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Sensor based Automatic Control System for Surgery Room

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Abstract

Worldwide every year over 2 million patient die during surgery, 25% of this deaths are caused due to complications of temperature and humidity. Excessive cooling leads to cardiac arrhythmias, hence temperature and humidity control system is the most important part to be controlled. The main target of this system is to design and implement the system in a cost-effective manner. This project consists of two modules, one is the design and development of a temperature, humidity monitoring and controlling system using microcontroller and LCD and the other is the detection of artificial oxygen leakage which has been provided for the patient to breathe in order to avoid breathing trouble. In addition to that, this paper incorporates the proposal to intimate the low/high pulse of the patient to the doctor before they reach their critical stage by detecting the velocity of blood flow.

Keywords: Artificial Oxygen Leakage Detector, Intimation of Heart Attack, Temperature and Humidity Controller

1. Introduction

The temperature and humidity monitoring and controlling system is an integrated system that allow users to give the inputs to a specific requirement of temperature and humidity for any environment say industry process, silk manufacturing process, surgery room, musical instruments, coating industry, drug, capsule manufacturing, food processing, pharmaceutical industries and so on. In which temperature and humidity monitoring and controlling system is necessary for surgery room since human's life is more important than any other industrial appliances. The patient's position is more hazardous than that of those exposed to climate extremes in industry or in the armed forces.

Deaths from heat stress have occurred in Britain with wet-bulb temperature in surgery room. The patient's temperature begins to rise when the wet-bulb temperature exceeds 23 degree Celsius (75 degree Fahrenheit). Surgery room must be designed to provide a space humidity of 20 to 60% and temperature of 68 to 75 degree Fahrenheit.

In surgery room, the surgeon expects a lower room temperature and it is always difficult to satisfy the surgeons in order to maintain the temperature at the range of 62 degree to 65 degree. Also the humidity which is too low causes damage to human body.

The artificial breathing is provided for the patient during their critical condition, the oxygen will be supplied for patient through oxygen cylinder by using oxygen mask. In that case, if oxygen leak from tube or from knob, the patient will trouble to breathe. This can be avoided by designing an oxygen leakage detection system.

Basically, lots of death occurs due to heart attack around the world. We have so much technique but still they die due to heart attack. Bad thing is that they don't die due to heart attack but because of not able to get the medical help in limited time. It is proved that if patient suffered by heart attack and if he/she get medical help within first 60 minutes of heart attack then 80% chance are there that his/her life can be safe.

This project also provides the proposal for heart rate monitoring system which monitor the pulse rate of the

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patient and intimate to the doctor when the pulse goes abnormal, this is done before they reach their critical stage by detecting the velocity of blood per minute and should be monitored from time to time to detect any abnormalities of the heart rate.

Five main requirements that influence the control of temperature and humidity in surgery room are,

- Maintaining humidity will avoid the risk of anesthetic explosions
- Promote the comfort and working efficiency of the staff
- Conserve the patient's resources
- Temperature and humidity must be in a specific range in order to maintain the normal body temperature
- Excessive cooling will leads to cardiac arrhythmias.

2. Block Diagram

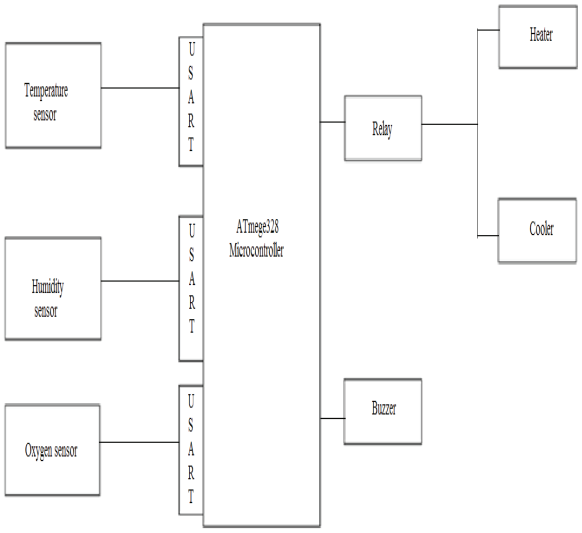

Figure 1. Block diagram of the project.

3. Temperature Sensing and Control

The temperature in the surgery room needs to be sensed and read before controlling it. A sensor is placed in surgery room where the patient is in surgery and the sensed temperature is given to the Arduino Uno Microcontroller.

3.1 Thermistor

The temperature is sensed using a Thermistor. Thermistors are lesser in cost and are readily available in market. They are easy to use and are adaptable. They respond quickly. Circuits with thermistors can have reasonable output voltages until the millivolt outputs from the thermocouples. Because of these qualities, thermistors are widely used for simple temperature measurements. They are not used for high temperatures, but in the temperature ranges where they work they are widely used.

From the above figure, it is noticed that the resistance drops from high value to very low as the range of temperature increases to a high value.

4. Implementation of the Temperature and Humidity monitoring and Controlling System

4.1 Software Implementation

In the software implementation part, the assembly code for measuring temperature and humidity is developed and is controlled according to the user's requirements and displaying the temperature and humidity in LCD module.

The software includes the reading of various measurements from sensor and is converted from analog value to digital values, displaying the temperature in the 16X2 LCD display and the program for controlling action.

The assembly level programming is done on Arduino IDE software, the developed program is installed in the ATMega328 microcontroller. The Arduino IDE combines project management and make facilities, source code

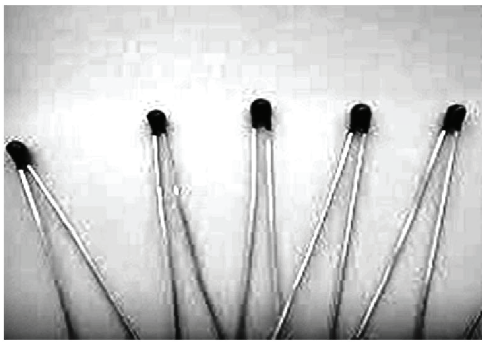

Figure 2. Thermistors.

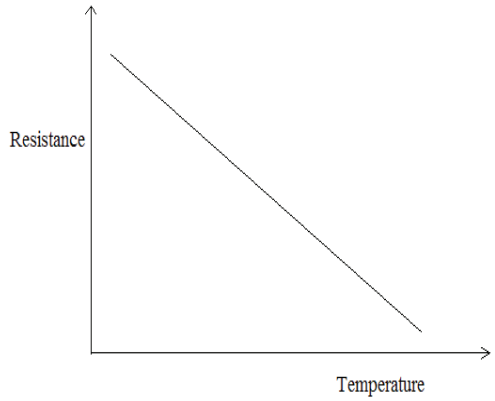

Figure 3. Characteristics of thermistor.

editing, program debugging, and complete simulation in onepowerful environment.

4.2 Hardware Implementation

In the hardware implementation part, Arduino Uno is used as a development board to control the temperature and humidity.ATmega328 microcontroller is used to control the temperature and humidity to a required range.

5. Effects of Oxygen Scarcity

Atmosphere includes mixture of gases, in which 21% oxygen, 78% nitrogen and other inert gases. Oxygen is essential for human body to survive their life. If it is less than 21% or below its normal level, hazardous health effects will occur. If oxygen concentration is below (21 to 19)% some physical activities may occur but they may not be noticeable. If it is (15 to 19)% the pulse rate of human body is reduced and also the breathing rate is further reduced this cause the impaired mental activities. If the oxygen concentration is reduced between (12 to 15)% then the human goes to emotionally upsetand this leads to poor judgement. Further if the oxygen concentration is reduced to (10 to 12)% may cause permanent heart damage possibly of fainting within a few minutes without any warning.

If the oxygen level is less than 10% the human loss their concentration and they move to unconscious.

6. Pulse Rate Detection

It has been already stated that if a person suffered by heart attack and if he/she get medical help within first 60 minutes of heart attack then 80% chance are there that his/her life can be safe. Hence it is necessary to detect the pulse rate and to intimate neighbours in order to give medical aid.

The pulse rate can be detected by using LED and photo diodeinstead of heart sensor. This is because; the heart sensor could produce heat. Normally for a device having its wavelength of above 1.5 causes the heat at the fingertip. Therefore LED and photodiode is used here to detect the pulse rate. The wavelength of LED and photodiode is 0.94 and hence it doesn't produce heat at the fingertip.

The photodiode and LED can be placed at the fingertip of the patient. And an alarm system is placed around patient to intimate neighbours.

When heart contracts, the blood density is high and it doesn't allow light to pass. Hence this case is considered as '0'. When heart expands, the blood density is low and it allow light to pass. Hence this case is considered as '1'. By this way, the pulse rate can be measured. If pulse rate is less than 60 or more than 100, then it mean that the patient suffered by heart attack.

7. Result

A step-by-step approach in designing the microcontroller based system for the measurement and control of temperature is followed. The results obtained from the measurement have shown that the system performance is quite reliable and accurate. This system requires a number of hardware components, properly integrated in accordance withtheir specifications. They need to have a continuous and reliable power supply provided to them.

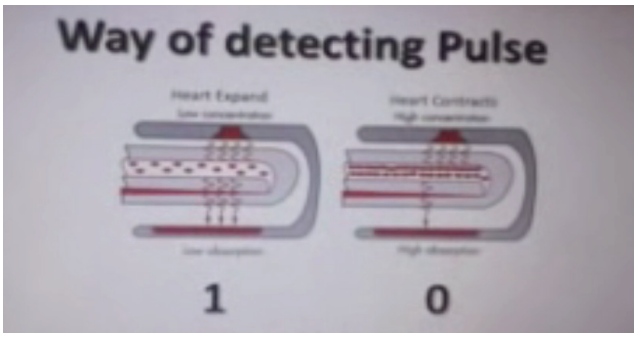

Figure 4. Way of detecting pulse.

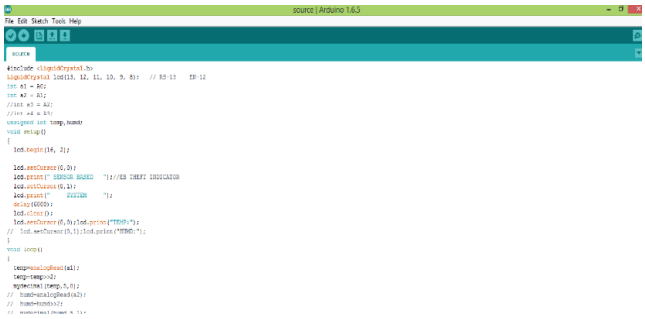

Figure 5. Screen shot of temperature sensing.

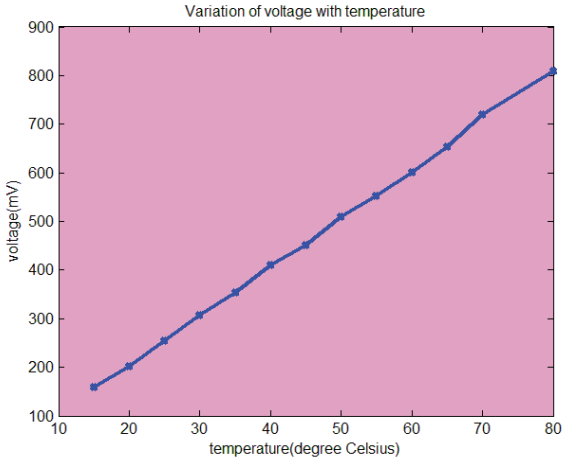

Figure 6. Change in temperature with voltage.

8. Conclusion

In this project, the temperature and humidity monitoring is done with the help of microcontroller. These sensor senses the temperature and humidity from the environment and the inbuilt ADC in the microcontroller produces corresponding digital signal which is further processed by the microcontroller and is displayed in the LCD. The user requirement is given in the form of a setpoint and then the microcontroller compares the ambient value against this setpoint and further necessitates the controlling action using relays. If the temperature and humidity goes beyond the setpoint then the cooler and heater goes on respectively and if the temperature and humidity goes below the setpoint then the heater and cooler will be switched on by relay.

The leakage of artificial oxygen which is provided for the patient to breathe will be detected automatically in absence of surgeons, in order to avoid the breathing trouble of the patient. Also the intimation of Heart rate can be done based on the density of the blood.

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