SMK PUTERI TITIWANGSA,

JALAN TEMERLOH, KUALA LUMPUR

INTELLIGENT CLOTHESLINE

IN SOLAR HYBRID POWER HOME

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1. Introduction

We, the students of SMK Puteri Titiwangsa will bring forward one of thousands of benefits of solar energy into our life. In general, solar energy technically can be converted to electrical energy and at the same time can be stored if we need to. Electrical energy from solar also always can support normal electrical energy supplied by the authority at any time we deserved. It was proven that the solar energy become a perfect electricity solution for the thousands of residences at the remote area in Malaysia. Solar energy is a free energy, highly efficient, can stand alone or completely independent and can be customized to suit our need and to suit various specific geographical regions in our country and also around the world. Solar energy can be specifically design for automatic operation from dusk to dawn or as per required operating with sufficient design autonomy for non sunny day.

Our objective in this assignment is to explore and discover on the importance of solar energy and how it can be benefit in our daily life. To realize this project, we had conducted researches and enquired information from multiple reliable resources such as from the internet, refers to an Electrical Professional Engineer and books regarding the production of our Intelligent clothesline and also the scientific theory of solar energy.

2. Innovative design

In designing the intelligent clothesline, various aspects were taken into considerations. Such as; the sensitivity of the solar panel, size of the wires, the type of solar panel, function of each component and how one component affects the other, components selection, layout of the project and also the uniqueness of its design.

3. Cost

More than 50% of the prototype consisted of used materials that were modified by us. There were only a small number of components that had to be purchased, so a lot of money was saved.

4. The photocell

The main theory used is that the photocell will control the circuit in both situations either under sunny or cloudy or severe weather condition that will potentially down pour the rain. The photocell has a special criteria where it’s internal resistance will

varies along with natural brightness from the sun. During sunny hours the resistance of a photocell can drop to as low as 300 Ohms (low resistance) if it is expose directly to sunlight. If the sun light heavily blocked by the cloud, the internal resistance of a photocell can easily increase to greater than 1 MegaOhms (high resistance).

In our circuit, the photocell will allow higher current to flow from solar panel through the relay coil when the photocell is in low resistance. The relay will "pick-up" when there is sufficient current flows through the coil. The pick-up relay will put the relay in "front contact" position. At this position, it will break all the supply from solar panel as well as from back-up battery to the motor.

In the absence of sunlight, electricity is not able to pass through the relay coil due to high resistance. It causing the relay to drop so the circuit is not disrupted allowing the motor and pulley to function. This explains why the pulley moves in the absence of sunlight and remains stationery in the presence of sunlight.

5. The solar panel

Another theory applied in this project is the solar panel's role as a source of energy in the presence of sunlight. It converts the solar power collected into electricity and charges the battery through the solar control unit. The battery then provides the energy needed to move the motor. So the energy source in this project is replenishable.

6. Objectives

6.1 Aim

Design an intelligent clothesline that is able to function by using the photocell and solar panel. The clothesline should be able to reel in clothes into a shaded area before it starts to rain so that the clothes will not be drenched.

6.2 Main objectives

i) To learn one of the many advantages of solar energy usage.
Solar energy is a natural resource that has just started to be explored. So far it has helped us in many ways. The studies of solar energy should be further continued as we have no idea of its limits in our world of science.

ii) To develop the usage of solar energy in our R&D.
In our ever developing technology nowadays, solar energy should be widely used and developed. If this is implored, our R&D will be able to expand wider than ever.

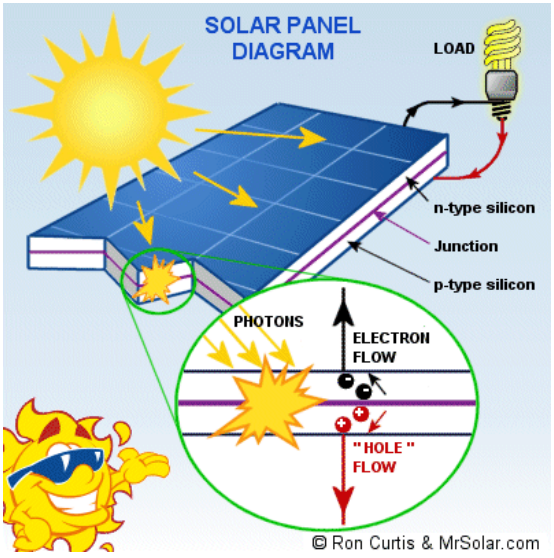
iii) To find out the extent of solar energy usage.
Even now, solar energy has helped out a lot and we have not yet found its limits. Further research must be done in finding out the other uses of solar energy, because we need to know to what extent it can help us and forward us in terms of technology.

iv. As an alternative in overcoming the crisis of energy shortage nowadays.
As we all know, a lot of our energy sources are coming to an end and we need to find a replacement fast. Right now, solar energy is being exploited to act as an alternative. For all we know, years later, solar energy might even be the leading energy source in our world.

v. To develop skills concerning the creativity and innovation of students.
By having these kind of projects, we are also able to raise the creativity and innovation among students. This is important because in the future, students will be the ones to continue our R&D.

vi. To raise awareness among the public concerning the usage and management of energy in a more responsible and intelligent way.
Nowadays, many people perform energy usage in an excessive manner. Many people recklessly waste energy without thinking of the negative effects it will bring. Hopefully by introducing students into the world of science, at least they will be more considerate when using energy.

7. Scientific Theory Of A Solar Panel



Solar panels collect solar radiation from the sun and actively convert that energy into electricity. A solar panel consists of solar cells. Solar cells consist of thin wafers of silicon. In making the wafers, the silicon is heated to extremely high temperatures. Chemicals such as boron and phosphorous are added. The solar cells from the solar panel collect solar radiation from the sun and convert them into electricity. In our case, the solar panel uses that to charge the rechargeable battery with the help of the solar control unit.

Moving on, when the photons of the sunlight hit a solar panel, the silicon's electrons are modified. These loose electrons are formed by electric fields in the photovoltaic panel. They then flow along the wires that have been placed within the cell and provide electricity for the load.

A higher quantity and quality of solar cells in a solar panel equals to a larger electrical output the solar panel can produce.

There are certain factors that affect the output of a solar panel;

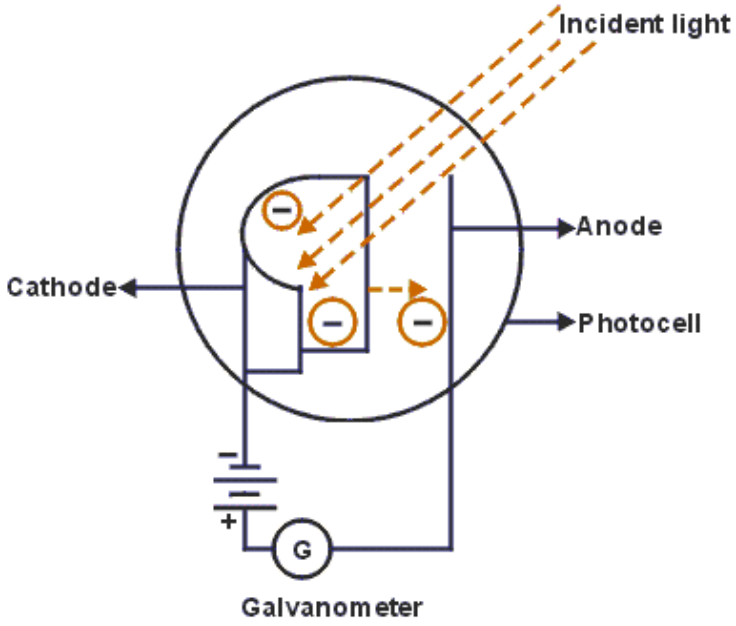
a) Weather conditions
b) Shade caused by obstructions to direct sunlight
c) The angle and position of the solar panel

For better control of a solar panel's electrical output, position it under direct sunlight and put it on a adjustable frame to get the maximum amount of direct sunlight exposure as possible.

8. Scientific Theory Of A Photocell

A photocell also known as a photoelectric cell, is a device whose electrical characteristics such as its current, voltage or resistance vary when light is incident upon it. It consists of a cathode and an anode in an evacuated glass tube connected to appropriate terminals of the battery as shown in the figure.

The material of the cathode is selected to suit to the frequency range of the incident radiation over which the cell is operated. When light of frequency greater than threshold frequency of the cathode falls on the cathode plate, photoelectrons are emitted.



These are attracted towards the anode and due to this flow of charges, current flows in the circuit. The number of electrons emitted depends upon the intensity of light. When intensity of light is increased, the value of current also increases. If light is switched off, the current flowing in the circuit also stops. This explains why its current, voltage and resistance vary depending on its exposure to sunlight.

9. INNOVATION

Throughout the whole project development and progress, we were guided by a Professional Engineer (Electrical) who well verse about solar energy. We also gathered the information from books and reliable internet sources. All these knowledge we implied into creating our own intelligent clothesline.

The followings are among of the innovations that we have made:

i. The selection of the type of solar panel

The solar panel we used is able to generate enough electricity to charge the battery and operate the load. It generates not too small and not too much electricity.

ii. The modification of the photocell

The photocell we used was modified to suit its role in sensing enough sunlight to aquire its suitable resistances for the flow of electric current in order to activate the relay. We cut the container of the photocell to increase its sensitivity.

iii. The materials used to make this project

Most of our materials consist of re-used materials.

iv. The design of the intelligent clothesline

We designed the layout of the clothesline to suit the components functions. For example, the solar panel and photo cell are placed high on a pole under direct sunlight while the rest such as the motor and battery are placed on a trolley under the shade. This is so that when the clothes are reeled in by the pulley, they are placed under the shade and are safe from getting drenched by the rain.

v. The function of the intelligent clothes line

The intelligent clothesline is supposed to activate when it is about to rain and reel in the clothes into a shaded area so that they will not get wet when the rain starts.

vi. The type of components used and how they work together to ensure the intelligent clothesline functions properly.

For example, the photocell is exposed to the presence or absence of sunlight. That determines whether or not electric current flows to the relay to energize the electromagnet that affects the relay contacts. Then if the circuit is complete, electric current flows from the battery (which is charged by the solar panel with the help of a solar controller) to provide power to rotate the motor which activate the pulley, reeling the clothes in. From this we can see that there is a flow where each component has its own function in order for the prototype to work.

10. Construction Materials

10.1 Purchased materials.

List of material purchased from local electronic shops.

i.	Wire	vii.	12V d.c maintenance free battery
ii.	Switches	viii.	Photocell (photodiode)
iii.	Solar Control Unit (Charger Controller)	ix.	Circuit board
iv.	Solar Panel (12V)	x.	12V d.c relay
v.	LED	xi.	Paint
vi.	Silicon		

10.2 Reused construction materials

List of refurbished items used in this project.

i.	Auto gate motor	v.	Wood (bed frame)
ii.	Car pulley – from a car belting system	vi.	Pole (used microphone stand)
iii.	Lab's trolley (school lab)	vii.	Used leather treadle belt (swing machine)
iv.	Trolley tire rim (school lab)	viii.	Used plant name plate with riveted stand (school garden)

10.3 List of Tools

i.	Sand paper	vi.	Soldering iron
ii.	Paint brush	vii.	Cutter and plier
iii.	Test pen	viii.	Electric drill
iv.	Precision wire stripper	ix.	Multiple sizes screw driver
v.	Digital multimeter		

11. Procedure in building the prototype

11.1 The used items are modified to suit their parts in the 'Intelligent Clothesline', such as the Auto Gate motor, Belt tensioner, Lab trolley, Trolley Tire Rim, bed frame, microphone stands, leather treadle belt and plant name plate.

11.2 The Auto Gate motor's base, the belt tensioner, the lab trolley, plant name plate and microphone stands are scrubbed smooth with sandpaper and then painted to prevent rusting.

11.3 The trolley tire is stripped bare to its rim and then painted to prevent rusting.

11.4 The bed frame is measured and chopped into uniform sizes. The wood pieces are scrubbed with sandpaper and painted.

11.5 The belt tensioner is attached to the Auto gate motor using silicone. The modified wood from the bed frame is nailed onto four corners of the base of the motor to act as a stand.

11.6 Next, the relay, the switches and the wires are connected to the circuit board. The wires connect the solar panel, the solar controller, the battery, the auto gate motor, the photo cell, the LED lamp, the relay and the switches passing through the circuit board. The circuit board is placed onto the base of the Auto gate motor.

11.7 Now, all the components are placed together at their righteous positions.

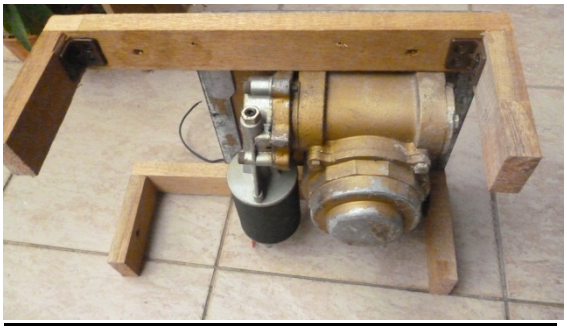
11.8 The base of the auto gate motor consisting of the motor, belt tensioner and circuit board is placed on the lab trolley. The battery and solar controller is placed next to it on the trolley. The trolley is placed under a shaded area. The plant name plate is placed onto the microphone stand and is placed under direct sunlight away from the trolley. The photocell and solar panel is placed onto the plant name plate. The LEDs however, are stuck to the sides of the motor's base.

11.9 Next, the pulley is put together. The tire rim is looped through the microphone stand and is placed a few feet away from the lab trolley. The tire rim is placed at the same level as the belt tensioner on the lab trolley. Then, the leather treadle belt is looped through both the tire rim and the belt tensioner forming a pulley which also acts as a clothesline.

11.10 The setup is completed and trials are done to test the prototype's workability.

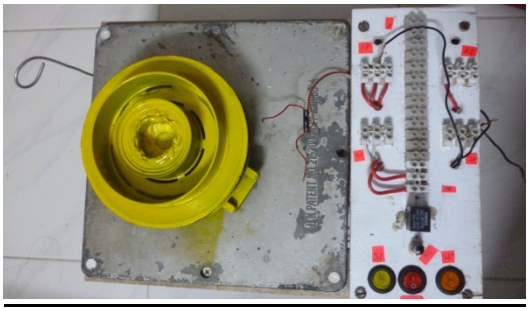
12. Building the prototype

Belt tensioner from the car belting system



Bed frame is chopped and stuck to four corners of the motor's base.

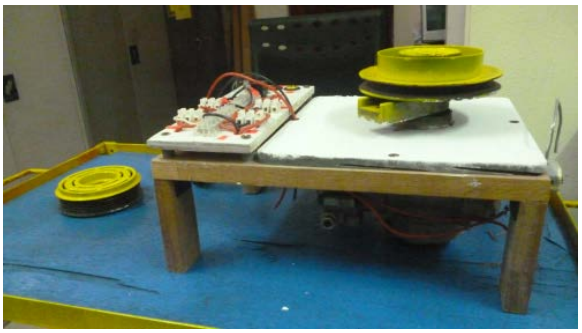
Silicone is used to glue the belt tensioner to the motor



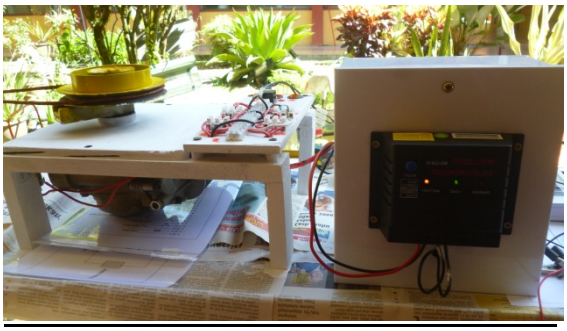
The ciruit board is stuck onto the base and the belt tensioner is painted.

Auto gate motor

The battery is place in a box and the solar controller is attached outside the box.



The base of the motor is painted white and they are placed on the trolley under a shaded area.



It is placed on the trolley next to the motor and circuit board.

The tire rim from the trolley is stuck onto the microphone stand

The microphone stand is placed away from the trolley and a leather treadle belt is looped through the car belt tensioner and tire rim making a clothesline.

The solar panel and photocell are placed on top of the plant name plate which is stuck to the other microphone stand.

It is placed under direct sunlight from the trolley and the prototype is completed. Trials are then run to check its workability.

13. Environmental friendly aspects of our project

13.1 50% of our materials are reused materials.

13.2 Reusing the used items:

i. **Auto gate motor**.

Harvested from an electrical gate and is used as a motor for the 'Intelligent Clothesline' to move the pulley. The motor's base is smoothed with sandpaper and then painted to prevent rusting.

ii. **Disposed Belt tensioner**.

Scavenged from an unused car belting system. It is used as a rotating shaft for the pulley in our 'Intelligent Clothesline'. Firstly, the belt tensioner is painted to prevent rusting. It is then joined together to the Auto Gate motor using silicone.

iii. **Lab Trolley**.

The unused lab trolley is acquired from the school lab and is repainted to prevent rusting and also for decoration purposes. It is then used as a base for the 'Intelligent Clothesline'. The connected belt tensioner and auto gate motor is placed on top of it along with the other components such as the circuit board, the solar controller and the battery. The trolley is placed on a shaded area.

iv. **Trolley Tire rim**.

One of the tires from the trolley is taken to build the pulley. The tire is stripped bare so that only the rim is left. The rim is then used as a rotating shaft for the pulley.

v. **Wood**.

The wood pieces are scavenged from an unwanted bed. The wood from the bed frame is measured and chopped up into uniform sizes and used as a stand for the motor, belt tensioner and circuit board.

vi. **Pole**.

The poles are actually old microphone stands. The old layer of paint is scraped of using sandpaper, then it is repainted to prevent rusting. The trolley tire rim is attached to the top of one pole, so that pole acts as part of the 'intelligent Clothesline'. Another pole is attached to the plant name plate and functions as a stand for the solar panel and photocell.

vii. **Leather treadle belt**.

The belt is harvested from a malfunctioned 'Singer' sewing machine. It is used as part of the pulley. It acts as the line for the "Intelligent Clothesline'.

viii. **Plant name plate**.

The name plate is scrubbed with sandpaper and repainted to prevent rusting. It is attached to an old microphone stand and placed under direct sunlight away from the trolley. It functions as a stand for the solar panel and photocell.

13.3 The impact of our project on the environment

i. Reduces pollution from usage of chemicals such as batteries. Instead we use a rechargeable battery that is charged by a solar panel.

ii. Saves unrenewable energy sources which are facing a shortage crisis by using a replenishable source; solar energy.

iii. Develops awareness in people on the crisis of energy shortage. This will teach them to have better management and more intelligent ways of energy usage.

iv. Develops creativity, designing and innovation skills among students. This will be good for our future technology as there will be a higher chance of eco-friendly ways to be discovered.

14. COST MANAGEMENT

MATERIALS	QUANTITY	COST (RM)
Wire	5 m	15.00
Switches	5 nos.	20.00
Solar controller	1 no.	140.00
Solar panel	1 no.	70.00
Battery	1 no.	50.00
Photocell	1 no.	15.00
Circuit board	1 no.	0.00
Relay	1 no.	5.00
LED	2 nos.	16.00
Paint	LS	20.00
Silicone	1 no.	7.50
Total cost	**-**	**353.50**

*Most materials are reused materials while all tools were provided by the school.

15. CONCLUSION

The design of our project consists of various aspects such as the sensitivity of the photocell, the wire connections, the type of solar panel, the workability of each component and how one component affects the other, the layout of the project and also the uniqueness of its design. Since more than 50% of the materials used are reused, we saved a lot of cost. The tools were unpaid for as they were provided by the school.

Scientifically the solar panel converts sunlight into electricity to charge the battery. Thus, one advantage is that the battery life is continuous and replenishable as long as the solar panel is working. The photocell however detects sunlight causing what is called the photoelectric effect and its resistance is varied depending on its exposure to sunlight. This determines the flow of electric current in the circuit.

Mainly, the 'Intelligent Clothesline' is a solar powered clothesline that is able to detect when it is about to rain and reel in the clothes into the safety of a shaded area before the rain starts to fall. This is how it works. In a normal condition, (which is when the photocell is not exposed to sunlight, the resistance is greater than 1 M Ohm) the switch in the relay is already connected and there is a continuous flow of current in the circuit. The circuit is not broken as electric current from the photocell is not able to flow to the relay and move its electromagnet due to a very high resistance. So when the battery is charged by the solar panel through the solar controller, it provides power to the motor which will operate the pulley and reel the clothes in. When the clothes reach the shade area, there is a cut-off switch which will break the circuit when pushed by the weight of the clothes. Thus, the movement will stop and the clothes will remain there. In another condition where the photocell is exposed to sunlight, the resistance is approximately 300 Ohm and current is able to flow to the relay to move the electromagnet. Thus, the switch will break and the circuit is disrupted. So, the battery cannot provide power to the motor and the pulley will remain stationery. This is why under hot sunlight, the clothes will remain under the sun to dry until the sun is gone.

This project is advantageous towards the environment and also for us. It is good for the environment because of its solar energy source. We on the other hand are able to go out and leave our clothes out in the open without the constant worrying that our clothes might get drenched or so on. For example, even if it starts to rain, we no longer need to rush home for our clothes will be in safe hands.