2EC403 – Microprocessor And Microcontroller

Special Assignment And Project

Topic : RPM Counter

Submitted by

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1. INTRODUCTION

A RPM Meter (also called Digital Tachometer) is a digital device that measures and indicates the speed of a rotating object. A rotating object may be a bike tyre, a car tyre or a ceiling fan, or any other motor, and so on. A digital tachometer circuit comprises LCD or LED read out and a memory for storage. They are more common these days and they provide numerical readings instead of dials and needles. It is an optical encoder that determines the angular velocity of a rotating shaft or motor. They are used in different applications such as automobiles, aero planes, and medical and instrumentation applications.

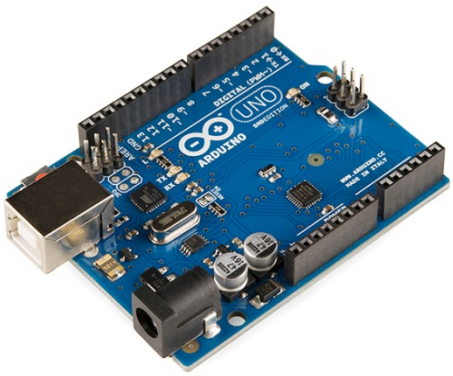
In this project we have designed Digital Tachometer/RPM Meter using IR Sensor with Arduino UNO for measuring the number of rotations of rotating Motor in RPM. Simply we have interfaced IR sensor module with Arduino UNO and Seven Segment LEDs for display. The IR sensor module consists of IR Transmitter & Receiver in a single pair that can work as a sensor for speed measurement of any rotating object.

2. COMPONENTS

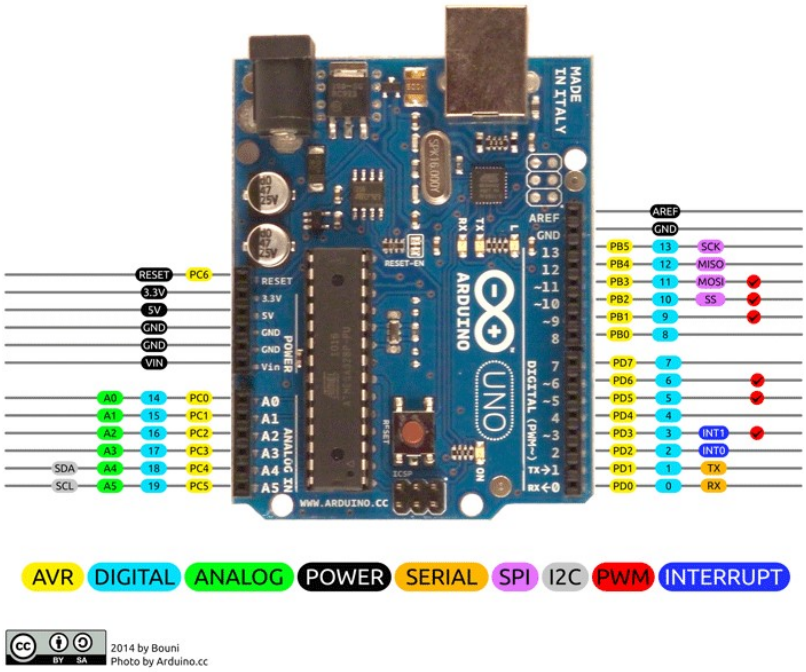
For designing Digital Tachometer using IR Sensor with Arduino & Seven Segment we need the following components:

A. Arduino Uno Board

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.



The pin configuration of the Arduino Uno board is shown in the above. It consists of 14-digital i/o pins. Wherein 6 pins are used as pulse width modulation o/ps and 6 analog i/ps, a USB connection, a power jack, a 16MHz crystal oscillator, a reset button, and an ICSP header. Arduino board can be powered either from the personal computer through a USB or external source like a battery or an adaptor.



This board can operate with an external supply of 7-12V by giving voltage reference through the IO Ref pin or through the pin Vin. Digital I/Ps It comprises of 14-digital I/O pins, each pin take up and provides 40mA current. Some of the pins have special functions like pins 0 & 1, which acts as a transmitter and receiver respectively. For serial communication, pins-2 & 3 are external interrupts, 3,5,6,9,11 pins delivers PWM o/p and pin-13 is used to connect LED.

Analog i/ps: It has 6-analog I/O pins, each pin provide a 10 bits resolution.

Aref: This pin gives a reference to the analog i/ps.

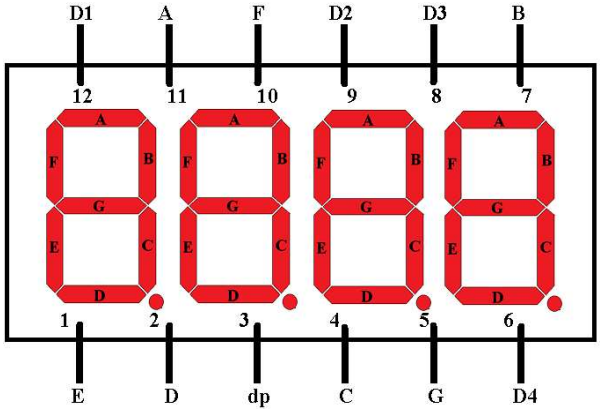
Reset: When the pin is low, then it resets the microcontroller.

Arduino Architecture:

Basically, the processor of the Arduino board uses the Harvard architecture where the program code and program data have separate memory. It consists of two memories such as program memory and data memory. Wherein the data is stored in data memory and the code is stored in the flash program memory. The Atmega328 microcontroller has 32kb of flash memory, 2kb of SRAM 1kb of EPROM and operates with a 16MHz clock speed

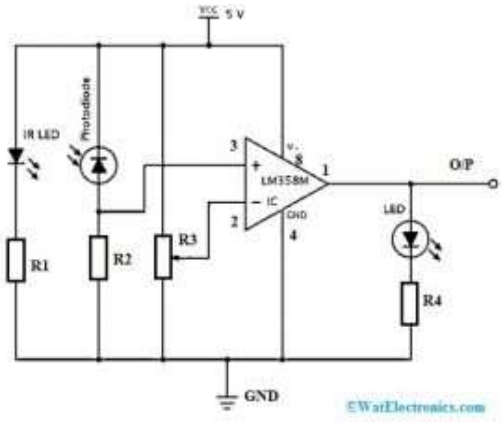
B. Four digit Seven Segment Display (Common Cathod Configration)

A 7 segment LED display consists of 7 LEDs arranged in such a way that it can display numbers from 0 to 9. The arrangement of LEDs in the display can be either common anode or common cathode. In this project, a 4 – digit 7 – segment LED display is used to display numbers using Arduino. Either a compact module containing four 7- segment LED displays can be used or four individual 7 – segment displays can be used by multiplexing them.



C. IR Sensor module

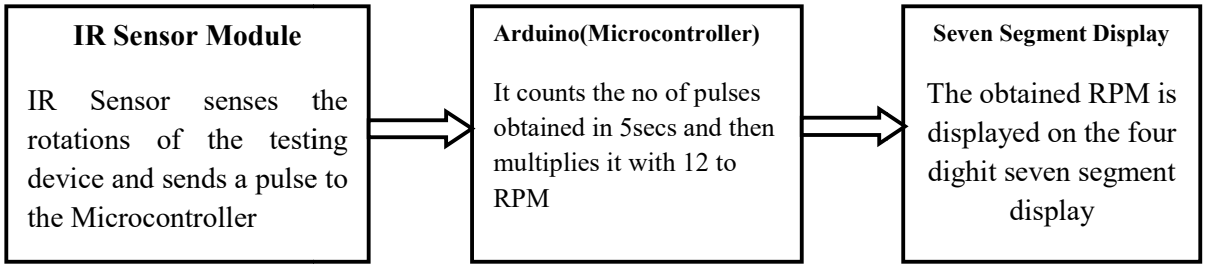
i. IR Transmitter and Receiver Pair
ii. LM358
iii. Resistors (560Ω x2 and 10kΩ)
iv. Variable Resistor 10kΩ



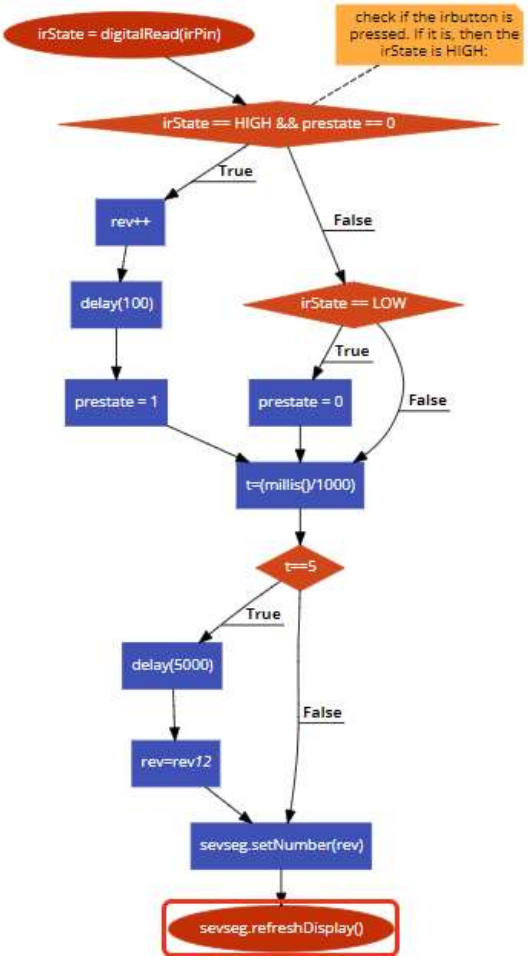
An infrared sensor is an electronic instrument used to sense certain features of its surroundings by either emitting and/or detecting infrared radiation. Infrared sensors are also able to measure the heat given off by an object and detect movement. The wavelength range from 0.75 to 3 m is known as the near infrared range. The range between 3 and 6 m is called mid-infrared, and infrared radiation with a wavelength longer than 6 m is called far-infrared.

D. Breadboard
E. Jumper Wires
F. ***DC Motor:*** A DC Motor is used as a testing equiment for our project
G. ***RPM Meter:*** A stanadarised RPM Meter is used to verify our project

3. BLOCK DIAGRAM



4. FLOW CHART



5. CODE

```
#include "SevSeg.h"   //Seven Segment Library is used
SevSeg sevseg;                  //An object has been created

const int irPin = 13;     // the pin number where IR ouput is connected

// variables will change:
int irState = 0;         // variable for reading the ir status
int prestate =0;
int rev=0;
int t=0;
int con=0;

void setup()
{
   byte numDigits = 4;                // We are using all four seven segment digits
   byte digitPins[] = {9,10,11,12};      // Pin No of digit selction pin
   byte segmentPins[] = {2,3,4,5,6,7,8}; // Pin No of A,B,C,D,E,F,G
   bool resistorsOnSegments = true;

   byte hardwareConfig = COMMON_CATHODE; // Seven Segment dispay is Common Cathod Type
```

```
  sevseg.begin(hardwareConfig, numDigits, digitPins, segmentPins, resistorsOnSegments);
  sevseg.setBrightness(90);

  pinMode(irPin, INPUT);          // initialize the ir pin as an input
}

void loop()
{
   irState = digitalRead(irPin);

   // check if the ir pin is active. If it is, then the irState is HIGH:
   if (irState == HIGH && prestate == 0)
   {
     rev++;
     delay(100);
     prestate = 1;
   }
   else if(irState == LOW)
   {
    prestate = 0;
   }

   t=(millis()/1000);
   sevseg.setNumber(rev);
   sevseg.refreshDisplay();

   if(t==5)
   {
      con=rev*12;                          //Rotations for 5sec is obtained and then multiplied with
                                           12 to give RPM
      delay(5000);
      sevseg.setNumber(con);
      sevseg.refreshDisplay();             //Display the RPM
   }

}
```

6. WORKING

In this circuit, the IR sensor module is interfaced with Arduino to measure fan rotation speed in RPM. The calculation is done on this basis.

After 5 seconds Arduino calculates RPM for a minute using the given formula.

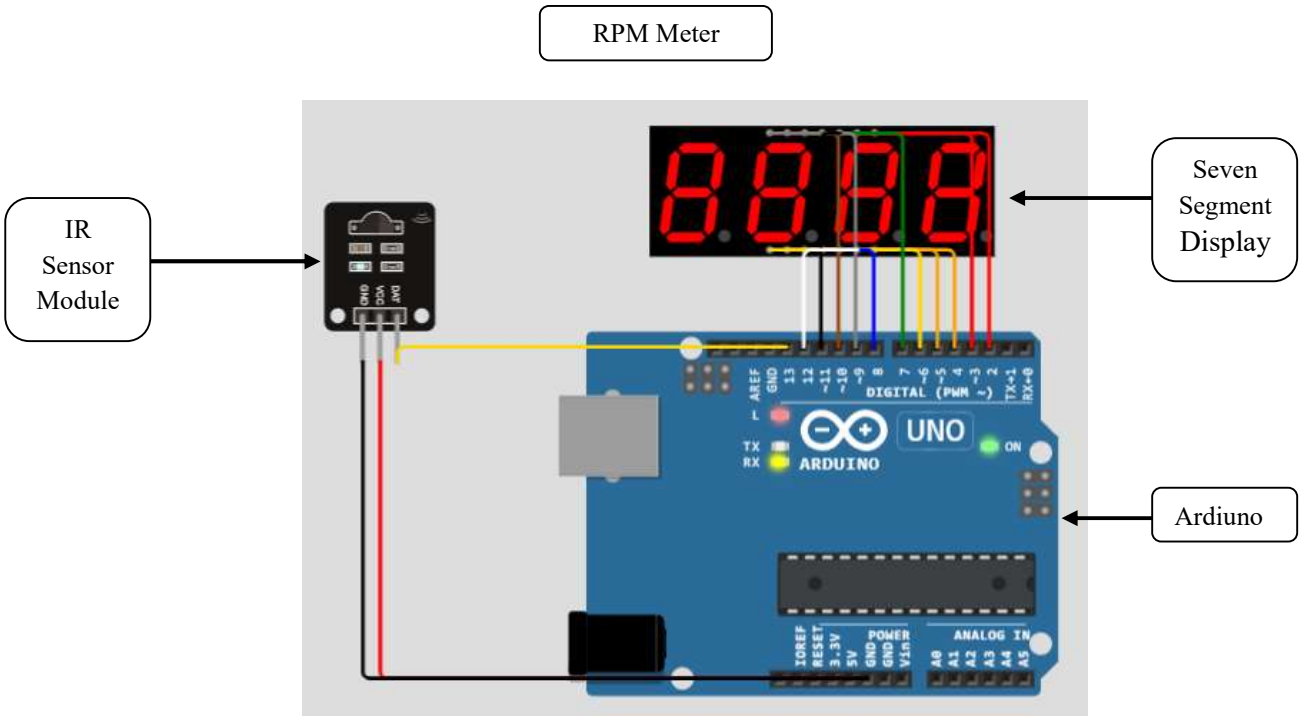
RPM= Count x 12 for single object rotating body.

But here we demonstrate this project using a ceiling fan. So we have done some changes that is given below:

RPM=count x 12 / objects

Where object = number of the blade in a fan.

7. INTERFACING OF ARDIUNO WITH SEVEN SEGMENT DISPLAY AND IR SENSOR MODULE



8. APPLICATIONS

- It is used to measure rotational speed.
- It can measure the flow of liquid with the help of an attached wheel with an inclined angle.
- It is applicable for the medical sector to measure the blood flow rate of the patients.
- It is used in vehicles to display the rate of engine crankshaft rotation.

9. CONCLUSION

The tachometer is one of the crucial elements in industrial motor control. Some of its basic functions include motor speed monitoring, counting, process control and ratio/pull application. While it is applicable to equipment such as conveyor belt, windmill, rotary valve, mill, dryer, auger, elevator, etc. Suitable industries include power plants, recycling and chemical plants, automotive and materials handling, food and beverage, paper mills, etc. Keep your equipment and car safe now by measuring the working speed of a motor and the safe speed range with help of a tachometer.

10. COST OF COMPONENTS

Sr No.	Component	Price
1.	Ardiuno	Rs 530/-
2.	Four Digit Seven Segment Display	Rs 63/-
3.	IR Pair	Rs 15/-
4.	LM358	Rs 10/-
5.	Resistors	Rs 5/-
6.	Variable resistor	Rs 10/-
7.	Red LED	Rs 2/-
	Total cost	Rs 635/-