

EVAS

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EVAS

Efficient & advanced rendering techniques for
devices

Immediate Mode vs. Scene Graph

- Immediate mode examples
 - OpenGL
 - Xlib
 - Xrender
 - Cairo
 - SDL
 - DirectFB
 - GDI
 - DirectX/3D

Immediate Mode vs. Scene Graph

- Scene Graph examples
 - GNOME Canvas
 - Piccolo
 - Quake Engine
 - Unreal Tournament Engine
 - Evas

Differences

- Scene Graph
 - less details needed
 - greater optimizations
 - closer to thoughts
 - more like widgets
 - more abstract
- Immediate Mode
 - greater control
 - more work to optimize
 - painters algorithm
 - more common
 - more device specific

Differences in how they
work?

Immediate Mode
vs
Scene Graph

Immediate Mode (naïve)

- Wait for something to happen
- React to events/timers/data
- Modify state in data structures
- Redraw entire screen...
 - Clear screen
 - Draw lowest elements first, working until the top-most

Immediate Mode (smarter)

- Wait for something to happen
- React to events/timers/data
- Modify state in data structures
- Redraw...
 - Calculate what screen areas changed based on state
 - Add in any damaged regions of the screen (Expose Events)
 - For each change region...

Immediate Mode (smarter - continued)

- Draw each element from bottom to top
- Skip elements that are not within the change region
- Try and avoid drawing elements that will just get completely covered by later draws

Other things to improve

- To avoid flicker, draw to a temporary/backing buffer
- Try and sync copies to the screen to vblank
- Try and abstract drawing to multiple toolkits (Xlib, Xrender, OpenGL, SDL, etc.)
- Have advanced drawing calls (ARGB image loading, alpha blending, scaling, etc.)

Scene Graph

- Wait for something to happen
- React to events/timers/data
- Modify state in data structures and their associated canvas objects
- Call canvas update call

Which one is simpler?

- 10 points for the correct answer

Evas does it all for you

- Calculates updated regions optimally
- Abstracts to multiple drawing engines (Xlib, Xrender, Framebuffer, OpenGL, DirectFB, Qtopia, Memory)
- Gives high level control over powerful objects
- Minimises memory use as it knows the “state of the world” in advance
- Minimal memory and dependency footprint

Constructs Evas gives you

- Images
- Rectangles
- Gradient boxes
- Polygons
- Lines
- Text strings
- Text blocks
- Smart Objects

Low Cost Shopping

- Each object consumes about 240-400 bytes
- Evas can handle 1000's of objects before seeing a slowdown due to object overhead
- Extra data (like font and image data) is loaded on-demand.
- Text objects consume only memory for the text strings – they only become images during rendering
- Only changes are rendered

Extensions

- Smart objects allow collecting basic objects together into groups that are 1 object (like custom widgets)
- Emotion provides smart objects that display a video stream/file and allow control
- Edje provides animated design objects (much like Flash)
- 2 widget sets are built on top of Evas (EWL and ETK)

Performance

- Performance varies based on engine, hardware and object usage
 - More objects slow Evas down
 - Complex objects are slower
 - Built-in software engine is extremely fast
 - Some engines are allowed to drop quality in return for speed
 - Engines are modular and abstract – adding new engines is easy

A tale of 2 systems

| | Core 2 Duo, 1.83Ghz, Nvidia 7900GTX | | | Penitum-M 600Mhz, Intel i845 | | | |
|-----------------------------------|-------------------------------------|---------|----------|------------------------------|---------|----------|--------|
| | GL | Xrender | Software | GL | Xrender | Software | |
| Image Blend Unscaled | 935.5 | 18.6 | 123.8 | 20.5 | 7 | 10.4 | |
| Image Blend Solid Unscaled | 990.4 | 94.2 | 61.4 | 39.6 | 29.7 | 29.8 | |
| Image Blend Nearest Scaled | 846.2 | 0.6 | 59.3 | 9.5 | 1.2 | 2.1 | |
| Image Blend Nearest Solid Scaled | 883.3 | 65.3 | 91.3 | 42 | 26.2 | 25.6 | |
| Image Blend Smooth Scaled | 819.6 | 0.5 | 13.1 | 2.3 | 0.8 | 1 | |
| Image Blend Smooth Solid Scaled | 869.7 | 46.2 | 79.6 | 28.7 | 15.2 | 15.9 | |
| Image Blend Border | 960.4 | 0.4 | 14.8 | 2.6 | 0.7 | 0.8 | |
| Image Blend Solid Border | 878 | 16.4 | 26.9 | 26.4 | 6.4 | 6.3 | |
| Image Blend Border Recolor | 961.4 | 0.5 | 19.3 | 3 | 0.6 | 0.9 | |
| Image Quality Scale | 2510.2 | 68.6 | 134.4 | 27 | 7.8 | 17 | |
| Image Data ARGB | 360.3 | 112.4 | 258.8 | 83.4 | 28.4 | 50.8 | |
| Image Data ARGB Alpha | 144.1 | 57.7 | 109.8 | 30.2 | 12.8 | 20.5 | |
| Image Data YCbCr 601 Pointer List | 1292 | 98.7 | 235.2 | 78.3 | 45.6 | 43.5 | |
| MAX | 6489.2% | 153.4% | 100.0% | MAX | 452.4% | 104.8% | 100.0% |
| AVG | 2271.9% | 42.9% | 100.0% | AVG | 237.3% | 79.0% | 100.0% |
| MIN | 131.2% | 1.0% | 100.0% | MIN | 132.9% | 45.9% | 100.0% |

Core 2 Duo Speed + Nvidia7900
vs.
Pentium-M + i845

| | GL | Xrender | Software |
|-------------|-----------|---------|----------|
| AVG SPEEDUP | 10839.01% | 275.98% | 1014.25% |

Modular

- Rendering engines are loadable modules
- Only build and install engines you need
- Only engines needed are loaded at runtime
- Can add more engine modules at runtime without rebuild
- Image loaders and savers also modules
- Abstract so loader can be added for new format
- Currently support PNG, JPEG, TIFF, SVG,

Memory Usage data dependent

| FUNCTION | ALLOC CLASS | MEM |
|---------------------------------------|--------------------|------------|
| evas_common_image_surface_alloc | IMAGE | 2187168 |
| engine_software_x11_args | X11 | 29859 |
| evas_common_font_init | FREETYPE | 25776 |
| evas_common_font_source_load_complete | FONT | 19850 |
| evas_common_tilebuf_set_tile_size | ENGINE | 7500 |
| evas_hash_add | DATA | 6944 |
| evas_object_new | EVAS | 6480 |
| _evas_mp_pool_new | DATA | 5792 |
| evas_common_font_int_cache_glyph_get | FONT | 5740 |
| evas_module_load | DATA | 4593 |
| object_text_font_cache_dir_add | FONT | 4348 |
| evas_common_font_int_load_complete | FONT | 4228 |
| evas_object_image_add | EVAS | 3168 |
| evas_stringshare_add | DATA | 1844 |

Almost all of it is image data

- 94% Image data

| IMAGE | FONT | ENGINE | EVAS | DATA | X11 | FREETYPE | APP |
|---------|-------|--------|-------|-------|-------|----------|------|
| 94.3% | 1.5% | 0.3% | 0.5% | 0.9% | 1.3% | 1.1% | 0.1% |
| 2137 Kb | 34 Kb | 8 Kb | 10 Kb | 21 Kb | 29 Kb | 25 Kb | 1 Kb |

Provided Software engine quality

- Highest image scaling quality around for high speeds
- All image scaling can do full super/sub sampling (better than OpenGL Anisotropic filtering)
- Displays in dithered quality at many bit depths
- 8bpp, 12bpp, 15bpp, 16bpp, 24bpp & 32bpp

Strawerries Wallpaper.jpg - Exhibit

File

Edit

View

Help

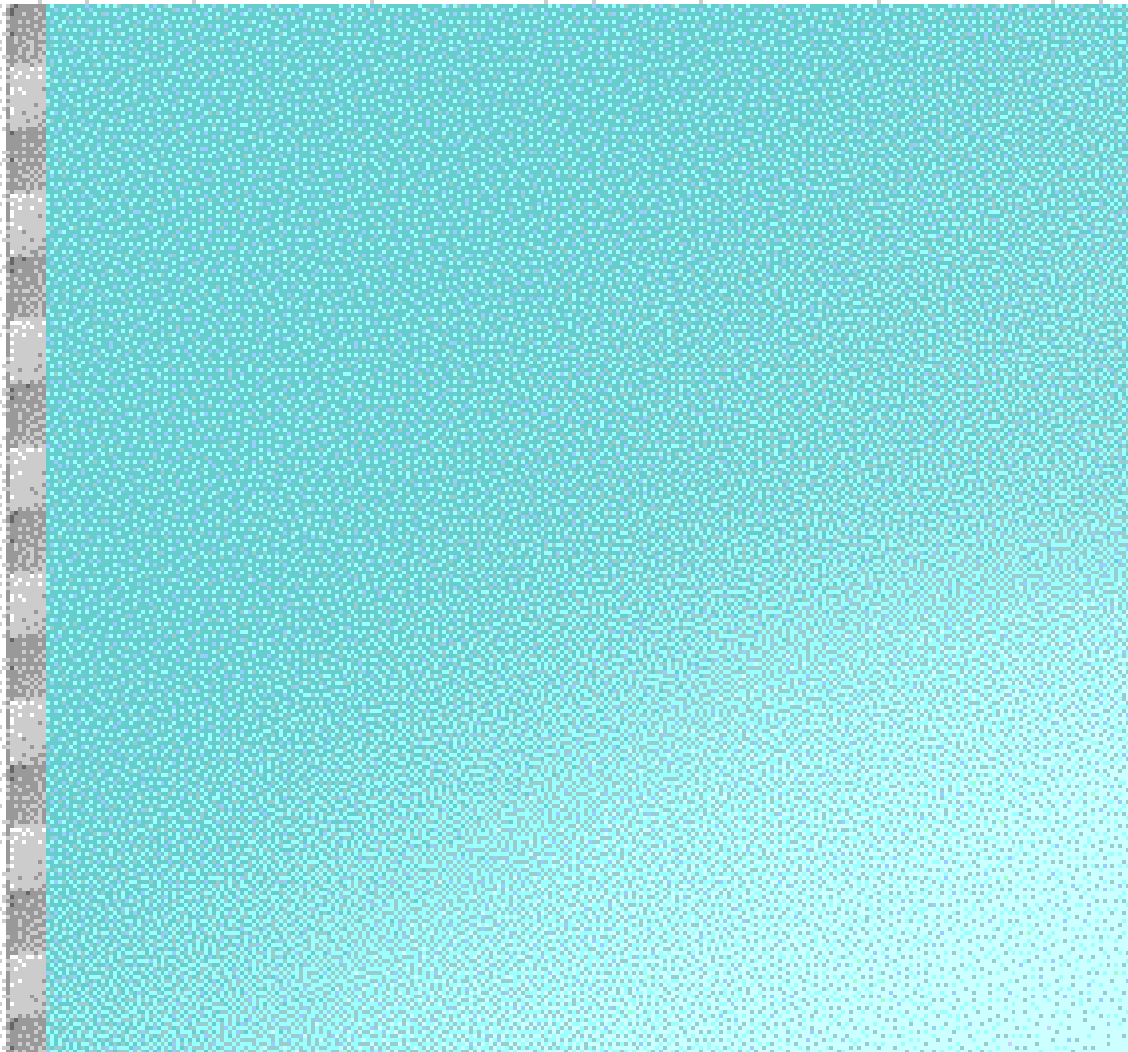


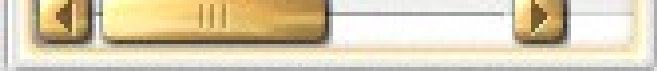
Search bar

Go



...





Strawerries__Wallpaper.jpg - Exhibit

File Edit View Help



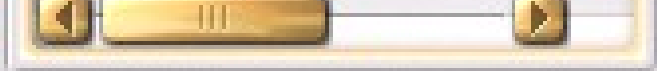
Search input field

Go



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Strawberries__Wallpaper.jpg - Exhibit

File Edit View Help



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Bad Scaling



Good Scaling



Pretty things

Happy lucky fun Demo time