http://ejournal.seaninstitute.or.id/index.php/InfoSains
Jurnal Info Sains : Informatika dan Sains, Volume 13, No 03 2023
E-ISSN.2797-7889, P-ISSN.2089-3329

Implementation of Arduino in the Control Panel Room Temperature Monitoring and Control System

Awan Setiawan
Program Studi Teknik Informatika, Universitas Langlangbuana Jl. Karapitan No.116, Cikawao, Kec. Lengkong, Kota Bandung
Email: awans2425@gmail.com

Keywords

Monitoring System, Temperature, Control Panel, Nodemcu

Abstract. A web-based air temperature and humidity monitoring system is a proactive strategy to prevent material damage in the component manufacturing process. Critical temperature and humidity conditions affect the integrity and quality of semiconductor components, both from physical and functional aspects. Controlling air conditions is essential for optimizing components on the control panel. With the machine operating at maximum capacity or under heavy load, this system utilizes a DHT11 sensor and Nodemcu v.3 microcontroller equipped with an esp8266 wifi module to send data to the server via the internet. Through temperature monitoring and control devices, information can be accessed and monitored from other devices. All measurement data is stored in a database for analysis of air conditions in the panel control area. This analysis information is useful for maintenance and improvement of the cooling system in the control panel room.

1. INTRODUCTION

In everyday life, temperature has a big influence on surrounding objects, especially electronic equipment. Extreme temperature conditions can accelerate the damage to electronic equipment and other objects in the control panel room in the manufacturing company's work area. In this work area there are lots of panel rooms that control production machines. Production machines operate 24 hours non-stop so that many spare parts on production machines are damaged and one of the factors causing damage to these parts is caused by temperatures that exceed capacity or often referred to as over temperature which causes the machine to stop and can even cause components to burn. The panel control room has an important role in a control system to monitor disturbances both inside and outside. For example, PLCs (Programmeable Logic Control) and inverters require stable temperatures and humidity to work optimally and extend their service life. In order to minimize this incident, technicians have additional work, namely checking the temperature of engine spare parts and control panel rooms. (Supriyanto, et al, 2017)

Room temperature can generally be adjusted manually using an air conditioner and fan. The addition of work to manually check the temperature of the control panel room does not reduce the incidence of over temperature which is still frequently experienced in companies. With the rapid development of systems and technology, it is very necessary to build an application system that aims to monitor temperature automatically. In this research, a web-based automatic room temperature monitoring and control tool will be designed and implemented. In this way, this system can provide a solution for monitoring and controlling the control panel room temperature to minimize over-temperature incidents.

Review Of Literature Related To The Problem

Temperature Monitoring and Control in the Control Panel Room

The control room is the area where operators carry out operations in manufacturing companies using control systems every day, and the safest, most comfortable and functional environment helps operators run production in manufacturing companies more efficiently. To ensure smooth business operations, production processes, supervision and monitoring activities, equipment control, data acquisition processes, and other activities carried out in the control room generally take place continuously without stopping. Machines, computers, control equipment and other supporting equipment continue to work non-stop 24 hours a day and have become the heart of the operational cycle of business activities. (Sanaji & Azhari, 2018)

Efforts to mitigate the risk of downtime on equipment need to map potential dangers that could cause disruption to system performance in the control room and control center. One of the risks that

can occur at any time is the danger of fire due to human error, the creation of fire from machine parts and computers or equipment contained in the control room, an electrical short circuit (electrical short circuit) due to the large number of cables and tools that use electric power, or other potential fire hazards can occur in the control panel room.

Monitoring is a routine process of collecting data and measuring progress on program objectives. Monitoring changes that focus on processes and outputs will provide information about the status and trends that measurements and evaluations provide repeatedly over time. Monitoring is generally carried out with an exclusive purpose, to check the process of an object or to evaluate conditions or progress towards a stated goal. There will be management of the effects of the action as long as some type of action is taken to maintain ongoing management. In general, monitoring aims to get feedback on the needs of the ongoing learning process program. By knowing these needs, program implementation will immediately prepare for the learning needs. Usual requirements include costs, time, personnel and tools. The program application will know how much money is needed, how much time is available for the activity. In this way, it will also be known how much energy is needed, as well as what tools must be provided to carry out the program. (Pangestu et al, 2019)

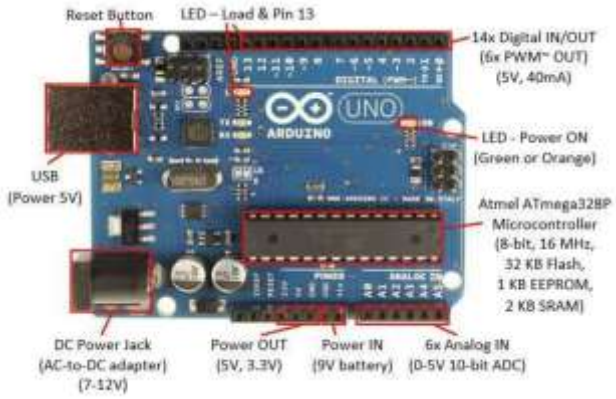
The control room in a manufacturing company is a vital operational center, where control, monitoring and operational activities within the manufacturing company are carried out continuously. In this environment, temperature is a key factor that must be monitored and controlled to ensure smooth operation and prevent the risk of system failure. The control room must be designed to provide a safe, comfortable, and functional environment. This is important because machines, computers and control equipment work non-stop 24 hours a day, making them the heart of business operations. Monitoring is not just data collection, but also evaluation of the status and objective progress of the program. Monitoring requires continuous analysis of processes and outputs to obtain effective feedback. This involves assessing the costs, time, personnel, and tools required to ensure operations run smoothly.

The following are several temperature monitoring and control activities: 1) Temperature Sensor: Use of accurate and reliable temperature sensors to monitor temperature changes in the control room; 2) Automatic Control System: Implementation of an automatic system that can respond to temperature changes quickly and efficiently; and 3) Integration with Security Systems: Integration of temperature monitoring with security systems to detect potential risks of fire or electrical short circuit. Monitoring and controlling temperature in the panel control room is a crucial aspect in ensuring operations in manufacturing companies run smoothly and safely. Through a comprehensive approach, including risk mitigation and implementation of advanced technology, companies can ensure a safe, efficient and productive work environment. Thus, a deep understanding of the importance of temperature monitoring and control is the key to improving the performance and safety of control rooms in manufacturing companies.

Implementation of Arduino in the Temperature Monitoring and Control System

Arduino is an electrical platform for prototyping that has open-source hardware characteristics. Arduino is designed with flexible and simple usability in mind, perfect for artists, designers, and other individuals who want to create interactive objects or environments. Even though it uses components like other microcontrollers, Arduino has special pin names that make it easier to use. The Arduino software is also open source, allowing users to download it at no cost. With a programming flow that is simpler than conventional microcontrollers, Arduino is an ideal choice for beginners who want to start their journey in the world of microcontrollers. Thus, Arduino can be considered as a combination of hardware and software that supports electroprototyping. (Arifin et al, 2016).

Following Figure 1 is an Arduino microcontroller.



Picture. 1 Arduino microcontroller

Arduino, as an electrical platform for prototyping, has opened up wide opportunities for various technological applications, one of which is temperature monitoring and control systems. The advantage of Arduino is that it is open-source hardware and software, offering a flexible, simple and efficient solution for temperature monitoring and control needs. The following Table 1 shows the advantages of Arduino in temperature monitoring and control.

Table I Arduino In Temperature Monitoring And Control

No	Advantages of Arduino	Main Components of Implementation	Benefits of Implementation
1	***Open-Source Hardware***: The open availability of designs and specifications enables easy integration with a variety of temperature sensors and other devices.	Temperature Sensor: Use of Arduino compatible temperature sensor to measure temperature with accuracy.	Energy Efficiency: With an intelligent system, energy use can be optimized according to temperature requirements, saving operational costs.
2	**Flexibilitas**: The flexible design allows adaptation to various types of temperature monitoring and control systems, from simple to complex.	Arduino microcontroller: As the brain of the system, Arduino will collect data from temperature sensors and run programs to control other devices as needed.	Automatic Control: Arduino can be programmed to respond to temperature changes automatically, ensuring that room conditions remain optimal.
3	**Simple for Beginners: With its intuitive** programming flow, Arduino is an ideal solution for beginners who want to develop temperature monitoring and control systems.	Output Controller: An output module such as a relay or actuator to control a device such as a heater or cooler based on received temperature data.	Integration with Other Systems: Arduino's open capabilities enable integration with other monitoring systems, such as security or other monitoring systems.

Arduino implementation of temperature monitoring and control systems offers a solution that is efficient, flexible, and can be adapted to specific needs. By utilizing the open source advantages of Arduino, development and integration of temperature monitoring and control systems becomes easier, more effective and cost-effective. Thus, Arduino's role as an innovative electrical platform proves to be an ideal solution to address the challenges of temperature monitoring and control in various industrial and technological applications.

2. METHOD

Engineering Research Methods

This research method includes planning, designing, building, implementing and developing. The following are the stages of the engineering method:

1. Planning (Planning), is an assessment that begins using a process of evaluation and identification of problems, an assessment of the problem, so that specifications of needs and information to support decision making are obtained to solve problems.
2. Analysis, the decomposition of a complete information system into its component parts with the aim of identifying and evaluating the conflict problems needed, as a result of which improvements can be proposed.
3. Design, is an effort to discover or create a method, formula, model or prototype according to the needs of potential users who need it in solving/overcoming problems. The results of this design must be tested mathematically/statistically or empirically.
4. Construction (Construct), is an effort to realize a product or system based on previously tested design results.
5. Application (Applied / Implementation), is an effort to diffuse, install, adapt / convert, operate / act, supervise, control, maintain and evaluate something that has been dis covered previously which is relevant to the needs in solving / overcoming problems.

Engineering research methods can be forward engineering and reverse engineering. The following is an explanation of each of these methods:

1. Forward Engineering, engineering carried out from planning, design, construction, to implementation, or in short stages of engineering, for example from design to construction only. Engineering is carried out starting from a higher abstraction to a level or several lower levels.
2. Reverse Engineering, is the engineering of existing products, systems, or prototypes into blueprints, formulas, or examples, or in short stages of engineering, for example from development to design only. Engineering is carried out starting from a lower abstraction to a level or several higher levels.

The research method that will be used in this research uses engineering methods with a forward engineering approach. Several research stages that will be carried out are as outlined in Figure 2 below:

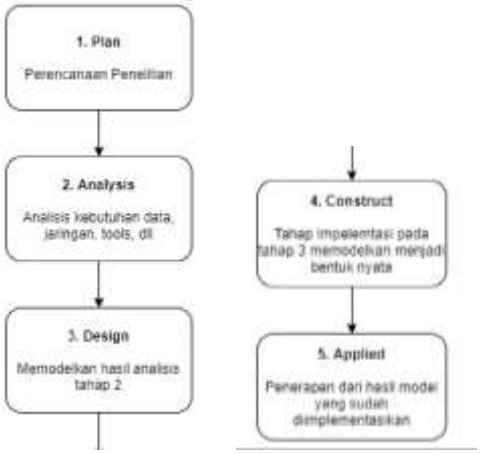


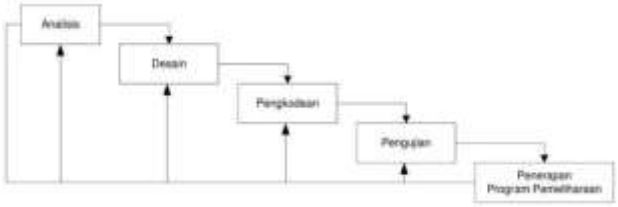
Figure 2 Forward Engineering Research Method

1. Plan, the initial planning stage of the research process, defining the objectives and scope of development then identifying existing problems, which can be resolved through system development.
2. Analysis, the decomposition of a complete information system into its component parts with the aim of identifying and evaluating expected problems, so that improvements can be proposed.
3. Design, this stage is the modeling stage of the analysis results presented in stage two, namely the advanced stage of system development after system analysis.

4. Construct, the implementation stage of a model formed in stage 3 into a real form.
5. Applied, is the application stage of the model results that have been implemented by the software to the user.

Model Waterfall

The waterfall model or what is often called the waterfall model is often called the classic life cycle, where it describes a systematic and sequential approach to software development, starting with user requirements specifications then continuing through the planning stages, modeling, construction and delivery of the system to customers/users (deployment), which ends with support for the complete software produced. In its development, the waterfall model has several sequential stages, namely: requirements (needs analysis), system design (system design), coding (coding) and testing (testing). (Rizaldi, 2017). The stages in the Waterfall model can be seen in Figure 3 below:



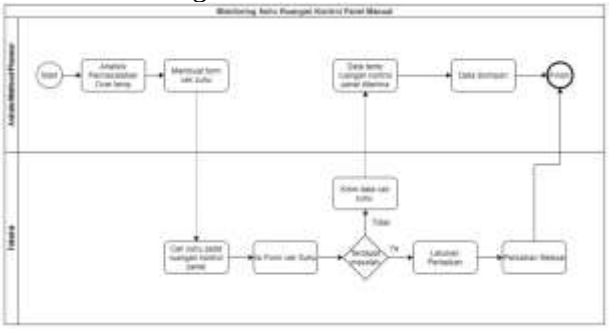
Picture. 3 Waterfall Models

1. Analysis, at this stage system developers need communication aimed at understanding the software required by users and the limitations of that software. This information can generally be obtained through interviews, discussions or exclusive surveys. information is analyzed to receive the data expected by the user.
2. Design, requirement specifications from the previous stage will be studied in this phase and a system design will be prepared. System Design helps in determining hardware and system requirements and also helps in defining the overall system architecture.
3. Coding, in this stage, the system is first developed in small programs called units, which are integrated in the next stage. Each unit is developed and tested for functionality which is called unit testing.
4. Testing, all units developed at the implementation stage are integrated into the system after testing carried out by each unit. After integration the entire system is tested to check for any failures and errors.
5. Implementation of a maintenance program, final stage in the waterfall model. Software that has been completed, run and maintained. Maintenance includes correcting errors not found in the previous steps. improving the implementation of system units and improving system services as new requirements.

3. RESULTS AND DISCUSSION

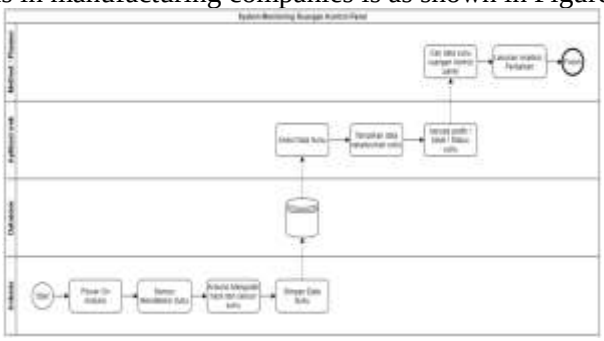
Business Process Analysis

The business process for the control panel room temperature monitoring system in a manufacturing company is as shown in Figure 4 below:



Picture. 4 Running System Business Processes

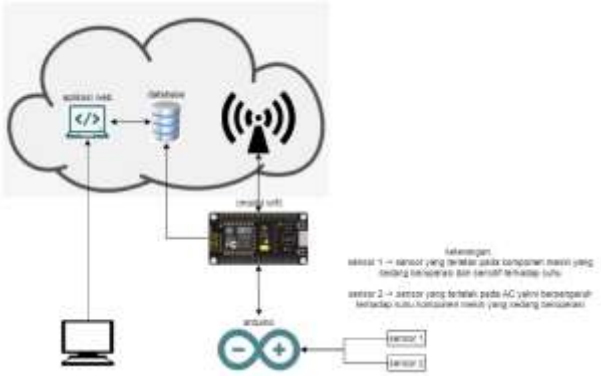
The proposed business process for a temperature monitoring and control system for room temperature control panels in manufacturing companies is as shown in Figure 5 below



Picture. 5 Proposed System Business Processes

Running System Architecture

The topology/architecture of the temperature monitoring and control system in the panel control room is as shown in Figure 6 below:

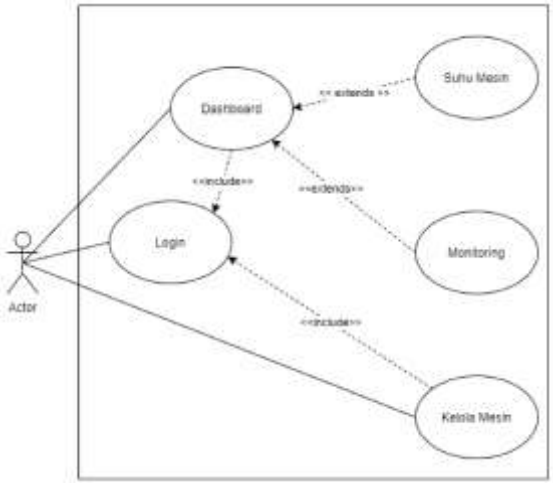


Picture. 6 System Architecture

1. For a table in the database to store data from temperature measurements using sensors
2. Sensors that have been connected to Arduino and nodeMCU are programmed using C++ language and platform.io as the Arduino framework. The medium for obtaining data is in the form of temperature values from sensitive components and AC which affects these components
3. So that the nodeMCU can connect to the internet nearby, the nodeMCU is programmed to request an IP address on the surrounding WiFi network
4. After connecting to the internet, the variables that have been created in the database must match the name of the temperature variable so that they are in sync and can be stored in the database
5. The temperature data values that have been stored in the database will be displayed on the web application in the form of tables or graphs and can be monitored by the analyst team.

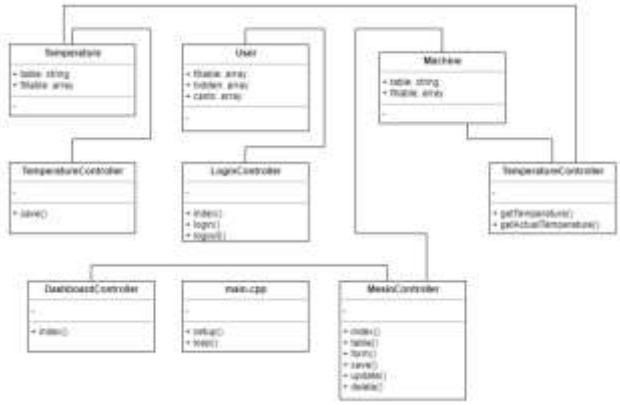
System Design

The following Figure 7 is a use case diagram for the temperature monitoring and control system in the control panel room.



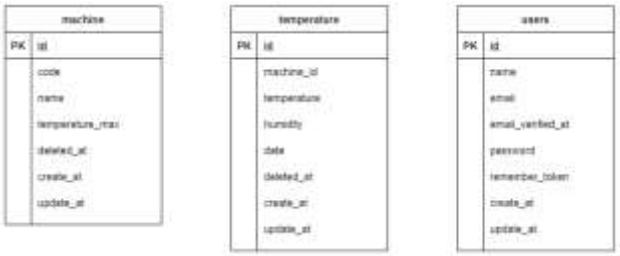
Picture. 7 Use Case Diagrams

The class diagram contained in the room temperature control panel temperature monitoring and control system is as shown in Figure 8 below.



Picture. 8 Class Diagrams

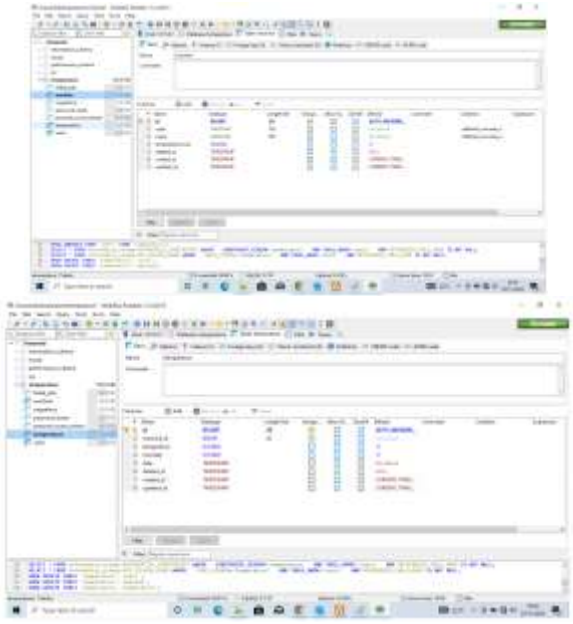
The database design for the control panel room temperature monitoring and control system is as shown in Figure 9 below:



Picture. 9 Database Design

System Implementation

The following is Figure 10 which is an implementation of the machine and temperature database design



Picture. 10 Database Implementation

The results of the implementation of the interface design for the control panel room temperature monitoring and control system are as shown in Figures 11 - 13 below:

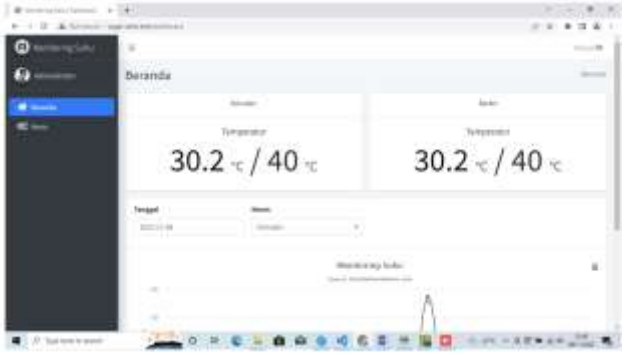
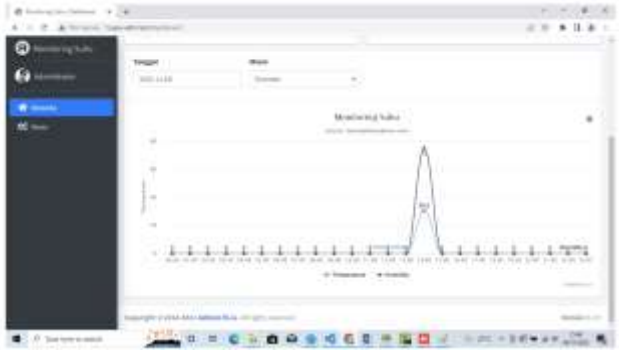


Figure 11 Implementation of the Machine Temperature Interface



Picture. 12 Machine Monitoring Interface Implementation

Picture. 13 Machine Data Management Interface Implementation

4. CONCLUSION

Based on the research results described in the previous chapters, the following conclusions can be drawn: The application can monitor room temperature automatically using an Arduino microcontroller connected to nearby WiFi to send temperature values to the web application. Users / admins can find out the warning or urgent status by using the color mark on the panel room temperature value and issuing an alarm in the form of an mp3 sound.

REFERENCES

Arifin, J., Zulita, L.N., Hermansyah., 2016, Perancangan Murottal Otomatis Menggunakan Mikrokontroller Arduino Mega 2560, Jurnal Media Infotama, Vol. 12, No. 1

Pangestu, A. D., Ardianto, F., Alfaresi, B., 2019, Sistem Monitoring Beban Listrik Berbasis Arduino Nodemcu Esp8266. Jurnal Ampere, Vol. 4, No. 1, pp. 187–197. https://doi.org/10.31851/ampere.v4i1.2745

Sanaji, Riki., Azhari, Rangga Dipta., 2018, Perancangan Monitoring Dan Kontrol Temperatur Dan Kelembaban Udara Ruang Kontrol Panel Mengunakan Raspberry Pi 2 Berbasis IoT, Media Elektrika, Vol.11, No.2, pp. 85-96

Supriyanto, Adolf Asih., Kurnia, Deni., Hania, Laksmita Dwi Nur., 2017. Monitoring Suhu Ruangan Berbasis Web, Pei.e Jurnal