AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electrical power and Machines Engineering Department

Development of battery charge controller for renewable energy systems

A Thesis

Submitted in partial fulfillment of the requirements of the degree of
Master of Science in Electrical Engineering

Submitted by

Yasser Elhosseny Atyea Elsayed
B.Sc. of Electrical Engineering
AIN SHAMS July 2000

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Cairo, 2015

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STATEMENT

This dissertation is submitted to Faculty of Engineering, AIN SHAMS University for the degree of Master of Science in Electrical Engineering (Electrical power and Machines Engineering). The author carried out the work included in this thesis at Electrical power and Machines Engineering Department, 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.

Name: **Yasser Elhosseny Atyea Elsayed**

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Curriculum Vitae

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ABSTRACT

Batteries are the power tank of renewable energy power systems. They play the role of power supply when the renewable energy power sources are not available. This thesis demonstrates the development of a new battery charge controller for renewable energy systems. A comprehensive review of the conventional controllers is conducted to collect their contributions, advantages, and disadvantages for comparison and validation.

The new controller designed based on a novel maximum power point tracking (MPPT) technique. The new MPPT technique utilizes a smart algorithm and is optimized using the genetic neural algorithm. In addition, the proposed controller utilizes a multistage charging algorithm in order to minimizing the charging time.

The components of photovoltaic generator system are introduced and mathematically modeled including the control and optimization methods. The charge controllers design aspects, functions, and charging control methods are discussed. Consequently, the new controller is modeled based on complete mathematical models.

In order to determine the performance parameters and evaluate the validity and efficiency of the new controller, a complete PV system is modeled and simulated using MATLAB/SIMULINK. Moreover, a complete experimental prototype is implemented. The simulation and experimental results are compared for validation and clarification. They strongly agree on that, under all test conditions, the new controller tracks the target maximum power point (MPP) more faster than the traditional methods. In addition, it can tracks successfully the global maximum power point (GMPP) in all partial shading conditions. Moreover, the charging time is significantly reduced.

The thesis is divided into six chapters organized as follows:

Chapter One introduces the components of a general photovoltaic system. Moreover, it reviews the recent publications and contributions in the scope of maximum power point tracking and charging control methods for renewable energy systems. In addition, it lists the thesis objectives and outlines.

Chapter Two covers the mathematical model of general photovoltaic systems and the control and optimization methods.

Chapter Three demonstrates the theory, design aspects, and control methods of the battery charge controllers.

Chapter Four shows the complete modeling, simulation, and validation of the proposed system.

Chapter Five presents a complete experimental version for the proposed system including all test cases and validation.

Chapter Six concludes the work and states the recommendations for future work.

ACKNOWLEDGEMENT

الحمد لله رب العالمين

I would like to take the opportunity to acknowledge the direct and indirect help of many people who made this thesis possible. Without the great support of my supervisors, it would be not possible to complete this work. I would like to express my appreciation to Prof. Dr. Abdel Haleem Zekry and Dr. Naggar Hassan for their continuous support and guidance. Finally, I would like to thank my wife **Dr. Marwa abdellah** for her support, encouragement, and quiet patience.

Yasser Elhosseny

January 2015

Table of Contents

Table of Contents

List of Figures

List of figures

List of Figures

List of Figures

List of Figures