

# Modeling and Designing of Solar Tracking System using Arduino

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## ABSTRACT

Solar energy is very important means of expanding renewable energy resources. In this paper is described the design and construction of a microcontroller based solar panel tracking system. Solar is a nonconventional source of energy, considering this we have developed solar panels so that we can fulfil our electricity need. But due to revolution of the earth, solar source i.e. sun does not face the panel continuously hence less electricity is produced. The energy panel should face the SUN till it is present in a day. The problem above can be solved by our system by automatic tracking the solar energy. This paper shows system architecture which consist of a LDR sensor senses max solar power which is being given to the ARDUINO which digitizes the LDR output. Controller then takes the decision according to then algorithm and tilts the panel towards the direction of the max energy given by LDR with the help of DC Motor. The Motor is used to rotate the LDR to sense the max solar power. A Solar Tracker is basically a device onto which solar panels are fitted which tracks the motion of the sun across the sky ensuring that the maximum amount of sunlight strikes the panels throughout the day. After finding the sunlight, the tracker will try to navigate through the path ensuring the best sunlight is detected. It is completely automatic and keeps the panel in front of sun until that is visible. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum.

**Keywords :** Microcontroller, Renewable, Algorithm, Monitor. Architecture.

## I. INTRODUCTION

In remote areas the sun is a cheap source of electricity because instead of hydraulic generators it uses solar cells to produce electricity. While the output of solar cells depends on the intensity of sunlight and the angle of incidence. It means to get maximum efficiency; the solar panels must remain in front of sun during the whole day. But due to rotation of earth those panels can't maintain their position always in front of sun. This problem results in decrease of their efficiency. Thus to get a constant output, an automated system is required which should be capable to constantly rotate the solar panel. The modelling and Designing of Solar Tracking System was made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of sun until that is visible. The unique feature of this system is that instead of take the earth as in its reference, it takes the sun as a guiding source. It is active sensors and arduino controlled operation constantly monitor the sunlight and rotate the panel

towards the direction where the intensity of sunlight is maximum. In case the sun gets invisible e.g. in cloudy weather, then without tracking the sun the Automatic Solar Tracker keeps rotating the solar panel in opposite direction to the rotation of earth. But its speed of rotation is same as that of earth's rotation. Due to this property when after some time e.g. half an hour when the sun again gets visible, the solar panel is exactly in front of sun.[1]

## II. LITERATURE REVIEW

Rosa A. Mastromauro and Marco Liserre[2] explained that Several MPPT techniques together with their implementation are reported in the literature. Researchers always feel confused while selecting an MPPT technique for a particular application. Unfortunately, only a few techniques were available in this field including Curve fitting, Fractional Short Circuit Current, Fractional Open Circuit Voltage, Look Up Table, One Cycle Control, Perturb and Observe,

Incremental Conductance and Feedback techniques earlier that includes discussions on MPPT techniques until 2007. But many new MPPT techniques such as Fuzzy logic, Artificial Neural Network, Adaptive Perturbation and Observation, Estimated perturb and perturb, Genetic Algorithm, Adaptive Neuro fuzzy and particle swarm optimization based MPPT, etc., have been reported since then illustrated in other papers.

K. K. Tse, M. T. Ho, H. S.-H. Chung, and S. Y. Hui [3] explained that hybrid systems using solar energy with technology based on genetic algorithms. Although exist various approaches based on intelligent techniques, the human knowledge has been interpreted just as information coming from sensors and electronics devices. This structure is simple and allows the initial setting of network parameters to be intuitively selected. Thus by following IF-THEN rules, similar to human sense, multivariate information could be included into the fuzzy inference system. But there exists human knowledge generated since many years ago in astronomical and physics research that should be a powerful tool-based-knowledge.

A. Mathew and A. I. Selvakumar [4] explained that however this problem is eliminated in Incremental Conductance method as the algorithm takes two samples of voltage and current to compute MPP. However, instead of more efficiency the complexity is very high compared to other methods hence the cost of execution increases. Since the maximum amount of solar energy, captured by the collector, is related to the accuracy for tracking sun's position, then a high-precision sun tracking controller should be considered. In previous years, several method have been proposed to improve tracking systems for sun radiations based on orientation and tilt motion control.

O. L-Lapeña, M. T. Penella, and M. Gasulla [5] explained that some of the most relevant and prominent control schemes, in solar applications, have been introduced which include: sun tracking systems using fuzzy control based on light-sensors, ambient temperature and electric load variations fuzzy algorithms to connect domestic apparatus on either the electrical grid or a photovoltaic panel.

### III. MOTIVATION

Solar trackers generate more electricity than their stationary counterparts due to an increased direct exposure to solar rays. There are many different kinds of solar tracker, such as single-axis and dual-axis trackers, which can help you find the perfect fit for your unique job site. Installation size, local weather, degree of latitude, and electrical requirements are all important considerations that can influence the type of solar tracker that's best for you. Solar trackers generate more electricity in roughly the same amount of space needed for fixed tilt systems, making them ideal optimizing land usage.

### IV. METHODOLOGY

The circuit of the solar tracker system is divided into three sections. There is the input stage that is composed of sensors and potentiometers, a program in embedded software in the Microcontroller and lastly the driving circuit that has the servo motor. The input stage has two LDRs that are so arranged to form a voltage divider circuit. A C program loaded into the Atmega328P forms the embedded software. There is a metallic frame that houses the components. The three stages are designed independently before being joined into one system. This approach, similar to stepwise refinement in modular programming, has been employed as it ensures an accurate and logical approach which is straight forward and easy to understand. This also ensures that if there are any errors, they are independently considered and corrected. Figure 1 shows the block diagram of Automatic Solar Tracker.

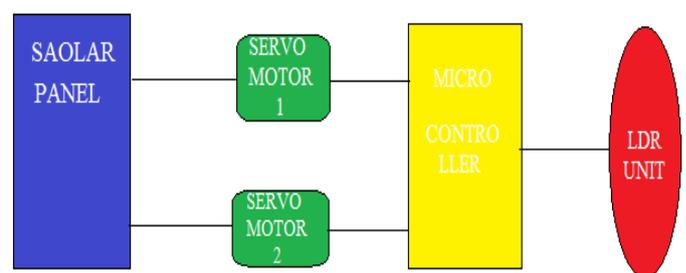


Figure 1. Block Diagram of Automatic Solar Tracker

#### A. FOR SOFTWARE (Keil u vision 4 SOFTWARE):

- Install the KeilSoftware in the PC in any of the drives.
- After installation, an icon will be created with the name “keil u vision 4”. Just drag this icon onto the desktop so that it becomes easy whenever you try to write programs in Keil.
- Double click on this icon to start the keil compiler.
- A page opens with different options in it showing the project workspace at the leftmost corner side, output window in the bottom and an ash colored space for the program to be written.
- Now to start using the keil, click on the option “project”.
- A small window opens showing the options like new project, import project, open project etc. Click on “New project”.
- A small window with the title bar “Create new project” opens. The window asks the user to give the project name with which it should be created and the destination location. The project can be created in any of the drives available. You can create a new folder and then a new file or can create directly a new file.
- After the file is saved in the given destination location, a window opens where a list of vendors will be displayed and you must select the device for the target you have created.
- The most widely used vendor is Atmel. So, click on Atmel and now the family of microcontrollers manufactured by Atmel opens. You can select any one of the microcontrollers according to the requirement.
- When you click on any one of the microcontrollers, the features of that microcontroller will be displayed on the right side of the page. The most appropriate microcontroller with which most of the projects can be implemented is the ATmega328P. Click on this microcontroller and have a look at its features. Now click on “OK” to select this microcontroller.
- A small window opens asking whether to copy the startup code into the file you have created just now. Just click on “No” to proceed further.
- Now you can see the TARGET and SOURCE GROUP created in the project workspace.
- Now click on “File” and in that “New”. A new page opens and you can start writing program in it.
- After the program is completed, save it with any name but with the .asm extension. Save the program in the file you have created earlier.
- You can notice that after you save the program, the predefined keywords will be highlighted in bold letters.
- Now add this file to the target by giving a right click on the source group. A list of options open and in that select “Add files to the source group”. Check for this file where you have saved and add it.
- Right click on the target and select the first option “Options for target”. A window opens with different options like device, target, output etc. First click on “target”.
- Since the set frequency of the microcontroller is 11.0592 MHz to interface with the PC, just enter this frequency value in the Xtal (MHz) text area and put a tick the Use on-chip ROM. This is because the program what we write here in the keil will later be dumped into the microcontroller and will be stored in the inbuilt ROM in the microcontroller.
- Now click the option “Output” and give any name to the hex file to be created in the “Name of executable” text area and put a tick to the “Create HEX file” option present in the same window. The hex file can be created in any of the drives. You can change the folder by clicking on “Select folder for Objects”.
- Now to check whether the program you have written is errorless or not, click on the icon exactly below the “Open file” icon which is nothing but Build Target icon. You can even use the shortcut key F7 to compile the program written.
- To check for the output, there are several windows like serial window, memory window, project window etc. Depending on the program you have written, select the appropriate window to see the output by entering debug mode.
- The icon with the letter “d” indicates the debug mode.
- Click on this icon and now click on the option “View” and select the appropriate window to check for the output.
- After this is done, click the icon “debug” again to come out of the debug mode.

The microcontroller program is the most important part of our project. It is written in c language.

## B. BENEFITS

- By use of this technique we can make the environment clean.
- High accuracy (due to programming in c language).
- It is reduces human efforts.
- It is reliable as it is automated.

## ACTUAL VIEW OF PROJECT



## V. CONCLUSION

The project “Modelling And Designing of Solar Tracking System Using Arduino” has been successfully designed and tested. It has been developed by integrating features of all the hardware components used and software also in which we have used C language. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly, using highly advanced microcontroller and with the help of growing technology the project has been successfully implemented. It has been concluded that by implementing these systems we can make our environment clean.

## VI. ACKNOWLEDGMENT

We are thankful to respected Er. Inderpreetkaur HOD (EEE); Er. Arwind Goswami (Assistant professor) and Er. Harpreet Kaur Channi (Assistant professor) for giving us this opportunity for making project based on software and hardware.

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