Sudan University of Science and Technology

College of Engineering

School of Electronics Engineering

Solar Tracking System Design and Simulation

A Research submitted in partial fulfillment for the requirements of the Degree of B.Sc. (Honors) in Electronics Engineering

Prepared By:

1. *Azza Ahmed Mohammed Ahmed*
2. *Esraa Gaffar Mustafa*
3. *Nada Abdelwahab Mekki*
4. *Rayan Ishag Fagir*

Supervisor :

Dr. Khalifa Eltayb

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الآيـــــــة

قال تعالى:

(... يَرْفَعِ اللَّهُ الَّذِينَ آمَنُوا مِنكُمْ وَالَّذِينَ أُوتُوا الْعِلْمَ دَرَجَاتٍ وَاللَّهُ بِمَا تَعْمَلُونَ خَبِيرٌ(11))

سورة المجادلة(11)

صدق الله العظيم

DEDICATION

This project is dedicated to...

The memory of ***Alwaia Salih*** a loving mother who passed away before seeing the success of her daughter

Our beloved ***Mothers*** and ***Fathers***

For their love, endless support and encouragement.

Brothers ,Sisters and

Our love ones

Dr. Khalifa Eltayeb

To those who accompanied us in path of ***friendship***

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Abstract

In daily life, the need of energy resources is increasing every day, so the renewable resources such as solar energy, became an attractive energy source. In Sudan sources of electrical energy are mainly generated from water, another source of energy is solar energy by using solar cells that converts sun radiation to electrical energy that can be used in common electrical application. Solar Cell main problem is the low efficiency of fixed panel and/or low accuracy of being vertical towards the sun, which results into wasting some of the useful energy.This project is concerned with developing a tracking system that tracks the sun from east to west during the day hours vertically to maximize the energy absorbed by the solar panels. The system is controlled by microcontroller which reads values from LDRs and processes the information to move the panel using stepper motor based on LDRs information.

المستخلص

في الحياة اليومية، الحاجة لموارد الطاقة تتزايد كل يوم لذلك فإن الموارد المتجددة مثل الطاقة الشمسية أصبحت مصدرا جذابا للطاقة .تعتبر الموارد المائية هي المصدر الاساسي لتوليد الطاقة الكهربائية في السودان ، مصدر آخر للطاقة وهو الطاقة الشمسية عن طريق استخدام الخلايا الشمسية التي تحول الإشعاع الشمسي إلى طاقة كهربائية يمكن استخدامها في مجموعة من التطبيقات. المشكلة الرئيسية للخلية الشمسية هي قلة كفاءة الخلية الناتجة من ثبات اللوح و / أو إنخفاض دقتها من كونها عمودية نحو الشمس، مما يؤدي إلى فقدان الطاقة. يهتم هذا المشروع بتطوير نظام لتتبع الشمس من الشرق إلى الغرب خلال ساعات اليوم بجعل سقوطها عموديا لتحقيق أقصى قدر من الطاقة الممتصة بواسطة الألواح الشمسية. يتم التحكم في النظام عن طريق متحكم دقيق الذي يقرأ القيم من المقاومات الضوئية ويقوم بمعالجة المعلومات لتحريك اللوحة باستخدام محرك الخطوة بناء على معلومات المقاومات الضوئية.

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List of symbols

K	Kilo
V	Volt
T	system torque
Tmotor	inertia torque of motor
Tin	inertia torque
M	system mass
G	gravitational acceleration
L	system length
F	system force
R	shaft radius
S.F	safety factor
Ω	Ohm
μ	Coefficient of friction

List of abbreviation

A

AC	Alternating Current
ADC	Analog to Digital Converter
A/D	Analog to Digital Converter
AVR	

C

CPU	Central Processing Unit
CMOS	Complementary Metal-Oxide Semiconductor

D

DC	Direct Current
D/A	Digital to Analog Convertor

E

EEPROM	Electrically Erasable Programmable Read Only

	Memory
I	
IC	Integrated Circuit
I/O	Input/ Output
L	
LDR	Light Dependent Resister
N	
NPN	Negative, Positive, Negative
P	
PV	Photo Voltaic
PWM	Pulse Width Modulation
PLC	Programmable Logic Controller
R	
ROM	Read Only Memory
RAM	Random Access Memory
RISC	Reduced Instruction Set Computing
S	
S	sensor
SMPS	Switched Mode Power Supply
SPRAM	Static Programmable Random Access Memory

U

ULN	unique learning number
USB	Universal Serial Bus

Chapter one

Introduction

Chapter one

Introduction

1.1 Preface:

Finding energy sources to satisfy the world's growing demand is one of society's foremost challenges for the next half-century. Sun energy is the cleanest and most abundant renewable energy source available.

Modern technology can harness this energy for a variety of uses, including generating electricity, providing light or a comfortable interior environment, and heating water for domestic, commercial, or industrial use.[1]

This project describes in detail the design and construction of a prototype for solar tracking system. Solar trackers are devices used to orient photovoltaic panels toward the sun. Since the sun position changes with seasons and time of day, trackers are used to align the allocation of the sun to maximize energy production. Several factors must be considered when determining the use of trackers. Some of these include: the solar technology being used, the amount of direct solar irradiation, the region where the system is deployed, and the cost to install and maintain the trackers. In this project the main goal is to absorb the maximum energy from the sun and convert it into electricity, achieving this goal require designing a close loop solar tracking system which analyze the environment and locate the sun position using photo sensor then change the tracker position using a motor until reach the perfect position. The perfect position is when the sun is vertical on the panels.

1.2 Problem statement:

The low efficiency of the solar cell because of fixed panel and/or low accuracy of being vertical towards the sun which results into wasting some of the useful energy.

1.3 Proposed solution:

Design a system that makes solar panels absorb as much energy as possible during the daylight hours by designing a solar tracking system that sense the light intensity then change the solar panel position angle till it reach the 90° angle that gives the highest power .

1.4 Objectives:

The main objective of this project is:

- To design the 3D layout of the solar tracking system.
- To simulate a Software of the solar tracking system.
- To build Hardware implementation of the solar tracking system.
- To build a hardware prototype of the solar tracking system.

1.5Methodology:

Firstly determine the objectives of the project and how to achieve them. Secondly, visit energy research center to collect information about solar cells .After that, review previous studies and researches in the area of solar tracking systems and write the literature review. Then choose the mechanism that helps in achieving the maximum absorption of the sun radiation. Thirdly build a simulated design to check the tracking system working. Fourthly build hardware prototype that contain a photo sensors, microcontroller, stepper motor, motor drive circuit and circuit to drive the signals from photo sensors to

microcontroller and testing the system performance. Finally write the final result, conclusion and recommendation.

1.6 Thesis outlines:

- Chapter one includes preface, problem statement, proposed solution, objectives and methodology.
- Chapter two includes definitions and types of solar cell, site visit and related works.
- Chapter three include block diagram, and system component.
- Chapter four includes system scenario, solar panel 3D layout, flow chart and system circuit.
- Chapter five contain the system simulation design and hardware implementation.
- Chapter six include conclusion and recommendations.