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SPEED CONTROL OF DC MOTOR USING ARDUINO

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ABSTRACT:

This work presents a simple speed control application for a DC motor in laboratory use. The purpose of this application is to maintain the desired speed on a generator operating on the same axis to the motor.

Two small laboratory DC machines of 1kw and 300W nominal power have been used for testing the controller. Close loop control has been applied by using appropriate speed encoder. The controller functions as a DC chopper and PWM signal is produced by an Arduino UNO controller. The nominal input voltage was 200Volt, so IGBT switching devices were used.

There are over voltage and over current protections and, moreover, a mode without speed metering is available (open loop control scheme). A detailed analysis is provided on the equipment and the techniques that have been used for the control of the power electronic device. The scope of this work was to plan and test the controller, in terms of energy efficiency and economical operation.

This study presents the critical results of the tests focusing on the best operational point and discusses the related conclusions. The controller's operation was efficient in both low and high speeds that were tested.

KEYWORDS:

DC MOTOR CONTROLLER; DC CHOPPER; ENERGY EFFICIENCY IN MOTORS.

INTRODUCTION

DC motors have many applications in many fields of industrial, commercial and other activities, such as robotics, automobiles, servomechanisms etc. The electric drive systems used in many industrial applications require higher performance, reliability, variable speed due to their ease of controllability. The speed control of a DC motor is crucial in applications where precision and protection are essential. The purpose of a motor speed controller is to take a signal representing the required speed and to drive a motor at that speed. Microcontrollers can provide easy control of a DC motor. A microcontroller-based speed control system consists of an electronic component and a microcontroller. There are many applications of DC motor drives that use power electronics to control the voltage and consequently the speed or position of the motor. For large motors it is highly economical to use power electronics, in order to minimize the power loss and the size of the motor. DC choppers are easily implemented.

In this paper, an Arduino UNO system (microcontroller) was used for the control signal. The DC motor fed by a DC chopper that was driven by the Arduino UNO microcontroller. The chopper is driven by a high frequency PWM signal. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn directly adjusts the motor speed. This work is a practical one and highly feasible from an economic and accuracy point of view.

The desired objective is to achieve a system running on a desired constant speed at any load condition. That means the motor will run on a fixed speed instead of varying with the amount of load.

MATERIALS:

DC MOTOR:

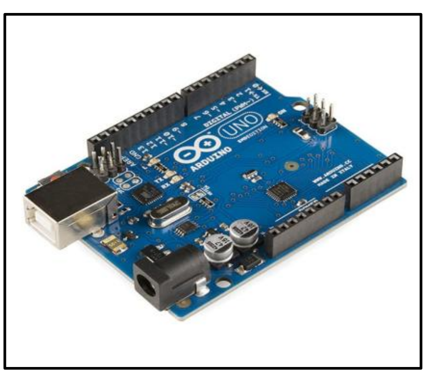
A DC motor is an electric motor that runs on direct current power. In an electric motor, the operation is dependent upon simple electromagnetism. A current-carrying conductor generates a magnetic field, when this is then placed in an external magnetic field, it will encounter a force proportional to the current in the conductor and to the strength of the external magnetic field. It is a device that converts electrical energy to mechanical energy. It works on the fact that a current-carrying conductor placed in a magnetic field experiences a force that causes it to rotate with respect to its original position. Practical DC Motor consists of field windings to provide the magnetic flux and armature which acts as the conductor.

The input of a brushless DC motor is current/voltage and its output is torque. Understanding the operation of the DC motor is very simple from a basic diagram is shown below. DC motor basically consists of two main parts. The rotating part is called the rotor and the stationary part is also called the stator. The rotor rotates with respect to the stator.

The rotor consists of windings, the windings being electrically associated with the commutator. The geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnets are misaligned and the rotor will turn until it is very nearly straightened with the stator's field magnets.

As the rotor reaches alignment, the brushes move to the next commutator contacts and energize the next winding. The rotation reverses the direction of current through the rotor winding, prompting a flip of the rotor's magnetic field, driving it to keep rotating.

ARDUINO UNO:



The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino.cc developed the Arduino UNO board.

Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits.

The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

LCD WITH I2C MODULE:

The character LCD is ideal for displaying text and numbers and special characters. LCDs incorporate a small add-on circuit (backpack) mounted on the back of the LCD module. The module features a controller chip handling I2C communications and an adjustable potentiometer for changing the intensity of the LED backlight. An I2C LCD advantage is that wiring is straightforward, requiring only two data pins to control the LCD.

A standard LCD requires over ten connections, which can be a problem if your Arduino does not have many GPIO pins available. If you happen to have an LCD without an I2C interface incorporated into the design, these can be easily acquired separately.

The LCD displays each character through a matrix grid of 5×8 pixels. These pixels can display standard text, numbers, or special characters and can also be programmed to display custom characters easily.

CIRCUIT DIAGRAM:

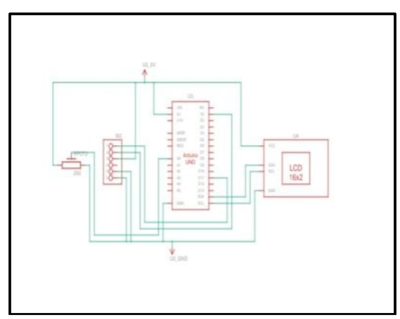


FIGURE: SYMMETRIC DIAGRAM OF SPEED CONTROL OF DC MOTOR USING ARDUINO

SAMPLE CODE:

```
#include <Adafruit_LiquidCrystal.h>
 // C++ code
 //
volatile int count = 0;
int interruptPin = 2;
float speedRPM = 0;
Adafruit_LiquidCrystal lcd_1(0);
void encoderPulse()
{
   count++;
}
void setup()
{
   Serial.begin(9600);
   pinMode(11,OUTPUT);
   lcd_1.begin(16, 2);
   lcd_1.setCursor(12, 0);
   lcd_1.print("VOLTS");
   lcd_1.setCursor(13, 1);
   lcd_1.print("RPM");
   pinMode(2, INPUT_PULLUP);
   attachInterrupt(digitalPinToInterrupt(2), encoderPulse,
RISING);
}
 void loop()
 {
    //put your main code here,
    float potvalue=analogRead(A0);
    float Measured_voltage=potvalue*5/1023;
    analogWrite(11,potvalue/4);

    lcd_1.setCursor(0, 1);
    count = 0;
    delay(200);
    speedRPM = count * 6.25;
    lcd_1.print(speedRPM);
    Serial.print("Measured_voltage");
    Serial.println(Measured_voltage);
    delay(100);
 }
```

RESULTS:

Towards to establish speed control, many tested have been taken place. Below in summary charts Torque to duty cycle are presented in the cases (scenarios) examined in two laboratory DC machines and the simulation model in MATLAB.

Notice that the slope of the curve changes depending on the machine power. For the Encoder motor which has quite higher power, there was more adjustment

Range for duty cycle stabilizer speed. It is reasonable because we have a greater range of load we can serve.

Also what can be presented as a conclusion is the variation in efficiency, of their power provision. Overall efficiency is quite high, especially in the larger loads.

Also of interest is the comparison of experimental measurements in relation to measurements in MATLAB as shown in the two graphs below, and to the change of the speed in relation to the duty cycle for various constant loads. The curve shows their inclinations are equivalent.

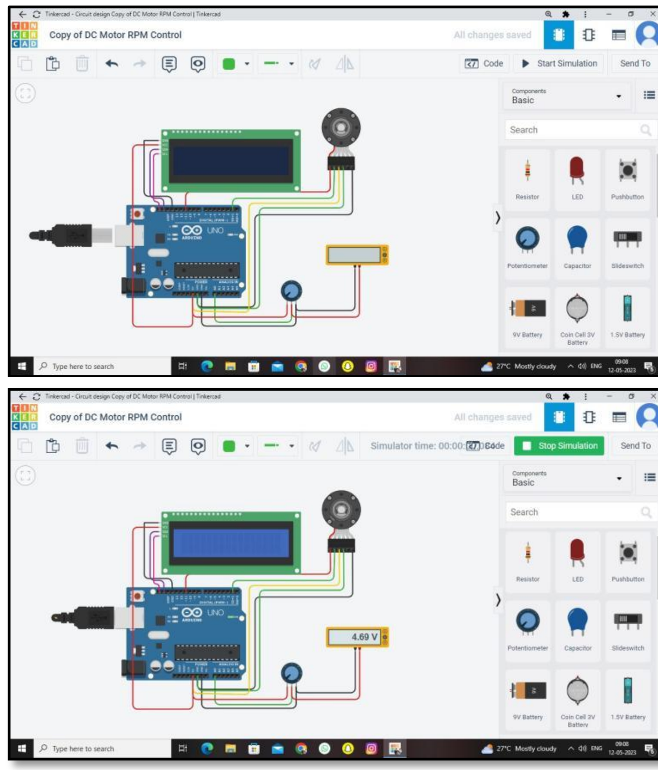


FIGURE: SPEED CONTROL OF DC MOTOR USING ARDUINO

CONCLUSION:

From all the measurements for the experimental devices implemented in the electrical machinery workshop, can be exported appropriate modelling for each engine in order to measure the drum power to determine the duty cycle for the desired constant speed. This contributes to the linearity of the operation of the DC motor, with constant agitation.

First, it was the automatic feedback speed control using tacho signal from the machine shaft. When performing experiments but found that the speed measuring device was defective, and not having any other option we turned to open-loop control, with potential for expansion in a closed loop, or using tacho, or drum current measuring device.

REFERENCES

1. Atul Kumar Dewangan, Nibbedita Chakraborty, Sashi Shukla, Vinod Yadu. "PWM Based Automatic Closed Loop Speed Control of DC Motor". International Journal of Engineering Trends and Technology (IJETT). V3(2):110-112 Mar-Apr 2012. ISSN:2231-5381. www.ijettjournal.org.published by seventh sense research group

2. Modeling, Simulation and Dynamics Analysis Issues of Electric Motor, for Mechatronics Applications, Using Different Approaches and Verification by MATLAB/Simulink, Ahmad A. Mahfouz, Mohammed M. K., Farhan A.Salem, International Journal of Intelligent Systems and Applications (IJISA)PP.39-57, Pub. Date: 2013-4-1http://www.mathworks.com/help/physmod/elec/ref/dcmotor.html

3. "Construction of a speed control device for an electric DC motor with power chopper circuit (DC chopper) Bachelor Thesis, Chairetis Vasilis, TEI of Crete -Department of Electrical Engineering TE, February 2014

4. " Speed control of asynchronous three-phase motor power 1KW using microcontroller" bachelor Thesis, John Pittos , TEI of Crete -Department of Electrical Engineering TE, Heraklion 2010

5. Electric Machines AC-DC - Stephen ChapmanR. Krishnan - Electric Motor Drives Modeling, Analysis, And Control

6. Akhilendra Yadav, Gurleen Kaur, Akanksha Sharma, MICROCONTROLLER BASED OPEN-LOOP SPEED CONTROL SYSTEM FOR DC MOTOR,IJREAS Volume 2, Issue 6 (June 2012) ISSN: 2249-3905

7. Sensorless speed/position control of brushed DC motor, Saadat Res. Inst., Shahid Beheshti Univ., Tehran, DOI: 10.1109/ACEMP.2007.4510598 Conference: Electrical Machines and Power Electronics, 2007. ACEMP '07