Design of Tensimeter Calibrators Completed with Pressure Leak Measurement Mode

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Abstract: ***Calibration is a technical activity which consists of determining and determining one or more characteristics of a product, according to a predetermined specific procedure. The purpose of calibration is to ensure the measurement results are in accordance with national and international standards. One of the medical tools that need to be calibrated is the tensimeter, while the tool for calibrating the tensimeter is the Digital Preassure Meter.The purpose of this research is to design a tensimeter calibrator equipped with a leak mode. The research design used is pure experimental research, namely the independent variable is pressure, and the dependent variable is time. The stages used are circuit design, testing andcalibration.After testing, the pressure sensor can accept pressures from 0 - 250 mmHg, with an average error of 0.080% in upward measurements and 0.063% in downward measurements. And the average error timer from the test results obtained an error of0.000833%.***

Keywords: Tensimeter Calibrator, Pressure Leakage Measurement Mode

1. Introduction

Currently with global demands for quality health services, the existence of ISO 9000 and Law No. 8/99 on consumer protection, it is necessary to measure and calibrate medical devices regularly. Calibration procedures must be carried out on a scheduled basis to maintain the safety of users or operators and patients as users. In this regard, it is necessary to calibrate to determine the truth value of a tensimeter by comparing it with traceable measurement standards. This is stated in Permenkes No. 363 / Menkes / PER / IV / 1998 concerning Testing and Calibration of Medical Devices at Health Service facilities. In this case the tensimeter calibration can be done with a DPM (Digital Pressure Meter), so that a high level of accuracy and precision is obtained (Republic of Indonesia. 1998. Permenkes NO. 363 / Menkes / PER / IV / 1998).

Tensimeter is a tool used to measure blood pressure that works manually or automatically, in pumping or reducing pressure on the cuff with a non-invasive system. In blood measurement, there are 2 types of blood pressure, namely systolic (upper limit) and diastolic (lower limit). Systolic pressure is 95 to 140 mmHg, while diastolic pressure is 60 to 90 mmHg. Along with the development of technology in the field of medical equipment, tensimeters have experienced developments ranging from mercury tensimeters, needle tensimeters, and most recently digital tensimeters. According to the author's observations, the results of measuring blood pressure using a mercury tensimeter are different from those made with a digital tensimeter. With the difference in the measurement results, it is necessary to identify the blood pressure measuring instrument.

The results of measuring blood pressure must be done correctly, this is because it involves patient health and safety. Errors in blood pressure measurement can be caused by human error or in the function of the tool itself, whose accuracy has exceeded the permissible threshold (Maximum standard error is 3 mmHg).

A tool to calibrate tensimeter is the Digital Pressure Meter. Digital Pressure Meter is a device designed to measure the pressure of medical devices in liquid or gas form to help calibrate medical devices, in this case the tensimeter calibration (flukebiomedical).

The leakage measurement mode is one of the procedures in performing the calibration where in this process the leakage measurement is carried out at the tensimeter to be calibrated. In this case the researcher designed a tool entitled Designing a Tensimeter Calibrator Equipped with a Pressure Leakage Measurement Mode.

Blood Pressure Meter is an instrument used to measure arterial blood pressure indirectly (non-invasive) with the help of a stethoscope

There are two types of Tensimeters:

1) Digital Tensimeter

Easy to operate and practical to use. In its use, when used in a large number of patients the reading results are invalid and inaccurate.

2) Manual Tensimeter

The mercury meter generally consists of an inflatable cuff that can be inflated, a measuring unit (Mercury Manometer), and a tube / container to connect the two, along with a pump equipped with a valve to prevent pressure leakage. Pressure regulator is used as a regulator in reading.When the system is not pressurized, the level of mercury in the container with that of the glass / plastic tube shows a "0" position on the cylinder scale. Pressure on the pump causes pressure on the cuff and container of mercury, then forces the mercury to rise at a certain scale (mmHg). The air displaced by the increase in mercury is discharged through a vent which contains a filter which functions to keep the mercury out and filter the air that enters the glass / plastic glass tube.

For aneroid tensimeter, the pressure applied will flex the diaphragm through a mechanical connection, this movement causes the needle to rotate at a certain number according to the pressure applied. Pressure pumps, valves / pressure regulators, cuffs and mercury tubes both aneroid tensimeter and mercury tensimeter have the same maintenance system. Manometer has a fundamental difference in its use.

Blood Pressure

The amount of blood pressure for a resting heart is between 120 mmHg as a systolic and 80 mmHg as a diastolic (which is written as 120/80 mmHg). This measure of blood pressure is not static, but experiences a natural variation from one person to another, depending on factors. nutrition, medicine / poison, or disease. Universal values are expressed in millimeters of mercury (mmHg). Systolic pressure describes the peak artery pressure and is associated with heart blood circulation, while the diastolic pressure is the lowest blood pressure.

Conceptual framework

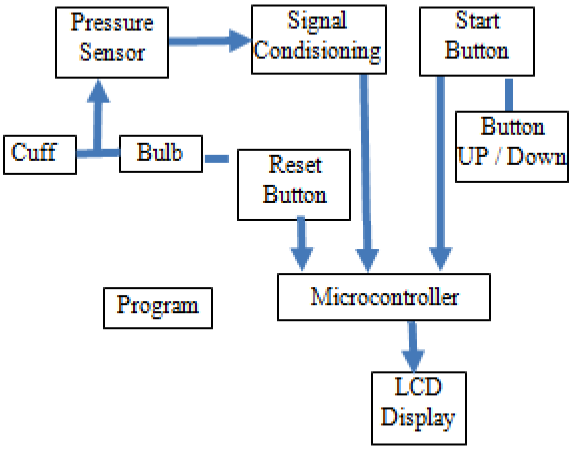

Figure 1 Block Diagram

When the power button is pressed, the entire circuit gets a voltage including all sensors, so that the sensor is ready and ready to operate. Then the selection of calibration measurements or pressure leakage measurements is carried out by pressing the up / down button. After that press enter.
To start the tensimeter calibration, select the pressure measurement mode. Then the pressure limit is selected as a reference point by pressing the up / down button. After that press enter. Before any pressure, the display shows a value of 0 mmHg. Pumping is done manually.

2. Research Methods

The incoming pressure will be received by the pressure sensor, then converted into an analog voltage. The voltage will then be processed by the analog signal conditioning circuit before entering the internal ADC that is available in the Microcontroller IC. After the ADC input voltage, the analog voltage will be converted into a digital voltage for processing by the microcontroller. The data resulting from this processing will be processed through a microcontroletler, then displayed on the LCD.
For the leakage measurement menu Pump the cuff until the display shows a pressure of 200 mmHg, press the enter key to start the timer. When the timer reaches 60s, the pressure reading is converted so that the leakage value appears

3. Result and Discussion

Table 1: Measurement Sensor Outputs

Accuracy Point (mmhg)	Output Voltage (V)
0	0.01
50	0.62
100	1.24
150	1.79
200	2.36
250	2.96

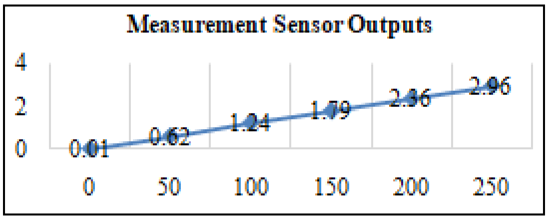

Figure 2: Comparison of Calculation and Measurement Sensor Outputs

From the results of comparisons between calculations and measurements, there is a difference in voltage of about 0.1 volts. This is because the sensor has a max error percentage of around 2.5%.

Table 2: Comparison of Calculation and Measurement PSA Output

No	Setting Timer Internal 120 detik
1	120
2	120
3	120
4	119
5	120
6	120
7	120
8	120
9	120
10	120
11	120
12	120
13	119
14	120
15	120
16	120
17	120
18	120
19	120
20	120
AVERAGE	119.9
Settting	120
ERROR	0.000833333

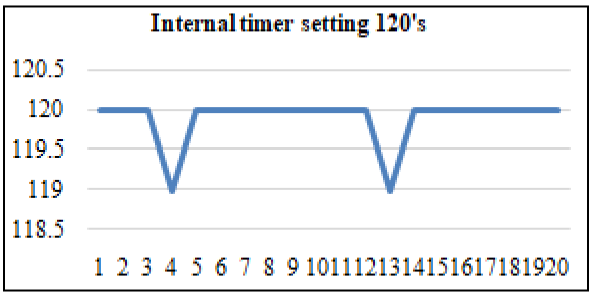

Figure 3: Comparison of Calculation and Measurement PSA Outputs

From the measurement results it can be concluded that the sensor output can be said to be linear because the increase in sensor output is quite linear.

4. Discussion on System Performance

For module performance, before the pumping process, the available modes are selected, namely leakage mode and calibration mode. In leakage mode, it is used to detect the leakage value of the tensimeter for 2 minutes. Measurements were carried out as much as 20 x with a setting time of 2 minutes and the average was 119.9 seconds.

While the calibration mode is to calculate the accuracy of the pressure at a certain point (0.50,100,150,200,250) and measure the temperature and humidity in the room during the calibration.

Measurements are made using a Digital Pressure Meter (DPM) and the measuring object uses a tensimeter. Data were collected 3 times. Based on the measurement results, when the pressure measurement rises to an accuracy point of 0 mmHg, the standard measurement result is 0.0 mmHg. At an accuracy point of 50 mmHg, a standard reading of 50.0 mmHg is obtained. At an accuracy point of 100 mmHg, a standard reading of 100.2 mmHg is obtained. At an accuracy point of 150 mmHg, a standard reading of 144.9 mmHg is obtained. At an accuracy point of 200 mmHg, the standard reading is 199.7 mmHg. At an accuracy point of 250 mmHg, a standard reading is obtained.

5. Conclusion

The conclusion of our study is that the measurement was carried out as much as 20 x with a time setting of 2 minutes and the average was 119.9 seconds. And when the pressure measurement drops to an accuracy point of 0 mmHg, a standard reading of 0.0 mmHg is obtained. At an accuracy point of 50 mmHg, a standard reading of 50.5 mmHg is obtained. At an accuracy point of 100 mmHg, a standard reading of 100.1 mmHg is obtained. At an accuracy point of 150 mmHg, a standard reading of 150.0 mmHg is obtained. At an accuracy point of 200 mmHg, a standard reading of 199.9 mmHg is obtained. At an accuracy point of 250 mmHg, a standard reading of 250.2 mmHg is obtained. From the measurement results, it is found that a certain accuracy point has a large enough error value, this is because the MPX5100GP sensor has a maximum error of ± 2.5 kPa or 18.75 mmHg.

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