# Play Paratrooper
and earn PE credits

Screen capture of the original paratrooper game

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 triggerred 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.
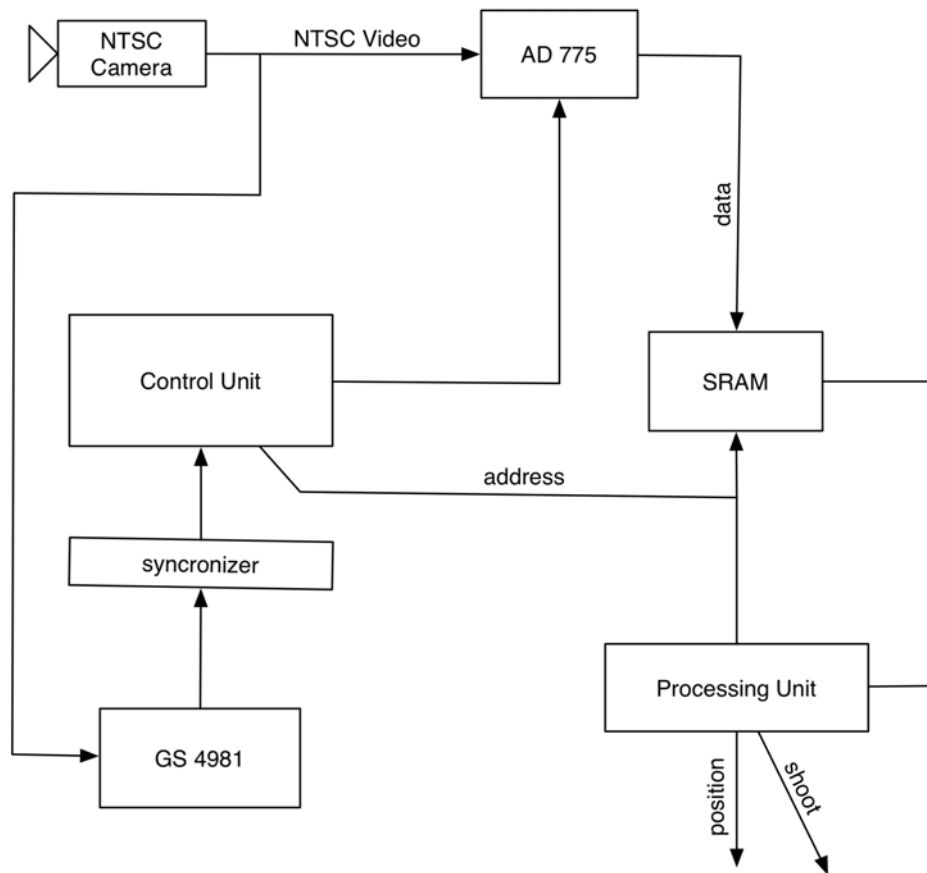
- Multiple levels

Block diagram
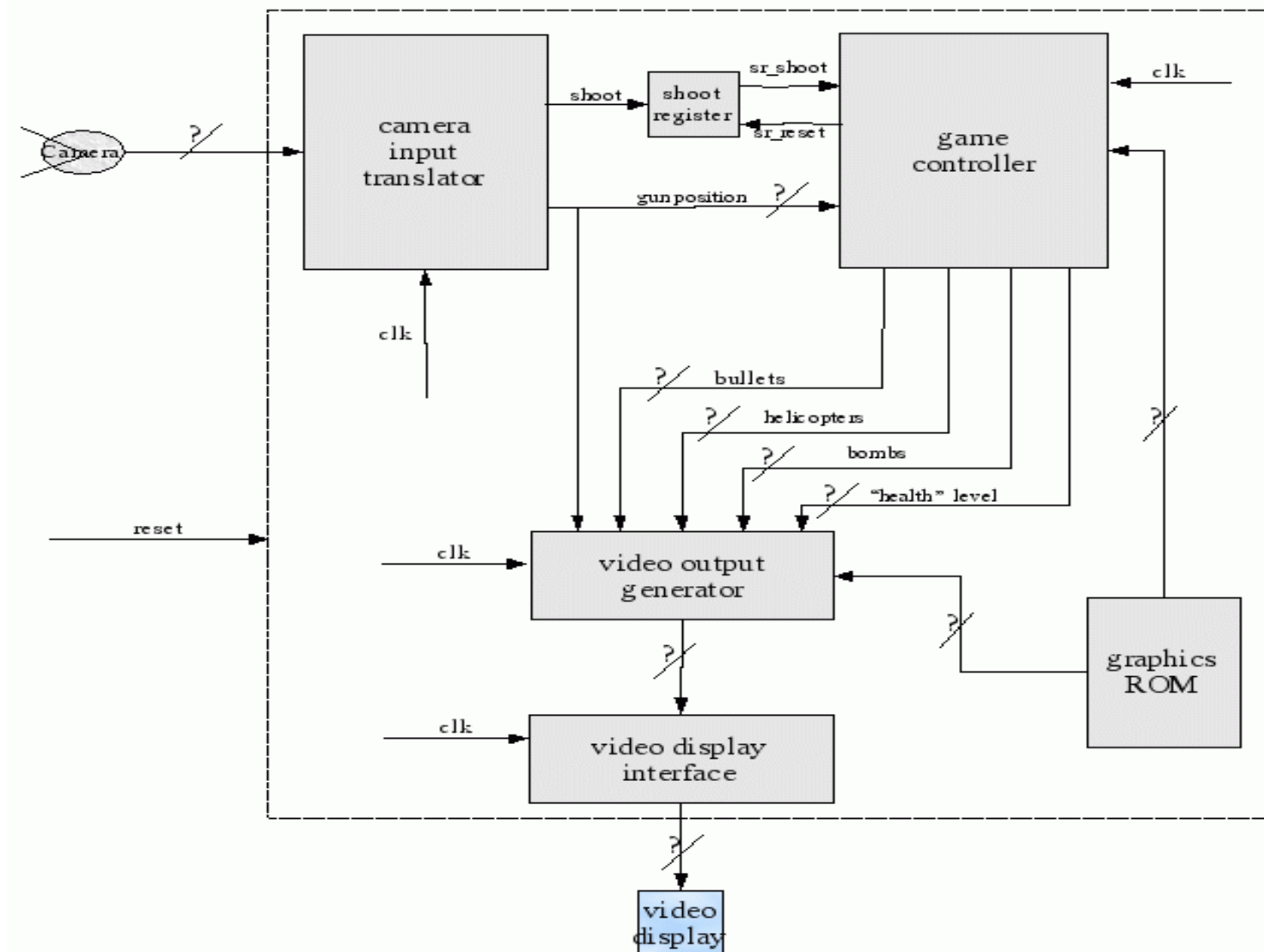
Game Environment

- 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
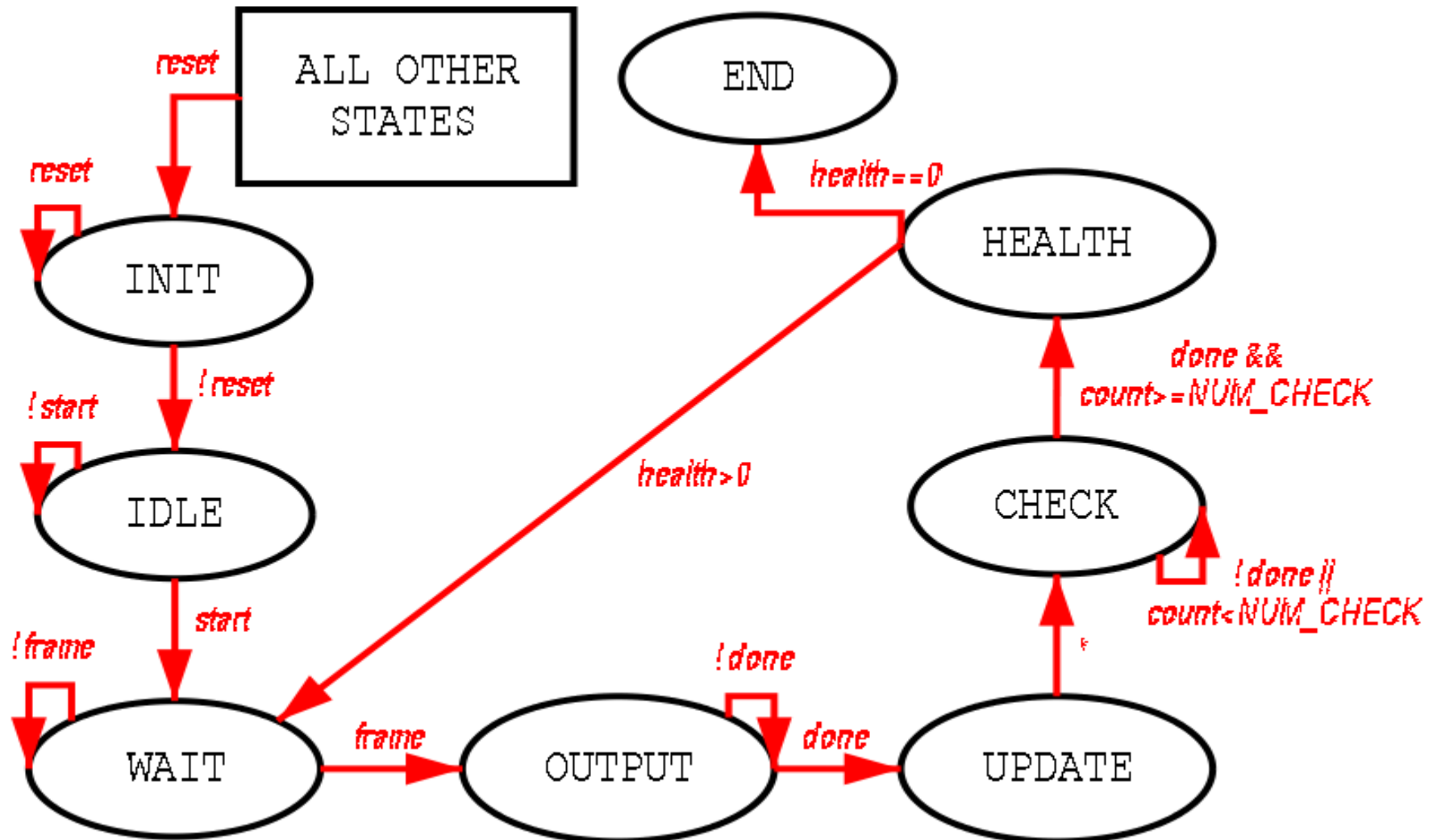
Game Controller FSM
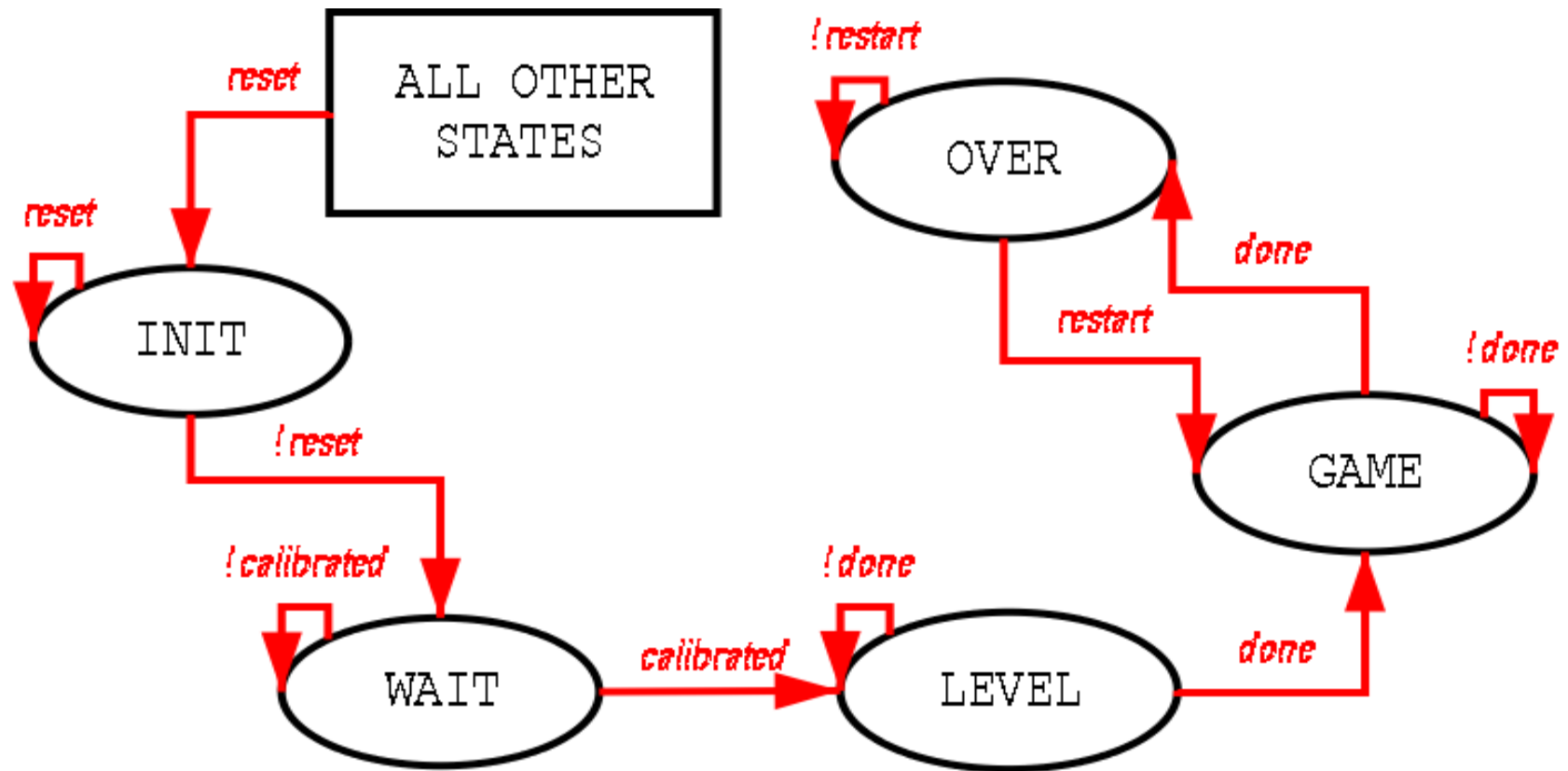
Level Selection

- 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

Game FSM

Video Subsystem