

Internet of Things

Design and Construction of Automatic Clothes Drying Rack Prototype Based on IoT (Internet of Things)

Abdillah Syahputra¹, Halim Maulana²

¹*Department of Information Technology, Faculty of Computer Science and Information Technology, Universitas Muhammadiyah Sumatera Utara, Medan, 20238, North Sumatra, Indonesia*

²*Department of Information System, Faculty of Computer Science and Information Technology, Universitas Muhammadiyah Sumatera Utara, Medan, 20238, North Sumatra, Indonesia*

ARTICLE INFORMATION

Received: September 20, 2024
Revised: December 19, 2024
Available Online: January 09, 2025

KEYWORDS

Internet of Things
Clothesline
Microcontroller
ESP8266

CORRESPONDENCE

Phone: +62 822-7444-7535
E-mail: abdillahsyahputra@gmail.com

A B S T R A C T

During the dry season, the intense heat of the sun is highly sought after by Indonesian communities for various needs, one of which is drying clothes that are still wet. Therefore, Indonesians prefer using clotheslines as a medium for drying clothes. Essentially, in addressing the issue of clotheslines, an automated control system is needed. Advances in the field of science and technology, particularly in IoT (Internet of Things), will lead to new innovations. One such innovation is an automatic clothesline control system, which helps and simplifies human tasks. The system automatically moves or shifts dried clothes to a place that is not exposed to rain. In this research, an automatic clothesline system is designed to secure clothes during rain or other weather changes using several sensors: rain sensor, Light Dependent Resistor (LDR), and Temperature and Humidity Sensor (DHT), as well as an external fan that functions as additional drying assistance during rain. This system utilizes the ESP8266 microcontroller and is based on the Internet of Things, allowing remote monitoring and control via smartphone. Based on conducted tests, this system effectively responds to weather changes.

INTRODUCTION

Recent climate change has caused instability in the changing seasons. This condition makes it difficult to predict the weather. Although drying clothes outdoors is considered the most economical option because it does not require special equipment, this method has several disadvantages, such as being less effective when it rains suddenly and there is no supervision that can move clothes that are exposed to rain [1,2].

In the dry season, the hot sun is very much needed by the Indonesian people for various needs, one of which is in drying clothes that are still wet. The drying process is usually done with various tools, namely a clothes dryer or dryer which has a fairly expensive price and consumes a lot of electricity, therefore the Indonesian people prefer clotheslines as a medium for drying clothes.

With the development of the Internet and other communication media, the field of Internet of Things research is increasingly developing. Along with the increasing human need for this technology, more and more research will be conducted in this field. So that IoT can help manage and optimize electronic devices and electrical equipment that are already connected to the Internet [3,4]. In the future, the need for computer use may dominate work and defeat human computing capabilities. The development and application of the Internet of Things also make it possible to identify, locate,

track, monitor, and trigger related events automatically and in real time. The development and application of computers, the Internet, and other information and communication technologies (ICT) greatly affect economic management, production operations, social management, and even personal life [5,6].

Several studies have shown that the Internet of Things has grown rapidly in many fields of science and industry, such as informatics, health, geography, and other fields. Among the many technologies used in the Internet of Things, sensors function as data readers, connected to the internet with various network topologies, wireless sensor networks, radio frequency identification (RFID), and various other technologies that will continue to be developed to meet needs.

A clothesline is a tool or device that is usually used to dry clothes using the help of hot sunlight. In general, Indonesian people when drying clothes prefer to leave it because of busy factors or having to travel far. However, problems are often faced when drying clothes, namely unpredictable weather, sometimes hot or sometimes suddenly raining, making you restless and worried when leaving the clothesline.

Basically, in helping to handle the problem of drying clothes, a control system or control system is needed that is carried out automatically. The advancement of science in the field of knowledge and technology, especially in the field of IOT (Internet Of Things) will produce new innovations, one of which is the innovation of the automatic clothesline control system with this innovation helping and facilitating human performance, namely the clothes that have been dried will automatically move or shift to a place that is not exposed to rain.

To handle this problem, a tool is needed with an automatic control system that helps people, especially housewives, to easily take out and put in laundry without using manual labor.

METHOD

Prototyping Method

In this study, the method used is the prototyping method which is useful as a basis for the framework in a study. The prototyping method is an initial software development technique that uses a physical model of the system's working design. This method helps developers and users communicate and facilitates the development process. The prototyping method was created with the aim that developers can collect data from users to interact with the designed prototype model. User involvement, namely when the designed prototype will benefit everyone involved in the process [7,8].

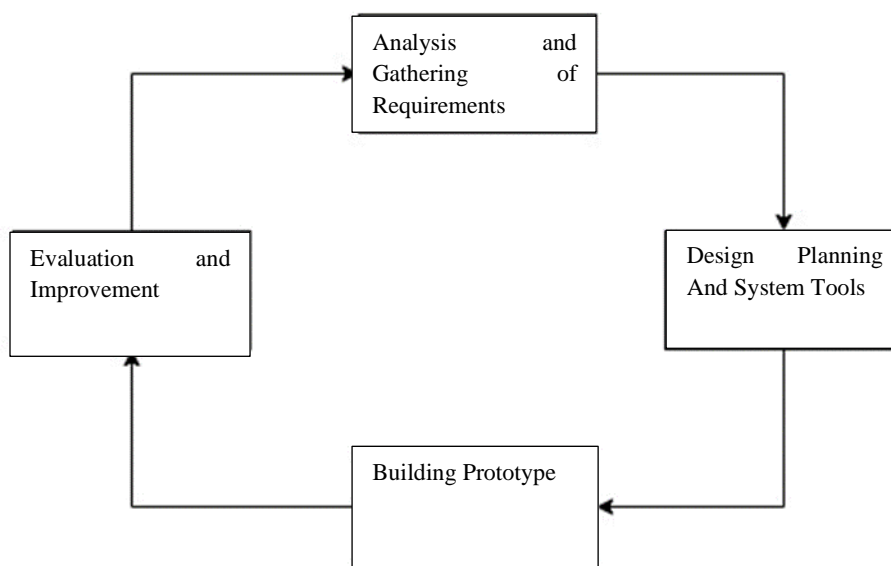


Figure 1. Prototyping Method Stages

The following are the stages of prototyping method research:

1. Analysis and Collection of Needs

At this stage, data collection is carried out with research and continued with observations made in everyday life both at home and in the surrounding environment by analyzing problems that arise when drying clothes. The technique of collecting needs binds discussions between developers and users so that they can determine all the goals for making software; then identify the basic requirements of the system to be built in full.

2. Design and System Tool Design

At this stage, ideas and system and tool designs will be distributed in implementing the Internet of Things system into an Automatic Clothesline Prototype using a NodeMCU microcontroller. The design focuses on the description of all aspects of the software from the user's perspective, at this stage the aspects include the output format, input and processes that will be created. The prototype design will be reviewed by the user and in the section analyzing the system design, adjustments will be made to the software and tool system requirements to be developed.

3. Building a Prototype

In making a Prototype, it will be designed to suit user needs, so that at that time the developer will know more details and what parts will be worked on. At this stage, it will also be implemented into an Internet of Things system on the Automatic Clothesline Prototype using the NodeMCU Microcontroller using the C++ programming language. At this stage, a series of automatic clothesline prototypes will be created containing several devices, namely the NodeMCU microcontroller, Light Sensor, Fan, Stepper Motor, Rain Sensor, Temperature and Humidity Sensor, Buzzer. At this stage, a controller will also be built that can be controlled remotely by utilizing the Blynk application.

4. Evaluation and Improvement

Then when the four stages of prototyping have been completed, the next stage is to design and build a more real product. At this stage, the system that has been created and is running will be implemented, then after that a mentoring method and also a review of the new or long-developed system are formed, the Developer can also make a comparison between the two. The evaluation process will continue to be carried out on the system technically and operationally, as well as user interaction.

Hardware Circuit Design

Hardware Design is a design of a series of tools that will be used in building an automatic clothesline prototype using the NodeMCU microcontroller. The following is a series of automatic clothesline devices that can be seen in Figure 2 below.

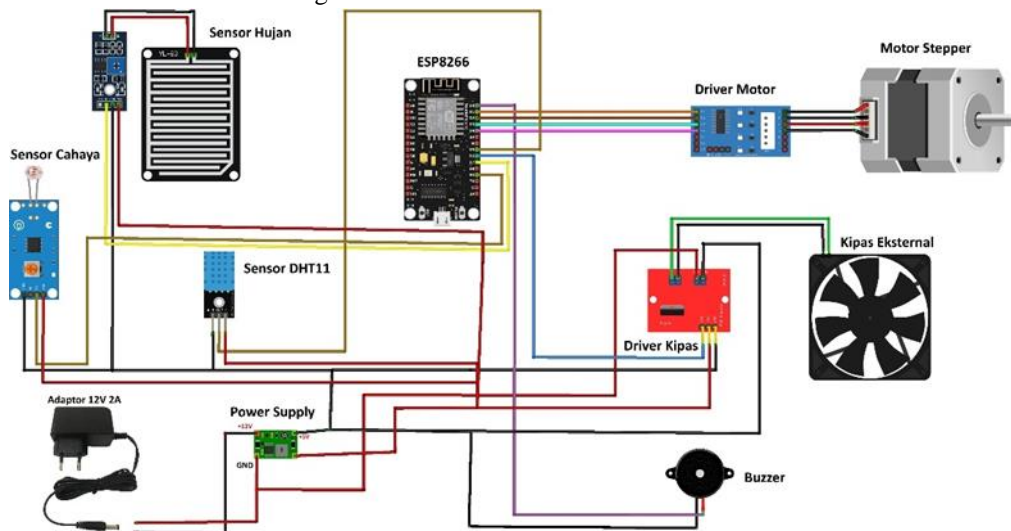


Figure 2. Hardware Circuit Design

By connecting sensors such as rain sensors, temperature sensors, LDR sensors with other components such as Stepper motor components, buzzers, and fans with NodeMCU microcontrollers using a single cable between the available pins, so that all devices can be connected to each other according to their functions.

NodeMCU Circuit

NodeMCU will obtain signal data originating from sensors and other components so that NodeMCU will obtain data and send the output to the Blynk application.

Motor Driver Circuit

The stepper motor controller circuit is built using 4 NPN transistors which are used as electronic switches in delivering current to the stepper motor. So that the stepper motor can be controlled clockwise or called clock wise (CW) and counterclockwise or also called counter clock wise (CCW) and Pulse Width Modulation (PWM) can provide speed values by using a combination of logic combinations on the HIGH and LOW inputs on both input lines contained in the ULN2003 motor driver circuit.

RESULTS AND DISCUSSION

Based on the results of the analysis and design that have been carried out in the previous chapter, the design of an automatic clothesline that uses a rain sensor, light sensor, and temperature sensor has been made. So that in order to find out how the device functions, testing is carried out based on various conditions for the rain sensor, light sensor, and temperature sensor. In addition, testing has also been carried out to find out how the conditions of the system and this tool can be used optimally and appropriately. Testing will be carried out with a number of stages on the sensors in the system, namely as follows:

1. Testing the light sensor or LDR (Light Dependent Resistor)
2. Testing the rain sensor
3. Testing the temperature sensor
4. Testing all components.

Testing on Light Sensor

The purpose of testing the Light Sensor (LDR) is to measure the resistance of light from the sun. Testing on the light sensor is by providing light to the light sensor panel. In testing the light sensor/LDR there are two conditions, namely when it is bright or dark. The light sensor will detect the value of light resistance entering the sensor. This test also involves the use of sunlight and also using light on the smartphone flash, namely by directing the smartphone flash light to the sensor.

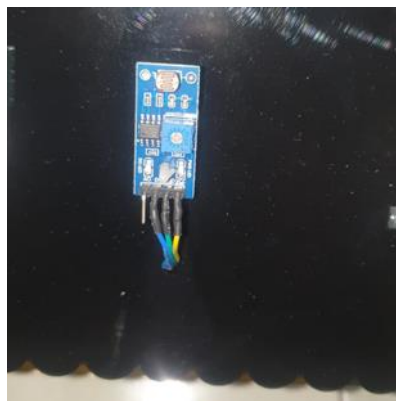


Figure 3. LDR Sensor

If the LDR sensor reads dark conditions, the clothesline will remain inside. However, if the LDR sensor reads bright conditions, the NodeMCU will provide output to the stepper motor, which will direct the stepper motor to rotate outward or remove the clothesline clockwise. If the clothesline is already outside and the LDR sensor detects dark light, the stepper motor will automatically move the clothesline to a closed place or the stepper motor will rotate counterclockwise. Here is a test scenario:

Table 1. Light Sensor Testing Scenario

Testing	Sensor Scenario	Case Study	Desired Result
---------	-----------------	------------	----------------

Light Sensor	The Light Sensor detects the presence of light.	Light Condition	The Stepper Motor will move clockwise / out and the clothesline remains outside (COMPATIBLE)
Light Sensor	The Light Sensor detects the absence of light.	Dark Condition	The Stepper Motor will move clockwise / out and the clothesline remains outside (COMPATIBLE)

Testing on rain sensor

Testing on this water (rain) sensor is used as a measure of rainwater intensity. The way to test the rain sensor is by splashing water onto the rain sensor panel, then the sensor will conduct electric current and send commands to the NodeMCU and other sensors. In testing this rain sensor, there are two conditions, namely in rainy conditions or non-rainy conditions.

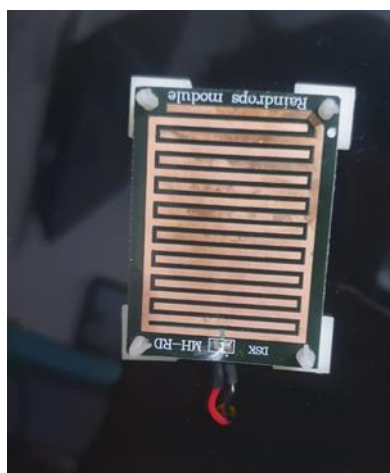


Figure 4. Rain Sensor

Testing on Temperature Sensor or DHT11

Testing on temperature and humidity sensor or DHT11 is used to measure temperature and humidity values in the area around the clothesline. To test the temperature and humidity sensor so that it can remove clothesline If the DHT11 sensor reads a cold temperature, the clothesline will remain inside. However, if the DHT11 sensor reads a hot temperature, the NodeMCU will provide output to the stepper motor, which will direct the stepper motor to rotate out or move to remove the clothesline clockwise. If the clothesline is already outside and the DHT11 sensor detects a cold temperature, the stepper motor will automatically move the clothesline to a closed place or the stepper motor will rotate counterclockwise.

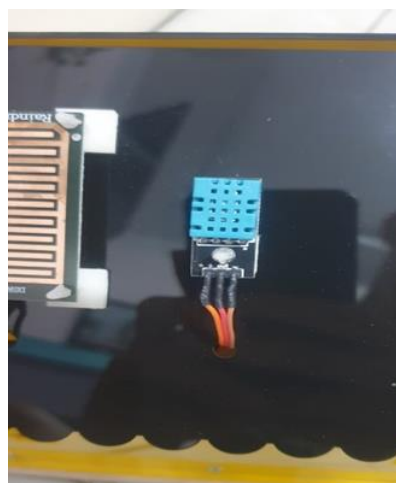


Figure 5. Sensor DHT11

Design testing on the Blynk application

The test results in the Blynk application are used to find out the entire menu so that it can function properly and correctly so that all the desired data can be displayed. The Blynk application is used by users to be able to monitor the movement of the clothesline circuit.



Figure 6. UI On Blynk App

In Figure 6, it can be seen that there are 4 displays, namely the first is the temperature indicator display that is read on the DHT11 sensor, the option switch menu, namely (ON/OFF) is used to turn on the device manually, and the "Enter" and "Exit" buttons are used to remove and insert clotheslines manually.

Testing All Components

Testing on all components is testing tools that are interconnected between input and output controlled by NodeMCU. The input process includes rain sensors, LDR and DHT sensors, while the output process includes External Fans and stepper motors. All input processes will be entered into NodeMCU as a controller then Arduino Uno will produce an output.



Figure 7. Miniature Clothesline Series

The results of all component tests are that the clothesline can enter and exit the garage perfectly, effectively and optimally. It can be seen from figure 7. That the clothesline is outside the garage.

CONCLUSION

In the smart clothes drying system based on IOT (Internet Of Things) can run well and correctly, As for sensors such as Light sensors (LDR), rain sensors (water) and humidity and temperature sensors (DHT11) can run as expected. NodeMCU ESP8266 also works as expected such as turning on or off the clothesline circuit via smartphone, namely via the Blynk application. The circuit will be active when it is connected to a power source, all sensors will automatically function. By turning it on by clicking the ON button on the Blynk application, the tool circuit will run manually and deactivate its

sensors, conversely if you click the OFF button it will turn off the manual function and the sensor will automatically run according to its function. The light sensor functions as a detector of light, the rain sensor will detect rainwater when the sensor panel is exposed to water, and the temperature and humidity sensors will detect whether the temperature is hot or cold. With the way the system works, namely when the light sensor detects light (bright) on the rain sensor detects the absence of rainwater falling and the temperature and humidity sensor detects hot temperatures, the stepper motor will move clockwise to a place exposed to sunlight and NodeMCU will send a notification to blynk if the clothesline is outside. Furthermore, if the light sensor (LDR) detects dark light, the rain sensor detects falling rainwater and the temperature and humidity sensor (DHT11) detects cold temperatures, the stepper motor will rotate counterclockwise so that the clothesline moves into its original place or to a closed place and the external drying fan automatically turns on to be able to continue drying manually and NodeMCU sends a notification to the smartphone that it is raining.

REFERENCES

Book: Single Author

- [1] Indah Purnama Sari. *Algoritma dan Pemrograman*. Medan: UMSU Press, 2023, pp. 290.
- [2] Indah Purnama Sari. *Buku Ajar Pemrograman Internet Dasar*. Medan: UMSU Press, 2022, pp. 300.
- [3] Indah Purnama Sari. *Buku Ajar Rekayasa Perangkat Lunak*. Medan: UMSU Press, 2021, pp. 228.

Book: Two or More Authors

- [4] Janner Simarmata Arsan Kumala Jaya, Syarifah Fitrah Ramadhani, Niel Ananto, Abdul Karim, Betrisandi, Muhammad Ilham Alhari, Cucut Susanto, Suardinata, Indah Purnama Sari, Edson Yahuda Putra. *Komputer dan Masyarakat*. Medan: Yayasan Kita Menulis, 2024, pp.162.
- [5] Mahdianta Pandia, Indah Purnama Sari, Alexander Wirapraja Fergie Joanda Kaunang, Syarifah Fitrah Ramadhani Stenly Richard Pungus, Sudirman, Suardinata Jimmy Herawan Moedjahedy, Elly Warni, Debby Erce Sondakh. *Pengantar Bahasa Pemrograman Python*. Medan : Yayasan Kita Menulis, 2024, pp.180
- [6] Zelvi Gustiana Arif Dwinanto, Indah Purnama Sari, Janner Simarmata Mahdianta Pandia, Supriadi Syam, Semmy Wellem Taju Fitrah Eka Susilawati, Asmah Akhriana, Rolly Junius Lontaan Fergie Joanda Kaunang. *Perkembangan Teknologi Informatika*. Medan: Yayasan Kita Menulis, 2024, pp.158
- [7] Muharman Lubis Ilham Firman Ashari, Debby Erce Sondakh, Rahmawati Rolly Junius Lontaan, Mustarum Musaruddin Indah Purnama Sari, Muh. Nadzirin Anshari Nur, Hanalde Andre Muh. Rais, Janner Simarmata. *Internet of Things (IoT) Dan Multimedia: Integrasi Dan Aplikasi*. Medan: Yayasan Kita Menulis, 2024, pp.182

Journal Article from the Internet

- [8] Sari, I.P., Al-Khowarizmi, A.K., Apdilah, D., Manurung, A.A., & Basri, M. (2023). Perancangan Sistem Pengaturan Suhu Ruangan Otomatis Berbasis Hardware Mikrokontroler Berbasis AVR. *sudo Jurnal Teknik Informatika* 2 (3), 131-142
- [9] Wardani., S, & Dewantoro., RW. (2024). Internet of Things: Home Security System based on Raspberry Pi and Telegram Messenger. *Indonesian Journal of Applied Technology, Computer and Science* 1 (1), 7-13
- [10] Sari, I.P., Al-Khowarizmi, A.K., Hariani, P.P., Perdana, A., & Manurung, A.A. (2023). Implementation And Design of Security System On Motorcycle Vehicles Using Raspberry Pi3-Based GPS Tracker And Facedetection. *Sinkron: jurnal dan penelitian teknik informatika* 8 (3), 2003-2007
- [11] Y.Efendi, "Internet of Things (IoT) Light Control System Using Mobile-Based Raspberry Pi", *Scientific Journal of Computer Science*, Vol. 4, no. 1, April 2018.
- [12] Sari, I.P., Basri, M., Ramadhani, F., & Manurung, A.A. (2023). Penerapan Palang Pintu Otomatis Jarak Jauh Berbasis RFID di Perumahan. *Blend Sains Jurnal Teknik* 2 (1), 16-25
- [13] SJ Sokop et.al, "Peripheral Interface Trainer Based on Arduino Uno Microcontroller", *E-Journal of Electrical and Computer Engineering* vol.5 no.3 (2016).
- [14] Sari, I.P., & Batubara, I.H. (2020). Aplikasi Berbasis Teknologi Raspberry Pi Dalam Manajemen Kehadiran Siswa Berbasis Pengenalan Wajah. *JMP-DMT* 1 (4), 6
- [15] M. Saleh and M. Haryanti, "Design of a Home Security System Using Relays", *Journal of Electrical Technology, Mercu Buana University*, Vol. 8 No. May 2, 2017
- [16] Sari, I.P., Batubara, I.H., & Basri, M. (2022). Implementasi Internet of Things Berbasis Website dalam Pemesanan Jasa Rumah Service Teknisi Komputer dan Jaringan Komputer. *Blend Sains Jurnal Teknik* 1 (2), 157-163

- [17] Matondang, M.H.A., Asadel, A., Fauzan, D., & Setiawan, A.R. (2024). Smart Helmet for Motorcycle Safety Internet of Things Based. *Tsabit Journal of Computer Science* 1 (1), 35-39
- [18] Sari, I.P., Novita, A., Al-Khowarizmi, A., Ramadhani, F., & Satria, A. (2024). Pemanfaatan Internet of Things (IoT) pada Bidang Pertanian Menggunakan Arduino UnoR3. *Blend Sains Jurnal Teknik* 2 (4), 337-343
- [19] Husaini, A., & Sari, I.P. (2023). Konfigurasi dan Implementasi RB750Gr3 sebagai RT-RW Net pada Dusun V Suka Damai Desa Sei Meran. *sud Journal Teknik Informatika* 2 (4), 151-158