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AUTOMATED CLOTHESLINE RETRIEVAL SYSTEM: MONITORING THE SYSTEM USING BLYNK APPLICATION

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Abstract— A conventional clothesline retrieval system relies on manual intervention for promptly collecting laundry, lacking the automated features and smart functionalities of modern innovations, making it lack the convenience of modern automation. This project addresses a prominent issue with such systems: the need for manual intervention to collect laundry before rain. This inconvenience prompted the development of an innovative clothesline with automatic movement and smart features. The system employs Direct Current (DC) geared motors, which respond

Raining, Sunny	to external weather conditions via a rain sensor connected to NodeMCU. This NodeMCU establishes connectivity with a home Wi-Fi network and Blynk server, enabling real-time rainfall monitoring and push notifications based on weather conditions. The results are impressive, with the clothesline moving automatically to shelter when rain is detected and back out when it subsides. Users receive timely alerts for both rainy and sunny conditions. This advanced system greatly enhances household laundry routines, offering significant benefits in residential areas.

I. Introduction

Situated near the equator, Malaysia experiences an equatorial climate characterized by consistent heat and humidity [1-3]. The drying time for clothes hung outside the house is significantly reduced on sunny days with continuous sunlight and a gentle breeze. In this context, various types of clotheslines have been invented over centuries, including retractable [4], rotary [5-7], folding [8], pulley [9], and T-post [9] designs, all aimed at simplifying the task for individuals.

Nevertheless, most existing clothesline systems require users to promptly collect their laundry when rain is imminent [10,11]. This approach proves to be both labour-intensive and time-consuming [12,13]. The unpredictable weather patterns make it challenging to leave clothes hanging outside without the constant concern of rain showers, often leading to the unfortunate situation of returning home after a long day's work to find clothes drenched by unexpected downpours. Ensuring users are adequately informed about the status of the clothesline system's operations

is also crucial for user satisfaction and effective system usage [12].

To tackle these issues, this project suggests creating a smart, fully automatic clothesline system with rain monitoring and push notifications. This integration aims to transform laundry management in equatorial areas, providing a practical solution for outdoor clothes drying challenges.

II. Literature Survey

The "Hang-and-Go: A Smart Laundry Hanging System" in [14] is a modern clothesline prototype that automatically detects rain and shields clothes to prevent wetness. Equipped with a rain sensor (Figure 1), this system detects rain and responds by extending a protective cover, safeguarding the clothes from moisture. It also features a fan to enhance drying, particularly in rainy seasons, by promoting airflow. Constructed with Lego Mindstorms EV3, Tetrix, and Arduino, the prototype lacks rain notifications.

The "Automatic Clothesline Retrieval (ACR) Prototype with Humidity Alert System" is another inventive solution, in addition to Hang-and-Go, tackling the issue of neglected clotheslines when weather changes [15]. It employs a DHT22 humidity sensor to detect shifts in weather conditions and automatically retrieves the clothesline upon humidity reaching a certain threshold. A desktop application notification prompts the user to retrieve the clothesline. A Micro Servo handles physical retrieval, powered by a laptop. However, the ACR system's reliance on stable power may limit its suitability in regions with unreliable electricity.

In the same year, the "S.M.A.R.T Automated Clothesline", utilizing an Arduino microcontroller, emerged as eco-friendly and automated clothes drying solution [12]. This clothesline integrates a rain sensor module to detect weather changes, adjusting clothesline positions accordingly. When rain is detected, the system automatically shelters the clothesline; when rain ceases,

the clothesline resumes its original position. Users receive mobile notifications about clothesline movement and can control the system via messages. Blynk facilitates remote control through mobile phones. Notably, the study lacks explicit mention of the Blynk functionality's development for the S.M.A.R.T Automated Clothesline system.

Based on the previous studies in [12,14,15], further studies are needed to explore the development and implementation of notifications system in the automated clothesline system, as well as its impact on the overall performance and user experience of the automated clothesline.

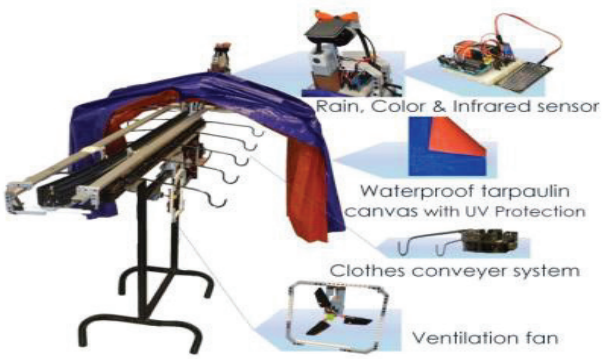


Figure 1: The Completed Prototype of Hang-and-Go: A Smart Laundry Hanging System [14]

III. Project Methodology

Figure 2 shows the general block diagram of the proposed Automated Clothesline Retrieval System.

The rain sensor is strategically positioned outdoors to maximize exposure to both sunlight and rain. When it's raining, the motors reverse the clothesline's movement into a sheltered area. Once the rain stops, the motors return the clothesline to its original position. The integrated Wi-Fi chip connects to the pre-configured home network, establishing access to the Blynk server via the Internet. Upon network connection, the hardware (NodeMCU) commences transmitting rain sensor data to the Blynk server

every second. Individuals using the same Blynk authentication token code gain the ability to monitor rainfall concentration via the Blynk application from any location.

In general, the development of the suggested project poses three main parts, which are software part, hardware part, and prototype part.

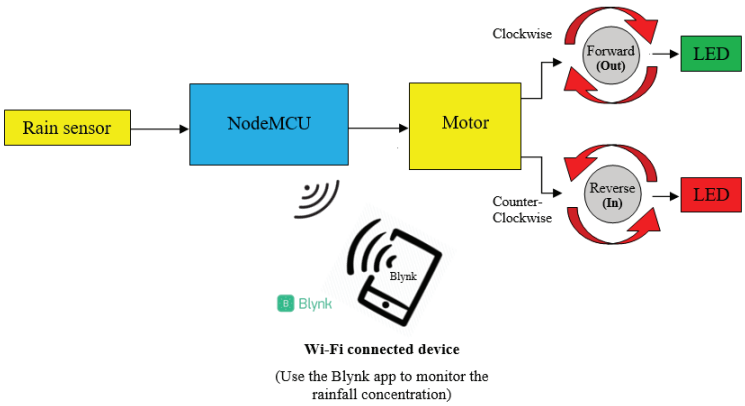


Figure 2: Block Diagram of the Proposed Automated Clothesline Retrieval System

A. Software Part

Four distinct software are employed in this project, each serving a unique purpose to ensure the project's successful operation. Table 1 provides a compilation of the software utilized in this project along with their respective functions.

Table 1: Lists of Software Used

Software	Function
Proteus 8 Professional	For designing and producing the Printed Circuit Board (PCB) layout for the project.
Fritzing	To construct a 2-dimensional (2D) circuit diagram of the project.
Arduino IDE	To write, test, modify and upload the code to NodeMCU.
Blynk Application	To monitor the rainfall concentration and receive alert notification for the rainfall outside of the house.

B. Hardware Part

The development of the proposed project involves the utilization of various types of electronic components. Each of these components serves a

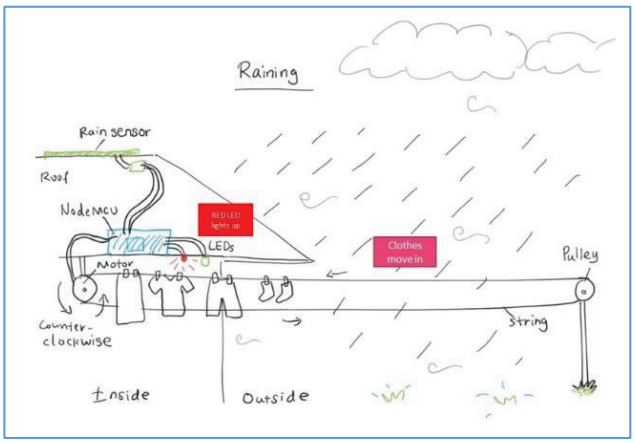
distinct function, collectively contributing to the seamless operation of the project. Table 2 lists the components used in this project.

Table 2: Lists of Components Used

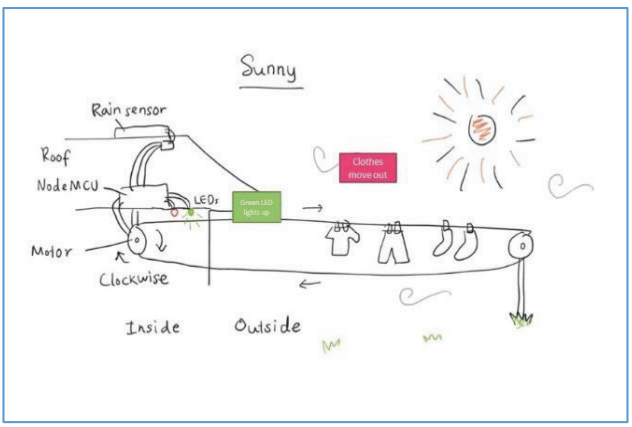
Components	Quantity	Function
NodeMCU	1	To serve as a compact and integrated platform for controlling the clothesline system, utilizing its Wi-Fi capabilities, GPIO pins, and analog input to interface with sensors and drive motor movement.
Rain sensor	1	To detect rainfall by measuring the change in resistance caused by raindrops on its sensing pad and provide an output voltage that indicates the presence or absence of rain.
5VDC low-level trigger relay	2	To act as a balancer for the limit switches, triggered by a low-level signal (below 2.2V), and provide 6 contacts (3 on each opposite edge) for controlling the circuit based on the 5V operating voltage supplied by the NodeMCU.
N20 DC geared motors	2	To provide torque for triggering the limit switch and move the clothesline, powered by the 5V supply from the NodeMCU.
L293D motor driver	1	To control the direction of the N20 DC geared motor, prevent backfire, and facilitate motor operation, with a 5V input for the IC and support for driving motors within a voltage range of 3V to 36V.
Limit switch	2	To halt the motor's movement at the ends of the T-post of the clothesline, offering a practical method of limiting the clothesline's motion without relying solely on software programming.
Light Emitting Diode (LED)	1 (red), 1 (green)	As indicators, with the red LED indicating ‘raining’ and the green LED indicating ‘sunny’.
330Ω resistor	2	To limit the excessive current supplied by the NodeMCU to the LEDs.

C. Prototype Part

This project's prototype encompasses both software and hardware components. To validate the functionality of the clothesline circuit and evaluate the feasibility of the concept, a prototype resembling a household shade is developed. Figure 3 illustrates the introduced prototype concept.



(a)



(b)

Figure 3: The Initial Sketches of the Prototype of Smart-Automated Clothesline Retrieval System: (a) Raining Condition, and (b) Sunny Condition

IV. Results and Discussion

The outcomes encompass all three parts: the software part, the hardware part, and the prototype part. The capabilities of the proposed clothesline system to send alert notification and react to weather conditions are evaluated and discussed at the end of this section.

A. Results of Software Part

Figure 4 displays the project's circuit diagram designed in Proteus 8 Professional software. Figure 5 depicts the PCB layout from the same software, indicating measurements in millimeters (mm).

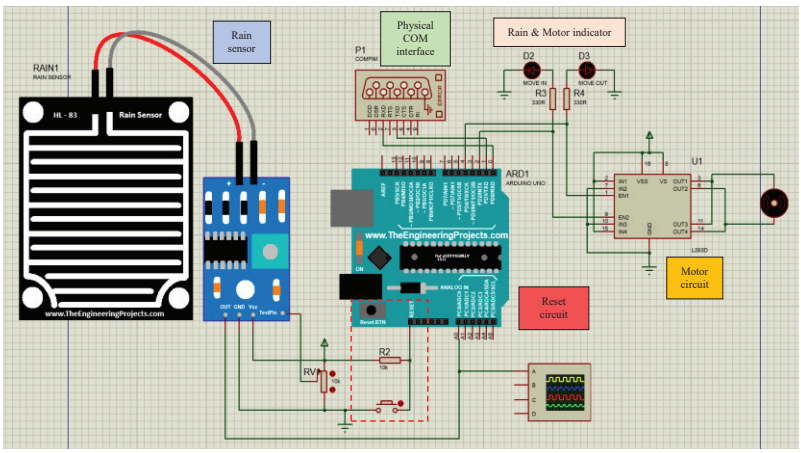


Figure 4: The Circuit Diagram Designed Using Proteus 8 Professional Software

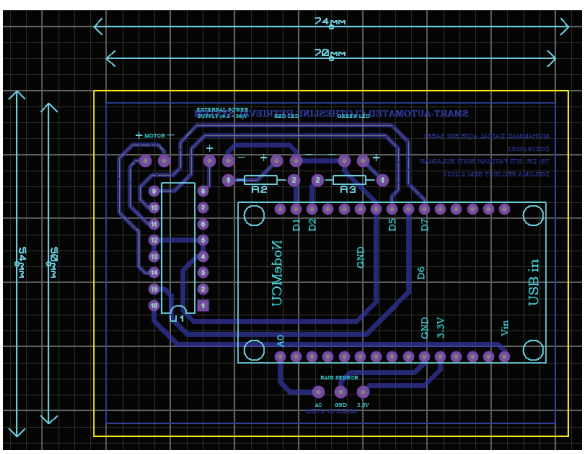


Figure 5: The PCB Layout Produced from Proteus 8 Professional Software

Figure 6 shows the complete 2D circuit diagram constructed in Fritzing software. In this project, the Blynk application is employed to oversee the levels of rainfall concentration and to issue alert notifications for rain occurring outside the premises. Figure 7 illustrates an alert notification on the Blynk application during rainy conditions, and when the rain has ceased.

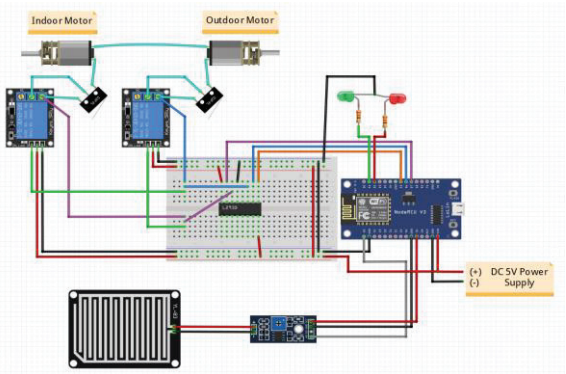


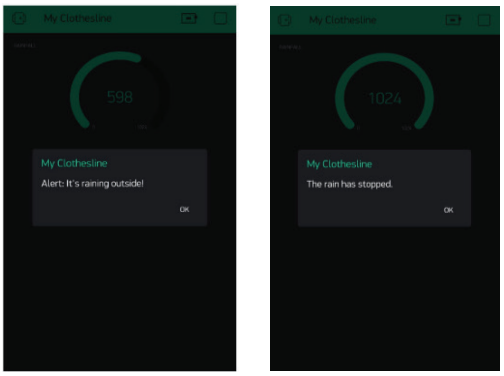
Figure 6: Circuit Diagram Constructed in Fritzing Software

The project utilized an FC-37 rain sensor, a basic type without specified resolution for accuracy. It detects rain by measuring resistance changes due to water presence on its pad. The sensor outputs a 10-bit analog value, ranging from 0 to 1023, with "1023" signifying dryness. As pad moisture increases, resistance, and analog value decrease. A value under 1023 indicates wetness or rain. These values guide rain response.

For this project, rain notification is triggered below 870. A low 'Meter Gauge' reading in the Blynk app (Figure 7(a)) shows rain, while exceeding 880 (Figure 7(b)) indicates rain cessation.

When the concentration of rain measured by the sensor reaches the threshold of 880, the system initiates a monitoring process. It continuously checks the rain intensity, and once the value of threshold below 870, the system triggers an alert notification. This mechanism ensures that users are promptly informed when the rainfall reaches a

certain level, allowing them to take appropriate actions or precautions. By setting these threshold values, the system effectively monitors and responds to changing weather conditions, providing users with real-time updates, and enhancing their overall convenience and safety.



(a) (b)

Figure 7: Alert Notification on Blynk Application: (a) Raining Condition, and (b) Sunny Condition

B. Results of Hardware Part

Figure 8 depicts the arrangement of components on the protoboard, where circuit connections were initially tested using Proteus 8 Professional software and Fritzing software.

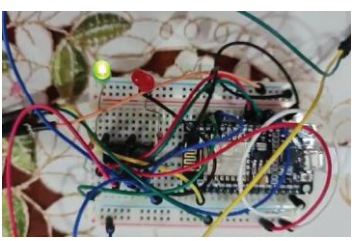


Figure 8: Arrangement of the Components on the Protoboard

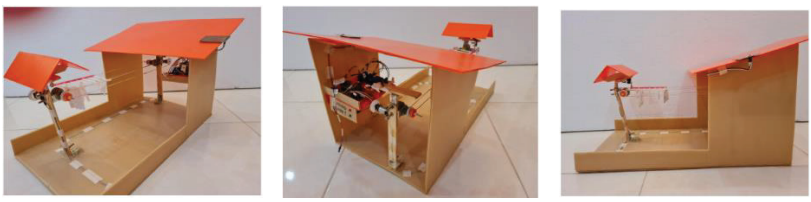
Figure 9 presents the outcomes of the PCB design, which were generated from the PCB layout produced using Proteus 8 Professional software (refer to Figure 5).

(a) (b)

Figure 9: Results of the PCB Design: (a) Top View, and (b) Bottom View

C. Results of Prototype Part

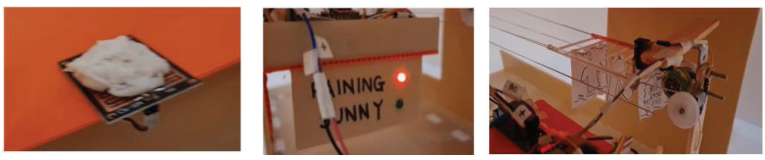
Figure 10 shows the prototype of the project taken from several different views. The proposed clothesline retrieval system can react to two weather conditions: Sunny and Raining.



(a) (b) (c)

Figure 10: The Prototype of the Project: (b) Front Angled View, (b) Rear Angled View, and (c) Right Side View

Figure 11 shows the outcomes of the project for raining condition, while Figure 12 shows the outcomes of the project for sunny condition.



(a) (b) (c)

Figure 11: The Project Outcome When Raining: (a) The Rain Sensor Sense the Presence of Rain (Wet Tissue), (b) Red LED Lights Up Indicating it is Raining Outside, and (c) The Motor Spins and Moves the Clothesline under the Shade

(a) (b) (c)

Figure 12: The Project Outcome When Sunny: (a) The Rain Sensor Fail to Sense Any Rainfall (No Wet Tissue), (b) Green LED Lights Up Indicating It Is Sunny Outside, and (c) The Motor Moves the Clothesline Out Away from The Shade

Based on the results presented in this section, the proposed clothesline system offers affordable and weather-independent functionality. It operates automatically by reacting to external weather conditions, eliminating the need for user input. The system's capability to send alert notifications ensures that users can confidently rely on it to protect their clothes from rain. Its user-friendly nature allows individuals of all ages to use the clothesline without restrictions, making it adaptable in household residential areas. The automatic movement of the clothesline provides an efficient solution for time management, enabling users to multitask.

Furthermore, this technology paves the way for future improvements and innovations in clothesline infrastructures and industries. The system's ability to send alert notifications and respond to weather conditions underscores its effectiveness and potential impact in providing convenience and peace of mind to users.

V. Conclusion

In conclusion, the development of the *'Automated Clothesline Retrieval System'* prototype marks a successful achievement in this project. The integration of rainfall alert notifications through the Blynk application provides users with valuable information on external weather conditions and the status of their drying clothes, even when they are not present at home. This feature significantly enhances user convenience and decision-making. The system's adaptability to both sunny and rainy weather conditions further underscore its versatility. On sunny days or when rain is not detected by the sensor, the

clothesline adjusts for optimal drying in open areas. Conversely, during rain, the system intelligently retracts the clothesline under shelter. Empirical assessments of the system's performance under various weather conditions consistently yielded impressive results. Therefore, the proposed Automated Clothesline Retrieval System presents itself as an effective and portable solution for fabric drying in residential settings.

VI. Acknowledgement

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