Jurnal Mantik, 5 (2) (2021) 894-897

Published by:Institute of Computer Science (IOCS)

Jurnal Mantik

Journal homepage: www.iocscience.org/ejournal/index.php/mantik/index

Design Arduino-Based Smart Laboratory

Erwinsyah Simanungkalit[1], Mardhiatul Husna[2], Jenny Sari Tarigan[3]

[1,2,3]Commerce Administration Department, Business Administration Study Program, State Polytechnic of Medan

Email : erwinsyahsimanungkalit@polmed.ac.id[1], Mardhiatul.husna@polmed.ac.id[2], jennysaritarigan@polmed.ac.id[3]

ARTICLE INFO

Article history:
Received: 01/06/2021
Revised: 10/06/2021
Accepted: 30/06/2021

Keywords:
Smart laboratory, Arduino, Microcontroller.

ABSTRACT

Electronic devices including Air Conditioner is always used during lecture process in computer laboratory. However, based on the observation, the device is often still in turn on condition even when the lecture activities have been ended. Such less efficient use leads to electricity waste which causes electricity bills to swell. This issue can be overcome by applying automation to the electronic devices in the laboratory. It is expected that by using this automation, these electronic devices are not easily damaged because the device will only turn on when needed so that it works more efficiently and electricity waste can be avoided. Current research was conducted aiming to develop an Arduino-based smart laboratory. This research was conducted in a computer laboratory at the Department of Commerce Administration, State Polytechnic of Medan. Based on the data obtained from the implementation stage, it showed that the Arduino-based Smart Laboratory System was functioning properly and can be used in computer laboratories.

1. Introduction

Electricity is essential for modern public activities. The current energy issue becomes a big problem since there are many incidences where people are in a hurry and forget to turn off the lights and air conditioners. In such a situation, a system that can save electricity is very useful, for example automation system. This system can make electronic devices work automatically, save energy and is efficient. This is not only useful in the industrial world, but also in computer laboratories which require convenience and cost-effectiveness in meeting needs or completing a job, for example in using electronic devices such as lamps, air conditioners, LCD projectors, and others[1]. Controlling the temperature of a room can be done in many ways, such as using fan, Air Conditioner (AC), ventilation, and others. One of the tools which have the ability to regulate the room temperature effectively is the Air Conditioner (AC). One AC unit that has a power of 1 PK can effectively control the temperature of a 50 cubic meter room. The use of air conditioning is needed in rooms that require stable low temperatures, such as a laboratory room[2].

2. Theoretical Basis

2.1 Laboratory (SCL)

Smart Classroom and Laboratory (SCL) as a part of SC is the implementation setting and monitoring of classroom/ laboratory which provides real time information because this overall systems are integrated to a bigger system which can be accessed through a network and platform [3]. Laboratory can be interpreted as follows: Laboratory is a supporting means for the department in the study concerned, and a basic resource unit for the development of science and education[4].

2.2 Automation

Automation is a process that automatically controls the operation and equipment of a system using mechanical or electronic equipment that can replace humans in observing and making decisions [5]. There are some reasons for using automation system, such as: (1) to increase company productivity; (2) the high costs of employment; (3) lack of workers for certain abilities; (4) workers tend to move to the service sector;

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

(5) the high price of raw materials (6) to improve product quality; and (7) to decrease Manufacturing Lead Time (MLT)[5].

2.3 Microcontroller

Microcontroller is a small electronic component which has the role as controller containing an interconnection system between the microprocessor, RAM, ROM, CPU, input, and output. Microcontroller is a computer on a chip employed to control electronic equipment efficiently and cost-effectively (Yuliana: 2011). Microcontroller is technically divided into 2 types, those are RISC and CISC. Each of them has a family, in which RISC (Reduced Instruction Set Computer) is a limited instruction but with more facilities, while CISC (Complex Instruction Set Computer) is a more complete instruction but with limited facilities.

2.4 Microcontroller Programming

IDE (Integrated Development Environment) can be employed for microcontroller programming. Programming is a sequence collection of commands to a computer to do something. These commands require its own language so that the computer can understand. There are two IDE software often used by programmers in microcontroller programming, those are code vision AVR and Arduino IDE. In its operation, IDE software uses the C language or ensembler which is the language used in microcontroller programming.

2.5 Arduino IDE

Arduino IDE is IDE(*Integrated Development Environment*)software. This software makes it easier for researchers to develop microcontroller applications starting from writing source programs, compiling, uploading compilation results, and testing in serial terminals [6]. However, Arduino has not been able to debug in simulation or hardware until now. Arduino can be run on computers using various platforms because it is supported or based on Java. The source program we made for the microcontroller application is C/C++ language and can be combined with assembly. The author used Arduino-based AVR microcontroller in an ATMEGA type, which are ATMEGA 8, 168, 328 and 328P[6]. Arduino is very easy to be used. This easiness because we do not need to know the hardware details of the microcontroller, especially concerning the registers configuration that must be applied as long as we know how the microcontroller works. Furthermore, Arduino is also very rich in libraries from both Arduino developers and donations from other people, because Arduino is open source. When the source is compiled, the result in the form of a hex file is uploaded to the microcontroller serially by utilizing the TX/RX pins.

3. Method

Smart Laboratory is generally illustrated by the following diagram.

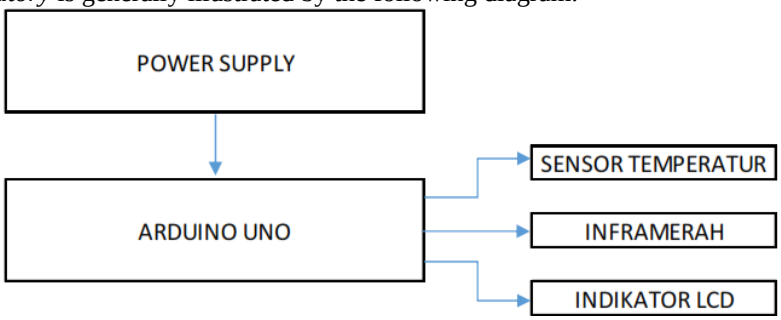

Fig 1. Block diagram of Automatic AC Temperature Control Device

Sensor employed in this study is Infrared LED type. Arduino will read the current room temperature via the DHT11 sensor for automatic AC temperature control devices. If the desired temperature is 24°C, and the air temperature in the laboratory is one degree more than the desired temperature, which is 25°C, the Arduino will send a temperature signal of 23°C to the AC using LED infrared transmission medium. If the room temperature is 26°C, Arduino will send a temperature signal of 22°C. Furthermore, if the room temperature reaches the coldest temperature of 21°C, Arduino will send a signal to turn off the AC. The block diagram design for the automatic AC temperature control device that will be developed is as shown in the image below.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

3.1 Testing Results

The microcontroller will turn on the AC at 17°C if the room temperature is above 27°C, 21-23°C if the room temperature is at 25-27°C, 24°C if the room temperature is at 24°C, 23°C if the room temperature is at 25°C, and will turn off the AC if the room temperature is below 23°C

Table 1.
Testing Results of Automatic AC Temperature Control Device

Procedure	Room Temperature	AC Temperature	Results
AC will turn on at 18'C if the room temperature is above 27'C	28	17	✓
AC will turn on at21-23'C if the room temperature isat 25-27'C	27, 26, 25	21, 22, 23	✓
AC will turn on at24'C if the room temperature isat 24'C	24	24	✓
AC will turn on at23'C if the room temperature isat25'C	23	25	✓
AC will turn off if the room temperature is below 23'C	22	Turn off	✓

The device was tested by testing the Arduino with the conditions that the required components/sensors are installed completely with the program code that has been made. In the code uploaded to this device, Arduino will change the AC temperature based on the room temperature obtained from the DHT11 sensor. If the room temperature is above 28°C, the AC will turn on at 17°C until the room temperature reaches 28°C. After that, AC will stabilize the room temperature by changing the air conditioner temperature within 20-28°C. If the room temperature is below 23°C, the air conditioner will automatically turn off. The system flowchart can be seen in the Fig below.

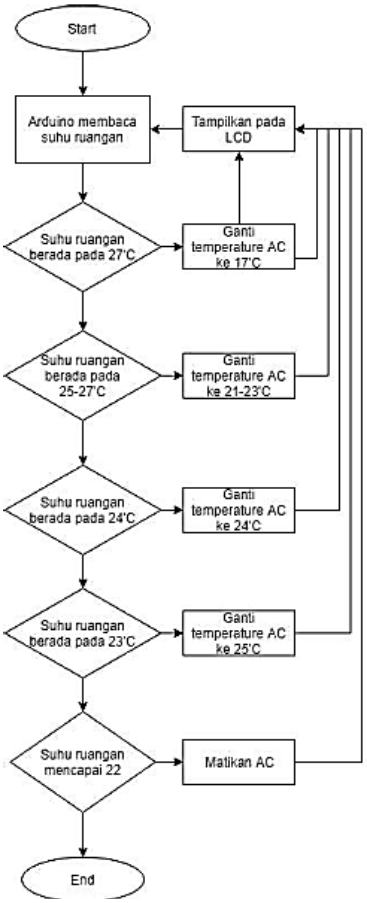

Fig 2. Flowchart of Automatic AC Temperature Control Device

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.

4. Conclusion

According to the explanations of the system sequence above, starting from the preparation of equipment and materials as well as the design and manufacture of the equipment that have been conducted, researchers draw the following conclusion. The system built is able to control the temperature of the Air Conditioner (AC) based on the room temperature obtained from the DHT11 sensor installed the laboratory.

5. References

[1] I. Oktariawan, M. Martinus, and S. Sugiyanto, "Pembuatan Sistem Otomasi Dispenser Menggunakan Mikrokontroler Arduino Mega 2560," *J. Ilm. Tek. Mesin FEMA*, vol. 1, no. 2, p. 1, 2013.

[2] S. M. Abizar Rachman, Zainal Arifin, "Sistem Pengendali Suhu Ruangan Berbasis Internet of Things (IoT) Menggunakan Air Conditioner (AC) Dan NodeMCU V3 ESP82," *Pros. Semin. Nas. Ilmu Komput. dan Teknol. Inf.*, vol. 5, no. 1, pp. 19–23, 2020.

[3] Rahmat, Wiwik, Firdaus, and I. Rimra, "Ruangan Kelas dan Laboratorium Pintar (Menuju Smart Campus dengan Internet of Things)," *J. Ilm. Poli Rekayasa*, vol. 14, no. 1, p. 58, 2018, doi: 10.30630/jipr.14.1.111.

[4] H. W. Luthfi and B. K. Riasti, "Sistem Informasi Maintenance Dan Inventaris Laboratorium Pada SMK Negeri 1 Rembang Berbasis Web," *J. Speed – Sentra Penelit. Eng. dan Edukasi*, vol. 3, no. 3, pp. 69–77, 2011, [Online]. Available: https://ijns.org/journal/index.php/speed/article/view/1219.

[5] S. Ari Beni Santoso, Martinus, "Pembuatan Otomasi Pengaturan Kereta Api, Pengereman, Dan Palang Pintu Pada Rel Kereta Api Mainan Berbasis Mikrokontroler," *FEMA*, vol. 1, pp. 16–23, 2013.

[6] D. Saputra and A. H. Masud, "Akses Kontrol Ruangan Menggunakan Sensor Sidik Jari," *Sentika*, vol. 2014, no. Sentika, p. 9, 2014.

Accredited "Rank 4"(Sinta 4), DIKTI, No. 36/E/KPT/2019, December 13th 2019.