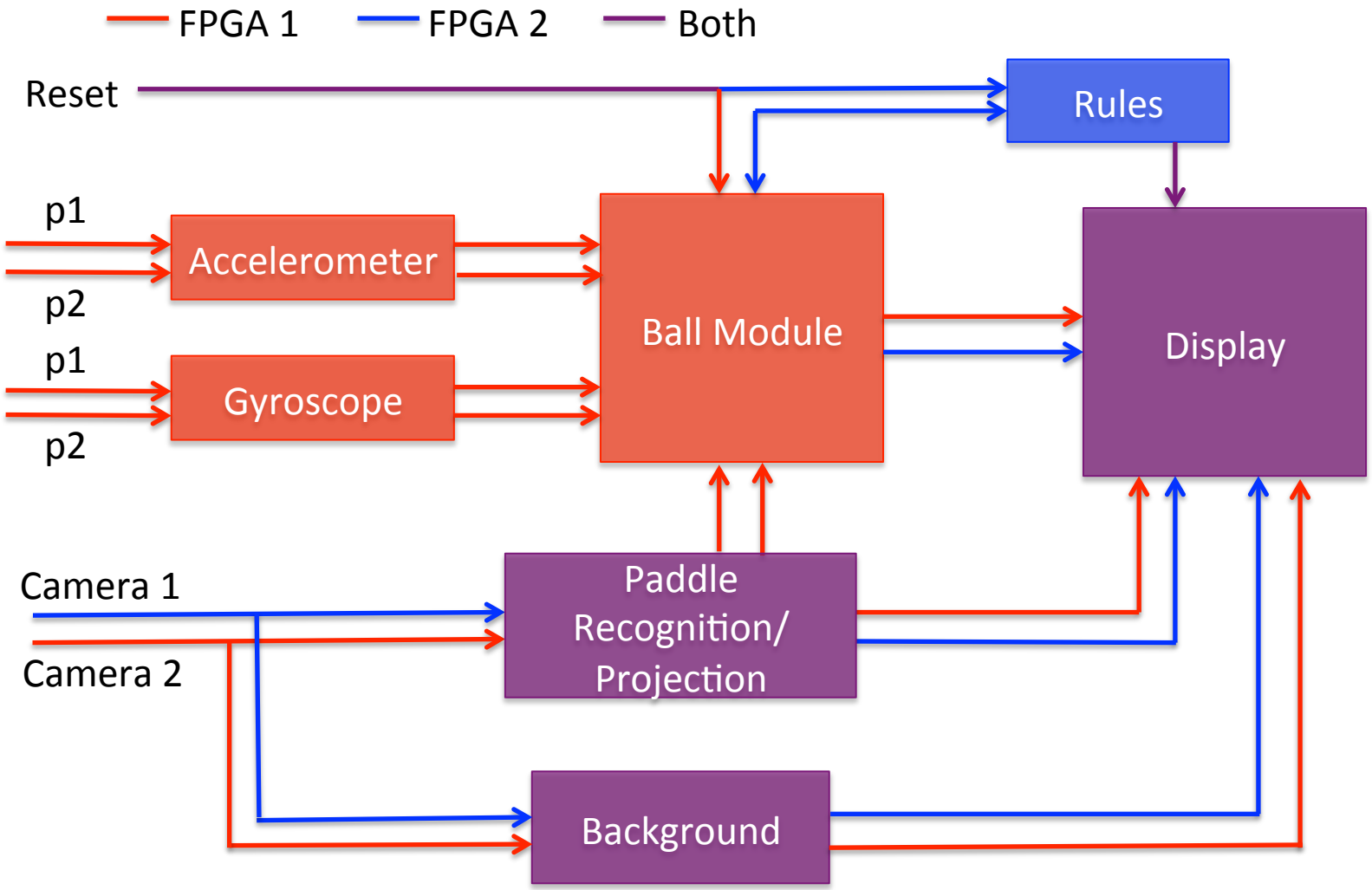
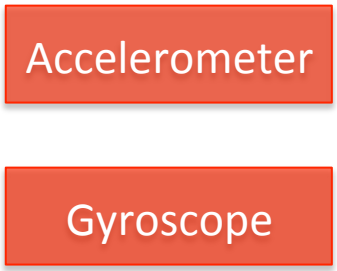
3D Virtual Table Tennis

Angel and Sarah

Block Diagram



Block Diagram



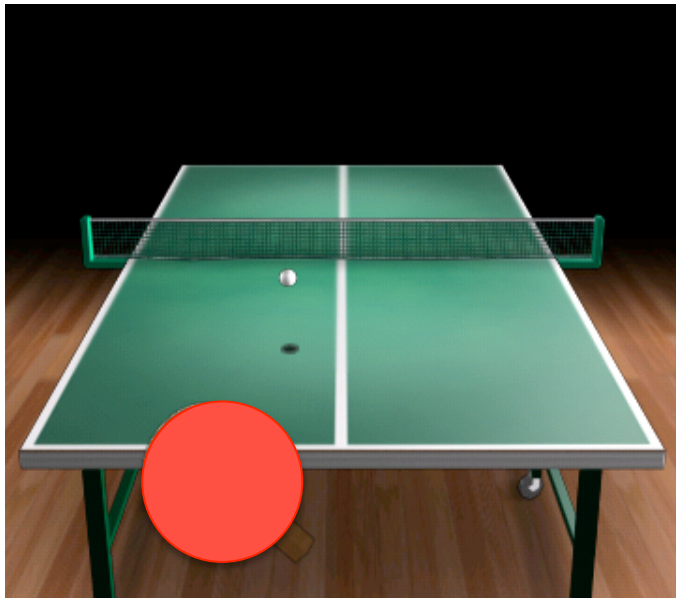
Accelerometer/Gyroscope Module

- Sensors will be attached to each paddle
- A/D converter for the sensor data
- Accelerometer data gives speed for the ball
- Gyroscope data gives direction for the ball
- Testing:
  - Use likely output readings from the sensors as inputs to the modules

Block Diagram

Paddle Recognition/Projection

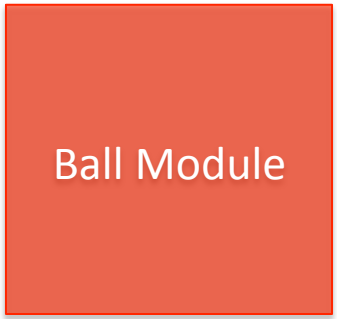
- This module will have two functions:
  - Determine paddle location in the frame of the camera
  - Determine the coordinates of the center of the paddle to be represented on the VGA display



Paddle Recognition/Projection

- Testing:
  - Display camera video using VGA
  - Compare the location of the paddle on the feed to the output coordinates that specify the location of the paddle

Block Diagram



Ball Module

- Manages the Ball mechanics
  - 3D coordinate system to 2D monitor Display
  - Camera Projection Matrix
  - Outputs Ball coordinates and size

$$
{}^{\mathbf{I}}\mathbf{P} = {}^{\mathbf{I}}_{\mathbf{W}}\mathbf{C}\ {}^{\mathbf{W}}\mathbf{P}
$$

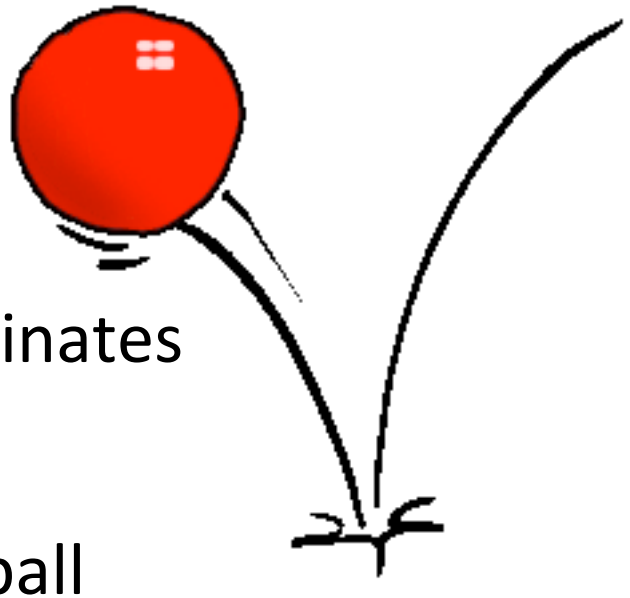
$$
\begin{bmatrix} s\,{}^{I}P_r \\ s\,{}^{I}P_c \\ s \end{bmatrix} = {}^{\mathbf{I}}_{\mathbf{W}}\mathbf{C} \begin{bmatrix} {}^{W}P_x \\ {}^{W}P_y \\ {}^{W}P_z \\ 1 \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & c_{13} & c_{14} \\ c_{21} & c_{22} & c_{23} & c_{24} \\ c_{31} & c_{32} & c_{33} & 1 \end{bmatrix} \begin{bmatrix} {}^{W}P_x \\ {}^{W}P_y \\ {}^{W}P_z \\ 1 \end{bmatrix}
$$

$$
{}^{I}P_r = \frac{[c_{11}\ c_{12}\ c_{13}\ c_{14}] \circ [{}^{W}P_x\ {}^{W}P_y\ {}^{W}P_z\ 1]}{[c_{31}\ c_{32}\ c_{33}\ c_{34}] \circ [{}^{W}P_x\ {}^{W}P_y\ {}^{W}P_z\ 1]}
$$

$$
{}^{I}P_c = \frac{[c_{21}\ c_{22}\ c_{23}\ c_{24}] \circ [{}^{W}P_x\ {}^{W}P_y\ {}^{W}P_z\ 1]}{[c_{31}\ c_{32}\ c_{33}\ c_{34}] \circ [{}^{W}P_x\ {}^{W}P_y\ {}^{W}P_z\ 1]}
$$

Ball Module

- Falling
  - Sense of Gravity
- Bouncing
  - Reversing the correct coordinates
- Coloring
  - Displaying who last hit the ball
- Paddle Hits
  - Manipulate trajectory

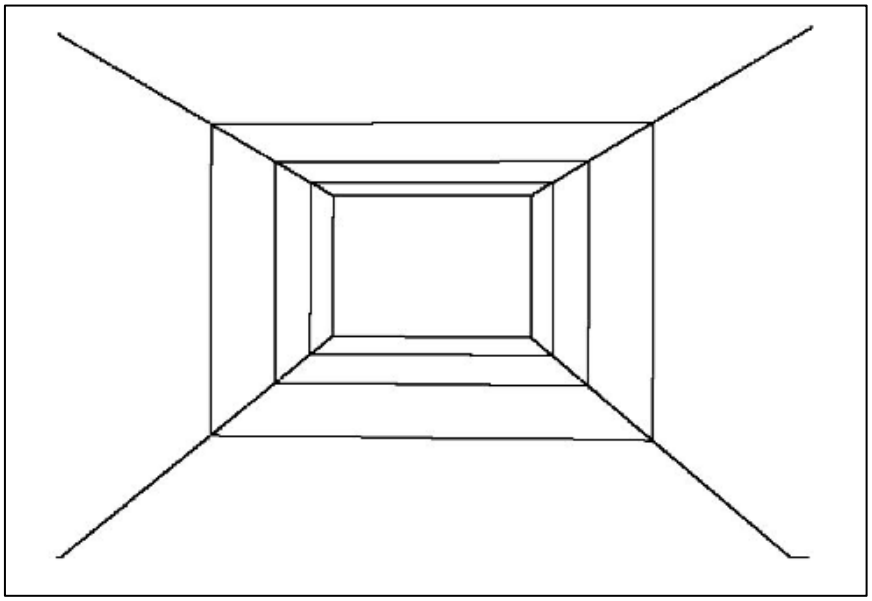


Block Diagram

Background

Background Module

- Downgrading/ Downscaling camera image
- Producing the table and net
  - Deciding images to be projected
- Producing the surrounding environment
  - Deciding images to be displayed



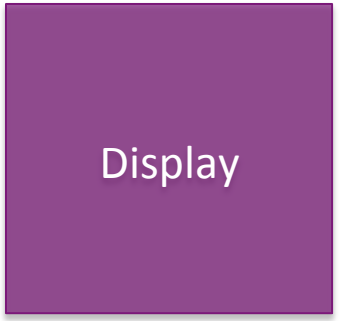
Block Diagram

Rules Module

- Referee
  - Serve mode/ Return mode
- Bounce Tracker
  - Needs ball coordinates

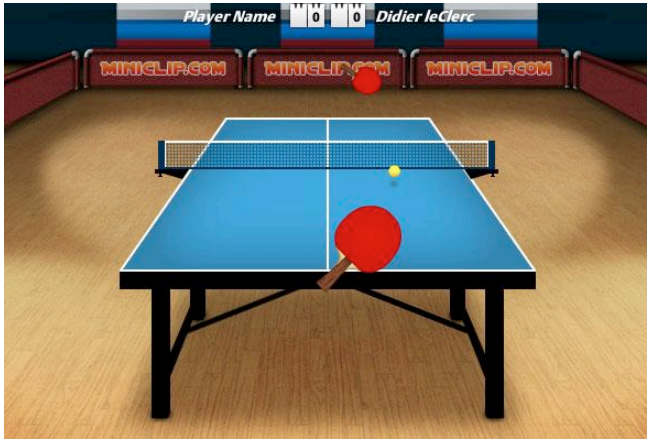
- Hands the ball off to the right person
- Awards points to players
  - Points will be displayed
- Decides winner

Block Diagram

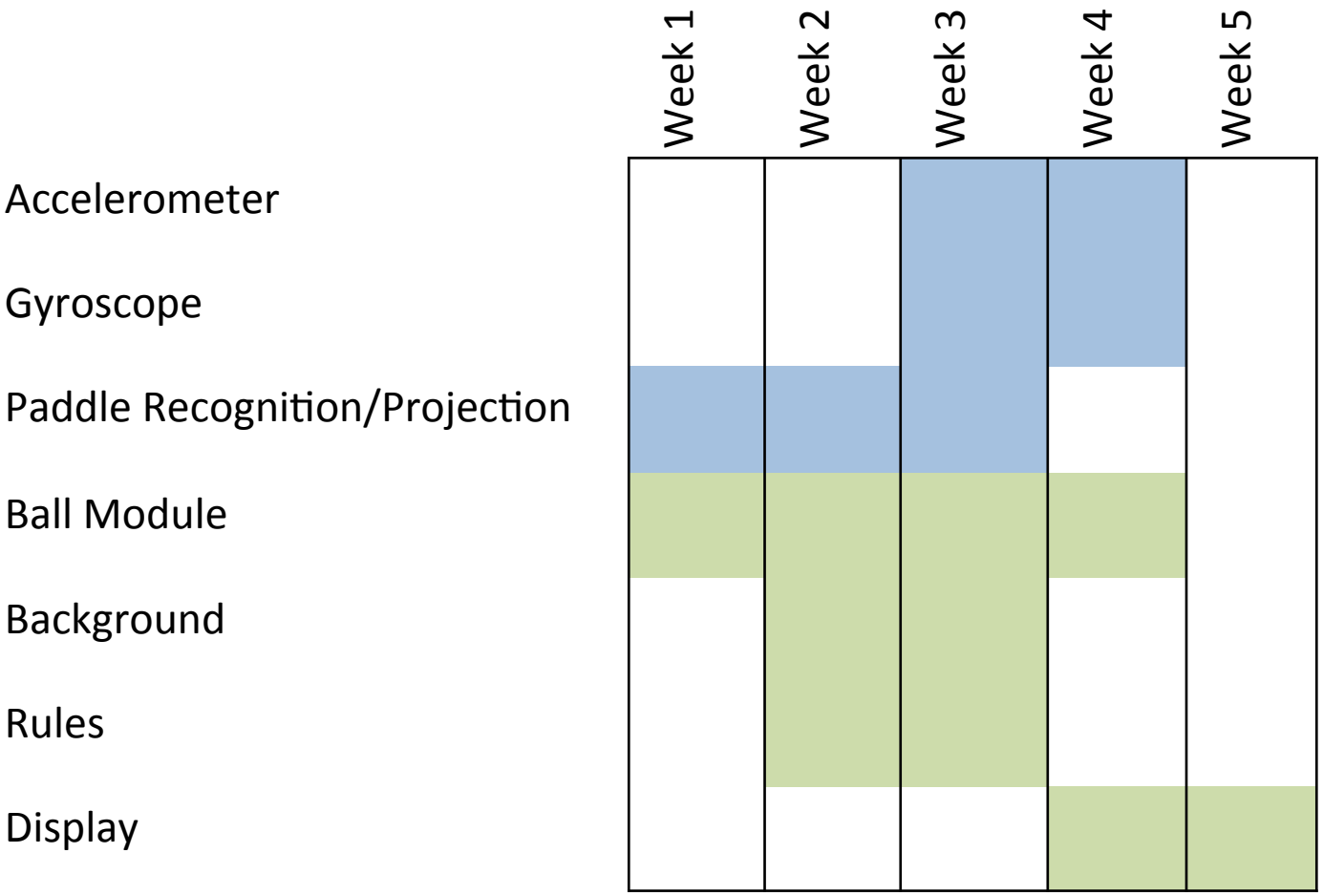


Display

- Compiles all images and visual elements
  - Ball image and Paddle crosshair
- Synchronize its inputs
- Alpha blend everything together



Timeline


Week 1
Week 2
Week 3
Week 4
Week 5
Accelerometer
Gyroscope
Paddle Recognition/Projection
Ball Module
Background
Rules
Display

Questions