Malaysian Journal of Industrial Technology, Volume 5, No. 2, 2021
eISSN: 2637-1081

MJIT 2021 Malaysian Journal of Industrial Technology

AUTOMATED OUTDOOR CLOTHESLINE

Z. C Terry[1, a], N. H Ja'afar [1, b], M. Mazumil[1, c]
[1]Instrumentation and Control Engineering Section,
Universiti Kuala Lumpur Malaysian Institute of Technology

*Corresponding author's email:
mazhaniza@unikl.edu.my

[a]zara.chastity@s.unikl.edu.my, [b]noorhuda.jaafar@unikl.edu.my,
[c]mazhaniza@unikl.edu.my

Abstract

Washing and drying clothes have been a daily routine for the majority of the people. However, one of the challenging parts of the process is the drying part. Due to the unpredictable weather changes and monsoon season in Malaysia, this has become one of the hardest challenges to overcome among others. This project introduces the Automated Outdoor Clothesline system that can automatically detects the presence of rain and sunlight intelligently while moving the clothing to a more secure and dry areawhen it is raining. This project began by analyzing and studying students traditionally drying their laundry at their respective hostel, which then expanded to parents who are working with a schedule of 8 – 5 pm every day, even those who have a very busy schedule with a hectic lifestyle that sometimes rarely spend any time at home. This project is programmed by using Arduino and designed with TinkerCAD software. This system uses humidity, raindrop, and LDR sensor, and servo motor to control the input and output of the system. The Arduino UNO microcontroller detect the signal transfer from the sensor and then shows the data ontothe Liquid Crystal Display. The motor will function according to the input of the sensor, whether to retract the clothing inside the awning or to extend outside to expose the clothing. Thus, this finding aided in the investigation of the existing laundry hanging systems, the development of a low – cost and inexpensive laundry line for household use, and the evaluation of the proposed system's performance.

Keywords: Weather Changes and Monsoon Season; Hectic Lifestyle; Programmed with Arduino; Sensors; Development of Inexpensive Laundry line.

1.0 INTRODUCTION

An outdoor clothesline has many benefits that can give to the consumer in terms of saving money, saving energy, increases the life expectancy of clothing, giving an overall fresh appearance to the clothes, andeven saving the environment as well. The outdoor clothesline proves that it serves the most economical, eco – friendly and energy saving methods for drying clothes every day [1], as it only uses the heat from the sun outside. Especially during this modern time, saving the planet is now a focused term that everyone would like to apply to thus, using an outdoor clothesline very conveniently and appropriately fall into this important category.

A clothesline or washing line is basically any type of rope, cord, or twine that has been stretched betweentwo points outside which is either the post or wall, abovethe level of the ground. Afterwards the wet clothes will bethen hanged along the line outside at most of the houseeither in the backyard, balconies, or garden, which is left

to dry under the sunlight. As stated, the main source of drying clothes the traditional way is the sunlight and of course, the air flow at the surroundings of the clothesline. In Malaysia, citizens often enjoy the tropical weather year-round however due to its proximity to water the climate is often quite humid. Despite this, the weather is never too hot and temperature often ranges from a mild 20 °C to 30 °C average throughout the year which makes it suitable to use this method every day as being displayed in Table 1 [2].

Table 1 Average Annual Climate in Malaysia.

Averages	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	199.9	146.4	170.4	198.3	203	177.3	180.2	200.6	249.4	294.8	317	301.6
Temp (°C)	25.8	26.1	26.5	26.9	27	26.7	26.5	26.4	26.2	26.2	26	25.8
Min Temp (°C)	22.1	22.1	22.4	22.8	22.9	22.6	22.4	22.4	22.3	22.4	22.3	22.2
Max Temp (°C)	29.5	30.2	30.9	31.3	31.3	31	30.6	30.6	30.4	30.3	29.8	29.5

Figure 1 Female (%0 Labor Force in Malaysia from 1990 until 2020.

2.0 EXPERIMENTAL

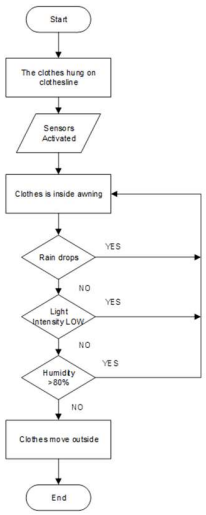

Figure 2 Process Flowchart.

Based on Figure 1, the study of labor force in Malaysia by The World Bank organization, an increase of female working has increased to 38.4% in 2019 [3] due to the increase of cost living in the country. Thus, through this research, it concludes the statement that the cost of living has increased and that both the husband and wife need to work to obtain more income to be able to deliver their responsibilities to their family. Without further ado, this project focuses on working couples that have a busy schedule due to working hours outside of the house and also to those who often forget to take their clothing when it is raining outside.

The Automated Outdoor Clothesline works by applying the Arduino UNO as the main feature, which give instructions to conduct this system properly and automatically retrieve in and out the clothes when it is raining or sunny outside. The clothesline need a stepper motor to work which acts as a mechanism that pulls in and pushed out the clothesline on the pulleywhen receiving instructions from the Arduino UNO. In this system, it also uses the Light Dependent Resistor (LDR) sensor which used to detect light and changes in the atmosphere. The LDR is connected to the Arduino UNO and when it receives signal from the sensor, the Arduino will act accordingly and pull in or push out the hanged clothing. In addition, the rain sensor is used to detect raindrops from the weather and attached at the rod of the clothesline.

Figure 2 shows the process flowchart of the prototype working mechanism. The Automated Outdoor Clothesline function by firstly hanging the wet clothes onto the clothesline. The original position of the clothesline should be inside the awning as it is easier for the user to access the clothesline and does not need to hurry in case there are any drastic changes to the weather. Then, the sensors are activated as power supply has been supplied to the system. The working principle of this system is quite simple, when either one of the sensors detect any changes which indicates whether it should be move into the awning, the system will respond by pulling the clothes back inside for safety and preventing it from being exposed to the rain or any cloudy weather. The commands are as such; (1) when there is any raindrops detection on the rain sensor, (2) when there is any low light intensity received by the LDR sensor, (3) when the value of humidity is > 70 % and temperature is low, or (4) there is no detection or changes in any of the sensors, clothing will remain outside.

The data output of this system was displayed on the LCD 1602 to tell users the temperature and humidity of their surroundings and informing themwhether the weather condition is appropriate for drying out their clothing. Although, the system is automatically retracting when night time comes as during that hour, it will be dark outside thus, the LDR sensor will act and send information to the Arduino to tell that it is night time outside. Otherwise, when the power supplied has been shut off, the clothesline will then be back to its original position which is inside the awning for future use.

3.0 RESULTS AND DISCUSSION

Electronic Circuit Design

This part shows the electronic circuit design that have been designed to create the wiring of the prototype.

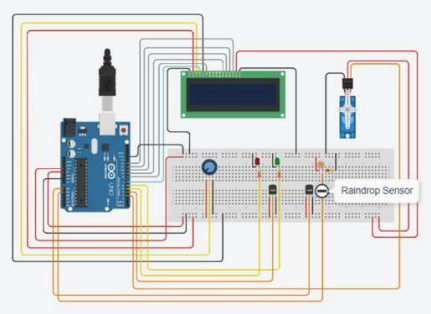

Figure 3 Arduino Uno Circuit Design.

Figure 3 illustrates the electronic circuit diagram of the Automated Outdoor Clothesline. The diagram consists of all the hardware that is used in the project; the Arduino Uno which is the brain of this prototype, the three sensors used which are the raindrop sensor, LDR sensor, and humidity sensor, the servo motor which acts as an output for the system, the potentiometer used to adjust the brightness of the LCD display, and the LCD that functions by displaying all the information received in the process which are manipulated by the change in data obtained from the sensors and also the Arduino. The power supply used to generate the system is by connecting the USB cable to the PC and directly to the Arduino. By doing so, it provide sufficient power supply to help generate the entire system and help it to function accordingly.

Sensor Behavior

This section explains about the sensor behavior when it detects any changes. There are four conditions where each of the sensors are to be tested.

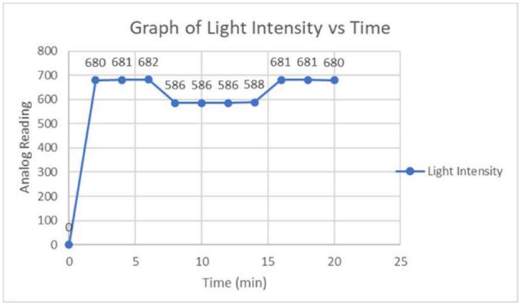

Figure 4 LDR sensor reading.

Figure 4 shows the reading obtained from the LDR sensor that indicates the light intensity results within 20 minutes. The reading changes when there was a flashlight pointed directly towards the LDR while the project was running. The value 586 to 588 lux was obtained when the flashlight was placed above it, which means that there was more sunlight during that process or else the value is maintain around 680 to 682 lux which means it is pretty dark.

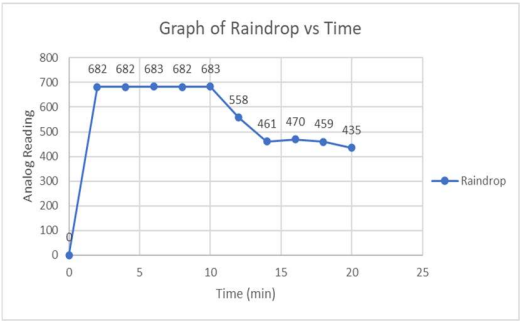

Figure 5 Raindrop sensor reading.

Figure 5 shows the reading obtained from the Raindrop sensor during the running process of 20 minutes. Thedata maintained at the value of 682 to 683 when there are no raindrops detected. But, when the sensor detects any raindrops, the value decreases from 683 until 435 as the raindrops on the surface of the sensor has overflowed.

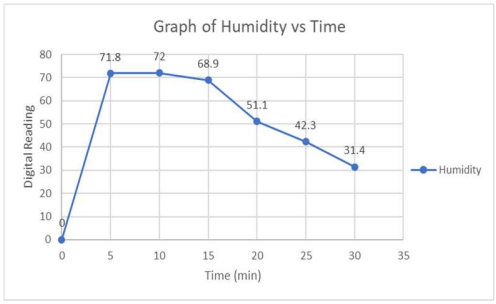

Figure 6 Humidity sensor reading.

Figure 6 shows the reading of Humidity sensor during the process for a total of 30 minutes while running the project. The humidity value of 71.80 is the highest, indicating that the water vapor at the surrounding is wetter than usual. This condition usually occurs during the night or when it is raining. Meanwhile, the value below 60 % indicates that the humidity is lower and the weather is drier and hotter. This shows the humidity that often occur when it is daytime or sunny outside.

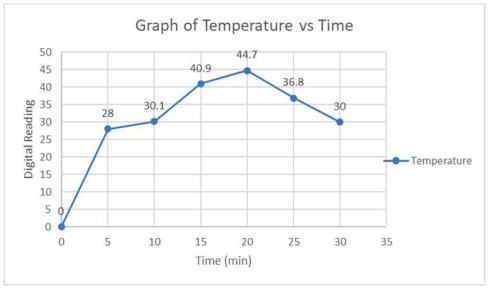

Figure 7 Temperature sensor reading.

Figure 7 shows the temperature taken when running the prototype for 30 minutes in total. While doing this experiment, the 28 °C temperature was taken during night time. Thus, to manipulate the temperature, heating element was applied directly to the humidity sensor that causes it to drastically change into the highest value of 44.7 °C which is very hot and humid. After the heating element was removed, temperature drops fast to 30 °C quickly going back to its original state of the experiment.

Monitoring System

For this section, the monitoring system used for the prototype is the LCD 1602, which is a Liquid-Crystal Display that will display the output of the sensors in the project. Apart from the LCD, LEDs are also used as a monitoring system in the project as it can show changes on the bulbs, indicating whether it is raining or sunny.

Figure 8 LCD reading when it is dry.

Figure 8 shows the reading on the LCD 1602 indicating that it is dry or sunny outside. This result is show when there is no rain or cloudy weather around the surroundings of the clothesline.

Figure 9 LCD reading when it is raining.

Figure 9 shows the display of it is raining outside. This data is displayed if the raindrop sensor detectsthat there are raindrops detected on the surface of the sensor.

Figure 10 LCD reading when it is night time.

Figure 10 is the displayed output data of the LDR sensor. When the LDR detects low light intensity, it assumes that it is currently night time.

Figure 11 LCD reading when it is day time.

Figure 11 is the LCD reading when the LCD sensor detects high light intensity on its surroundings. It display a day time as it assumes it is currently bright and hot outside.

Error for Classification

Before the completion of this project, there were several trial and error done to test the sensibility for each sensor and the servo motor. This is to ensure that these sensors and servo motor will function well before proceeding to assemble the project properly and accordingly to its placement.

Table 2 Error for Classifications.

NO.	TYPE OF SENSOR	SUCCESS	FAILURE
1.	Raindrop sensor	7	4
2.	LDR sensor	8	3
3.	Humidity sensor	10	6
4.	Servo motor	12	8

By referring to Table 2, there were many trials and error done to complete the prototype. Listed above are the four-hardware used in the project. The highest numbers of trial and error was the servo motor as it has a specific condition and placement that it needs to be situated on the clothesline. Meanwhile, for the rest of the tests, it was either tested alone or with each other, thus the higher number of testing occurred. Overall, after many tries, the prototype was able to function well altogether with the sensors and servo motor.

Discussion

Based on the data collected from the project outcome and process, the development of the automated outdoor clothesline can be declared as successful and well-functioned. From the testing of sensors and motor, data collection, data analyzation, data comparison, and classification, this project can run accordingly to its need and requirement. By applying these steps, the servo motor can rotate by following the correct procedure of this project followed by using the most suitable programming. The error of classification also made process easier as student can identify the problems quickly so that they can overcome and provide a solution. Furthermore, the trial and error for each of the sensors including making a graph to show the data more clearly helps student to understand the process happened during the initiation of the prototype. In addition, the monitoring system also help to monitor the system more properly as it shows the indication and changes that occurs among the sensors.

4.0 CONCLUSION

In conclusion, this study focuses on the development of an automated outdoor clothesline system that is generated by using several sensors, hardware, and software. The Arduino was the main medium of this project that controls the system while the TinkerCAD was to create and design the prototype. The system is divided into several factors which are the detection of humidity and temperature, raindrops, and light intensity of the surroundings. Thus, there are a few components that is crucial and needed to fulfil the requirement of this project.

The components are such as Arduino Uno R3, humidity sensor, LDR sensor, rain sensor, and the servo motor. The sensors and Arduino play a role in manipulating the input meanwhile, the servo motor acts as the main output controller of the system. The servo motor is to control the movement of the clothesline which is one of the most important process in the project. Then, the humidity sensor is used to detect humidity and temperature, rain sensor is to detect raindrops, and the LDR sensor is to detect the light intensity.

Next, for the monitoring system, an LCD wasused and implemented on the project to display thedata output obtain from the sensors. Although, all of these components cannot function respectively to theirneeds if the Arduino Uno R3 is not applied as it is themain brain of the entire system. Thus, this project was a success as it was able to achieve all the mainobjectives of this project which are to develop a prototype using the Arduino and TinkerCAD, to monitor and control the changes of humidity, light intensity, and raindrops by using sensors, and lastly is to monitor theentire system by displaying the output on an LCD.

Acknowledgement

First and foremost, praises and thanks to God, the Almighty, for His showers of blessings and the strength He has given to me in order to complete this project. I would like to express my deep and sinceregratitude to my supervisor, Mdm. NoorHuda Ja'afar for giving me the opportunity to do this project and providing invaluable guidance throughout this project. I would also like to thank all the other lecturers in UniKL, Dr. Ashraf Rohanim Binti Asari, Mrs. Mazhaniza Binti Mazumil, Mrs. Ernie Mazuin Binti Mohd Yusof, Dr. Ainul Hakimah Binti Karim and Mrs. Siti Hafshar Binti Samseh.

Nevertheless, I also want to give the utmost respect and appreciation to my constant, my family, especially my parents, Mr. Terry Manak anak Nitih and Mrs. Rose Anak Punpun, for giving me continuous support from the beginning until the end of the project either in terms of prayers, budget, spirit, mentality, motivation, support, and encouragement that have been given to me throughout this entire project.

References

[1] BreezeCatcher. (1992). *breezecatcher-clothesline.com*. Retrieved from Outdoor Clothesline - The Benefits Are Many: https://breezecatcher-clothesline.com/pages/about-breezecatcher-clotheslines

[1] Group, W. B. (21 June, 2020). *data.worldbank.org*. Retrieved from Labor Force, female (% of total labor force) - Malaysia: https://data.worldbank.org/indicator/SL.TLF.TOTL.FE.ZS?locations=MY

[2] Travelonline. (January, 2020). *Malaysia Weather & Cliamate*. Retrieved from travelonline.com: https://www.travelonline.com/malaysia/weather.html

[3] [4] Leverette, M. M. (8 April, 2020). Top 10 Reasons to Line Dry Laundry. Retrieved from the Spruce: https://www.thespruce.com/reasons-to-line-dry-laundry-2145997

[5] Mishra, R. (2019). Nanotechnology in Textiles. Retrieved from sciencedirect.com: https://www.sciencedirect.com/topics/chemical-engineering/photodegradation