Better Utilisation of Solar Energy using PLC

[1]Ajay Bhosale, [2]Prashant Bodhe, [3]Vinay Chavan, [4]Mrs. Priyanka Patil
[1234]Dept. of Electronics and Telecommunication,
DYPIET Pimpri Pune

***Abstract*— Solar energy is very important means of expanding renewable energy resources. In this paper we have described the design and construction of a PLC based solar panel tracking system. Solar tracking allows more energy to be produce because the solar array is able to remain aligned to the sun. Aiming at low density of solar energy, intermittent of solar ray, changing light intensity and direction with time.**

The main aim is to calculate the trajectory of the sun by calculating the azimuth angle and the elevation angle. This is done by using trigonometric formulae. The input given to the PLC is the latitude and longitude and the time zone of the position where the solar panels are set. The PLC will then calculate the azimuth angle and the elevation angle, using which the PLC will generate pulse to move to stepper motor. The stepper motor is attached to a gear assembly which is further attached to the solar panels. Due to this system the energy of the sun will be fully utilized. Theoretically, the trajectory of the sun has the advantage that even in low lighting conditions, this system will still track the sun.

Hence, the utilization ratio has been improved due to the better capturing of the solar rays by the motion of the panel.

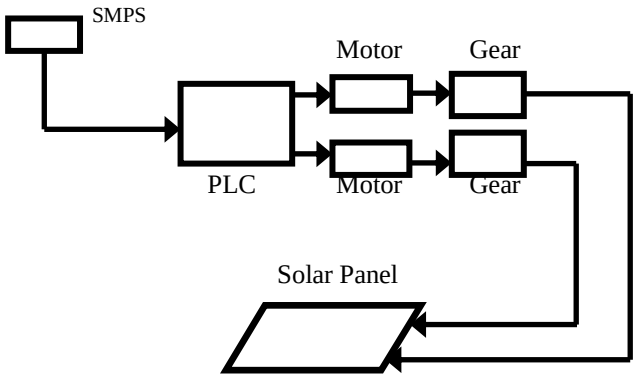
Keywords—Azimuth angle; elevation angle; latitude; longitude; SMPS; PLC; solar panal

I. INTRODUCTION

In [1] the sun is being tracked using a sensor continuously, the monitoring equipment of forest fire prevention usually needs all-weather supply of electric power. But most of solar power systems applied in forest fire prevention use fixed-mounted solar panels. This problem results in low efficiency of electricity generation. Thus the area of solar panels has to increase to meet electricity demand of the equipment. An all-weather automatic solar tracking method was proposed, which combined the photoelectric detection and the solar trajectory tracking modes. The method used a sunlight intensity sensor to estimate weather conditions firstly. Then it utilized a solar position sensor and a solar trajectory algorithm to determine the changes of solar position. Finally, different tracking models were taken to track the sun in sunny, cloudy and rainy days. Through simulation experiments, this method could effectively reduce the impact of weather change and ensure to track the sun stably and accurately all weather. Here the sun can be more efficiently tracked if we calculate the trajectory of the sun theoretically and further applications can be implemented. In [2], the paper states that a microcontroller based system to track the sun. Energy crisis is the most important issue in today's world. Conventional energy resources are not only limited but also the prime culprit for environmental pollution. Renewable energy resources are getting priorities in the whole world to lessen the dependency on conventional resources. Solar energy is rapidly gaining the focus as an important means of expanding renewable energy uses. Solar cells those convert sun's energy into electrical energy are costly and inefficient. Different mechanisms are applied to increase the efficiency of the solar cell to reduce the cost. Solar tracking system is the most appropriate technology to enhance the efficiency of the solar cells by tracking the sun. A microcontroller based design methodology of an automatic solar tracker is presented in this paper. Light dependent resistors are used as the sensors of the solar tracker. The designed tracker has precise control mechanism which will provide three ways of controlling system. A small prototype of solar tracking system is also constructed to implement the design methodology presented here. His system can be made more advanced by the use of PLC instead of the micro-controller, replace the sensors.

II. BASIC PRINCIPLE

A. *Block diagram*



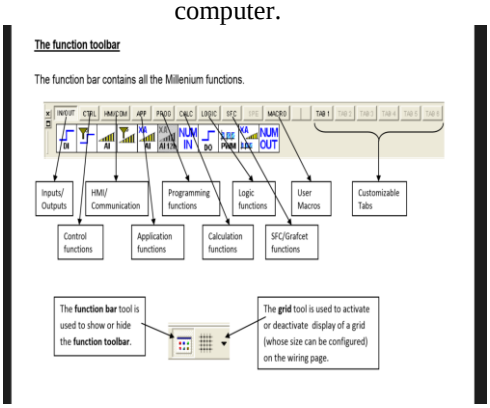
B. *Algorithm*

- Step 1: Start.
- Step 2: Enter the latitude, longitude and time zone of the panel.
- Step 3: Calculate azimuth and elevation angle using trigonometric formulae.
- Step 4: By the use of the angles calculate the movement required by the motor.
- Step 5: Generate the signals to give the motor in order to rotate it as required.

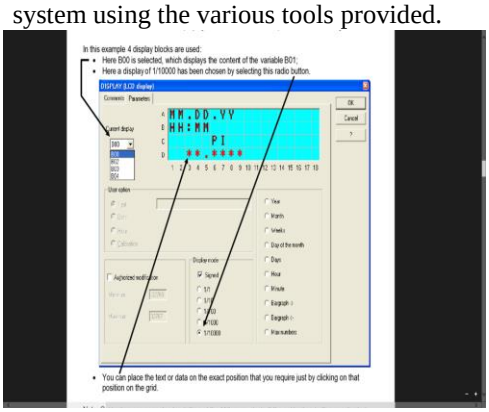
- Step 6: Movement of the motor as per required.
- Step 7: Check if panel is in the right position.
- Step 8: If not correctly place go to step 2.
- Step 9: Go to step 4

C. Procedure

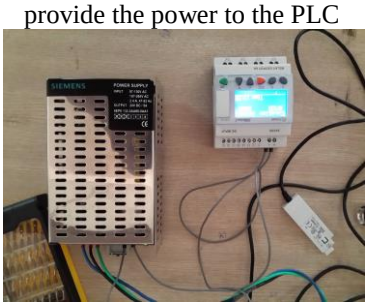
- Open "Millenium3" software on the computer.



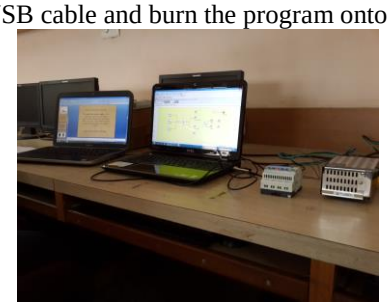
- Write the code for the solar tracking system using the various tools provided.



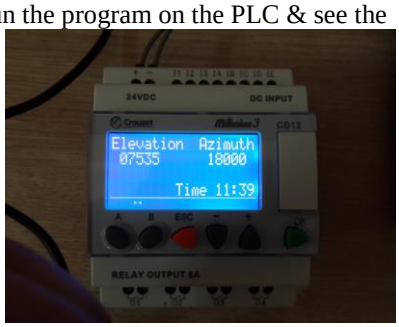
- Connect the PLC to the SMPS which will provide the power to the PLC



- Connect the PLC to the computer with USB cable and burn the program onto it



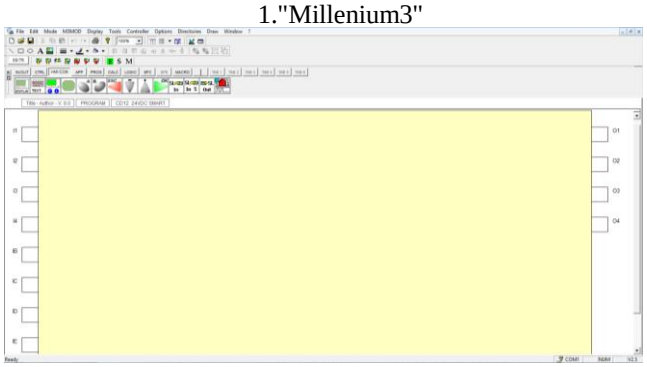
- Run the program on the PLC & see the o/p



III. RELATED WORK

A. Software Details

1."Millenium3"



The coding is done on ladder or functional block diagram.

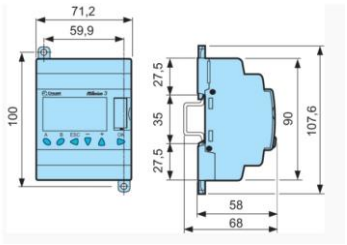
2. The location of the major cities is obtained from the table below which is used for coding

Town	Latitude	Longitude	Time difference	Time zone
Los Angeles	34°08	118°37	-8 hrs	-480 min
Washington	38°88	77°03	-4 hrs	-240 min
Brasilia	-15°75	47°95	-3 hrs	-180 min
Bamako	12°67	7°98	0 hrs	0 min
Paris	48°85	-2°33	+1 hr	+60 min
Cairo	30°00	-31°28	+2 hrs	+120 min
Moscow	55°75	-37°62	+3 hrs	+180 min
New Delhi	28°62	-77°22	+5 hrs 30	+330 min
Canberra	-35°30	-149°13	+10 hrs	+600 min

B. Hardware Details

- We use SMPS to step down the voltage from 240V AC to 24V DC

- We use the PLC



IV. ADVANTAGES

- Excellent reliability, Redundancy, Multi-Equipment control and fast communication can be easily achieved.
- PLCs are good at turning outputs on or off based on the state of inputs. (control)
- PLCs are good at bringing together and concentrating a lot of data and status that is uploaded into a computer in a compact form.
- PLCs are more rugged than computers and typically last five, seven, ten years without needing replacement.
- Comparatively very powerful and Easy to Use.
- Advanced cure control.
- Multi access using more than one programming or maintenance tools plus visualization stations.
- Cost advantage for simple applications, minimal downtime and large base of maintenance personnel familiar with ladder programming.

V. CONCLUSION

As stated in the papers published on this topic, the use of micro-controller and sensors prevails. Due to this the system cannot perform up to the mark when the weather is not suitable. That is when the weather is cloudy or in case of thunder storms. Even when there in an eclipse the system will fail. So in our system these parameters will not affect the output as no sensors are used. The trajectory of the sun is always constant. The movement is also always going even in case of clouds and eclipse. So the values calculated will not change with respect to the conditions around.

VI. FUTURE SCOPE

The goals of this project were purposely kept within what was believed to be attainable within the allotted timeline. As such, many improvements can be made upon this initial design. That being said, it is felt that this design represents a functioning miniature scale model which could be replicated to a much larger scale.

- It Can be used for energy storing and we could also convert this energy into another forms of energy. for example : - electrical energy into mechanical energy.
- The solar tracking system can be placed on home roofs , villages (where electricity is still a big issue).
- This system can be used in hospitals for the continuous backup power supply (because lack of electricity cannot be tolerated in hospitals).
- It works on the principle of ONE TIME INVESTMENT , so the solar tracking system is highly efficient and saves money plus the very precious non renewable energy resources .

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