AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer Engineering and Systems

Smart Maximum Power Point Tracking for Photovoltaic Systems

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science in Electrical Engineering

(Computer Engineering and Systems)

by

Ahmed Saeed Ahmed Darweesh

Master of Science in Electrical Engineering

(Computer Engineering and Systems)

Faculty of Engineering, Ain Shams University, 2017

Supervised By

Prof. Wahied Gharieb Ali Abdelaal

Dr. Bassem A. Abdullah

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Smart Maximum Power Point Tracking for Photovoltaic Systems

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Bachelor of Science in Electrical Engineering

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Faculty of Engineering, University, year

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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

One of the important factors to maximize the utilization and efficiency of any Photo-Voltaic (PV) system is the Maximum Power Point Tracking technique (MPPT). MPPT is specifically used to extract the maximum available power form the PV array, maximum power can be achieved by tracking the Maximum Power Point (MPP) using specialized algorithms. There are a lot of algorithms used for the MPPT, Perturb and Observe (P&O), and Incremental Conductance (INC) are the most common classic techniques that are used due to its simplicity in implementation but one of drawbacks of these algorithms is the cost of perturbations and oscillations at the steady state condition. For that reason we decide to turn into modern controllers. Fuzzy Logic Control (FLC) is one of the most robust and modern control techniques.

The work in this thesis illustrates the positive effect of the MPPT technique on the PV system. In addition, illustrating the theory of operation and simulating the behavior of both algorithms P&O and INC. The simulation work (using Matlab/Simulink) evaluates the algorithms under different operating conditions (temperature and solar irradiance) and showed that each algorithm has advantages over the other. P&O is the fastest to reach the MPP and to charge the battery but it can’t retain the MPP as INC algorithm can do. Meanwhile INC can reach the MPP with lower perturbations, consequently lower switching rate, higher efficiency, and higher life time for the used components.

The simulation results of FLC showed that FLC has the best results under all atmospheric conditions except at low irradiance level. FLC is the most convenient method to get higher and smoother output power at lower switching rate. It can reach the maximum power faster, reduce the power losses, increase the system efficiency, reduce the overall costs because of its simplicity, can be adapted with atmospheric variations, and has the lowest oscillations around the MPP.

Keywords: PhotoVoltaic, MPPT, MPP, P&O, INC, FLC, Maximum Power, Irradiance, Atmospheric Temperature, DC-DC converter, Buck Converter.

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