two sensors is helpful for abdominal breathing exercises. Unravel the strap and attach it around the abdomen (or torso) so that the sensor is in the front. Ask the client to breathe out as fully as possible and attach the sensor so there is minimal tension. The fit should be snug enough that the strap stays fixed when the subject is relaxed. To interface with a sensor, a single sensor cable may be cut in half. Both sides can then be used to make custom interfacing cables by stripping the outer insulation of each required conductor. The figure 2 below sensor cable contains 4 color coded conductors.

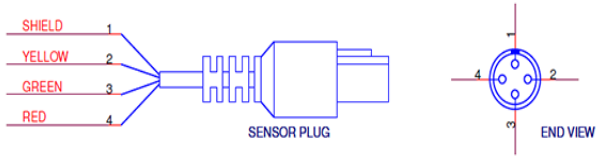

Figure 2 Respiration sensor color coded

D. Blood Pressure sensor

Blood pressure monitors can use Korotkoff, Oscillometry, or Pulse Transit Time methods to measure blood pressure. They employ a pressure cuff, pump, and transducer to measure blood pressure and heart rate in three phases: Inflation, Measurement, and Deflation. They include an LCD, selection buttons, memory recall, power management, and USB interface.

The pressure transducer produces the output voltage proportional to the applied differential input pressure. The output voltages of the pressure transducer range from 0 to 40 mV, which need to be amplified so that the output voltage of the DC amplifier has a range from 0 to 5V. Thus, we need a high-gain amplifier. Then the signal from the DC amplifier will be passed on to the band-pass filter. The DC amplifier amplifies both DC and AC component of the signal. The filter is designed to have large gain at around 1-4 Hz and attenuate any signal that is out of the pass band. The AC component from filter is important for determining when to capture the systolic/diastolic pressures and heart rate of the patient. The final stage of the front end is an AC coupling stage, after which the signal is sent to analog to digital converters, and digitized.

The digital measurements of pressure and heart rate are performed by the microprocessor. Measurements results are stored in EEPROM or FLASH memory as a data log that can be uploaded to a PC via USB. The analog circuit is used to amplify both the DC and AC components of the output signal of pressure transducer so that we can use the MCU to process the signal and obtain useful information about the patient's health.

E. Temperature Sensor

A thermistor is a type of resistor used to measure temperature changes [2], relying on the change in its resistance with changing temperature [16]. Thermistor is a combination of the words thermal and resistor. The shape of Thermistor Figure 3 is give below,

Figure 3 Thermistor

In this circuit the thermister is used to measure the temperature. Thermister is nothing but temperature sensitive resistor. There are two type of thermister available such as positive temperature co-efficient and negative temperature co- efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased. Here the thermister is connected with resister bridge network. The bridge terminals are connected to inverting and non-inverting input terminals of comparator. The comparator is constructed by LM 324 operational amplifier. The LM 324 consist of four independent, high gains, internally frequency compensated operational amplifier which were designed specifically to operate from a single power supply over a wide voltage range [16].

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The first stage is a comparator in which the variable voltage due to thermister is given to inverting input terminal and reference voltage is given to non-inverting input terminal.

III. WIRELESS DEVICES

A. GSM Modem

A GSM modem [13], is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.A GSM modem can be an external device. As mentioned in earlier sections of this SMS tutorial, computers use AT commands to control modems. Both modems and dial-up modems support a common set of standard AT commands. You can use a GSM modem just like a dial-up modem.

In addition to the standard AT commands, GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards. With the extended AT commands, you can do things like:

- Reading, writing and deleting SMS messages.
- Sending SMS messages.
- Monitoring the signal strength. Monitoring the charging status and charge level of the battery.
- Reading, writing and searching phone book entries.

The number of SMS messages that can be processed by a GSM modem per minute is very low -- only about six to ten SMS messages per minute.

SMS is an area where the modem can be used to provide features like:

- Pre-stored SMS transmission
- These SMS can be transmitted on certain trigger events in an automation system
- SMS can also be used in areas where small text information has to be sent. The transmitter can be an automation system or machines like vending machines, collection machines or applications like positioning systems where the navigator keeps on sending SMS at particular time intervals.
- SMS can be a solution where GSM data call or GPRS services are not available.

B. USART Communication

A universal synchronous asynchronous receiver/transmitter (usually abbreviated USART and pronounced) is a type of "asynchronous receiver/transmitter", a piece of computer hardware that translates data between parallel and serial forms. USARTs are commonly used in conjunction with other communication standards such as EIA RS-232.

A USART is usually an individual (or part of an) integrated circuit used for serial communications [13], over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers.

C . Asynchronous receiver and transmitter

In asynchronous transmitting, teletype-style UARTs send a "start" bit, five to eight data bits, least-significant-bit first, an optional "parity" bit, and then one, one and a half, or two "stop" bits. The start bit is the opposite polarity of the data-line's idle state. The stop bit is the data-line's idle state, and provides a delay before the next character can start. (This is called asynchronous start-stop transmission). In mechanical teletypes, the "stop" bit was often stretched to two bit times to give the mechanism more time to finish printing a character. A stretched "stop" bit also helps resynchronization.

The parity bit can either make the number of "one" bits between any start/stop pair odd, or even, or it can be omitted. Odd parity is more reliable because it assures that there will always be at least one data transition, and this permits many UARTs to resynchronize.

D. Asynchronous Serial Communication

Asynchronous serial communication describes an asynchronous, serial transmission protocol in which a start signal is sent prior to each byte, character or code word and a stop signal is sent after each code word. The start signal serves to prepare the receiving mechanism for the reception and registration of a symbol and the stop signal serves to bring the receiving mechanism to rest in preparation for the reception of the next symbol. A common kind of start-stop transmission is ASCII over RS-232, for example for use in teletypewriter operation. The number of data and formatting bits, and the transmission speed, must be pre-agreed by the communicating parties.

The "stop bit" is actually a "stop period"; the stop period of the transmitter may be arbitrarily long. It cannot be shorter than a specified amount, usually 1 to 2 bit times. The receiver requires a shorter stop period than the transmitter. At the end of each character, the receiver stops briefly to wait for the next start bit. It is this difference which keeps the transmitter and receiver in synchronism.

E. LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

F. IPV6 Techniques

An IP address [19], serves the purpose of uniquely identifying an individual network interface of a host, locating it on the network, and thus permitting the routing of IP packets between hosts. For routing, IP addresses are present in fields of the packet header where they indicate source and destination of the packet.IPv6 is the successor to the Internet's first addressing infrastructure.

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Internet Protocol version 4 (IPv4). In contrast to IPv4, which defined an IP address as a 32-bit value, IPv6 addresses have a size of 128 bits. Therefore, IPv6 has a vastly enlarged address space compared to IPv4. An IPv6 address consists of 128 bits.

IV. DESIGN AND IMPLEMENTATION

A. Design Criteria

The PIC start plus development system from microchip technology provides the product development engineer with a highly flexible low cost microcontroller design tool set for all microchip PIC micro devices. The PIC start plus development system includes PIC start plus development programmer and MPLAB IDE.

The PIC start plus programmer gives the product developer ability to program user software in to any of the supported microcontrollers. The PIC start plus software running under MPLAB provides for full interactive control over the programmer. In this program store in a PIC Kit-2 software to give PIC16F877A.

B. Block Diagram

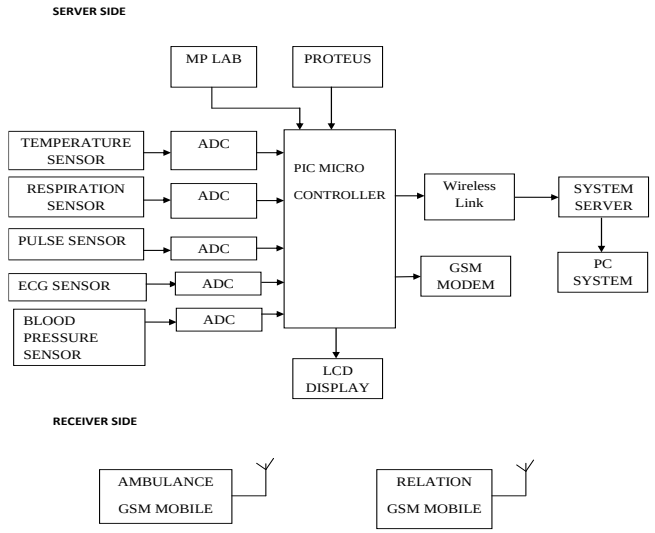

Figure 4 Block Diagram Of Sender and Receiver Side

Sender Side

Figure 4 sender side Sensor Units are analyze the Temperature, Respiration, pulse rat, ECG Signal and Blood Pressure and monitoring the real time process. ADC units are convert the analog to digital signals through the PIC Micro controller [16]. LCD display connect from Microcontroller give the bio signals digital values. Incase of patient want to know the body condition via SMS by GSM Modem. The wireless link (IPV6) or wired connection Ethernet connected from PIC16F877A recording values are through the server system. server system connected to multiple client system use wired and wireless links [19].

Receiver side

Figure 4 receiver side GSM Modem is a connected from Microcontroller through the bio signal values to Patient, Doctor and Ambulance.

C. Proposed Methodology

- The proposed Healthcare Monitoring system in this work is composed of two main components: the Patient unit (Transmission part), and the Mobile unit (Receiving unit).
- Patient Unit:

It permits continuous Patient monitoring through the sensors placed on the patient's body.

- Bio signals are analog values. So this values are converted analog to digital using PIC Microcontroller.
- Sensor to real time monitoring very fast calculate. These values give the LCD.
- Ethernet card or IPV6 Techniques includes transferring from Microcontroller to server PC. Server PC storing the all bio signal digital values. Retrieve the storing information using a LABVIEW Software.
- Mobile Unit:

This unit is used to intimate the Ambulance, Patient relative and the doctor if the health condition of the patient is abnormal.

V. RESULTS AND DISCUSSION

The Temperature Sensor is used to measure the temperature. Temperature sensor is nothing but temperature sensitive resistor. There are two type of temperature sensor available such as positive temperature co-efficient and negative temperature co- efficient. Here we are using negative temperature co-efficient in which the resistance value is decreased when the temperature is increased. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the value is greater than assigning value then led on else led off. The bio signal values are updated for every 30 seconds. Health constraints figure 5 flow chart explain below,

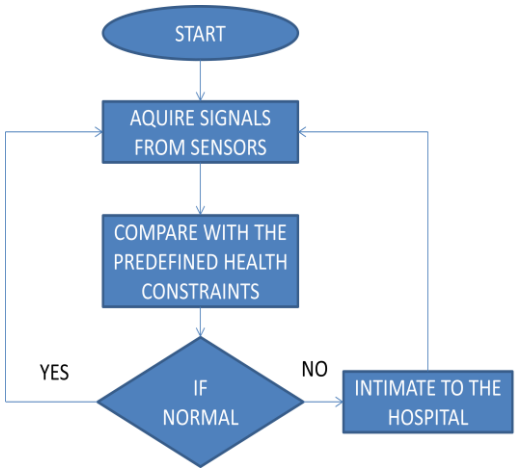

Figure 5 Flow Chart

The Pulse Sensor is used to measure the heart beat. This sensor monitors the flow of blood through ear lobe. As the heart forces blood through the blood vessels in the ear lobe, the amount of blood in the ear changes with time. The sensor shines a light lobe (small incandescent lamp) through the ear and measures the light that is transmitted. The clip can also be used on a fingertip or on the web of skin between the thumb and index finger.

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The signal is amplified, inverted and filtered, in the box. By graphing this signal, the heart rate can be determined. Heart rate varies between individuals. At rest, an adult man has an average pulse of 72 per minute. Athletes normally have a lower pulse rate than less active people. Children have a higher heart rate (approx. 90 beats per minute), but also show large variations. The heart rate rises during exercise and returns slowly to the rest frequency after exercise. The rate at which the pulse returns to normal can be used as an indication of fitness. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the pulse value less than or equal to 30 and greater than or equal 80 led on else off. The Respiration Sensor is a sensitive girth sensor using an easy fitting high durability latex rubber band fixed with self-adhering belt. It detects chest or abdominal expansion/contraction and shows the respiration waveform and amplitude. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values.

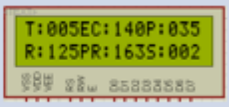
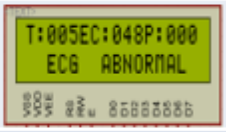
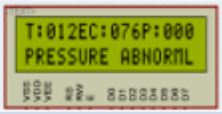
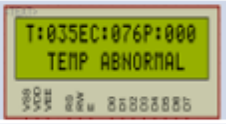
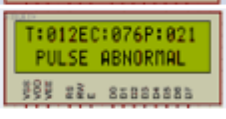
Parameter	Status	LCD Screenshot
ECG, Respiration, Blood Pressure, Temperature and Heart rate.	Normal	
ECG	Abnormal	
Respiration	Abnormal	
Blood Pressure	Abnormal	
Temperature	Abnormal	
Heart rate (Pulse)	Abnormal	

Figure 6 Normal and Abnormal Status

If the value is smaller than assigning value then led on else led off. The bio signal values are updated for every 30 seconds. Pulse Transit Time methods to measure blood pressure. Blood pressure monitors consist of either manually inflated cuffs with a stethoscope for listening to arterial wall sounds or a blood pressure monitor that contains a pressure sensor for sensing arterial wall vibrations. The automatic blood pressure monitors consist of upper-arm and wrist models. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the value is smaller than assigning value then led on else led off. The bio signal values are updated for every 30 seconds. An electrocardiogram records the pathway of electrical impulses through the heart muscle, and can be recorded on resting and ambulatory subjects, or during exercise to provide information on the heart's response to physical exertion. Bio signals require a digitization step in order to be converted into a digital form. This process begins with acquiring the raw signal in its analog form, which is then fed into an analog-to-digital converter. The LCD's are connected to PIC Microcontroller display the digital values. If the value is smaller than assigning value then led on else led off. The bio signal values are updated for every 30 seconds. All sensor Normal and Abnormal status mention the below this figure 6. Temperature, Pulse, Respiration, Blood Pressure and ECG values are stored in the Particular System IP within help of Wireless devices. Server system will get patient information from Ethernet card via Hub. In Case of emergency, the Ambulance is automatically called with the help of the IP Address and the Patient is also informed about the abnormality prevailing in health condition.

VI. CONCLUSION

Here improve a technology through which, bio-signal values of the health conditions of a patient is delivered to them using serial communication. The present method represent sensor networks deployed in the patients collect the bio signal information through the Microcontroller. The LCD's are connecting from Microcontroller displays the digital bio signal values. The wireless device record and analyze bio signal of the patient affect body to indicate the Normal and abnormal status. The proposed system is able to adopt it self to the patient taking into account his personal data and his clinical history. In details such information is used to estimate the reliable on health condition of patient. The aim of the present is to provide a simple to use tool that is able to perform a qualified display status and reduce the cost. Patient information stored in the Particular System IP within help of Wireless devices. In addition, a mobile healthcare application can be deployed on mobile devices, such as smart phones, tablet PCs, and laptops to monitor biomedical signals in real-time for healthcare services. In Case of Emergency, the Ambulance is automatically called with the help of the IP Address and the Patient is also informed about the abnormality prevailing in health condition. This work can be extended in future replacing the microcontroller to connect the another long distance wireless devices and the efficient support of wireless communication with the IEEE 802.15.4 protocol in healthcare applications.

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