MONITORING SYSTEM DESIGN SYSTEM AS MEASURING TEMPERATURE MEASURES

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ABSTRACT

Monitoring system tool as a temperature gauge in the field is a tool that serves as a temperature gauge this happens there are several factors that first the temperature, humidity, and light intensity in the ranks of the Army is still using the manual way. In this tool uses 3 sensors that have 4 parameters of interconnected results to generate index data. The usefulness of each sensor is SHT11 as a temperature and humidity gauge, TSL2591 as a light meter, and anemometer as a wind speed gauge. This tool can serve as a wind speed gauge on a jumping workout.

Keywords: Arduino Uno 328, Sensor SHT11, Sensor TSL2591

1. INTRODUCTION

In this case to support in monitoring and know condition of change of weather or nature that is not stabilized and avoid existence of victim during exercise then used temperature gauge which aims to know index temperature of environment at area where we will conduct exercise, so with data about index The temperature will be able to decide whether the exercise can be held or not, because in order to avoid the risk of casualties. However, on the ground there are still many army equipment still manually in the reading, spending information, and still need three personnel which are operated to monitor that is involving the picket officer and health team as the monitoring and transportation team as the delivery of news or information about the decision to be taken.

2. METHODE

2.1. Sensor SHT11

The SHT11 sensor (SHT11 Datasheet in Darjat, 2008) is a relative humidity sensor as well as a temperature sensor. This sensor is a pair that is equipped with 14 bit analog to digital converter and serial interface circuit. This sensor produces a quality signal with a fast response and is not sensitive to outside interference. The physical shape inside and outside the SHT11 sensor will be shown in Figure 1 below:

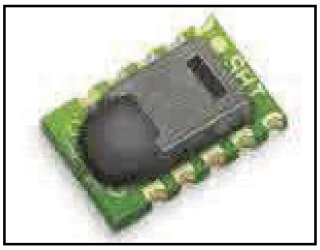

Figure 1. Physical Display of the SHT11 Sensor

2.2. Anemometer

Anemometer is a wind speed gauge that is widely used in the field of Meteorology and Geophysics or weather station forecasts. The name of this tool comes from the Greek word anemos which means wind. The first designer of this tool is Leon Battista Alberti in 1450. In addition to measuring wind speed, this tool can also measure the amount of wind pressure it. Meteorological unit of wind speed is Knots (Beaufort scale). While the meteorological unit of the wind direction is 0o - 360o and the direction of the wind (0o position indicates the North). When blown by the wind, the propeller or bowl that is on the anemometer will move in the direction of the wind. The greater the speed of the wind blowing the bowls, the faster the speed of rotating the bowl plates. From the number of turns in one second it can be known the speed of the wind, because in the anemometer there is an enumerator tool that will calculate the wind speed. In general there are two types of anemometers, an anemometer that measures wind speed (velocity anemometter) and anemometer that measures wind pressure.

Figure 2. Cup Anemometers

2.3. Light Intensity Sensor TSL2591

TSL2591 is a sophisticated digital light sensor because it can be used in various light situations and can distinguish between sunlight and light from incandescent lights. TSL2591 sensor is also much more sophisticated than the LDR sensor because the sensor output is digital so it does not require calibration in its use as well as more efficient because this sensor is faster and precise for the calculation of Lux. The TSL2591 sensor can detect the range of light from 188 Lux to 88,000 Lux quickly because this sensor portion contains both infrared diode spectra that can measure infrared and full spectrum or

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visible light by the human eye. The TSL2591 sensor and pin configuration will be shown in Figure 3:

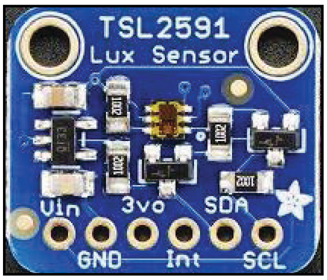

Figure 3. Sensors TSL2591

2.4. ATMega328 AVR Microcontroller

ATMega328 is a microcontroller output from atmel that has a RISC architecture (Reduce Instruction Set Computer) where every data execution process is faster than CISC (Completed Instruction Set Computer) architecture.

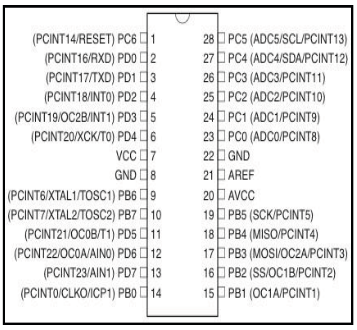

Figure 4. ATMega328 Pin Configuration

2.5. Arduino Uno 328

Arduino Uno 328 is a combination of hardware and software that is open source. The Arduino Uno Board has 14 digital input / output pins (of which 6 pins can be used as PWM output), 6 analog inputs, 16 MHz crystal oscillators, USB connection, reset button power jack. These pins contain everything needed to support the microcontroller and only connect to a computer with a USB cable or a voltage source can be obtained from an AC-DC adapter or a battery to use it. The Arduino Uno 328 board image and Arduino Uno 328 description will be shown in Figure 5 below:

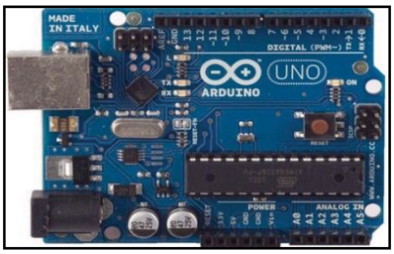

Figure 5. Board Arduino Uno 328

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2.6. LCD (Liquid Crystal Display)

LCD (Liquid Cristal Display) is one component of electronic that serves as a display of data, either characters, letters or graphics. LCD display is available in the form of a module that is LCD display along with its supporting circuit including ROM etc.

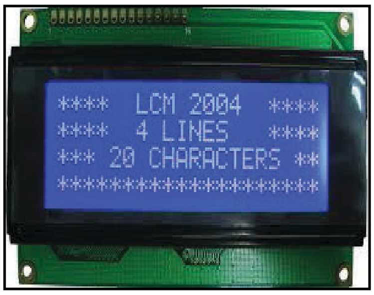

Figure 6. 20x4 LCD display

2.7. 12C (Inter Integrated Circuit)

Inter Integrated Circuit or often called I2C is a two-way serial communication standard using two channels designed specifically for sending or receiving data. The I2C system consists of SCL (Serial Clock) and SDA (Serial Data) channels that carry data information between I2C and its controllers. Devices connected to the I2C Bus system can be operated as Master and Slave.

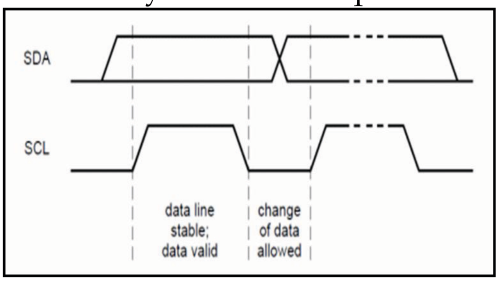

Figure 7. Trasfer Bit on I2C bus

3. RESULT AND DISCUSSION

3.1. Tool Planning

Planning tool design of the monitoring system as a field temperature gauge consists of hardware planning (hardware), hardware device planning includes designing in the whole circuit. From the planning and design of tools that will be made then making block diagram in the manufacture of monitoring system tools as a temperature meter is needed because it will facilitate the reading of the tool working system. Block diagram in the manufacture of monitoring system equipment as a temperature gauge will be shown in Figure 8 below:

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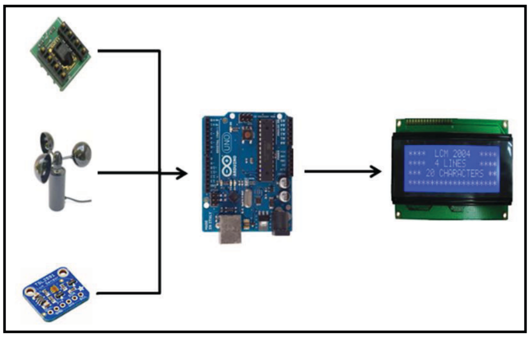

Figure 8. Tool Block Diagram

3.2. Software Design (software)

To control and manage the entire hardware system that has been created it must be supported with the software (software). Software is a programming language design that will be embedded in Arduino Uno 328. Software (programming language) embedded in the microcontroller is a command that will run to control the rangakain of a system so that it can work in accordance with the design and planning. Microcontroller workflow in executing software (programming commands) that have ditanakamkan in it, useful to control the hardware system so that in accordance with the planning, before creating a program to run the tool then first the authors create the flow of the program (flowchart) to facilitate in making the desired program can See in Figure 9:

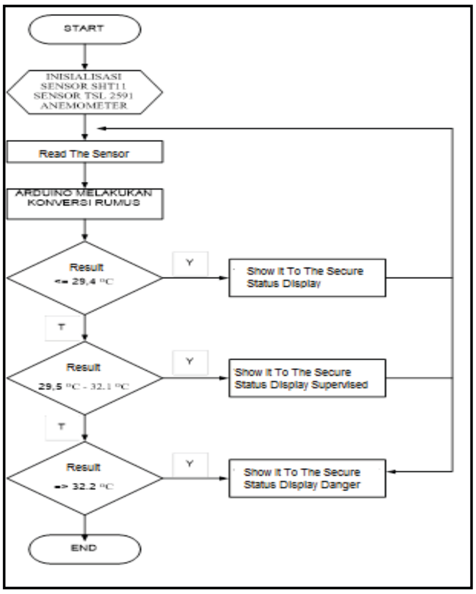

Figure 9. Flowchart of the Software

Figure 9 shows the flow diagram of the designed tool, here is an explanation of the working system sequence both software and hardware. The first is START start the tool. There is an initialization process on each sensor. Arduino receives data from each of the sensors. If the conversion result <= 29.4

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OC then it will be displayed on the display with a secure status and then in the loop back to look for more data on the sensor read. But if the result of the conversion on Ardunio Uno 328 " NO " (the conversion result is greater than 29.4 OC it will be forwarded to the next process.

If the conversion result is 29.5 OC - 32.1 OC then it will be displayed on display with safely supervised status then will do loop back again to find more data on read sensor. but if the result of the conversion at Uno Ardunio 328 " NO " (conversion result is greater than 29.5 OC - OC 32.1 then it will be forwarded to the next process.

If the conversion result => 32.2 OC then it will be displayed on display with hazard status then will do loop back again to find more data on read sensor. If the temperature continues to increase then the status on the display will remain the same.

3.3. Arduino Uno 328 Microcontroller Test Results

After the program is executed then the existing LCD on port C will turn on and will display the characters according to which we compile before through the program. This shows that Arduino Uno 328 Microcontroller can work well and shown in Figure 10 below:

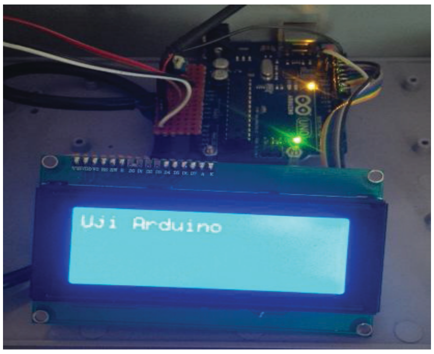

Figure 10. Arduino Board Test View on LCD

3.4. Result of Sensor Tests SHT11

From the results of SHT11 sensor testing that has been done at the time of listing the program successfully uploaded then show the character that shows the temperature and humidity of the sensor SHT11 on LCD 4x20. From this testing process shows that the SHT11 sensor is in good condition as shown in Figure 11 below:

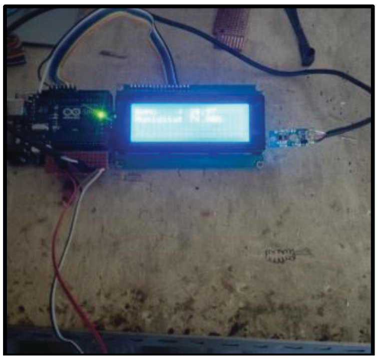

Figure 11. Test View Sensor Sensor SHT11

From the testing stages of the sensor SHT11 shows that the listing of programs uploaded / compiled on the Arduino Uno 328 board is correct and the SHT11 sensor can read the temperature and humidity well. The next SHT11 sensor test is performed by measuring the actual temperature using a digital thermo hygrometer so that the temperature measured by the digital thermo hygrometer is then compared with the temperature data that has been obtained by the SHT11 sensor. The above test results are to get the comparison of SHT11 sensor and the actual measuring instrument (Thermo hygrometer digital) which will be shown in Figure 12 and the comparison result data will be shown in Table 3.4.1 below:

Figure 12. Comparative Test View of SHT11 and Thermo Sensors Digital Hygrometer (Source: Testing)

From the comparative data of SHT11 sensor and Thermo Hygrometer Digital measuring instrument can be shown in table 3.4.1 below:

Table 3.4.1. Results of Experimental Data Sensor SHT11 Against Thermo Hygrometer Digital

NO	Sensor SHT11		Thermo Hygrometer Digital		difference °C	difference %
	(°C)	RH (%)	(°C)	RH (%)		
1	26.85	75.30	27.2	71	0.35	4.3
2	28.30	65.45	28.12	63	0.18	2.45
3	29.01	71.09	28.85	70	0.16	1.09

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3.5. TSL2591 Sensor Test Results

The TSL2591 sensor shows that the listings of uploaded / compiled programs on the Arduino Uno 328 board are correct and the TSL2591 sensor can read the light intensity well. To get more valid results, TSL2591 sensor testing is done by performing a comparison with Lux Meter Digital measuring instrument. The results of comparison testing will be shown in figure 13 and the comparison data will be shown in table 3.4.2 below:

Figure 13. TSL2591 Sensor Comparison Test View and Digital Lux Meter Measure Tool

From the result of comparison data on TSL2591 sensor and Lux Meter measuring instrument get the results that will be shown in table 3.4.2 below:

Table 3.4.2. Sensor Comparison Test

Sensor TSL2591	Lux Meters Measure Tool	Difference Lux
375Lux	370Lux	5Lux
280Lux	290Lux	10Lux
480Lux	455Lux	25Lux
2035Lux	2115Lux	20Lux

3.6. Sensor Design TSL2591

The design of hardware on the monitoring system as a temperature measuring device that includes designing TSL2591 sensor that serves as a sensor of light intensity gauge. Below will show the design block diagram of TSL2591 sensor shown by Figure 14:

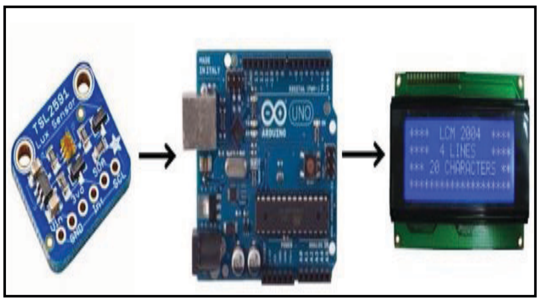

Figure 14. TSL2591 Sensor Design Block Diagram

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3.7. Design of Anemometer

The design of hardware in monitoring system tools as a temperature meter in the field that includes designing an anometer tool that serves as a wind speed gauge. In Figure 15 we will show the block diagram of an anemometer design:

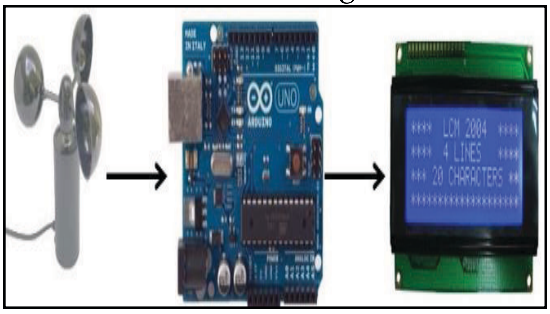

Figure 15. Anemometer Design Block Diagram

Explanation of the block diagram design from Figure 3.11 above can be explained as follows:

A. The anemometer is connected to Arduino Uno A2 pin, after the angina speed data is received it will be sent to Arduino Uno 328.

B. Once Arduino Uno 328 receives data from the anemometer it will be displayed on the LCD.

C. The 4x20 LCD is connected to the Arduino Uno 328 on pins 8, 9, 10, 11, 12, 13 as a data viewer display of anemometer with m / s unit.

3.8. Anemometer Test Results

From the results of Anemometer testing by way of programming on Arduino Uno 328 and rotation speed measurement test showed that Anemometer sensor in good condition which is shown in picture 16 below:

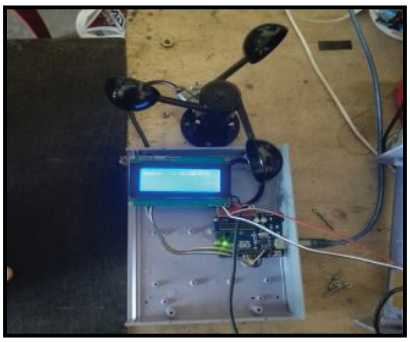

Figure 16. Display Test Sensor Anemometer

3.9. TA Tool Test Results

From the result of testing of TA tool monitoring system as measuring of temperature of field showed that tool have good with in show in Figure 17 below:

Figure 17. Testing Tool Results

3.10. Overall Tool Analysis

Analysis of the tool as a whole functioned to get the data that is done by doing the conversion from the sensor that is used in the instrument design system monitoring as a temperature gauge field.

3.11. Analysis With Conversion Formula

The tool that is made now is involving several variables in order to determine the value that is equipped with a wind speed gauge and has a temperature measurement unit that is oF or oC. At the Wet-Ball World Temperature (ISBB) the equation involves only the unit of temperature composite (oC), moisture (%), and light intensity (Lux). However, in the design tool monitoring system as a temperature gauge which is equipped with wind speed measuring instrument with unit m / s then use the formula as follows:

$AT = Ta + 0.348 \times e - 0.70 \times ws + 0.70 \times Q / (ws + 10) - 4.25$

Information :

Ta = Dry ball temperature (° C)
E = vapor pressure (hPa) [moisture]
Ws = Wind speed (m / s) at a height of 10 meters
Q = Radiation or light intensity

The United States Health Conference In Government Industries publishes a threshold value (TLV) that has been adopted by many governments for use in the workplace. The process for determining ISBB is also described in ISO 7243 based on the ISBB index. The American College of Sports Medicine bases the guidelines on the intensity of sports practice based on the ISBB.

In hot places, some US military installations display flags to indicate hot categories based on ISBB. The military published guidelines for water intake and physical activity levels to adapt and unacclimated individuals in different uniforms by heat category, can be seen in table 3.4.3 below:

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Table 3.4.3. ISO Tables and The American College of Sports Medicine

Category	`F	`C	Color Flag
1	< = 79.9	< = 26.6	White
2	26.7 – 29.3	26.7 – 29.3	Green
3	29.4 – 31.0	29.4 – 31.0	Yellow
4	31.1 – 32.1	31.1 – 32.1	Red
5	= > 90	= > 32.2	Black

4. Conclusions

Based on the result of planning and making of temperature monitoring system as temperature gauge in the field, it is concluded as follows: (i) The design of monitoring system tools as temperature gauge field has been running well on each component that is in use and the cost of making this tool cheaper. (ii) In the tool conversion tool on each sensor to get a good result that is by mnggunakan the formula that has been specified that AT = Ta + 0.348 × e - 0.70 × ws + 0.70 × Q / (ws + 10) - 4.25. (iii) To get the result of wet temperature and dry temperature can use additional sensors, but in this tool does not use wet temperatsure index and dry temperature because in Indonesia the temperature does not reach minus degrees, the wet temperature and dry temperature is not given but can be made as a reference for development.

5. Suggestion

After going through several observations made on this tool and done some testing, then the suggestions that want to be given the author to improve the usefulness of this application are: (i) Continue and further develop the tools that have been created. (ii) Developing a monitoring system design tool for measuring the temperature of the field in order to deliver the measurement result automatically through data transmission. (iii) Refine the tool by providing additional sensors in order to read wet and dry temperatures.

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