Project Overview

- **3D world for exploration** (actual game as reach objective)
- **Game controller for walking around**
- **Headphones with gyroscope for looking around**
- **Footstep sound through headphones**
- **FPGA controls game FSM, hardware logic, audio generation, etc.**
3D Graphics Module

- Static World with changing perspective
- Virtual “camera” position and orientation as inputs
- VGA output to screen
- Triangle (Polygon) Graphics
- Triangles compute in parallel while pixels compute in series
- Each triangle module involves a change of coordinates, interior testing, and depth interpolation
Gyroscope Coordinate Transform Module

- Gyroscope outputs three rotation values
- We only want two of them, but for the user’s head, not for the gyroscope itself
- So we use a change of coordinates
- The parameters for this change of coordinates depend on gyroscope readings at fixed reference points at configuration time
- Robust against different use conditions
Audio Module

- Footstep -> bass square wave
- Sound is triggered by enable signal from FSM module
- In FSM:
  - Compute distance traveled each clock cycle
  - Increment counter by computed distance
  - At certain threshold, trigger audio module and reset counter

Game FSM Module

if walking

count up

threshold reached!

play sound through FPGA
Game FSM Module

- Tie everything together
- Configure gyroscope coordinate transform module
- Store user coordinates in registers; update using input from controller
- Combine transformed gyroscope coordinates with user coordinates to get virtual camera coordinates for the graphics module
- Trigger footstep sound
Hardware Interface

- Several necessary parts outside of the labkit
- VGA out and headphone out: part of the labkit
- Gyroscope: external IC, interfaced with ADCs; attached physically to the headphones
- Controller: external component; synchronized in labkit
<table>
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<tr>
<th>Task Description</th>
<th>Week of 11/2</th>
<th>Week of 11/9</th>
<th>Week of 11/16</th>
<th>Week of 11/23</th>
<th>Week of 11/30</th>
<th>Week of 12/7</th>
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<tbody>
<tr>
<td>1. Graphics and VGA interface, order parts</td>
<td>Red</td>
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<td>2. Gyroscope and controller game logic</td>
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<td>3. Audio module SW</td>
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<td>4. Interface gyroscope and controller HW</td>
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<td>5. Test integration of modules</td>
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<td>6. Buffer week for testing and/or catch up</td>
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<td>7. Demo and Checkoff</td>
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