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UTILIZATION OF RADIO FREQUENCY IDENTIFICATION FOR AIR CONDITIONING MONITORING SYSTEM

Sunardi[1], Nurmahendra Harahap[1*], Muhammad Amril [1] dan Habib Muharry[1]
[1,*]Teknologi Pemeliharaan Pesawat Udara, Politeknik Penerbangan Medan
email : *nurmahendraharahap*@gmail.com*

Abstract: Comfortable room conditions are one of the factors that can affect the success of a job and the learning process. to keep the room comfortable, the temperature in the room must be cool. Maintaining the health of an Air Conditioner (AC) is needed for the coolness of a room. Many air conditioners in the office and educational environment make air conditioning health checks quite time and effort-consuming. To save time and effort in checking the health condition of air conditioners, then designed a device that can check the health of air conditioners by utilizing UHF RFID to identify each air conditioner. This device is divided into 2 parts, the first is an AC condition sending device that detects room temperature and current in the AC. Second, the receiver of the AC condition functions to find out the AC condition and sends the AC condition to mobile device. This experiment was carried out on 3 AC units. Each air conditioner is in a different room with a type of dividing wall made of glass and gypsum. The test results of this device are in a room with a length of 10 meters, the device can detect AC conditions. The air conditioner is in a different room with glass and gypsum walls, the device can still read the condition of the air conditioner.

Keywords: AC condition detection; Air Conditioner Health; UHF RFID,

Abstrak: Kondisi ruangan yang nyaman merupakan salah satu faktor yang dapat mempengaruhi keberhasilan suatu pekerjaan dan proses pembelajaran. Untuk membuat ruangan tetap nyaman, suhu di dalamnya harus sejuk. Menjaga kesehatan Air Conditioner (AC) sangat dibutuhkan untuk kesejukan sebuah ruangan. Banyaknya AC di lingkungan kantor dan pendidikan membuat pemeriksaan kesehatan AC cukup banyak memakan waktu dan tenaga. Untuk menghemat waktu dan tenaga dalam melakukan pemeriksaan kondisi kesehatan AC, maka dirancang sebuah alat yang dapat melakukan pemeriksaan kesehatan AC dengan memanfaatkan UHF RFID untuk mengidentifikasi masing-masing AC. Alat ini terbagi menjadi 2 bagian, yang pertama adalah alat pengirim kondisi AC yang mendeteksi suhu ruangan dan arus dalam AC. Kedua, penerima kondisi AC yang berfungsi untuk mengetahui kondisi AC dan mengirimkan kondisi AC tersebut ke perangkat seluler admin. Percobaan ini dilakukan pada 3 buah AC. Setiap AC berada di ruangan yang berbeda dengan tipe dinding pemisah yang terbuat dari kaca dan gipsum. Hasil pengujian perangkat ini berada di dalam ruangan dengan panjang 10 meter, perangkat dapat mendeteksi kondisi AC. Pada AC yang berada di ruangan yang berbeda dengan kaca dan dinding gipsum, perangkat tetap dapat membaca kondisi AC tersebut.

Kata kunci: deteksi kondisi AC; Kesehatan Air Conditioner; UHF RFID

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INTRODUCTION

In the process of learning, teaching, and working, many factors must be considered so that cadet learning and employee work become more conducive. The success of students in learning can be influenced by internal factors and external factors [1]. Internal factors are caused by the cadets themselves, while external factors can be caused by family, environsment, learning facilities, and so on employee performance is influenced by several factors, namely: salary, work environment, organizational culture, leadership, and work motivation, work communication discipline and other factors[2]. Thus, it can also be said that the comfort of a room is one of the factors that affect the learning outcomes of cadets and the performance of the employees.

The comfort of a room is greatly influenced by the air temperature in the room. The ASHRAE Handbook of Fundamentals recommends that if the temperature ranges from 75°F or about 23°C at 50% humidity to 78°F or about 26°C at 70% humidity, there can be a sense of comfort somewhere [3]. While the recommendation from the Indonesian National Standard (SNI) 03-6572-2001, states that the temperature comfort area for the tropics can be divided into 3, the first is cool, between an effective temperature of 20.5°C-22.8°C and RH 40% - 60%. The second is comfortable, between the effective temperature of 22.8°C-25.8°C and RH 40% – 60%, and the third is warm, between the effective temperature of 25.8°C-27.1°C and RH 40% – 60%.

For the comfortable conditions caused by the air temperature to be maintained, an Air Conditioner (AC) is needed in good condition. In general, offices, schools, and campuses have so many air conditioners that are used to expedite the work and learning process. The number of scattered air conditioners results in a long time to check the condition of the air conditioner. From this problem, it is hoped that there is a more effective and efficient way in terms of time that can be used to see if the air conditioner is in good condition or not.

This paper will offer a device that can facilitate the performance of employees to check the condition of the air conditioner by utilizing Radio Frequency Identification (RFID) to determine the condition of each air conditioner in the Politeknik Penerbangan Medan.

In carrying out this research, several studies have been carried out such as Monitor Breathing with Commodity RFID Systems [4]. RFID Enabled Health Monitoring System for Aircraft Landing Gear[5]. Vital Signs Monitoring with RFID: Opportunities and Challenges [6], Respiration Monitoring with RFID in Driving [7].

The difference with previous research is the design of the device that uses a servo motor to activate the RFID Tag. In this study, the air conditioner must be on.

METHOD

In the AC condition sending device, SCT 013-030 is used to measure the current flowing in the power cable that supplies power to the AC. The DHT22 sensor is used to read the temperature in the room. The data read by SCT 013-030 and DHT22 is sent to the Arduino pro mini which then controls the servo motor to drive the RFID antenna from signal removal using copper on the PCB. To be clearer can be seen in Image 1.

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Image 1. Sending device in AC condition

Furthermore, on the receiving device in AC conditions, a UHF RFID Reader is used as a passive RFID tag reader, the data read by the RFID Reader is then processed by nodeMCU 12E which is then sent to the admin mobile device. The display of this device can be seen in Image 2.

Image 2. AC condition receiving device

The stages in this research can be seen in Image 3.

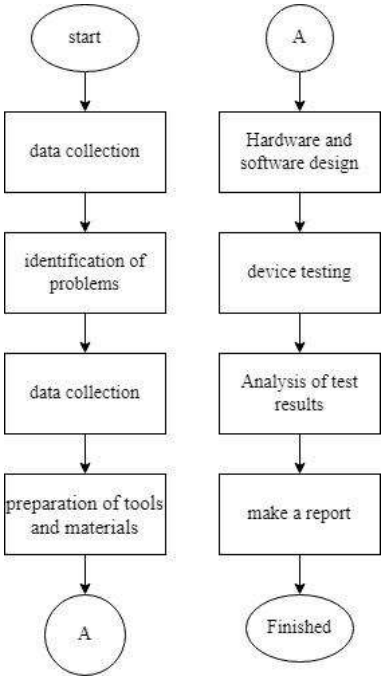

Image 3. Research Stages

For the overall working system of the devices in the study, it can be seen in Image 4.

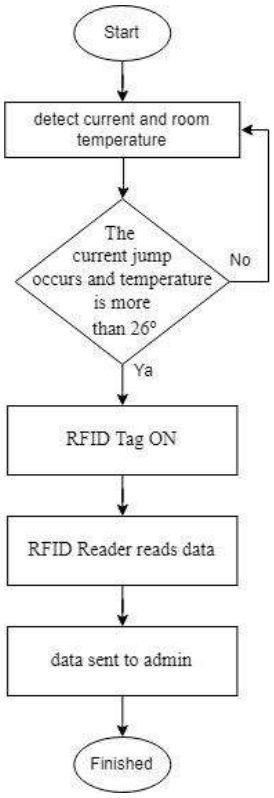

Image 4. Overall working system

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There are several aspects tested in this research, including testing the accuracy of the temperature on the DHT22 sensor by comparing it with a mercury thermometer. In addition, measurements of the power consumption used by this device are also carried out. To find out the readable areas between the receiving device and the transmitter in AC conditions, testing of this device is also needed. Finally, testing was carried out on 3 AC devices in different rooms, each air conditioner was installed with a monitoring device to determine the effectiveness of this device. The partitions between the room are made of glass and gypsum.

RESULTS AND DISCUSSION

From the tests that have been carried out on the DHT22 sensor in the room, the data is generated as shown in Table 1.

Table 1. Results of the DHT22. Sensor Accuracy Test Results

Time (Minutes)	DHT22 (Celcius)	Thermometer (Celcius)
1	28,1	28
2	28,2	28
3	28,2	28
4	28,1	28
5	28,2	28
6	28,3	28
7	28,3	28
8	28,4	28
9	28,4	28
10	28,4	28

From the data obtained, it can be seen that the temperature value on the mercury thermometer is almost the same as the DHT22 sensor. Meanwhile, the consumption of electrical power used on the sending device in AC conditions can be seen in Table 2.

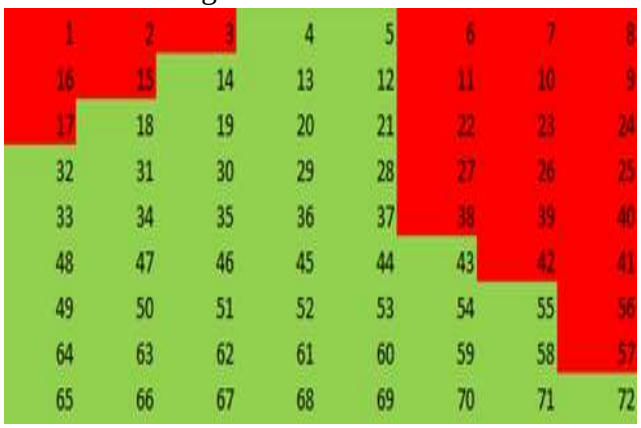
Table 2. Electrical Power Consumption on the Sending Device in AC Conditions

No	Condition	Daya
1	Standby	0
2	When the tag is open	1,3
3	When the tag is closed	1,4
4	When the tag has been opened	0
5	When the tag has been closed	0

From the data obtained, it can be seen that electricity consumption occurs when the RFID tag is open and closed, while when the RFID tag is not moving either in the open or closed position, the visible power consumption is 0.

In this test, it is also known that the reading area of the receiving device with AC conditions on the sending device with AC conditions is as shown in Image 5 where the red color is the area that is not detected by the RFID Reader.

Receiving device AC Condition



Imageure 5. Reading Range Area for AC Condition Receiver Devices

The distance between the coordinates in Image 5 is 1 meter, so the length and

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width of the room in this study are 10 x 8 meters. The maximum distance that can be read by the device is 10 meters according to the length of the data collection room. Image 5 also shows that the device works effectively when the sending device and receiving device are in AC conditions.

Subsequent tests were carried out to determine the efficiency of 3 monitoring devices for AC conditions in different rooms. The wall of the room that blocks the sending device in AC conditions with the receiver in AC conditions in the form of glass, gypsum, and without a barrier (Sending and receiving devices are still in the same room. From this test, the data is generated as shown in table 3.

Table 3 Device Success When There Are Obstacles

Testing to	Barrier Type		
	No Barrier	Glass	Gypsum
1	✓	✓	✓
2	✓	✓	✓
3	✓	✓	✓
4	✓	✓	✓
5	✓	✓	✓
6	✓	✓	✓
7	✓	✓	✓
8	✓	✓	✓
9	✓	✓	✓
10	✓	✓	✓

From the data in table 3, it can be seen that the device can penetrate barriers such as glass and gypsum. So it can be said that whether there are walls in the room in the form of glass and gypsum or without walls, the devices in this study can work effectively.

CONCLUSION

This research designed a device that can monitor the health of the AC by detecting the current and temperature of the AC. This device uses RFID to identify each air conditioner in a different room. From the trials of 3 AC units that have been carried out, it can be said that this device can work well. The device can make it easier to check the health condition of the air conditioner. The device can also still function properly even though there are glass or gypsum barriers that block the receiving or sending device. This research can also be seen that the device can read the condition of 3 AC units in 3 different rooms.

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