



Smart Moving-Spiral-Clothesline for Urban Society

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ABSTRACT

This paper presented a smart moving-spiral-clothesline for urban life. The design of the clothes dryer is flat and used in the manner of spiral movement. 3D models have been designed to show the basic component of the proposed smart clothesline. To evaluate the proposed system, the simulation results have been set up to show the operation of the proposed system. The proposed system of the clothes drying rack (spiral moving type) can support the drying weight of 2.5 kg per one drying time, which can save 68.2% of the space compared to old clothes drying (fix type). This, consequently, can assist in terms of movable space. The proposed system can also analyze the situation when dust affecting the drying may damage clothes from the simulation of the operation of the device and the sensor. It is found that the proposed equipment can be used in the actual design. In addition, it is necessary to adjust the light value to suit the installation area to prevent equipment failure

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1. INTRODUCTION

The growth trend of urban society has increased significantly. The structure of urban society is similar in that the population density per area is higher. This change resulted in less living space for each family. Most of these living spaces will be used together. For example, the parking area and the drying area are the same. In addition, the living space inside the house, if managed to the maximum benefit, can produce food even if there is no sunlight for cultivation.

During the COVID-19 outbreak Countries with little arable land are becoming more aware of food security. Countries like Singapore have begun to install vertical cultivation systems to increase enough arable land for the country's population. It is well known that crises, such as COVID-19, are causing shipping problems around the world. The crisis has caused airlines to be unable to import food despite their huge budgets (Liu *et al.*, 2020). The vertical farming model is gaining a lot of attention as it can increase yield per area by as much as 20 times and also offer flexibility to arable land. Landless areas can also use vertical hydroponic cultivation patterns (Despommier, 2019).

To manage the area to be beneficial movement mechanisms to achieve greater efficiency with different systems has been studied extensively The research involved in this type of application is the work related to the solar panel tracking system. Generally, this type of system can be divided into 2 types according to the motion axes: 1-axis and 2-axis solar tracking system (Deekshith *et al.*, 2015). In 2018, researchers presented a solar tracking system with a distributed shape solar tracking feature that makes the system work more flexibly (Chen *et al.*, 2019).

To make good use of the space, this article focused on the study of structural movement and movement of structures for broad application of urban society. The proposed system is applied to the clothesline. From the simulation, it was found that the proposed system can be designed for various sensor systems. of the system to work in harmony with each other effectively.

2. METHODS

We used simulation methods in the working characteristics of the new clothes drying rack model (spiral moving) and old clothes drying rack (fix type) to calculate the volume and area of use. The height is 0.8 meters, the width is 0.4 meters, and the length is 2 meters. It will account for 100% of the area. Then, we removed the calculation to the clothes drying rack (spiral moving) and the difference of the area to know the use of the floor. Two types of drying clothes were tested to the simulation of the working system in a grid to find out the error or the possibility of the device to be created according to the operation of the program. The characteristics of the clothes drying rack (spiral moving) in the design of this clothes drying rack have a feature that is a form of automation using the smart flower design or the nature of the spiral. The designed model can be folded in the design style. Thus, it will give more space to contract and unfold. Such characteristics are appropriate in the design of the clothes drying rack with space, which will be good for the limited dimensions in terms of height. The model has designed the pole of the clothesline to be retractable according to the appropriate manner due to the area used that may be in a balcony. The movable part design will help in drying and storing the clothes as well. In this drying rack design, sensors are also installed at the connection points and the fabric cover to be used as a sort. We also consider the model for humidity, light, and rain values to calculate weather conditions and operations (**Figure 1**).

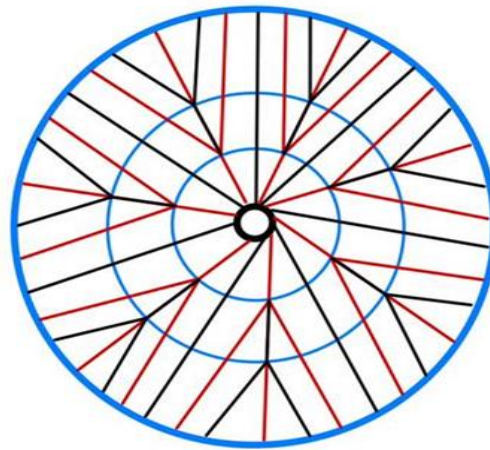


Figure 1. Designed model.

Figure 1 shows the angle at which the light is scattered and heated. The drying time of the fabric can be found in Equation [1].

$$EVT = \frac{\Delta (R_n - G) + \rho_a c_p \frac{(e_s - e_a)}{r_a}}{\Delta + \gamma \left(1 + \frac{r_s}{r_a}\right)} \quad (1)$$

where EVT is the hourly evaporation, R_n is the net radiation, G is the soil heat flux, e_s is the saturated vapor pressure of the air, and e_a is the vapor pressure of the air at the current relative humidity, ρ_a is the average air density at the pressure constant, c_p is the specific heat of air, Δ means the slope of the temperature relationship with the saturated vapor pressure, and γ is the psychrometric constant. r_s and r_a are the (bulk) surface and the main aerodynamic resistance, respectively.

From the results, we obtained and compared them with the normal drying rack. It will receive more light and can be obtained from the light scattering request from the study of the spiral pattern drying rack automatically. It will be able to enhance the capabilities of the existing clothes drying rack and develop 4.0 innovation that is modern in the era of automatic innovation. Then, we compare it with the old style (fix) clothes drying rack. To evaluate the proposed cloth lines model, the section presents the experimental results. From the analysis using a 3D Model, it is a characteristic of the smart flower design. We also compared it with the old clothes drying rack (fix type). Our design also can be brought to any area (moving type). By finding the area and volume as well as subtracting them to find the difference from Equations [2] and [3], we can obtain

$$v = \pi R^2 h \quad (2)$$

$$v = l \times b \times h \quad (3)$$

After subtracting the volumes, we converted the volume of the old clothes drying rack to the percentage form to find the difference in volume to form Equation [4].

$$p = \frac{x \cdot 100}{y} \quad (4)$$

Several considerations are:

- (i) Presentation of Smart Moving-Spiral-Clothesline for Urban Society treatment plant. The 3D model design requires a multi-step process to calculate (**Figure 2**).

- (ii) Steps in the design of Smart Moving-Spiral-Clothesline for Urban Society. In the design to be able to be used in the form of smart moving spiral (see **Figure 2**), it is necessary to simulate and find the working efficiency of the vacancy to get the area suitable for use in various locations. to the design.

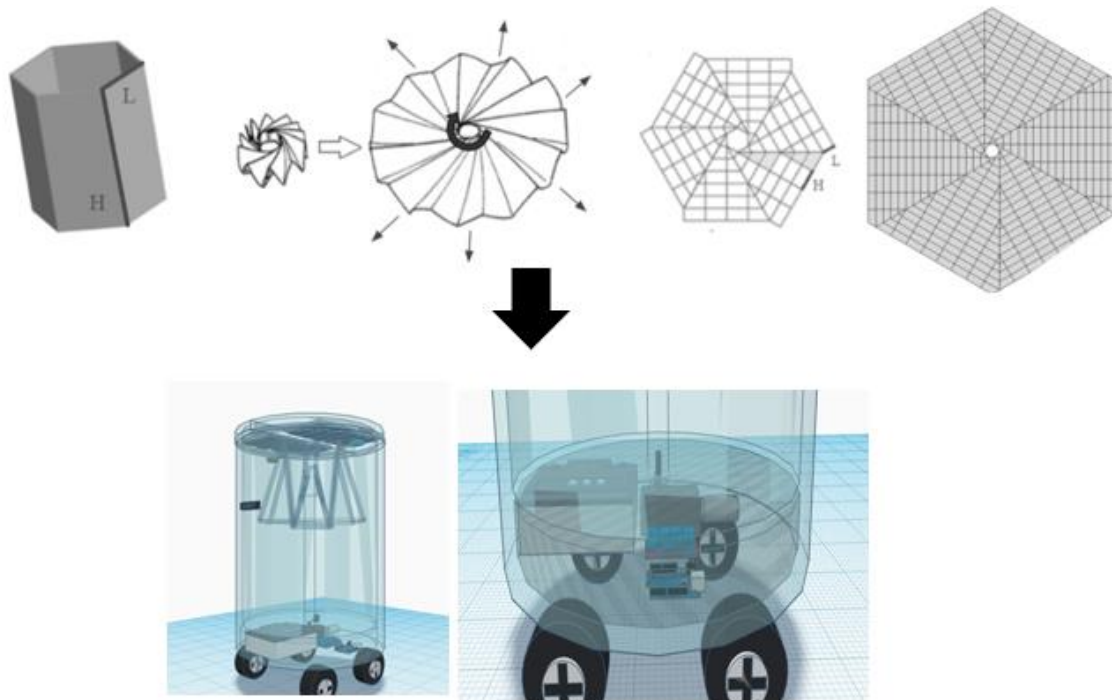


Figure 2. Schematic diagram of the physicochemical treatment process in the station of the textile industrial unit.

3. RESULTS AND DISCUSSION

By simulation method, the equation will be used to create a model according to **Figure 3**, we found the proportions and compared to find the relationship of the volumes of the two types to get the appropriateness, which from finding the volume of the old clothes drying rack. We fixed the type that is equal to 0.64 m^3 and the volume of (moving type) that is equal to 0.20352 m^3). When we used to calculate, we can get the percentage to find the fraction by giving $0.64 = 100\%$ and $0.20352 = 31.8\%$. After subtracting them, we got 68.2% more area. After knowing the area to determine the performance of the clothes drying rack (moving type), a simulation was performed and the results were collected in a table format to collect the performance results (see **Table 1**).

From **Table 1**, it can be seen from the simulation of the clothes drying rack (moving type) that it operates in the form of periods of high sunlight and inconsistent times in the operation of the device. During the day when there is no bright sky and no rain and no humidity (due to each area having different weather conditions in actual condition), we should adjust the brightness of the device as appropriate for each country.

Figure 3 shows the working results of the 3D model. The work from this simulation shows that the model can be used in practice and can also be automated.

Table 1. Shows the operation of the device.

Water Detection Sensor Module	Ambient Light Lux Sensor	DHT11 Temperature Humidity Sensor	Simulation Results
ON	OFF	OFF	Close the clothesline
ON	ON	OFF	Close the clothesline
ON	OFF	ON	Close the clothesline
OFF	ON	ON	Close the clothesline
OFF	OFF	ON	Close the clothesline
ON	ON	OFF	Close the clothesline
OFF	ON	OFF	Spread the clothesline
OFF	OFF	OFF	Spread the clothesline

**Figure 3.** Show work simulation in the form of 3d model.

4. CONCLUSION

This paper presents a smart moving-spiral clothesline. Due to the design of the 3D model, there is a problem with the materials used in the design. This model may choose to use materials that are lightweight and cost-effective in use. From the 3D model simulation, the area increased by 68.2 percent, which can save space and is suitable for the urban society that needs to use more usable space. From the simulation of the operation of the device and the sensor, it is found that it can be used in the actual design. It is necessary to adjust the light value to suit the installation area to prevent equipment failure. According to the smart flower design, the design can receive 360 degrees of light, making the fabric dry evenly compared to normal drying. According to the experiments, the results showed the proposed system can achieve the design outcome.

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