The Tactus Project

Novel Multi-Touch Task Management

Ryan Pavlik

The Project Definition

- Overall objective: Do something neat and new.
- Build hardware to enable multi-touch (MT) input to a computer system.
- Develop software to use this hardware in a novel way.
  - Refinement: Create task-management software to use multi-touch

Getting it done...

Lots of sawdust, plenty of error messages

Hardware Deliverables

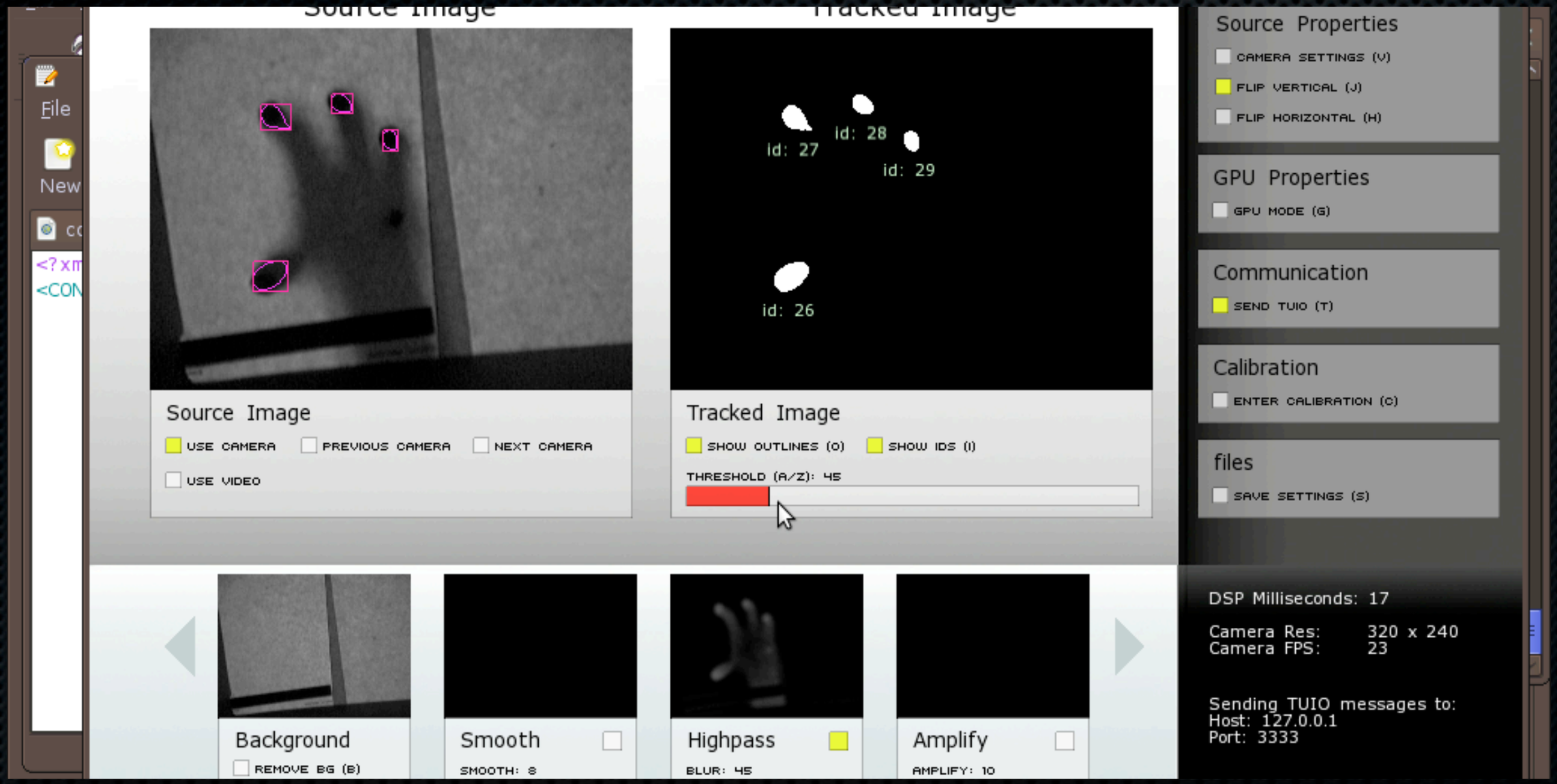
- Multi-touch displays capable of also supporting a “standard” workstation
  - “MT Mini” temporary test device
  - Desk #1 - Projected Rear DI - complete
  - Desk #2 - LCD Laser Light Plane - lasers arrived on Monday...

Software Deliverables

- rp-mt-scripts - Multi-touch software system
  - Linux-based (Ubuntu 9.04) system for automatic setup and management of multi-touch software
    - Now installing required software a one-step process
- tactus-navigator - “Nav display” task manager
  - Replacement for task bar
  - Places icons for current applications on MT display

What's up with multi-touch?

- Keyboard
- Mouse
- Touchscreen
- Multi-touch tablets/screens

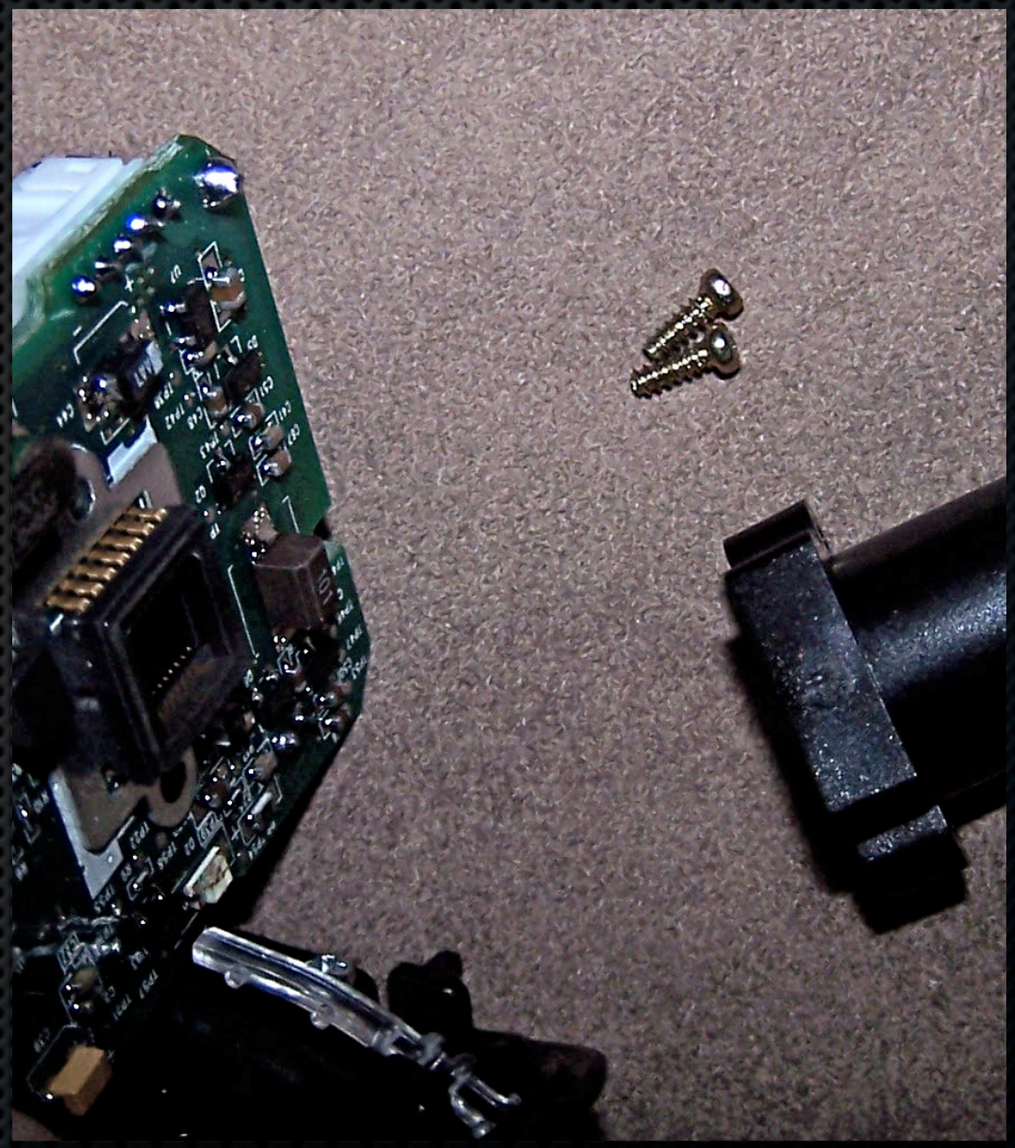


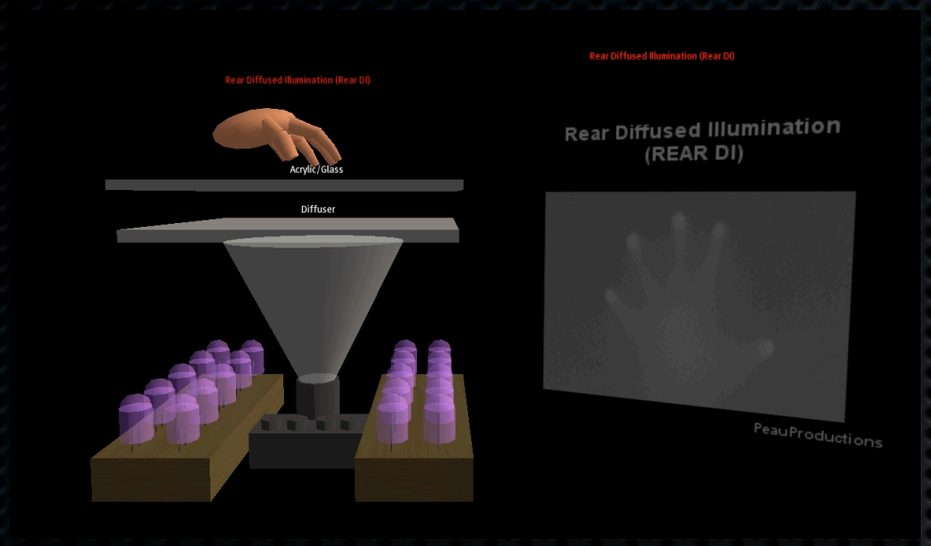
Optical multi-touch sensing

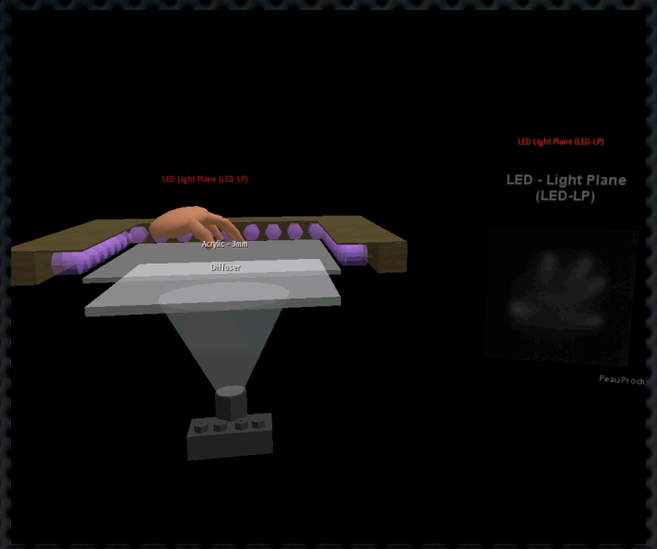
Blob tracking through computer vision

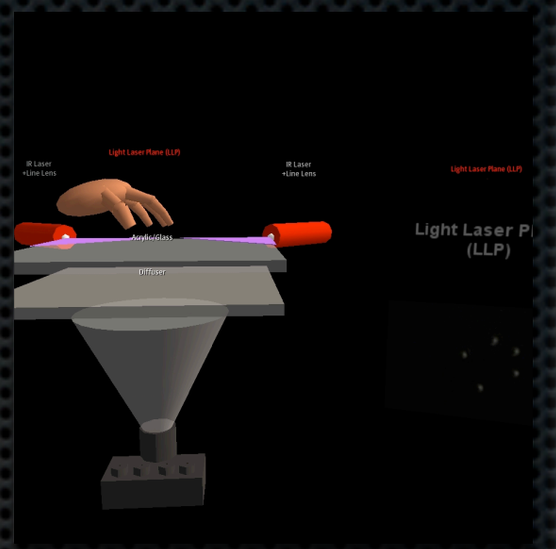
Infrared sensing

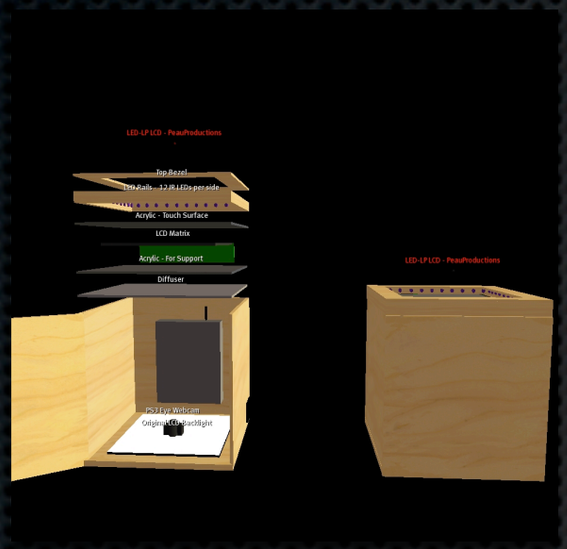
Permits multi-touch displays, not just tablets











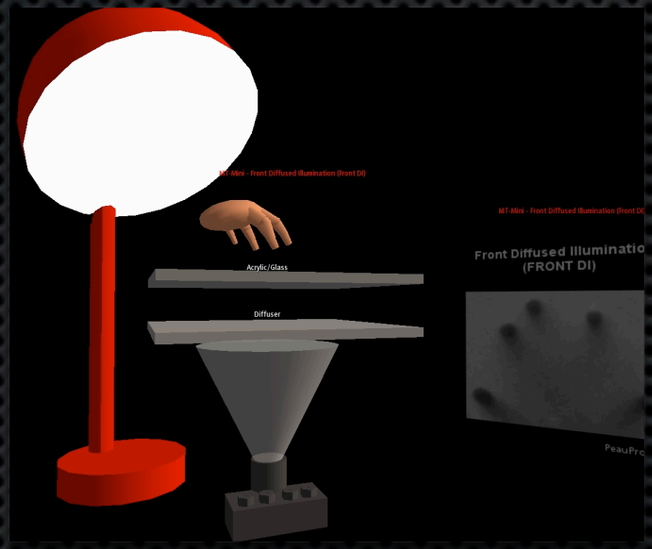
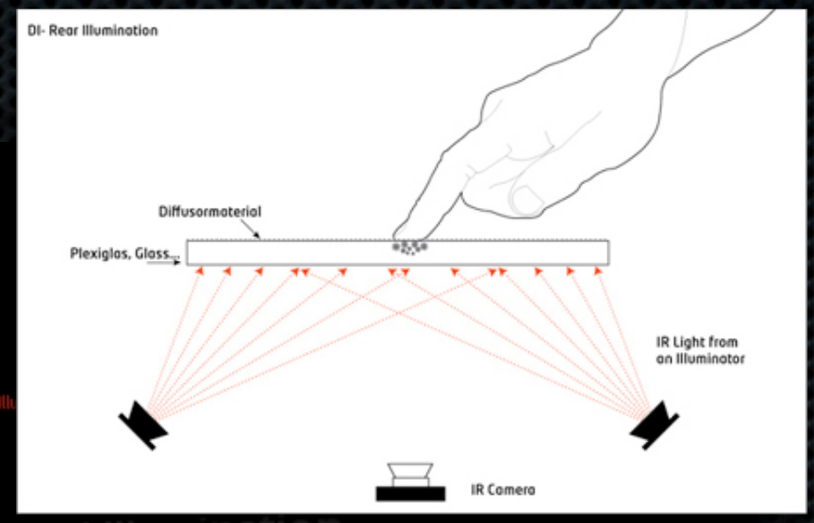


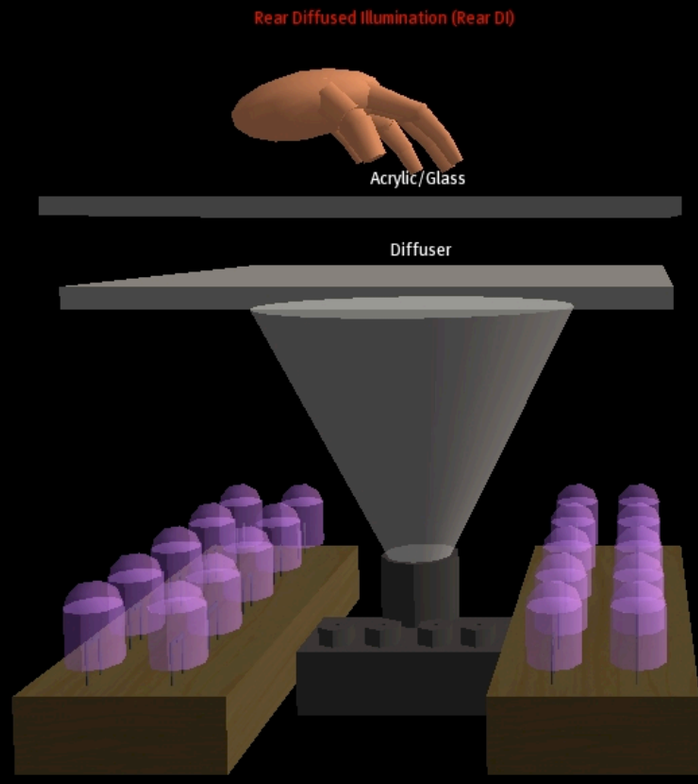
Table design principles

1001 ways to make a multi-touch screen

Revision 0: “MT Mini”

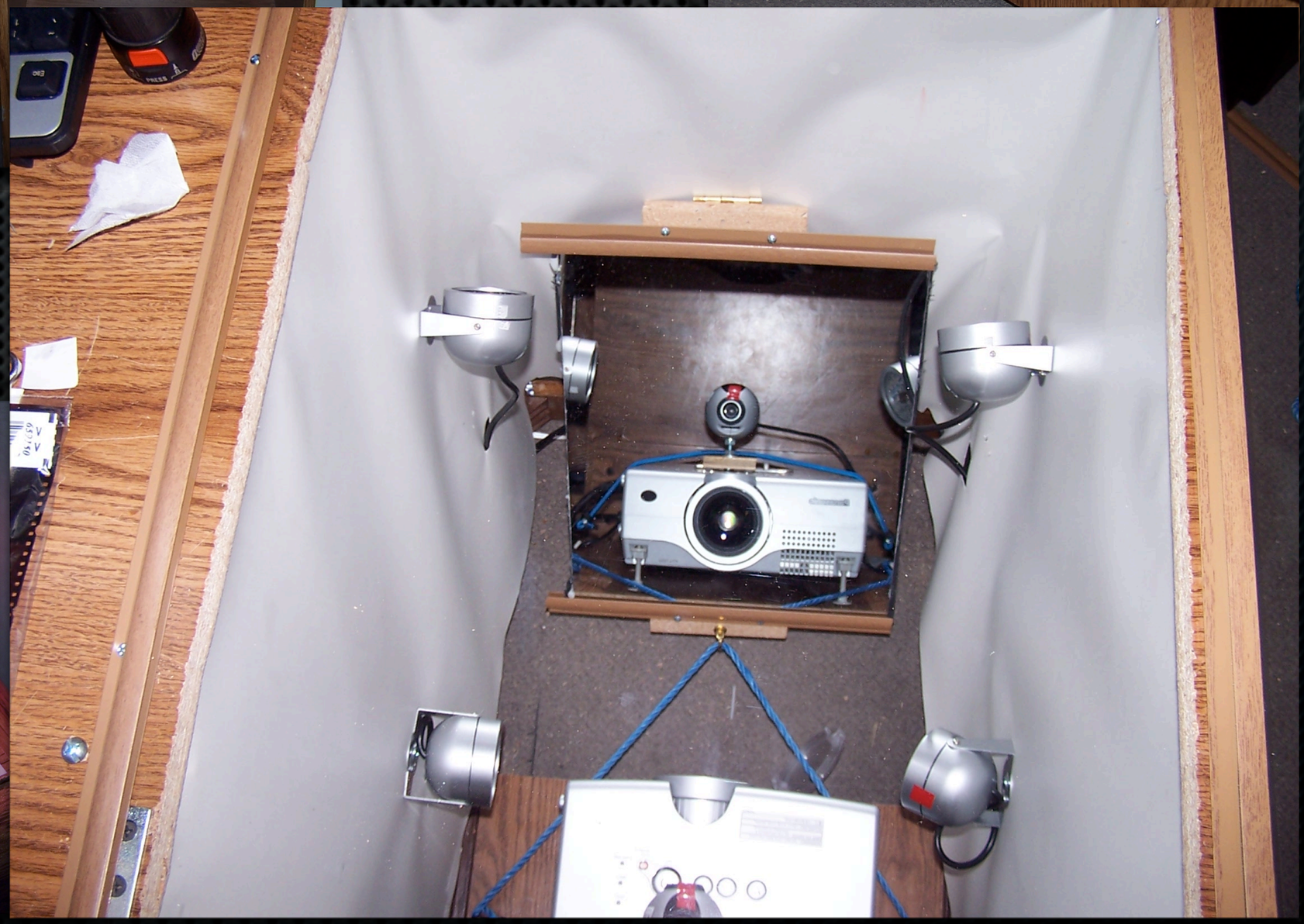
Software test platform, works by “front DI”





Rear diffused illumination

"Projected rear DI" chosen for first hardware revision




Turn off IR power
when done!

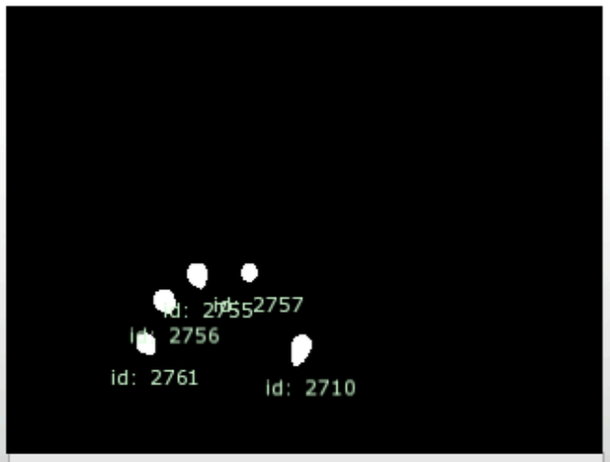
Source Image

Source Image

USE CAMERA | PREVIOUS CAMERA | NEXT CAMERA

USE VIDEO

Tracked Image



Tracked Image

SHOW OUTLINES (O) | SHOW IDS (I)

THRESHOLD (A/Z): 6

Background

REMOVE BG (B)

DYNAMIC SUBTRACT

Smooth

SMOOTH: 2

Highpass

BLUR: 7

NOISE: 4

Amplify

AMPLIFY: 57

Source Properties

CAMERA SETTINGS (V)

FLIP VERTICAL (J)

FLIP HORIZONTAL (H)

GPU Properties

GPU MODE (G)

Communication

SEND TUIO (T)

Calibration

ENTER CALIBRATION (C)

files

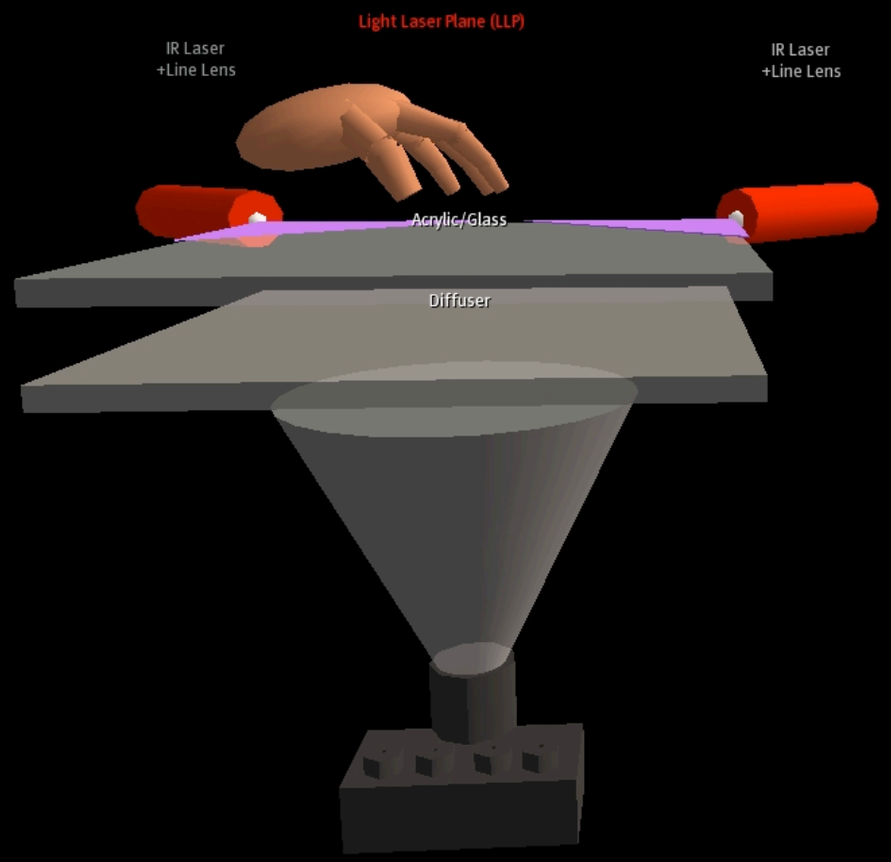
SAVE SETTINGS (S)

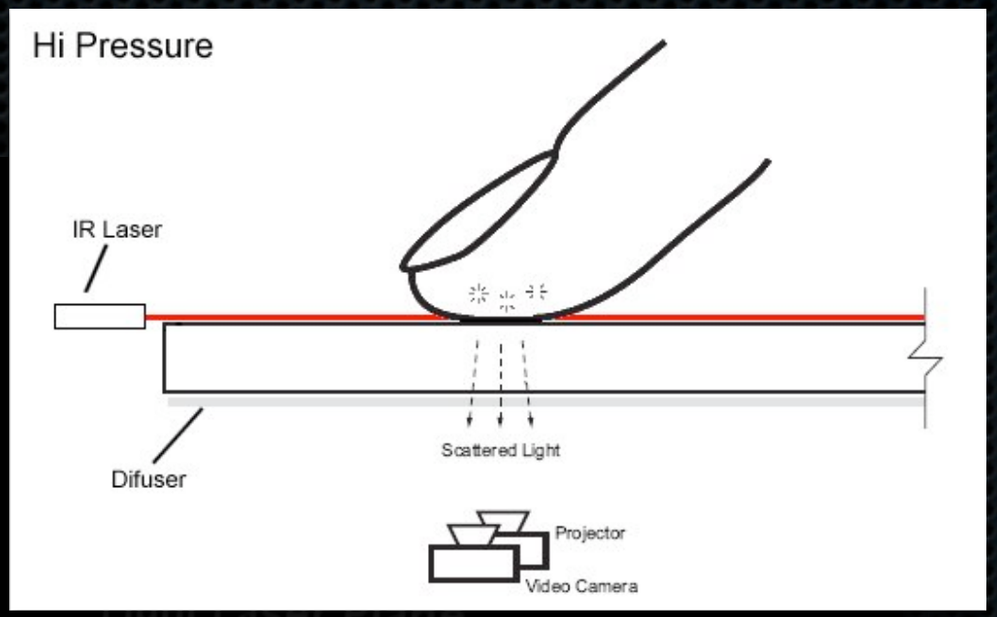
DSP Milliseconds: 8

Camera Res: 320 x 240
Camera FPS: 31

Sending TUIO messages to:
Host: 127.0.0.1
Port: 3333

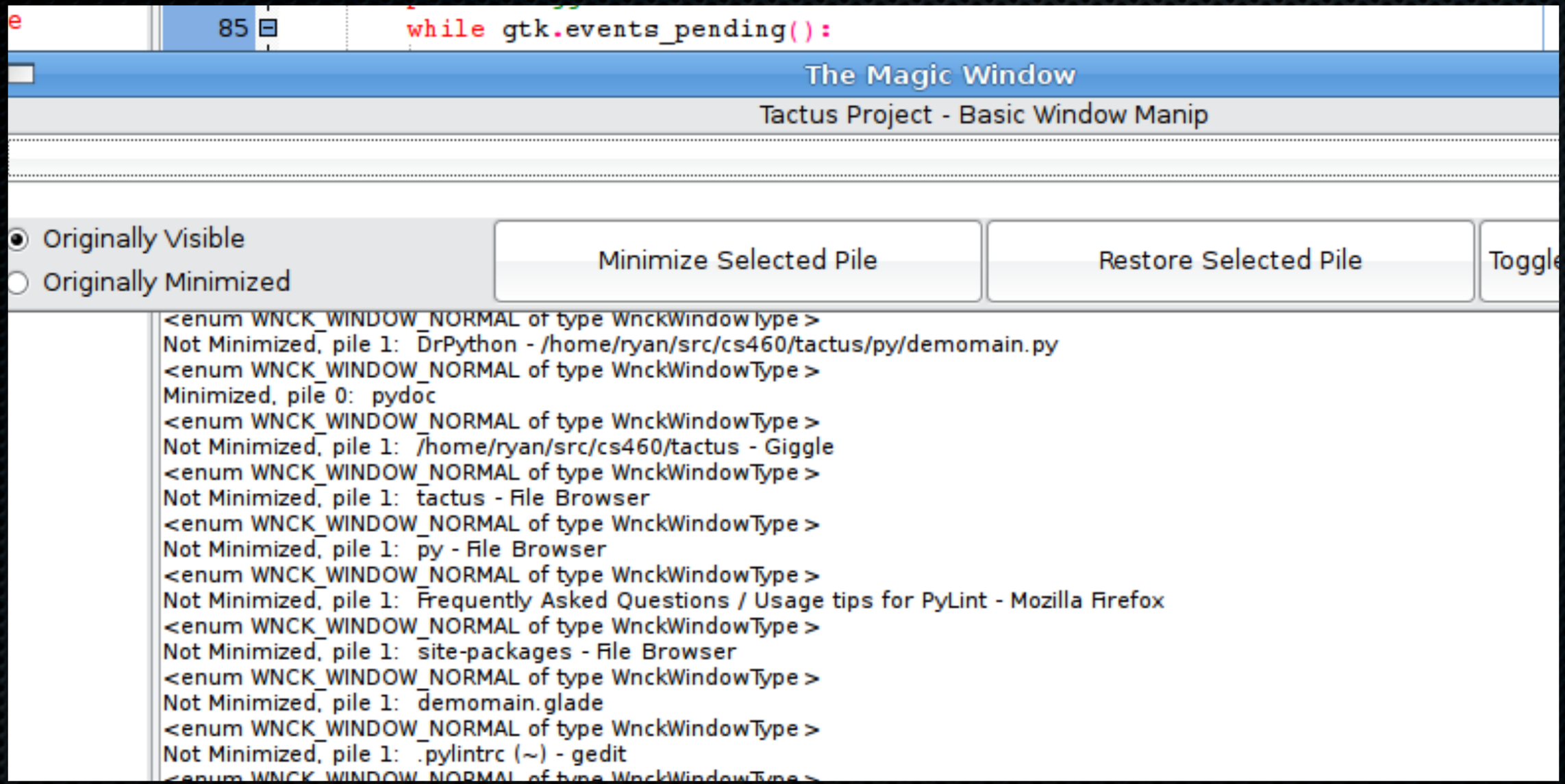
Press spacebar for mini mode





Laser light plane (LLP)

LCD LLP: Slow shipping is disappointing...



Software

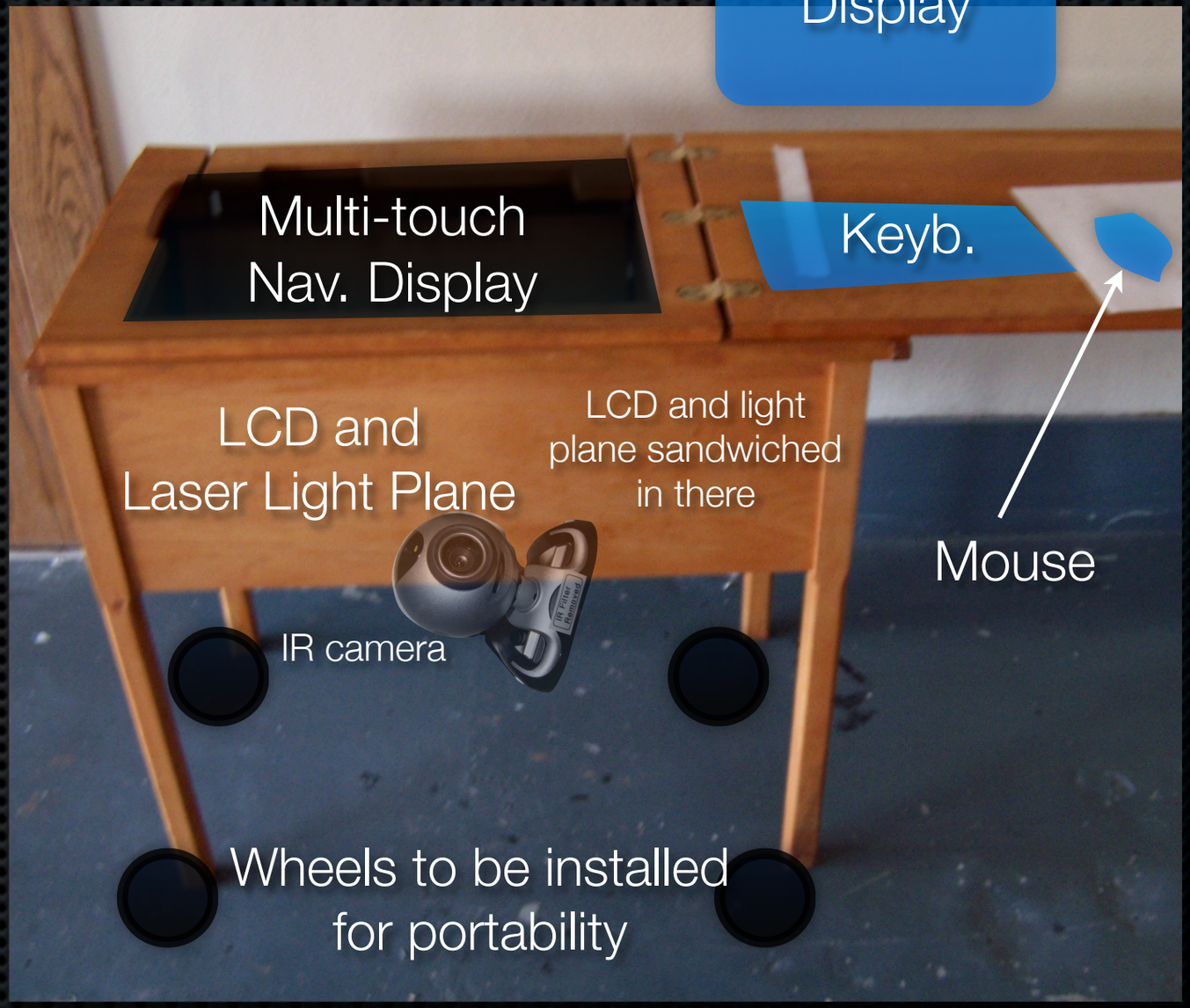
Doing work with multi-touch, without throwing out your keyboard or mouse

Navigation display

- Multi-touch surface as secondary display
- Enhance interaction with existing software
- Requires a custom desk for both multi-touch I/O and normal I/O

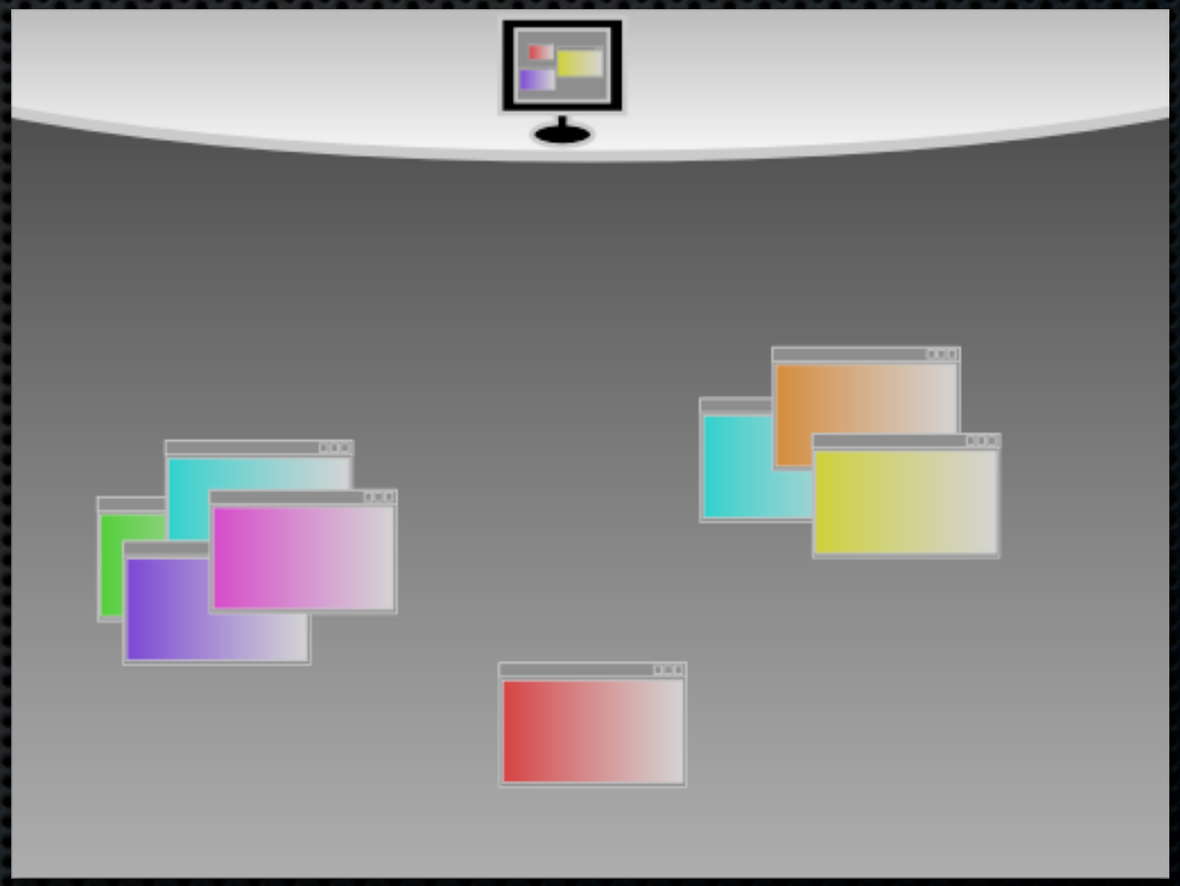
Physical Layout

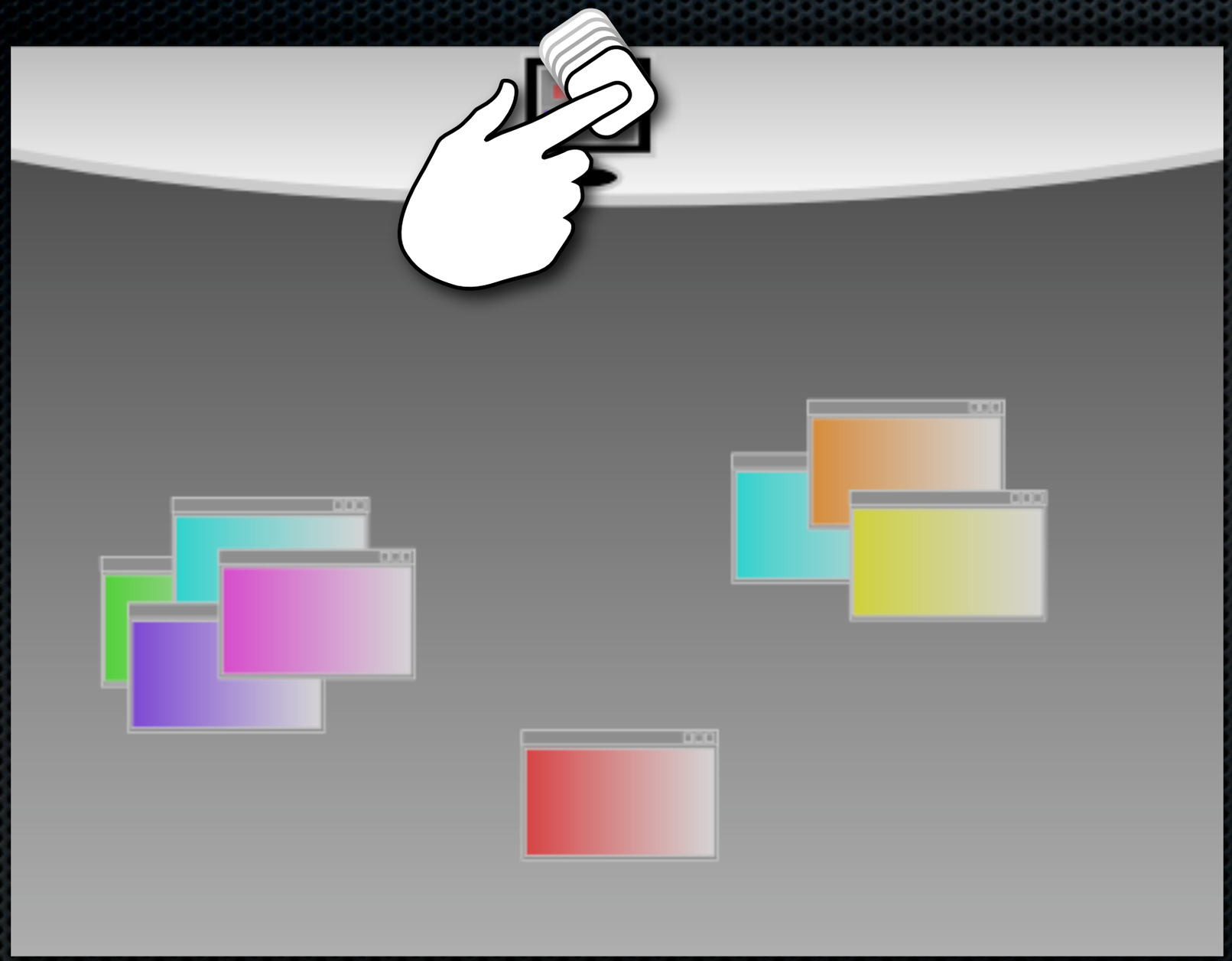
"Normal" desk with the multitouch surface to the left of the keyboard



Navigation display

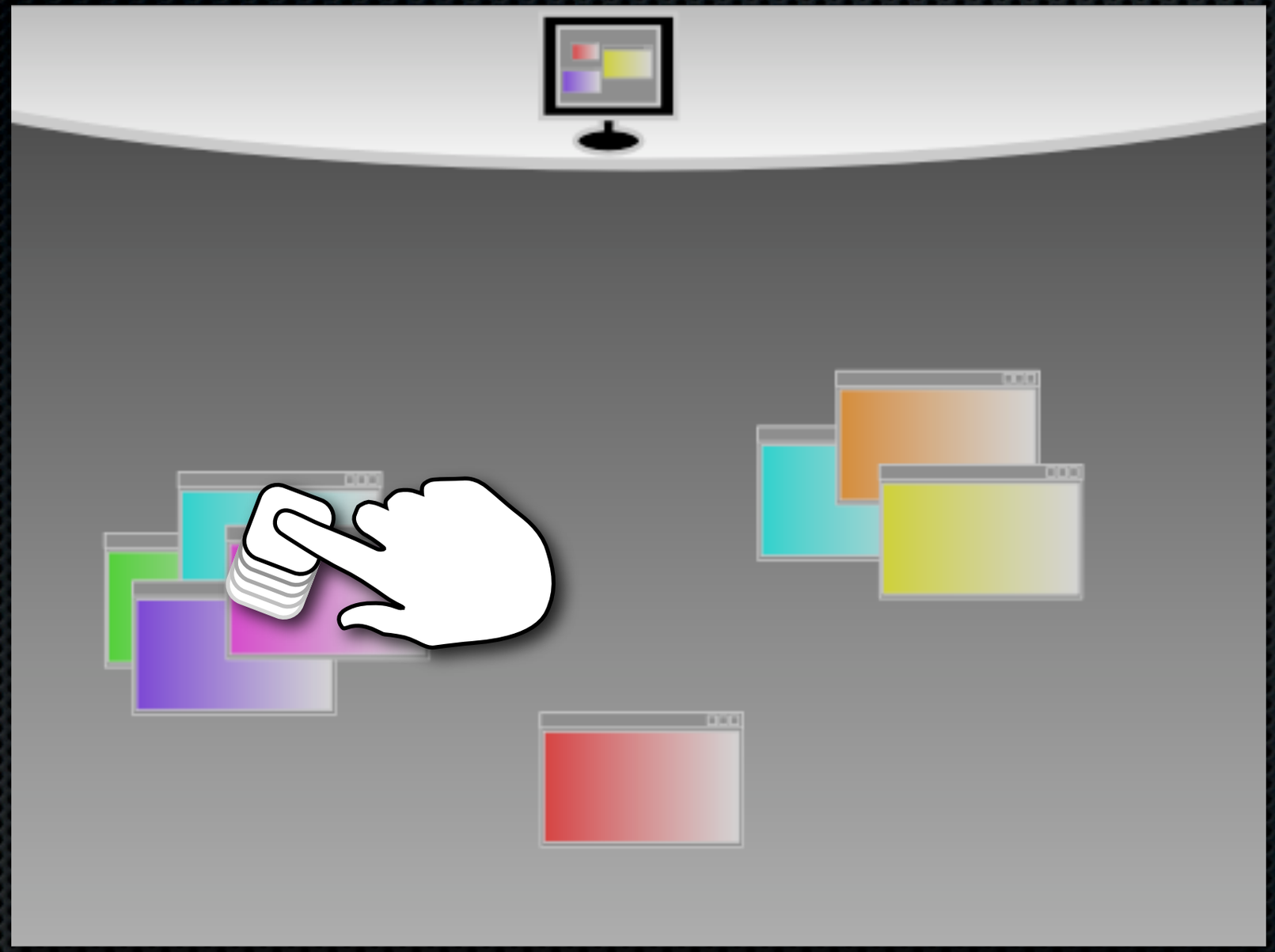
- Replaces your taskbar, dock, etc.
- Horizontal multi-touch screen
- Supports a variety of gestures





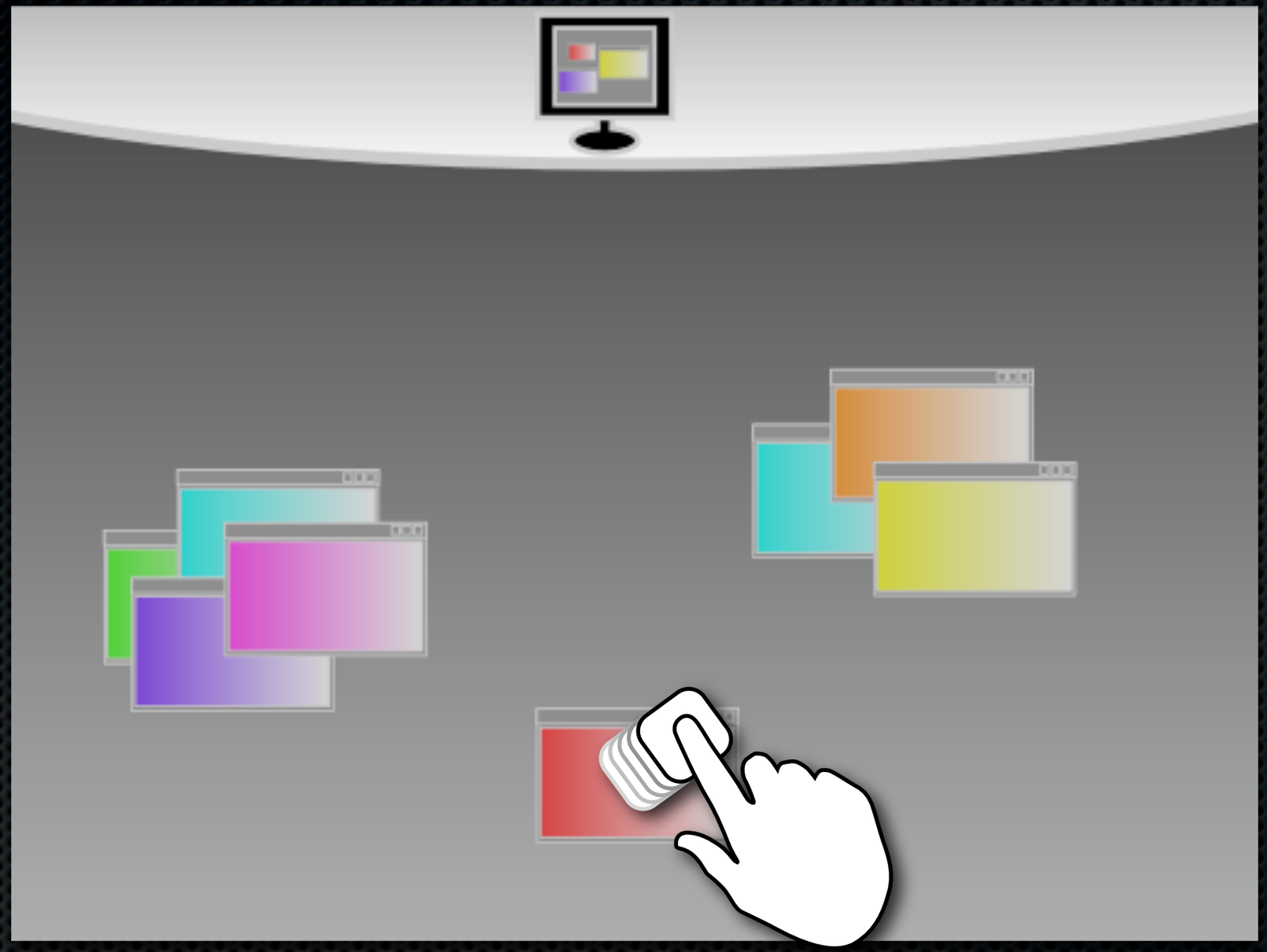
Minimize all current windows

Drag from “current display” bar into “pile canvas”



Restore a “window pile”

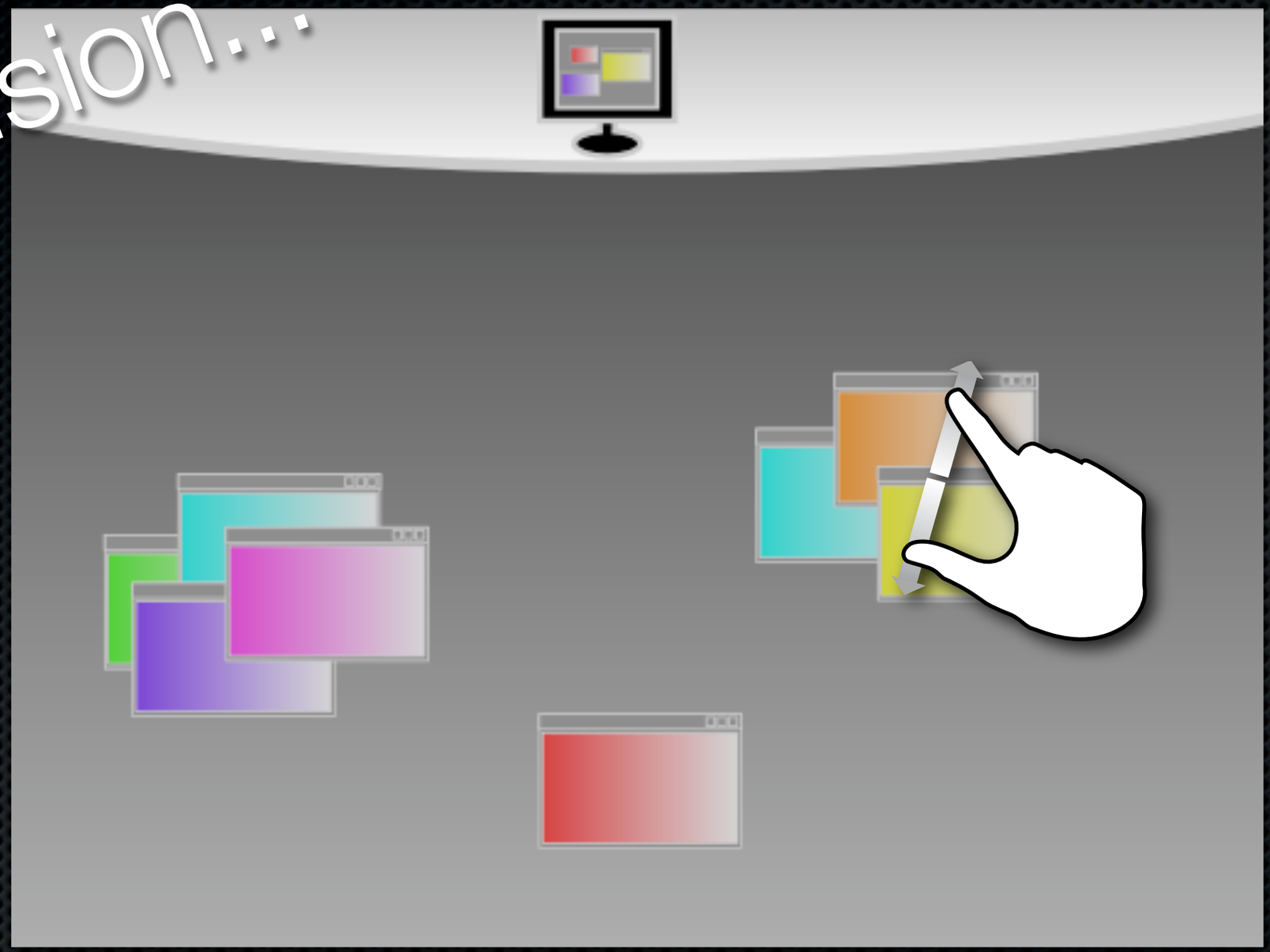
Drag from “pile canvas” into “current display” bar



Move window to new “pile”

Drag a single window between piles, possibly expanding first if you find it helpful

Extension…



Spread out a “pile”

Drag a single window between piles, possibly expanding first if you find it helpful

Demo time

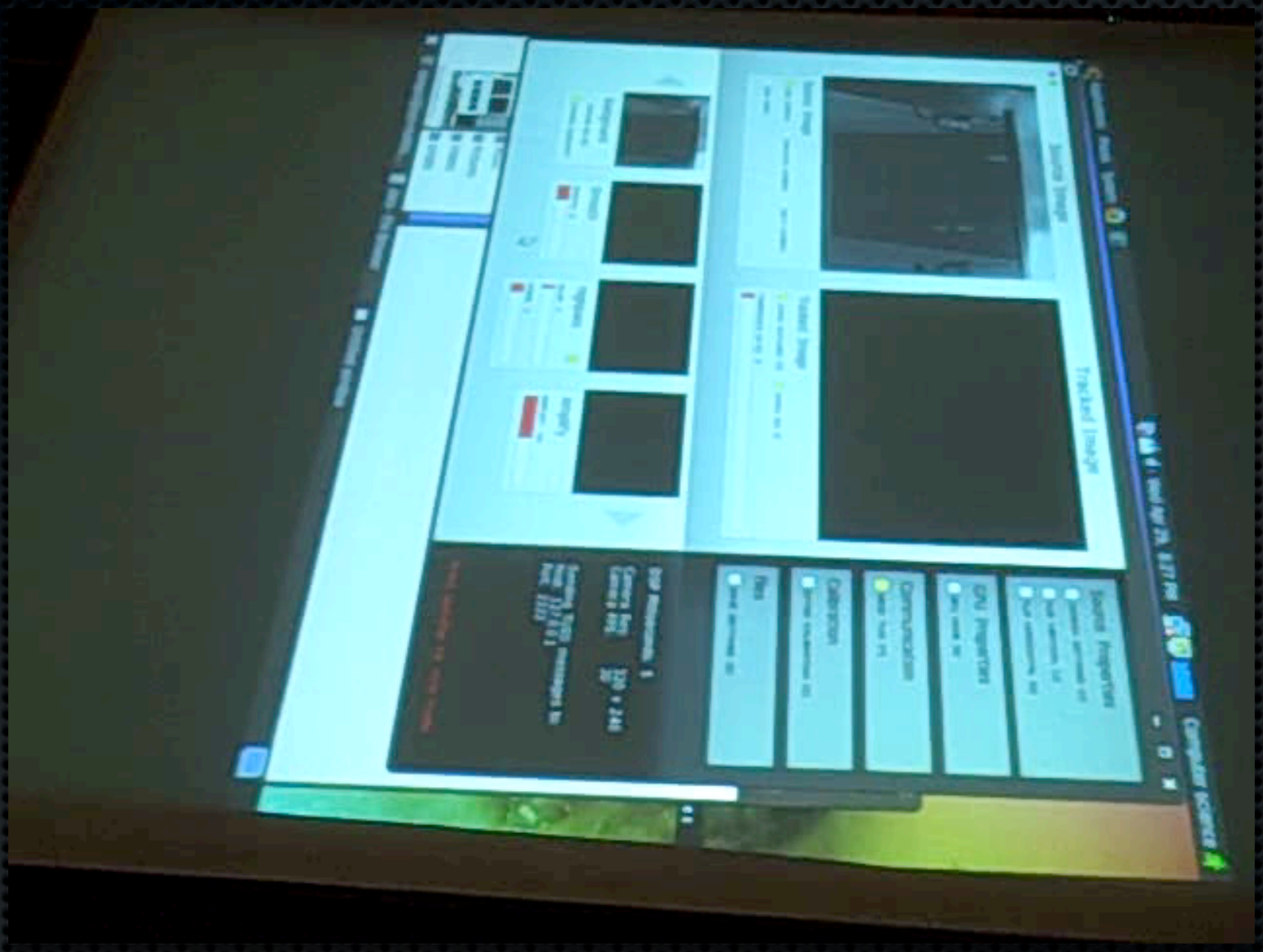
Please feel free to ask questions, etc...

Inside tour of the desk

Saving you the trouble of sticking your head in confined spaces

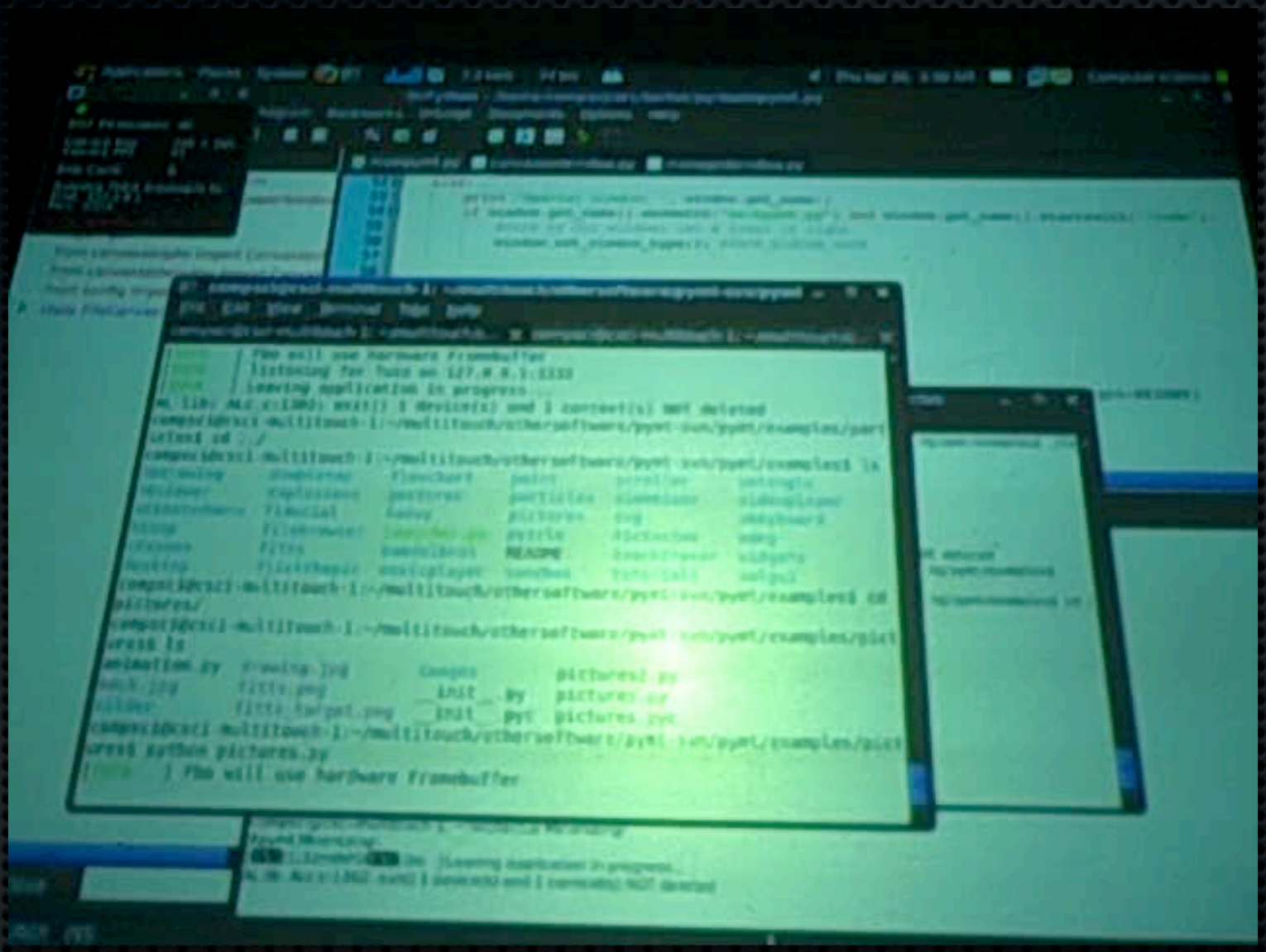
Hardware Tour

IR Illumination powered by computer power supply, and looks neat



Touch recognition

tbeta providing blob tracking and calibration



Obligatory photo demo

Can’t build a multi-touch system without trying this demo...

How it got done

What I used, what I learned

Process

- Research/Comparison
- Interaction Design
- Parallel Platform Development:
  - Hardware Construction
  - Software platforms (task nav. with no interface, rp-mt-scripts)
- Integration

Strategies

- Internet resources: nuigroup.com forums, etc
  - DIY MT is popular right now
- Use existing components where possible
  - Avoid re-inventing the wheel when you can do just as well without doing so.
- Careful design consideration and comparison of alternatives

Knowledge

- Object-oriented programming - CS core
  - Lots of polymorphism and multiple inheritance
- Linux skills, shell scripting - CS370 (Operating Systems)
- Python programming language
- Event programming - PyMT/Pyglet and GTK+ (to build test interface to window manager) event systems
- Open-source dev techniques - version control, etc.

Advice

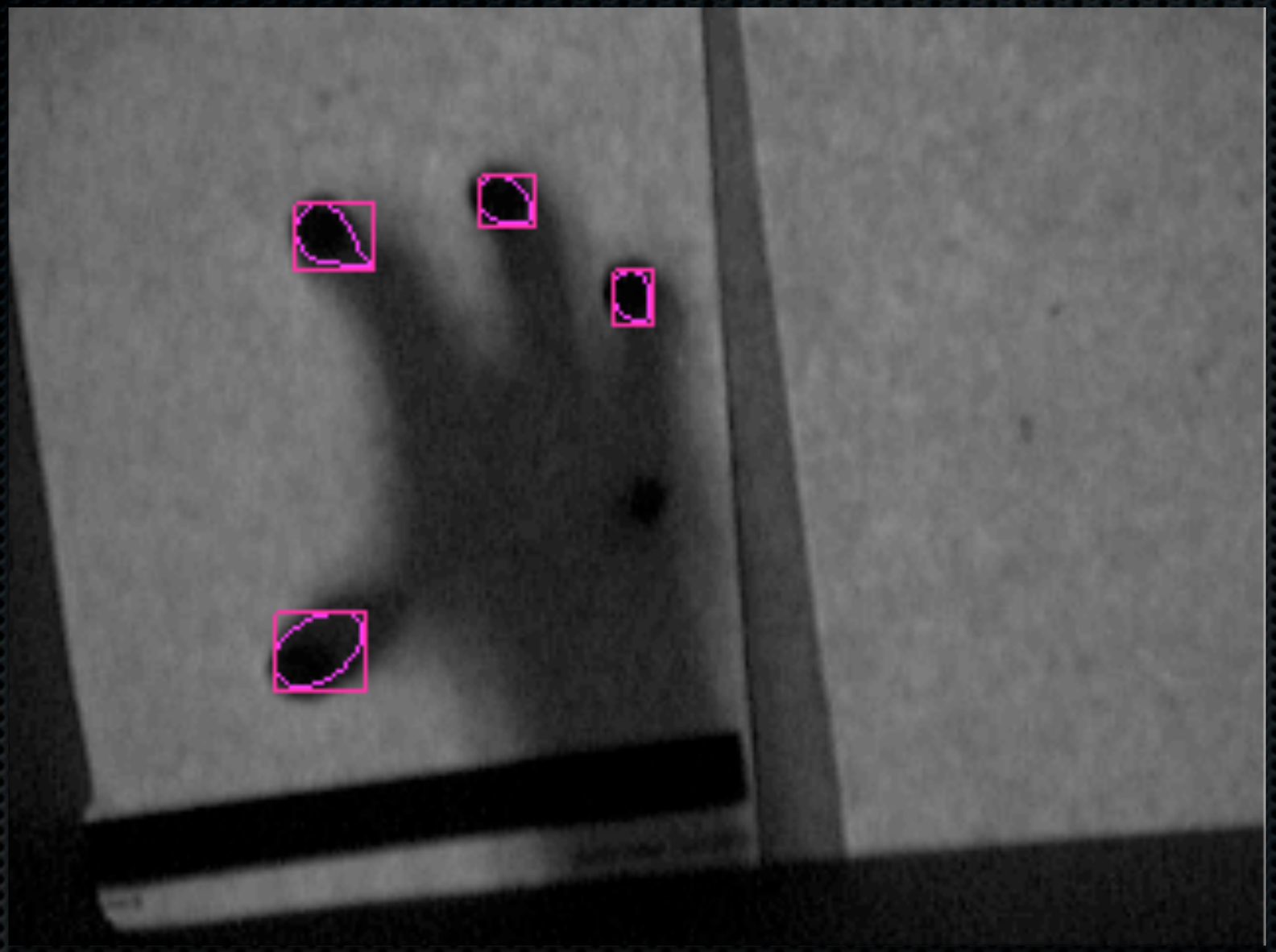
- Hardware always takes time
- Make bold decisions - be wary of the paradox of choice
- Use version control software - git and github.com
- Build on open platforms when possible
  - the “shoulders of giants” principle

Difficulties and scope control...

- Pile interaction there but disabled for demo
- Auto-clustering algorithms designed but not coded
- Ordering and shipping delays slowed construction
- Transportation to demos led to hardware damage

Extensions

- Implement other gestures planned and more
- User interaction/efficiency studies
- Add launcher functionality



Acknowledgements

It takes a college, a city, and an Internet to create this technology...

Acknowledgements: Presentation

- 3d images of multi-touch techniques: Nolan, from PeauProductions.org and NUI Group Forums
- Schematics and samples for techniques: Seth (cerupcat) from NUI Group Forums
- Touch gesture images, from the *Designing Gestural Interfaces* book by Dan Saffer, drawings by Rachel Glaves: DesigningGesturalInterfaces.com

Acknowledgements: Project Support

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- SNC Computer Science Department - hard drive for Linux on test machine, camera for IR sensing conversion, construction and management advice, assembly space
- My family - construction assistance

Acknowledgements - Software

- Ubuntu Linux and GNOME
- Python
- libwnck and python-gnome for window management
- setpwc for webcam adjustments
- NUI Group's tBeta (using OpenCV) for blob tracking
- PyMT for interface development

The Tactus Project

Hope you enjoyed this walkthrough!