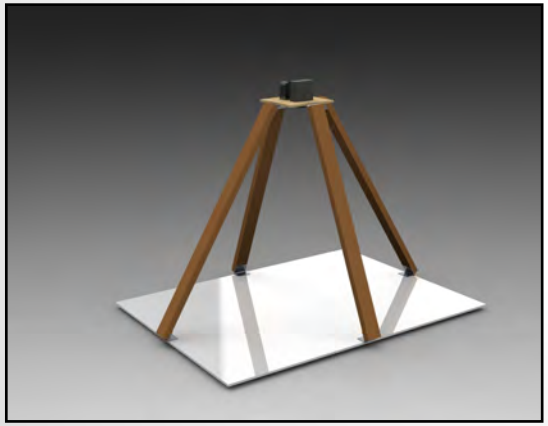
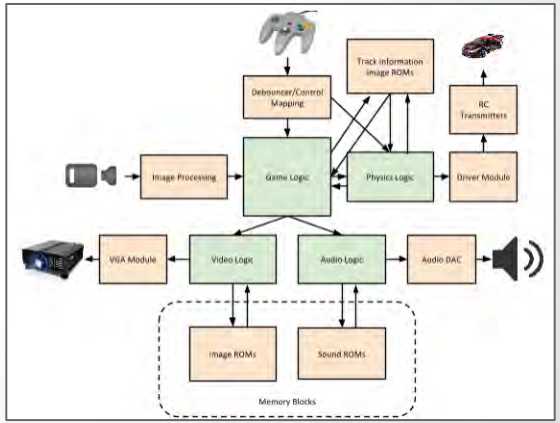
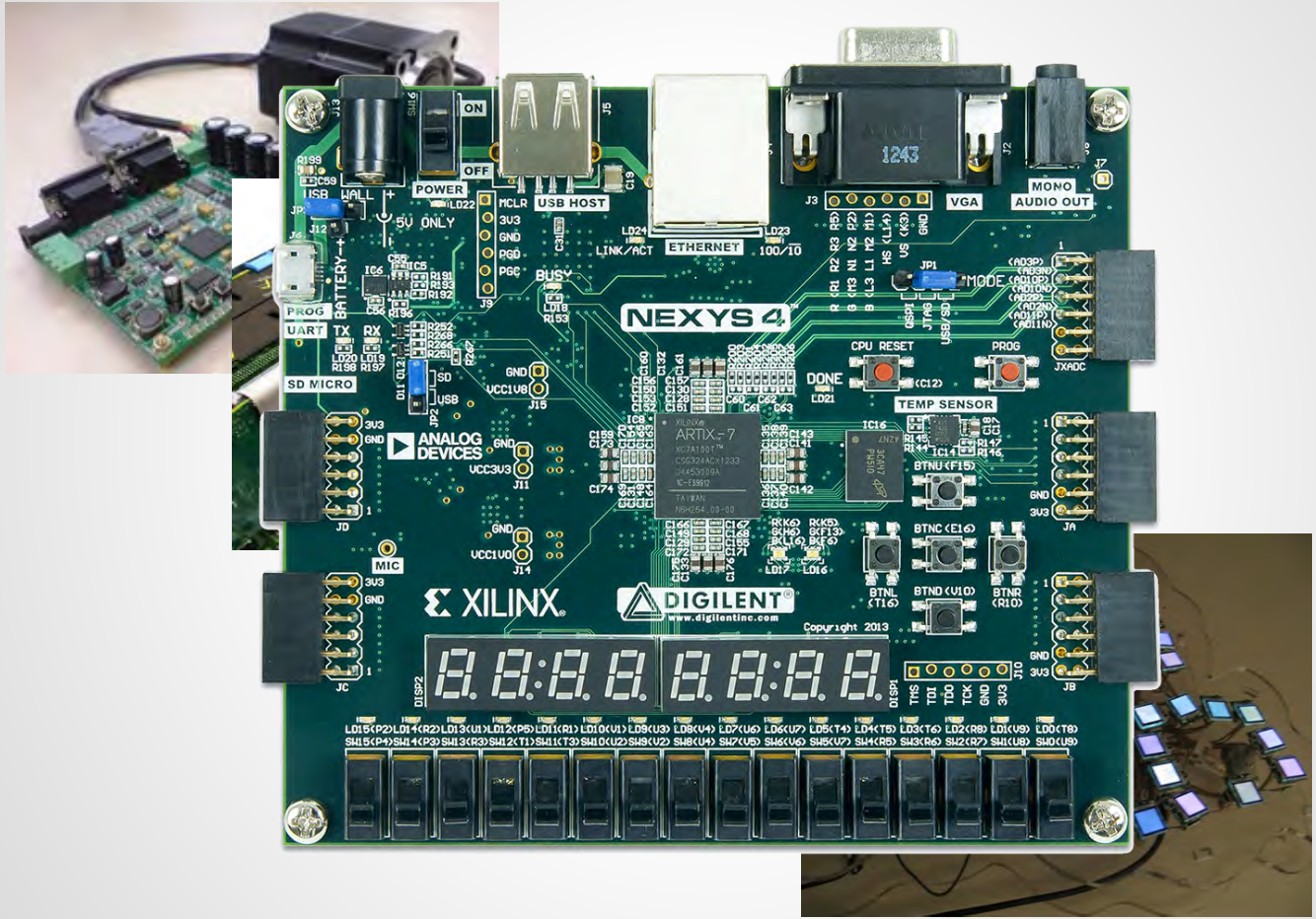
Live-Action RC Mario Kart™

Bradley Gross | Jonathan Matthews | Nathaniel Rodman

6.111 Final Project Presentation



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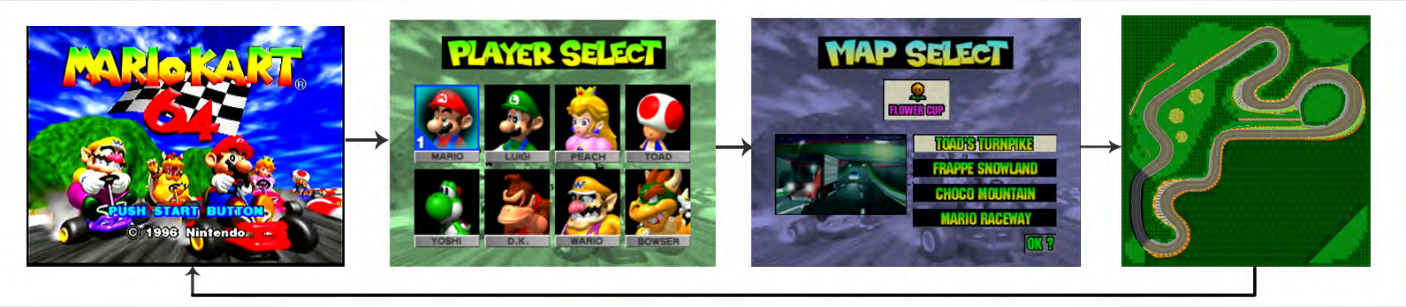
Mario Kart 64

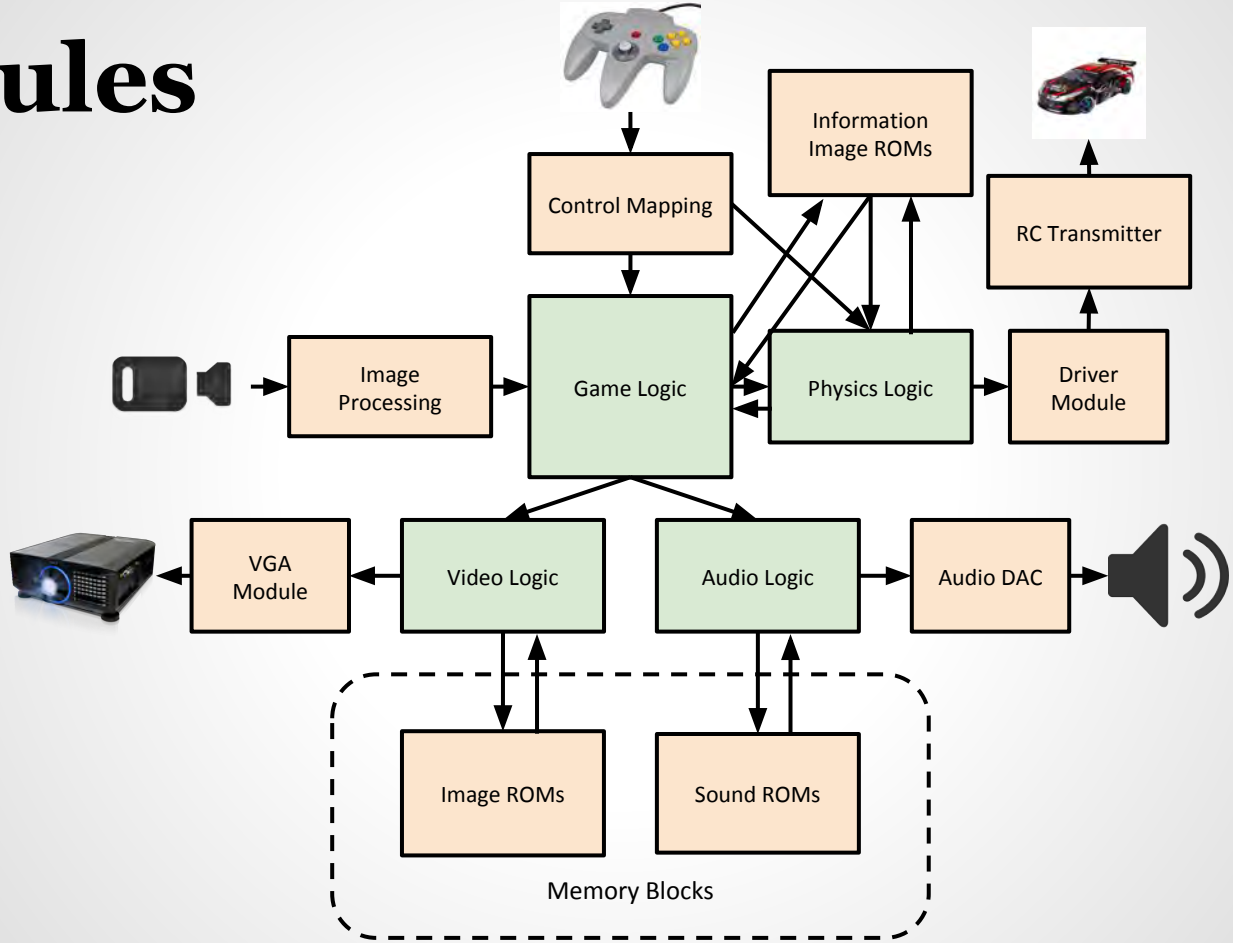


- Go-kart racing video game
- Four players, multiple character options
- Power-ups on race track

Bringing the Game to Live-Action

- Project track on platform
- Players race RC cars
- Camera detects car position
- FPGA handles logic, control of cars, items…

Modules


Information Image ROMs
Control Mapping
RC Transmitter
Image Processing
Game Logic
Physics Logic
Driver Module
VGA Module
Video Logic
Audio Logic
Audio DAC
Image ROMs
Sound ROMs
Memory Blocks

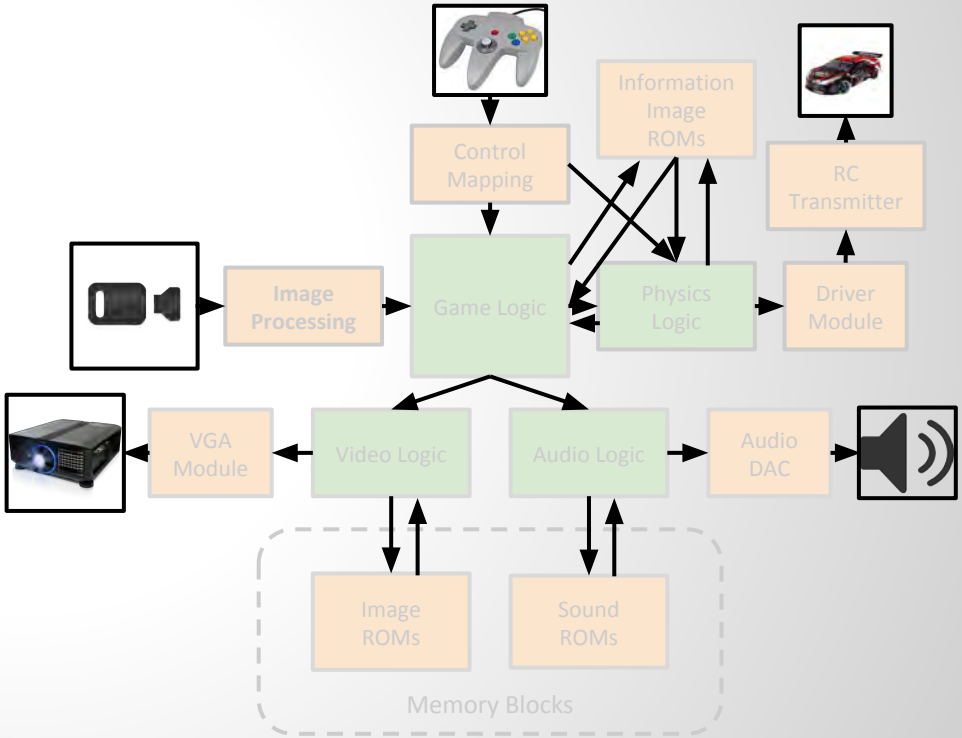
Physical Setup

- Sony VX-AW15 Projector
- Lab-supplied NTSC camera

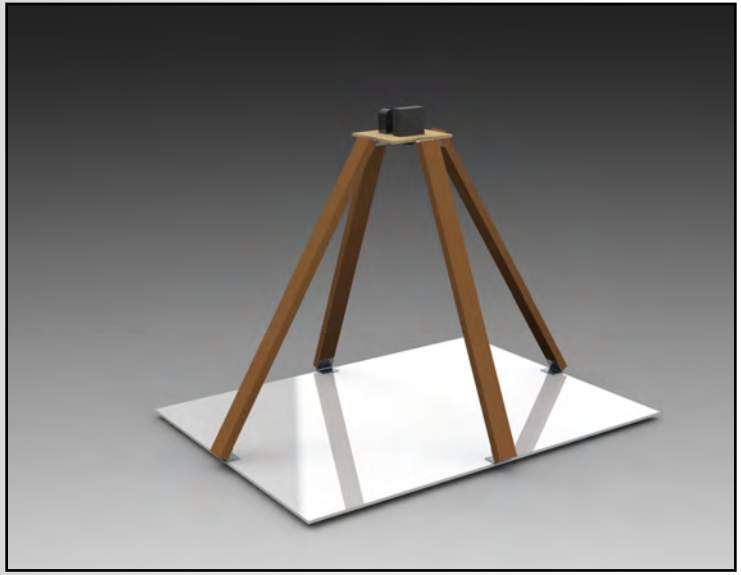
  IR filter
- N64 controller

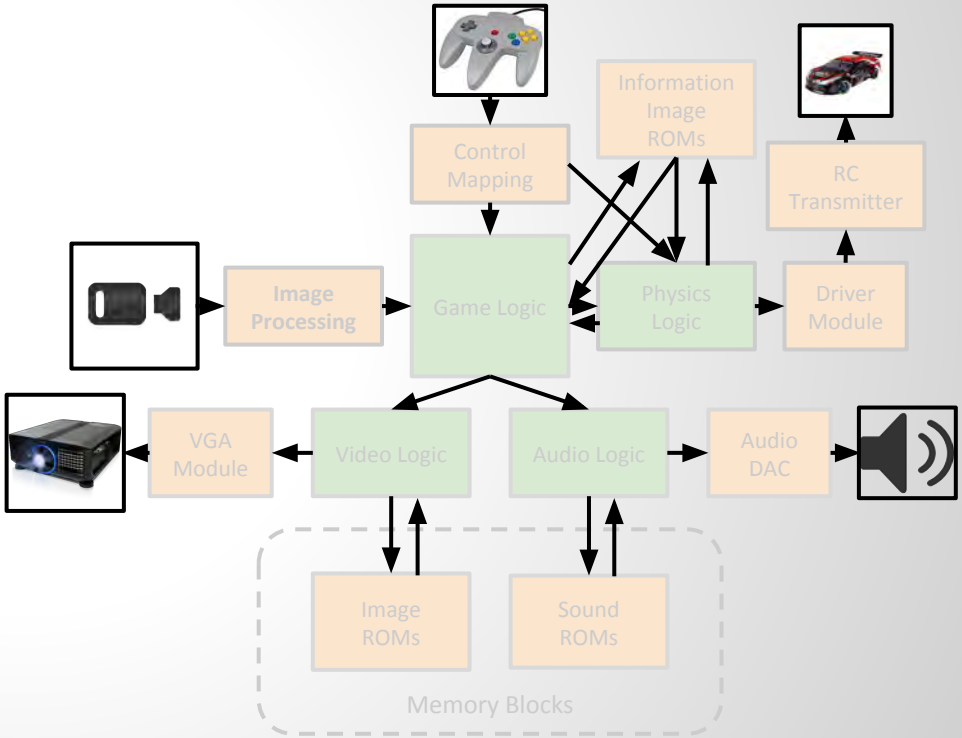
  Gut old N64 for ports
- “Coke Can” Mini RC Cars

  IR LEDs
- Computer speakers



Physical Setup





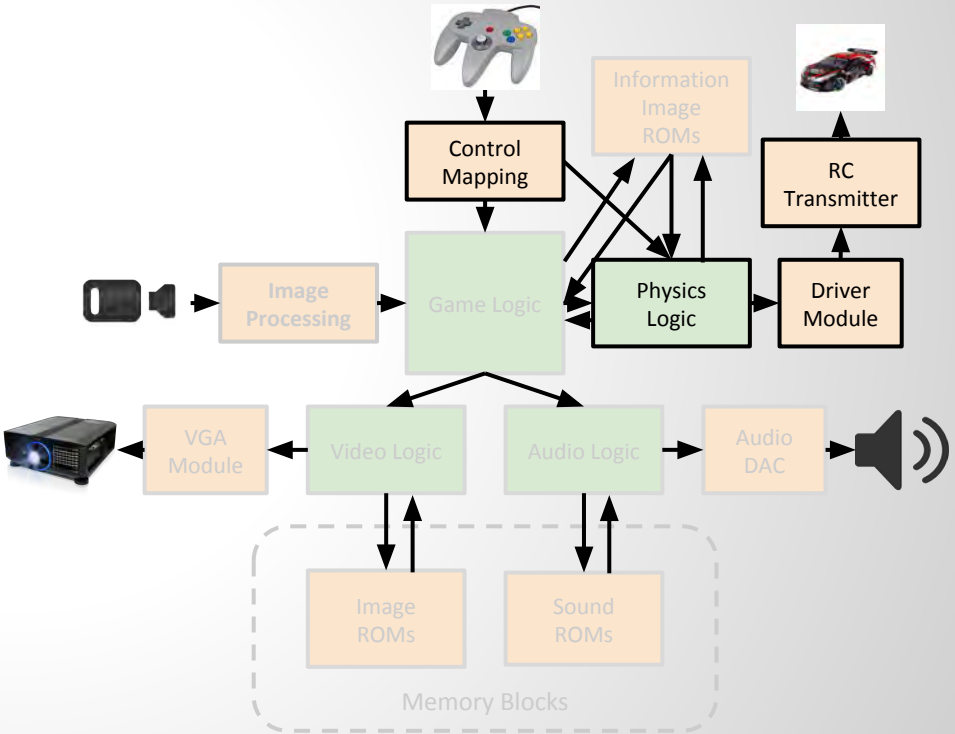
Driving Cars

- N64 controller interface module
- Physics logic decides commands

  Is car on "grass"? slow : normal

  Is car boosting? fast : normal
- Driver module translates to PWM

  Mini RC cars are binary speed & turning
- RC controller + transistor array sends signals to car



Tracking Cars

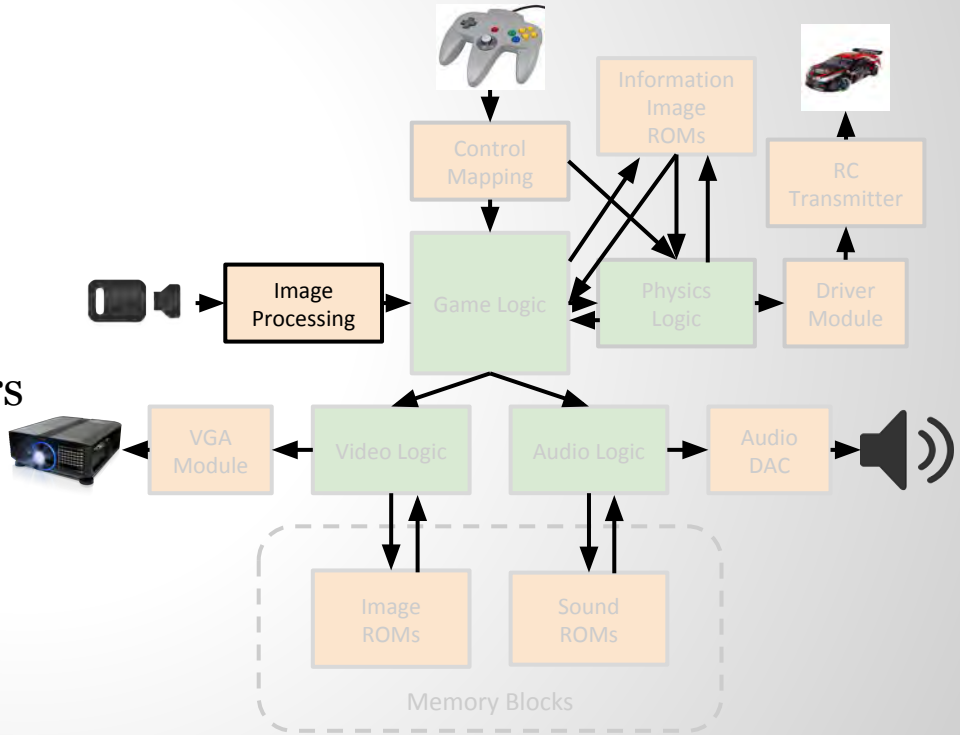
- Cars outfitted with IR LEDs
- Camera feed next to projector

  IR bandpass filter
- Image processing locates [x,y] of cars

  Center-of-mass algorithm

  Neighborhood of prev. car location
- Calibrated offset

  Camera coordinates → world coordinates



Displaying Video

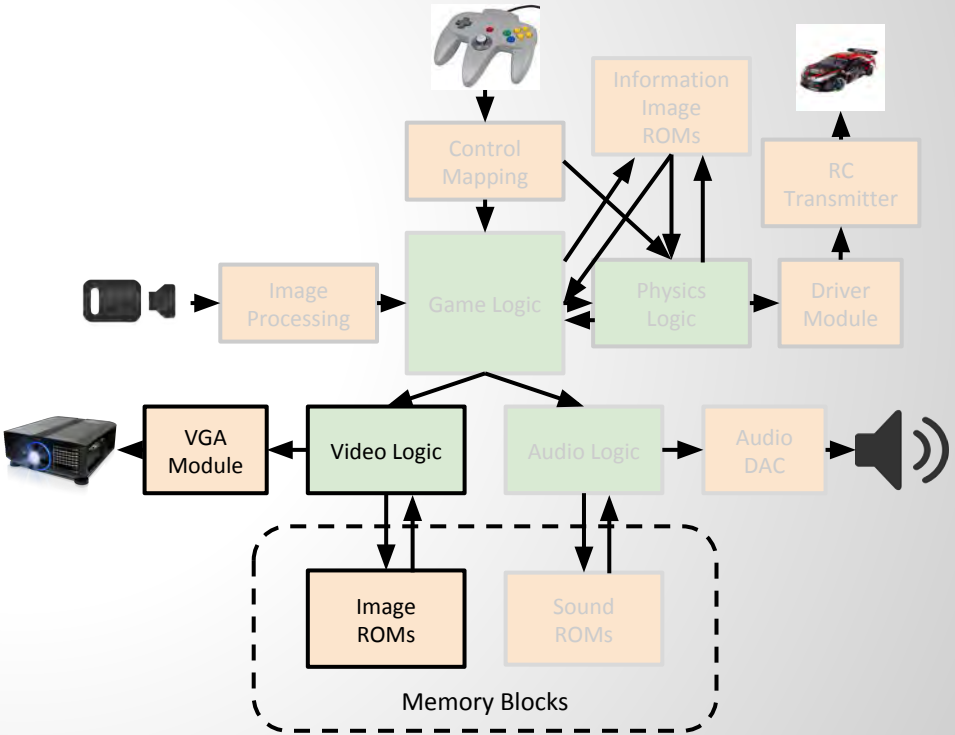
Video logic prepares pixels

- Which objects are present?
- Depth ordering

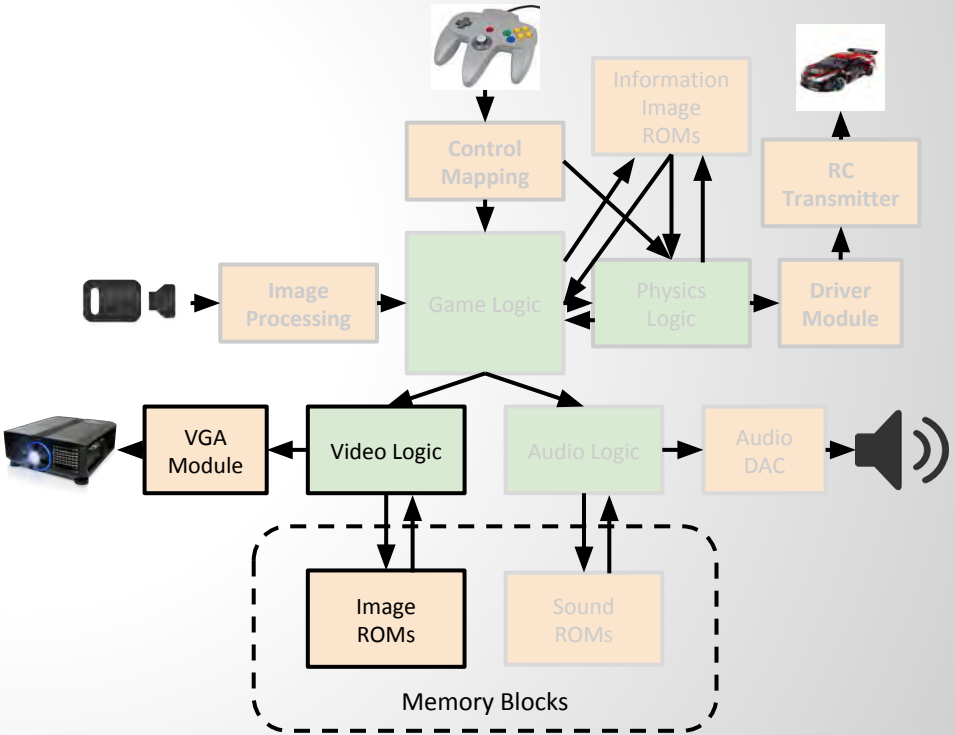
Pixels loaded from memory

- *Nexys 4 has 4.8 Mbits BRAM*
- *1 scene images > 3Mbits*
- *2+ scenes, need > 25MHz random access*
- *SD card loader into BRAM for each scene*

VGA 640x480 output



Displaying Video



Playing Audio

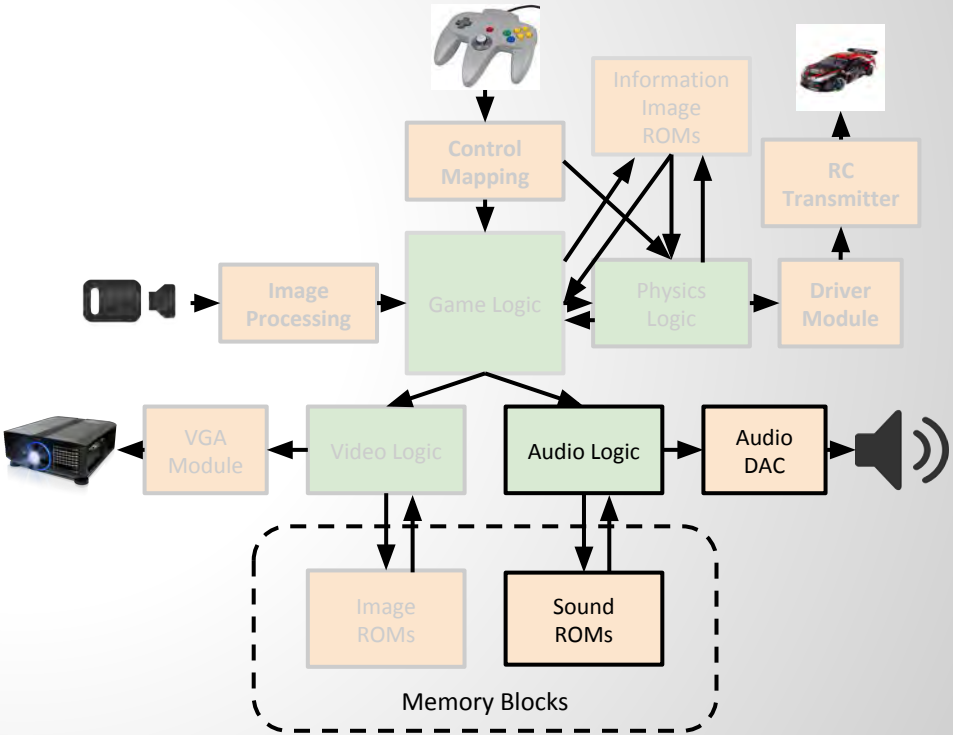
Audio logic prepares samples

- *Background music*
- *Item noises*

Samples loaded from memory

- *Same issue as video*
- *BRAM not enough for video + audio*
- *Audio ~6KHz sampling, random access*
- *SD loader to cellular RAM, power-on*

Reconstruction filter → speakers



Game Management

Game phase FSM

Start screen, character select, racing

Race state FSM

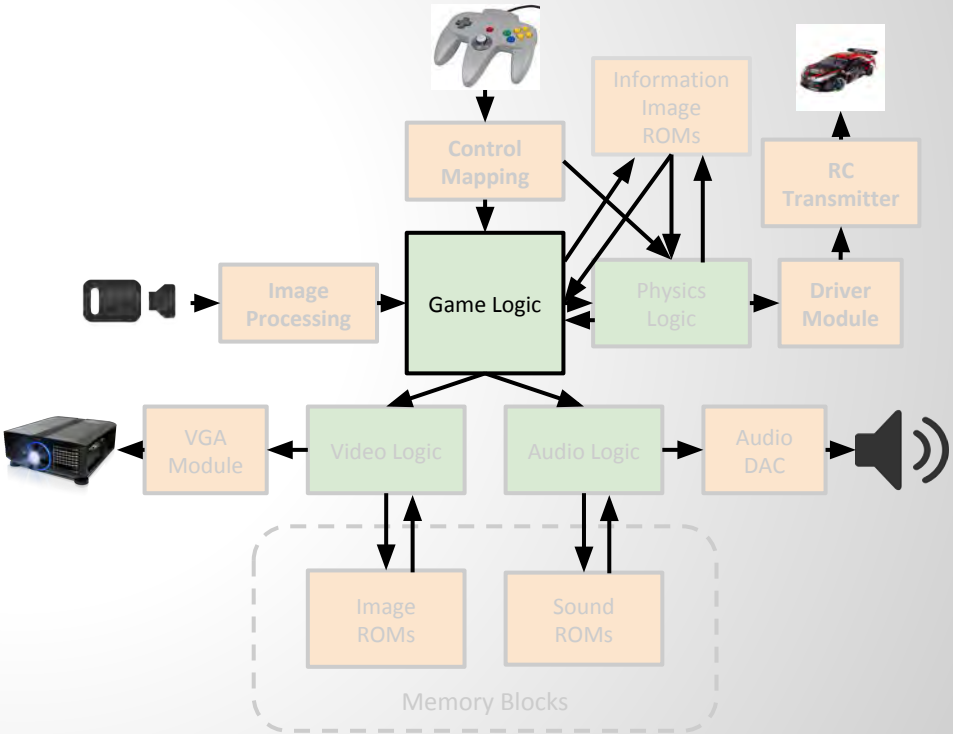
Car [x,y], power-ups, race time, etc.

Updated by other modules

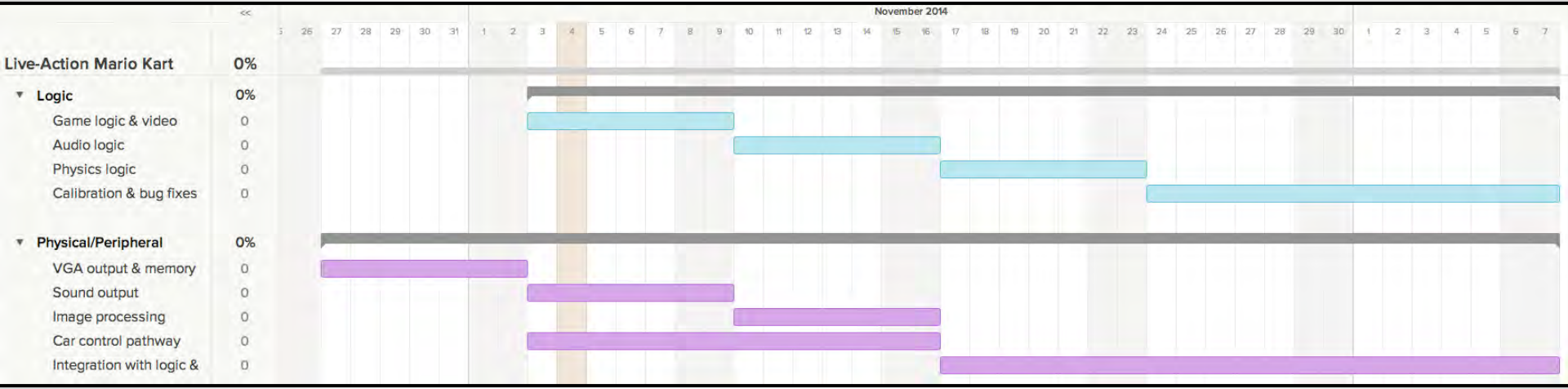
Menu nav. & race actions from controllers

Car positions from camera

Item updates from physics



Timeline


November 2014
Live-Action Mario Kart 0%
Logic 0%
Game logic & video 0
Audio logic 0
Physics logic 0
Calibration & bug fixes 0
Physical/Peripheral 0%
VGA output & memory 0
Sound output 0
Image processing 0
Car control pathway 0
Integration with logic &

Start Your Engines