EECS 3216 Interim Progress Report - Snake Game

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Progress Documentation

1. Work Completed

- **System Architecture**:
  - Designed and implemented the top-level module hierarchy connecting all components
  - Completed module interfaces for `DE10_Lite_Snake`, `snake_game`, `vga_controller`, and `button_debounce`
  - Finalized VGA configuration (640x480 @60Hz) with a functional pixel clock divider
- **Core Functionality**:
  - Implemented snake movement logic using rotational controls (clockwise/counter-clockwise buttons)
  - Developed basic collision detection for boundary and self-collision
  - Integrated debounced button inputs to ensure reliable direction changes
  - Created a pseudo-random food placement system using LFSR
- **Hardware Progress**:
  - Successfully generated stable VGA output with visible game elements (snake head, borders, food)
  - Verified button responsiveness and debouncing on the DE10-Lite board
  - Established initial score tracking in binary format
- **Design Diagrams**:
  - System architecture diagram finalized (see Appendix A in final report)
  - State machine diagrams for game logic (IDLE, RUNNING, GAME_OVER)

2. Initial Results

- Functional snake movement with directional controls
- Basic VGA display rendering game elements (snake head, borders, food)
- Successful debouncing of button inputs (latency <20ms)
- Validated food placement algorithm using LFSR

Problem Identification and Resolution

1. Scoreboard Implementation

Challenge:

- Current score display on seven-segment LEDs (HEX3-HEX5) intermittently fails to update.
- Binary-to-BCD conversion logic produces incorrect digit mappings.

Steps Taken/Planned:

- Developed a BCD converter module but identified synchronization issues between score updates and display refresh.
- Plan to implement a double-buffering system to decouple score calculation from display updates.
- Debugging incorrect digit mappings by re-verifying BCD lookup tables.

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2. Tail Growth Mechanism

Challenge:

- Snake body does not consistently grow after consuming food.
- Array indexing errors cause segments to disappear or render incorrectly.

Steps Taken/Planned:

- Identified faulty logic in the snake body update loop where new segments overwrite existing ones.
- Currently restructuring the snake coordinate arrays to shift elements correctly during movement.
- Testing incremental growth by appending new segments only after food consumption.

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3. Video Synchronization Errors (Mirrored Display)

Challenge:

- VGA output displays the game mirrored in a 4-way grid due to improper pixel addressing.
- Suspected miscalculations in column/row counters or grid positioning logic.

Steps Taken/Planned:

- Traced issue to incorrect `grid_x` and `grid_y` calculations in the display generation module.
- Adjusting pixel coordinate divisions to align with 32x24 grid boundaries (current formula: `grid_x = vga_column / GRID_SIZE`).
- Testing revised VGA timing parameters to eliminate redundant screen regions.

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4. Additional Minor Issues

- **Flickering Display**:
    - Temporary fix: Added display enable signal stabilization in the VGA controller.
- **Random Food Placement on Snake Body**:
    - Enhanced LFSR validation loop to regenerate coordinates if food overlaps snake.

Next Steps

1. Finalize scoreboard synchronization and BCD conversion.
2. Debug and validate snake tail growth logic.
3. Correct VGA grid calculations to resolve mirrored display.
4. Conduct comprehensive hardware testing after fixes.
