SENSORS AND ACTUATORS

DC MOTOR AND MAGNETOMETER

Laboratory Guide

IDENTIFICATION

Weekday	Date	Hour	Group	Students
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INTRODUCTION

The magnetoresistance effect is the increase in electrical resistance to the flow of electrons in a given direction in the presence of a magnetic field. This increase is due to the scattering of the conduction electrons caused by the magnetic field which results in less overall current flowing through the device. This happens in transition metals like Nickel where most charge carriers are electrons in the 4s orbital. Those electrons scatter more when traveling parallel to the magnetization.

A DC motor also uses the interaction between a magnetic field and an electric current to produce, in this case, a movement of rotation. The stator consists of a permanent magnet. The rotor includes one coil driven by a DC current. The current direction switches every half revolution of the rotor so that torque is always in the same direction which leads to a continuous rotation of the motor.

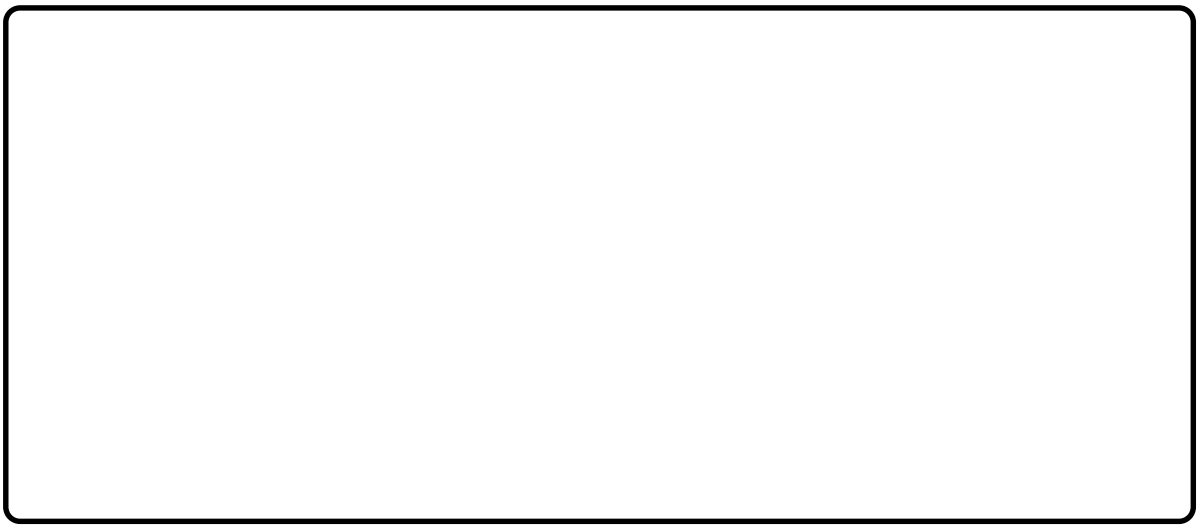
In this work one wants to measure the rotational speed of the DC motor using an anisotropic magnetoresistive effect sensor, model HMC5883 from Honeywell, to detect the change in the magnetic field of a permanent magnet attached to the motor shaft. A microcontroller is used which receives information from the magnetoresistive sensor and generates a PWM (pulse width modulation) signal to control the speed and direction of rotation of the motor.

Recommended reading: https://en.wikipedia.org/wiki/Magnetoresistance and https://en.wikipedia.org/wiki/DC_motor.

EXECUTION

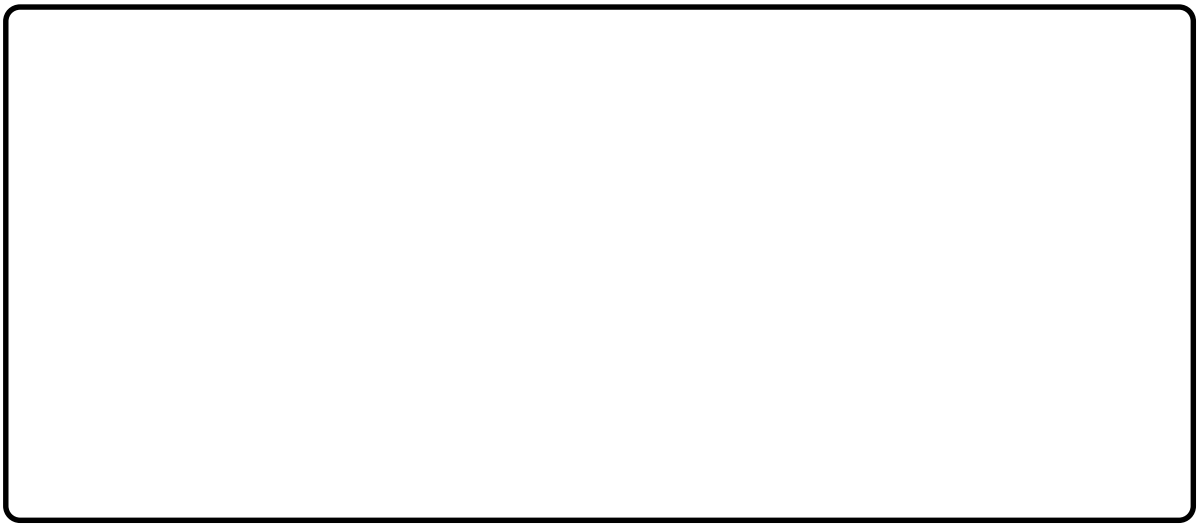
1) Driving the DC Motor

Use an Arduino microcontroller with an Ardumoto Motor Driver Shield (H-Bridge) to make the DC motor rotate in both directions. Present the electrical circuit assembled.



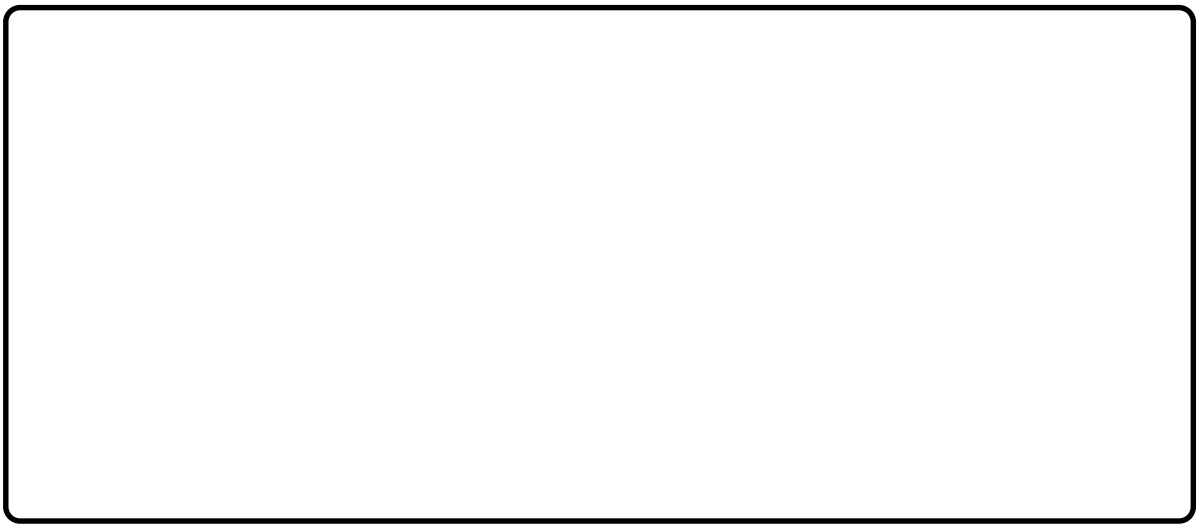
2) Measuring rotation speed with the magnetoresistive sensor

Attach the permanent magnets available to the shaft of the DC motor. Place the magnetoresistive sensor in proximity in order to detect the presence or absence of the magnetic field created by these magnets in various stages of rotation. Connect the sensor to the microcontroller and develop the software to determine the rotation speed and display it to the user. Draw the structure built. And discuss the operation of the measurement system.



3) Angular Velocity versus Voltage Transfer Function

For five different values of voltage applied to the motor (determined by the duty cycle of the PWM signal) measure the rotational speed. Plot the graph of the rotational speed versus voltage. Comment the result.



MATERIAL

- 1 DC motor.
- 1 magnetoresistive sensor Honeywell HMC5883.
- 1 board with an Arduino UNO microcontroller.
- 1 Ardumoto Motor Driver Shield (H-Bridge).
- A set of permanent magnets.