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Outdoor Solar Powered Smart Cloth Hanger: Retracting Clothes Upon Sensing Rain

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Abstract : Due to average normal working hours of from 8 am to 5.30 pm daily, clothes will be left at open spaces to self-dry before 7.00 am to near 7.00 pm. These clothes are vulnerable to rain within this time. Upon sensing a water drop, a sensor will switch on a motor that rotating pulleys. These pulleys will pull the clothes to a required safe location. Solar power will provide the required electricity to the motor. In the analysis, depending the amount of clothes placed on the ropes, it takes about 6 to 9 seconds to pull the clothes. The product is useful since it does not require human intervention to make sure the clothes does not hit by rain.

Keywords: Cloth Hanger, Raindrop Sensor, Solar, Pulleys, Motor

1. Introduction

On average, the daylength in Malaysia is from 7.00 a,m. to 7.00 p.m. [1] while the normal working hours is from 8.00 a.m. to 5.30 p.m. Taking the account of time spent in commuting to work, a normal person in Malaysia will left his or her house before 7.00 a.m. and reach back home near or after 7.00 pm. This situation creates a condition where clothes are be left to dry at open space [2] before 7.00 a.m. to after 7.00 p.m. These unattended clothes are vulnerable to rain. Data from Malaysian Meteorological Department (MET) shows in **Figure 1** that peninsular Malaysia received about 1000 to 4000 mm rain while Sabah and Sarawak received about 2000 mm to over 5000 mm rain monthly in average. During the northeast monsoon season, the exposed areas like the east coast of Peninsular Malaysia, Western Sarawak and the northeast coast of Sabah experience heavy rain spells [3]. The seasonal wind flow patterns and local topographic features gave the high patterns of precipitation in Malaysia [4].

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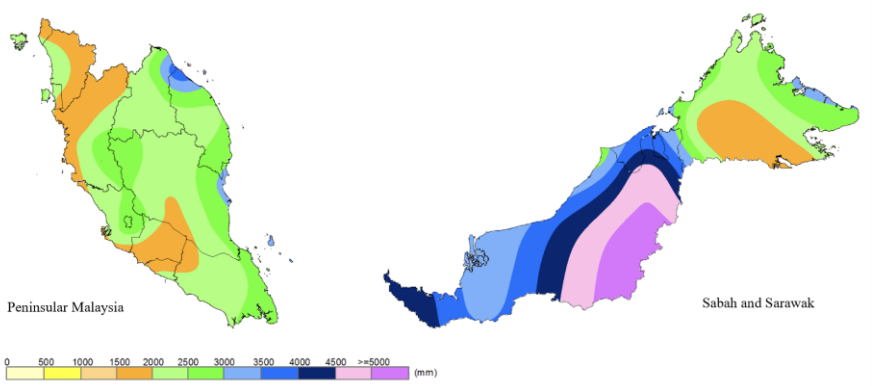
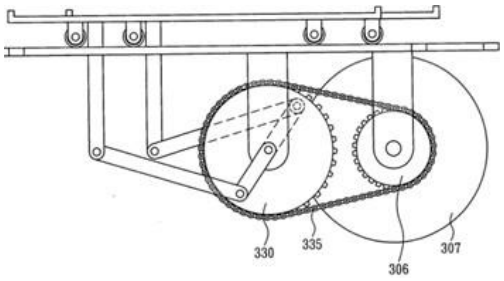
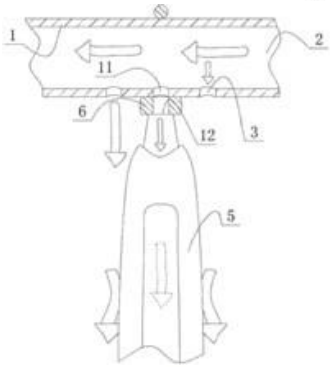


Figure 1: Mean monthly rainfall (Annual) [3]

To avoid clothes from rain while drying the clothes in open spaces, the product demonstrates the usage combination of a raindrop sensor, a solar panel and a DC motor. When a raindrop sensor detects water [5], it will send a signal to activate the DC Motor and pull clothes that was placed on a stainless steel into a protected location. Since the clothes are dried in an open space, a solar panel is used to provide the electricity required to the DC motor.

Table 1: Component Review and Listed in Project

Type	Mechanism	Description
Motor		The primary part of this product is connected to the motor, which rotates the bevel gear attached to it and moves the hanger string in accordance with the rotation of the motor that has been set.
Hanger String		This hanger string is moved to ensure that all clothing may reach the shelter, the direction of the string's movement will only travel in one direction. The clothes that have already arrived there will be stopped on the stopper, preventing them from moving along the string as it rotates another full turn.
Cloth rack		This clothing rack is set up in a parallel configuration that forms a circle, allowing the string to continue to revolve and the hanger to transport the hanging clothing to a shelter that was created especially to protect the clothing from the elements.

The mechanisms of the product are shown in **Table 1**. First is the motor. The primary part of the mechanism is connected to a DC motor. This DC motor rotates the bevel gear attached to it and moves the hanger string in accordance with the rotation of the motor that has been set. Next is the hanger. The hanger string is moved to ensure that all clothing may reach the shelter, the direction of the string's movement will only travel in one direction. The clothes that have already reached there will be stopped on the stopper, preventing them from moving along the string as it rotates another full turn. After that is the cloth rack. This clothing rack is set up in a parallel configuration that forms a circle, allowing the string to continue to revolve and the hanger to transport the hanging clothing to a shelter that was created especially to protect the clothing from the elements.

2. Methodology

2.1 Product Fabrication

The main component of the product is a stainless-steel rod. Using a steel cutter, Ossman BCO1452 355MM Cut-Off Machine, the stainless-steel rods were carefully cut to the required dimension. Prior to the cutting, precise measure measurement was done and these steps were repeated until all the required rods dimension according to the design is acquired.

Since the cutting creates sharp edges, it needs to be grinded to provide smooth edges for safety and to ease assembly of the rods. The grinding process uses BOSCH GWS 060 4" Angle Grinder. After the edges are smooth, the rods were connected to shape the foundation of the product. In order to connect the rods into the required shape, each rod is tacked one by one, segment by segment and part by part. After the tacking process, the joint of the rods was welded to increase the stability of the product.

After the welding process, each welding material excess at the joint were properly grinded to provide even welding quality. After the quality of the welding is satisfactory, rollers were fastened on top of the product and ropes [6] were then tied on the rollers. One of the rollers were welded to the motor as that rotator of the product. When the DC motor is switched on, this roller pulls the ropes holding the clothes into required location.

2.2 Testing Operation

Clothes were hanged on the ropes to justify whether ropes being pulled down or not. In addition, it is to ensure that the product is able to withstand the weight of the clothes. The weight of the clothes is chosen to be 200g as the nominal weight of a T-shirt [7]. As the welding were properly done, the product is able to withstand and hold its shape. The next testing was the operation of the pulling of the clothes. The testing of the operation are be discussed in Chapter 4.

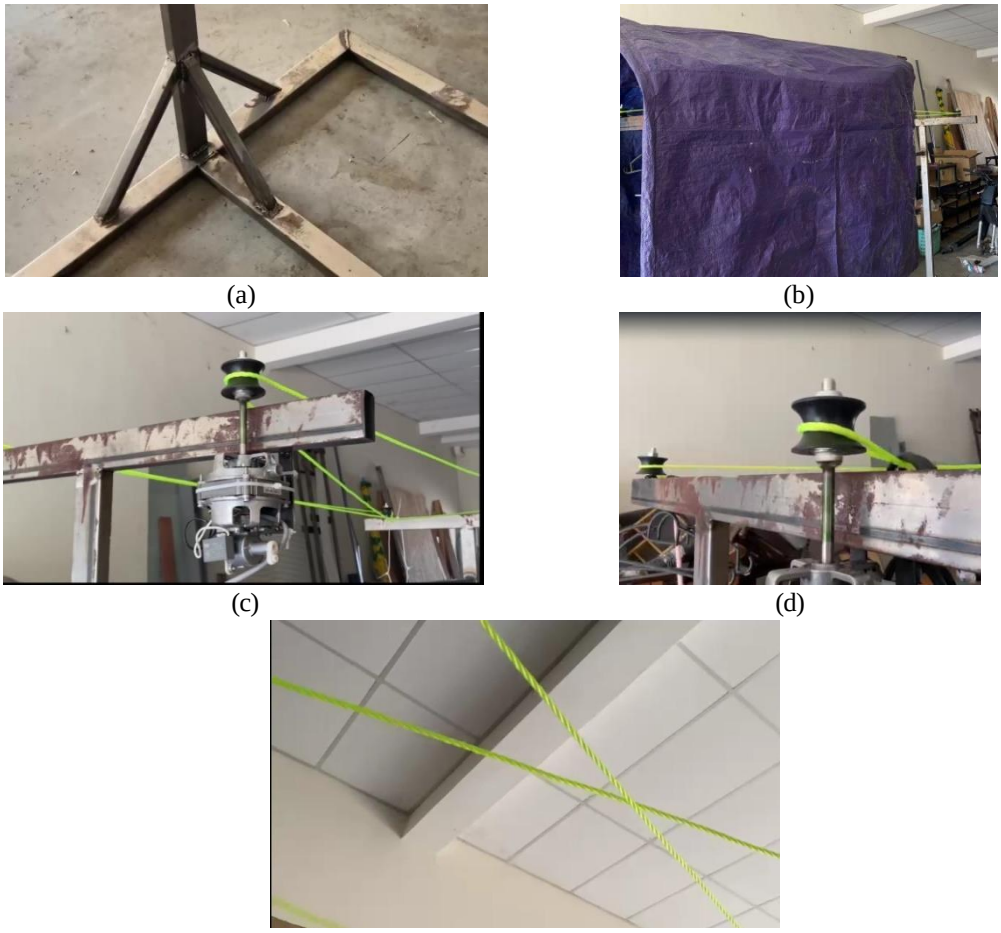
3. Results and Discussion

The scope of the discussion is the functionality of the DC motor to pull the hanging clothes on the ropes to the required location. AC power source will be used instead of Solar Power, and the use of raindrop sensor will be bypassed. Both Solar Power and raindrop sensor will be discussed as theory.

3.1 Structure of Solar Powered Smart Cloth Hanger

The structure of Smart Cloth Hangers is discussed as follows. The foundation of base of product is shown in **Figure 2(a)**. It consists of hollow bars material size of 2 times 1 inch. The bar is cut at different length based on required dimension. **Figure 2(b)** shows the shelter part of the product. The function f the shelter part of the product is to protect the clothes from the outside weather which is mainly rain. The shelter part is made from canvas because it is durable and it has a long lifespan. **Figure 2(c)** shows the motor that is main component for the mechanism to function. **Figure 2(d)** shows the wire guide roller that are used to put the rope in motion to move the hanged clothes to the shelter. There are 4 different wire guide rollers that are used in the product to make sure the movement of the rope is smooth

so that the clothes will not fall down while moving. **Figure 2€** shows the rope that is used to hang the clothes. The material of the rope is braided nylon rope. It is easily obtained and also durable to the outdoor weather conditions.



(a) (b) (c) (d) (e)

Figure 2: Solar Powered Smart Hanger, (a) Cloth hanger base (b) Shelter of the cloth hanger (c) DC motor (d) Pulley for the movement of the rope (e) Braided nylon rope in x position

3.2 Mechanism of Solar Powered Smart Cloth Hanger

This project of Solar Powered Smart Cloth hanger uses a solar panel to supply electricity which is then connected to a DC motor which allows the system to operate. As to detect water, a raindrop sensor was used to detect the small particle of water. Then when the raindrop was detected, a reverse logic gate to then allow the electricity to go through then powered up the DC motor. The DC motor will rotate and allow the wire guide roller to rotate the nylon rope which was attached to the wire guide roller. Then since the rope is already rotating, the cloth that was hanged on the nylon rope will slide in into the shelter then will be stopped at the wire guide roller.

3.3 Time taken to move clothes into the shelter

Table 2: Time taken for the clothes to move into the shelter

Number of hanged clothes	Total weight (kg)	Time for the clothes to be pulled into the shelter (s)
3	0.6	6
6	1.2	9

Table 2 shows the observation number of clothes placed on the rope and the time taken for the clothes to move into the shelter. For a 3 clothes placed on the rope, it takes 6 seconds for the clothes to be moved to the shelter while for 6 clothes, it takes 9 seconds to move the clothes to the shelter.

4. Conclusion

In conclusion, a product that can retract clothes from open spaces and moves them to a required location so that it will not hit by rain is required. The Solar Powered Smart Cloth Hanger is able to pull the clothes to the required location by using the mechanism of motor, pulley and rope. However, the product is not yet fully fabricated in sense that the solar power is and raindrop sensor is not yet installed to the product. Upon installing the solar power and the raindrop sensor, This the product can be useful for people that are too busy with their work that they almost do not have any time to give attention to their hanged clothes when it is left to dry in the sunlight. This product can help pull the clothes that are hanging to the shelter part so that the clothes are protected from the rain.

Acknowledgement

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