

# Pulse Width Modulation

**Spoken Tutorial Project**

<https://spoken-tutorial.org>

**National Mission on Education through ICT**

<http://sakshat.ac.in>

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# Learning Objectives



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- PWM i.e. Pulse Width Modulation



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- PWM Duty Cycle



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- PWM Frequency



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- PWM i.e. Pulse Width Modulation
- PWM Duty Cycle
- PWM Frequency
- L293D Motor Driver IC



# Pre-Requisites

**To follow this tutorial, you should have basic knowledge of:**



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To follow this tutorial, you should have basic knowledge of:

- Electronics and





# Pre-Requisites

To follow this tutorial, you should have basic knowledge of:

- Electronics and
- C or C++ programming language



# System Requirements

**To record this tutorial, I am using**



# System Requirements

To record this tutorial, I am using

- **Arduino UNO board**



# System Requirements

To record this tutorial, I am using

- Arduino UNO board
- Ubuntu Linux 16.04 OS



# System Requirements

To record this tutorial, I am using

- Arduino UNO board
- Ubuntu Linux 16.04 OS
- Arduino IDE



# External Components Required



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- **Breadboard**



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- **10K Ohm Potentiometer**





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- Breadboard
- 10K Ohm Potentiometer
- LED



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- 220 Ohm Resistor



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- Jumper Wires



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- Breadboard
- 10K Ohm Potentiometer
- LED
- 220 Ohm Resistor
- Jumper Wires
- Push Button



# DC Motor



# L293D Motor Driver IC



# Pulse Width Modulation



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- PWM signal is a square wave signal which has a high frequency i.e. (1KHz)





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- PWM is a technique by which the width of the pulse is varied



# Pulse Width Modulation

- PWM signal is a square wave signal which has a high frequency i.e. (1KHz)
- PWM is a technique by which the width of the pulse is varied
- It is done while keeping the frequency of wave constant



# Pulse Width Modulation



# Pulse Width Modulation

- PWM signal consists of two main properties that define its behaviour



# Pulse Width Modulation

- PWM signal consists of two main properties that define its behaviour
- They are duty cycle and frequency



# Duty Cycle



# Duty Cycle Formula



# PWM Frequency





# PWM Frequency

- Frequency determines how fast the PWM completes a cycle



# PWM Frequency

- Frequency determines how fast the PWM completes a cycle
- How fast it switches from HIGH to LOW states



# Example - Duty Cycle

- We will perform one simple experiment by varying duty cycle



# Example - Duty Cycle

- We will perform one simple experiment by varying duty cycle
- This will control brightness of LED



# Arduino PWM Pins



# LED Connection



# L293D - Pinout



# DC Motor Connection





# DC Motor Live Setup



# Summary

- **Pulse Width modulation**
- **PWM Duty Cycle**
- **PWM Frequency**
- **How to control speed and direction of DC motor**



# Assignment

- **Connect a Buzzer instead of LED in the above circuit connection**
- **Upload same program and check the output**
- **You would hear a noise with different frequencies**



# About the Spoken Tutorial Project

- Watch the video available at [http://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](http://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- It summarises the Spoken Tutorial project
- If you do not have good bandwidth, you can download and watch it



# Spoken Tutorial Workshops

## The Spoken Tutorial Project Team

- Conducts workshops using spoken tutorials
- Gives certificates to those who pass an online test
- For more details, please write to [contact@spoken-tutorial.org](mailto:contact@spoken-tutorial.org)



# Forum for specific questions

- Do you have questions in THIS Spoken Tutorial?
- Please visit <http://forums.spoken-tutorial.org>
- Choose the minute and second where you have the question
- Explain your question briefly
- Someone from our team will answer them



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