

Beat Gunner:

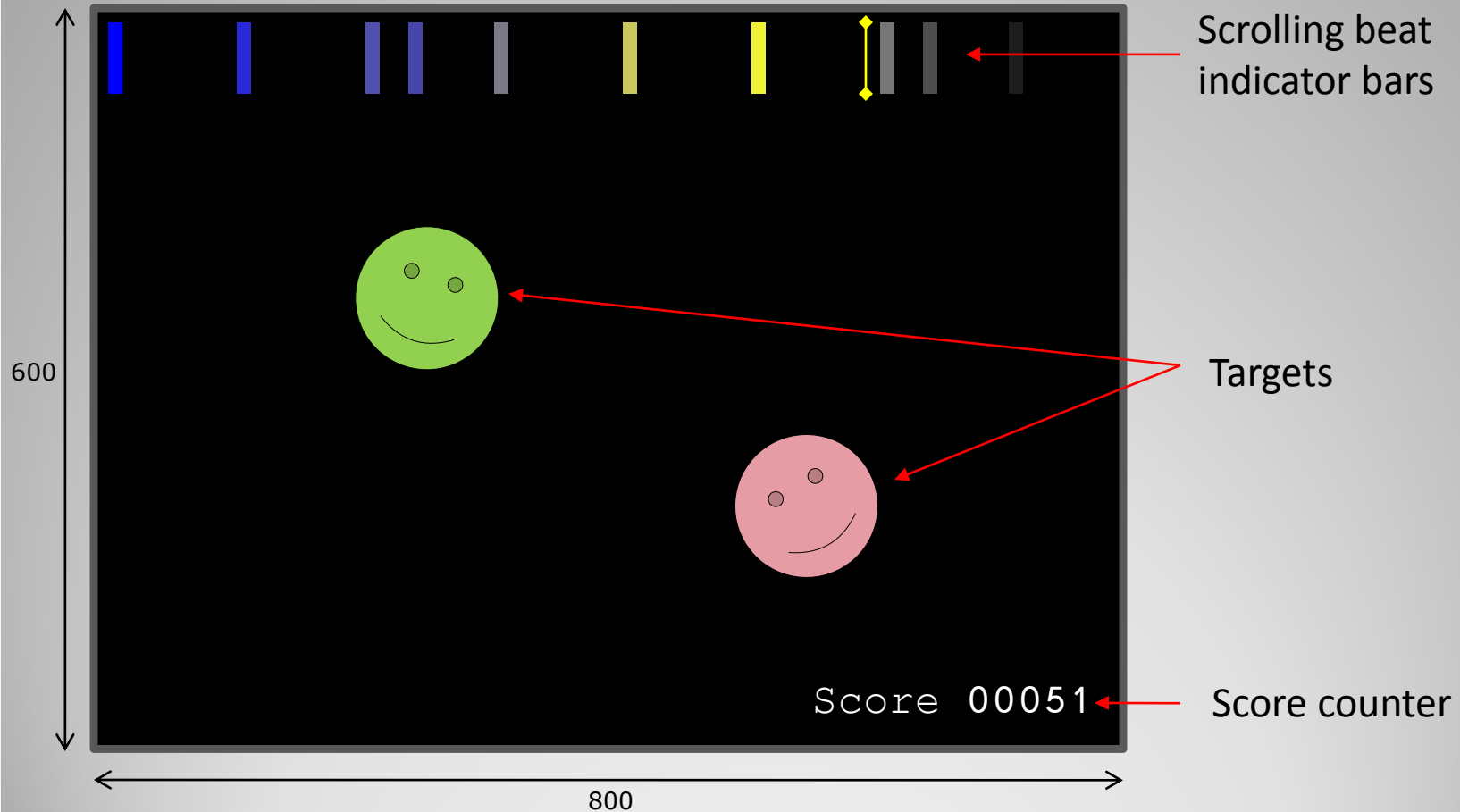
A Rhythm-Based Shooting Game

by TungShen Chew, Stephanie Cheng and An Li

Overview

- The player fires at two moving targets on the screen using a 'light gun'.
- The background music is supplied by an analog audio source (iPod, CD player, etc.).
- The game detects music beats in real time and displays them as scrolling lines on top of the screen.
- You earn more points by scoring hits in time with the beat of the music!

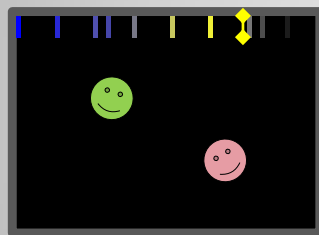
Mockup of Game Screen



800x600 pixel SVGA screen

Game Mechanics: Hit Detection

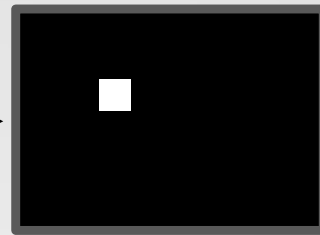
- When the player pulls the trigger:
 1. The game sets the whole screen to black
 2. The observed light level of the gun is recorded
 3. A white box is drawn at the location of a target
 4. The game checks if the observed light level has increased
 5. Steps 3 and 4 are repeated for each target



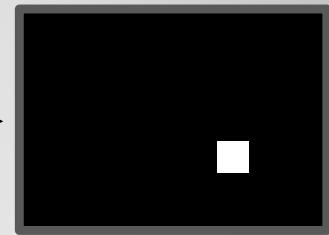
Trigger hit!



1. Set to black



3. Draw white box



Repeat per target

Game Mechanics: Beat Detection

- Proposed beat detection algorithm:
 1. Low-Pass Filter at 100Hz
 2. Compare signal to a threshold at 90% of the highest observed peak within a moving window
 3. If signal is higher than this threshold, set 'beat detect' to TRUE for 20ms



Original Signal



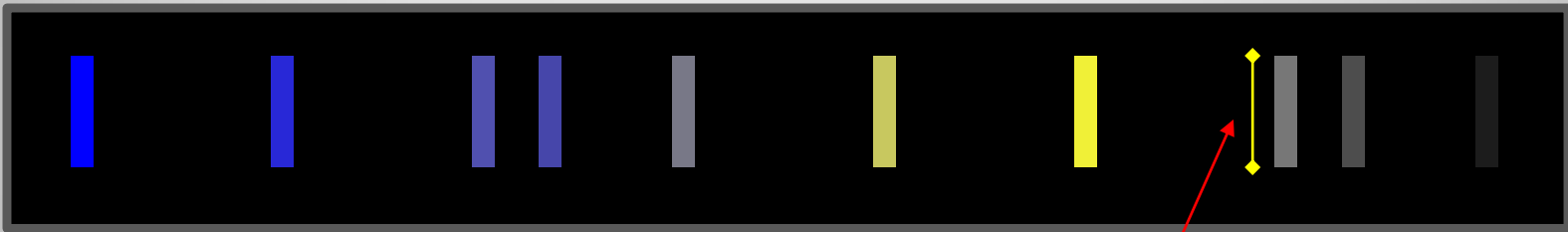
After Low Pass Filter



Threshold and carry over

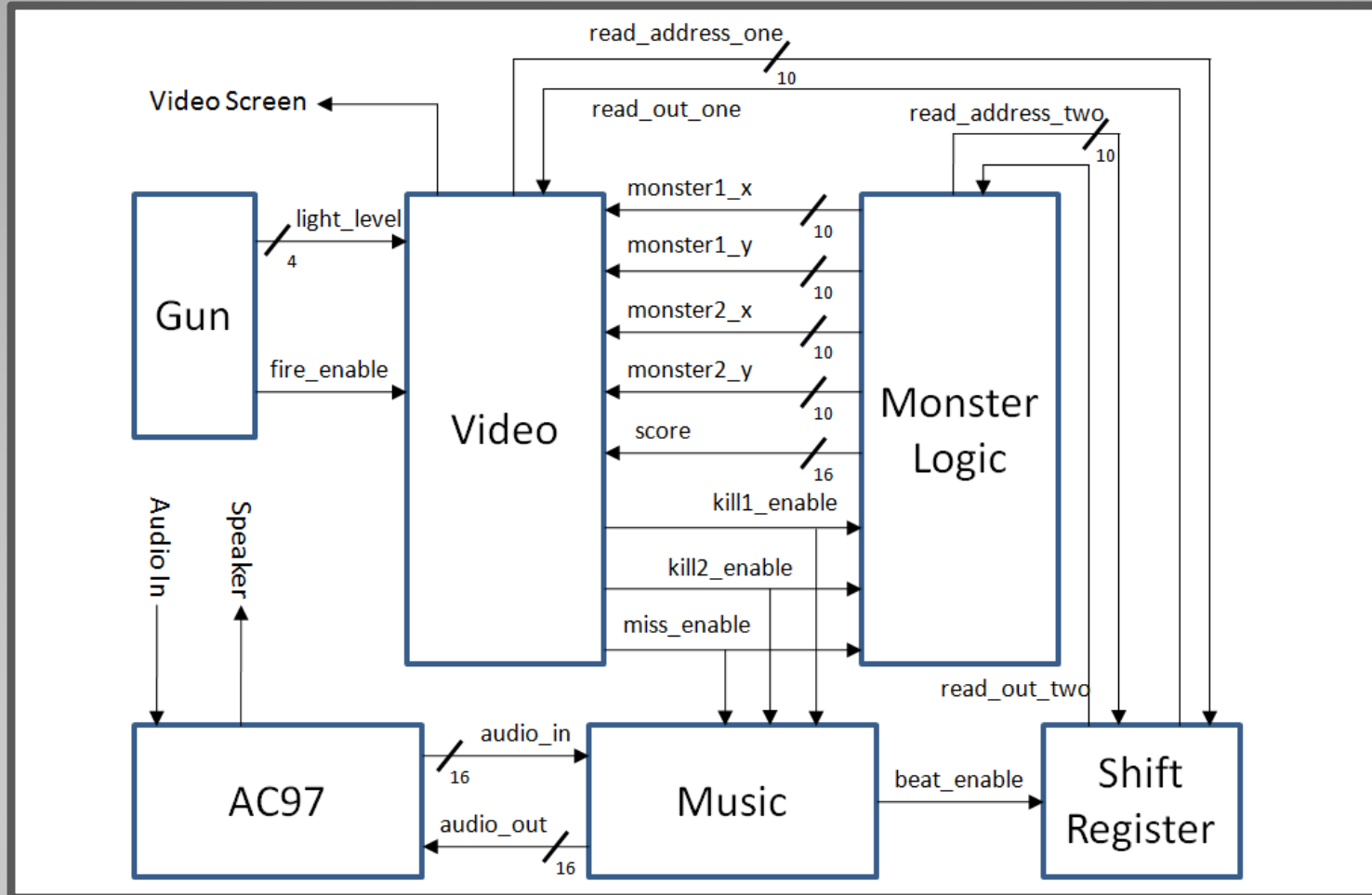
Game Mechanics: Scoring

- Player receives a much higher score for hitting a target during a beat.
- If player does not hit the target during the beat, the score received depends on proximity to the nearest beat.



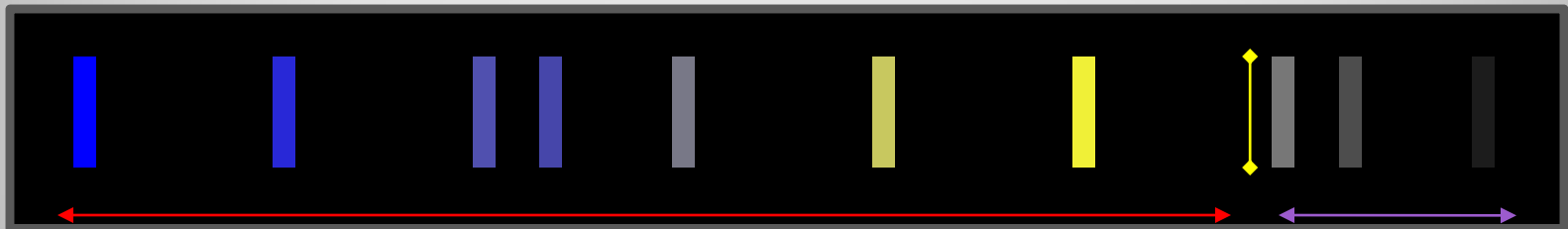
Score depends on proximity to 'now line'

Block Diagram



Module Description: Music

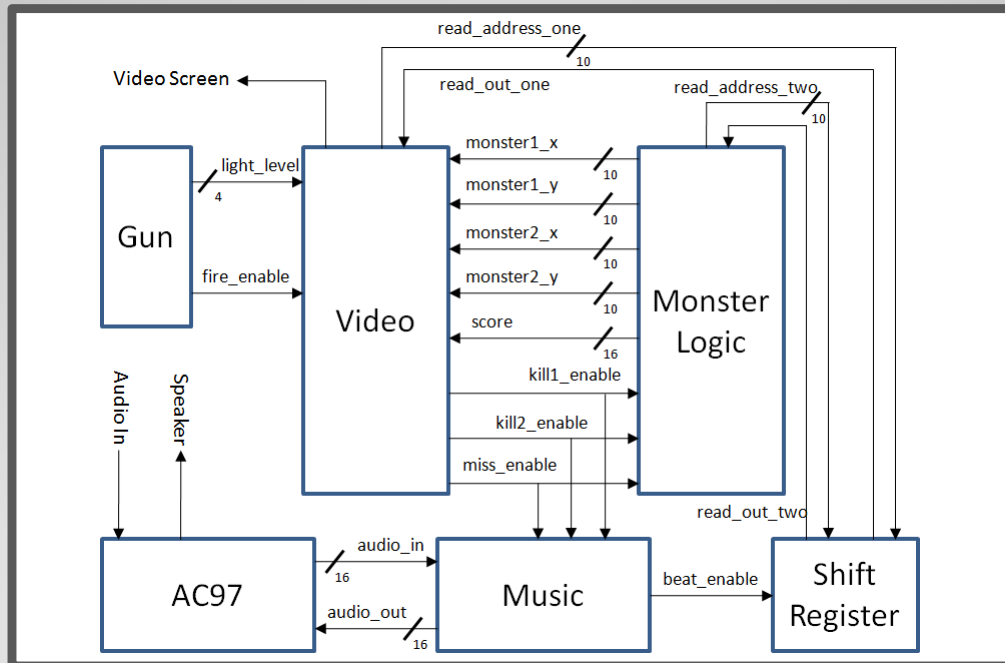
- Delays music playback by 3 seconds to display 3 seconds of incoming beats.
- Stores 3 seconds of music at 12-bit, 24kHz.
- Down-samples music to 200Hz sample rate before performing beat detection.
- Stores 4 seconds of beat detection data in Shift Register module.



3 seconds of beat data to allow player to anticipate beats 1 second post-beat data

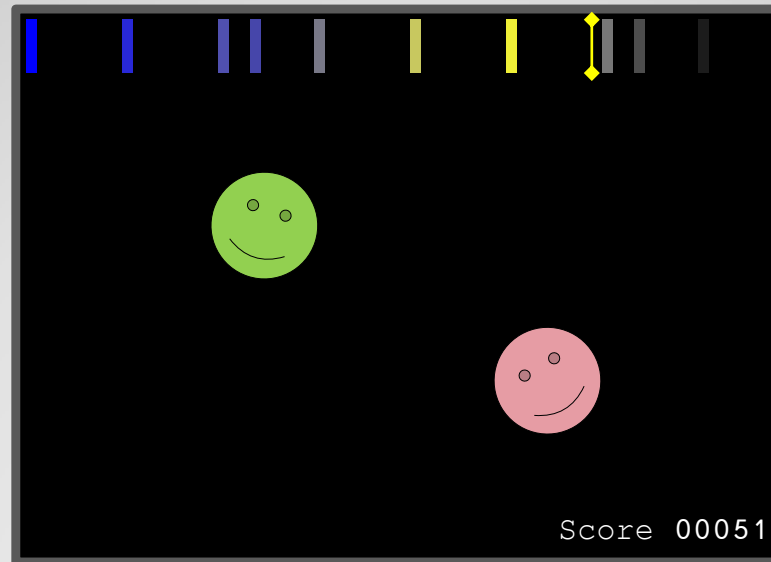
Module Description: **Monster Logic**

- Keeps track of XY-position of each target
- Calculates score based on beat data in Shift Register
- Monsters change speed & direction on the beat



Module Description: Video

- Displays SVGA video: 800x600 pixels, 60Hz
- Performs hit detection and notifies Monster Logic module of hits and misses
- Draws monster, beat lines and score counter



Module Description: Gun

- Contains phototransistor inside the barrel to detect light levels of any object it is pointed at
- Contains solenoid to simulate recoil
- Long, reflective barrel allows phototransistor to be extremely directional

Timeline

- Week of Nov 16
 - Beat Detection functional
 - Shift Register completed
 - Monster physics completed
 - Video display functional
- Week of Nov 23
 - Playback delay completed
 - Gun basic functionality completed
 - Monster beat behavior completed
 - System ready for integration
 - Hit detection functional
- Week of Nov 30
 - Score calculation and display completed
 - Gun additional features completed
 - Upgraded sprites
- Week of Dec 7
 - Report Writeup