Ain Shams University

Faculty of Engineering

Cairo-Egypt

Department of Electronic and Communication Engineering

Supervision and fault detection in PV Systems

by

Yousra Mohamed Abbas saleh

A Thesis

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

in Electrical Engineering

at

Faculty of Engineering – Ain Shams University

Supervised by

Prof. Dr. Wagdy Refaat Anis

Professor in the Electronics and Communications Engineering Department Faculty of Engineering – Ain Shams University

Prof. Dr. Ismail Mohamed Hafez

Professor in the Electronics and Communications Engineering Department Faculty of Engineering – Ain Shams University

Cairo, 2017

Ain Shams University

Faculty of Engineering, Cairo, Egypt

Department of Electronic and Communication Engineering

Supervision and fault detection in PV Systems

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Electrical Engineering

by

Yousra Mohamed Abbas Saleh

Examiners Committee

Title, Name and Affiliation	**Signature**
Prof.Dr. Elsayed Mostafa Saad Helwan University, Faculty of Engineering, Electronic and Communication Engineering Dept.	….....
Prof. Abdelhalim Abdelnaby Zekry Ain Shams University, Faculty of Engineering, Electronic and Communication Engineering Dept.	….....
Prof. Ismail Mohamed Hafez Ain Shams University, Faculty of Engineering, Electronic and Communication Engineering Dept.	….....
Prof. Wagdy Rafaat Anis Ain Shams University, Faculty of Engineering, Electronic and Communication Engineering Dept.	….....

Date:…../……/……

Disclaimer

This thesis is submitted as partial fulfillment of M.Sc degree in Electronics and Communication Engineering, Faculty of Engineering, Ain Shams University.
The work included in this thesis was carried out by the author during the Period from 2015 to 2017 and no part of it has been submitted for a degree or qualification at any other scientific entity.
The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

Name
Yousra Mohamed Abbas Saleh

Signature
…….

Date …/…/....

CURRICULUM VITAE

Researcher Name	: YOUSRA MOHAMED ABBAS
Date of Birth	: 24/6/1984
Place of Birth	: Cairo – Egypt
First University Degree	: B.SC. in Electrical Engineering
Date of Degree	: 2006
Second university degree	: M.SC in Electrical Engineering
Date of Degree	: 2017
Faculty	: Faculty of Engineering
University	: Ain shams University
E-mail	: deference_ y@ hotmail.com

ACKNOWLEDGEMENTS

First of all, I am grateful to God Almighty for his reconciliation and guidance and enlightenment of my vision in all my steps to complete this research.

All thanks and sincere gratitude to my great Professors who given their time, their thought and summarized of their experiences to overcome obstacles, solve problems and develop ideas to become practical steps that can be implemented in a systematic scientific way.

Acknowledgments and thanks to all who helped me with his knowledge and especially thanks:

Prof. Dr. Wagdy Refaat Anis for his given of his great knowledge to put me on the right path, cutting off his precious time to answer questions and clarify and simplify dilemmas.

Prof.Dr. Ismail Hafez for his follow-up, guidance and careful observation during the research stages.

Prof.Dr. Abdelhalim Zekry for giving the research a part of his precious time to see it and make valuable comments and suggestions intended to be a complete research.

Prof.Dr. ELsayed Mostafa Saad for giving the research a part of his precious time to see it and make valuable comments and suggestions intended to be a complete research.

I would also like to thank everyone who has provided me with information and data to make the research in its final form.

I also extend my deepest thanks and appreciation to my parents and my brother, who have made great efforts and have always been as a force push forward. Especial thanks to my sister Dr. Marwa Mohamed Abbas for her encouragement, support and efforts.

I would to thank to my dear husband, who carried a lot of effort to give me time to complete the research.

Yousra Abbas

■ ABSTRACT

The research deals with the study of the reasons for the existence of a large difference between the theoretical value of the rate of energy production of photovoltaic systems and the real value of the rate of production. It was one of the most frequent causes of faults and time consuming to discover the cause and place of faults, and was the search to seek to provide a proposed methodology for the design of the system able to quickly detect and locate faults.

- In order to achieve this, the research dealt with two axes: "The focus of the analysis study, the focus of the applied study". The research aims to provide a suggested design for a wireless system that can detect the fault of the PV system.

-The analysis study dealt with the causes of the faults that occur in the PV system and the effect of these faults on the performance of the PV system " DC-side faults "field of research.

-The analysis study also examined and analyzed the methods used in previous researches to detect PV system faults and to divide them into main and sub-types and to discuss the technology used with each of them to identify their advantages and disadvantages.

-The applied study dealt with the design of a proposed system for detecting PV system faults and implementing applications using the proposed fault detection system and achieving the detection of three types of faults in different locations in the PV system model.

The research includes five chapters:

Chapter one:

It deals with the search for the causes of PV system faults and negative effects.

Chapter Two:

Discusses the methods used to detect faults in previous researches and their division and to identify the best alternative from the point of view of the researcher.

Chapter Three:

Includes the practical part, which is represented in designing a system capable of detecting PV system faults; this system is characterized by immediate detecting and locating the faults.

Chapter Four:

Includes the practical application of fault detection using the proposed system examines and implements the practical procedure for detecting three types of faults at different locations.

Chapter Five:

Includes results and recommendations. Also get results for a proposed system capable of saving time and effort in the fault detection and the provision of energy losses by the interruption of the PV system.

Keywords: faults of Photovoltaic (PV) system, Fault detection, Arduino and LabView program.

Paper Publication: Dr. Wagdy R.Anis, Dr. Ismail M.Hafez , Eng. Yousra M Abbas "Automatic Supervision and Fault Detection in PV System by Wireless Sensors with Interfacing by LabView Program", in the International Journal of Scientific & Technology Research on 12th December 2016.

■ INTRODUCTION

Recently, the scientific research has focused on the exploitation of renewable energy sources due to they are clean, environmentally friendly, renewable and cannot be depleted. The efforts of scientists and researchers in this field have been about access to multiple methods of exploitation all types of renewable energy to provide the necessary energy to meet human varying needs. Indeed, these efforts have been fruitful as scientists and researchers have reached the possibility of using (wind energy, potential energy of running water and solar heat and light from the sun) to produce several types of energy the most important of which is electric energy, the most important of which is electric energy. The solar energy is distinguished from the rest of the renewable sources by its regular presence in all places. Therefore, the greatest interest is the use of this energy to produce electricity. This was achieved through the establishment of a photovoltaic system in which solar energy is converted into electric energy. In order to achieve the quantitative production of electricity it is necessary to establish photovoltaic fieclds on large areas requires large amount of electrical cables and wires exposed to damage may caused by weather or rodents

which lead to a lot of faults are difficult to detect and determine its source and this causes large parts of the field being stopped of bumping energy and this lead to a large losses in the amount of energy extracted.

This has enabled the researcher to design a proposed system for the immediate detection of faults and locating them by wireless fault detection and diagnosis system to avoid wiring fault. This system can reduce the time of repair and losses energy and prevent the aggravation of the faults that expose the PV arrays and the whole PV system to damage if not repaired.

■ Research problem

The projects of photovoltaic power stations have been a promising success in meeting the energy needs. There are challenges that threaten the success of these projects, which are frequent faults and difficult to detect and need for a long time to complete the reform, which negatively affects the rate of energy produced by the stations. These challenges may lead to the failure to achieve the economic feasibility of these projects, thus exposing them to non-sustainability. Hence, the researcher's idea was crystallized to research these challenges in order to find practical solutions to these research problems.

■ Research purpose

The primary aim of the research is to study the reason for taking a long time to repair the faults of PV system and it's negatively affect on the average output of the PV system to develop a model methodology to immediate detect and locate the faults to increase the reliability and efficiency of the PV systems.

The main objective will be achieved through the achievement of three secondary aims, summarized in:

1. Determine the negative points in the previous methods followed to detect faults
2. Design of a proposed system to help quickly detect faults and locate them.
3. Implementation of the scientific procedure to detect some of the various faults in different locations.

■ The limits of research

The research deals with the study and analysis of the use of photovoltaic system in the Mass-production of electrical energy and analyzes the faults "DC-side" of photovoltaic system, especially three types of faults "open-circuit of module, open-circuit of string and partial shading fault". The research will not discuss the faults "AC-side" of photovoltaic system. The research provides an theoretical research reading in the methods of detecting faults in previous researches, then go towards to design Wireless fault detection and diagnosis system apply in practice.

■ Research Hypotheses

The hypothesis of the research is the possibility of raising the reliability and efficiency of the PV systems through design a fault detection and diagnosis system which helps to reduce the time needed to detect, locate and repair the faults of PV system.

■ Research Methodology

The research follows the hybrid approach, where the researcher has proven the hypotheses of research and achieved objectives through several approaches, which are summarized as follows:

-The extrapolation method: The analysis study includes the common types of faults in the DC-side of the PV system, their causes and their negative impact on the performance of the PV system and study of the methods used in the previous researches to detect faults and the technique used in each method, including data is monitored and analyzed to draw conclusions.

-The field approach: Includes applied study and Include design of a system to detect the faults of the PV system wirelessly and the work of research applied to detect several types of faults in different locations.