

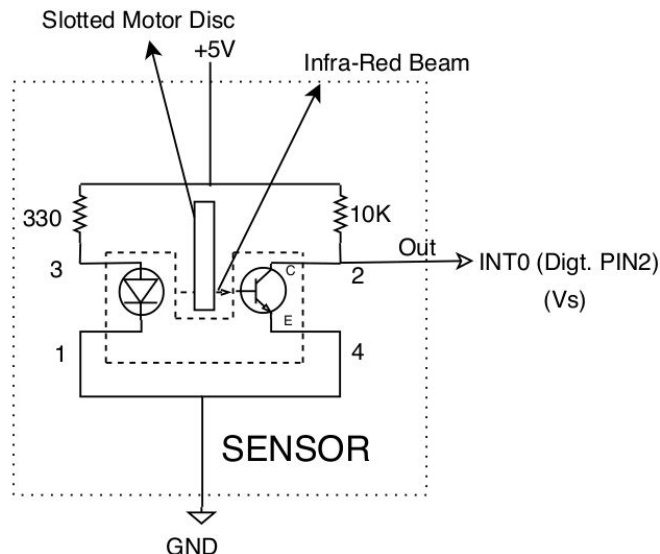
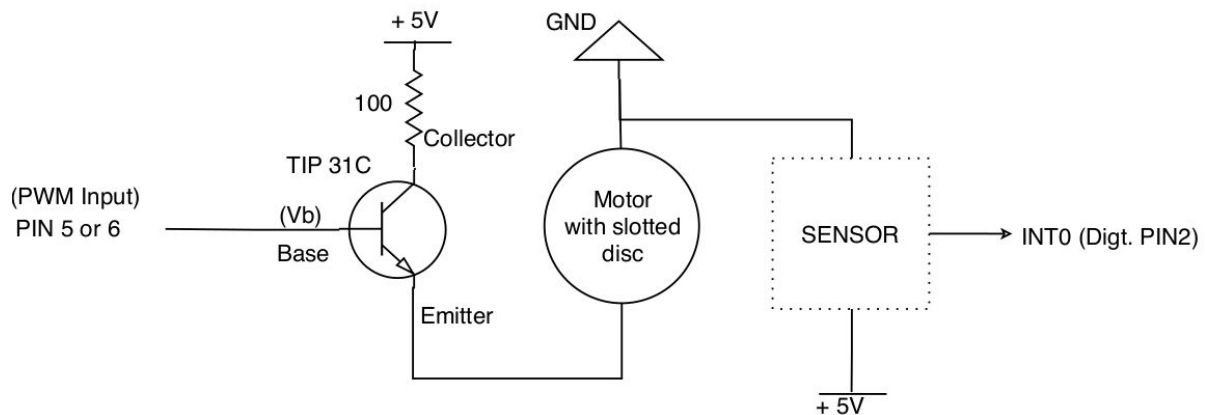
Experiment - 9

Monsoon 2018

Speed Control of a small DC Motor

Small DC motors like those used in cassette players and disc drives, use permanent magnet stators, and the speed of the motor depends only on the voltage applied to the rotor. The most convenient and energy-efficient way of controlling the speed of such motors is to apply a Pulse Width Modulated (PWM) voltage to the motor and control the duty cycle of the PWM waveform. The ATmega328 Microcontroller provides several PWM outputs with programmable duty cycles. In this experiment, the motor will be driven by PWM pin (Say Vb) through a transistor (TIP 31C), and the motor speed will be measured by means of an optical sensor (a circular disc with 20 holes along its periphery mounted on the motor shaft, passing through the slot of an optical switch (SENSOR)).

As the motor runs, the infra-red beam of the optical switch (SENSOR) gets alternately passed and blocked, resulting in a pulse stream having 20 pulses per revolution of the motor. This pulse output (say Vs) will be applied as the interrupt input INT0 of the microcontroller (Digital pin 2) and the speed will be measured by counting the number of interrupts coming in a pre-determined time interval, using default PWM frequency.



1. Motor speed control through PWM

- 1) Set up the circuit shown in the diagram.
- 2) Write a main program to perform the following sequence of jobs:
 - a) Program as usual for Serial write operation. Program Port digital pins as follows: PIN 5 or PIN 6 as output
 - b) Apply a 100 percent duty cycle output on the pin 5 or 6 for motor output.
 - c) Change the duty cycle from 10% to 100% in increments of 10% and observe the changes in the speed of the motor.

2. Getting Count from the Sensor

- 1) Write an interrupt routine to increment a variable (global & volatile) "count" every time the ISR is executed.
- 2) Program PIN2 as input to the interrupt and connect it to output of SENSOR.
- 3) Print the value of "count" on Serial Monitor.
- 4) Rotate the SLOTTED DISK by hand and observe the increment in "count".

3. Measurement of Speed (Optional)

- 1) Write a main program to perform the following sequence of jobs:
 - a) Program as usual for Serial write operation. Program Port digital pins as follows: PIN 5 as output, PIN 2 as input and Pin 6 as output.
 - b) Apply a 100 percent duty cycle output on the pin 5 or 6 for motor output.
 - c) Print the value of "count" on the Serial Monitor.
 - d) Go back to step b after a delay of 300 msec.
- 2) The value displayed on the Serial Monitor gives the count corresponding to the maximum speed of the motor, and one can hence find the value of count corresponding to any required speed.
- 3) Change the duty cycle and observe "count" as the duty cycle changes.

Ref: <https://www.arduino.cc/en/Tutorial/PWM>

Ref: <https://www.arduino.cc/reference/en/language/functions/analog-io/analogwrite/>