# DPM Two Modes Equipped With Temperature And Humidity

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**Abstract**

**Calibration is a technical activity that consists of the determination, the determination of one or more properties or characteristics of a product, process or service in accordance with a special procedure has been set. The purpose of this is to ensure the calibration measurement results in accordance with national and international standards. The tools used for the calibration of pressure Digital Pressure Meter. This tool is used to measure the pressure and suction pump sphygmomanometer or other devices that use parameters for measuring pressure. This module manufacturing system using Arduino system as a controller and as processing analog data into digital data of the sensor MPX5100GP and MPXV4115V using analog signal conditioning circuit and displayed on the LCD Touchscreen with 2 modes of measurement that is positive pressure and vacuum pressure with pressures ranging from 0-300 mmHg for positive pressure and 0 –(-400) mmHg to vacuum pressure. There is also a DHT22 sensor, As a detector for temperature and humidity for use in the work method in the calibration process. Based on a stress test generated and using comparators Digital Pressure Meter 2 plus brand fluke, this tool has an error value of 0 to 0.58% and has a value increment or correction value of 0 - 3. It can be concluded that the DPM DUA MODE this deserves to be used.**

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## I. INTRODUCTION

Every medical device used in health care facilities and other health facilities must be periodically tested and or calibrated by health facility testing centers or health facility testing institutions. Calibration is the activity of observation to determine the correctness of the value of the appointment of measuring instruments and or measuring materials .

Blood pressure measurement is an important component of the general examination of each patient and a sphygmomanometer is one of the most commonly used diagnostic medical devices. Accurate blood pressure measurement requires the use of an accurate sphygmomanometer[1]. A manual sphygmomanometer is a tool used to measure blood pressure and consists of inflatable cuffs, mercury manometers (or aneroid gauges) and inflation balls and gauges. Inflatable cuffs are used to limit blood flow, and manometers are used to measure pressure. The accuracy of the sphygmomanometer is very dependent on carrying out the correct maintenance and calibration process of this equipment. One of the most common errors in blood pressure measurement is caused by using a calibrated sphygmomanometer and improper use of cuffs. Inadequate maintenance and calibration of a sphygmomanometer is the cause of systematic errors in blood pressure measurements.[2]

One of the calibrators is DPM (Digital Pressure Meter). DPM is a tool used to measure positive and negative pressure from medical devices in the form of either liquid or gas to assist in the repair and quality control. In this case, DPM is used to calibrate the tensimeter of mercury and suction pump.[3]

This tool is very much on the market, one of the electromedical engineering students who made the final assignment entitled Portable Tensimeter Calibrator Based on ATmega 8535 Microcontroller is Heru Wahyu Purnama (2014). In this tool raised the concept of positive pressure for one type of perimeter only by displaying on the character LCD, but this tool is not equipped with suction pressure (vacuum pressure). In 2017 Junia Dyah Permata Wibisono made a final assignment entitled Digital Pressure Meter (DPM) Vacum Pressure with character LCD display. In this tool only uses 1 (one) mode which is used only for the suction pump. In 2018 Yosep Kurniawan made a final assignment on the two modes Digital Pressure Meter (DPM), namely positive pressure and suction pressure but

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this tool has not been equipped with temperature and humidity sensors as a support in the calibration process.

The calibration environment conditions must be arranged according to the requirements of the calibration method such as temperature and humidity. Calibration should not always be done in tightly conditioned rooms. Conditioning the calibration environment is usually done for calibration of equipment that is easily changed due to the influence of temperature, humidity, vibration, light, and so on. To find out the temperature and humidity during the sphygmomanometer calibration process, a Thermo Hygrometer is needed which is an external device from the DPM calibrator.[4]

Based on the results of the search problem above, for effectiveness, a two-mode DPM was made equipped with temperature and humidity to determine the temperature and humidity of the environment contained in the calibrator.

## II. Materials and Methods

### A. Experimental Setup

This research uses objects with a sphygmomanometer and suction pump. Retrieving the data is done sequentially starting from low to high pressure. Data collection is 6 sets when going up and down.

#### 1) Materials and Tool

This study uses MPX5050GP sensors as a positive pressure detector and MPXV4115V6CU sensor as a vacuum pressure detector. The components using Arduino Nano as a Microcontroller, DHT22 sensor, and Nexion LCD as a display.

#### 2) Experiment

In this study the researchers measured the output of a positive pressure sensor circuit using a Sphygmomanometer with pressure settings 50, 100, 150, 200, 250 and 300 and measured the output of a series of vacuum pressure using a suction pump with a pressure setting of -50, -100, -150, -200, -250, -300, -350 and -400. Measurement using a comparison of the Crystal 30 Series calibrator. Measurement of temperature and humidity using TH108 thermohygrometer for comparison. The research was conducted at BPFK Surabaya.

### B. Diagram Block and Flowchart

When the switch is turned ON, the power supply will supply voltage to the entire circuit. The sensor will receive pressure given both positive pressure and vacuum pressure. The sensor output goes to the buffer amplifier circuit then the ADC data is processed on the microcontroller circuit and the results will be displayed on the TFT LCD screen. the results of the DHT sensor in the form of digital data will be sent to the microcontroller circuit and will immediately be displayed on the TFT LCD screen in the form of temperature and humidity.

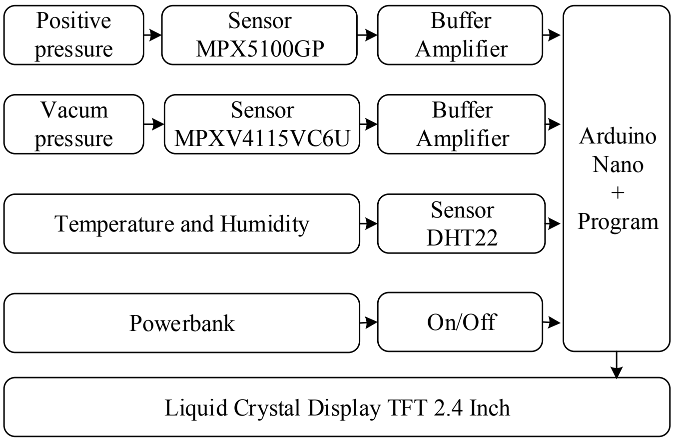

Fig. 1. The diagram block of the DPM 2 mode

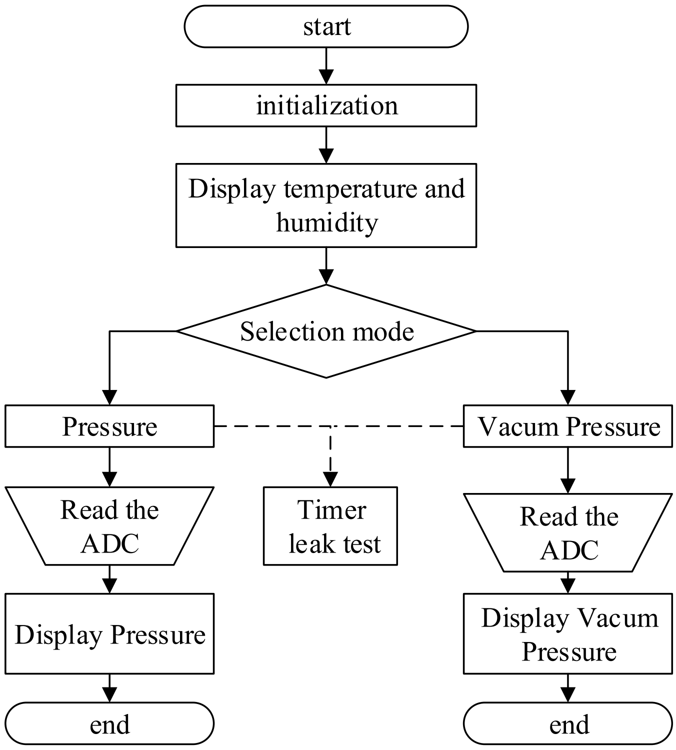

Fig. 2. The Flowchart of the Arduino Program

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### *C. The Flowchart*

Arduino program runs like a flowchart Fig. 2. The program starts from the initialization of microcontroller displays the temperature and humidity of the room and there is a choice of modes namely pressure and vacuum pressure. if the selection of both is done. reading the adc sensor data will be read mikrokontoller and the results will be displayed. there is also a leak timer button.

### *D. Circuit*

#### *1) Buffer Amplifier*

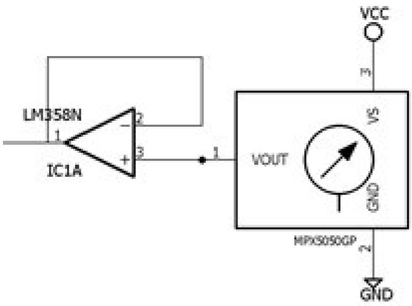


Fig. 3. Instrumentation amplifier

The buffer Intrusion Amplifier circuit, as shown above, gets input from the MPX5050GP sensor that gets positive pressure / MPXV4115VC6U. Combine this buffer as a current buffer circuit so that the input voltage and output voltage are the same.

#### *2) DHT 22 Connection*

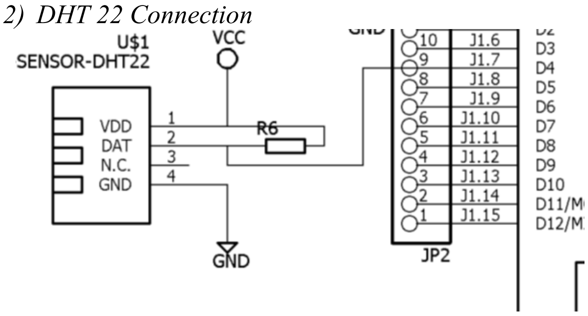


Fig. 4. Band pass filter

The DHT 22 circuit is connected to the Arduino Microcontroller by connecting the pin sensor pin 2 output to the Arduino digital pin.

#### *3) Nextion Connection*

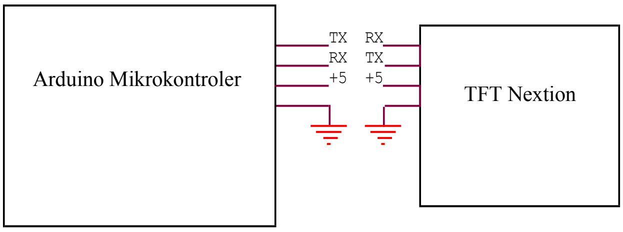


Fig. 5. Bluetooth Conection

Nextion TFT LCD circuit connected to the Arduino Microcontroller by connecting the Arduino TX pin to the Nextion TFT LCD pin and vice versa, the Arduino RX pin to the Nextion TFT TX LCD pin

## III. RESULTS

In the research conducted a trial on DPM using a sphygmomanometer and suction pump, measurements were also made using crystal 30 series (crystal, 30 series, Germany).


Fig. 6. DPM two modes

#### *1) DPM Design*

Image design tools can be seen in Fig. 6. there are two connecting connectors for vacuum pressure and pressure. pressure has a limit up to a maximum of 300 mmHg and for vacuum pressures up to 800 mmHg. The settings button is on the LCD touch screen

#### *2) Arduino DPM Program Results*

In this journal arduino program divided by 3, which is a program pressure reading (vacuum pressure and pressure), program temperature and humidity readings and time in the next application

Listing program 1. The program to send the sensor to the microcontroller

```
===== Positive Pressure ===========
void loop (void){
  delay (50);
  sensorValue = analogRead (sensorPin);
// reading the positive sensor ADC mpx5050GP
  Vout = (sensorValue * 5.0 / 1023.0) * 1000;
// convert ADC data to Vout sensor voltage
  Value_Kpa = (Vout-161.29) / 90;
 Value_mmHg = (Value_Kpa * 7.5) - zero;
// conversion of Kpa unit pressure value to value pressure
unit mmHg (1 Kpa = 7.5 mmHg)
  static char pressure Positive [6];
  dtostrf (Value_mmHg, 3, 0, Positive pressure);
  t9.setText (Positive pressure);
// Send the sensor reading on nextion screen
  delay (50);

====== Vacuum pressure ===========
delay (50);
  sensorValue2 = analogRead (sensorPin2);
// the mpxv4115vc6u vacuum sensor ADC reading
   Vout2 = (sensorValue2 * 5.0 / 1023.0) * 1000;
// convert ADC data to Vout sensor voltage
  Value_Kpa2 = (4644.0- Vout2) /38.26;
// conversion of Vout voltage sensor data to Kpa unit
value
// (adjusts to the sensor datasheet)
Value_mmHg2 = (Value_Kpa2 * 7.5);
// conversion of Kpa unit pressure value to pressure value
// unit mmHg (1 Kpa = 7.5 mmHg)
  static char pressure Negative [7];
  dtostrf (Value_mmHg2, 3, 0, negative pressure);
  t10.setText (Negative pressure);
// Send the results of sensor readings on the nextion screen
  delay (50);
```

Listing program 1. The program to send the sensor DHT22 to the microcontroller

```
// ====== Temperature and Humidity ===
  void bupdatePopCallback (void * ptr) {
  // read the humidity }
float h = dht .readHumidity ();
  // read temperature temperature
  float t = dht.readTemperature ();
  if (statement (h) || name (t) ||) {
    return;
 // update temperature in Celsius
  static char temperature is Temp [6];
  dtostrf (t, 6, 2, temperature CTemp);
  tTempC.setText (temperatureCTemp);
  // update humidity
  char hTemp [10] = {0};
  utoa (int (h), hTemp, 10);
  tHumidity.setText (hTemp);
  jHumidity.setValue (int (h));}
```

*3) Results of the Nextion TFT program*

```
====== Leakage time ===========
n4.val ++
if (n4.val> 59)
{
  n5.val = 1
  n4.val = 0
  tm1.en = 0
} else
{
  n5.val = 0
}
```

The Nextion program above works for the pressure leak count time.

*4) Results of output pressure measurements using Crystal 30 Series*

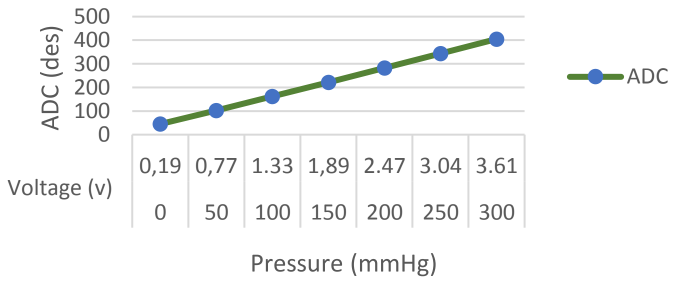


Fig. 7. Pressure sensor output measurement chart

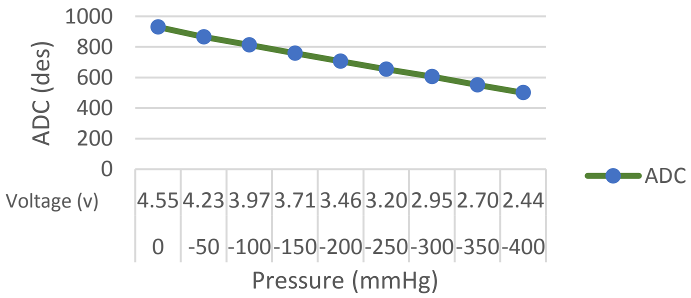


Fig. 8. Vacum Pressure sensor output measurement chart

5) *Measurement error*

TABLE I. THE ERROR OF MEASUREMENT FOR DPM PARAMETER BETWEEN THE DESIGN AND CALIBRATOR.

| No | Pressure (mmHg) | Error (%) |
|---|---|---|
| 1 | 0 | 0.00 |
| 2 | 50 | 0.58 |
| 3 | 100 | 0.26 |
| 4 | 150 | 0.28 |
| 5 | 200 | 0.33 |
| 6 | 250 | 0.04 |
| 7 | 300 | 0.11 |

TABLE II. THE ERROR OF MEASUREMENT FOR DPM PARAMETER BETWEEN THE DESIGN AND CALIBRATOR.

| No | Pressure (mmHg) | Error (%) |
|---|---|---|
| 1 | 0 | 0.00 |
| 2 | -50 | 0.55 |
| 3 | -100 | 0.04 |
| 4 | -150 | 0.23 |
| 5 | -200 | 0.23 |
| 6 | -250 | 0.05 |
| 7 | -300 | 0.05 |

## IV. DISCUSSION

Based on the pressure measurement the sensor circuit with DPM produces output according to the sensor specifications with data collection of 6 sets. That is 50, 100, 150, 200, 250, and 300 for positive pressure and -50, -100, -150, -200, -250, and -300 for vacuum pressure in units of mmHg.

Results The output pressure sensor produces a variable and linear voltage each increase and decrease ranging from 0.19-3.61 V for positive pressure and 4.55-2.44 V for vacuum pressure with a given pressure limit. The results of the DPM tool are also compared with Crystal 30 Series tools for detecting Pressure. The value of the error obtained from measurements between Modules and Crystal 30 Series is positive pressure starting from (0) -0.00%, (50) -0.58%, (100) 0.26%, (150) -0.28%, (200) -0.33% , (250) 0.04%, (300) -0.11%, and negative pressure starting at (0) -0.00%, (-50) -0.55%, (-100) 0.04%, (-150) -0.23%, ( -200) -0.23%, (-250) 0.05%, (-300) -0.05%

While for the measurement results of Temperature and humidity using TH-108 Thermohygrometer produces a value of 0% Error for TEMPERATURE and Error -1.24% for humidity.

## V. CONCLUSSION

This study has shown the development of DPM to calibrate the sphygmomanometer and suction pump with the addition of temperature and humidity and leakage time. This study was built on the Arduino microcontroller and several analog and touch screen LCD circuits. This study has proven that its accuracy is appropriate for the calibration process. In the future, this research can be made and used for calibration.

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