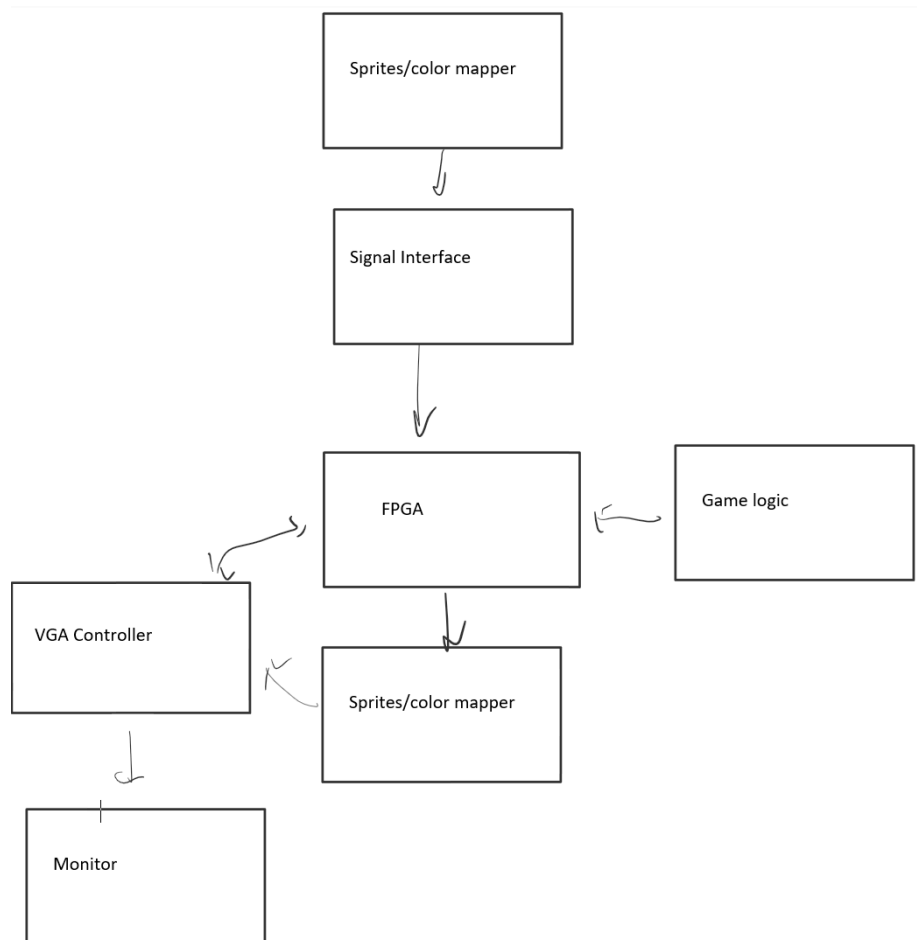


1) Idea and Overview

For our final project, we propose implementing a version of the popular game *Fireboy and Watergirl* on an FPGA (AMD Spartan 7 Board). Our System-on-Chip (SoC) design will feature several key components, each implemented using SystemVerilog. These components include a main CPU for executing game logic, a color mapper for graphics rendering, and a peripheral interface for managing input/output devices, such as a keyboard and VGA display. Additionally, we will integrate RAM for data storage, a speaker module for audio output, and other essential elements to deliver a complete and functional game experience. The MicroBlaze controller will serve as the CPU, managing game logic and facilitating interactions with the USB interface. Our goal is to create a baseline version of a game level, supporting two-player gameplay through USB-connected devices.

2) Block Diagram



3) List of Features

3.1 Baseline Features

For the baseline version of *Fireboy and Watergirl*, we plan to implement a simplified two-player version of the first level. The following features are essential for the project to be considered functional:

- **Start and End Screens:** The game will open with a start screen. The end screen will display either “Game Over” if players fail the level or “Success” if they complete it, offering options to retry or exit.
- **Basic Player Movements:**
 - **Fireboy Controls:** Move left, move right, and jump, controlled by keyboard inputs (A, D, W).
 - **Watergirl Controls:** Move left, move right, and jump, controlled by arrow keys (left, right, up).
- **USB Keyboard Input:** The MicroBlaze controller will interpret input from a USB keyboard to control each character’s movement.
- **Collision Detection and Boundaries:** The game will include boundaries (walls, floor, and ceiling) to prevent characters from moving out of the playable area. Basic collision detection will stop characters when encountering obstacles or boundaries.
- **Obstacle Interactions:** Players can interact with game objects, such as boxes and levers. Characters can automatically push a box when touching it and press a floor button by standing on it.
- **Character-Specific Elements:** Implement additional features for Fireboy and Watergirl to interact with character-specific obstacles, like Fireboy being immune to fire areas and Watergirl being immune to water areas.
- **Toxic Liquid and Failure Condition:** Falling into a toxic liquid area will result in a “Game Over” screen, simulating the consequence of failing the level.
- **Collectibles and Score Display:** Diamonds collected by each player will be counted and displayed on the FPGA’s hex display, providing a basic score-tracking feature.
- **Goal and Success Condition:** The level will be completed when both characters reach their designated exit gates. This will trigger a “Success” end screen.

3.2 Additional Features

If time permits, we plan to enhance the baseline version by adding more complexity and approaching the original game’s functionality:

- **Background and Notification Sounds:** We will add background music and sound effects, such as a sound when a player falls into toxic liquid or reaches the exit.
- **Advanced Obstacles and Puzzles:** Add more complex obstacles like levers, doors, and moving platforms that require specific actions to navigate.
- **Multiple Levels:** Extend the game by creating additional levels, each with unique layouts and increasing difficulty.

4) Expected Difficulty

With baseline features, this game should get a difficulty rating of 7. The components that give it this rating include Start and End Screens, USB Keyboard Input, Character Control and Basic Movements, Collision Detection and Boundaries, Obstacle Interactions, Character-Specific Elements, Toxic Liquid and Failure Conditions, Collectibles and Score Display, and the Goal and Success Condition.

With additional features, the background sounds should add 1-2 points, and advanced obstacles/puzzles or multiple levels should also add 1-2 points.

5) Proposed Timeline

Week	Goals
Week 1	Data Collection and Initial Setup: Gather graphics data for the game map, character sprites, and essential visual elements (e.g., obstacles, collectibles). Design the map layout for the first level, including placements for obstacles, paths, and boundaries. Begin converting these graphics into a format compatible with VGA rendering. Develop a plan for SystemVerilog modules for color mapping and prepare the MicroBlaze environment.
Week 2	Integrate Graphics and Basic Gameplay: Integrate map and character graphics into the VGA display using the color mapper. Begin

	implementing basic character movement for Fireboy and Watergirl, as well as initial floor, wall, and boundary elements based on the map layout. Work on USB keyboard input for controlling characters. By Friday's mid-project checkpoint, aim to have the first level partially functional, with basic movement, boundaries, and initial collision detection in place.
Week 3 (Thanksgiving)	Complete Baseline Features: Finalize character movement, collision detection, and interactions with obstacles. Ensure game start, game over, and success screens function as expected. Complete integration of USB keyboard inputs for both characters. Achieve a fully playable first level, including all core baseline features. Start debugging any issues that arise.
Week 4	Refinement and Testing: Thoroughly test all gameplay features, refining collision detection, game logic, and USB input handling. If baseline features are stable, start additional features, such as background music or advanced obstacle interactions. Address remaining bugs and optimize performance.
Week 5	Finalization and Demo Preparation: Conduct final testing and polish the game for stability. Prepare for the demo by assembling presentation materials and completing the final project report, summarizing the design, development, challenges, and results achieved.