

# **MICROCONTROLLER BASED ADJUSTABLE SPEED CLOSED-LOOP DC MOTOR DRIVE**

**By**

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**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in  
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**Chairman: Samsul Bahari Mohd Noor, Ph.D.**

**Faculty: Engineering**

The speed control of DC motors is very crucial especially in applications where precision and protection are of importance. This work investigates and implements a microcontroller-based adjustable speed drive system for a DC shunt motor. The theory of the armature voltage control algorithm in a closed loop system has been successfully implemented.

An IGBT switch is used in buck configuration to control the armature voltage of the motor. The PWM signal that controls the IGBT is generated from a Motorola 68HC11 microcontroller. The speed of the motor is measured by a shaft encoder and directly fed to the microcontroller along with a speed reference signal.

A data acquisition routine reads the measured speed and the reference speed in digital format and generates the error value signal. The error value signal is directly fed into the proportional controller routine to commute the controller output.

Finally, the controller output is used to generate a PWM, which completes the loop by controlling the switch. To protect the motor from high current, a current monitoring routine is implemented to read the motor current through a Hall effect sensor. If the motor current is higher than its rated current halting the PWM generation routine will stop it.

Experimental results obtained have supported the idea of the design. The speed of the motor could be controlled over a wide range using the dc chopper and the PWM.

Employment of a microcontroller has shown a great improvement in the acceleration, speed reduction, and deceleration and over current protection of a dc motor.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai  
Memenuhi keperluan untuk Ijazah Master Sains

**LITAR TERTUTUP BOLEH-UBAH KAWALAN KELA JUAN MOTOR DC  
BERAZASKAN PENGAWAL-MIKRO**

**Oleh**

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Kawalan kelajuan bagi motor dc adalah penting terutama dalam sesuatu penggunaan yang memerlukan persetujuan ketepatan dan perlindungan. Bidang elektrik kuasa telah membangun dan berkembang pada masa sekarang. Pelbagai peranti kawalan telah dibangunkan untuk memudahkan kawalan motor ciri. Ini ditambah lagi dengan litar bersepadu, pemproses mikro, mikropengawal yang diletakkan pada posisi yang betul bagi pemprosesan isyarat dan kawalan bagi pacuan elektrik.

Kajian terkini telah memfokuskan kepada ciri-ciri peranti elektrik kuasa dan parameter yang sedia ada pada mereka untuk digunakan sebagai suis keadaan padu.

Penggunaan kaedah keadaan padu yang berbeza telah sedia ada bagi kawalan yang tepat untuk kelajuan dan perlindungan bagi motor. Kesemua fungsi ini telah memperbaiki bila penggunaan litar bersepadu pengawal mikro digunakan.

Dalam tesis ini, penggunaan mikro-pengawal untuk kawalan laju dan perlindungan motor dc dibentangkan. Voltan anker bag motor diubah dengan menggunakan satu pemenggal dc yang mana ia merubah kelajuan motor. Pengawal mikro akan mengesan isyarat kelajuan yang disupbalik dan seterusnya menghasilkan isyarat PWM yang akan melaraskan voltan get bagi pemenggal dimana ia akan menghasilkan voltan yang diperlukan bagi sesuatu kelajuan.

Kelebihan kaedah ini adalah ia boleh disesuaikan pada kadaran motor yang berbeza. Ia juga dibanagunkan dengan mesra pengguna. Satu padkunci dan satu paparan disediakan untuk antaramuka fungsi yang diperlukan dan parameter terpilih boleh dilihat pada satu paparan. Dengan cara ini operator yang tidak mahir juga boleh menggunakan sistem ini. Keputusan ekperimen menguatkan idea untuk merekabentuk. Kelajuan motor boleh dikawal dengan lebih luas dengan menggunakan pemenggal dc dan PWM. Penggunaan mikro-penagwal telah menunjukkan satu kemajuan dalam pecutan, balikan kelajuan, kelambatan dan perlindungan arus lebihan bagi satu motor dc.

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I certify that an Examination Committee met on 04 February 2004 to conduct the final examination of Yousef S. Ettomi Ali on his Master of Science thesis entitled “Microcontroller Based Adjustable Closed-loop DC Motor Speed Controller” in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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## **DECLARATION**

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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**YOUSEF S. ETTOMI Ali**

Date:

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