Embedded Patient Monitoring System

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Abstract

ICU stands for Intensive Care Unit, a place in the hospital where patients are monitored very closely. Typically, the patient-staff ratio is very low and the LIFE-SAVING EQUIPMENT used is very advanced. Generally ICU is a hospital facility for provision of intensive nursing and medical care of critically ill patients, characterized by high quality and quantity of continuous nursing and medical supervision and by use of sophisticated monitoring and resuscitative equipment. The patients in the ICU need a constant monitoring of their temperature and heart beat. This paper presents a working model, which incorporates sensors to measure important parameters namely the temperature, respiratory temperature and heart beat. The sensors are interfaced to a microcontroller, so that the condition of a patient can be analyzed by doctors in any part of the hospital wherever they are.

Whenever there is an abnormality felt by the patient, the particular patient will give an alarm signal, by which the doctor can rush to the patient. Even when the patient is in an unconscious condition, all the parameters will be sensed and doctor will be cautioned.

This is a working model which incorporates sensors to measure parameters like heart beat and temperature. The patient condition can be analyzed by doctors in LCD. - Thus it reduces doctor's workload and also gives more accurate results.

This system also incorporates a monitoring system which gives an alarm when the saline bottle is about to empty.

1. Introduction

This is a wireless technique to transmit information between sensors and monitoring control center. The free space of patients is enlarged, and the efficiency of the modern management of hospitals is improved. The core of wireless medical monitoring system is the design of wireless monitoring terminal, and the development of system software.

The monitoring terminal generally consists of three modules: the sensor module, the control module, and the wireless communication module. The sensor module is used for acquiring patient's physical conditions like temperature and heart beat. These parameters are then converted into digital signals using Micro controller section. The control module compares the digital signals with the threshold values stored in the brain of monitoring terminal. If the digital values exceed the threshold values, this control module sends the information to the doctor. The wireless communication module mainly deals with the wireless transmission of information. This system detects and transmits heart beat rate and body temperature with high accuracy. If the parameters exceed the threshold levels, it alerts doctor immediately using GSM modem.

2. Overview of the System

The system uses AT-Mega Micro controller, the temperature sensor LM35, and the heart beat sensor LM385 as the principal parts. The temperature sensor and the heart beat sensors send the patient's physical conditions as analog signals. These analog signals are taken by the Micro controller and its in-built ADC converts these analog signals into digital information and the results are displayed on LCD screen and simultaneously to the GSM modem which are interfaced with the Micro controller. Then the GSM modem gives the information to the respective doctor.

Figure 1. shows the working module of the system.

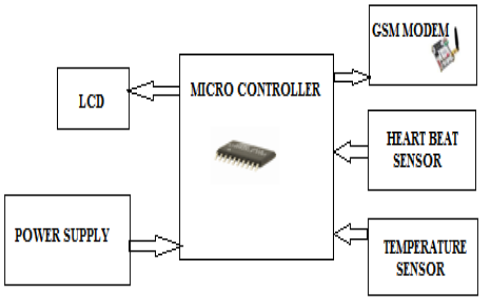

Figure 1. Working Module of the System

3. AT-Mega 8 Features

1. High performance, low power 8- Bit Micro controller.
2. Advanced RISC Architecture.
3. High Endurance Non-volatile Memory segments.
4. 8Kbytes of In-System Self-programmable Flash program memory.
5. 512Bytes EEPROM.
6. 1Kbyte Internal SRAM.
7. In-System Programming by On-chip Boot Program True Read-While-Write Operation.
8. Programming Lock for Software Security.
9. Three PWM Channels.
10. 8-channel ADC in TQFP and QFN/MLF package Eight Channels 10-bit Accuracy.
11. 6-channel ADC in PDIP package, Six Channels 10-bit Accuracy.
12. Byte-oriented Two-wire Serial Interface.
13. Programmable Serial USART.
14. Master/Slave SPI Serial Interface.
15. On-chip Analog Comparator.
16. Power-on Reset and Programmable Brown-out Detection.
17. Internal Calibrated RC Oscillator.
18. External and Internal Interrupt Sources.
19. Five Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, and Standby.
20. 23 Programmable I/O Lines.
21. Available in 28-lead PDIP, 32-lead TQFP, and 32-pad QFN/MLF packages.
22. Operating voltage is 4.5V - 5.5V with 0-16 MHz speed.

4. LM 35 Temperature Sensor

LM 35 is a precision integrated temperature sensor. Its output is linearly proportional to the Celsius (Centigrade) temperature.

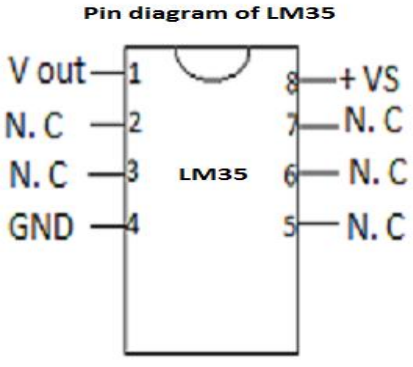

Figure 2. Pin diagram of LM 35

4.1. Testing of Temperature Sensor

In order to test the temperature sensor, various temperatures are applied to the LM35 sensor and these temperatures are measured using thermometer. The respective output voltages of LM35 sensor are measured using multimeter.

Table 1. Observations of temperature sensor

Temperature (in ◦C) measured using thermometer	Output Voltage (mV) measured at V out pin of LM35
25	252
27	275
30	301
32	323
35	350
38	381
40	404
43	433

44	441

4.1.1. Conclusion. Above readings indicate that output voltage of LM35 sensor rises by 10 mV /◦C rise in temperature approximately. Thus its output is linear with scale factor 10mV/◦C.

4.2 Interfacing LM35 with AT-Mega8

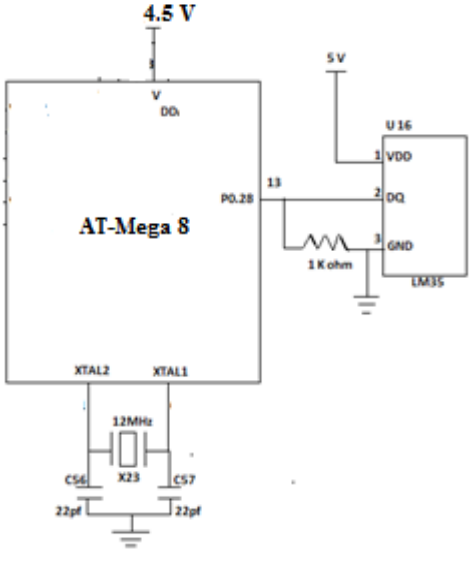

Figure 3. Interfacing temperature sensor

5. Heart Beat Sensor LM 385

Figure 4. LM 385 sensor

The sensor consists of a super bright red led and light detector .the LED needs to be super bright as the maximum light pass spread in finger and detected by detector . now when the pumps a pulse of blood through the blood vessels ,the figure becomes slightly more opaque and so less light reached the detector .with each heart pulse the detector signal varies . This variation is converted to electrical pulse.

This signal is amplified and triggered through an amplifier which output +5V logic level signal. The output signal is also indicated by a LED which blinks on each heart beat.

6. GSM

Figure 5. GSM modem

This system uses “SIMENS GSM MODEM”. The messages are sent from the GSM modem to the doctor’s mobile set to perform the necessary tasks. The main concept behind this system is to receive the SMS sent and processing it further as required to perform several operations. The type of operation to be performed depends on the nature of SMS sent.

7. LCD

One of the most common devices attached to a micro controller is an LCD display. Some of the most common LCD’s connected to the many microcontrollers are 16×2 and 20×2 displays .This means 16 characters per line by 2 line and 20 characters per line by 2 lines, respectively .the lcd enquires 3 control line as well as either 4 or 8 I/O lines for the data bus . The user may select whether the LCD is to operate with a 4 –bit data bus 8-bit data bus.

Figure 6. LCD block diagram

8. CONCLUSION

In this system, a complete working model of a patient monitoring system using AT-Mega8 Microcontroller is implemented. The programming and interfacing of microcontroller has been mastered during the implementation. The versatility of a microcontroller how it can be interfaced with various peripherals to obtain the desired results is shown.

9. References

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