Frequency Counter Using Arduino

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Abstract: *Frequency Counter, as the name indicates, is an electronic device or component, which is used to measure the frequency of a signal. In case of a repetitive electronic signal, a frequency counter measures the number of pulses in that signal.We generally use an oscilloscope to depict the signal, calculate the time period of the signal and finally convert it to calculate the frequency of the signal. But, oscilloscopes are very expensive and everyone cannot afford it.Hence, a simple Digital Frequency Counter can be built which might come in handy to measure the frequency of a clock signal, for example.In this project, an Arduino based Digital Frequency Counter is designed to measure the frequency of an incoming signal.*

1. Introduction

Almost every electronic hobbyist must have faced a scenario where he or she must measure the frequency of signal generated by a clock or a counter or a timer. We can use oscilloscope to do the job, but not all of us can afford an oscilloscope. We can buy equipment for measuring the frequency but all these devices are costly and are not for everyone. With that in mind we are going to design a simple yet efficient Frequency Counter using Arduino Uno and Schmitt trigger gate.

This **Frequency Counter** is cost effective and can be easily made, we are going to use **ARDUINO UNO** for the measuring the frequency of signal, UNO is the heart of project here.To test the Frequency Meter, we are going to make a dummy signal generator. This dummy signal generator will be made by using a 555 timer chip. The timer circuit generates a square wave which will be provided to UNO for testing.With everything in place we will have a Frequency meter and a square wave generator.

The design of the Frequency Counter using Arduino UNO can be divided in to two parts: The Arduino part, where the processing of the signal's information takes place and the Signal Generator part, where the signal whose frequency to be measured is generated.

2. Circuit Design

The design of the Frequency Counter using Arduino UNO can be divided in to two parts:
1)The Signal Generator part, where the signal whose frequency to be measured is generated.
2) The Arduino part, where the processing of the signal's information takes place.

Component Description

Arduino UNO: The ATmega 328P microcontroller based Arduino UNO is the main part of the project. It captures the time period of the incoming signal and calculates the frequency of the signal.

555 Timer IC: The 555 Timer IC is used as a pulse generator i.e. it works in astable mode.

16 X 2 LCD: The 16×2 LCD module is used to display the key information like welcome (or any custom) messages and the calculated frequency of the signal.
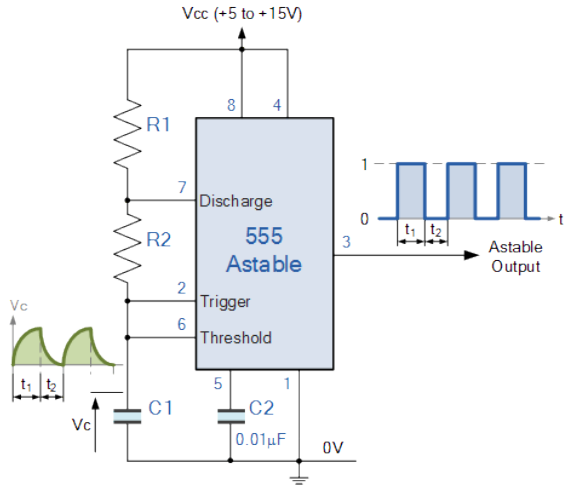
555 TIMER
IC 555 timer is a well-known component in the electronic circle. The timer got its name from the three 5 kilo-ohm resistor in series employed in the internal circuit of the IC.There are a lot of applications on the basis of this IC, mostly used as vibrators like, AstableMultivibrator, MonostableMultivibrator and BistableMultivibrator.It works as square-wave form generator with duty cycle varying from 50% to 100%, Oscillator and can also provide time delay in circuits. The 555 timer comes as 8 pin DIP (Dual In-line Package) device.
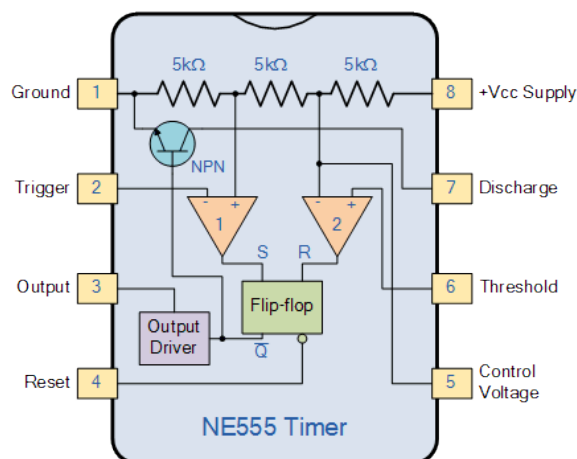
In this project we are using Astable mode of operation to generate a signal of certain frequency. When 555 timer IC is connected in Astable mode, it produces a very stable 555 Oscillator circuit. Hence highly accurate free running waveforms whose output frequency can be adjusted with the help of externally connected RC tank circuit consisting of just two resistors and a capacitor.

The obtained output signal (Rectangular waveform) has a frequency f which is given by the equation
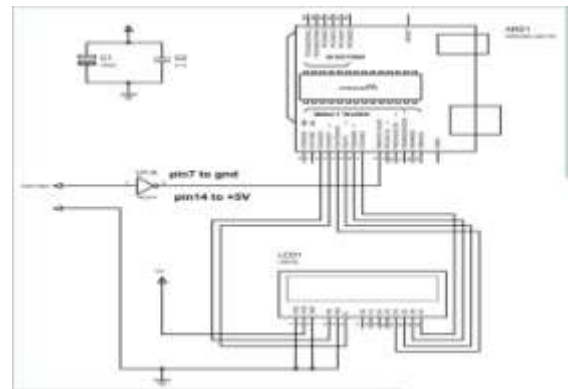$f=1/T=1.45/((R1+R2)C)$.

Schmitt Trigger

Schmitt trigger is an electronic circuit with positive feedback which holds the output level till the input signal to comparator is higher than the threshold.It converts a sinusoidal or any analog signal to digital signal. It exhibits hysteresis by which the output transition from high to low and low to high will occur at different thresholds.
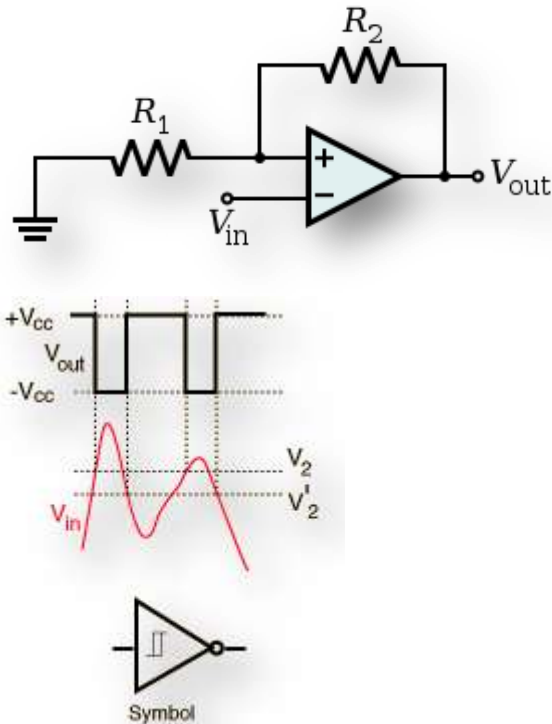
The necessity of using Schmitt trigger is to convert any form of signal into a rectangular form, because the arduino cannot detect a waveform another than rectangular or square waveform.

ARDUINO

Arduino is an open-source electronics platform based on easyto use hardware and software. Arduino boards are able to read input-light on a sensor, a finger on a button, a message and turn it into an output i.e activating a motor, turning on an led etc.

In the connection between Arduino and the 16x2 LCD Display, pins 1 and 2 of the LCD i.eVss and Vdd are connected to ground and 5V supply respectively. Pin 3 (Vee) which is used to adjust the contrast of the display, is connected to Potentiometer. Pins 4 and 6 (RS and E) of the LCD are connected to digital I/O Pins 2 and 3 of the Arduino. Pin 5 (RW) of the LCD is connected to ground.Pins 11 to 14 (D4 to D7) i.e. the data pins of the LCD are connected to the digital I/O pins 4 to 7 of Arduino. Pins 15 and 16 of the LCD are supply pins of the backlight LEDs and are connected to ground and 5V (Pin 16 to 5V through a 1KΩ resistor) respectively.

Source Code

The code which is used to count the frequency of the given input signal is as follows

```
#include <LiquidCrystal.h>
LiquidCrystallcd(2, 3, 4, 5, 6, 7);
intHtime;            //integer for storing high time
intLtime;            //integer for storing low time
float Ttime;         // integer for storing total time of a cycle
float frequency;     //storing frequency
void setup()
{
   pinMode(8,INPUT);
   lcd.begin(16, 2);
}
void loop()
{
   lcd.clear();
   lcd.setCursor(0,0);
   lcd.print("Frequency of signal");
   Htime=pulseIn(8,HIGH);     //read high time
   Ltime=pulseIn(8,LOW);      //read low time

   Ttime = Htime+Ltime;
```

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```
    frequency=1000000/Ttime;    //getting frequency with
Ttime is in Micro seconds
    lcd.setCursor(0,1);
    lcd.print(frequency);
    lcd.print(" Hz");
    delay(500);
}
```

LCD DISPLAY 16x2

An LCD is an electronic display module which uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7 pixel matrix.

3. Operation

As mentioned earlier, the 555 Timer IC is configured to operate in Astable mode. Hence, the output of the 555 Timer IC or rather the signal generator circuit is a pulse with variable frequency, which can be varied using potentiometer. This pulse is given as input signal to the Arduino UNO at one of its digital I/O pins.

In the Arduino, we make use of a function called "pulseIn ();" The function pulseIn can be used to read either LOW or HIGH pulse on a digital I/O pin and returns the length of the pulse in microseconds.

For example, if the pulseIn function is used to read a HIGH pulse on a pin, it waits for the pin to go HIGH. Once the pin goes HIGH, it starts the timer and runs until the pin goes LOW. The duration (in microseconds) of this HIGH pulse is then returned.

In our project, we are calculating the duration of the HIGH pulse and LOW pulse and by adding them together, we get the period of the input signal. Inverse of this value gives the frequency of the signal which is displayed on the LCD.

4. Applications

- A simple frequency counter, using simple components is designed that can be used to measure the frequency of a pulse without the need of an oscilloscope.
- Multiple ranges of frequencies can be measured by selecting suitable components.
- Frequencies of all types of test signals can be calculated by adding a Schmitt Trigger between the generated signal and Arduino.

5. Result

Hence, the input pulse wave which is given to input port of Arduino will be calculated and shown on the LCD display. As the value increases the error also increase by 1%. This helps in getting frequency of the input wave without using any costly device or Instruments.

References

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