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Design and Implementation of MPPT Solar System Based On the ANN & ANFIS

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Abstract: *The project works with maximum power point tracking (MPPT) using the Perturb and Observe (P&O) algorithm. The P&O algorithm is implemented using the controller make up of logic components such as voltage follower, voltageinverter, differentiators, comparators, and X-OR gates. The solar energy harvested from solar panel is fed into the MPPT system to acquire maximum power output at the load. Typical solar panel works with low efficiency such < 15% thus, maximizing from the solar panel energy is a necessity to achieve optimum performance of solar energy. A simple MPPT system is built to maximizethe power of solar panel.*

Key Word: *Energy; Tracking; Solar Cells; Power; Temparature.*

I.INTRODUCTION

The development of renewable energy has been an increasingly critical topic in the 21st century with the growing problem of global warming and other environmental issues. With greater research, alternative renewable sources such as wind, water, geothermal and solar energy have become increasingly important for electric power generation. Although photovoltaic cells are certainly nothing new, their use has become more common, practical, and useful for people worldwide. The most important aspect of a solar cell is that it generates solar energy directly to electrical energy through the solar photovoltaic module, made up of silicon cells. Although each cell outputs are relatively low voltage, if many are connected in series, a solar photovoltaic module is formed. A photovoltaic module is used efficiently only when it operatesat its optimum operating point.

Unfortunately, the performance of any given solar cell depends on several variables. At any moment the operating point of a photovoltaic module depends on varying insolation levels, sun direction, irradiance, temperature, as well as the load of the system. The amount of power that can be extracted from a photovoltaic array also depends on the operating voltage of that array. As we will observe, a maximum power point (MPP) will be specified by its voltage-current (V-I) and voltage-power (V-P) characteristic curves. Solar cells have relatively low efficiency ratings. Thus, operating at the MPP is desired because it is at this point that the array will operate at the highest efficiency. With constantly changing atmospheric conditions and load variables, it is very difficult to utilize all of the solar energy available without a controlled system. Forthe best performance, it becomes necessary to force the system to operate at its optimum power point. The solution for such a problem is a Maximum Peak Power Tracking system (MPPT).

II.MATERIAL AND METHODS

ACADEMIC REVIEW: Firstly, research about the meaning of the Maximum Power Point Tracking (MPPT) device and its function with photovoltaic cell will be done. Via internet and other resources, circuit of the MPPT device will be learnedas well as method of how the MPPT device controls the power which will supply directly to the load. In addition, some useful equations will be reviewed as well so that the modeling can be done easily.

MODELLING: The modelling part is divided into three parts. The first part /s the photovoltaic cell (also known as solar cell). Photovoltaic has a method for generating power using solar cells to convert energy from the sun into the flows of electrons. Solar cells have a complex relationship between solar irradiation, temperature and total resistance that will produces non-linear output efficiency. Secondly, MPPT system is used to sample the output of the cells and apply the proper

resistance (load) to obtain maximum power for any given environmental conditions. MPPT system will be build accordingto the desired output and supply to the desired load.

SIMULATION: Circuit will be simulated using LT Spice Software to ensure whether the installation of the circuit can be running or not. The circuit will be tested using different sorts of input to get the desired output.

HARDWARE REALISATION: After the simulation is done, circuit will be constructed. The collected power from solar panel will and the maximum power that can archive will record to ensure it ready to be connected to the circuit. The final stage to complete this circuit is combined the circuit with the final structure.

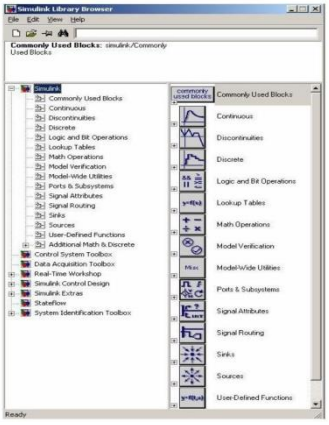
III.RESULT

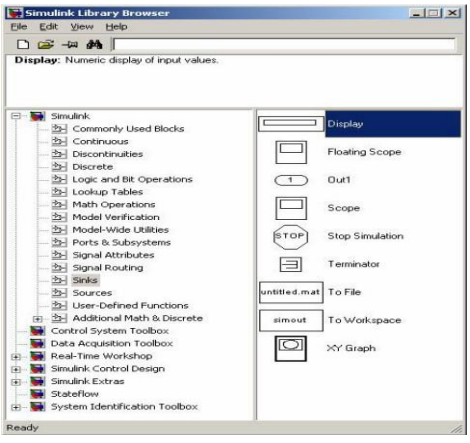
Thus, in this way the efficiency of power consumption from a solar panel can be maximized by the use of appropriate circuits. This is one of the important topics to be considered as of now as the demand for electricity keeps on increasing with increasing households and industries. Solar energy, being a renewable energy source plays a vital role in satisfying the growing electricity needs.

Using Simulink: Simulink is a simulation tools library for dynamical systems. Any system in nature can roughly be thought of as a "black box" receiving an input vector u and eliciting a unique output vector y. In the case that both u and y vary with time we are talking about dynamic systems.

Associated with a system is the so-called state vector which loosely speaking contains the required information at time that together with knowledge of the input for time greater than, uniquely determines the output for. A general continuous dynamical system can be modeled by using the following set of ordinary differential and algebraic equations.

Simulink Library Browser: Simulink can be launched by typing >> Simulink in the Simulink icon in the Commandwindow of the default MATLAB desktop.





Simulink Subsystems: In MATLAB programming, functions are used to encapsulate a computation so that it can be used

repeatedly without having to duplicate code wherever it is needed. In addition, a function can insulate its calling script from having to worry about its implementation details. In Simulink, subsystems play a similar role. Using subsystems in Simulink has these advantages:

It helps reduce the number of blocks displayed in the model window. Functionally related blocks can be kept together.

It permits the establishment of a hierarchical block diagram, wherein a Subsystem block is on one layer and the blocksthat make up that subsystem are on another.

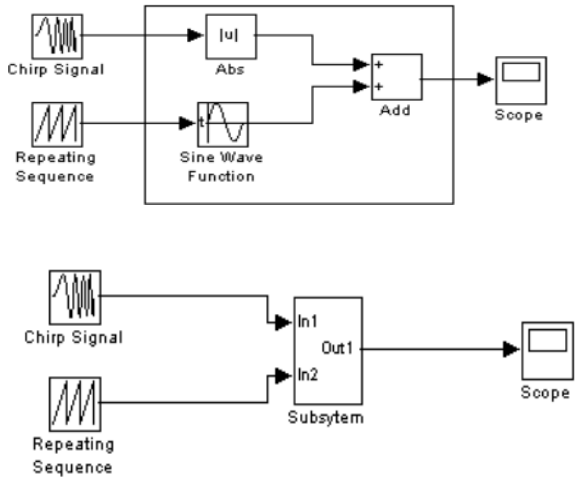
In Simulink, a subsystem can be created in two ways:

One way is to add the blocks that make up the subsystem to the model, then group those blocks into a subsystem.

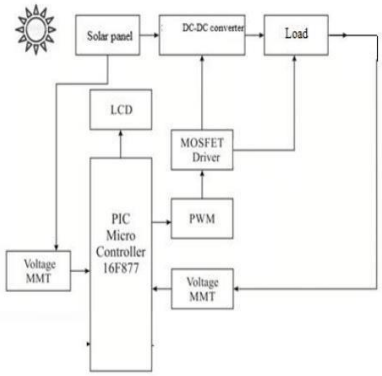
The other way is to first add a Subsystem block to the model, then open that block and install the component blocks of the Subsystem to the subsystem window.

Grouping existing blocks into a Subsystem: If a model already contains the blocks needed for a desired subsystem, youcan create the subsystem by grouping those blocks: Enclose the blocks and connecting lines that you want to include in the subsystem within a bounding box. For example, the figure below shows a model that does signal processing. The Abs, Sine Wave Function and Add blocks that do the signal conversions are selected within a bounding box.

The components within the box will be selected when the mouse button is released. Choose Create Subsystem from the Edit menu. Simulink replaces the selected blocks with a Subsystem block. The figure below shows the model after the Create Subsystem command has been chosen. If necessary, the Subsystem block can be resized so that the port labels are readable).



Block Diagram:



IV.DISCUSSION

The solar panel exhibits the P-V curve as above. The P&O algorithm is implemented using the MPPT controller. By referring to the Maximum Power Point (MPP), the voltage array is increased or decreased by charging or discharging of capacitor.

At point A, V the V'(t) is negative as well for as the P'(t) while retreating from MPP. The switch is opened to let the capacitor charging to increase V towards Vmpp. V now increases towards Vmpp, V'(t) and P'(t) are now positive while increasing towards MPP. The switch opens and capacitors charging to increase.

the V'(t) is positive but P'(t) is negative while retreating from Vmpp.The swith is closed and the capacitor starts discharging resulting V decreases towards Vmpp . V now is decreased towards Vmpp.V'(t) 33 now is negative and P'(t) is positive while P is increasing towards MPP. The switch is closed and capacitor is discharged resulting V decreasing towards Vmpp.

In conclusion, the circuit operation is tabulated in table. The table shows the simplified circuit operation of tracking MPP by P&O algorithm.

Condition	$\frac{dV}{dt}$	$\frac{dP}{dt}$	Comparator output		X-OR output	Switch	Voltage
			X_V	X_P			
$V<V_{MPP}$	Negative	Negative	0	0	0	Open	Increases
	Positive	Positive	1	1	0	Open	Increases
$V>V_{MPP}$	Positive	Negative	1	0	1	Close	Decreases
	Negative	Positive	0	1	1	Close	Decreases

Varray (in volts)	**Output at the voltage follower (in volts)**	**Output at the voltage inverter (in volts)**	**Output at the Multiplier IC (in volts)**
5	2.31	0.33	0.0663
7.5	3.1	0.52	0.162
12	5.44	0.72	0.394

V.CONCLUSION

A renewable energy system, like the one implemented here, is suitable for residential and/or industrial applications. The results suggest that, on the basis of maximum power point tracking efficiency, the perturb-and-observe method, alreadyby far the most commonly used algorithm in commercial converters, has the potential to be very competitive with other methods if it is properly optimized for the given hardware thus a system such as this can be deployed easily with little concern about adapting a home or business's electrical wiring to take advantage of solar energy. Many areas allow surplus energy generated by systems such as this to be sold to the utility grid in a policy known as "net metering." After accomplishing the model of PV modules, the models of DC-DC buck-boost converter and MPPT systems are combined with it to complete the PV simulation system with the MPPT function. The accuracy and execution efficiency for each MPPT algorithm can then be simulated under different weather voltage. Therefore, it was seen that using the Perturb & Observe MPPT technique increased the efficiency of the photovoltaic system by approximately 126% from an earlier output power.

References

1. *Dylan D.C. Lu, R.H. Chu, S. sathiskumar & V.G Agilides, "A Converter with simple Maximum Power Point Tracking for Power Electronics Education Solar Energy System" in IEEE trans. On power electronics.*
2. *S. B.Kjaer, J.K.Pedersen, and F.Blaabjerg,"A Review of Single-Phase Grid Connected Inverters for Photovoltaic Modules," in IEEE Trans. on Power Electron., Vol. 41, No. 5, pp. 1292–1306, Sep. /Oct. 2005*
3. *Power Electronics: Circuits, Devices and Operations (Book) - Muhammad H. Rashid.*
4. *Power Electronics (Book) Dr. P.S.Bimbhra*
5. *Resource and Energy Economics C - Withagen - 1994 – Elsevier*
6. *Webpage: http://en.wikipedia.org/wiki/buck-boost*
7. *Webpage: http://en.wikipedia.org/wiki/solarcell*

Websites:

http://www.atmel.com/ http://www.microchip.com/ http://www.8052.com http://www.beyondlogic.org http://www.ctv.es/pckits/home.html http://www.aimglobal.org/