Prototype of Temperature, Humidity and Soil PH Measurement as a Analysis Tool Soil Resistance in Grounding System

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Abstract: One of the requirements of grounding system is having a small soil resistance value. Factors affect the soil resistance are temperature, humidity and soil pH levels. There has been no integrated instrument of temperature, humidity and soil pH. It must use three instruments to determining the amount of temperature, humidity and soil pH. Based on the background, main problem in this research is how performance measuring instrument temperature, humidity and soil pH?. The research method use Research and Development. In this research is only test the feasibility and performance of a measuring instrument temperature , humidity and soil pH without looking at the depth statistical aspects. The results showed that the accuracy of this measuring instrument is accurate and feasible to use with an average 0.5% error percentage. The results showed that the effect of temperature on the resistance of soil type showed to be directly proportional, for the humidity is inversely to the soil type resistance where every soil moisture increase there is a decrease of the soil type resistance value and the soil pH level is proportional to the type resistance where each pH value decrease the resistance value also decreased.

1 INTRODUCTION

The requirements of a good grounding system are to have a small grounding resistance value. It serves to avoid the dangers posed by the presence of ground faults, but in practice it is not easy to get a small grounding resistance value because of the many factors that influence it, one of which is the value of the soil resistance. Soil resistance (ρ) is a representation of soil material properties, water content factors, temperature, humidity and soil pH.

These magnitudes affect the resistance of the grounding system directly, if this value is too small to pass large disturbance currents, the metal composition of the parts connected to the ground will be dangerous to touch and a dangerous voltage gradient will arise on its surface. The price of soil type resistance at a certain depth depends on several factors including soil temperature, soil moisture and soil pH.

The current problem is that there is no tool seen from the aspect of temperature, humidity and soil pH as a tool for analyzing soil type resistance. People often use soil thermometers as a measure of soil temperature, soil tester to measure soil moisture and pH meter to measure soil pH levels. The use of measuring instruments that are less practical because they have to use three measuring instruments in determining the amount of temperature, humidity and soil pH, is the reason for making this prototype.

Therefore, prototypes of soil temperature, humidity and pH measuring instruments using K type thermocouples as a temperature sensor, YL-69 sensor as a humidity sensor and ETP 306 electrode as a pH sensor based on the Atmega328 microcontroller are used. This prototype is expected to help analyze the influence of soil temperature, humidity and pH levels on soil type prisoners.

2 METHOD

The research method used in this study is Research and Development (R & D). Research and Development research methods or often abbreviated as R & D is a research method used to research, design, produce, and test the validity of products that have been produced. In methodology, development research has four difficulties: research without testing (not making and not testing products), testing without researching (testing the validity of existing products), researching and testing efforts to develop

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existing products, researching and testing in creating products new.

The product produced through this research is a prototype for measuring temperature, humidity and soil pH as a tool for analyzing soil type resistance. With the prototype it is expected to measure the temperature, humidity and pH of the soil whose measurement results can be used in analyzing soil type prisoners.

2.1 The Collection of Data and Information

The collection of data and information in this study uses measurement methods using the measuring instruments produced. The instrument in this study was to use data collection instruments including data on soil resistance values, soil type resistance, soil temperature, soil moisture and soil pH. The data obtained are then analyzed to determine the effect on soil type prisoners.

2.2 Design of Prototype

the design of prototypes for measuring temperature, humidity and soil pH using a 9 volt voltage source, Atmega328 Arduino Uno microcontroller, thermocouple K temperature sensor, YL-69 humidity sensor and pH electrode ETP-306. In general, the block diagram of the prototype of the temperature, humidity and pH of the soil can be seen in Figure 1:

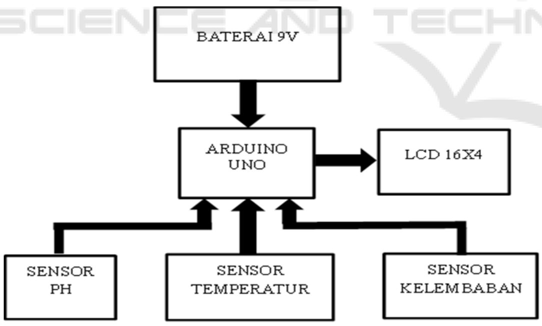

Figure 1: Block diagram of a prototype.

3 RESULT AND DISCUSSIONS

3.1 Tool Result

After going through according to the steps that are in accordance with the RnD research method, the final results are prototypes of soil temperature, humidity and pH measuring instruments as a tool in analyzing the influence of the three variables on soil type resistance. Figure 2 shows the process of measuring temperature, humidity and soil pH.

Figure 2: Measuring temperature, humidity and soil pH.

3.2 Tool Testing Results

Tools are tested so that errors do not occur and function properly. The test was carried out after all the tool manufacturing process was carried out, the testing was carried out in stages to find faults and work shortages in the tool in this study carried out three tests namely testing the temperature sensor, humidity sensor and soil pH sensor.

3.2.1 Temperature Sensor Testing

This test is done to ascertain whether the type K Thermocouple sensor can function properly. The K type Thermocouple sensor functions as a sensor to measure soil temperature. Test data of soil temperature measurement tools in the form of measurement comparison data using Thermocouple type K sensor with standard tools namely iTuin. Data from the test results of type K Thermocouple sensor with calibrator is illustrated in Table 1:

Table 1: Measurement of temperature sensors.

No.	Thermocouple K (°C)	iTuin (°C)	Difference	Percentage of Error (%)
1.	18,3	18	0,3	1,67
2.	20,6	20	0,6	3,00
3.	22,5	22	0,5	2,27
4.	25	25	0	0,00
5.	27,9	28	-0,1	-0,36
6.	31,1	31	0,1	0,32
7.	35,4	36	-0,6	-1,67
8.	45,8	46	-0,2	-0,43
9.	48	48	0	0,00
10.	51	51	0	0,00
Average	32,56	32,5	0,06	0,18
Std. Deviasi	11,97	12,17	0,25	1,41

Measurements were made ten times at various points on the land in the Ungaran area. The average value of the soil temperature obtained using the iTuin tool is 32.5 while using the research prototype is 32.56 the difference in value is 0.06 and the average error is 0.18%.

3.2.2 Humidity Sensor Testing

Soil sensor testing moisture YL-69 to ensure the sensor can work properly. Soil moisture YL-69 functions as a sensor for measuring soil moisture. Test data of soil moisture measurement tool in the form of measurement comparison data using soil moisture sensor YL-69 with a standard tool that is ETP-306.

Table 2: Measurement of humidity sensors.

No.	Sensor YL-69 (%)	ETP-306 (%)	Differen ce	Percentage of Error (%)
1.	7	7,2	-0,2	-2,78
2.	9,4	10	-0,6	-6,00
3.	12,2	11,7	0,5	4,27
4.	15,6	15,7	-0,1	-0,64
5.	18,1	18	0,1	0,56
6.	18,9	18,9	0	0,00
7.	21	21,3	-0,3	-1,41
8.	22,7	23,1	-0,4	-1,73
9.	25,6	25,6	0	0,00
10.	26,3	26,2	0,1	0,38
Average	17,68	17,77	-0,09	-0,51
Std. Deviasi	6,60	6,56	0,31	2,63

Table 2 shows the measurement of humidity sensors. The average value of soil moisture obtained using the soil tester ETP-306 is 17.77 while using the research prototype is 17.68 the difference in value is -0.09 and the average error is -0.51%.

3.2.3 Soil pH Sensor Testing

Testing the soil pH sensor using an electrode from the pH meter ETP-306 to make sure the sensor works properly. PH meter electrode ETP-306 functions as a sensor to measure soil pH. Data testing of soil pH measurement tools in the form of measurement comparison data using electrode pH meter ETP-306 with standard tools, namely iTuin. Data from the test results of the pH meter ETP-306 electrode with the calibrator are described in Table 3:

Table 3: Measurement of soil ph sensors.

No.	ETP-306 Sensor	iTuin	Difference	Percentage of Error (%)
1.	3,1	3	0,1	3,33
2.	3,2	3	0,2	6,67
3.	3,7	4	-0,3	-7,50
4.	4,1	4	0,1	2,50
5.	4,4	4,5	-0,1	-2,22
6.	4,8	5	-0,2	-4,00
7.	5,2	5	0,2	4,00
8.	5,9	6	-0,1	-1,67
9.	6,3	6,5	-0,2	-3,08
10.	6,6	6,5	0,1	1,54
Average	4,73	4,75	-0,02	-0,04
Std. Deviasi	1,25	1,30	0,18	4,34

Measurements were made ten times at various points on the land in the Ungaran area. The average value of soil pH obtained using the iTuin tool is 4.75 while using the research prototype is 4.73 the difference in value is -0.02 and the average error is -0.04%.

3.2.4 Testing the Effect of Soil Temperature, Soil Humidity and Soil pH on Prisoners of Soil Resistance

Based on the results of the tests that have been carried out on a piece of clay in the area of East Ungaran, it can be concluded that each variable (temperature, humidity and soil pH) has a different soil resistance value. Table 4 below shows the value of soil type resistance based on soil temperature, humidity and pH.

Table 4: Data measurement of soil resistance each variables (temperature, humidity and ph).

No.	Temperature (T)	Soil Resistance (ρ_T)	Humidity (K)	Soil Resistance (ρ_K)	Soil pH (pH)	Soil Resistance (ρ_{pH})
1.	26°C	322.477 Ωm	25%	743.157 Ωm	5.82	51.491 Ωm
2.	23°C	216.025 Ωm	50%	667.884 Ωm	5.33	26.898 Ωm
3.	20°C	135.658 Ωm	70%	593.746 Ωm	4.82	13.978 Ωm
4.	18°C	77.639 Ωm	100%	409.637 Ωm	4.27	8.616 Ωm
Average	21.75°C	187.95 Ωm	61.25%	603.61 Ωm	5.06	25.25 Ωm

Based on the table above, you can illustrate the graph of the resistivity values of the soil types of each variable (temperature, humidity and pH) in Figure 3:

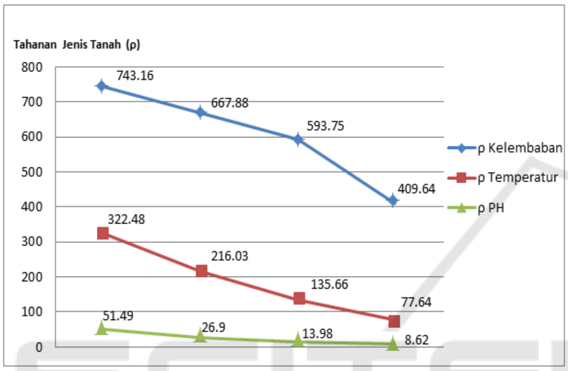

Figure 3: Graph of soil resistance according to temperature, humidity and soil pH.

4 CONCLUSIONS

Based on the results of the prototype of the temperature, humidity and soil pH measuring instrument as a tool to analyze the resistance of soil types in the grounding system, it can be concluded as follows: 1.) The effect of temperature on soil type resistance is proportional where any decrease in temperature decreases the value of soil type with value the highest type of resistance is 322.477Ωm at a temperature of 26 ° C and the lowest resistance value is 77.639Ωm at a temperature of 18 ° C. 2.) The effect of humidity on the resistance of soil type is inversely proportional where every increase in humidity there is a decrease in the value of soil resistance with the highest soil type resistance 743,157Ωm at 25% humidity and the lowest resistance value 409,637Ωm at 100% humidity. 3.) The effect of soil pH on soil type resistance is directly proportional to any decrease in soil pH there is also a decrease in soil resistivity value, with the highest soil type resistance value of 51,491Ωm at pH 5.82 and the lowest soil resistance value of 8,616Ωm at pH 4.27. 4.) The prototype of soil temperature, humidity and pH measuring instruments can work well and is suitable for use because each sensor only has an error percentage of less than 1%.

After conducting research, there needs to be further development for prototypes of soil temperature, humidity and pH measuring instruments, so the authors suggest the following: 1.) In selecting sensors, the level of accuracy in reading data must be considered so that when applied in an error value tool produced is not too large. 2.) The prototype made is expected to be further developed with more integration of functions.

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