Plotter Solar

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Summary--- **Electrical energy is the flow of electrons that pass through a conductor that helps us in everyday life, due to a large number of equipment and tools that are used daily to perform basic tasks in homes, factories and businesses, but at this time it has had an increasing cost and in the same way it has come to create pollution to the environment for this was introduced in our project the Idea of using renewable energy, specifically solar energy to generate electricity. The main objective sought with this project is a proposal to a conventional solar panel, adding movement, with which it is expected to have a greater capture of sunlight on the panel. In much less time, solar technology has evolved so much that it is competitive with conventional sources of electricity generation in some countries and in a few decades will become a substantial part of a sustainable energy system. To start the project, we started by collecting information about the different solar trackers that exist, the basic functioning of each of them and the elements that compose them. A search for information was carried out to support the project and thus make a comparison with the existing ones. Subsequently, a sketch of the possible project was made, then the project was physically built and electrical and mechanical tests were carried out to verify its correct operation. At the conclusion of the project, it was found that the implementation of the solar plotter on the solar panel increased the capture of solar rays by 15%, resulting in a viable proposal to implement.**

Keywords — Photoelectric cell, thermal radiation, angular position, electrical energy storage.

I. INTRODUCTION

In Mexico, the problem of electric power has led to the introduction of renewable energies, which have not yet been implemented at a considerable level, due to the high cost of mass production of solar panels. Therefore, although the use of non-renewable energies affects the economic and environmental aspect, they are still the most viable consumption option in our country.

In renewable energies, the use of solar panels for the self-production of electricity in homes has emerged as an option to current energy consumption. This, generating the need to improve a cooperative photovoltaic solar panel. Thesun's energy is renewable and clean, because it does not contain pollutants, so it was decided to make a solar tracer

to adapt it to a polycrystalline solar panel. By adapting it by means of an automated mechanism, it will allow a

movement in the X, Y axes to a solar panel, this to take advantage of even more the energy of the sun, improving the level of capture than in a conventional solar panel. According to the technical sheet of the polycrystalline solar panel, it reaches an efficiency of 38% - 46% of solar ray capture and electricity generation. But with the movement implemented in this project in its axes, it is expected to achieve an efficiency in the capture of ultraviolet rays of up to 50% or higher.

For the present project, the polycrystalline solar panel with solar tracer will be implemented in a house to determine its viability. However, this proposal could be a good option for those people and companies looking to start generating their own electricity cleanly and reliably and thus avoid the use of fossil fuelsand reduce environmental pollution, in addition to this a reduction in electricity costs is expected.

II. THEORETICAL FRAMEWORK

The solar energy that is generated by the Sun and travelsthrough radiation until it impacts the Earth. It is a renewable energy, which the human being takes advantage of by creating systems of conversion to electrical energy, efficiently for its use and exploitation through different technologies that have evolved over time.

The Sun provides the energy needed to sustain life in our solar system. Within an hour the earth receives enough solar energy to meet the demand needed for a year's production. In other words, this is about 5000 times the energy the Earth produces from all its energy sources. (State Meteorological Agency between 1940 and 2003.)

The Sun is composed of a mixture of gases with a predominance of hydrogen. Like the Sun converts hydrogen into helium in a thermonuclear fusion of atmosphere.

This type of energy is inexhaustible and very abundant and therefore in addition to being a renewable source, it is a clean energy and proposes an alternative to other types of non-renewable energy such as fossil energy or nuclear energy. (Arizona State University December 3, 1998)

It was Becquerel who first discovered that sunlight could be converted directly into electricity in 1839, when he observed thephotov oltaic effect. Then in 1876, Adams and Day found that selenium possessed photovoltaic properties. When Planck postulated the quantum nature of light in 1900, the door opened for other storytellers to build the theory. Then in 1930 Wilson proposed the quantum theory of solids, which provided a theoretical link between the photon and the properties of solids.

Ten years later, Mott and Schottky developed the solid-state diode theory, and in 1949 Bardeen, Brattain, and Shockley invented the bipolar transistor. This invention revolutionized the world of solid-state devices. The first solar cell was developed by Chapin, Fuller, Pearson, followed in 1954, which had an efficiency of 6%. Just four years later, the first solar cell was used on the American Vanguard I satellite.

1. Solar thermal energy

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Solar thermal energy takes advantage of the sun's energy to produce heat, which is subsequently used as an energy source both domestically and industrially, transforming it into mechanical energy and from it into electricity.

In the case of domestic energy, we would be talking about a low temperature solar thermal installation, with an installation formed by collectors or solar collectors installed on the roof or in a sunny part of the building. These capture solar radiation and convert it into heat, which is passed through a circuit of metal tubes and generates enough energy for the usual use in a home: hot water and heating.

But solar thermal energy can also be harnessed on a large scale. We are talking about the solar thermal plant or solar thermal power plant, large tracts of land with high temperature solar energy collectors. These facilities operate at temperatures above 500ºC: they transform thermal energy into electrical energy to supply the traditional electricity grid, being able to cover large areas of territory. In addition, current technologies allow heat to be stored in a very economical way, being able to transform it later into electricity as it is needed, thus regulating production.

2. Photovoltaic solar energy

Unlike solar thermal, photovoltaic solar energy consists of directly obtaining electricity from solar radiation. This is achieved thanks to the installation of photovoltaic solar panels, which have silicon cells that transform the light and heat of the sun into electricity. As in the case of solar thermal, these solar panels or panels can be installed both domestically in buildings and houses, and in large installations – known as photovoltaic plants.

Photovoltaic panels do not produce heat, so this energy cannot be stored; However, the surplus of this photovoltaic energy can be poured into the consumption grid, which is known as "photovoltaic surplus". Thanks to photovoltaic panels, energy self-consumption has been greatly democratized, that is, each household can produce its own electricity for its own consumption.

3. Solar panels.

The history of the solar panel has its origin in the photovoltaic effect, which was discovered in 1838 by the French physicist Alexandre Edmond Becquerel. After many studies and experiments, Becquerel discovered that thanks to sunlight, and with the help of two metal electrodes, he could generate electricity.

In 1958 solar energy began to be usedin space and with the passage of time and new discoveries, it was introduced into everyday life, becoming currently the most used renewable energy.

Solar panels are elements that are responsible for capturing the energy produced by the sun and converting it into electricity. This process is possible thanks to photovoltaic cells, which are responsible for capturing photons from the sun through various semiconductor materials, such as crystalline silicon or gallium arsenide, and transforming them into electricity.

Photovoltaic panels: are formed by numerous cells that convert solar thermal energy into electricity. These, called cells, are commonly known as photovoltaic cells. Solar panels are composed of silicon mixed with other materials that generate positive or negative charges, such as phosphorus that has five electrons and boron that has three.

The principle of operation is as follows: the light energy that comes from the sun produces agitation of the outer layers of the semiconductors that make up the cells. This energy can break the potential barrier of the P-N junction that forms the semiconductor, and thus exit it through an external circuit in the form of electric current.

The cells or cells are joined forming sets that give rise to the photovoltaic panels we know. This diverse combination allows to achieve desired voltages and powers and therefore, that the transformed energy can be used and consumed in everyday life.

In the history of the solar panel, elements have been incorporated that made its use much more useful and feasible. Reaching the models that are used and marketed today.

Solar panels are composed of two semiconductors that are interspersed and that give off a positive and a negative charge. Silicon is the material that is responsible for originating these charges and, by itself, is not capable of generating energy, but requires the photons emitted by the sun to achieve it.

It can be displayed in three different ways:

•Polycrystalline silicon

•Monocrystalline silicon

•Amorphous silicon

After the history of the solar panel and the discoveries and evolution that has been achieved, photovoltaic panels are currently manufactured mainly by silicon, from quartz stones, with 98% purity. Silicon, after oxygen, is the most abundant element on planet Earth.

To condition this mineral and be able to apply it in photovoltaic panels, rigorous washing and pickling must be carried out through chemical procedures. Once it is completely clean, the function of the mineral is carried out, with which monomolecular layers are formed around a crystallization germ once it solidifies. This process is usually done at temperatures above 1,500ºC.

In the case of producing a polycrystalline module, it melts directly producing small irregular layers, which together end up forming the different photovoltaic cells.

4. Solar trackers

Solar energy conversion is one of the most important topics of renewable energy research. There are several ways to make this transformation, one of them is to convert solar energy into thermal energy, using solar concentrators, they need to follow the path of the sun. There are several types of systems that meet this objective, passive systems (Cliffor, 2004) and active systems: which use motors to orient themselves. (Hession & Bonwick, 1984).

Finally, due to the type of displacement they must perform, there are two basic types of concentrators: Single-axis systems, the concentrator must follow the sun from sunrise (east) to sunset (west) (Cope et. al. 1981) and two-axis systems that combine two movements. (Al-Naima & Yaghobian N.A., 1990, 1991).

The production of energy in PV is carried out through solar collectors arranged either in fixed structures, providing the panels with a fixed orientation angle determined by the latitude of the place, or through solar trackers that allow a modification in the orientation of the collectors to maximize solar capture at all times.

Installations with monitoring have a higher energy production compared to conventional fixed solar collection systems (Sumathi et al., 2017). Other authors (Abdallah, 2004; Gay et al., 1982) estimate an increase between 30% and 40% of annual radiation collection from installations with trackers versus installations with fixed panels.

Solar monitoring represents a technological improvement in the production of photovoltaic energy in which work has been done for decades (Nsengiyumva et al., 2018). It tries to alleviate the negative effects of the high variability of the solar resource, both in time and space, reorienting the photovoltaic panels towards possible directions that increase the capture of solar irradiance.

For this, solar trackers are very useful in large photovoltaic plants connected to the grid, where it is necessary to increase the energy generated per square meter of collector surface, thus increasing their performance. Depending on the type of movement, solar trackers can be classified (Hafez et al., 2018; Nsengiyumva et al., 2018) in:

• Single-axis tracking systems in which a moving element adapts its position by rotating around a fixed 1 axis

• 2-axis tracking systems in which the plane of the collector rotates around 2 axes, achieving the orientation towards any direction of the celestial vaultAnother classification of the solar trackers is based on the systems of drive of the same and can be classified into 5 types based on the tracking technology (Hafez et al., 2018). Thus, we can distinguish:

• Active tracking, where it is the system itself that determines the solar path during each day through the use of sensors. (AL-Rousan et al., 2018) highlight those who seek the position of the sun by the variation of light received (sensor driver system).

• Passive tracking, in which the drive is not mechanical, but is caused by the thermal imbalance of a gas that translates into an angular movement to achieve a homogeneous degree of illumination in the solar panel (Awasthi et al., 2020).

• Semi-passive tracking (SPSTC), is a system designed for solar tracking using small mechanical stresses, as is the case study using a matrix system of mirrors located on a Fresnel lens (León et al., 2014).

III. METHODOLOGY

1. Study and design

For the study of ray tracing, a code was used that allowed an estimate of the direction of the rays coming from the sun, once they are reflected on the flat walls of the concentrator. In order to identify the opening angle with the highest efficiency in the radiation collection, three different values 90, 85 and 80% were tested. For each of these values, a ray tracing analysis was carried out modeling three different angles of incidence of radiation 0, 15 and 30° with respect to the normal to the plane of the concentrator. Once the most efficient opening angle was determined, the optimal distance between the apex of the concentrator and the absorber was estimated in order to minimize radiation losses in the system. To this end, three different aperture values were tested.

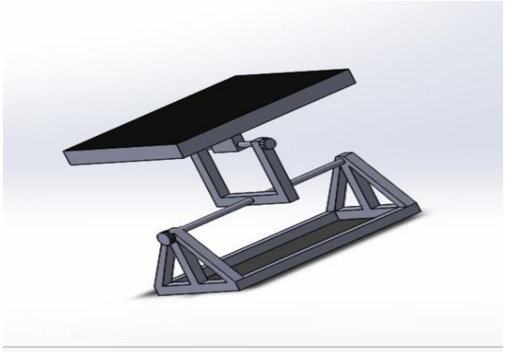

Fig.1. Design

2. Testing process

Once the design and construction of the solar tracer was completed, field tests were carried out, some considerations were taken:

1. Find a suitable location for such testing.
2. Have the necessary instruments and devices to perform these.

3. Location

To carry out the field tests it was necessary to locate a place, which in the first place had wide and clear clearings, where it would allow to capture the greatest amount of solar energy and secondly that would provide the necessary services that is water and electricity.

4. Materials

For the implementation of our proposal we decided to make a body and a movable base, in this was used for its constructionangle of 1/8' x 1 1/2' and square tubular profile of 1 1/2' x 1/2'. This material was cut and welded in terms of the measures corresponding to the panel, to give it its movement, for this two electric motors of 24v and 12v were used coupled to each of the axes of movement, using their respective systems of straight gears, concluded this phase was continued with the part of the programming, in which, an Arduino microcontroller was used, one to send the signals to control the LDR photoresistors and the 1k potentiometers which already calibrated help control the direction and rotation of our motors in the X and Y axes respectively con help of a 4 relay plate which give way to the current to each of the aforementioned motors.

Finally, for the generation of electricity and its capture by the panel, a 12v LTH battery was used with which the electronic circuit is powered, self-sustaining, and in turn electricity is generated for own consumption.

IV. Results

This project seeks to optimize the operation of a photovoltaic panel, this by means of a solar tracer where it was able to follow a beam of light.

At the end of the project we managed to obtain a two-axis tracer, capable of following the path of a beam of light, with which we fulfilled the objective of optimizing the operation of a solar panel, thus achieving an option of a clean and renewable energy source that we can take advantage of even more than a normal photovoltaic panel.

For the structure of the tracer, profile and angle of 1 1/2 inches of iron were used, of adequate dimensions and with screw assembly, to be able to support the panel that is formed of polycrystalline sackcloth cells, all this was used to give resistance to our follower.

The structure of the solar panel support was constructed of two +-shaped axes, rotating at 90 degrees in both directions.

Guy	Multicrystal
Model	LA361J48
OUTPUT	48.0 W
OPTIMAL VOLTAGE	16.7 V
OPTIMAL CURRENT	2.88 A
DIMENSION	985x445x36mm
No. SERIES	904219071
(DATE)	1990.4

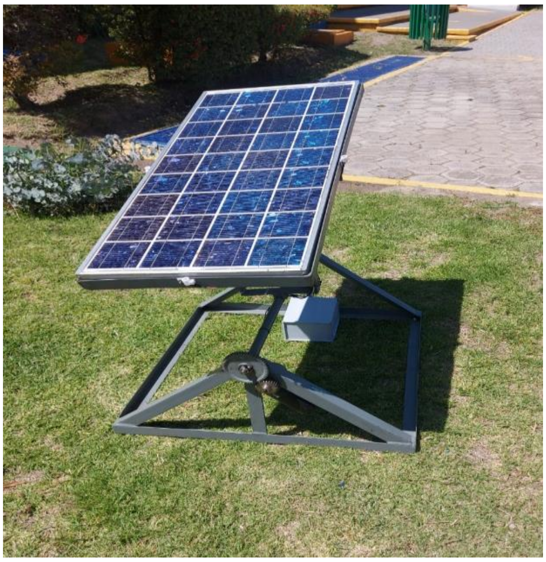

Fig.2. Solar tracer.

V. CONCLUSIONS

The evidence presented above shows that the implementation given to the conventional photovoltaic solar panel was very useful to test the hypothesis about the greater capture of sunlight and likewise it was also possible to observe greater efficiency competing with a conventional one, since the movement is very useful when generating electricity, The problem of having a more efficient solar panel without suffering changes in its constitution or materials or any process. of manufacture, it was solved, since at no time was it suggested to make a change, because this was more an adaptation of a movement equipment than anything else. The results obtained were a great success, although there were many setbacks when assembling the metal body and especially the programming of the electronic components, the adaptation of the battery and both axes of the motors had a high degree of complexity, but the movement without problem of both axes was achieved. Itis important to mention that all the tests of operation and checks of the project, have been very useful to focus more on the resolution of early errors in terms of failures or defects in the movements of the axes and the same programming, with all this already taken into account it was clearer what had to be done and how to do it so as not to cause a gravity failure. or having to make the change of One part since there was not a wide variety of spare parts, and the margin of error had to be minimal for the success of the project.

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