AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
MECHATRONICS ENGINEERING DEPARTMENT

DESIGN, IMPLEMENTATION AND CONTROL OFA PHOTOVOLTAIC/THERMAL HYBRID SOLAR SYSTEM

A thesis Submitted in partial fulfillment of the requirements of the
Master of Science degree in Mechanical Engineering

By

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B.Sc. in Mechanical Engineering (Mechatronics), Tenth of Ramadan City
Higher Technological Institute, January 2007

Supervised By

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STATEMENT

This dissertation is submitted to Ain Shams University for the degree of Master of Science in Mechanical Engineering (Mechatronics).

The work included in this thesis was carried out by the author at the Mechanical Department (Mechatronics), Faculty of Engineering, Ain Shams University, Cairo, Egypt. No part of this thesis was submitted for a degree or a qualification at any other university or institution.

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ABSTRACT

One of the most challenges in using photovoltaic systems is the low energy conversion efficiency of PV cells and, furthermore, this efficiency decreases further during the operational period due to the increase of the cells temperature above a certain limit. To increase the efficiency of PV systems one way is cooling them during the operation period and these temperature losses from the PV modules can be tapped in other applications.

This thesis investigates the efficiency of PV modules with utilizes of the heat generated to heat the water and use it in another enforcement. A comparison between theoretical (Comsol Multiphysics) and experimental work results for fixed and tracking Photovoltaic/ Thermal (PV/T) hybrid system is presented.

In the second part of the experimental work, a one axial sun-tracking system is designed where the movement of a photo-voltaic module is controlled to follow the Sun's radiation using a Data acquisition card (DAQ) unit. Finally an active cooling system is designed and conducted to cool the fixed and tracking modules at which an absorber system consists of copper pipe welded with aluminum plate is attached underneath the PV modules to allow water flowing below the modules, the water absorbed heat from the copper pipes which is absorbed previously from the plate of PV modules causing reduce in modules temperature.

In addition to the above an electrical analysis for both systems is presented where I-V, P-V, power with 12 mourning hour's and electrical efficiency. Beside that the thermal analysis for the fixed and tracking PV modules and the piping water is presented where the input, output temperatures, rate of heat transfer, overall heat transfer coefficient and thermal efficiency are calculated. As a result, a significant enhancement in the total electrical efficiency is observed with acceptable increase in the output water temperature.

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TABLE OFCONTENTS

LIST OF FIGURES