

# ECEN 2350: Digital Logic

## Assignment #14

### Project

(Standard or Individual)

The final Lab of the semester is a Project. You may choose a standard (canned) project, or create a project of your own design. More complex novel projects may be permitted to be worked on in groups.

As discussed in class, grading will include evaluation of code quality, a brief written report about your design, a video of its operation, and special credit for involving interfacing to hardware (beyond what has been used in prior labs, {HDMI, UART, J1/J2 GPIOs, XADC, audio output}).

The project is due in lab on Thursday, May 1, and will involve a demonstration of its operation to the class.

#### Standard Projects

1. Using the quadrature encoder from prior labs, use the encoded value to control a PWM signal to an LED, allowing the dimming of the LED from off to bright. For full credit, take your input from an external rotary encoder, via the PMOD connector.
2. Create the Transmit side of a UART (a UA\_T?) capable of transmitting a character from the Boolean Board to a computer in RS-232 format. (Ask a TA for a UART interface for your computer). The character's ASCII value would be set using `sw[7:0]`, and `btn[0]` would initiate transmission, sending the character.
3. Create the game "Launch," a two-player game, operating per the demo in class. Each player may launch a "projectile" from their side (`btn[0]` for player A, `btn[1]` for player B), which is displayed and travels toward their opponent's side. Response projectiles may be used to neutralize their opponents's projectile. If a projectile reaches the opponent's side, the player's score is incremented and displayed on the 7-segment displays (`D0_*` for player A, `D1_*` for player B). Pressing `btn[3]` resets the game.
4. Generate the serial input signal needed by a WS2812B RGB LED, lighting an LED with a chosen color. Switches `sw[11:0]` should select the color in 4-bit groups, duplicated into 8-bit groups for the RGB values (e.g. `sw[11:0]` set to 12'hABC should send 24'hAABBCC. Transmission should be initiated by pressing `btn[0]`.

## Personal Initiative Projects

5. Personal initiative projects of sufficient complexity may be completed by a small team. Check with the professor to approve project ideas and (if applicable) team composition. Presence of hardware components is strongly encouraged. Use the `Display4` module you created in lab, if at all possible (e.g. for game scores). Project examples:
  1. Display anything on a video screen using the HDMI video output. Bonus points if you can make it interactive (color changes, movement of objects).
  2. Extend "canned" project 2 to create both the Receive and Transmit side of a UART (as above, plus transmit), additionally displaying the received character on the 7-segment displays.
  3. Make a musical device, capable of outputting sound from the Audio Output port, taking input from the XADC potentiometer input, from the switches, or from a quadrature encoder knob input.
  4. Connect two Boolean Boards together via the J1/J2 PMOD connectors, using a protocol of your own design to send one's switches to the other's LEDs (or 7-segment displays).
  5. Make a game like "Simon" where a sequence of numbers is presented, and the user must replicate those numbers via button-presses.
  6. Make a "Tug-of-War" game, where `sw[0]` and `sw[15]` advance the "knot" toward player 1 and player 2's goals. `btn[0]` can reset the game.

## Submission

Demonstrate your project by Lab on Thursday, May 1. On Canvas you will turn in your Verilog code, a video of its basic operation, and a brief (half page) report describing your design, discussing its evolution, decisions made and problems encountered. Verilog code quality includes good modular design, sensible file organization and structure, variable naming, indentation and thorough comments.