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DrySense Smartline System with Weather API Integration

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ABSTRACT

In the Philippines, where the weather can be quite unpredictable with frequent typhoons between June and November, drying clothes outside is quite challenge. Despite this, many laundry workers still prefer sun-drying because it is affordable and preserves the freshness of the clothes. However, drying clothes outside has its challenges like odors, allergens, animal droppings, and weather surprises.

DrySense helps predict rain and detect smoke, and it has an automated system features for retrieving garments. The results of the tests conducted on the system's performance following its installation showed positive feedback from respondents, who gave a weighted score of 3.1, indicating that users strongly agreed with the system's overall performance and its ability to lighten household chores. The respondents rated the built shelter and manual control positively, and the developed software, which employs an algorithm for retrieving and releasing decision- making mechanisms from weather API data, was also successful in achieving its objective. The researchers concluded that the DrySense system is efficient and reliable, able to lighten household chores, and provide users with a hassle-free experience.

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1. INTRODUCTION

In the tropical Pacific, the southwest monsoon brings with it a torrential downpour and fierce winds to the Philippines, typically lasting from June to November. The country experiences an average of 20 typhoons annually, with five of these typhoons causing destruction each year [1]. Due to the effects of global warming, weather patterns have become increasingly unpredictable, and intense rainstorms may hinder the traditional practice of drying clothes outside. Despite these challenges, hanging laundry outside to dry remains a popular and effective method among laundry workers, as it is considered to be a simpler and low-cost way to dry clothes. Moreover, the process of sun-drying clothes offers an added advantage, as it has been scientifically proven to be an effective method for killing pathogens, including viruses and bacteria [2]. Thus, this traditional practice of drying clothes outside continues to be widely adopted in the Philippines, not only as a cost effective alternative but also for its health benefits. At present, individuals face significant difficulties in fulfilling their daily basic work obligations. This can be attributed to the heavy workload and the surge in growing industries, which has made it challenging for many individuals to reach their intended destinations on time. Fortunately, with the advancement of technology, solutions to these problems have emerged. The latest technologies have facilitated the resolution of many seemingly arduous problems, thereby making individuals of all formats more comfortable and blither. However, despite these technological advancements, certain challenges still persist.

2. METHOD

The researchers utilized a quasi-experimental quantitative approach to investigate the effects of DrySense, a smart clothesline system, on people's daily laundry routine. The research objectives were aimed at discovering pertinent answers to the research questions. Quantitative research is a structured methodology for obtaining and interpreting numerical data from either a small or large population. This approach emphasizes objective measurements and computational analysis, including mathematical and statistical manipulation of data from surveys, polls, and questionnaires. It seeks to evaluate the results based on a specific population.

The respondents for the study are the people who have an experience in laundry works within Arayat, Pampanga. The researchers utilized purposive sampling from non-probability sampling when researchers used their judgment in selecting samples in a given population to respond in their surveys.

The researchers in this study have identified and selected the categories of Functional Suitability, Usability, Reliability, Portability, and Maintainability from the ISO/IEC 25010 standard to guide their evaluation of the software system's quality attributes. This approach allowed the researchers to utilize a well-defined and established framework for evaluating the system's performance and quality characteristics in a structured manner.

The researchers employed a survey to gather data on the performance, dependability, and usability of DrySense, a Smart Clothesline System. The researchers ensured that ethical guidelines were followed to safeguard the privacy and confidentiality of the respondents' data, in accordance with the provisions of the Data Privacy Act of 2012 (R.A. 10173). The study's objectives and goals were clearly explained to the participants, and questionnaires were distributed to gather data on their responses. The researchers then collected the completed questionnaires to analyze the data gathered in the study.

In order to analyze and assess the system's functionality and usefulness, the researchers calculated the frequency and weighted mean of the data they had gathered from the respondent. Then, using these findings, descriptive evaluations that are adapted from the Likert scale—which ranges from strongly agree to strongly disagree—are interpreted.

The weighted mean is calculated using the formula:

$\bar{x}_{\omega} = \frac{(SA*4)+(A*3)+(D*2)+(SD*1)}{10}$ Where:

SA = Strongly Agree

A = Agree

D = Disagree

SD = Strongly Disagree

Table.1 Descriptive Evaluations Chart per Likert Scale Point used to Evaluate DrySense

Weighted Mean	Point Scale	Descriptive Interpretation
3.01- 4.00	4.00	Strongly Agree
2.01 - 3.00	3.00	Agree
1.01 - 2.00	2.00	Disagree
0.01 - 1.00	1.00	Strongly Disagree

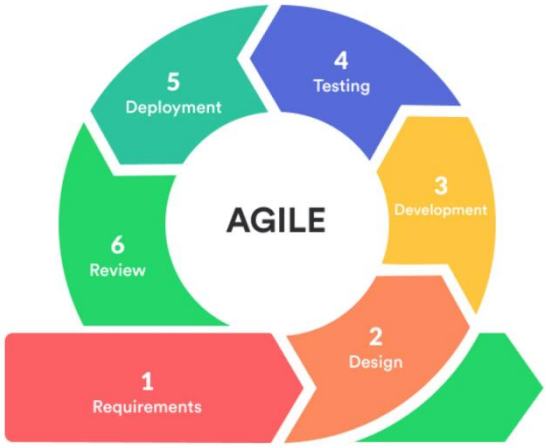

Figure 1: Agile Methodology Framework (retrieved from: *https://www.nature.com/articles/s41598-024-78613-x*)

Researchers used the agile development methodology which divides the activities into iterations in the software and hardware system as they develop the entire system of the DrySense Smartline System. Initially, researchers collected information that is required in the development of the system. Researchers implemented the design of the system based upon the collected information gathered. After the final development of the system, the researchers implemented the developed system to test the functionalities and to improve and maintain the found problems in the system.

The researchers identified and analyzed the functionality of the software system which is the DrySense Smartline Web Application. The researchers used different diagramming techniques to understand how the system functions.

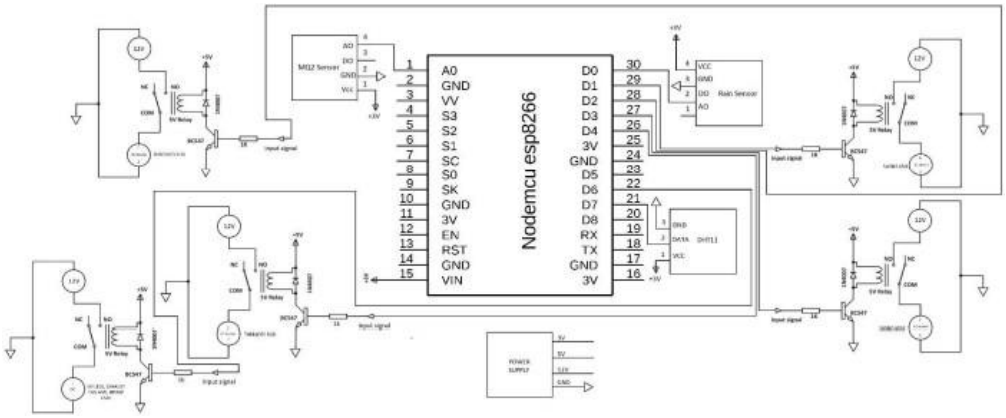

Figure 2: Schematic Diagram of the DrySense Smartline System

Table 2. List of components used to build DrySense

NAME	DESCRIPTION
Tubular steel	Tubular steel is a type of steel formed into hollow, commonly used in construction and manufacturing due to its strength, durability, and versatility. It is a popular choice for buildings, bridges, machinery, transportation equipment, and furniture manufacturing.
Wiper motor	Wiper motor is an electric motor that moves the windshield wiper. It is used in system to be able to rotate the sprockets for the actuator to be able to move upwards or downwards.
Sprockets and Chain	Sprockets and chains are components used in machinery to transfer power from one rotating shaft to another. A sprocket is a toothed wheel that meshes with a chain, which is a series of interconnected links.
Polycaronate	Polycarbonate is also known for its excellent heat resistance and ability to withstand extreme weather conditions, making it a popular choice for outdoor applications. It can be easily molded into different shapes and is available in a variety of colors and finishes. Polycarbonate is a versatile material that is valued for its strength, transparency, and durability.
Cables	Cables include electrical cables, which are used to transmit electricity between power sources and appliances.
Plyboard	Plyboard consists of softwood strips glued together which make up its core. The softwood strips are placed edge to edge and covered by hardwood or software veneer sheets on both the sides. The veneer sheets are bonded to the softwood strips under high temperature and pressure to form a plyboard.
Power supply	A power supply for electronic devices. Also called an "AC adapter" or "charger," power adapters plug into a wall outlet and convert AC to a single DC voltage.
UV LEDs	A UV LED strip is a new lighting form. Plus, it's a flexible linear circuit board—like we mentioned earlier. The LED tape strip has many single LED emitters on its narrow frame. This helps disinfect and are more environmentally friendly as they do not contain harmful mercury, do not produce ozone, and consume less energy.
Fans	Fans are used to draw cooler air into the case from the outside, expel warm air from inside and move air across a heat sink to cool the clothes inside the shelter.
CH340 microcontroller	CH340 is a USB bus conversion chip, it can realize USB to UART interface or USB to printer interface. In serial UART mode, CH340 provides common MODEM liaison signal, used to expand UART interface of computer or upgrade the common serial device to USB bus directly.
Relay	A relay is an automated switch that regulates a high- current signal to a low-current signal in an autonomous control circuit. The input voltage of the relay signal ranges from 0 to 5V. This module's primary purpose is to interface with various microcontrollers, such as the CH340.

To create the web application of DrySense Smartline System, the researchers utilized the following programming languages and frameworks. Bootstrap 5 framework was used to develop the user interface of the DrySense web application. It is a pre-written code that utilizes a content delivery network to avoid writing code design from scratch. JavaScript, a client-side programming language was used to make the DrySense UI design more dynamic. Where the developers used the jQuery library to refresh some data from the website like sensor values, DrySense mode status and, time without reloading the whole page. It is also used JSON to store the sensor data without using a database. PHP, a server-side programming language was used to develop the backend of DrySense. It was utilized to decode JSON files which contain settings and sensor data, it is also encoded settings which the microprocessor Node MCU will serialize the file using HTTP Request methodology. Moreover, PHP was used to obtain the API from OpenWeather which was displayed in the Bootstrap 5 table. Lastly, PHP has the capability to do MySQLi queries like the updating the settings and, login DrySense authentication.

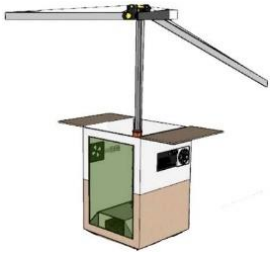

Figure 3: Overall Hardware Design

Figure 4: DrySense Application Homepage

Note. Figure 6 depicts the design of the homepage ui where the user can see the weather forecast in the place that the user chose, device status and the button where the user can manually retrieve or release the clothes. The image on the right shows if the toggle menu is pressed.

3. RESULTS AND DISCUSSION

After conducting the evaluation, the researchers computed the weighted means of the data gathered from the participants and used a four-point Likert scale to interpret the results. This approach aimed to determine if the respondents found the developed system acceptable, helpful, and recommended for use. The results of the system evaluation, based on the survey questionnaire adapted from the ISO/IEC 25010 standard, are presented in this section. The tables 3 to 7 provide a descriptive interpretation of the functionality, usability, portability, maintainability and reliability of the designed system.

Figure 5: DrySense System

Table 3. Summary of the System's Overall Evaluation

CRITERIA	WEIGHTED MEAN	DESCRIPTIVE INTERPRETATION
Functionality	3.10	Strongly Agree
Usability	3.42	Strongly Agree
Portability	2.90	Agree
Maintainability	3.30	Strongly Agree
Reliability	3.15	Strongly Agree
Overall Weighted Mean	3.20	Strongly Agree

4. CONCLUSION

The results of the tests conducted on the system's performance following its installation showed positive feedback from respondents, who gave a weighted score of 3.1, indicating that users strongly agreed with the system's overall performance and its ability to lighten household chores. The respondents rated the built shelter and manual control positively, and the developed software, which employs an algorithm for retrieving and releasing decision- making mechanisms from weather API data, was also successful in achieving its objective. The researchers concluded that the DrySense system is efficient and reliable, able to lighten household chores, and provide users with a hassle-free experience.

In conclusion, the DrySense Smartline System provided an innovative solution to a longstanding problem and demonstrated the potential of technology in improving traditional practices. The system's efficiency and reliability can help alleviate the burden of household chores and promote sustainable living. The researchers' contribution to the field of laundry drying technology opens opportunities for future research and development of smart home systems that can further improve the quality of life of people

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