

Application of Solar and Wind Energy

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Abstract

The main objective of this research was to produce energy without using toxic products that are harmful to the environment. Therefore, the use of renewable energy such as solar and wind energy is the best option. The methods of constructing solar and wind energy systems are often considered to be more efficient and have great potentials than the non renewable energy system. Throughout the research, we designed and constructed a solar house, wind turbine and rotary parking projects using solar and wind energy. Solar panels transform the light received from the sun; specifically, they capture the electromagnetic radiation and convert it into electricity, the electricity harnessed is in the form of direct current (DC). In this research, we also used a wind turbine to rotate a series of gears which could turn a coil inside a generator which produces an electrical energy. This research was conducted a group of high school students. The research project culminated in a showcase of student work and explored improvements to increase their efficiency.

Keywords: solar panel, wind turbine, renewable, electromagnetic, generator and electrical energy.

1. Introduction

With the progression of technology, the demand of the production of energy has increased. The limited amount of nonrenewable energy such as fossil fuel that exists in the earth has restricted the progression of the technology. Another aspect of the energy is that the nonrenewable energy sources often produce greenhouse gases which contribute to the development of global warming and the rise of sea level. As a consequence, the instigations of new form of energy like solar energy and wind energy become extremely significant. If all the energy that is absorbed into the earth's atmosphere is added together it would be enough to serve the energy consumption of the United States 40,000 times. Solar Panels are made up of solar cells which assembled into modules and then arrays [1]. The solar panels convert sunlight directly into electricity (DC) through the processes of photovoltaic effect.

A solar cell is made up of semiconductor materials such as silicon and germanium that takes advantage of the photovoltaic effect, in which electricity is produced when the semiconductor's PN junction is irradiated

is created by the p-type (+) and n-type (-) of semiconductor

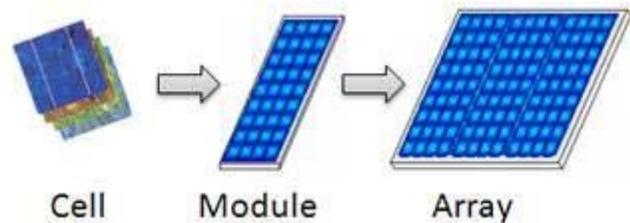


Fig.1 Solar Panel Configuration [1]

, usually silicon; p-type silicon has a high concentration of holes and n-type silicon has a high concentration of electron [2]. The movement of holes and electrons into n-type silicon and p-type silicon exposes ion cores with opposite charge and creates a region called depletion zone where electric field and voltage are produced as shown in Fig.2.

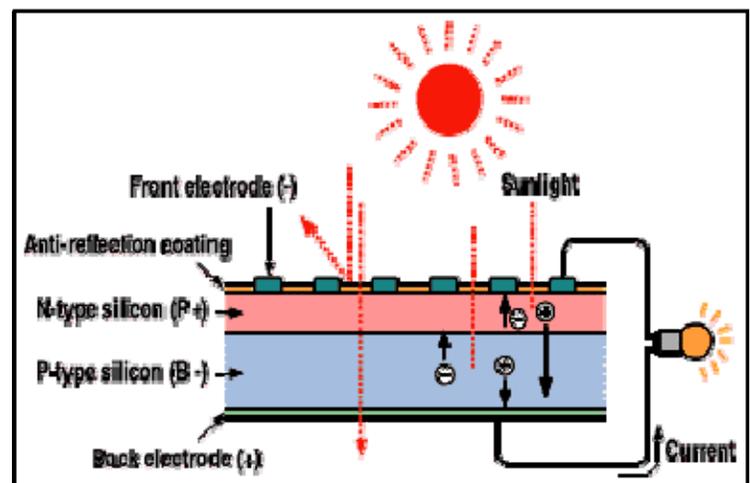


Fig.2 PN Junction [2]

The principle operation of wind energy was that the wind turbines convert the kinetic energy, wind energy into mechanical power. Firstly, wind is produced when the heat and atmospheres hit the earth surface unevenly; it creates a higher pressure in the air and lower pressure in the ground which leads to the movement of air from high pressure to

low pressure. This phenomena result in the production of wind is illustrated in Fig.3.

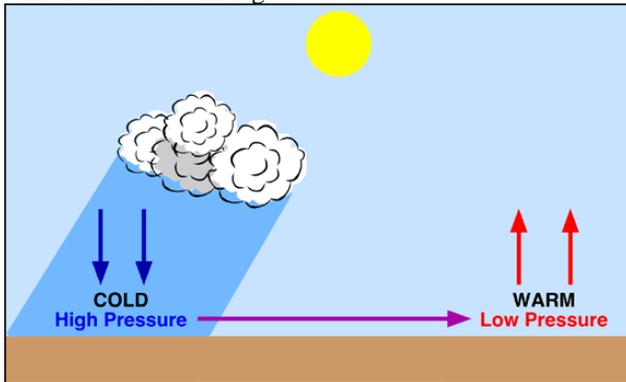


Fig. 3 Formation of Wind [3]

The utilization of wind energy is generally through wind turbines. The main purpose of wind turbines is to capture and convert this kinetic energy into electricity. Wind turns the turbine blades, which spin a shaft and connects to the generator and makes electricity. A local transformer is then used to step up the electrical voltage, so that the electricity can then be sent through transmission and distribution lines to homes, businesses and other users. Wind turbines generally produce electricity when winds blow at speeds of 13 kilometers an hour or greater [3]. The amount of wind energy produce is based on the speed of wind, greater the speed, larger the energy can be produced.

2. Tools

We use the following tools in this research.

- VEX Robotic metal and hardware pieces
- Screwdrivers
- Solar Panels
- Wind Turbine Kite

3. Experimental Procedure and Set up

3.1 Wind Turbine

We constructed vertical axis wind turbine, and used the materials and followed the instruction from the instrumental kits. We did not only do the construction of the wind turbines, but also tried to understand different parts of the wind turbine and their functions. The blades of the wind turbine were used to capture the wind which was use sticks instead. The generator of the wind turbine system converts the wind captured by the blades into electricity.

3.2 Solar House

We constructed the solar house is the VEX metal pieces. As we finished the framework of the solar house, we decided to use solar panels and wind turbines together as the energy source of the solar house, so it would obtain more power. After that, we came out of plans about how we design the interior and the placements of the solar panels and wind turbines. The solar panels must be located on the top of the solar house in order to absorb more lights and the winds turbines must be placed in the position where it could capture the largest wind.

3.3 Rotary Parking

We constructed and designed a rotary parking tower using VEX metal pieces, a VEX, and a VEX chain which is to attach the carriages for the cars to be carried up. We decided to split up into 2 groups to make the work faster, one group made the carriages and the other group made the tower.

The first group that was creating the carriages decided to go with a rectangular shape carriage that would sustain the car in one place so that it could be moved up and this influence the structure of the tower because the tower had sustain enough area in order to freely move the carriages without any obstruction in the motion of the device. The tower group made a base that could support the weight of the tower so we wouldn't tip over when it is in motion. Then they made four pillars to support the motor and the chain. They used two motors a shaft and gears to rotate the chain. The two motors reduced the stress on one motor and the belt would move more smoothly. The chain had to be made a certain size in order to fit the carriage when fully extended. Then we used zip ties to attach the carriages to the chain. Finally the micro modular controller was placed in a position as to not obstruct the motion of the belt. The controller made it possible to operate the motors via computer by using a program called Easy pro. The controller could be powered by solar panels.

4. Results and Discussion

4.1 Wind Turbine

Once the wind turbine set up is done, we connected a LED into the turbines. As we rotated the blades, the LED lit up, the processes of converting wind into electricity which was successful. During this construction, we encountered many issues. One of the difficulties we had encountered during the process of construction was when we tried to figure out how we were able to put in the

blades, or sticks since it was not stated in the instruction. We solved the issue by cutting the sticks into a total of four pieces using a saw.

4.2 Solar house

The very first thing each of our group member was asked to do was to research the theory and principle of operation behind the solar energy system before the construction of solar house. Throughout the research, we learned the basic knowledge of ohm's law, semiconductor, PN Junction and photovoltaic effects etc. Ohm's law indicates the relationship between current, voltage and resistance in a circuit; PN Junction plays a significant role in the operation of solar system; photovoltaic effects show how the solar energy can be converted directly into electricity (DC).

4.3 Rotary Parking

The construction of rotary parking went very smoothly with much obstacle. The only difficulty we encountered was before the carriages were built the belt size we had was our ideal belt size that we wanted on the rotary parking lot but after we had finished the carriages the belt size had to be changed because the arm of the carriages when fully extended were too long and so we had to compromise the size of the belt.

Overall, the final piece of rotary parking works fine, and due to the space limits, we were only able to put two carts on it.

4. Conclusions

Throughout this research, we experienced and constructed systems that were powered by renewable energy which were solar and wind energy. The study presented us with the benefits and future potentials of the solar and wind energy system. The possibility for solar energy to replace the non-renewable energy system such as fossil fuels and other energy resources that bring negative impact to our environment is near in the future. Once the solar energy system overcomes its limitations, it will be very beneficial to the progression of the society.

Other than the understanding of the wind turbine and solar energy system, the processes of construction have enhanced our ability to work in a group collaboratively alongside with brainstorming and hand-on work experience. This helped us to better understand the process of solar and wind energy through experience from our peers and mentors.

The only down side of the study was that due to the time limit, we only did the basic framework of the solar

systems and was not to go in debt to them. Also, we had to do our project indoor. Therefore, we did not get chance to see the actual voltage could be generated by our small wind turbine and solar system. For the rotary parking, we were supposed to power it by solar panels, but due to the limitation, we did it by computer and used battery. Moreover, we lacked equipments needed for the project. Though we had limitations, we were able to resolve the errors and used alternative resources that replaced the abundant sources.

Our basic goal was to look for alternative resources other than fossil fuels or coals. We found out throughout our experimental study that solar and wind energy can not replace the Earth resources by 100% due to its limitations, but they are eco-friendly and save a lot of energy. Solar and wind energy are great alternative useful resources. Our experimental studies are successful. We will be looking forward to research more about it and enrich environmental engineering.

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