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Automatic Cloth Hanger System Using IoT

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Abstract: Hanging clothes is a very difficult task to do for working citizen in Malaysia where the probability for rain is high. The objectives of this project are to help in keeping the clothes away from the rain and send information of the situation of the proposed project to the user through IoT platform. The project used NodeMcu ESP 32 as it microcontroller, digital humidity and temperature sensor (DHT) and rain sensor to gather input, a linear actuation using DC stepper motor for mechanical movement and Blynk interface as IoT platform that collect information from the project. The Blynk interface will be used in displaying the output perform by the project such as displaying temperature and humidity in a graph that update in real-time, rain and the condition of the hanger (extend/retract) are displayed using color led in the Blynk interface. The temperature and humidity data are gathers from the DHT sensor while the movement for extend and retract of the project is depend on the rain sensor. If the rain sensor threshold is exceeded, the system will recognize it as sunny and the motor will extend. If the rain sensor value is below the threshold, the system will recognize it as rain and the motor will retract.

Keywords: Automatic Clothes Hanger, IoT, DHT Sensor, Rain Sensor, Linear Actuator

1. Introduction

The working citizen had majority of their time invest into improving their working career. Therefore, the time allocate at their own home is less and making the time for them to rest and doing the normal household routine is cramped together. Thus, many of them will have a major problem doing their normal household routine such as laundry. They have to wash their clothes early in the morning and hang them outside before their leave to work. The washed and wet clothes will be hung outside throughout the day until they arrive home. The weather in Malaysia is warm and humid all year[1]. The chance for the laundry to remain damp due to the rain is high. This will cause the young working adults to feel anxiety and discomfort when they are doing their laundry. This kind of feeling will make their

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focus and productivity decrease during their working hours. Therefore, an automatic hanger system that can inform them about the weather and move the laundry is a great assistance for them.

Traditional cloth hanger is simple and easy to use the equipment. It is also the cheapest type of cloth hanger and does not require any electricity to operate. This is due to its working principle, which depends only on the weather and human labor. This cloth hanger needs to supervise and human labor by someone, to avoid the laundry get wet when raining. It is inconvenient for single young working adults to do their chores.

Next on the list is the cloth dryer machine. This machine is very convenient, fast, and easy to use. With a push on the button and in 30 minutes of waiting, the laundry will come out dry and warm. There are two types of dryer machines which are the gas-based dryer machine and electric dryer machine. There are two types of dryer machines which are the gas-based dryer machine and electric dryer machine. The gas-based dryer machine has a low power consumption rate but the drawback is the gas need to be refilled if the tank is empty[2]. The owner must always keep track of the gas tank in the dryer machine. The electric dryer machine does not use gas and completely uses electric power to operate. Thus, making the machine, one of the pieces of equipment in the household that has a high power consumption rate[2]. It is a major loss in terms of money for the single working adult to use this machine to dry their clothes. Both types of cloth dryer machines are expensive machines and not affordable for a single working adult to purchase.

Therefore, this project is to purpose a prototype of an automatic hanger system to ease household chores and increase the efficiency of the hanger system. The idea for this project is to give an upgrade to the traditional cloth hanger by equipping it with sensors, a microcontroller, and motors.

1.1 Literature Review on Clothes Hanger System

According to B S Kumar Sathish et al in [3], used a variety of sensors such as rain sensor, light sensor, proximity sensor, and temperature sensor. These sensors will feed the output values through the Arduino kit and the processed data will be given to the microprocessor unit (PIC 16F877) to determine the weather. The microprocessor unit will send a command to another slave unit to actuate the DC motor. This project also used a solar panel to gather and generate electrical power and then save it to the rechargeable battery. The system also had a drying system controlled by another slave unit of the system. The clothes drying time is set using a push-button, and when the drying time is up, it autonomously retrieves the clothing using a DC motor. The disadvantage of this project is it used up a lot of space to fit all of the projects and it is not preferable to a house with limited space.

According to Zulzilawati Jusoh et al in [4], proposed a project to use a single microprocessor which is ATmega328-P to control and run the operating system of the hanger. This project used Light Dependent Resistor (LDR) and rain sensor to give input from the surrounding. The dc motors act as a mechanical movement of the system. The movement of the first dc motor is to pull in and out the clothes from the shade depending on the weather. The second dc motor is integrated into a pulley and it is used to bring the hung clothes down or up. This mechanism is to help someone old or sitting in a wheelchair. The disadvantage of this project is the number of hanging clothes that can be hung. The project is small to be loaded with a regular size of laundry.

According to the Xingjian Jia et al in [5], the main key component of his proposed project are a machine frame, hanging hanger, screw rod, cover curtain, main motor, and deputy motor. The machine frame aims to support the entire hanger. The hanging hanger's purpose is to hang garments, but it can also outspread and fold. The screw rod is used to raise the slider, and the cover curtain is made up of two hollow tubes that are used to cover the garments and keep the rain out. The power supply used to operate the system is two pieces of a 12V battery. The project also used a combination of sensors such as a rain sensor (SD-12Y), temperature sensor (DS18B20), and photosensitive sensor. The system of this project is controlled by a single-chip microcontroller (AT89C52). The disadvantages of this project

are it used a standing frame. The standing frame is big, so it required a lot of space to operate. The stand also had a chance to fall over due to heavy rain.

Based on the Ooi Wei Lynn in [6], his proposed project come up with a concept of providing air circulation for the hanging clothes during the downpour. The project uses a ventilation fan to provide air circulation. A modified conveyor chain with the help of a motor is used to pull or retract the hanged clothes against the rain. This project used a rain sensor and LDR to bring information about the weather. This project also used an Arduino board as its microcontroller. This project used a lot of recycled material to reduce some of its production costs. The base and frame of the hanger are made by using an old used bicycle and clothesline. The conveyor chain is a second-hand material. This project also had a waterproof and UV protection canvas to provide a shield to the hanging clothes during the downpour. The disadvantage of this project is the material for the frame of the project. Although the project used a lot of recycled material for its design, the material itself is hard to find, expensive, and not always available at the market.

According to the Haddijatou Touray in [7], the proposed project is divided into four different parts such as the frame, the mechanical movement, the sensor and microcontroller, and lastly the cover or shield. The frame of this project is similar to the common retractable wall-mounted hanger. The mechanical movement of this project is produced by two DC stepper motors. The first motor is used as the movement of forward and retract of the hanger while the second motor is used to pull up the cover during rain. The sensors used in this project are LDR, rain sensor, and humidity sensor. This sensor is used to collect data from the atmosphere. The microcontroller used to process all the input and produce commands for the output in this project is Arduino UNO. The cover or shield for the hanging clothes of this project is a soft fabric Polyvinyl Chloride (PVC). This is one of the cheapest and versatile fabrics. The disadvantages of this project are it cannot give a signal to the user when it rain. The project will push forward or retract the hanged clothes without giving any information back to the user.

2. Materials and Methods

The methodology of this proposed project focused more on details, and explanation of the automatic cloth hanger system. The idea of this chapter is to bring forth the working principle, development, and method used in completing this project. This chapter will also discuss the component selection and the software used in this project.

2.1 Working Principle of project

The proposed project can be divided into several main parts. Each of the part, will play important roles in the system such as:

- Clothes hanger frame
- Sensor (Input)
- Motor (Output)
- Controller (NodeMcu-ESP32)

The clothes hanger frame will be the equipment to place load (clothes) and provide the extend/retract ability to the system. The sensors (DHT and rain sensor) will provide input gather from the surrounding area. The motor will provide the mechanical movement for the extend and retract ability. The controller will be the brain of the system. The controller will process the input and provide output based on the input of the system.

2.2 General flowchart

In order to help and guide the proposed project to reach its objective, a flowchart must be built. This also ensure the procedure or step in making the system program is built according to the required requirement of the system. The general flowchart of the system is shown in figure 1 below:

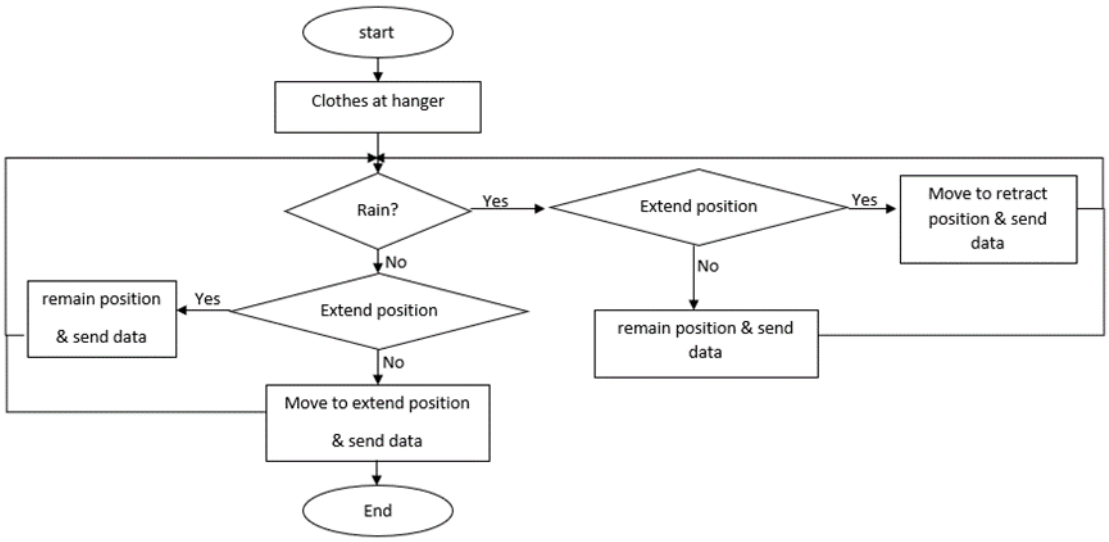

Figure 1: General flowchart of the system

The automatic hanger system using IoT starts by having the clothes at the hanger. Then, the sensor is used to detect humidity, temperature of the surrounding air, and raindrop in the area. If the sensor detects rain droplets in the surrounding area, the DC stepper motor will move and thus retract the hanger. If the sensor does not detect rain at the project area, the DC motor will move if the hanger is in retract condition or remain extended if the hanger is in the extended condition. The data from the sensor such as the humidity value, temperature, rain sensor indicator, and motor position will be sent to the user through the Blynk interface regardless of the situation. Blynk is a complete set of software for prototyping, deploying, and remotely managing linked electronic devices at any scale, from small IoT usage to millions of commercially available connected items. This software helps connecting the hardware of the project to the cloud.

2.3 Electrical Circuit Design

The design circuits of the project are separated into two, which are the electronic circuit and the mechanical circuit of the project. The electronic circuit contains the microcontroller (NodeMcu ESP 32) and sensors (DHT ,rain sensor) used in the project while the mechanical circuit contains the microcontroller (NodeMcu ESP 32), driver (A4988), and motor (DC stepper motor) used in the project. The electronic circuit is built to provide input to the system and processed it. The analog pin for the DHT sensor will be connected to the input pin (D4) in the microcontroller while the rain sensor analog pin is connected to input pin (D34) in the microcontroller. The mechanical circuit provide the movement for the circuit based on the system output. The motor driver will be connected signal pin and ground pin will connected to the microcontroller and Dc stepper motor will be connected to the motor driver. The 12 V power supply will be connected to capacitor before it connected to the motor driver. This is to avoid breakdown on the motor driver if there is voltage spike happen in the circuit. The electronic circuit is built as shown in Figure 2 and the mechanical circuit is shown in Figure 3.

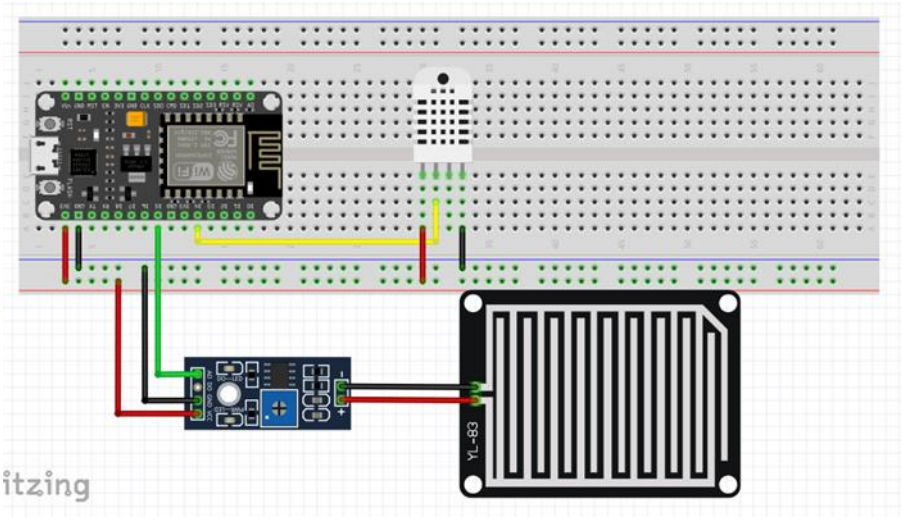

Figure 2:The electronic circuit

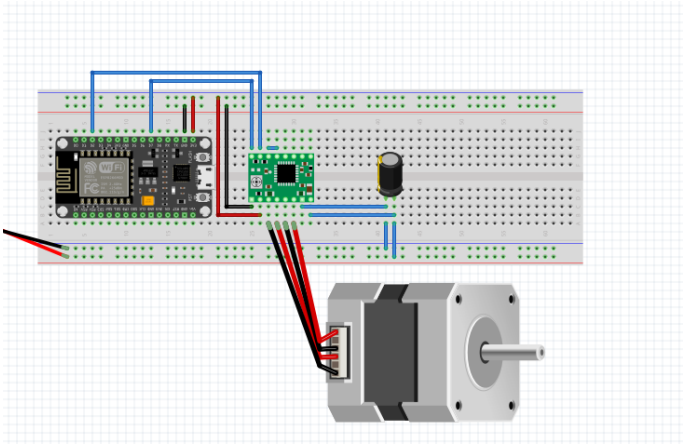

Figure 3: The mechanical circuit

3. Results and Discussion

In this chapter, the result of the project is shown after completely built the proposed project. This process is needed to ensure the project will run and execute according to its purpose. The complete prototype will be executed to evaluate and measure the project based on the mentioned outlines and goals of the project.

3.1 Results

The full prototype of the project had a complete circuit equipped into the frame of the system. The prototype will be run and operate in two situation which are rain and sunny. The rain situation is stimulated by using wet tissue. The wet tissue will be placed on top of the rain sensor. The result of the project is displayed at Table 1.

Table 1: Result of the project

Rain/Sunny	Hanger		Rain LED	Motor Extend LED
	Before	After		
Sunny	Retract	Extend	Off	On
Sunny	Extend	Extend	Off	On
Rain	Retract	Retract	On	Off
Rain	Extend	Retract	On	Off

From the data gathered in Table 1, the project's motor will move from retract position (initial) to extend position if the system detect sunny situation. The project will sent data to Blynk to light up the motor extend led while switch off the rain led. If the initial position of the project is in extend position, the motor will not move and remain in extend position. The project will sent data to Blynk to light up the motor extend led while switch off the rain led. If the weather condition is rain and the initial position of the project is in retract position, the motor will not move and remain in retract position. The project will sent data to Blynk to light up the rain led while switch off the motor extend led. If the initial position of the project is in extend position, the motor will move from extend to retract position. The project will sent data to Blynk to light up the rain led while switch off the motor extend led.

The project was tested by using a lab coat as a sample of hanged cloth (load) for the project. The project was tested inside a closed room. The condition for rain will be triggered by using wet tissue. This measure is taken to avoid water wastage during the testing of the project. The motor is extending the clothes hanger when there is no rain in the area. The threshold of the rain sensor does not fall under the system threshold. Thus, making the motor rotate to extend the hanger. The data collected by the DHT and rain sensor is sent directly to the Blynk interface. The figure 4 below showed the result testing it the sunny condition.

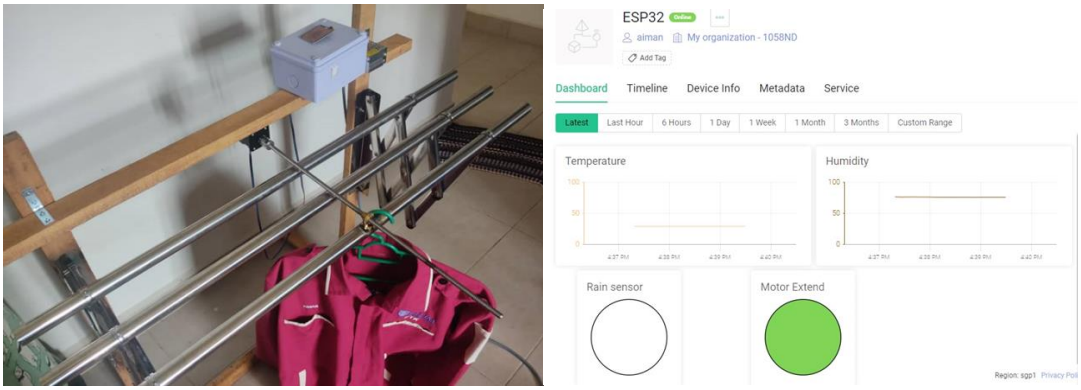

Figure 4: Sunny condition

After testing the project in a sunny condition, then the project will be tested under rainy conditions. The wet tissue will be placed on the rain sensor to stimulate rain conditions. This will make the sensor value drop under the threshold. Thus, making the motor rotate anticlockwise and retract the hanger. The data collected by the DHT and rain sensor is sent directly to the Blynk interface. The figures 5 below showed the result of the testing on the rainy situation.

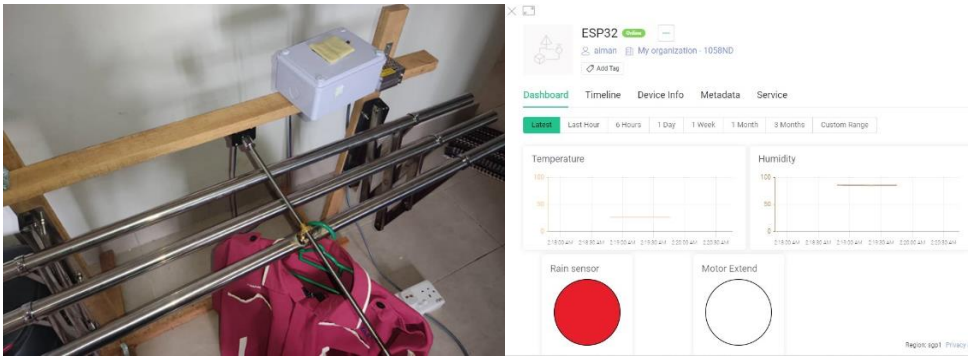

Figure 5: Rain condition

3.2 Discussions

The project can run, operate, and perform properly based on the situation of the area. The circuit had been soldered to give a proper look and more secure connection between the components. The data

from the project can be sent through an online platform (Blynk) which can be accessed using a smartphone and laptop (web dashboard).

4. Conclusion

In conclusion, the automatic cloth hanger system by using IoT had successfully been developed. This system used NodeMcu ESP32 as its microcontroller. This device helps in running the system, analyzing data from the sensor, and giving the desired output signal. This device is compatible with Arduino IDE software. The system used DHT and rain sensor as its main input data while DC stepper motor and Blynk interface as its main output signal. The movement of the system is based on a linear actuator. This type of movement can move the hanger to extend and retract based on the output signal of the microcontroller. The evaluation result for the project system was successfully obtained and met the requirement of the proposed project. Thus, proving that the objectives stated in chapter 1 had been achieved.

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