Automatic canopy drive system against weather changes

Erizahrawati Febriana[1], Riki Mukhaiyar [1]
[1]Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang, Padang, Indonesia

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ABSTRACT

Unpredictable weather changes are a challenge in everyday life, especially in household activities such as drying clothes. This study develops an automatic canopy drive system based on the Internet of Things (IoT) to respond to weather changes in real-time. This system uses a NodeMCU ESP8266 microcontroller connected to the Blynk application and various sensors, including a rain sensor, light sensor (LDR), and temperature sensor (DHT11). These sensors detect environmental conditions and control the opening and closing of the canopy automatically to protect the drying area. Tests show that the system works optimally with temperature parameters of more than 25°C, light intensity of more than 10,000 lux, and no rain conditions to open the canopy, while if one of the conditions is not met, the canopy will automatically close. With a monitoring feature via a mobile application, this system provides convenience and efficiency for users in dealing with unpredictable weather changes.

Corresponding Author:

Erizahrawati Febriana
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Padang
Kampus UNP Pusat, Jl. Prof. Hamka, Air Tawar, Padang 25131, Indonesia
Email: erizahrahwatif05@gmail.com

1. INTRODUCTION

Unpredictable weather changes are one of the challenges in everyday life, especially in household activities such as drying clothes. Dependence on sunlight for the clothes drying process is often hampered by unpredictable weather conditions, such as sudden rain or reduced sunlight intensity [1]. This can cause discomfort and increase the risk of clothes becoming damp or not drying properly [2]. Along with the development of technology, the concept of smart home has begun to be applied to increase efficiency and comfort in everyday life. Smart home is a home automation system that allows intelligent control of various devices, both manually and automatically, through Internet of Things (IoT)-based technology[3]. One implementation of smart home that can be a solution in dealing with weather changes is the automatic canopy drive system.

Several previous studies have developed an automatic canopy or drying roof system based on IoT technology. However, there are still several limitations, such as less than optimal connection stability between hardware and applications, limitations in sensor accuracy, and lack of flexibility in the control system [4], [5]. Therefore, this study aims to develop an Automatic Canopy Drive System for Weather Changes by utilizing the NodeMCU ESP8266 connected to the Blynk application. This system is designed to detect environmental conditions using a combination of rain sensors, light sensors (LDR), and temperature sensors (DHT11), so that it can control the opening and closing of the canopy automatically. In addition, the system is also equipped with a manual mode that provides additional flexibility for users. With this system, users can easily control and monitor the condition of the drying line remotely via mobile devices. The implementation of IoT technology in this system is expected to provide innovative and efficient solutions in dealing with unpredictable weather changes, as well as being the first step in the development of broader and more integrated smart home technology in the future.

2. METHOD

This automatic canopy drive system for weather changes is a tool designed to be able to control the canopy on the house automatically and can even be controlled using the blnyk application via smartphone. The canopy will open and close automatically according to the temperature, light intensity and weather variables that have been set on the smartphone using the blynk application. This tool is designed in a block diagram like the following Figure 1.

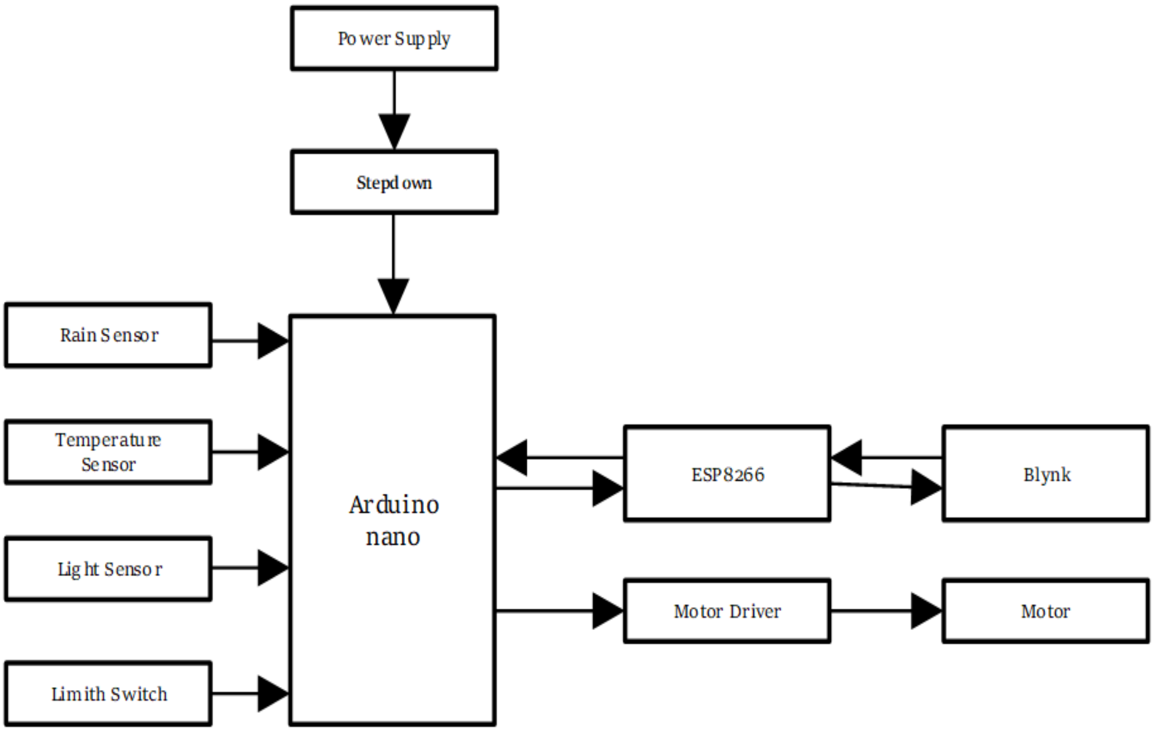

Figure 1. System block diagram

Based on the image 1 above, the Arduino Nano microcontroller is an Arduino microcontroller where in the system to be designed, the Arduino Nano functions as a sensor data processor and motor driver controller. Arduino also functions as a data sender to the ESP8266 and receives data from the ESP8266[6], [7]. NODEMCU ESP8266 is a microcontroller that uses the[6] IC which has integrated wifi . This module will later receive data from the Arduino Nano and then send the data to blynk using the internet network. While the power supply functions as a power source for the tool [8]. The microcontroller and sensor modules use DC voltage. The stepdown module functions to lower the voltage from the powersupply, where the 12 Volt power supply output is lowered to 5 Volts so that it can be used by the module and microcontroller [9]. The rain sensor functions to read the temperature, the output from this temperature sensor will later be processed by the Arduino Nano and become a variable that determines the opening and closing of the canopy [10], [11], [12]. In addition, the light sensor functions to read the intensity of sunlight, the output of this light sensor will later be processed by the Arduino Nano and become a variable that determines whether the canopy is open or closed. This limit switch will be installed at the end of the canopy as an indicator that the canopy is open or closed [13]. The motor driver functions to control the motor rotation, because the motor voltage is high so that the Arduino cannot directly control the motor rotation, so a driver controlled by the Arduino is needed [14]. The motor is a component used to open and close the canopy. The direction of motor rotation will be controlled through the motor driver motor. ESP8266 is a microcontroller that is integrated with a wifi module. ESP 8266 is tasked with receiving data from the Arduino Nano and forwarding the data to Blynk [5], [15] . As for more details regarding the design of the components used, it can be seen in Figure 2 below.

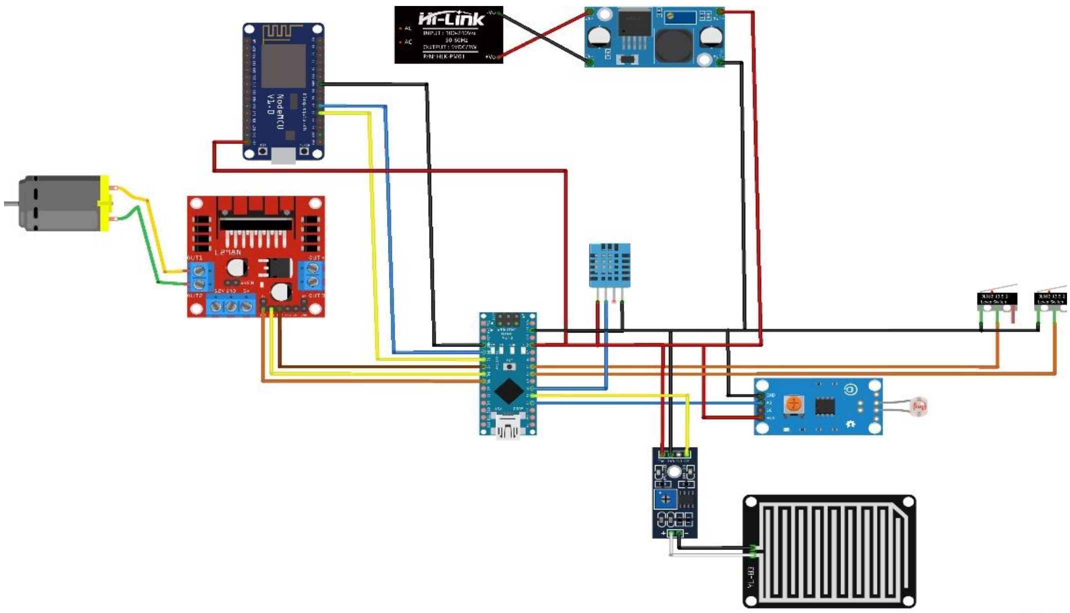

Figure 2. Component wiring

This research was conducted on a prototype that can be seen as in Figure 3 below, this was done to facilitate testing of the integration of sensors, microcontrollers, and Internet of Things (IoT)-based control systems that can be done more flexibly and efficiently. In addition, development in the form of a prototype allows identification and improvement of potential system deficiencies, such as connection stability, sensor responsiveness, and efficiency of the canopy drive mechanism, before being produced in a final form that is ready to be applied in everyday life [4], [6].

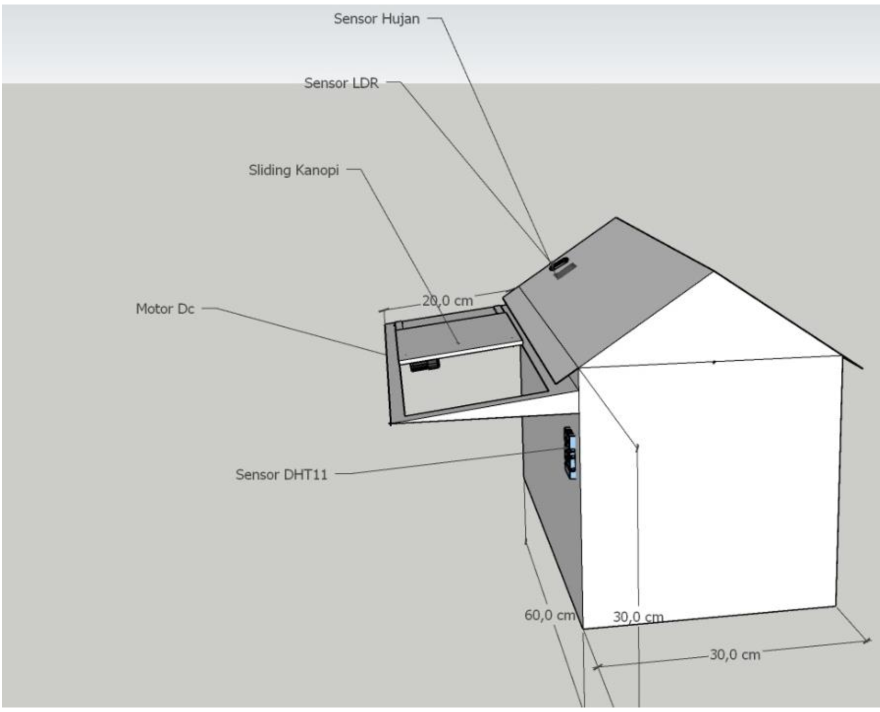

Figure 3. System prototype

The working principle of this automatic canopy drive system begins with the variable initialization process, where the system sets the variables used to store sensor data. After that, the system starts reading data from the rain sensor. If the sensor detects rain, the motor will move to close the canopy to protect the area below. Furthermore, the system also reads data from the light sensor (LDR). If low light intensity or dark conditions are detected, the motor will move to close the canopy. In addition, the system monitors the temperature sensor, where if the detected temperature is less than 25°C, the canopy will also automatically close. If there are no conditions that meet the trigger parameters, such as no rain, bright enough light, and temperature above 25°C, the motor will move to open the canopy. This system is also equipped with a remote monitoring feature, where data from the sensor is sent in real-time to the Blynk application via the internet network. Thus, users can monitor environmental conditions and canopy status at any time via mobile devices. This process continues automatically until the system is deactivated. For more details, see the system flowchart in Figure 4.

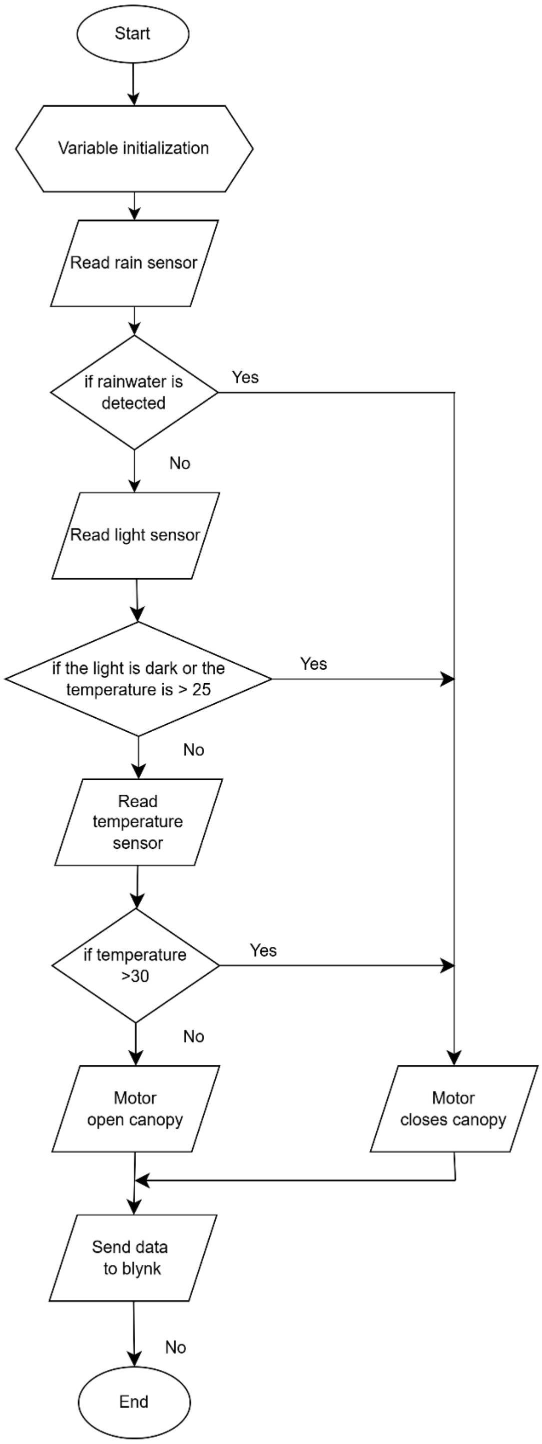

Figure 4. Flowchart

3. RESULTS AND DISCUSSION

This automatic canopy is controlled by the parameters of the sensors used on the device where the parameters are temperature, light and rain sensors. In order for the canopy to open, it must meet all the trigger values that have been determined by the author. To be able to open the canopy, the temperature is > 25 C, Light > 10000 lux and Rain sensor = 1. If one of them is not met, the canopy will automatically close. The following are the test results from the automatic canopy control can be seen in Table 1.

Table 1. Automatic canopy control

No	Temperature (˚C)	Light (lux)	Rain Sensor	Output Driver Motor (Volt)	Description
1	26	12300	0	-3,6	Motor rotates to close the canopy
2	26	8000	1	-3,6	Motor rotates to close the canopy
3	25	11000	1	-3,6	Motor rotates to close the canopy
4	28	13500	1	-3,6	Motor rotates to open the canopy

Based on the test results in Table 1 above, it can be analyzed that the automatic canopy functions properly and as specified. Where the canopy will open when the temperature parameter is> 25 C, light> 10000 lx and rain sensor = 1. If one of them is not met, the canopy will be closed. Users can see the sensor parameters and status of the canopy using a smartphone and the blynk application. Where this tool will send sensor parameters and canopy conditions in real time using the internet network. In order to connect to the internet network, the tool designed uses the ESP8266 module which has been integrated with wifi. The monitoring display on the smartphone can be seen in Figure 5.

Figure 5. Blynk Application Monitoring

4. CONCLUSION

This research successfully developed and tested an IoT-based automatic canopy driver system to deal with real-time weather changes. This system works by detecting temperature, light, and rain parameters using sensors integrated with the NodeMCU ESP8266 microcontroller and the Blynk application for remote monitoring. The test results show that the automatic canopy functions according to the specified parameters, where the canopy will open when the temperature is > 25°C, light intensity is > 10,000 lux, and there is no rain, while in other conditions the canopy will close automatically. Implementation of this system can increase efficiency in protecting the drying area from uncertain weather conditions and provide flexibility for users in controlling the system from mobile devices.

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