Beat Gunner: A Rhythm-Based Shooting Game

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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

- Score counter
- Targets
- Scrolling beat indicator bars

Score 00051
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
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’
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