PWM Resolution in Microcontrollers

PWM Resolution Overview

Pulse Width Modulation (PWM) is a technique used by microcontrollers to simulate analog output. The resolution of PWM defines how many distinct duty cycle steps can be produced. For example:

- 8-bit PWM: 256 steps (0-255)

- 10-bit PWM: 1024 steps (0-1023)

- 16-bit PWM: 65536 steps (0-65535)

Higher resolution allows finer control over the output signal.

Importance of Higher Resolution

In humanoid robotics, high-resolution PWM is critical for two main reasons:

1. Smooth Joint Movement:

  Higher resolution means smaller step sizes in signal duty cycles, resulting in more fluid and natural joint motion. This is especially important for tasks like walking or gesturing, where jerky motion can cause imbalance or mechanical wear.

2. Torque Control During Balancing:

  For dynamic balance, joints need to apply variable torque smoothly and precisely. Higher resolution PWM enables fine-grained torque adjustments by controlling the motor current more accurately. This is crucial for maintaining stability on uneven terrain or while making quick corrective movements.

Conclusion

Choosing a microcontroller with higher PWM resolution (10-bit or 16-bit) is essential in applications requiring precise control, such as humanoid robots. It enhances both the smoothness of movement and the reliability of real-time torque response, contributing to more lifelike and stable robot behavior.