Lasers and Webcams

two great things that go great together?

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How to (not) give a talk

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Summer School of Science

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Minutiae: laser pointers

- Abusing them is the **#2 sin** of talks
- If you want to use them, learn how
  - Avoid overuse
  - Control your hands
  - Put the pointer in your pocket when not in use
  - Always use your shadow instead if possible
  - Touching the screen adds nice tactility

#2 sin?

- Laser pointers will be abused in this talk
  - In ways Ivan never dreamed of

Worse Yet...

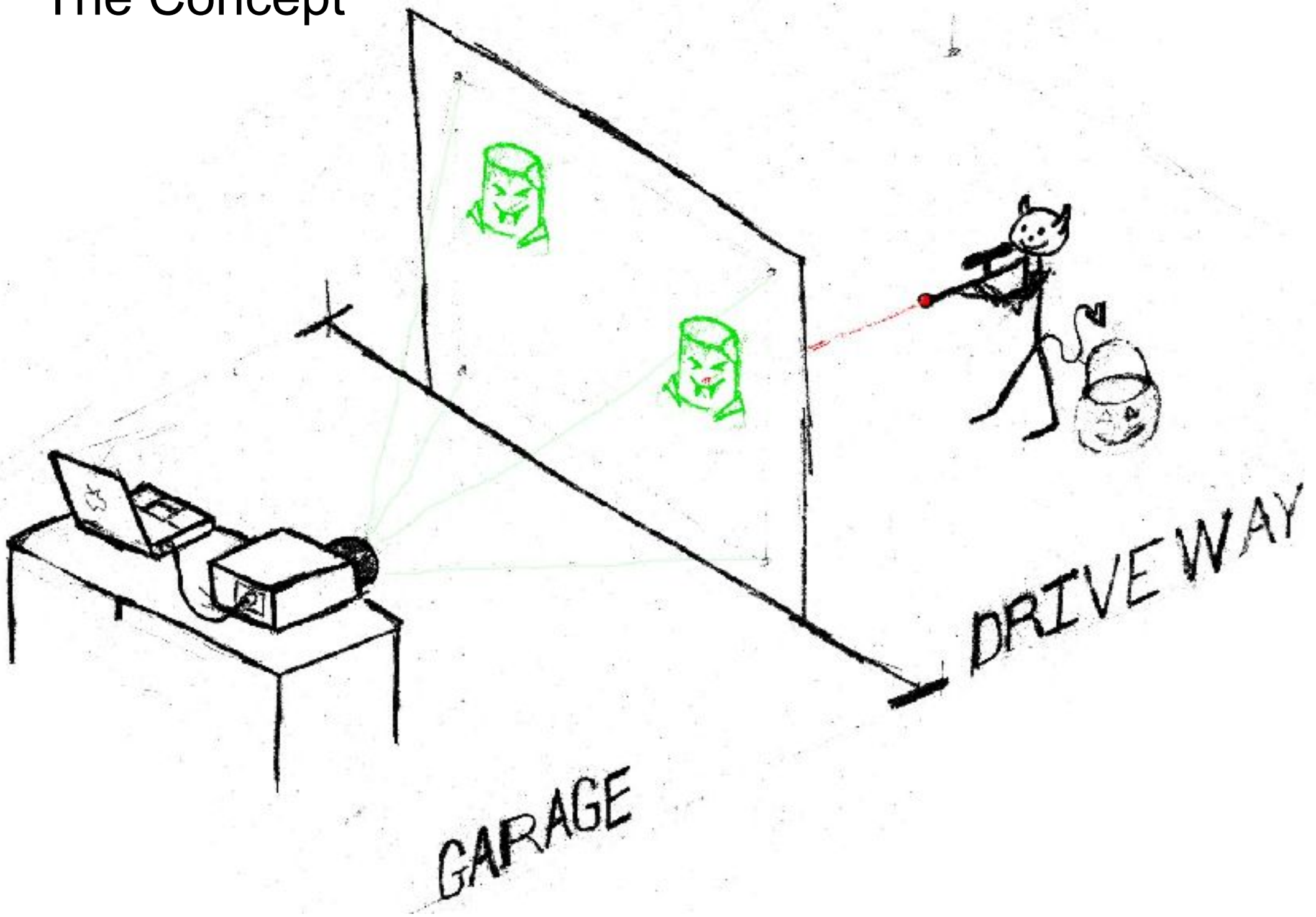
Worse Yet...

- I will make a complete fool of myself
- Don't worry
- It's ok to laugh
- You'll see

The Inspirations

- Graffiti Research Lab's Laser Tag Project
  - http://youtube.com/watch?v=DKbtTPYZEig
  - Local copy
- H/Malloween
  - http://homestarrunner.com/malloween.swf
  - Local copy

The Concept



The Problem

- What I had:
  - MacBook Pro with iSight
  - Laser Pointer
  - A garage
- What I lacked:
  - Projector
  - Screen
  - Software to access iSight
  - Game to play
  - Any clue about Python

PySight

- Easy Access to iSight
- Wraps CocoaSequenceGrabber

PySightTest

- I'm lazy – especially when confronted with a new language
- I'm lucky – PySight comes with PySightTest and is a simple and functional iSight app
- SequenceGrabberTest

Looking for Red in the PySightTest Event Loop

- Given RGB values, what is red? Two tests:
  - 1st test is simple and is performed on all pixels: red must meet a threshold value which is 2/3rds of the highest red seen so far
  - 2nd test only happens if 1st is passed:
    - redness = red*2 – green – blue
- Pixel with highest score for 2nd test is what we're interested in.
- If nothing meets 1st test then there is no result.

What Would Be Better

- Generate a list of all sufficiently red pixels.
- Sort by “redness”.
- Remove any pixels within 10 pixels of first pixel in list.
- Repeat for remaining pixels.
- Append pixels to a list.

PyGame

- PyGame comes with an aliens.py demo that did roughly what I wanted – basically simple space invaders using arrow keys and space bar.
- Modified to change how the aliens move.

Error!

- I should have made a mouse based interface to speed testing without using laser and PySight.

Linking the Two Programs

- Once again I was lucky: my brother Matt knows his Python and how to link two event loop based processes.
- Shared global variables used to communicate:

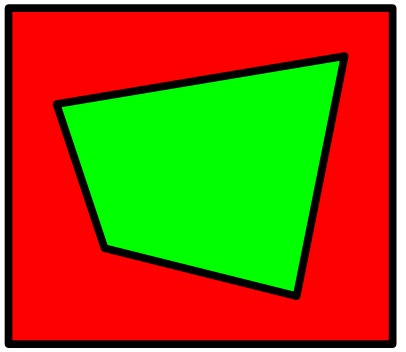
```
X = 0
Y = 0
SHOT = False
TOP = 0
BOTTOM = 480
LEFT = 0
RIGHT = 640
```

Performance Concerns

- Scanning is slow
  - Scanning every pixel of every frame makes the game too slow to play
- Only scan every 5^{th} frame
- Use calibration to limit scanning area
- Only scan 1 in 4 pixels

Calibration Thoughts

- Need to transform iSight coordinates to screen coordinates.
- Derived a 4 point calibration that would perform an arbitrary transform.

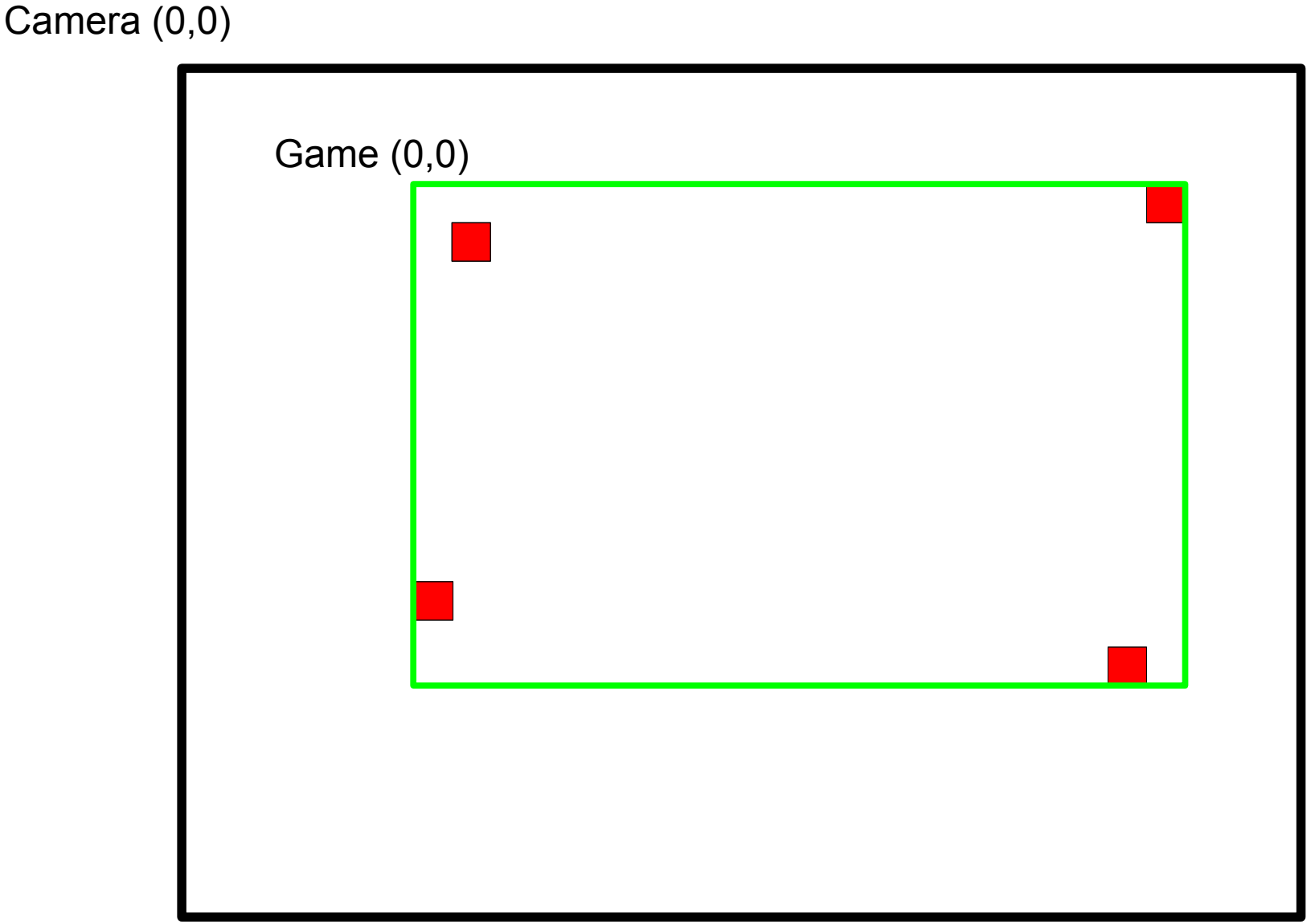


- Decided to try implementing a stupid simple method first.
- Worked well enough since camera is roughly aligned with projector so I stuck with it.

Simple Calibration

- Game puts a red dot in a corner, waits for iSight to “see” it and then put a dot in the next corner.
- Top & bottom y camera coordinate saved.
- Left & rightmost x camera coordinate saved.
- Assume that image of screen is rectangular.
- gameX = gameWidth * (cameraX – left) / (right - left)
- gameY = gameHeight * (cameraY – top) / (bottom - top)
- Note that camera code only scans between top & bottom, left & right, improving performance.

Callibration Illustration



You'll Shoot Your Eye Out Kid!!

A Christmas Story

Laser Safety

- Safety Disclaimer: Lasers can be dangerous. I am not an expert. I bought low power (<1mW) laser pointers for Halloween as I was handing this to kids. I had no need for more power.
- Many laser pointers are <5mW. This is powerful enough to cause eye damage if you stare at it but your blink reflex should prevent accidents.
  - http://www.osha.gov/SLTC/laserhazards/
  - http://en.wikipedia.org/wiki/Laser_safety

Where I Bought Lasers

- Low powered pointers:
  - http://www.laserpointer.net/
- Giveaway lasers:
  - http://www.surpluscomputers.com/
- Modules:
  - http://mfgcn.com/

Constructing Laser Guns

- PVC Gun
  - Laser pointer with the button taped down in some PVC from Home Depot
  - Radio Shack switch worked poorly
- Star Wars Gun
  - Laser module put into normal gun in place of LED
  - Hardest part was getting the gun open without breaking it

Results

- It works and was a big hit at Halloween!
- Needs to be dark to work with low powered lasers and a bedsheet.
- Inherently multiplayer.
- Works best if you aim for a dark area.
- Response is slower than I'd like.
- Firewire DV cam: plug it in and it just works.

Other Ideas

- Missle Command seems like it would be fun
- 3D games possible, need way to move player
- WiiMote to do head tracking?
  - http://youtube.com/watch?v=Jd3-eiid-Uw
- IR Lasers?
  - Would allow full color games
  - But you can't see them
  - Use both red and IR?

Demo

- Marshie Attacks