A Review on PWM by Using 555 Timer circuit

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Abstract— The aim of development of this project is towards providing efficient and simple method for control speed of DC motor using PWM technique. The modulation of pulse width is obtained using scimit trigger and rectifier. There are several method for controlling the speed of DC motors. One simple method is to add series resistance using rheostat. As considerable power is consumed in the rheostat, this method is not economical. Another method is to use a series switch that can be closed or opened rapidly. This type of control is termed as chopper control. The PWM based circuit smoothy control the speed of general purpose DC motor. To get desired modulation of pulse width as output, we have used schimit trigger and rectifier within regulator as the source of varying output.

Keywords: PWM, 555 Timer circuit

I. INTRODUCTION

Today's industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production a reduced costs. The variable speed drives, which can control the speed of AC/DC motors are indispensably Today's industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production a reduced costs. The variable speed drives, which can control the speed of AC/DC motors are indispensably controlling elements in automation systems. Depending on the applications, some of them are fixed speed and some of the variable speed drives Direct Currents motors have been used in variable speed drives for a long time. The versatile characteristics of dc motors can provide high starting torque which is required for traction drives. Control over a wide speed range, both below and above rated speed can be very easily achieved. The methods of speed control are simpler and less expensive than those of ac motor. There are different technic available for the speed control of the dc motors. The phase control method is widely adopted in which ac to dc converter are used to supply the dc motor. But has certain limitation mainly it generates harmonics on the power line and it also has poor p.f. When operated at lower speeds. The seconds methods is PWM technique, which has got better advantages over the phase control method. In our project, it is a real time project and this can be further improvised by using more no. of IGBT provides two or four quadrant chopper which will vary the motor in bidirectional mode.

II. 555 TIMER CIRCUIT

The 555 Timer is a commonly used IC designed to produce a variety of output waveforms with the addition of an external RC network

We have seen that Multivibrators and CMOS Oscillators can be easily constructed from discrete components to produce relaxation oscillators for generating basic square wave output waveforms. But there are also dedicated IC's especially designed to accurately produce the required output waveform with the addition of just a few extra timing components.

One such device that has been around since the early days of IC's and has itself become something of an industry "standard" is the 555 Timer Oscillator which is more commonly called the "555 Timer".

The basic 555 timer gets its name from the fact that there are three internally connected 5kΩ resistors which it uses to generate the two comparators reference voltages. The 555 timer IC is a very cheap, popular and useful precision timing device which can act as either a simple timer to generate single pulses or long time delays, or as a relaxation oscillator producing a string of stabilised waveforms of varying duty cycles from 50 to 100%.

The 555 timer chip is extremely robust and stable 8-pin device that can be operated either as a very accurate Monostable, Bistable or Astable Multivibrator to produce a variety of applications such as one-shot or delay timers, pulse generation, LED and lamp flashers, alarms and tone generation, logic clocks, frequency division, power supplies and converters etc, in fact any circuit that requires some form of time control as the list is endless.

The single 555 Timer chip in its basic form is a Bipolar 8-pin mini Dual-in-line Package (DIP) device consisting of some 25 transistors, 2 diodes and about 16 resistors arranged to form two comparators, a flip-flop and a high current output stage as shown below. As well as the 555 Timer there is also available the NE556 Timer Oscillator which combines TWO individual 555's within a single 14-pin DIP package and low power CMOS versions of the single 555 timer such as the 7555 and LMC555 which use MOSFET transistors instead.

A simplified "block diagram" representing the internal circuitry of the 555 timer is given below with a brief explanation of each of its connecting pins to help provide a clearer understanding of how it works.

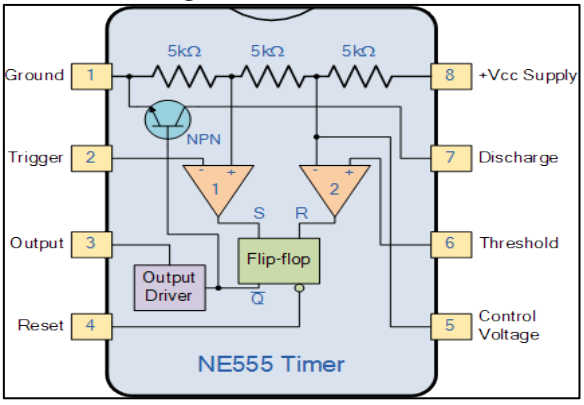

Fig. 1: 555 Timer Block Diagram

- Pin 1. – Ground, The ground pin connects the 555 timer to the negative (0v) supply rail.
- Pin 2. – Trigger, The negative input to comparator No 1. A negative pulse on this pin "sets" the internal Flip-flop

when the voltage drops below 1/3Vcc causing the output to switch from a "LOW" to a "HIGH" state.

- Pin 3. – Output, The output pin can drive any TTL circuit and is capable of sourcing or sinking up to 200mA of current at an output voltage equal to approximately Vcc – 1.5V so small speakers, LEDs or motors can be connected directly to the output.
- Pin 4. – Reset, This pin is used to "reset" the internal Flip-flop controlling the state of the output, pin 3. This is an active-low input and is generally connected to a logic "1" level when not used to prevent any unwanted resetting of the output.
- Pin 5. – Control Voltage, This pin controls the timing of the 555 by overriding the 2/3Vcc level of the voltage divider network. By applying a voltage to this pin the width of the output signal can be varied independently of the RC timing network. When not used it is connected to ground via a 10nF capacitor to eliminate any noise.
- Pin 6. – Threshold, The positive input to comparator No 2. This pin is used to reset the Flip-flop when the voltage applied to it exceeds 2/3Vcc causing the output to switch from "HIGH" to "LOW" state. This pin connects directly to the RC timing circuit.
- Pin 7. – Discharge, The discharge pin is connected directly to the Collector of an internal NPN transistor which is used to "discharge" the timing capacitor to ground when the output at pin 3 switches "LOW".
- Pin 8. – Supply +Vcc, This is the power supply pin and for general purpose TTL 555 timers is between 4.5V and 15V.

III. USES

The IC 55 timer is used in many circuits, for example One-shot pulse generator in Monostable mode as an Oscillator in Astable Mode or in Bistable mode to produce a flip/flop type action. It is also used in many types of other circuit for achievement of various purposes for instance Pulse Amplitude Modulatin (PAM), Pulse Width Modulation (PWM) etc.

IV. ASTABLE MODE TO GENERATE PWM OUTPUT AT CONSTANT FREQUENCY:

The problem in above PWM circuit is, its output frequency will also change as the output width changes. The output frequency is inversely proportional to the value of resistance. So as resistance is increased or decreased, the frequency is decreased or increased.

So what should be done to keep the output frequency constant or fixed?

The answer is again to use diode. This time not just one but two diodes. The circuit is as shown below.

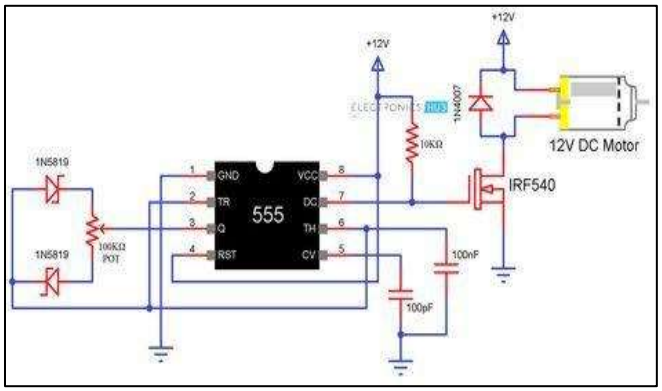

Fig. 2: Connections of 555 IC for PWM

V. CONNECTIONS

The two diodes are connected back to back with two terminals of 10K potentiometer with discharge pin as shown. The slider pin is connected with 1 µF capacitor and threshold pin. Rest of the connections are similar.

VI. WORKING

In this circuit, the dc motor is operated by a 555 Integrated circuit. The IC 555 in this circuit is being operated ed in a-stable mode mode, which produces a continuous HIGH and LOW pulses.

One of the best things about this circuit is that you can make it work as an a-stable multi vibrator with little hardware and little cost, which can save both the cost involved in making it as well as the space on the printed circuit board.

If you want a sophisticated pulse width modulator which works more accurately and which can have more adjusting capabilities, then it is better to use a micro controller based pulse width modulator than the one which we are using now.

However, the circuit or the application for which we are using a pulse width modulator is not so sensitive and hence does not demand so much of accuracy. In such a case, the circuit which we are using with a bare IC 555 is better as it saves our monetary as well as space resources in building the circuit.

The duty cycle of the circuit can be changed by changing the value of the potentiometer. If we increase the duty cycle, the speed of the motor increases and if we decrease the duty cycle, the speed of the motor decreases.

Thus by sliding pot on both side the ON time and OFF time increases / decreases but total time remains constant and that's why frequency also remains constant. The waveforms are as shown in figure.

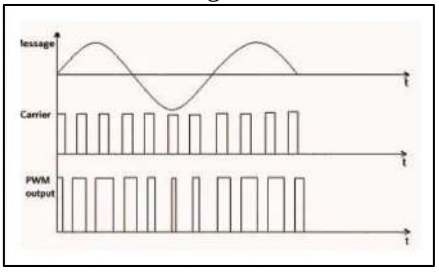

Fig. 3: PWM waveform by using 555 Timer circuit

VII. CONCLUSION

It fulfill all the requirements for its application. The motor respond to the average value of pulse and not to the individual pulses as the chopper works at high frequency. Changing the duty cycle of the pulse by changing the speed of regulator changes the average voltage level. It is possible to improve overall performance of the motor speed.

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