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Temperature Monitoring Efficiency With Internet of Things-Based Temperature Sensor Variations

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Abstract

This research was conducted in the lab. Automation to measure temperature by several temperature sensors monitored through Internet of Things (IoT) technology. The method used is a quantitative method with experiments. The temperature monitoring system with a variety of temperature sensors based on the Internet of Things (IoT) can work well. The difference in temperature measurements taken through the IoT simulation within 1 hour between the sensors used has a small value, an average of 0.07 Celsius. This means that the precession level of each sensor is relatively good. The need for calibration on the sensor in order to obtain the best measurement results. Noting the results of the above analysis, it is recommended that users conduct a more in-depth study to obtain a more appropriate (actual) value. This analysis can also be taken into consideration for users to develop IoT-based monitoring systems in the future.

Keywords

Monitoring, Temperature Sensor, IoT Technology

INTRODUCTION

One of the developments in internet technology at this time is the development of the Internet of Things. The Internet of things is a global infrastructure for the information society, enabling sophisticated services, by connecting objects both physical and virtual based on information exchange technology and communication technology. Remote temperature monitoring (telemetry) is very useful if it is carried out in large areas, dangerous places or for data retrieval speed because only sensor equipment and transmission systems are on site. Remote access can be through wired, wireless or fiber optic media either point to point or network.

Sensors are devices used to detect changes in physical quantities such as pressure, force, electricity, light, movement, humidity, temperature, speed and other environmental phenomena. After observing the changes, the detected input will be converted into an output that can be understood by humans either through the sensor device itself or transmitted electronically through a network to be displayed or processed into useful information for its users.

Temperature Sensors are components that can convert heat quantities into electrical quantities so that they can detect symptoms of temperature changes in certain objects. The temperature sensor measures the amount of heat / cold energy produced by an object so that it allows us to know or detect symptoms of these temperature changes in the form of Analog or Digital output. Temperature Sensors are also from the Transducer family. Examples of electrical and electronic equipment that uses Temperature Sensors include Room Temperature Thermometers, and many more.

Publications related to monitoring or measuring temperature remotely already exist with a variety of methods both in terms of remote transmission and the protocols used. Temperature data transmission is done point to point wirelessly using the Universal Asynchronous Synchronous Receiver Transmitter (UASRT) communication protocol, which is a standard serial data transmission protocol. This research utilizes the Internet of Thing (IoT) to send temperature data and notifications via messages to telegram. This system is able to reach long distances but is still point to point.

METHODS

With the intent and purpose of wanting to analyze temperature monitoring in a particular room with a variety of temperature sensors, the authors try to analyze the IoT integrated temperature in monitoring. The temperature sensors used are thermostats, thermistors, resistive temperature detectors, and thermocouples. Thermostat is a device that can disconnect and connect electric current when detecting changes in temperature in the surrounding environment in accordance with the specified temperature settings. Mechanical Thermostats are basically a type of Contact Temperature Sensor that uses Electro-Mechanical principles and Electronic Thermostats use electronic components to detect changes in temperature. This temperature detection device is widely used in electrical devices such as ovens, refrigerators, air conditioners (AC), engine temperature control in cars and irons. Thermistor is one type of resistor whose resistance value or resistance value is affected by temperature. Thermistor consists of 2 types, namely Thermistor NTC (Negative Temperature Coefficient) and Thermistor PTC (Positive Temperature Coefficient). The

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resistance value of the NTC Thermistor will drop if the temperature around the NTC Thermistor is high (inversely proportional / negative). As for the PTC Thermistor, the higher the temperature around it, the higher the resistance value. In general, the NTC Thermistor and PTC Thermistor are electronic components that function as sensors in electronic circuits related to temperature. Thermistor operating temperatures vary depending on the Thermistor Manufacturer itself, but generally range from -90 ° C to 130 ° C. Some applications of NTC and PTC Thermistors in our daily lives include fire detection, temperature sensors in car engines, sensors to monitor the temperature of battery packs (cameras, cellphones, laptops) when charging, sensors to monitor the temperature of incubators, temperature sensors for refrigerators, temperature sensors on computers and so on.

Figure 1. Thermostat sensor

Figure 2. PTC and NTC Thermistors

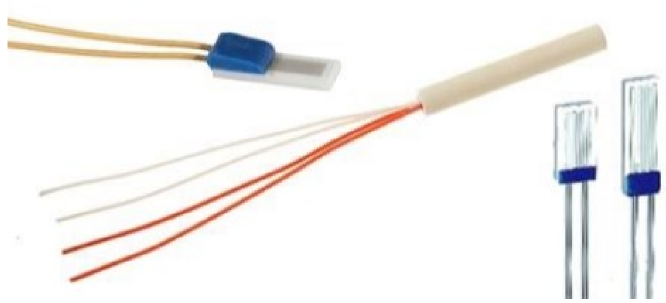

Figure 3. RTD Sensor

Resistive Temperature Detector or abbreviated with RTD has the same function as the PTC type Thermistor, which can convert electrical energy into electrical resistance proportional to temperature changes. However, the Resistive Temperature Detector (RTD) is more precise and has higher accuracy when compared to the PTC Thermistor. Resistive Temperature Detector is generally made of Platinum material so it is also called Platinum Resistance Thermometer (PRT). The main concept of the underlying temperature measurement with a resistive temperature detector is the electrical resistance of the metal that varies proportional to temperature. The comparability of this

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variation is precise and can be repeated again, allowing consistent temperature measurement through detention detection. Materials that are often used RTD is platinum because of linearity, stability and reproducibility.

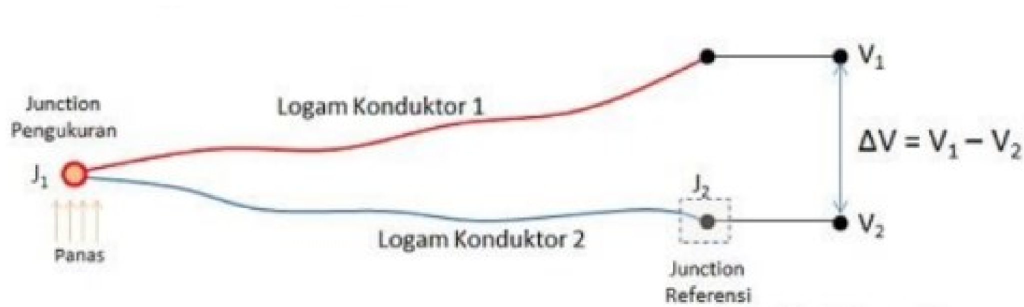

Figure 4. Thermocouple Installation

Thermocouples are one of the most popular types of temperature sensors and are often used in various circuits or electrical and electronic equipment related to temperature. Some of the advantages of thermocouples that make them popular are their fast response to temperature changes and also their wide operational temperature range, which ranges from -200˚C to 2000˚C. In addition to the fast response and wide temperature range, Thermocouples are also resistant to shock/vibration and easy to use. The working principle of thermocouples is quite easy and simple. Basically, a thermocouple only consists of two conductor metal wires of different types and combined ends. One type of metal conductor contained in Thermocouple 11 will function as a reference with a constant (fixed) temperature while the other is a metal conductor that detects hot temperatures. In conducting the analysis, the author uses quantitative and comparative methods, where the results of the analysis of the type of temperature sensor monitored with IoT in the database.

RESULT AND DISCUSSION

In this study, several planning and design steps are needed, namely from making wiring schemes in autocad software, PCB manufacturing process, component installation, soldering process, hardware testing process, and program creation process, software testing process until the tool is complete. In the planning method, the first thing to do is planning the system by making a wiring scheme in the autocad software. The following Figure 5 is a wiring diagram of a room temperature monitoring system with a variety of IoT-based temperature sensors. There are a variety of sensors that will be tested to obtain the expected test result data.

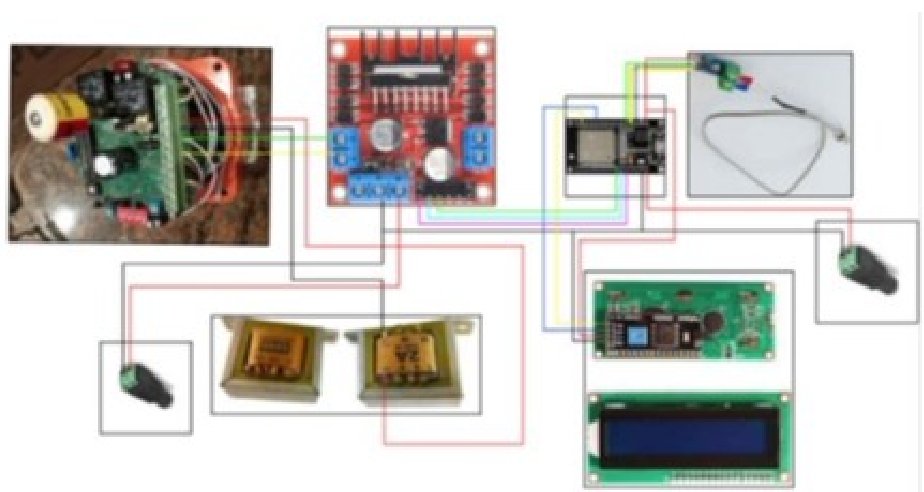

Figure 5. Circuit Wiring Diagram

Next, do hardware design such as making a PCB layout design, then printing and dissolving the PCB, then installing the components to be used on the PCB. The last thing to do is planning a system program or software by creating a program using the Arduino IDE, then compiling the program, and uploading the program to the

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microcontroller. Figure 6 is a program display on the Arduino IDE. In testing this tool can be done by measuring the temperature in the room. The purpose of this temperature measurement is to determine the fluctuations in changes in temperature. Temperature every hour. The test is carried out by uploading the program that has been made in the Arduino IDE software to the microcontroller and then providing a voltage supply to the control component of 5V for the microcontroller, after the control component gets the voltage supply, the temperature is measured and the results of each temperature sensor test are recorded.

Testing is also done by uploading the command program that has been made to the microcontroller. The command program is divided into 5 conditions according to the sensor used, namely: starting from 0% condition when not yet connected to the sensor, followed by measurement of the thermostat sensor in the system until monitoring results are obtained, then the thermistor sensor, thermocouple sensor and RTD sensor.

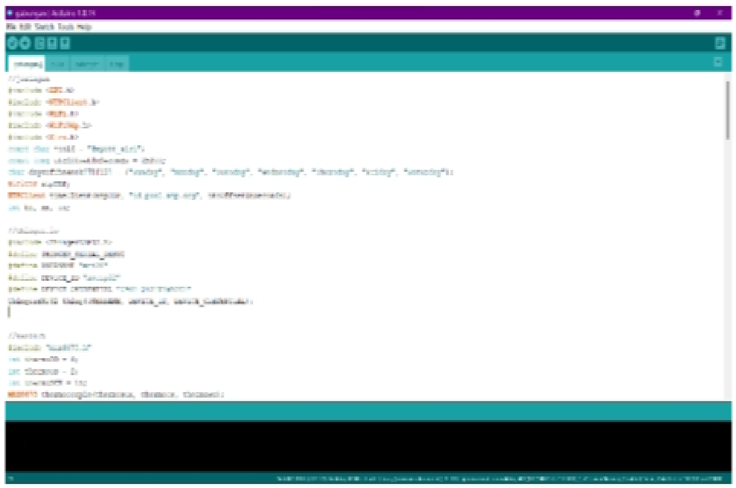

Figure 6. Arduino IDE display

Monitoring of the measurement results of each sensor will be carried out every day and then collected on a spreadsheet so that analysis can be carried out related to the data obtained. Figures 7 and 8 below are pictures of the research process flow chart and work flow chart of the temperature monitoring system with this sensor variation. Monitoring of temperature with this sensor variation is carried out alternately with the integrated Internet of Things (IoT) for 24 hours for each type of sensor.

Monitoring of the measurement results of each sensor will be carried out every day and then collected on a spreadsheet so that analysis can be carried out related to the data obtained. Figure 8 below is a flowchart of the research process and the work of the temperature monitoring system with this sensor variation. The first stage carried out in this research begins with conducting a literature study, collecting references related to the research. The next step is to identify problems to formulate problems. Followed by determining the objectives and determining the limitations of the problem in the research. Then the hardware and software design is carried out followed by testing. If the test is not appropriate, system improvements are made and if the test is as expected, continue with testing the entire system. Monitoring of temperature with this sensor variation is carried out alternately with the integrated Internet of Things (IoT) for 1 hour for each type of sensor.

In the discussion of the results of implementation and testing, it will discuss the results of implementation and testing that have been carried out as an evaluation of the success of the system that has been made and analyze the effectiveness of the prototype made based on the success of the prototype in monitoring temperature with variations in temperature sensors and comparison of measurement results from prototypes made with conventional tools that show measurement results from variations in temperature sensors in prototypes with conventional measuring instruments carried out for 1 hour that the average measurement between one temperature sensor and another in prototypes with conventional measuring instruments is almost the same.

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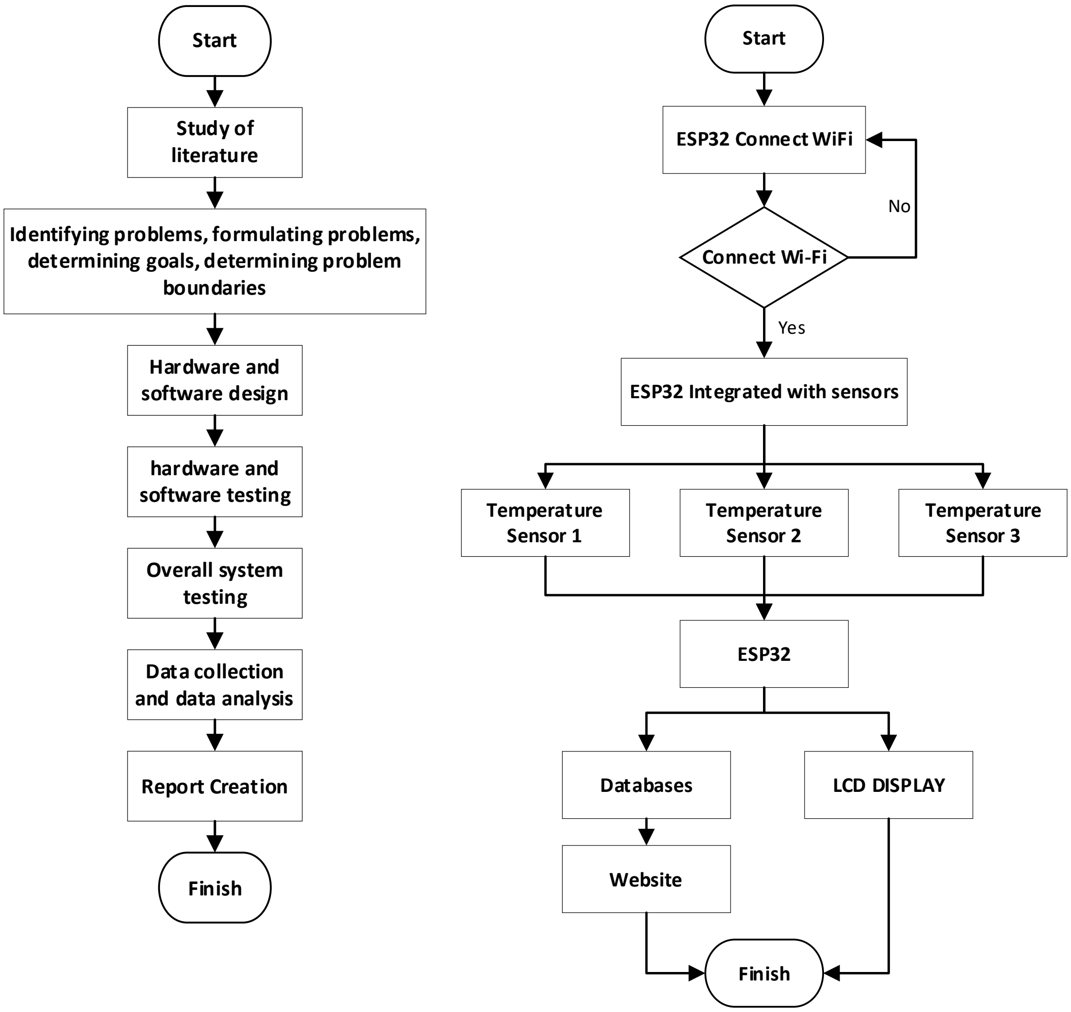

Figure 7. Flowchart of the monitoring system

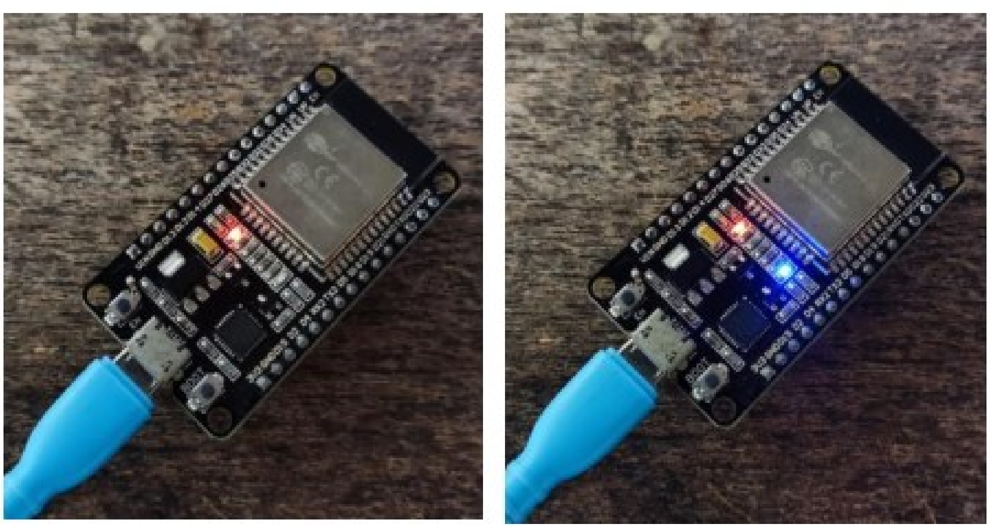

Figure 8. ESP32 Testing Process

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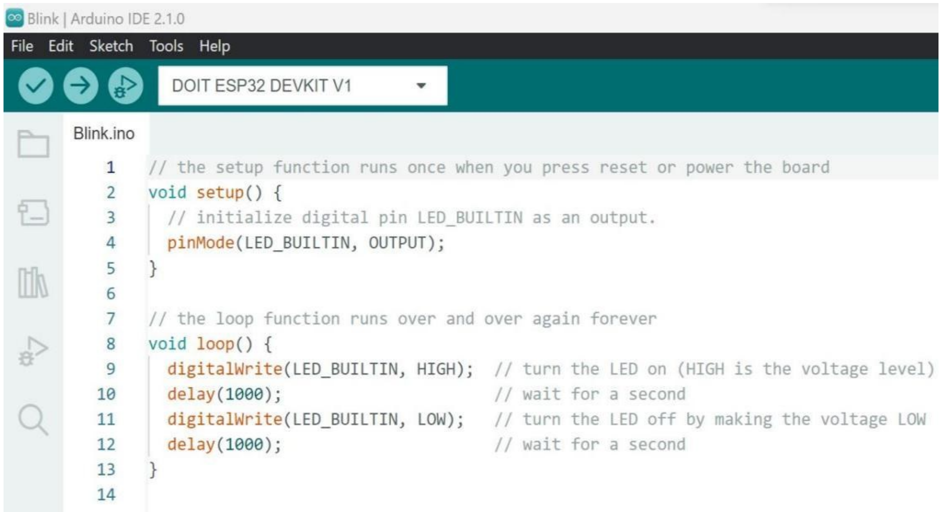

Figure 9. Program Testing Process with Arduino IDE

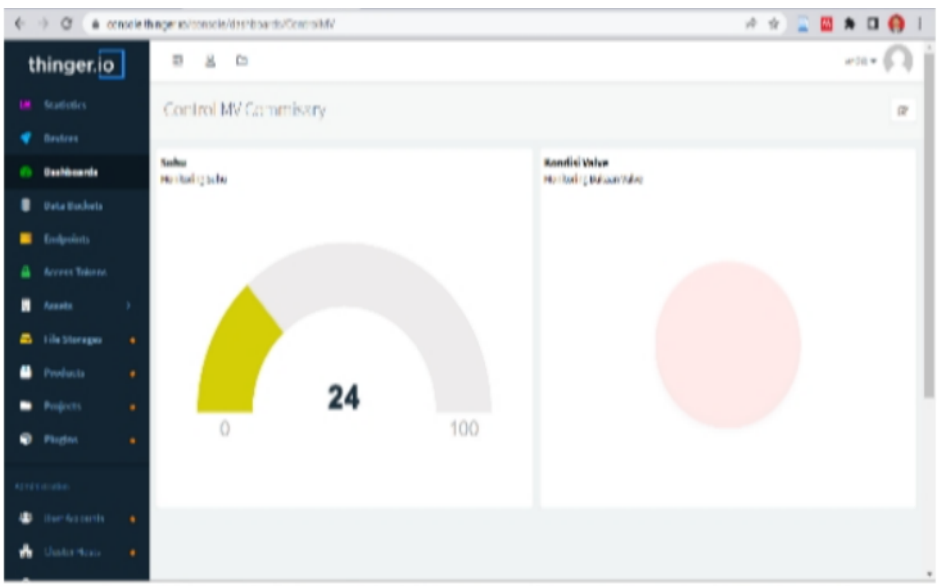

Figure 10. Snapshot of the response to temperature measurement results by the system

TABLE 1

TABULATION OF TEMPERATURE MEASUREMENT SIMULATION RESULTS

Time	Sensor 1 (°C)	Sensor 2 (°C)	Sensor 3 (°C)	Sensor 4 (°C)
10:00	26.69	26.69	27.00	26.69
10:05	26.69	26.62	27.00	26.62
10:10	26.69	26.69	27.00	26.69
10:15	26.69	26.69	27.00	26.69
10:20	26.69	26.69	27.00	26.69
10:25	26.69	27.00	27.00	27.00
10:30	26.62	27.00	27.00	27.00
10:35	26.69	27.00	27.00	27.00
10:40	26.69	26.60	27.00	27.00
10:45	26.69	26.60	27.00	27.00
10:50	26.62	26.60	26.60	27.00
10:55	26.62	26.60	26.60	27.00
11:00	26.62	27.00	26.60	27.00

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CONCLUSION

Based on the above analysis, it can be concluded and at the same time become a consideration for users regarding the following matters. Temperature monitoring system with a variety of temperature sensors based on the Internet of Things (IoT) can work well. The difference in temperature measurements taken through the IoT simulation in a span of 1 hour between the sensors used has a small value, an average of 0.07 degrees Celsius. This means that the precession level of each sensor is relatively good. The need for calibration on the sensor in order to obtain the best measurement results. Taking into account the results of the analysis and conclusions above, it is recommended that related parties conduct a more in-depth study to obtain more appropriate (actual) values. This analysis can also be a consideration for related parties for the development of IoT-based monitoring systems in the future.

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