

**SUDAN UNIVERSITY OF SCIENCE AND
TECHNOLOGY**

COLLEGE OF ENGINEERING

SCHOOL OF ELECTRONIC ENGINEERING



WIRELESS SPEED CONTROL OF DC MOTOR USING MICROCONTROLLER

A Research Submitted In Partial Fulfillment for the Requirements
of the Degree of B.Sc. (Honors) In Electronics Engineering

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September 2014

الاستهلال

قال تعالى:

[وَقُلْ اَعْمَلُوا فَسَيَرَى اللّهُ
عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ
وَسَتُرَدُّونَ اِلَى عَالِمِ الْغَيْبِ
وَالشَّهَادَةِ فَيُنَبِّئُكُمْ بِمَا
كُنْتُمْ تَعْمَلُونَ]

صدق الله العظيم

التوبة [105]

DEDICATION

TO

WHO SHOULD WE GIVE OUR LOVE, OUR RESPECT AND OUR
HONOR

TO AFTER ALLAH AND PROPHET OF ALLAH COMES;

OUR MOTHERS,

OUR FATHERS,

SISTERS AND BROTHERS,

FRIENDS,

AND ABOVE ALL OUR TEACHERS.

ACKNOWLEDGEMENT

First of all we are grateful to ALLAH S.W.T for blessing us in finishing our project.

We have no words to express our gratitude for our families for their love, prayer, support and care. Our appreciation goes to our supervisor Dr. Mudather Fagiri for the guidance and enthusiasm given throughout the progress of this project. Also to the faculty members.

Our hearties thanks to Eng.Hashim Btraan, Eng. Ahmed Hemaida , Eng.Ahmed Mustafa, Eng.Nagwa faroug,For their help and support, and at last our friends and colleagues ... thank you all.

ABSTRACT

Direct Current (DC) motor has already become an important drive configuration for many applications across a wide range of powers and speeds. The ease of control and excellent performance of the dc motors will ensure that the number of applications using them will continue grow for the foreseeable future. The aim of developing this project is to control the speed of DC motor. In this project the classical technique control which is PI controller has been studied for servo application to drive the system or loads to control speed and torque. To achieve the speed control an electronic technique called pulse width modulation (PWM) is used which generates high and low pulses. These pulses vary the speed in the motor. For the generation of these pulses a microcontroller (atmega16) is used. The PWM signal will send to motor driver to vary the voltage supply to motor to maintain a constant speed. During this project a wireless system amplitude shift keying (ASK) is going to be used to enhance the dc motor operated manually. This system will actually adapt the requirements of the modern technology. With the help of this system one can control the speed of the dc motor controller from remote sites. It can also control the direction of the dc motor. This project is practical and highly feasible in economic point of view, and has an advantage of running motors of higher ratings. This project gives a reliable, durable, accurate and efficient way of speed control of a dc motor.

مستخلص

تعتبر متحكمات التيار المباشر ذات أهميه عظمى لأنها تستخدم في تطبيقات كثيرة ومجال عملها واسع في مجال القدرة والسرعة , سهولة التحكم والأداء الممتاز لمتحكمات التيار المباشر يضمن إستمرارية عملها في عدد كبير من التطبيقات حتى في المستقبل. هذا المشروع يتناول التحكم في سرعة محركات التيار المباشر بإستخدام المتحكم الدقيق. في هذه الدراسة استخدمت تقنية تعديل عرض الموجة وهي عبارة عن إشارة يتم توليدها في المتحكم الدقيق . في تقنية تعديل عرض الموجة يتم توليد موجة مربعة عبارة عن نبضات عالية ومنخفضة وعلي حسب عرض الموجة في النبضة العالية يتم التحكم في سرعة الموتور. في هذا المشروع إستخدم متحكم دقيق من نوع آتميكا 16 للتحكم في العملية الكلية .

في هذا المشروع تم استخدام نظام التحكم عن بعد وذلك بإستخدام لاسلكية تحول نظام قفل السعة ويمكن الارسال عن طريقه الى مسافة تصل مائة متر . وهذا النظام فعلا يمكنه التكيف مع متطلبات التكنولوجيا الحديثة. مع مساعدة من هذا نظام يمكن التحكم في سرعة المحركات من مواقع نائية . ويمكن أيضا التحكم في اتجاه المحرك. هذا المشروع هو عملية ومجدية للغاية في الناحية الاقتصادية، ولديهم ميزة تشغيل المحركات من تصنيفات أعلى. هذا المشروع يعطي وسيلة موثوقة ودائمة ودقيقة وفعالة للتحكم في سرعة المحركات .

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LIST OF ABBREVIATIONS

AC	ALTERNATING CURRENT
ASK	Amplitude shift keying
Atmega16	Atmel mega 16
Bascom	Basic compiler
CW	Clock wise
CCW	Counter-clockwise
DC	DIRECT CURRENT
DIP	Dual In Line
EMF	Electromotive Force
EEPROM	electrical erasable programmable ROM
EQ	Equation
FM	Frequency Modulation
GND	Ground
IC	Integrated circuit
IR	infra-Red
I/O	Input /Output
KVL	Kirchhoff's Voltage Laws

LED	LIGHT EMITTING DIODE
MATLAB	Math laboratory
MCU	Microcontroller unit
PI	Proportional Integrated
PID	Proportional Integrated derivative
PWM	Pulse Width Modulation
RAD	Radian
RAM	Random access memory
RF	Radio Frequency
PROM	Programmable Read Only Memory
SEC	Second

LIST OF SYMBOLS

S	-	No. of parallel paths
B	-	Damping ratio of the mechanical system
B_m	-	Motor Coefficient
E	-	Voltage
E_a	-	Excitation Voltage
E_b	-	directed opposite to the supplied voltage
G_p	-	Transfer Function
I	-	Electrical Current
I_a	-	Armature current
J	-	Moment of inertia of the rotor
J_m	-	Moment of Inertia
K	-	Related Parameter
K_b	-	Back emf constant
K_m	-	motor gain
K_t	-	Electromotive force constant
L	-	Electric inductance
L_a	-	Armature inductance
N	-	Speed of DC motor

P	-	No of poles
Q	-	Flux per pole
R	-	Electrical resistance
R_a	-	Armature resistance
T	-	Torque
T_m	-	Total Electromagnetic torque
V_a	-	Armature emf
W	-	Speed
Z	-	No. of conductors

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CHAPTER ONE

INTRODUCTION

CHAPTER ONE

INTRODUCTION

1.1 Introduction:

The modern machines, including the positioning systems, the robots, the flexible manufacturing systems and the application specific machine-tools, require a form of energy conversion toward mechanical energy. There are well known types of energy converters such as electric motors, pneumatic motors, hydraulic motors etc. Perhaps the most widely used motors are the electric ones because of their high flexibility and reliability as well as of their cost. The common electric motors can be grouped in four major classes: DC motors, stepper motors, asynchronous motors and synchronous motors. The mechatronic systems, robots and low to medium power machine-tools often use DC motors to drive their work loads. These motors have rather simple functional and constructive models. There are several well-known methods to control DC motors such as: PI, PID or dispositional. These can quite easily be implemented using analog electronics. However, modern digital computers provide an easy way of implementing very complex control algorithms.[1]

DC motor has been widely used nowadays and historically in DC drive applications. It's been very popular drives for speed and position control application. This drives usually been implicated in application of printer, robots, scanner and others. In conjunction with the highly demand for the drives in so many field of works and need specially in engineering sectors, factory automation,

and not forgotten our daily life, the motor accuracy and effectiveness have to be improved.[2]

Direct current (DC) motors have variable characteristics and are used extensively in variable-speed drives. DC motor can provide a high starting torque and it is also possible to obtain speed control over wide range.

DC motor plays a significant role in modern industrial. These are several types of applications where the load on the DC motor varies over a speed range. These applications may demand high-speed control accuracy and good dynamic responses.[3]

In home appliances, washers, dryers and compressors are good examples. In automotive, fuel pump control, electronic steering control, engine control and electric vehicle control are good examples of these. In aerospace, there are a number of applications, like centrifuges, pumps, robotic arm controls, gyroscope controls and so on. [4]

Purpose of a motor speed controller is to take a signal representing the required speed and to drive a motor at that speed. Pulse Width Modulation (PWM) is the technique of utilizing switching devices to produce the effect of a continuously varying analog signal.[5]

The Pulse-Width-Modulation (PWM) in microcontroller is used to control duty cycle of DC motor drive. PWM is an entirely different approach to controlling the speed of a DC motor. Power is supplied to the motor in square wave of constant voltage but varying pulse-width or duty cycle. Duty cycle refers to the percentage of one cycle during which duty cycle of a continuous train of pulses. Since the frequency is held constant while the on-off time is varied, the duty cycle of PWM is determined by the pulse width. Thus the power increases duty cycle in PWM.

The Amplitude Shift Keying (ASK) is used in order to control the system wirelessly from a remote area. The hardware is designed with transmitting and receiving capabilities. Analogue output is fed to the FM Transmitter and sent through the antenna. At the other end, the FM Receiver picks up the signal and feeds it to the signal decoder, there the decoding takes place and this decoding data is given to the Microcontroller. [6]

1.2 Objectives

Basically, the objectives are a guideline and goal in order to complete this project is conducted to achieve the following objectives:

- To proceed the speed control of DC motor.
- To enable wireless scheme to control the DC motor.
- To design the simulation of the project.
- To build hardware for the project.
- To implement controller using microcontroller as programming and PWM.

1.3 Problem statements:

The problem encounter when dealing with DC motor is the lag of efficiency and losses.

Many practical control issues (motor control problems):

- Variable and unpredictable inputs.
- Noise propagation along a series of unit processes.
- Unknown parameters.
- Changes in load dynamics.

Major problems in applying a conventional control algorithm in a speed controller are the effects of non-linearity in a DC motor. The non-linear characteristics of a DC motor such as saturation and friction could degrade the performance of conventional controllers. Many advance model-based control methods such as variable-structure control and model.

1.4 Proposed solutions:

In order to eliminate those problems, controller was introduced to the system. There's few type of controller but in this project Atmega16 Microcontroller with PWM technique was used to control the speed of DC motor in the Hard Implementation.

1.5 Methodology :

Doing analysis and research on the project is the main things that had to be implemented first. On this purpose, all the information is collected from the sources such as, reference books, journals and from the internet (i.e. cascade control structure, transfer function and DC motor).

In order to achieve the objective of the project, there are several scope had been outlined. The control algorithm is builder in BASCOM software and downloads by programmer in the microcontroller to program microcontroller, build hardware for the system and to achieve the control of DC motor. The Pulse Width Modulation then is derived using the velocity equation to get the velocity of the DC motor speed. The speed acquired and the signal send can create a closed loop system with PI controller to control the speed of the DC motor.

Use the ASK wireless to control the speed and direction of dc motor remotely to a distance reaches 100 meter .An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna ,The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

1.6 Outline of thesis:

This thesis contains five chapters:

Chapter1: discusses the objective and scope of the project as long as summary of works.

Chapter 2: will discuss more on theory and literature reviews that have been done. It well discuss about types of motor, speed control technique and Microcontroller.

Chapter3: the discussion will be on the methodology hardware and software implementation of this project.

Chapter 4: The result and discussion will be presented in.

Chapter 5: discusses the conclusion of this project and Recommendation that can be done.