PWM DRAWER

Amit Graduation Project

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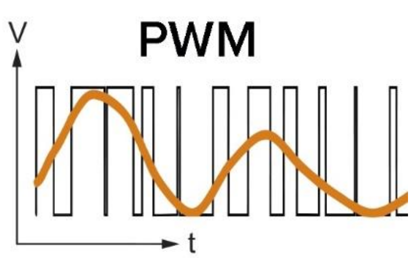
CONTENTS

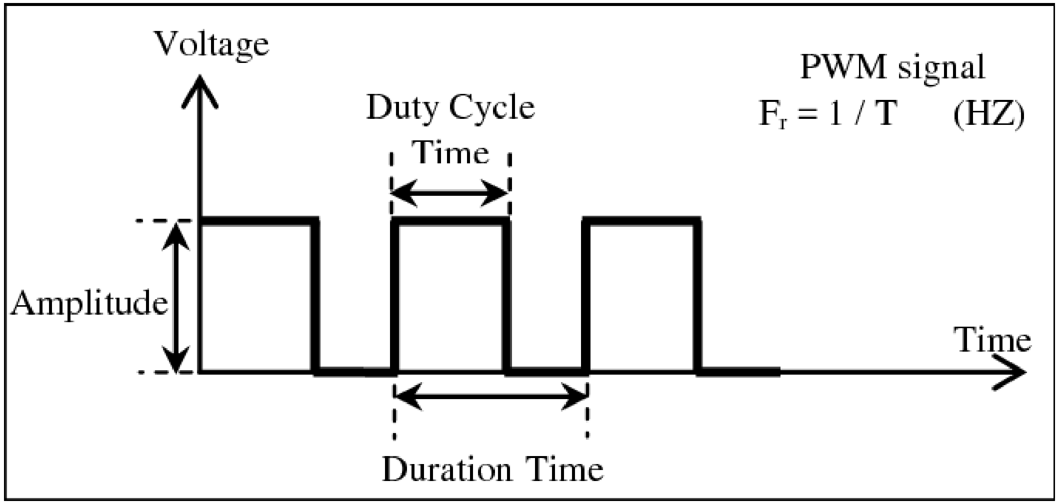
01 Introduction

Pulse width modulation is a powerful approach for controlling semiconductor devices. PWM, or pulse width modulation, is a typical control technique for generating analogue signals from digital devices such as microcontrollers. The resulting signal will comprise a train of pulses that are in the shape of square waves. As a result, the wave will be either high or low at any given time. In this project, PWM is utilized in a more straightforward manner to adjust the effective voltage applied to an external module.



1.1 Parameters Of PWM

The duty cycle is simply how much of the overall pulse time is taken up by the ON time.



Duty Cycle = On Time / Total Period

Frequency = 1/ Total Period

02 Project Configuration

PD7 is the output pin (internal PWM output):

- Using PWM Driver
- Fast PWM , non-inverting mode
- No prescaling (PWM_NO_Prescaling)

cycle can be calculated using the following formula in non-inverted mode:

$$\text{Duty Cycle} = \frac{OCR0 + 1}{256} \times 100$$

Similarly, the duty cycle formula for inverted mode is as follows:

$$\text{Duty Cycle} = \frac{255 - OCR0}{256} \times 100$$

Project Configuration cont.

PD6 is the input pin (PWM reading pin):

- TIMER1 (ICU Driver)
- Measuring with Input capture unit (ICU)

Measuring pulse width

We can use the following steps to measure the pulse width of a wave.

1. Initialize TCCR1A and TCCR1B, and select capturing on rising edge.
2. Initialize ACSR to select the desired event source.
3. Monitor the ICF1 flag in TIFR to see if the edge has arrived. Upon the arrival of the edge, the TCNT1 value is loaded into the ICR1 register automatically by the AVR.
4. Save the ICR1 and change the capturing edge to the falling edge.
5. Monitor the ICF1 flag in TIFR to see if the second edge has arrived. Upon the arrival of the edge, the TCNT value is loaded into the ICR1 register automatically by the AVR.
6. Save the ICR1 for the second edge. Subtract the second edge value from the first edge value to get the time.

Measuring period

We can use the following steps to measure the period of a wave.

1. Initialize the TCCR1A and TCCR1B.
2. Initialize the ACSR to select the desired event source.
3. Monitor the ICF1 flag in TIFR to see if the edge has arrived. Upon the arrival of the edge, the TCNT1 is loaded into the ICR1 register automatically by the AVR.
4. Save the ICR1.
5. Monitor the ICF1 flag in TIFR to see if the second edge has arrived. Upon the arrival of the edge, the TCNT is loaded into the ICR1 register automatically by the AVR.
6. Save the ICR1 for the second edge. By subtracting the second edge value from the first edge value we get the time. See Examples 15-23 and 15-24. Also see Figure 15-20.

03 Modularity

Application

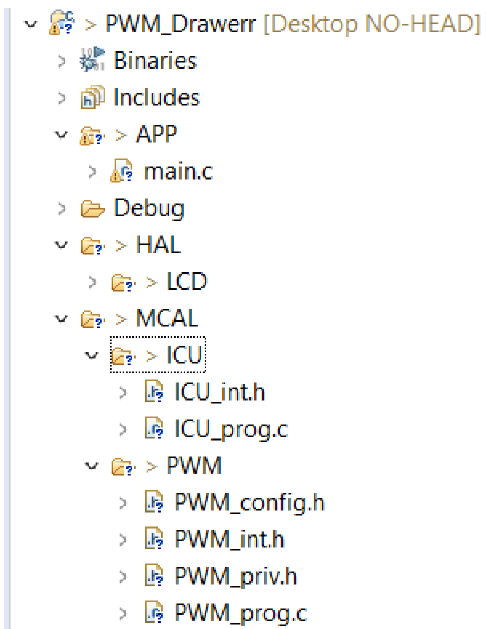
main.c

HAL

LCD (16x2) module

MCAL

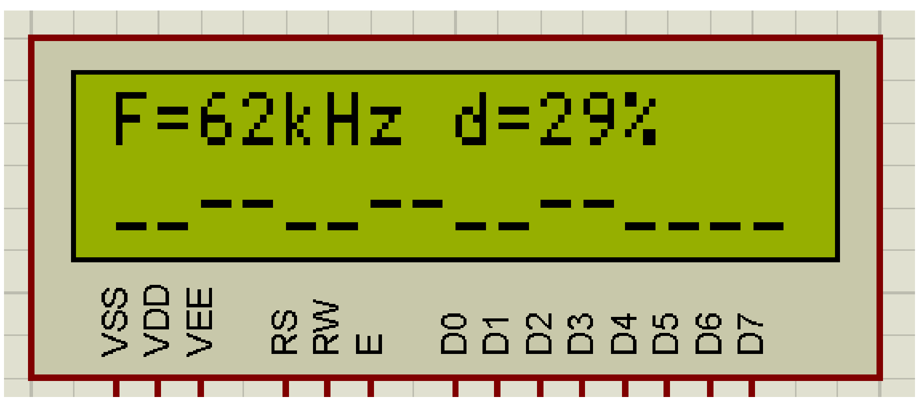
1) PWM (TIMER2 peripheral)
2) ICU (TIMER1 peripheral)

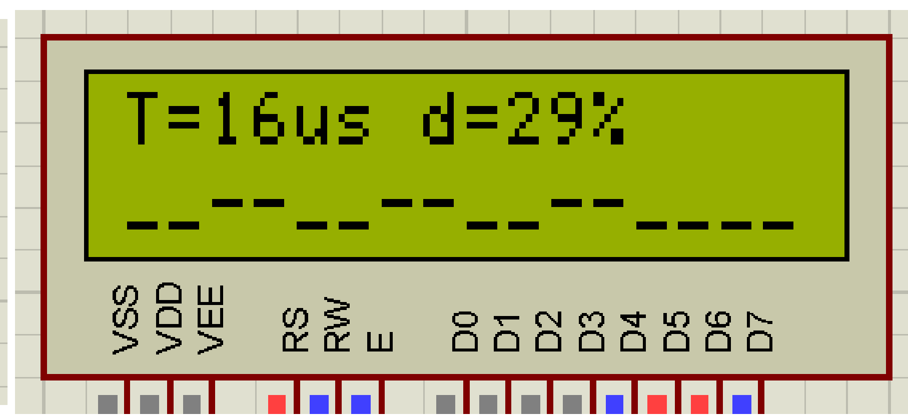


04 Display Mode

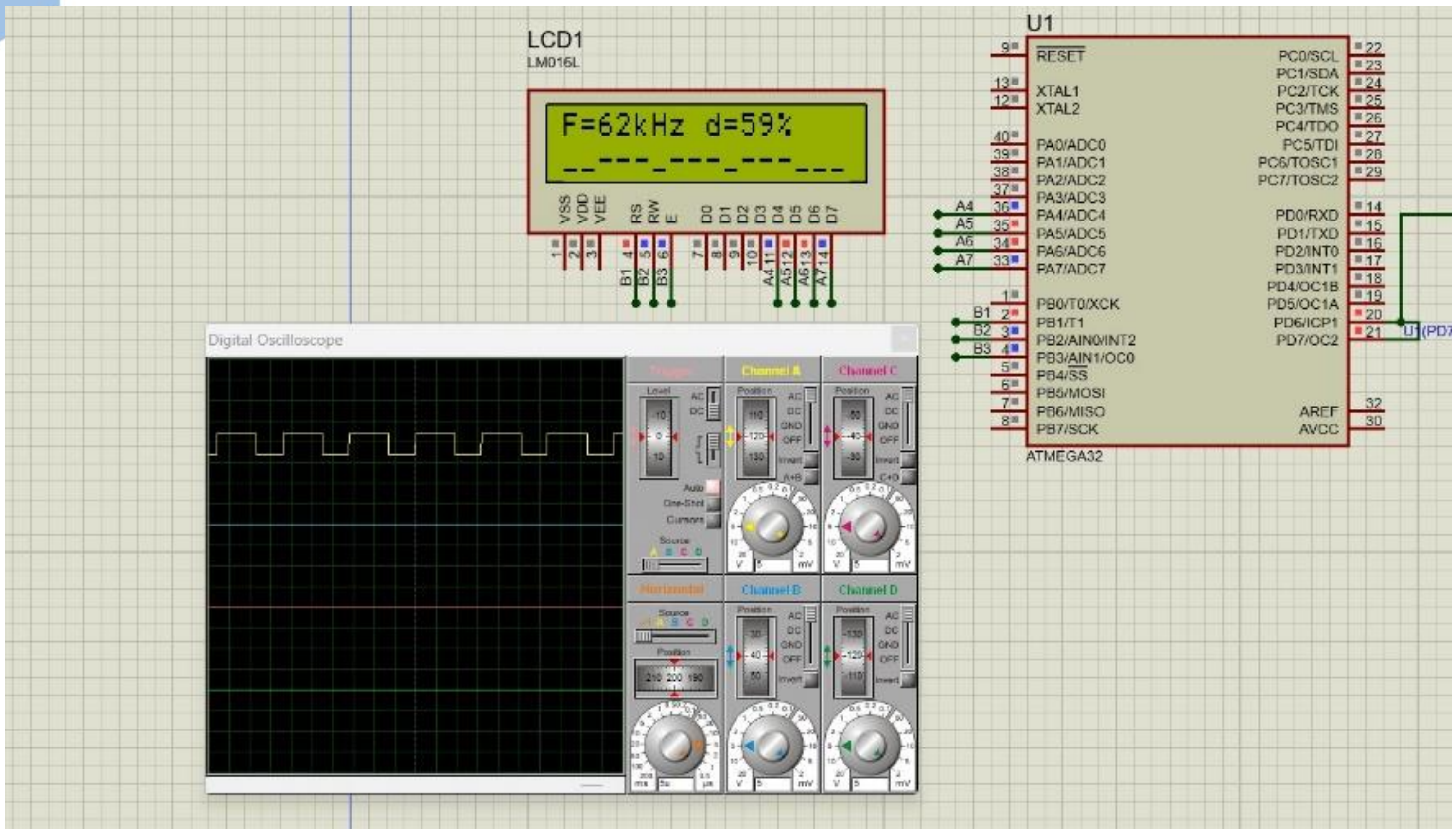
Because the frequency and period may be readily retrieved from one another using (f = 1/T), a DISPLAY macro is utilized If set to FREQ (the default), the LCD will display the frequency and duty cycle along with the waveform.

If it is set to TIME , the LCD will display the period instead of the frequency and the other characteristics as usual

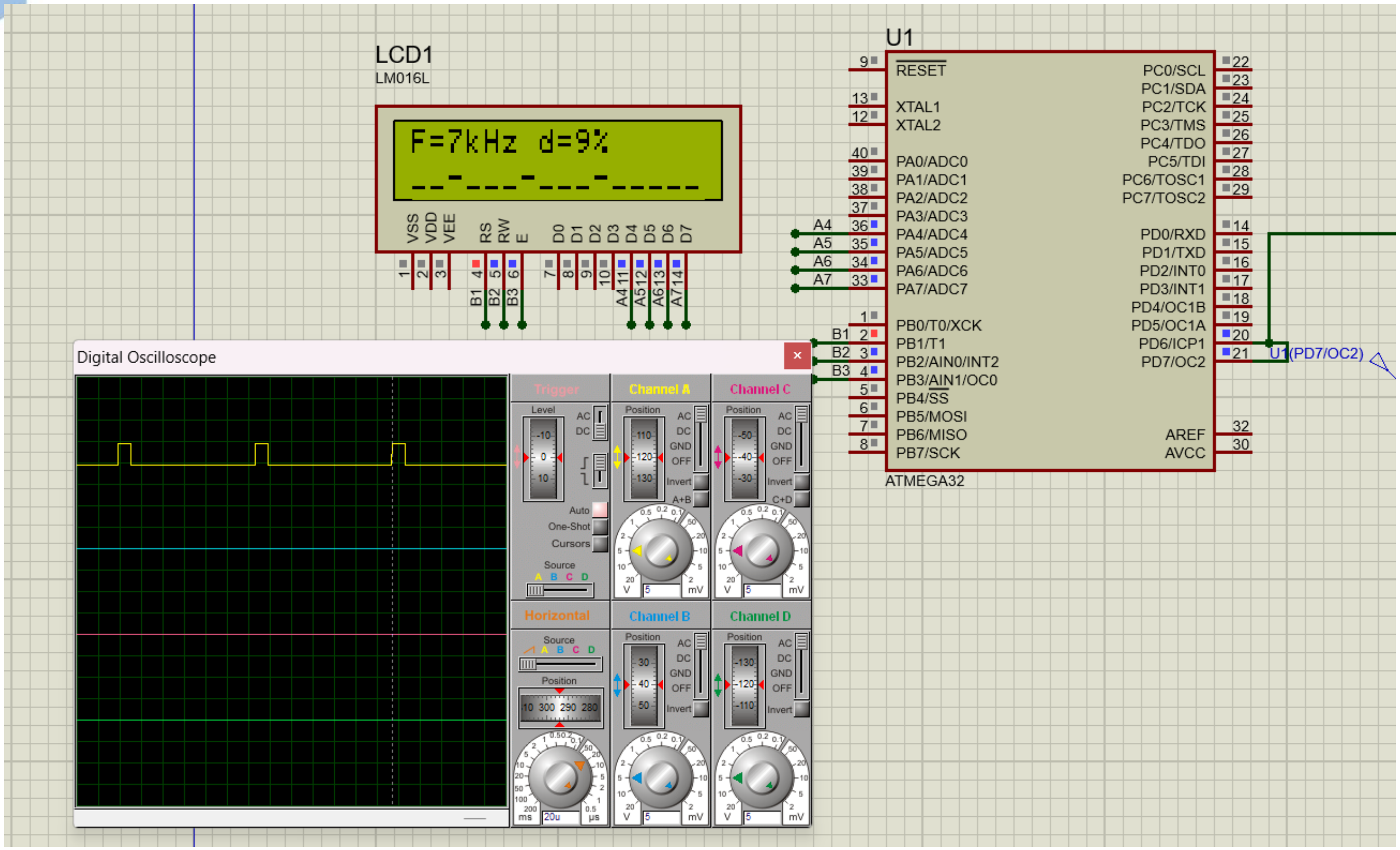




4.1 Perviews

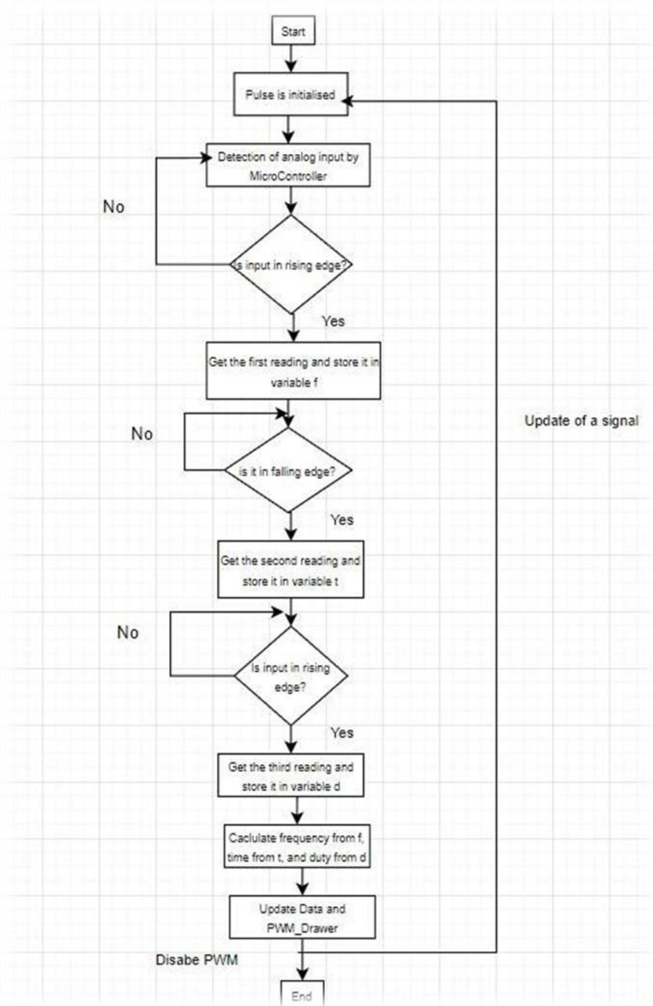


4.2 Perviews



05

Flowchart



This Flow Chart Describes the algorithm of the ICU and How it measures the PWM generated Signal

06 Conclusion

The aim of this project is to create an Oscilloscope in a LCD. Visualizing a duty cycle on a 16x2 LCD with a range of 10.

THANK YOU