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The Use of Two DPM Modes Equipped with a Thermo-hygrometer and Pressure Selection for the Implementation of Community Service

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ABSTRACT Calibration is a technical activity consisting of determination, determination of one or more properties and characteristics of a product, process,s or service in accordance with a specific procedure that has been determined. The purpose of calibration is to ensure that the measurement results comply with national and international standards. Digital Pressure Meter (DPM) Two Modes equipped with Thermohygrometer and Pressure Selection is a device used to determine positive pressure and negative pressure (vacuum). Using the MPX 5050GP sensor as a positive pressure sensor. maximum pressure requirement is 300 mmHg. Using a DHT 22 sensor for temperature humidity. This device is also equipped with a leak test timer. The display used in this module is a 2.4-inch TFT Nextion LCD. After carrying out the measurement process to the mercury sphygmomanometer 6 times, the smallest result was 0 mmHg at 0 mmHg pressure and the largest was 298.0 mmHg at 300mmHg pressure. Based on the temperature humidity data collection carried out in the room obtained 31℃ at temperature and 87% at humidity.

INDEX TERMS Calibration, tensimeter, humidity, community health center, community service.

I. INTRODUCTION

Digital Pressure Meter (DPM) is a device used to measure positive and negative pressure on medical devices in liquid or gas form to assist in the repair and quality control. The way this device works is by converting the value of the pressure sensor to be changed and displayed on the display. There are many forms, types, and functions of Digital Pressure Meters, such as those that function only as blow pressure and suction pressure. In this study, the use of DPM is related to the calibration of the mercury sphygmomanometer and suction pump. Tensimeter is a device to measure blood pressure that is often used in the medical world. Its function is very vital because it becomes the basis for doctors to diagnose patients' health.

Accurate blood pressure measurement requires the use of an accurate sphygmomanometer. The accuracy of the sphygmomanometer is highly dependent on the proper maintenance and calibration of this equipment. One of the most common errors in blood pressure measurement is caused by using an uncalibrated sphygmomanometer and improper use of a cuff. Inaccurate maintenance and calibration of the sphygmomanometer is the cause of systematic errors in blood pressure measurement

According to data on medical equipment inventory at Syarifah Ambami Rato Ebu Hospital, Bangkalan, Madura in 2018 it had 69 mercury Tensimeters, of which 66 devices were in good condition and 3 devices were heavily damaged. In 2014 the Digital Pressure Meter (DPM) owned by RSUD Syamrabu was damaged, so to overcome the maintenance and calibration of the mercury sphygmomanometer so that the device was maintained properly. The hospital maintains a manual leak test and waits for a year for calibration from the BPFK. The sphygmomanometer and suction pump were previously made by an electrical engineering student who made a final project entitled Portable Tensimeter Calibrator Based on the ATmega 8535 Microcontroller, Heru Wahyu Purnama (2014) In the device that was made there was only one type, namely a mercury sphygmomanometer displayed on the character LCD, but this device was not equipped with a vacuum pressure [1]. In 2015 Rosyi Dwi Putranti conducted research entitled "Analysis with a Needle Tensimeter", the analysis stated that the number of leaks in the mercury sphygmomanometer was 25% of the 16 devices tested with a maximum leak of -77.6 mmHg, the number of leaks in the needle sphygmomanometer. as much as 6.25% of the 16 devices tested with maximum leakage of -46mmHg, the mercury sphygmomanometer leak is higher than the needle sphygmomanometer, so the authors think that to reduce the occurrence of leaks, calibration and maintenance of the sphygmomanometer is needed [2]. In 2017 Junia Dyah Permata Wibisono made a final project entitled Digital Pressure Meter (DPM) Vacum Pressure with a character LCD display. This device only uses 1 (one) mode which is used only for the suction pump[3]. In 2018 Yosep Kurniawan made a final project about a Digital Pressure Meter (DPM) with two modes, namely positive pressure, and suction pressure, but this device has a relatively standard level of accuracy, which has a different value or correction value of 0 – 3mmHg [4]. In 2019 Mukhamad Ryan Nur Rohman made a final project on the Digital Pressure Meter (DPM) Tensimeter and Suction Pump, but this device still has drawbacks, namely the leakage rate used when measuring the sphygmomanometer and the lack of temperature, humidity in the calibration of the sphygmomanometer and suction pump. The temperature and humidity of the room must be considered because they can affect the results when taking measurements [5].

The conditions of the calibration environment must be adjusted according to the requirements of the calibration method such as temperature and humidity. Calibration does not always have to be carried out in a strictly conditioned space. Conditioning of the calibration environment is usually carried out for the calibration of equipment that changes easily due to the influence of temperature, humidity, vibration, light, and so on.

II. MATERIALS AND METHODS

A. Research Design

This research uses the measurement of mercury sphygmomanometer with positive pressure setting; 0mmHg, 50mmHg, 100mmHg, 150mmHg, 200mmHg, 250mmHg, 300mmHg, which can then be converted to kPa. Data collection was repeated 6 times.

1. TOOLS AND MATERIALS

This research uses the MPX 5050 GP sensor to function as blow pressure. And the DHT 22 sensor functions as a temperature, humidity sensor. The MPX 5050 GP sensor output then goes to the buffer circuit input. The output of the buffer circuit then vcc, output, and gnd from the DHT 22 sensor foot are then entered and processed to the Arduino Nano. Arduino Nano as controller and controller. Arduino Nano output in the form of a display on a 2.4-inch TFT Nextion LCD.

2. EXPERIMENT

In this study, after the design was finished, the Digital Pressure Meter (Positive Pressure) output was tested with pressures of 0mmHg, 50mmHg, 100mmHg, 150mmHg, 200mmHg, 250mmHg, 300mmHg, then measured with a Tensimeter. Each set was calculated to validate the results of this study.

B. Blok Diagram

In this study, Positive data were obtained from the cuff hose and pump hose from the Tensimeter with several pressures, namely 0mmHg, 50mmHg, 100mmHg, 150mmHg, 200mmHg, 250mmHg, 300mmHg, which are shown in FIGURE 1. MPX 5050 GP sensor as blow pressure. The sensor output then enters the input buffer circuit as a current amplifier without a voltage amplifier. The output buffer is then entered and processed to the Arduino Nano. There is a conversion from mmHg to kPa which will be processed to the Arduino Nano as well. After processing using Arduino Nano, the output is a display on the 2.4 inch Nextion TFT LCD.

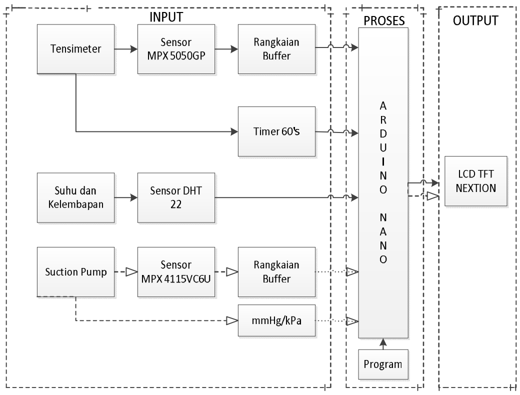

FIGURE. 1. **Blok Diagram**

Description:
.... = Not discussed
_________ = Discussed

1. Sphygmomanometer

There is a calibration process, the cuff hose and the pump hose from the sphygmomanometer are used for calibration testing materials.

2. Sensor MPX 5050 GP

As an inflatable pressure sensor. The sensor output then goes into the Buffer circuit.

3. Sensor DHT 22

As a humidity temperature sensor, vcc, output and ground are connected to the Arduino nano pins.

4. *Buffer Circuit*

As a buffer, where the basic principle is a current amplifier without a voltage amplifier. The output buffer is then entered and processed to the Arduino Nano.

5. Timer 60 seconds

serves as a timer to perform a leak test when taking measurements on the sphygmomanometer

6. Arduino Nano

Arduino Nano as controller and controller. The output is a display on the 2.4 inch Nextion TFT LCD.

7. LCD TFT Nextion 2,4 inch

Nextion TFT LCD serves as a display to display the measurement process, calibration. In the Digital Pressure Meter tool system, the LCD displays the pressure and conversion results

C. Flowchart

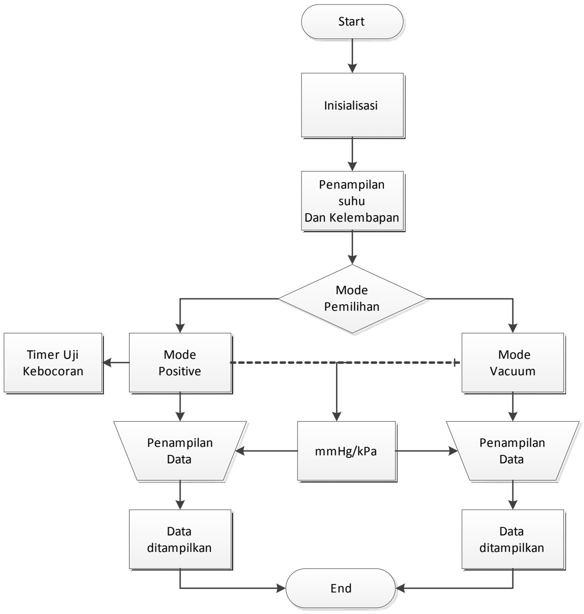

FIGURE. 2. **The Flowchart**

shown in FIGURE 2. When the module is started, initialization occurs, the appearance of temperature, humidity, there are two mode selections, namely positive and vacuum modes. When selecting positive mode during manual pumping, the MPX 5050 GP sensor will read and the results will be displayed in the measurement. The positive mode has a 60-second timer for leak testing. From the results of these readings, the pressure unit can be converted again from mmHg to kPa then the data is displayed on the Nextion 2.4 inch TFT LCD.

D. Circuit Schematic

1. BUFFER AMPLIFIER

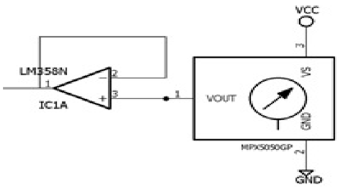

FIGURE. 3. **Buffer Circuit**

The Intrusion Buffer Amplifier circuit, as shown above, gets input from the positive MPX5050GP pressure sensor.

2. DHT 22

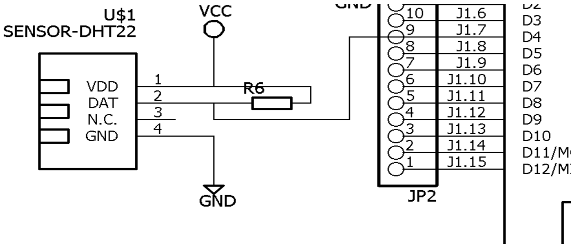

FIGURE. 4. **DHT circuit connected to Arduino pins**

FIGURE 4 The DHT 22 is connected to the Arduino Pin by connecting the sensor pin output to the Arduino digital pin.

3. TFT NEXTION DISPLAY

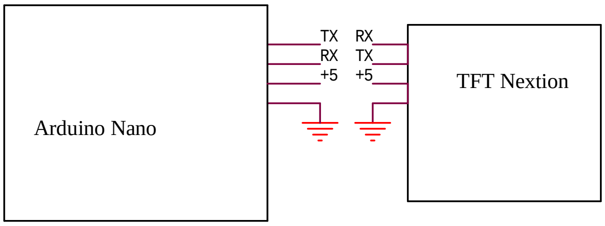

FIGURE. 5. **Nextion Tft Connector to Arduino**

TFT Nextion pin connected to Arduino by connecting Arduino TX pin to TFT Nextion pin RX and vice versa Arduino RX pin to TX pin TFT Nextion (FIGURE 5)

III. RESULT

In this study, the Digital Pressure Meter has been measured using a mercury sphygmanometer (FIGURE 6)

FIGURE. 6. **Measurement on the sphygmomanometer**

1. DIGITAL PRESSURE METER MODULE DESIGN

The Digital Pressure Meter module is shown in FIGURE 7. There is each connection of the sensor output. The maximum pressure of the vacuum pressure is -400 mmHg. The display used is a Nextion TFT LCD.

FIGURE. 7. **Digital Pressure Meter Module**

2. ARDUINO PROGRAM

Listing Program 1. reading the pressure value from the MPX 5050 GP sensor gram 1. pembacaan nilai tekanan dari sensor MPX 5050 GP

```
void loop(void)
{
  delay(50);
  sensorValue = analogRead(sensorPin);
  //pembacaan ADC sensor positif mpx5050GP
  Vout = (sensorValue *5.0/1023.0)*1000;
  //konversi data ADC ke tegangan Vout sensor
    Value_Kpa= ( Vout-165.29)/90;
//rumus Kpa disesuaikan dengan datasheet sensor
Value_mmHg = (Value_Kpa*7.5);
//1 Kpa = 7.5 mmHg
static char tekananPositif[6];
dtostrf(Value_mmHg, 3, 1, tekananPositif);
t9.setText(tekananPositif);
delay(50);
```

Program Listing 2. Temperature Humidity

```
void bupdatePopCallback(void *ptr) {
 // membaca kelembaban
 float h = dht.readHumidity();
 // membaca temperature suhu
 float t = dht.readTemperature();

 if (isnan(h) || isnan(t) ||) {
   return;
 }
 static char temperatureCTemp[6];
 dtostrf(t, 6, 2, temperatureCTemp);
 tTempC.setText(temperatureCTemp);
 char hTemp[10] = {0};
 utoa(int(h), hTemp, 10);
 tHumidity.setText(hTemp);
}
```

3. MEASUREMENTS ON MERCURY SPHYGMOMANOMETER

TABLE 1.
Measurement Results on Mercury Tensimeter

Pressure mmHg	Up 1	Down 1	Up 2	Down 2	Up 3	Down 3	Average
0	0,0	0,0	0,0	0,0	0,0	0,0	0
50	48,0	48,0	49,0	47,0	49,0	48,0	48,2
100	96,0	97,0	102,0	97,0	100,0	96,0	98,0
150	150,0	149,0	149,0	148,0	151,0	146,0	148,8
200	201,0	199,0	198,0	197,0	200,0	197,0	198,7
250	248,0	248,0	247,0	247,0	248,0	248,0	247,7
300	295,0	295,0	297,0	297,0	298,0	298,0	296,7

Data retrieval in this module is carried out with a mercury sphygmomanometer. This measurement was carried out for 6 measurements (TABLE 1).

4. CONVERSION OF MMHG TO KPA PRESSURE UNITS

TABLE 2.
Mmhg To Kpa . Conversion Results

Pressure (mmHg)	Measurement mmHg		mmHg to kPa	
	Up 1	Down 1	Up 1	Down 1
0	0,0	0,0	0,0	0,0
50	48,0	49,0	6,4	6,5
100	96,0	102,0	12,8	13,6
150	150,0	149,0	20	19,8
200	201,0	199,0	26,8	26,5
250	248,0	248,0	33,1	33,1
300	295,0	295,0	39,3	39,3

From the table above, it is the result of data conversion on positive pressure, every increase or decreases the result is divided by 7.50062 to get a conversion to kPa. From the conversion results, the results are not always far away when calculated manually (TABLE 2).

5. MPX 5050 GP SENSOR OUTPUT MEASUREMENT

TABLE 3.
Sensor Output Results Mpx 5050 GP

V. Supply (Volt)	Tekanan (mmHg)	V.Out Sensor (Volt)	
		Upward	Downward
5,00	0	0,15	0,17
5,00	50	0,67	0,65
5,00	100	1.18	1.20
5,00	150	1,71	1,70
5,00	200	2.25	2.27
5,00	250	2.67	2.69
5,00	300	3.88	3.82

Measurement of the MPX 5050GP Sensor Output using a multimeter (TABLE 3).

6. MEASUREMENT OF TEMPERATURE HUMIDITY

TABLE 4
Temperature Comparison

Temperature On Module	Temperature On Module
31.0 ^{0}C	30.7 ^{0}C

TABLE 5
Humidity Comparison

Humidity On Module	Humidity on Thermohygrometer
87%	86%

Measurement of temperature and humidity on the tool module using a comparison tool Thermo-Hygrometer model:HTC-2 The test is carried out in a room.

IV. DISCUSSION

Positive pressure measurement 0- 300mmHg with a drop of 50mmHg dots. Measurement of this module has been carried out data collection on a mercury sphygmomanometer device for 6 measurements. The results of the data obtained show that the measurement is not much different from the original pressure of the tool. Measurement of temperature and humidity is carried out in the measurement room, only 1 measurement is carried out with a comparison tool, the results of the data obtained are not too far away.

V. CONCLUSION

Seca Overall this research can conclude that:
The overall circuit made is in accordance with the needs of the DPM module, namely for ADC, touch screen display buttons. The results of positive pressure measurements, namely pressures from 0 to 300 mmHg, are measurements on a device using a mercury sphygmomanometer. Measurements were carried out six times. Measurement of the positive sensor output or the Mpx 5050GP sensor is done by measuring the output and gnd of the pressure 0-300 mmHg from the sensor using a multimeter.
The results of temperature and humidity measurements are measurements using a Thermo-Hygrometer model: HTC-2 as comparison data collection. how to compare the display display pressure readings on the DPM module TWO MODE model : HTC-2.

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