# PWM-Based LED Brightness Control
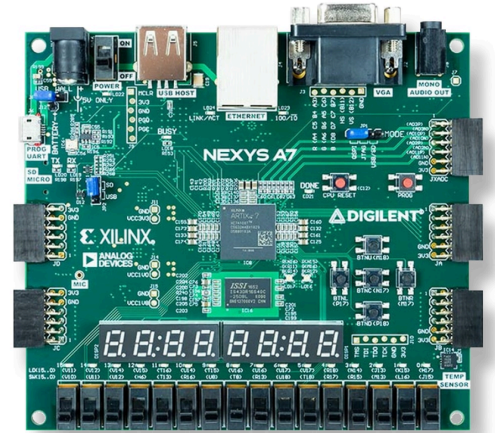
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This project demonstrates the use of Pulse Width Modulation (PWM) for controling the brightness of RGB LEDs on the Nexys-A7 50T FPGA development board. The PWM technique quickly switches the signal on and off. The perceived brightness is controlled by adjusting the duty cycle.





The VHDL design contains three main modules: pwm, controller, and top_level. The pwm module generates the signal by comparing internal counter to duty_in, which directly controls LED brightness. The controller adjusts the duty cycle up and down automatically, reversing at limits to create a smooth fading effect. The top_level connects all components and sends the PWM signals to the RGB LEDs. The simulation shows how the pulse width expands and decreases, showing the main behavior of PWM-based brightness control.

LEDs gradually smoothly fade by increasing and decreasing brightness using PWM.

Buttons/switches are used to:
- Adjust brightness (btnu / btnd)
- Reset the system (btnc)
- Select color components (RGB) via switches (SW[0–2], SW[13–15])





https://github.com/256735/DE1-Project