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Project SAMPAY: A Sensor-Activated Machine for Cloth-Placing and Drying

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ABSTRACT: "Project SAMPAY: A Sensor-Activated Machine for Cloth-Placing and Drying" tackles the problems with conventional clothing drying techniques, which either depend on the weather or use a lot of energy, like electric dryers. In order to automate the drying process, this study investigates the creation of a sensoractivated cloth drying machine that incorporates temperature, humidity, and moisture sensors. The technology automatically modifies drying parameters to guarantee energy efficiency and fabric care by continuously observing ambient elements and fabric conditions. Because less human involvement is required, the drying process is more effective, convenient, and energy-efficient. Additionally, it offers the possibility of more intelligent, environmentally friendly solutions by utilizing machine learning and IoT capabilities for customized drying cycles. In addition to improving the user experience, the article shows how these advances might help reduce the environmental effect and energy consumption of traditional drying processes. The results lend credence to the increasing promise of sensor-based drying technologies in creating more ecological and effective home appliances.

KEYWORDS: Project Sampay, Sensor-Activated Machine, Cloth-Placing, Drying, Raspberry pi,

INTRODUCTION

In the modern era, technological advancements have significantly impacted everyday domestic activities, especially household chores. One of the most time-consuming tasks is drying clothes, which traditionally requires either air drying or the use of energy-intensive electric dryers. Air drying is highly dependent on environmental factors, such as weather conditions, and can be time-consuming, while electric dryers, though effective, are often associated with high energy consumption and potential damage to delicate fabrics. The integration of sensors in household appliances has provided a new avenue for enhancing efficiency and user experience, particularly in the area of cloth drying. A sensor-activated machine for cloth drying promises to combine convenience, energy efficiency, and fabric care by automating the drying process based on real-time conditions and fabric requirements.

The methods of drying clothes have evolved from simple hanging on clotheslines to the introduction of mechanical and electric dryers. Early clothes dryers were mechanical in nature, using wind or manual rotation to remove moisture from fabrics. The invention of electric dryers revolutionized this process, offering rapid drying through heated air, but this method often comes with significant drawbacks, including high energy consumption and potential fabric wear due to the excessive heat and mechanical tumbling (Hossain et al., 2024). The energy demands of electric dryers contribute to a household's overall electricity consumption, making them a costly appliance to operate. Additionally, the risk of fabric damage—such as shrinkage, color fading, and wear—is a concern for users, especially with delicate fabrics like wool and silk (Ahmadi et al., 2021).

The challenge of improving the efficiency and fabric care aspects of cloth drying has led to the development of smarter solutions. One such solution is the sensor-activated cloth drying machine, which uses sensors to detect moisture levels and automatically adjusts drying parameters to suit the specific fabric being dried. These sensors can monitor various environmental and fabric conditions, such as humidity, temperature, and moisture content, allowing the machine to optimize the drying process (Galat et al., 2024).

The incorporation of sensors into cloth drying systems aims to address the limitations of traditional dryers by creating machines that can respond dynamically to changing conditions. Moisture sensors are crucial for detecting the remaining moisture content in clothes, allowing the dryer to stop automatically when the clothes are sufficiently dry (Mishra et al., 2023). These sensors can be used to prevent over-drying, which is a common problem in conventional dryers that can lead to fabric degradation and energy waste.

Temperature and humidity sensors play an equally important role by monitoring the environment within the drying chamber. When the humidity reaches a certain threshold, the machine can adjust its temperature or airflow to expedite the drying process, thus conserving energy. Furthermore, the temperature sensors prevent overheating, which can otherwise damage delicate fabrics or result in excessive energy consumption (Ibrahim et al., 2023). Additionally, by using adaptive control systems that integrate these sensors, the drying machine can provide an optimized, personalized drying cycle for different types of fabrics, enhancing the care of clothing and promoting energy savings.

A major advantage of sensor-based machines is the potential to reduce human intervention. Traditional dryers require users to manually set the drying time or to monitor the drying process. This not only requires time but also leads to the risk of clothes being either under-dried or over-dried. With sensors, however, the drying process can be fully automated based on real-time measurements, making it more efficient and convenient for users (Tegrotenhuis et al., 2017). Energy consumption has become a significant concern in household appliances, particularly in the context of global efforts to reduce carbon footprints and promote sustainability. Electric dryers are among the highest consumers of energy in the average household, contributing to higher electricity bills and environmental degradation (Tegrotenhuis et al., 2017). The development of energy-efficient drying technologies is essential for reducing the environmental impact of domestic appliances.

A sensor-activated cloth drying machine can help mitigate the energy consumption problem by adjusting its operation to minimize unnecessary energy use. For instance, if the machine detects that the clothes are nearly dry, it can reduce the heat or shorten the drying cycle, thus consuming less energy. This efficiency is especially critical in regions where electricity costs are high or where environmental sustainability is a priority. Furthermore, energy-efficient dryers can help to address concerns regarding the depletion of natural resources by reducing the carbon emissions associated with high electricity consumption.

The user experience is another important consideration in the design of sensor-activated cloth drying machines. The ease of use, along with customizable settings that allow users to select specific drying modes based on fabric types, adds significant value to the appliance. Automated drying cycles ensure that the user does not have to worry about monitoring or adjusting settings during the drying process. Instead, the machine operates autonomously, providing convenience while ensuring fabric protection (Ahmadi et al., 2021). Moreover, the integration of IoT (Internet of Things) capabilities in these machines can further enhance their functionality. IoT-enabled dryers can be connected to smartphones, allowing users to monitor and control the drying process remotely. This can be especially useful for those who wish to start or stop their dryer while away from home (Mishra et al., 2023). In addition, machine learning algorithms could be implemented to learn the user's preferences over time, leading to even more efficient and personalized drying cycles.

In this study, the development of sensor-activated cloth drying machines represents a significant advancement in domestic appliance technology. By integrating moisture, temperature, and humidity sensors, these machines provide a more efficient, energy-saving, and fabric-friendly drying process. The automatic adjustment of drying parameters based on real-time data not only reduces human intervention but also contributes to reducing energy consumption and the environmental impact of traditional drying methods. As technology continues to evolve, the potential for smarter, more sustainable drying solutions will likely grow, offering new opportunities for household efficiency and fabric care.

METHODOLOGY

In this study, the researchers conceptualized the design and requirements of the automatic clothesline retriever using the Project Development Method (PDM). The project was built and put together with parts that followed the design specifications. As a result, any discovered and observed flaws were corrected, and the device was then reassembled until it was clearly functional. The community can use the automatic clothesline retriever that the researchers have created to dry their clothes.

SYSTEM ARCHITECTURE

The project is referred to as a Sensor-Activated Machine for Cloth-Placing and Drying, and the Raspberry Pi serves as its primary microcontroller. As shown in Figure A, the architecture takes four factors into account. The first is the garment weight in kilograms, which is used to determine the minimum and maximum capacities for the project. Second, a rain sensor is used in the project's setup to find raindrops on the clothes. Thirdly, the LDR sensor evaluates cloudiness and sunlight to assist in decision-making. The smoke sensor is then used to detect smoke, which causes automatic clothing retrieval to take place at the designated shelter.Figure 2,3,and 4 shows the general process when all sensors are connected to the microcontroller. From the shelter, when LDR sensors detect sunlight, they will automatically hang it out, and vice versa, when the sensors detect a cloud, rain, or smoke, the clothes will automatically be retrieved from the shelter.

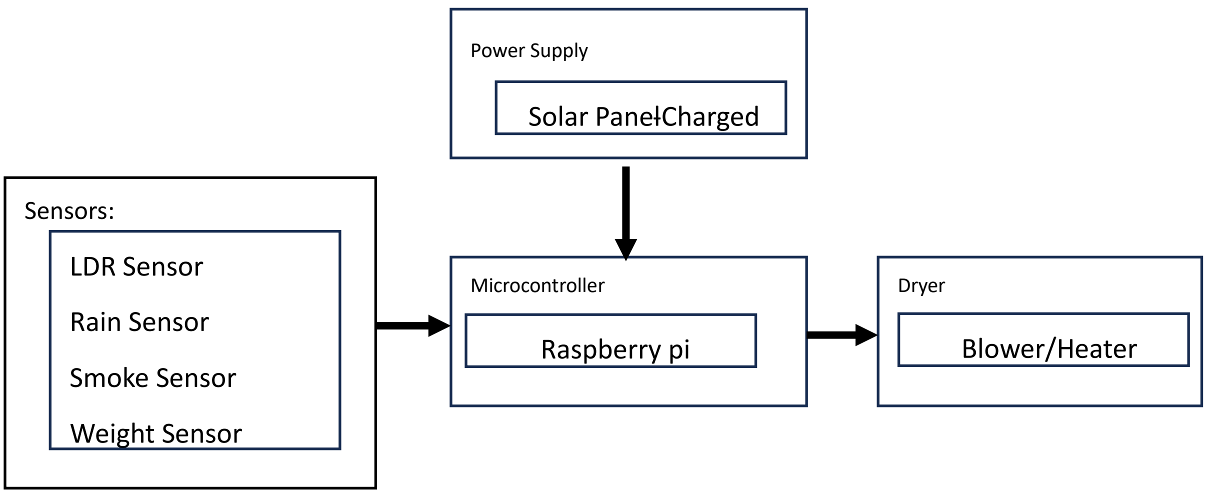

Figure 1. System Architecture of Project Sampay: A Sensor-Activated Machine for Cloth-Placing and Drying

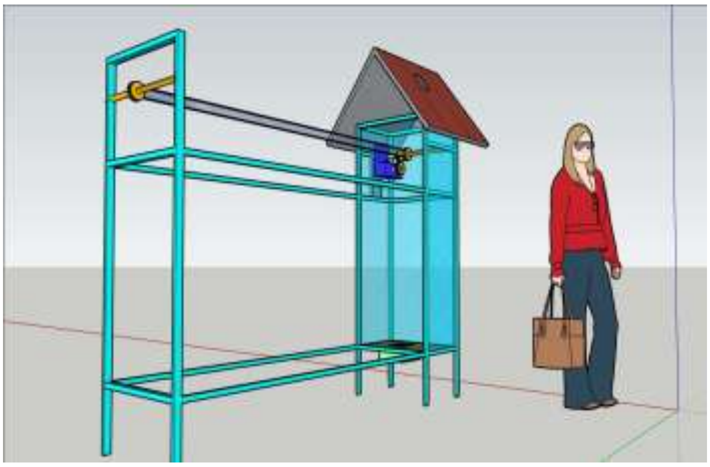

Figure 2. The developed designed Project Sampay: A Sensor-Activated Machine for Cloth-Placing And Drying

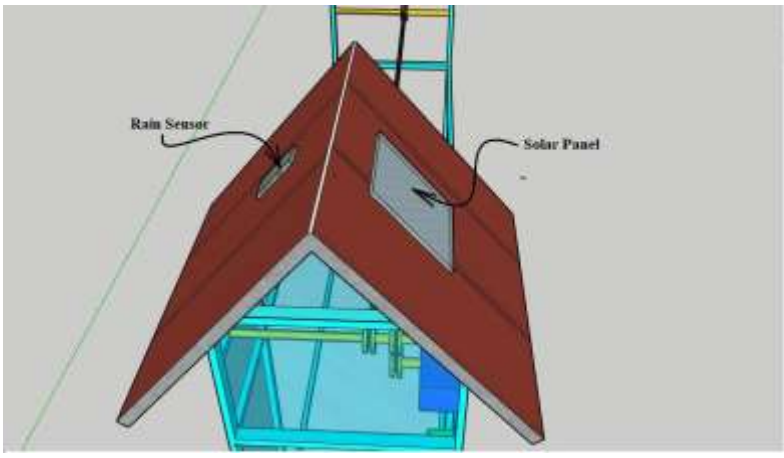

Figure 3. The connections of Solar Panel and Rain Sensor in the Activated Machine for Cloth-Placing And Drying

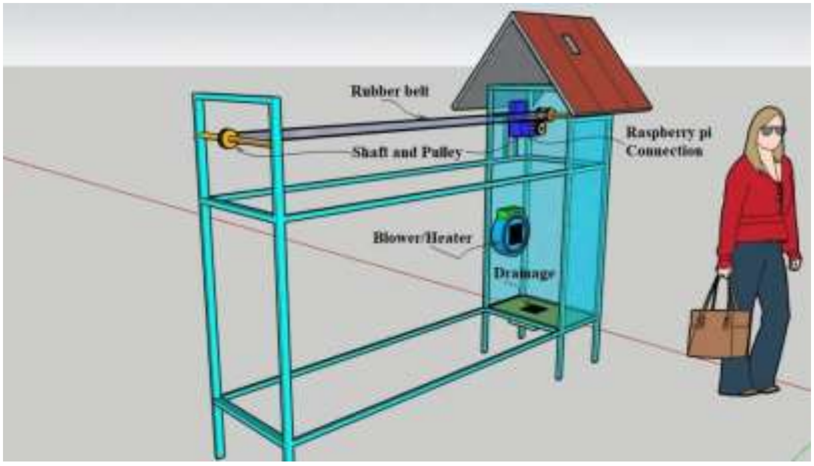

Figure 4. The spare parts of Activated Machine for Cloth-Placing and Drying

DETECTION SYSTEMS

One of the developed project's functions is detection. Figure 3 shows how the rain sensors detect raindrops on the clothes when they are hanging outside the covered area of the machine that has been turned on to place and dry the clothes. There is no human involvement; the developed project operates automatically whereas other sensors have the same functionalities for detection.

The first parameter, detection, includes rain, smoke, and sunlight. The second parameter is retrieving, where the clothes are automatically retrieved (forward and backward) if the sensors detect something related to their functionalities.

TESTING

The developed project Activated Machine for Cloth-Placing and Drying also uses testing to determine its benefits and make improvements. testing of clothing for wetness, dryness, and drying time. Additionally, the weight of the clothing used for testing the Activated Machine for Cloth-Placing and Drying's range and capacity.

RATING SCALE

The scale shown was used to interpret the data collected for evaluation

Scale	Verbal Interpretation
5	High Acceptable **(HA)**
4	Very Acceptable **(VA)**
3	Acceptable **(A)**
2	Fairly Acceptable **(FA)**
1	Not Acceptable **(NA)**

One of the most important elements of the study is the evaluation. The researchers came up 20 respondents to evaluate the completed project by testing the functionality and safety of the developed project Activated Machine for Cloth-Placing and Drying.

RESULTS AND DISCUSSIONS

Design

Figures 5 show the designed project, Activated Machine for Cloth-Placing and Drying, with dimensions of 2.14 m in height, 1.80 m, and 0.64 m.

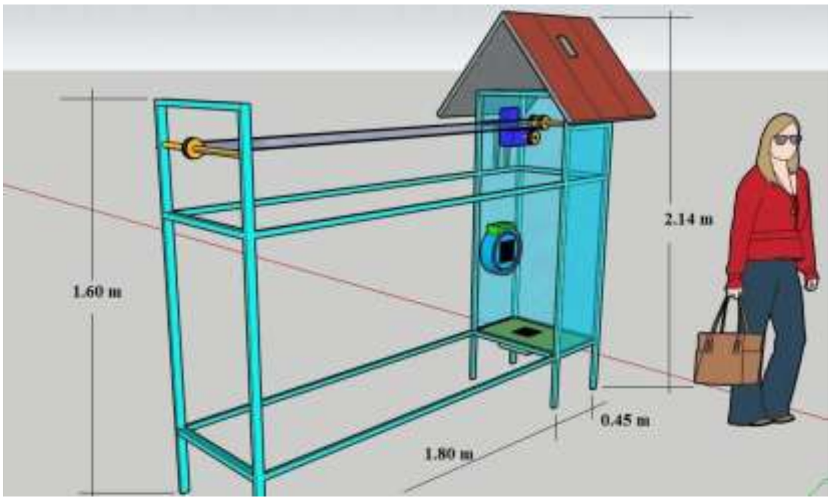

Figure 5. The overall design of Activated Machine for Cloth-Placing and Drying

Figure 6. The sample of Activated Machine for Cloth-Placing and Drying

Figure 7 shows the outcomes of the study's dry run and clothing testing, where its minimum capacity is 1 cotton shirt and its maximum capacity is 6 cotton shirts. The minimum capacity (1 pc) of the study subject test moves forward at a speed of 3.5 m/s during the dry run and testing phases. The speed at which the study reacts varies depending on the volume of the clothes placed inside. To the study's minimum capacity, travel more slowly than the others, and the maximum capacity of six articles of clothing.

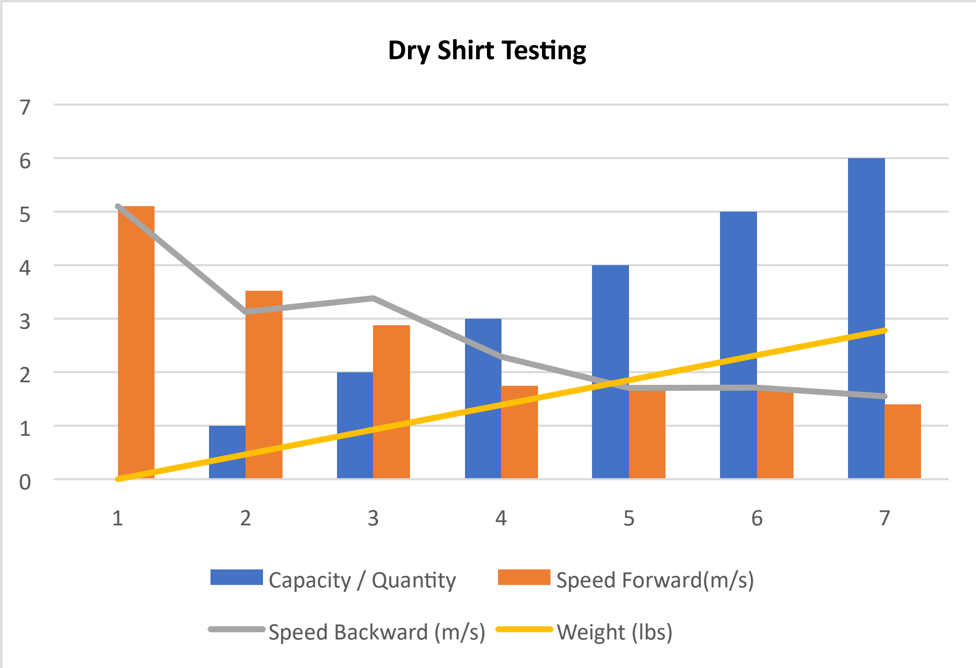

Figure 7. Dry Shirt Testing (Cotton)

Figure 8 demonstrates how the weight of the cotton clothing would increase and become heavier than the dry clothing when it was wet. The results of the study's dry run and testing with wet clothes indicate that the study responds to its coded program more slowly the heavier the clothing.

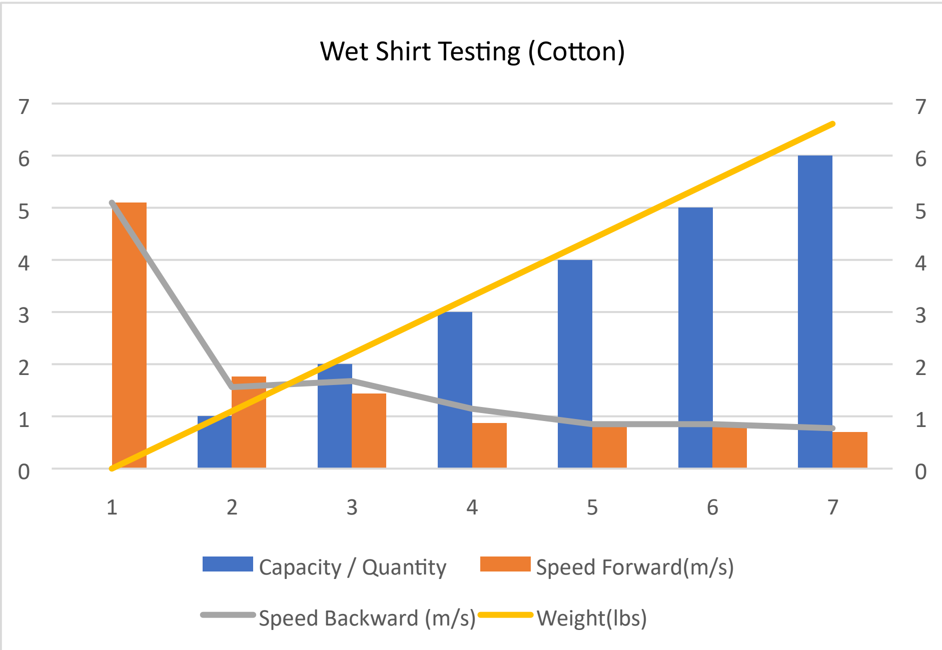

Figure 8. Wet Shirt Testing (Cotton)

Figure 9 shows the findings from the study's dry run and clothing testing, where the minimum capacity was one cotton shirt and the maximum was six. The minimum capacity (1 PC) of the study subject test moved forward at a speed of 5.1 m/s during the dry run and testing of the study. The speed at which the study reacts varies depending on the volume of the clothes placed inside. To the study's minimum capacity, travel more slowly than the others, and the maximum capacity of six articles of clothing.

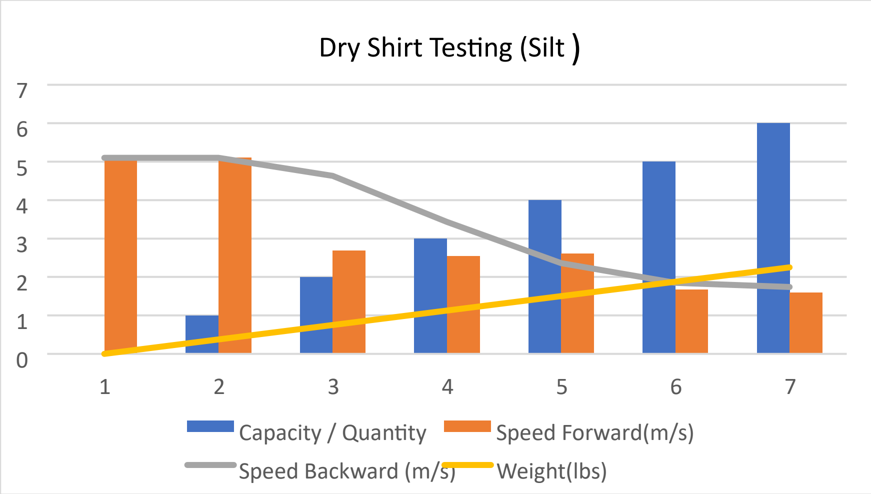

Figure 9. Dry Shirt Testing (Silt)

Figure 10 demonstrates how cotton clothing gains weight when it is wet, making it heavier than dry clothing. The results of the study's dry run and testing with wet clothes indicate that the study responds to its coded program more slowly the heavier the clothing.

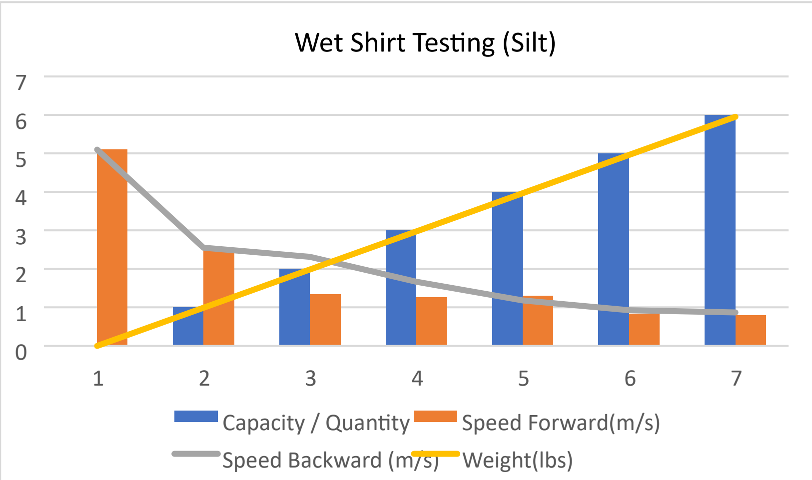

Figure 10. Wet Shirt Testing (Silt)

The testing of dry and wet pants is shown in figure 11 and figure 12. The total quantity or maximum capacity for both dry and wet pants is 1, according to the tabulated data.

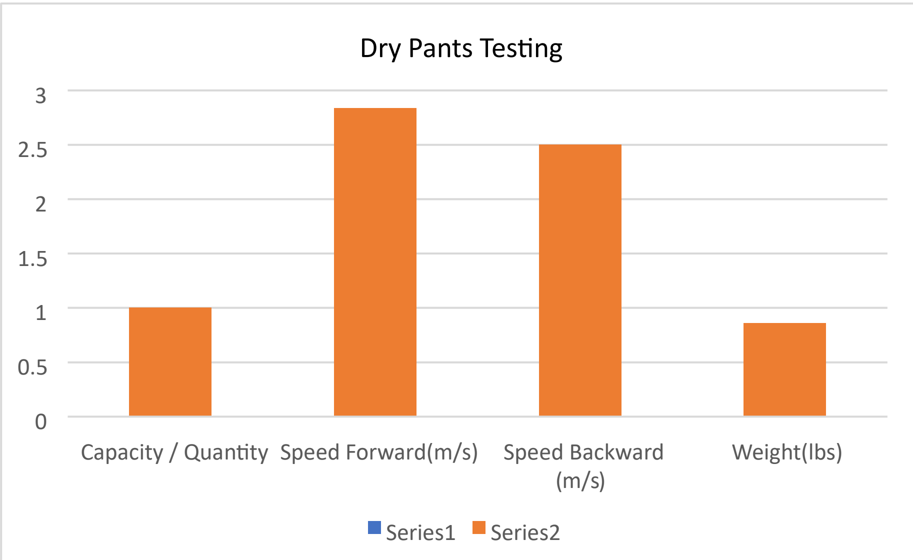

Figure 11. Dry Pants Testing

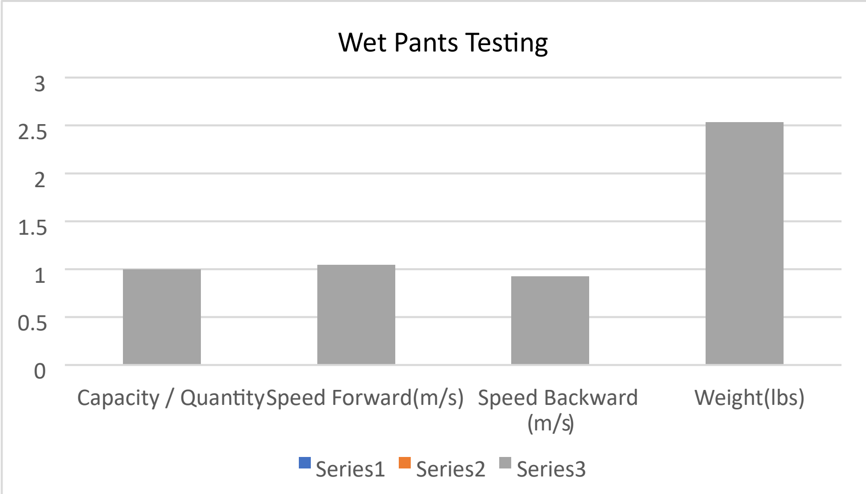

Figure 12. Wet Pants Testing

EVALUATION

The developed project was evaluated by its functionality and safety. Where the following was obtain as shown in table 1 and 2.

Table 1. Functionality of develop designed Project Sampay: A Sensor-Activated Machine for Cloth-Placing and Drying

A.	**Functionality**	**5**	**4**	**3**	**2**	**1**
1.	Provision of comfort and convenience		14	6		
2.	Ease of operation		11	9		
3.	Quality of output	20				

Table 1 shows the provision of comfort and convenience has received a data majority for Very Acceptable interpretation with 14 evaluators and 6 evaluators for Acceptable; ease of operation has received a data majority for Very Acceptable interpretation with 11 evaluators and 9 evaluators for Acceptable; and quality of output has received a data majority to High Acceptable interpretation with 20 evaluators that leads to a favorable conclusion.

Table 2. Safety of develop designed Project Sampay: A Sensor-Activated Machine for Cloth-Placing and Drying

B.	**Safety**	**5**	**4**	**3**	**2**	**1**
1.	Absence of toxic/ hazardous materials	20				
2.	Absence of sharp edges	20				

After the project (Automatic clothesline retriever) was evaluated as shown in table 2, the majority of the data for both the absence of toxic/hazardous materials and the absence of sharp edges were collected for a highly acceptable interpretation that ensures the evaluators' safety.

CONCLUSION

The sensor-activated clothesline system's testing showed that it could modify its speed in response to changing conditions, including the weight and moisture level of clothing. When clothing is heavier, especially when wet, the system responds more slowly, which facilitates effective drying while reducing fabric damage. The technology has the potential to enhance clothesline automation by providing ease and energy efficiency for drying clothing with little assistance from humans. The system's capacity and efficiency for a wider range of clothing and climatic circumstances could be improved with additional development and optimization.

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