

Design of the Digital Pressure Meter with Thermohygrometer

Andjar Pudji

Department of Electromedical Engineering, Health Polytechnic of Surabaya, Indonesia

M.Ridha Mak,ruf

Department of Electromedical Engineering, Health Polytechnic of Surabaya, Indonesia

Abstract

Sphygmomanometer is one of the most widely used medical devices for patient diagnosis. This device_ is used to measure the patient's blood pressure non invasive. To maintain the accuracy of the measurement results Sphygmomanometer required calibration periodically. Calibration is an activity to determine the truth of a measuring instrument or measuring material. Tool for calibration tensimeter is Digital Pressure Meter (DPM). Thermohygrometer is a tool that combines the function of thermometer with hygrometer. In general we are more familiar with the thermometer and hygrometer, because its function as a temperature gauge is often used in everyday life. While hygrometer relatively rarely heard for the layman because it is only useful for measuring the air humidity both inside and outside the room. This thermohygrometer tool can be used to measure the temperature of air and humidity both in the room and also outside the room. In the calibration Sphygmomanometer must be considered the temperature and humidity of the room because it can affect the measure of pressure on the Sphygmomanometer. In this study the researchers designed the Sphygmomanometer Calibrator Tool equipped with thermohygrometer. Based on the measurement and comparison of data made 10 times error rate of 0.2% on the measurement rises, and measurement of room temperature and 0.2% on the humidity measurement.

Keywords: Calibration sphygmomanometer, Thermohygrometer

1. INTRODUCTION

Sphygmomanometer is an instrument that used to measure blood pressure that works manually or automatically, in the pumping or reduce pressure on the cuff with a non-invasive system. In the measurement of the blood, there are two kinds of blood pressure, the systolic (upper limit) and diastolic (the lower limit). Systolic pressure of 95 up to 140 mmHg, while diastolic pressure sebesar 60 up to 90 mmHg. According with technological development in the medical devices, sphygmomanometer has been developed ranging from mercury sphygmomanometer, aneroid sphygmomanometer, and most recently the digital sphygmomanometer.

According to the writer's observation, the results of blood pressure measurement is performed with a mercury sphygmomanometer results are different from the results of measurement conducted by digital sphygmomanometer. With the difference of the measuring results it is necessary to identify the blood pressure measuring devices. The results of blood pressure measurements should be done properly, this is due to concern health and safety of patients. Errors in the measurement of blood pressure can be caused by human error or the function of the tool itself that its accuracy has exceeded the allowable threshold (Standart error up to 3 mmHg).

In connection with the global demands in the quality of health services, the ISO 9000 and Law no 8 / 99 on consumer protection, the necessary measurement and calibration of medical must be scheduled. The procedures of calibration must be performed on a scheduled basis in order to maintain the safety of the user or operator and patients as consumers. In this regard needs to be calibrated to determine the truth value of a sphygmomanometer by comparing it with a standard measuring traceable. It is listed in Health Minister Regulation No. 363 / Menkes / PER / IV / 1998 on Testing and Calibration Medical Devices in Health Care facilities. In this case sphygmomanometer calibration can be done with DPM (Digital Pressure Meter), to obtain a degree of accuracy and a high degree of precision (Health Minister Regulation NO 363 / Menkes / PER / IV / 1998).

Thermohygrometer is a tool that combine the fuction between thermometer and hygrometer. Thermohygrometer can be use to measure the air temperature and humidity in indoor and outdoor. Thermometer is a tool that use to measure the temperature or the changing of temperature. Thermometer come from Latin words that means heat and meter mean ro measure. The unit of this measure is usually using Celcius (0C).

Hygrometer is an instrument used to calculate the percentage of water vapor (moisture) in the air, or simply a tool to measure the level of air humidity. Unit of measurement is the percentage (%). The larger the percentage, the higher the humidity.

At the hospital, the tool is used to measure the level of humidity of a room or a device that has a certain standard operating room, for example, 45-60% moisture is needed, laboratory space, baby care, sterilization is required 35-60% (Ministry of Health Decree No. 1204 / Menkes / SK / X2004)

Based on the problems above, The Researchers Designed A Chronological Related Devices Such Problems With The Title Design Of The Sphygmomanometer Calibrator Equipped With Thermohygrometer

2. RESEARCH METHOD

This research was experimental research that was conducted in the field with the design of posttest only control group. The subject of this research was comparison of Output Sensor. The procedure of this research was compare output sensor measurement and out sensor calculation. Dhe data was processed descriptively.

3. RESULT AND DISCUSSION

Blood Pressure

Blood pressure is the pressure used by the blood at an angle of 90^0 were punched in the wall of blood vessels, blood pressure refers to systemic arterial blood pressure, the pressure in the veins or arteries that send blood to body parts other than the lungs, as the main pulse with respect to the arm (in the arm). Values that are universally stated in millimeters of mercury (mmHg). Illustrates the peak systolic pressure artery pressure and circulatory kejantung, while diastolic pressure is the lowest blood pressure (Ahmad, Muhlisin.2013). The magnitude of the blood pressure to heart resting between 120 mmHg as systolic and 80 mmHg as diastolic (written as 120/80 mmHg), measure blood pressure is not static, but undergo natural variations from one person to another person, depending on nutrition factors, drugs / toxins, or disease (Ahmad, Muhlisin.2013).

Sphygmomanometer

Sphygmomanometer or Blood Pressure Meter is an instrument used to measure arterial blood pressure indirectly (Non Invasive) with the help of a stethoscope (Booth, J.1977). Sphygmus word of the Greek word meaning pulse, the scientific term manometer or pressure meter. At first discovered by Dr Samuel Siegfried Karl Ritter von Basch.Scipione Riva-Rocci, from Italy, in 1896. And popularized by Harvey Cushing in 1901 (Booth, J.1977).

Thermohygrometer

Thermohygrometer is a device that combines the functions of a thermometer and hygrometer. Thermohygrometer tool can be used to measure the air temperature and humidity both indoors and outdoors. (Source: Adi R W, 2011)

The Working Principle of Thermohygrometer

a. Temperature

Air temperature is a measure of kinetic energy average of the movement of molecules. Temperature of an object is a state that determines the ability of objects stretcher, to move (transfer) of heat to other objects or receive the heat from the other objects. In a system of two objects, objects that heat loss is has a higher temperature.

b. Humidity

Humidity can be interpreted in several ways. Relative Humidity is generally capable of representing the sense of humidity .To know the Relative Humidity, Absolute Humidity should be known first. Absolut Humidity is the amount of water vapor in a certain volume of air that is affected by temperature and pressure. Relative Humidity is a percentage ratio of the amount of water vapor contained in the volume compared with the maximum amount of water vapor that can be contained in the volume (occurs when experiencing saturation). Relative Humidity is also the percentage ratio of the current vapor pressure measurements were taken and the water vapor pressure when saturation.

Thermometer

Thermometer is an instrument used to measure the temperature or a change in temperature. The term comes from the Latin thermometer, thermo means heat and meter means to measure. The working principle of the thermometer is diverse, the most commonly used is mercury. When thermometer measuring the temperature is using thermometer, there are several scales which are used, such as the Celsius scale, Reamur, Fahrenheit and Kelvin scale. The four scales have differences in temperature measurement.

Hygrometer

Hygrometer is an instrument used to measure the relative humidity of the air, or the number of invisible water vapor in a given environment. Lower moisture will prevent the growth of fungus which is an enemy on the equipment.

The Relations Between Temperature and Humidity

When the temperature increases, the humidity will decrease and the capacity to accommodate the water vapor in the air will be increase. If the water vapor decreases, the temperature decreases and will lead to increased humidity.

Pressure Sensor (MPX)

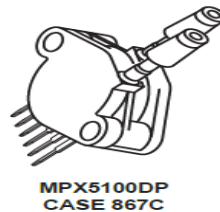


Figure 1 MPX Sensor

MPX 5100 sensor is a pressure sensor with temperature compensation, signal conditioning and has been calibrated. The pressure sensor is a monolithic silicon pressure sensor designed for a variety applications, especially using a microcontroller or microprocessor with input A / D (Sensor Datasheet MPX series).

Humidity Sensor 808 H5V5

Humidity sensor 808 H5V5 is a sensor based capacitive humidity sensor that changes the amount of moisture into a voltage. This sensor can measure humidity. This sensor contains a substrate thin film of polymer or metal oxide mounted between two conductive electrodes.

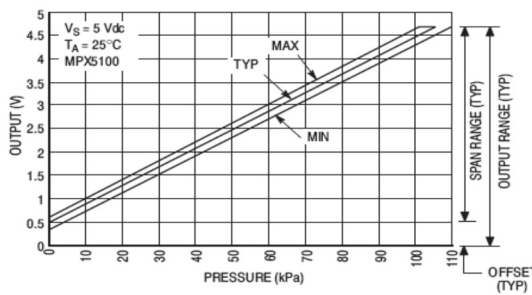


Figure 2 Humidity Sensor 808 H5V5

LM35

LM35 Temperature Sensor is one type of sensor that changes the temperature scale electric unit into voltage. LM35 have three pieces of pin legs, pin1 to INPUT positive voltage (+), PIN2 OUTPUT, INPUT pin3 negative voltage / GND (-). It can operate at voltages of 4 volts to 30volt

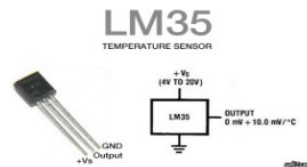


Figure 3 Temperature Sensor LM35

IC Mikrocontroller ATmega 328

ATmega 328 is a microcontroller in a group of AVR 8 bit.

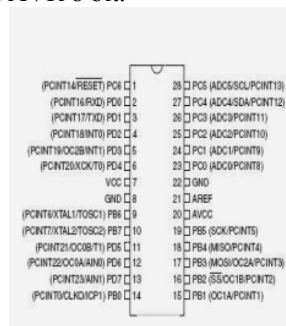


Figure 4 IC Microcontroller

ATmega328 has three main PORT, PORTB, PORTC and PORTD with a total pin input / output 23 pins. That PORT eventually serves as the input / output function as a digital or other peripherals.

LCD Character 2x16

LCD Character is a dot matrix display is enabled to display the text in the form of numbers or letters as desired

(according to the program used to control). LCD Module can be easily connected to the microcontroller. LCD to be used has a wide display 2 rows 16 columns or commonly referred to as character LCD 2 x16

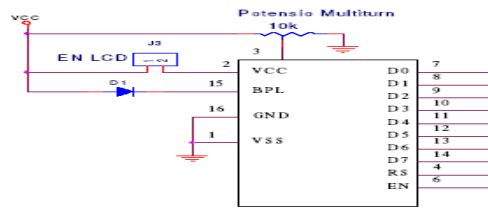


Figure 5 LCD Character circuit

Microcontroller Atmega 8 Circuit

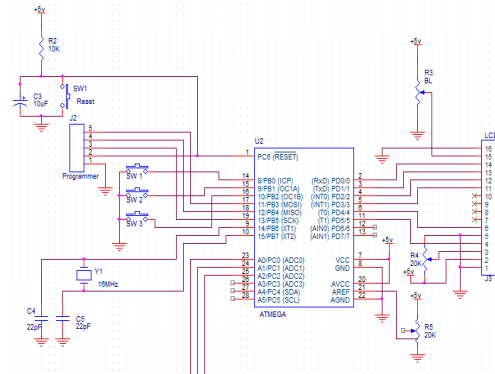


Figure 6 Microcontroller Atmega 8 Circuit

MPX 5100 GP Sensor Circuit

The Specifications of MPX 5100 GP Sensor Circuit required as follows:

1. The input is 5V and ground
2. MPX 5100 GP given the pressure which then entered the PORTC.0 for display to the LCD.

Table 1. The Comparison of Output Sensor Calculation and Measurement

Accuracy Point (mmhg)	Output (V)	
	Measurement	Calculation
0	0,36	0,312
50	0,65	0,612
100	0,92	0,912
150	1,27	1,212
200	1,55	1,512
250	1,86	1,812

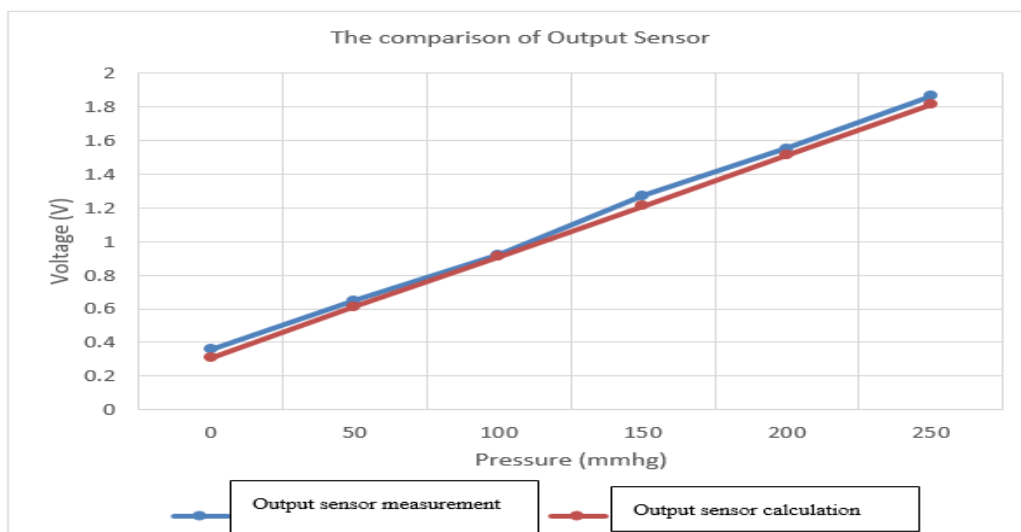


Figure 7. The comparison of Output Sensor (Calculation and Measurement)

From the comparison between measurements and calculations, there is a difference of voltage is about 0.1 volts. This is because the sensor has presentese error about 2.5%

4. CONCLUSION

- a. After measurements obtained sensor output is 0.1 volts between measurements and calculations, this is because the sensor has a percentage of error of about 2.5%.
- b. After measurements on a circuit of PSA there is a voltage difference is about 0.01 volts to the circuit summing amplifier and an inverting amplifier, this is because the effect of LM358 tolerance and resistance values used in the circuit is not exactly the same.
- c. After making the minimum system, the using of digital pin and analog pin si already matching with the necessary to LCD Display, button and ADC input.
- d. After testing, the pressure sensor can receive pressure of 0-250 mmHg, with an average of 0.091% on the measurement error up and down 0.083% on the measurement.
- e. After testing, the temperature sensor can tolerate temperatures of 10-60 ° C, with an average error of 0.2%.
- f. After testing, the humidity sensor can receive humidity 20-85% RH, with an average error of 0.44%

5. SUGGESTION

- a. Minimizing percentage error values so the result can be more accurate by using components that have little tolerance.
- b. Equipped by the indicator for battery.
- c. Can be developed with a connection to a PC (Personal Computer) for data collection.

REFERENCES

- Awan Suck T. (2014). Hygrometer Sebagai Sensor Thermal Pendeteksi Kelembaban.
<https://awambelajar.wordpress.com/2014/03/23/hygrometer-sebagai-sensor-thermal-pendeteksi-kelembaban/2014>
- Hygrometer. (2012). Laboratorium Core. Medan.
<http://laboratoriumcore.blogspot.co.id/2012/04/hygrometer.html>
- Keputusan Menteri Kesehatan RI Nomor 1204/MENKES/SK/X/ 2004
- Lakitan, Benyamin. (2014). Dasar-dasar Klimatologi. Cetakan ke II. Raja Grafindo Persada
<http://budisma.web.id/apa-itu-hygrometer/2014>
- Middleton W.E.K.A. (2002). History Of The Thermometer And Its Use In Meteorology. Baltimore: Johns Hopkins Press. Reprinted ed 2002. <http://id.wikipedia.org/wiki/termometer>
- Onny. (2011). Prinsip Kerja Termometer. <http://artikel-teknologi.com/prinsip-kerja-termometer/>
<http://perpustakaancyber.blogspot.com/2013/01/temperatur-perpindahan-kalor-pemuaian-zat-pengukuran-pengertian-perubahan.html>
- Thermohygro Medan. (2013). Sekilas Mengenai Suhu dan Kelembaban.
<http://www.pengukursuhutop.blogspot.com/p/beranda.html> 2013
- Fluke biomedical. Digital pressure meter. (2014)
<http://www.flukebiomedical.com/Biomedical/usen/pressure-meters/DPM4-Pressure-Vacuum-Temperature-tester.htm?PID=55945>
- Soeprijatno, Djoko. (2013). Sphygmomanometer atau tensimeter.
<http://djokosoeprijanto.blogspot.com/2013/04/sphygmomanometer-atau-tensimeter.html> , Peraturan Menteri Kesehatan RI No.363/MENKES/PER/IV11998
- Muhlisin, Ahmad.(2013). Tekanan Darah .<http://mediskus.com/penyakit/tekanan-darah.html>
- Anderson, Paul D. (1996). AnatomidanFisiologiTubuhManusia. Jakarta : EGC Kalibrasi alat kesehatan
<http://elektromedik.blogspot.com/2008/04/kalibrasi-alat-kesehatan>.
- Booth, J (1977). A short history of blood pressure measurement *Proceedings of the Royal Society of Medicine*