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EEE-2002 SEMICONDUCTOR DEVICES AND CIRCUITS

J COMPONENT PROJECT FINAL REPORT

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PULSE WIDTH MODULATOR

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SLOT- A1

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PULSE WIDTH MODULATOR LED CONTROLLER

INTRODUCTION

A Pulse Width Modulation is a technique through which we can transmit input signal in the form of Pulses. The pulses generated have different width which enables to be used for various Switching electrical and electronic circuits. This technique can be used to control the velocity of car based on the relative separation between the car and an obstacle. Here in this circuit diagram, we have used one Saw- toothed waveform and connected with the positive terminal of the comparator and the input signal to the negative terminal of the comparator. Now, depending on the amplitude of input signal, the output waveform is obtained in CRO (cathode ray oscilloscope). The software used is Proteus 8 professional to show the waveform while arduino is used for building up the project.

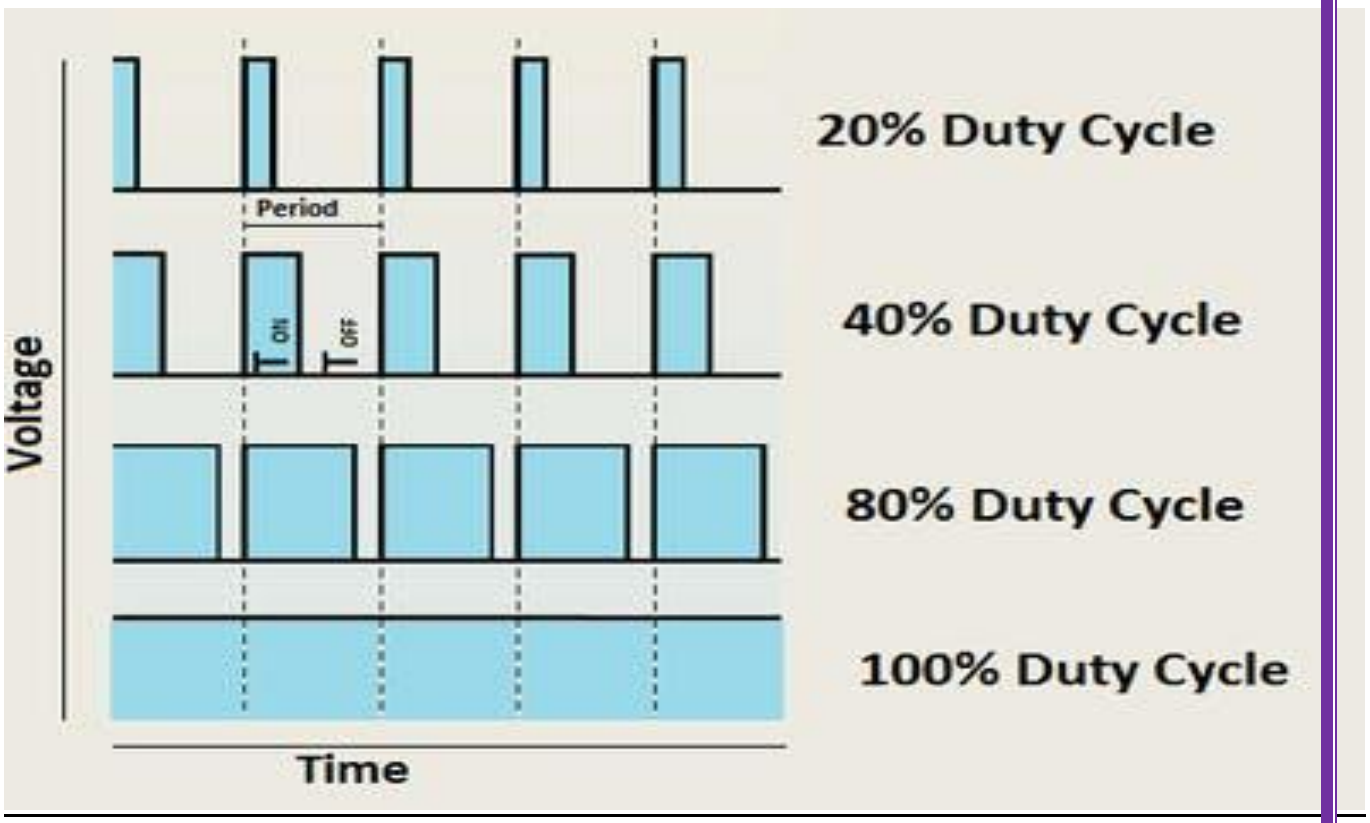
LEDs are becoming common choice in most of the lighting applications and hence the demand of LEDs are also growing rapidly. So technologies combine together to improve lighting control systems and power reducing. PWM is a very powerful and important technique for controlling LED brightness.PWM can be used to reduce the total power delivered without losses which normally occurs when a power source is limited by resistive means. The duty cycle is a part of PWM period and describes the proportion of on time to regular interval. Many loads, such as, resistors integrate the power into a number matching the percentage and it is easy to convert it to its analog form. LED are very nonlinear in their response to current, but with PWM the light level produced by LED is very linear.

PRINCIPLE

LED brightness control has two basic principles: - Analog dimming and PWM dimming. Since we are dealing with PWM controlled LED, so the discussion will be limited to PWM.

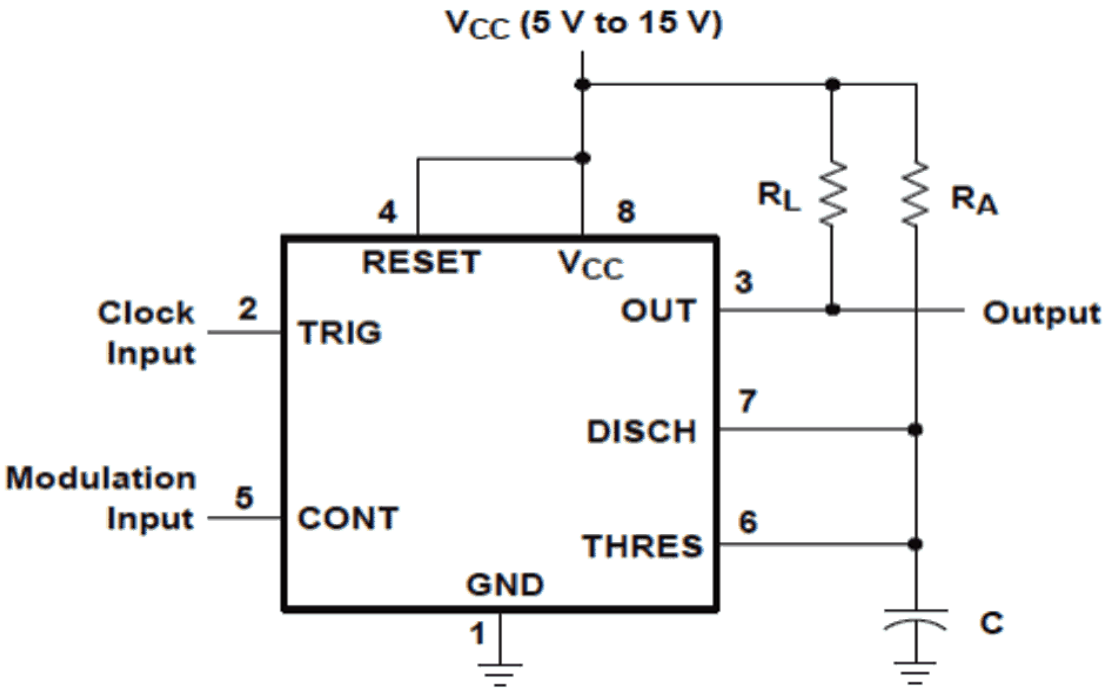
PWM uses digital signals to control power applications as well as back to analog easily using a hardware. LEDs are operated with full amplitude pulses of current, the width of pulses is varied to control the apparent brightness. PWM dimming may be implemented in the power supply or in the driver but the pulse rate must be high enough so that eye perceives only the average

light intensity. In place of controlling the forward current, the duty cycle of the switch is controlled to vary the brightness across the LED. The current for LED is switched periodically and this current is controlled from low to its high value using the switch. Using this technique peak value of the current remains fixed which is required for dimming. However the slow rate of PWM and the continuous ON and OFF of the switch creates oscillation in the current signal which ultimately causes heat loss.

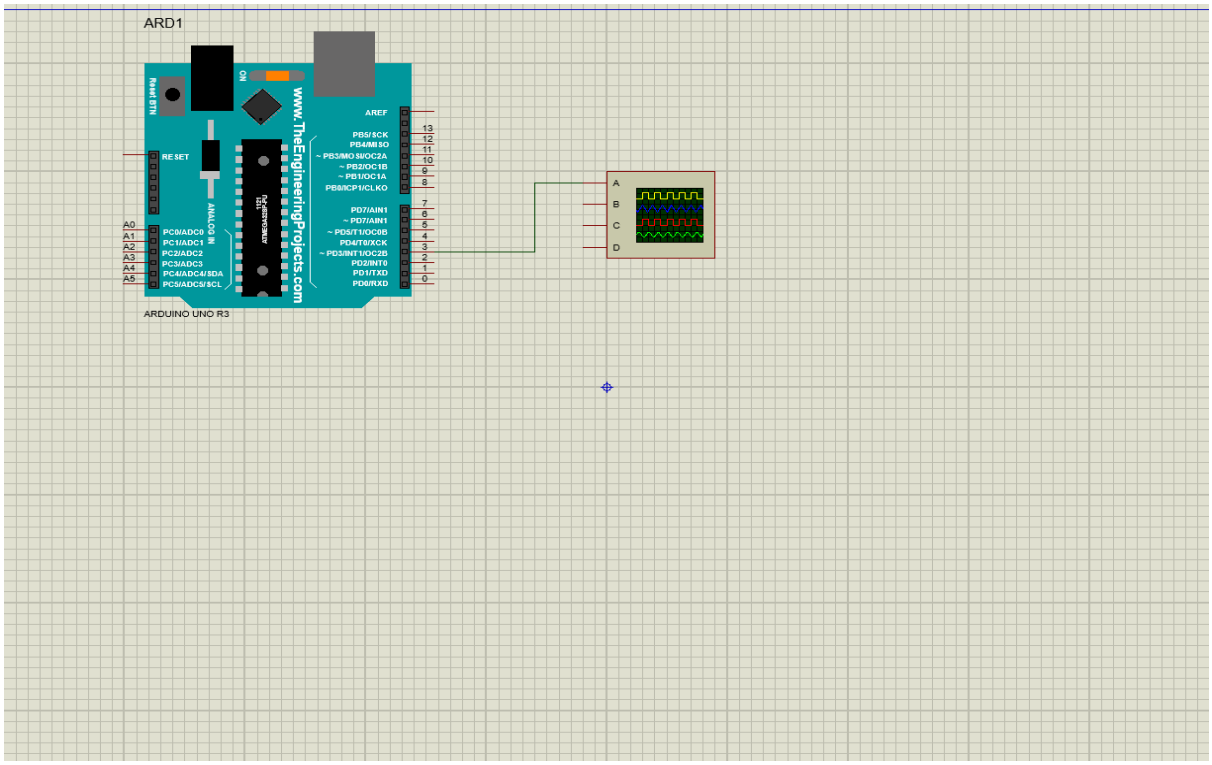


Duty cycle is the amount of time digital signal is in the active state relative to the period of the signal denoted in percentage. Duty is basically, the ratio of 1s and 0s output by the PWM command. Considering the output at a particular pin to be high, voltage at that pin becomes close to 5V. In case of BASIC stamp, duty cycle can vary from 0 to 255. So PWM output voltage can be easily determined by the formula: (duty/255)* 5V. The process of dimming can only be achieved by varying the duty cycle.

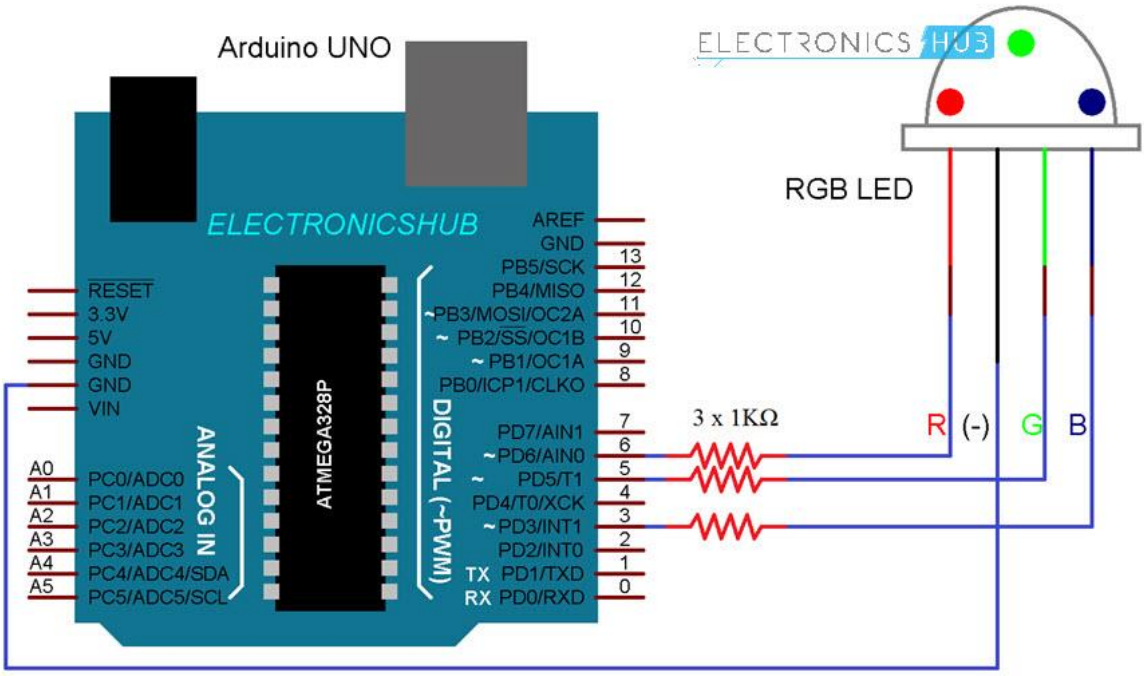
CIRCUIT DIAGRAM



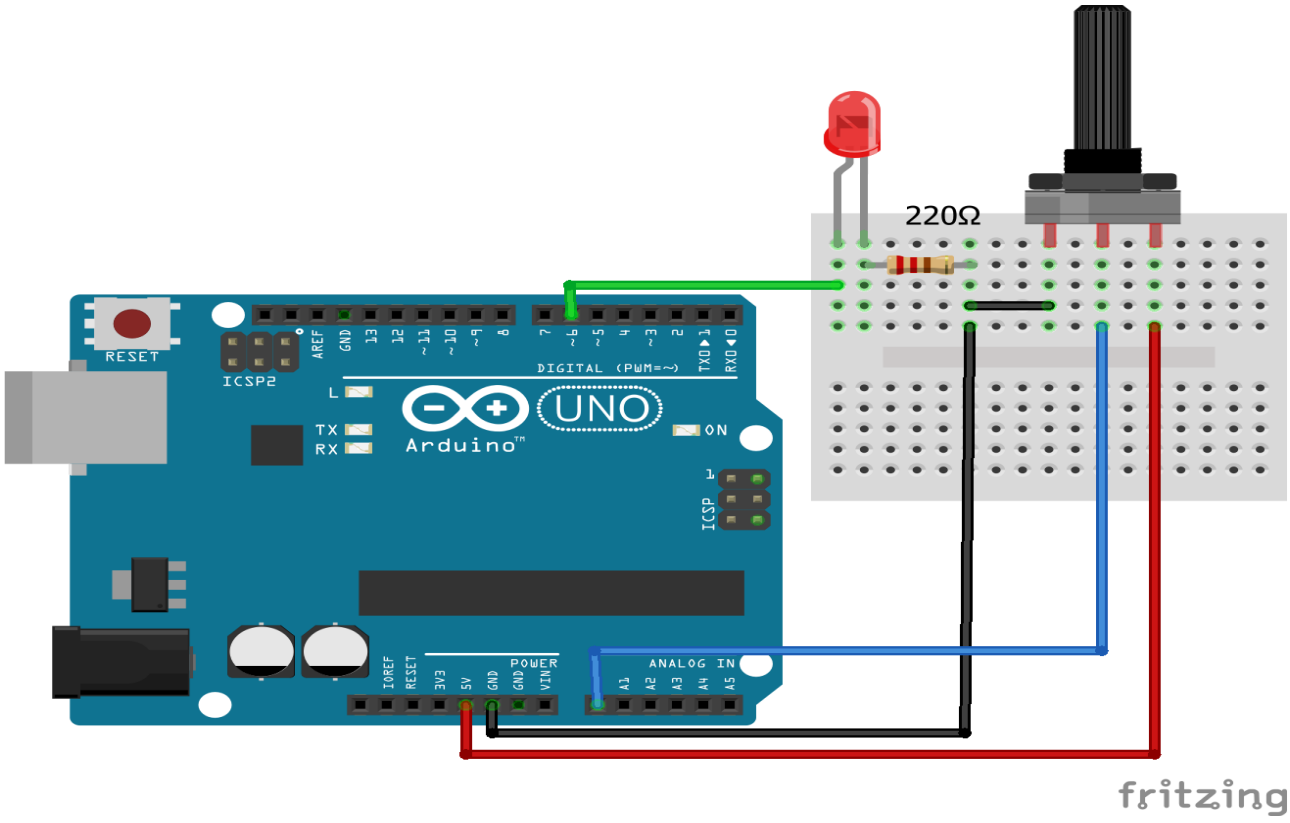
PWM LED DIMMER CIRCUIT USING A 555 TIMER IC



PROTEUS 8 PROFESSIONAL CIRCUIT DIAGRAM TO MEASURE WAVEFORM



CIRCUIT DIAGRAM OF PWM CONTROLLED LED(RGB) USING ARDUINO



CONNECTION PLOT OF PWM CONTROLLED LED USING ARDUINO

MATERIALS REQUIRED

NAME OF COMPONENT	QUANTITY
ARDUINO UNO	1
LED(GENERIC)	1
SINGLE TURN POTENTIOMETER (10K Ohms)	1
RESISTOR(220 Ohms)	1
BREADBOARD(GENERIC)	1
JUMPER WIRES(GENERIC)	1

WORKING OF THE CIRCUIT

The Arduino digital pins either give 5V or 0V and the output is square wave signal. So if we want to dim the LED, we cannot get a voltage between 0V and 5V from the digital pin but we can change the ON and OFF time of the signal. If we change the ON and OFF time fast enough then the brightness of the LED will change. If we increase the frequency to 50Hz (50 times ON and OFF per

second), then the LED will be seen glowing at half brightness by the human eye. The Arduino IDE has a built in function, analogWrite (), that can be used to generate PWM signal. The frequency of this generated signal for most pins will be about 490Hz and we can give the value from 0-255 using this function.

analogWrite (0) means a signal of 0% duty cycle.

analogWrite (127) means a signal of 50% duty cycle (half of the value)

analogWrite (255) means a signal of 100% duty cycle.

On Arduino UNO, the PWM pins are 3, 5, 6, 9, 10 and 11, and is labelled with ~ sign. The frequency of PWM signal on pins 5 and 6 will be about 980Hz and on other pins it is 490Hz. Connect the longer leg(+ve) of LED to digital pin 6 of arduino and connect one end of 220 ohm resistor to the shorter leg(-ve) and the other end of resistor to the ground pin of Arduino. Add 10k ohm potentiometer and connect two ends of it to 5V and GND of Arduino. Upload the code and run it.

APPLICATIONS OF PWM LED CONTROLLER

PWM enables us to control the brightness of LED and make it dimmer, but this property has many applications and advantage:-

- Dimming the light means controlling the current flow and hence it helps to save electricity.
- It is energy efficient and can change the mood of the room by changing the brightness of the room.
- It reduces the time duration of their highest energy point and hence it helps to increase the longevity of the light sources.
- It is easy to install and due to its small size, it can be adjusted in any place of the room.
- Provides increased light quality, efficiency, durability and lifecycle.
- Helps to maintain specific characteristic of LED like color, temperature, etc. and also provides a wide dimming range.

RESULT/INFERENCE

555 timer IC with other electrical elements is also used to make PWM controlled LED with the same result as received using Arduino. The Arduino along with potentiometer was successfully able to control the brightness of the LED.

LINK OF THE VIDEO

https://drive.google.com/file/d/18G2ute7gOsQM3pUd-SmEFJDAM8Y0KwBM/view?usp=sharing