

الآية :

اللَّهُ الَّذِي خَلَقَ السَّمَوَاتِ وَالْأَرْضَ وَمَا بَيْنَهُمَا فِي سِتَّةِ أَيَّامٍ ثُمَّ اسْتَوَى عَلَى
الْعَرْشِ مَا لَكُمْ مِنْ دُونِهِ مِنْ وَلِيٍّ وَلَا شَفِيعٍ أَفَلَا تَتَذَكَّرُونَ (4) يُدَبِّرُ الْأَمْرَ مِنَ
السَّمَاءِ إِلَى الْأَرْضِ ثُمَّ يَعْرُجُ إِلَيْهِ فِي يَوْمٍ كَانَ مِقْدَارُهُ أَلْفَ سَنَةٍ مِمَّا تَعُدُّونَ (5)
ذَلِكَ عَالِمُ الْغَيْبِ وَالشَّهَادَةِ الْعَزِيزُ الرَّحِيمُ (6) الَّذِي أَحْسَنَ كُلَّ شَيْءٍ خَلَقَهُ
وَبَدَأَ خَلْقَ الْإِنْسَانِ مِنْ طِينٍ (7) ثُمَّ جَعَلَ نَسْلَهُ مِنْ سُلَالَةٍ مِنْ مَاءٍ مَهِينٍ (8)
ثُمَّ سَوَّاهُ وَنَفَخَ فِيهِ مِنْ رُوحِهِ وَجَعَلَ لَكُمُ السَّمْعَ وَالْأَبْصَارَ وَالْأَفْئِدَةَ قَلِيلًا مَّا
تَشْكُرُونَ (9)

صدق الله العظيم

سورة السجدة الآيات (4-9)

Dedication:

To our families

To our parents

To our brothers, sisters, friends and colleagues

Acknowledgement:

Firstly we thank Allah, the lord of the worlds, for His mercy and limitless help and guidance. May peace and blessings be upon Mohammed the last of the messengers.

Secondly, we want to express our appreciations to our supervisor, Giddani Osman Adlan for giving us support not only in technical problems solving, but also moral support from the beginning of the project until the accomplishment of the project.

Finally, we would like to thank all colleagues for their help through the tough aspects of our project. We feel so grateful to have friends like them because they willing to help us directly or non-directly. Their enthusiasms have driven us to accomplish this project so that we all can graduate on time together.

Abstract:

In present time, the need of energy increases each and every day. A new way to cover this increasing by using solar energy. The solar energy convert solar irradiation to power that can be used in common electric appliances. However, the angle of the sun is proportional to the energy converted. If the sun is 90° vertical to the solar panel, the energy received is maximum compare to other angles. In this case, stepper motors used to track the solar during the movement of the sun from morning till night. The ASTS (Automated Solar Tracking System) is developed by moving the solar panel during anytime of the day that the sun is available and the motor will move the panel to a 90° vertical angle directly to the sun. The system is controlled by Arduino Uno controller which will process data from the sensor and convert it to output for the motor movement. As the result, a prototype of Automated Solar Tracking System is operated and able to achieve the objective of this project.

المستخلص :

في الوقت الحاضر يزداد الاحتياج للطاقة بشكل يومي ولتغطية الطلب المتزايد تم اللجوء الي استخدام الطاقات المتجددة ومنها الطاقة الشمسية. ويتم استخدامها عن طريق تحويل اشعة الشمس الى طاقة يمكن استخدامها في التطبيقات الكهربائية المختلفة. ولكن هذه الطاقة تتناسب مع زاوية سقوط اشعة الشمس وتعطي اقصى طاقة عند تعامد الاشعة مع اللوح الشمسي وللمحافظة على هذا الوضع يتم استخدام محركات الخطوة لتحريك اللوح تبعاً لحركة الشمس. وتم استخدام نظام (نظام تتبع الشمس التلقائي) (Automated Solar Tracking System) ASTS لتحريك اللوح الشمسي تبعاً لموقع الشمس خلال اليوم. وهذا النظام يتم التحكم فيه عن طريق استخدام متحكم اوردوينو اونو (Arduino UNO) الذي يستقبل البيانات من المحسسات ويعالجها ويحولها الى خرج للتحكم في حركة المحرك للموضع المطلوب وكنتيجة لذلك تم تصميم نموذج تجريبي لنظام التحكم التلقائي لتحقيق هدف المشروع .

TABLE OF CONTENTS

content	Page No.
الأيّة	i
DEDICATION	ii
ACKNOLEDAGMENT	iii
ABSTRACT	iv
المستخلص	v
TABLE OF CONTAINITS	vi
LIST OF FIGURES	viii
LIST OF TABLES	ix
LIST OF ABBREVIATIONS	x
LIST OF SYMBOLES	xi
CHAPTER ONE	
INTRODUCTION	
1.1 Overview	1
1.2 Problem Statement	2
1.3 Project Objectives	2
1.4 Methodology	2
1.5 Project Layout	2
CHAPTER TWO	
STEPPER MOTOR FUNDAMENTALS	
2.1 Stepper Motor	3
2.2 Applications	5
2.3 Types of Stepper Motors	6
2.3.1 Variable Reluctance Stepper Motors	8
2.3.2 Permanent-Magnet Stepping Motor	14
2.3.3 Hybrid Stepper Motor	16
CHAPTER THREE	
SUN TRACKING SYSTEM	
3.1 Introduction	18
3.2 Solar Power Fundamentals	19
3.3 An Overview about Tracking Technique	20
3.3.1 Types of Tracker Actuator Driver	20
3.3.1.1 Electronic (Active) Tracker	20
3.3.1.2 Mechanical (Passive) Tracker	21
3.3.1.3 Altitude / Azimuth Trackers	23

3.3.2 Type of Solar Tracker Axis	23
3.3.2.1 Single Axis Tracker	23
3.3.2.2 Dual Axis Tracker	24
3.3.3 Type of Tracker Mount	25
3.4 Existing Tracking Technology	26
CHAPTER FOUR	
SIMULATION AND RESULTS	
4.1 System layout and Control	27
4.1.1 Light sensor selection and circuit	28
4.1.2 Actuator and drive selection	28
4.1.3 Stepper motor	29
4.1.4 Control system and microcontroller	31
4.1.5 power supply	33
4.2 Full simulation diagram	34
4.3 Results and Description	35
4.4 Hardware circuit diagram	37
CHAPTER FIVE	
CONCLUSION AND RECOMMENDATION	
5.1 Conclusion	38
5.2 Recommendations	38
REFERANCES	39
APPENDIX	40

LIST OF FIGURES

Figure	Title	Page
2.1	Variable Reluctance Stepper Motor	6
2.2	permanent magnet stepper motor	7
2.3	hybrid stepper motor	7
2.4	Variable Reluctance Stepper Motor construction	8
2.5	operation of Variable Reluctance Stepper Motor	9
2.6	Half step mode	13
2.7	construction and operation modes of PM stepper motor	15
2.8	Hybrid stepper motor construction and operation	16
3.1	An Active Solar tracker	21
3.2	A Passive Solar Tracker	23
3.3	A Horizontal Single Axis Solar Tracker	24
3.4	A Vertical Single Axis Solar Tracker	24
3.5	Dual axis	25
3.6	The Polar Axis Tracking Ridge Concentrator	26
4.1	Simplified block diagram of solar tracking system	27
4.2	LDR position	28
4.3	driver internal construction	29
4.4	stepper motor model 28BYJ-48 – 5V	29
4.5	Open-loop control system	31
4.6	Closed loop control system	32
4.7	Arduino Uno	32
4.8	Full simulation diagram	34
4.9	sun tracker system while tracking	35
4.10	sun tracker while holding position	35
4.11	solar tracker while correcting	36
4.12	the solar tracker during sunset	37
4.13	hardware circuit diagram	37

LIST OF TABELS

Table No	Title	Page No
2.1	one phase on mode (A,B,C,A)	11
2.2	2-phase-on mode	11
2.3	half step mode	12
2.4	Operation modes	15
4.1	PM stepper motor properties	30
4.2	Arduino UNO properties	31

LIST OF ABBREVIATIONS

ASTS	Automated Solar Tracking System
LDR	Light Depended Resistor
W	Watt
PPS	Pulse Per Second
IC	Integrated Circuit
VR	Variable Reluctance
PM	Permanent Magnet
CW	Clock Wise
CCW	Counter Clock Wise
DC	Direct Current
AC	Alternative Current
GPS	Global Positioning System
PV	Photo Voltaic
TTL	Transistor-Transistor Logic
PWM	Pulse Width Modulation
USB	Universal Serial Bus
ICSP	In-Circuit Serial Programming
SRAM	Static random-access memory
EEPROM	Electrical Erasable Programmable Read Only Memory
PID	Proportional-Integral-Derivative controller

LIST OF SYMBOLES

μ	micro
β	Step angle
N_r	Number of rotor teeth
N_s	Number of stator teeth
Ω	ohm