Play Paratrooper
and earn PE credits
Modifications to the game

- Gun moves left and right instead of varying the angle.
- The player controls the position of the gun by moving left and right across a black screen. Shooting is triggered by the player raising and lowering their hand. The player's motions are captured using a video camera. Calibration is done at the start of the game.
- The helicopters drop bombs in addition to paratroopers. The player loses varying amounts of “health points” if these fall to the ground. By shooting them, the player earns PE points.
- Multiple levels
Block diagram
Game Environment

- Player stands in front of a white background
- Faces camera placed above the game output monitor
- Moves left and right to control position of gun
- Lifts and lowers arm to assert the shoot signal
- Players may increase health benefits of playing games by wearing wrist weights while they play the game
System Overview

- Video camera produces NTSC analog signal of playing area
- NTSC signal input to AD775 analog-to-digital converter and GS4891 video chip
- Controller FSM uses H-sync and V-sync output of video chip to initiate AD conversions.
- Video sampled at a resolution of 128x96 pixels into SRAM using majority pixel averaging
- Processing FSM computes position and shoot signal
Position & Lighting Calibration

- Required to adjust shooting threshold for different player heights
- User resets game by moving out and back into the playing area on the Game Over screen
- Required to stand 5 seconds while the camera reads height information
- Output monitor displays player’s outline with a line to indicate detected height
- Player raises his hand for another 5 seconds to calibrate shooting height
- 3 switches provided for setting black/white pixel threshold to accommodate different lighting conditions
Computing Position & Shoot Signal

- Processing FSM computes leftmost and rightmost black pixels and averages them to find the position.
- Processing FSM computes highest black pixel and asserts shoot signal if it exceeds calibrated shoot level.
Interface with Game Controller and Video Output subsystems

- 8-bit unidirectional bus to Game Controller Unit provides positional information
- Additional 1-bit signal used to indicate shoot gesture. Implemented as a level to pulse converter to prevent automatic rapid fire!!
- 14-bit input address bus and 8-bit output data bus provides SRAM access to video output subsystem during calibration
Game Controller FSM

INIT

WAIT

LEVEL

GAME

OVER

ALL OTHER STATES

reset

!reset

!calibrated

calibrated

!done

done

!done

restart

done

!restart
Level Selection

- Player can move left and right to select the level
- Player confirms the level selected by raising his or her hand
- Paratroopers, bombs, and helicopters move faster at higher levels
- Paratroopers and bombs may also get dropped at a higher frequency
Video Subsystem

- Video output generator
  - Data, WE
  - Address
  - FS_bar

- RAM
  - Address
  - MS_bar

- Video display interface
  - Address
  - HS, VS, R, G, B

- Display