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Implementation of A-TH3 Transmitter Sensor for Temperature and Humidity Monitoring System in Furniture Warehouse

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Abstract: The furniture industry is a potential sector to be developed in Indonesia because it is supported by the availability of abundant natural resources in the country. This furniture market opportunity will continue to grow in the future but must be supported by production factors, namely the provision of quality raw materials, capital and skilled labor. However, this industry is not free from problems such as the quality of raw materials. Wood raw materials in Indonesia are abundant but there is no special treatment to maintain its quality, so the quality of production is hampered. Good wood raw materials are raw materials that avoid damage and weathering. To maintain this quality, the ideal requirement for room temperature for storage is 18^{o}C and room humidity 65%. Changes in temperature and humidity in the storage warehouse always follow changes in temperature and humidity around it. For this reason, further studies are needed on the temperature and humidity monitoring system in the storage warehouse and if there are significant changes, a dehumidifier device is used to keep the temperature and humidity in a room stable.

Keywords: Furniture, Wood Raw Material Quality, Temperature and Humidity Sensor, Internet of Things (IoT)

1. Introduction

The furniture industry is one of the potential sectors to be developed in Indonesia because it is supported by the availability of abundant natural resources in the country. This industry is a labor-intensive and export-oriented industrial sector, so that it can make a significant contribution to efforts to restore the national economy after the Covid-19 pandemic.

The rattan and furniture handicraft industry has experienced various dynamic changes, both an increase in production and sales and a decline. The Ministry of Industry noted that the export value of furniture products (HS 9401-9403) in 2020 reached USD1.91 billion, an increase of 7.6% from 2019 which reached USD1.77 billion. The largest export destination countries for Indonesian furniture in 2020 include the United States, Japan, the Netherlands, Belgium and Germany. In the first quarter of 2021, the performance of the furniture industry was able to rise and grow positively by 8.04% after experiencing a contraction of 7.28% in the same period last year due to the impact of the Covid-19 pandemic. Furthermore, the wood, wood goods, rattan and furniture industry subsectors contributed 2.60% to the growth of the agro-industrial group.

This furniture market opportunity will continue to grow in the future but must be supported by production factors, the most important of which are the provision of quality raw materials, capital and skilled labor. The abundant availability of raw materials as a comparative advantage, supported by the business climate ease policy issued by the

Government through Law Number 11 of 2020 concerning Job Creation, which can realize industries that produce high added value, are globally competitive, and environmentally sound.

Indonesia's wood furniture and handicraft industry is expected to continue to innovate and explore the richness of national culture with modern packaging and following global market trends. This innovation will increase the added value and competitiveness of a furniture product.

However, this industry is not free from problems, namely the quality of raw materials. Wood raw materials in Indonesia are abundant but there is no special treatment to maintain their quality, so the quality of production is hampered. Good wood raw materials are raw materials that avoid damage and weathering. Many factors affect the quality of wood. One of the elements that affect storage conditions is temperature [1]. To maintain this quality, pay attention to how to store wood raw materials, namely in a room that is not humid so that moss does not grow and termites develop [2]. Providing air space in adjacent wood arrays of 25 cm so that moisture can escape [3][4]. Storage warehouse conditions must be dry and there is no potential for leaks when it rains [5][6]. Avoiding the storage of wood raw materials that are exposed to the sun directly [7][8]. The ideal room temperature for storage is 18^{o}C and room humidity is 65% [9]. If the temperature and humidity are not ideal, it will affect the durability of the wood material and the level of weathering of the wood [10].

Changes in temperature and humidity in storage warehouses always follow changes in temperature and humidity in the city. For this reason, further study is needed on the temperature and humidity monitoring system in the storage warehouse and if there are significant changes. In this research, a dehumidifier device is used to maintain the temperature and humidity in a room. With the development of automation technology at this time, it is hoped that it can help the monitoring system to maintain indoor temperature and humidity so that the quality of wood raw materials that will later be used in the furniture industry remains good.

Based on the above studies, this research will design an indoor temperature and humidity monitoring system using automation technology and based on the Internet of Things (IoT). The solution to this problem can be overcome using Internet of Things technology, which is a monitoring system used to monitor and control various environmental parameters in the data center, one of which is temperature and humidity [11]. The system is in the form of an A-TH3 Transmitter temperature and humidity sensor installed in the warehouse. This sensor can be monitored remotely, such as the degree of temperature and percent humidity in the warehouse and if there is a significant change, the system will activate the dehumidifier device to maintain the temperature and humidity in a room. This research attempts to integrate an IoT-based temperature and humidity monitoring system with an alarm and notification system that can provide warnings automatically if the temperature or humidity is outside a safe range [12][13]. It is also important for individuals to have easy and intuitive access to storage room temperature and humidity data available on the mobile application [14][15].

2. Method

2.1. Research Stages

The stages of this research are explained through the flowchart as shown in Figure 1. The stages are literature study, software and hardware design, software and hardware installation, testing and analysis. The parameters to be measured are indoor temperature and humidity. Component requirements consist of RS485 wireless components, cloud server, GSM communication module, and dehumidifier. User-side programming in the form of websites and android. The research location was carried out at the Politeknik Negeri Medan Electronics Laboratory. Sensor components consisting of temperature and humidity sensors.

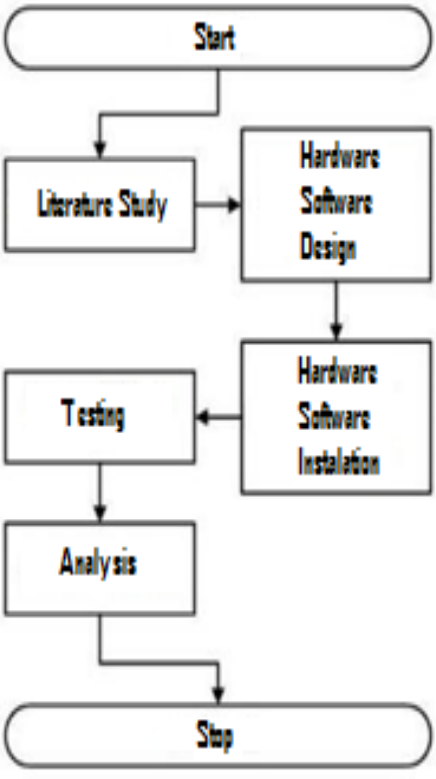

Figure 1. *The Research Stage*

2.2. Research Model

This research uses the A-TH3 Transmitter sensor device which can detect temperature and humidity in the room. This sensor is equipped with a transmission system. Every successful temperature and humidity data detected, the data is immediately sent to the RS485 wireless as an interface to the cloud server. The connection of sensor, gateway (RS485 wireless), and cloud server are shown in Figure 2.

Figure 2 *The connection of sensor, gateway (RS485 wireless), and cloud server*

A picture of the A-TH3 Transmitter temperature and humidity sensor can be seen in Figure 3 and RS485 Wireless as in Figure 4. Diagram block for this research as shown in Figure 5.

Figure 3. *A-TH3Transmitter Sensors*

Figure 4. *RS485 Wireless*

Figure 5. *Diagram Block of the Research*

3. RESULTS

3.1. Measurement

The warehouse room temperature and humidity are tracked and initially shown. The database stores the values from the A-TH3 Transmitter sensor. Table 1 shows how the temperature spectrum is described. The temperature range's and humidity membership function, as seen in Figure 5 and Figure 6.

Every minute, the control system records the temperature and humidity in the room. The storage saves the temperature and humidity measurements. Suppose the air temperature and humidity data surpass the temperature limit, which is 18°C minimum and 19°C maximum, or the humidity limit, which is at least 60% and maximum humidity of 65%. In that case, the sensor will send a warning on website.

The measured temperature and relative humidity values in miniature home between August, 23 – 28, 2023 respectively. It can be seen that the measured values are similar from room to warehouse. There is no significant difference in relative humidity between room and warehouse. It is visible that the average daily temperatures are above the 18°C based on air conditioner notification.

Table 1. *Temperature and Humidity Spectrum*

Room Temperature	Room Humidity	Status
18°C - 19°C	60% - 65%	Normal
>19°C	>65%	High
<18°C	<60%	Low

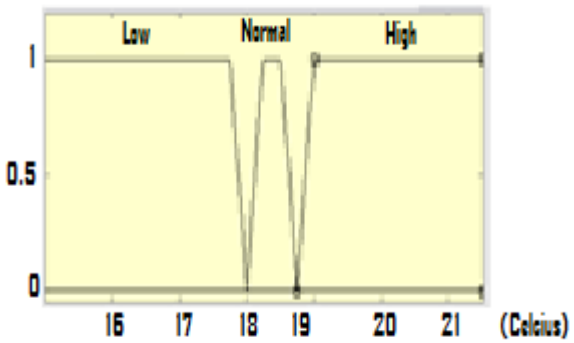

Figure 6. *The Temperature Range*

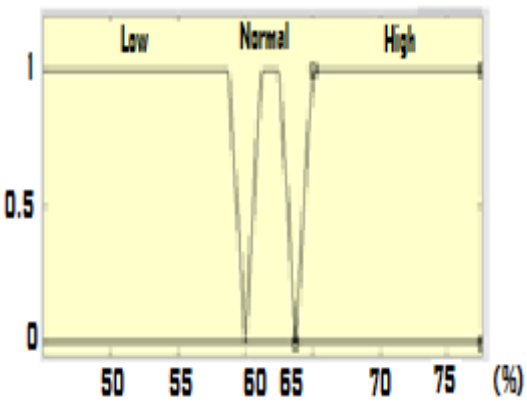

Figure 7. *The Humidity Range*

3.2. The Humidifier Testing

The control system read the room temperature and humidity by looking at the data in the database, which can be viewed on the website. if there is a significant change, the system will activate the dehumidifier device to maintain the temperature and humidity in warehouse. The humidifier will active if the condition is out of normal.

The testing was carried out by a warehouse and switch off air conditioner which produces heat in the room. when the temperature has exceeded the threshold, sensor turns on the dehumidifier automatically. The environmental temperature of the Furniture Warehouse Room should be controlled at 18 ± 1 °C, and the relative humidity is maintained in the range of 60% to 65% RH.

The main statistical indicators are shown in Table 2. The maximum temperatures was 31.94°C. This value is much higher than the often-considered thermal comfort limit of 26°C. During the measured period, there were also cooler periods when the internal temperature by air conditioner reached 16–21°C, when, with adequate ventilation, the external temperature effectively cooled the dwelling. However, the average room temperature remained above 26 °C (27.90 °C).

The relative humidity averaged 49.46% in the room during the measurement, ranging from 30.06% to 72.49%. It shows the internal temperatures is significantly lower than in the other room. It also shows that the internal temperature peaks are mainly concentrated in the external temperature range of 33–36°C.

Table 2. *Statistics of the Measured Temperature and Relative Humidity*

	Temperature (◦C)	Relative Humidity (%)
Min.	22.45	30.06
Max.	31.94	72.49
Mean	27.90	49.46
Standard Deviation	1.64	8.56
Median	27.85	47.42

4. Conclusion

The control system read the room temperature and humidity by looking at data in the database, which can be viewed on the website. This control is useful for maintaining the quality of raw furniture wood materials. Users will be able to control and monitor the condition of the wood storage warehouse to maintain the quality of the wood furniture. This system will help business owner to ensure the quality of the furniture materials is in good condition.

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