Duckhunter

Final Project Presentation

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Outline of Talk

- Objectives and System Overview
- Block Diagram
- Input System
- Output Servomechanizm
- Calibration
- What's Next?
- Conclusions

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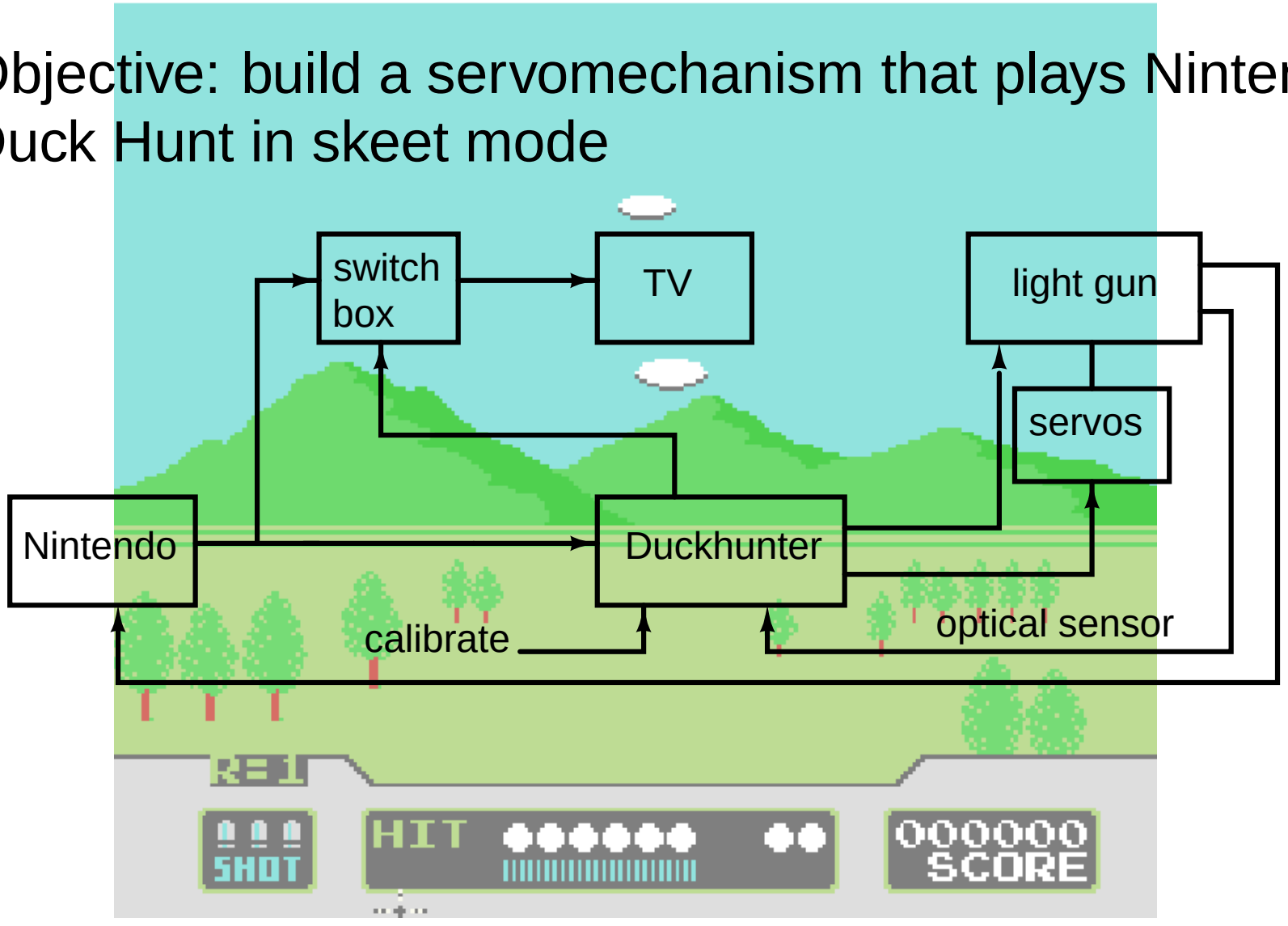
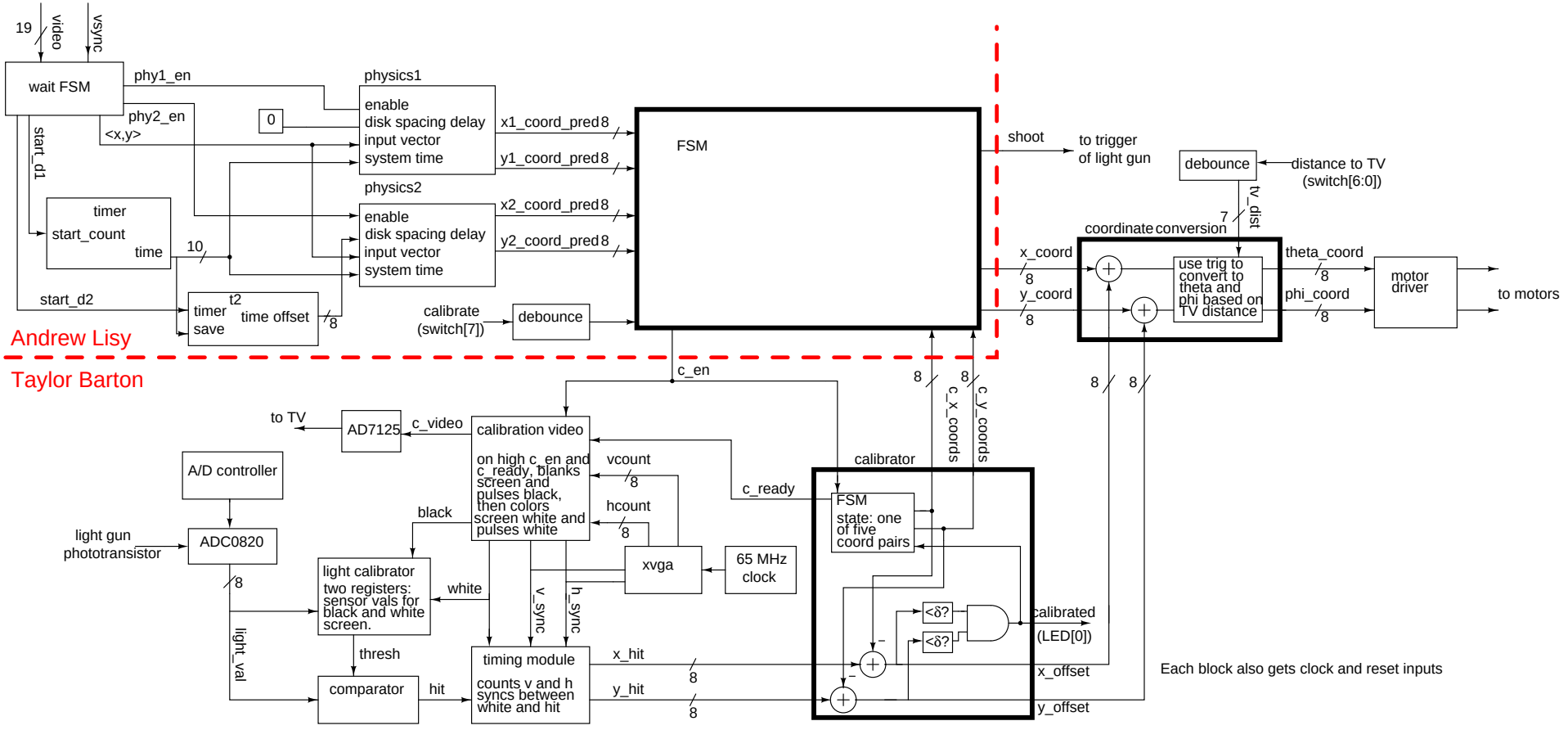
Objectives and System Overview

- Objective: build a servomechanism that plays Nintendo's Duck Hunt in skeet mode



Block Diagram



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- Physics Engine - Using vectors, apply formulas:

$$x_t = \overrightarrow{x_0}t,\ y_t = \overrightarrow{y_0}t + \tfrac{1}{2}g_{nes}t^2$$

where $g_{nes} =$ experimentally determined gravity force of NES (in $\mathrm{pixels/frame}^2$).

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- Timer - keeps track of delays in $1/10$ seconds.

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4. Output $< x_{A2} - x_{A1}, y_{A2} - y_{A1} >$ to vector output
5. Repeat process for next disk (using register bank B1, B2). When blip for next disk is found, assert start_d2.

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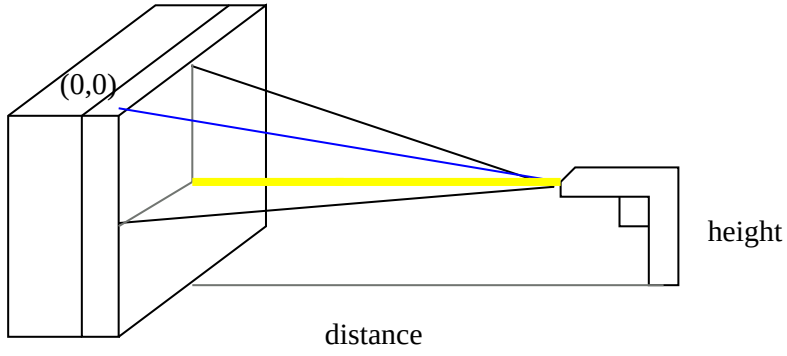
Implementation: The first physics engine receives input t from *timer*, t_{aim} from experimental values, and t_{sp} wired to ground (since it handles the first disc, there is no spacing delay). The second module receives t and t_{aim} from the timer and experimental values, as well as t_{sp} from the *t2* module.

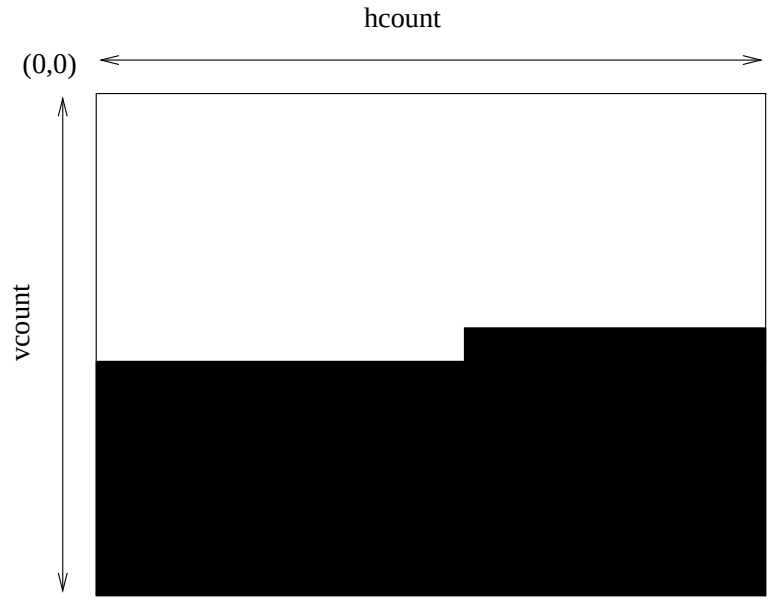
Servomechanism

- The output system takes the (x, y) coordinate from the physics engine and translates it into angles for the servomechanism.



- inputs: (x, y) coordinates, (x, y) offsets, distance from TV, height (constant)
- outputs: motor control signal
- Servo resolution ≈ 1 degree.

Servomechanism: Calibration



- Calibrator outputs video to TV: first black, then white screen.
- Timing module counts the hsync and vsync signals between the start of the white screen and the gun sensing a hit to determine position.

- System is calibrated by comparing intended and actual coordinates.

What's next?

1. Real-time Feedback: If we are able to find a version of the NES *Duck Hunt* game that uses a specific mode of hit detection (blanking then whiteing the entire screen), we can implement real-time calibration to our system, thus increasing the accuracy.

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3. Duck Hunt Mode: Depending on the mechanical limitations of our tracking and firing mechanism, *Duckhunter* could be implemented to play the Duck Mode of *Duck Hunt*

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- The calibration routine, while seemingly mundane, is a very critical part of the system, since the gun will be moved from station to station. Manual calibration would be tedious and unreliable.
- Determining the coefficients for the physics engine may require a separate system to track and analyze data from previous runs.
- If we are successful, this system may succeed where we have failed: reaching the final level of *Duck Hunt*