

Google™





Writing Real-Time Games For Android **Redux**

Chris Pruett
May 2010



Please Wave Me, Bro!

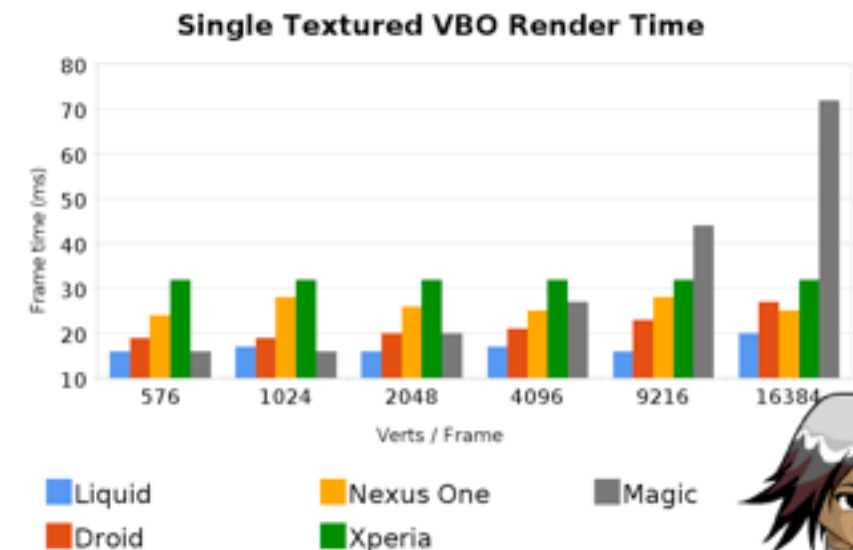
<http://bit.ly/c5nm4w>

Intro

- I'm a *Developer Advocate* for Android.
 - My focus is games.
- Before I joined Google, I was a video game programmer.
 - I guess I'm still a video game programmer.
 - But that's not my title.
 - It's complicated.

Agenda

- How the World Has Changed
 - Device Classes
 - Performance Benchmarks
- Game Architecture for Android
 - Using OpenGL ES
 - Using the NDK
 - Tips and Tricks
- Android Market for Games
 - Traits of Successful Titles
 - Replica Island
 - Lessons Learned



REPLICA ISLAND



May 2009

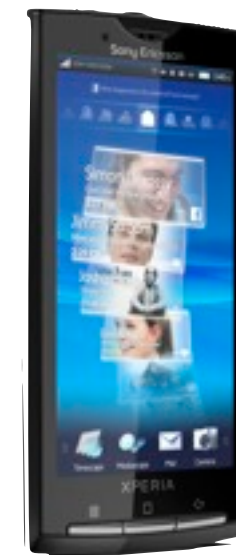
- Android 1.5 had just been released.
- The G1 was the (only) device.
- Android Market had < 5000 apps



Now: Discrete Device Classes

Second Generation

First Generation



First Generation Devices

- 528mhz ARM11 CPU (at ~400mhz)
- Qualcomm MSM7200A chipset
- OpenGL ES 1.0 integrated ATI GPU, various 1.1 extensions.
- 3.2" HVGA (480x320) screen
- ~5000 verts/frame @ 30 fps*
- ~1024 verts/frame @ 60 fps*
- Android 1.5 / 1.6
- About 60% of the market right now



*Textured, unlit, colored verts

Second Generation Devices

- 600 mhz - 1 ghz CPUs
- Snapdragon, OMAP3
- OpenGL ES 2.0, 1.1 + extensions
- WVGA (800x480) screen
- ~27000 verts/frame @ 30 fps*
- Typically fill-limited to 30 fps
- Android 1.6 ~ Android 2.1
- Almost 40% of the market right now
- First device shipped in December 2009



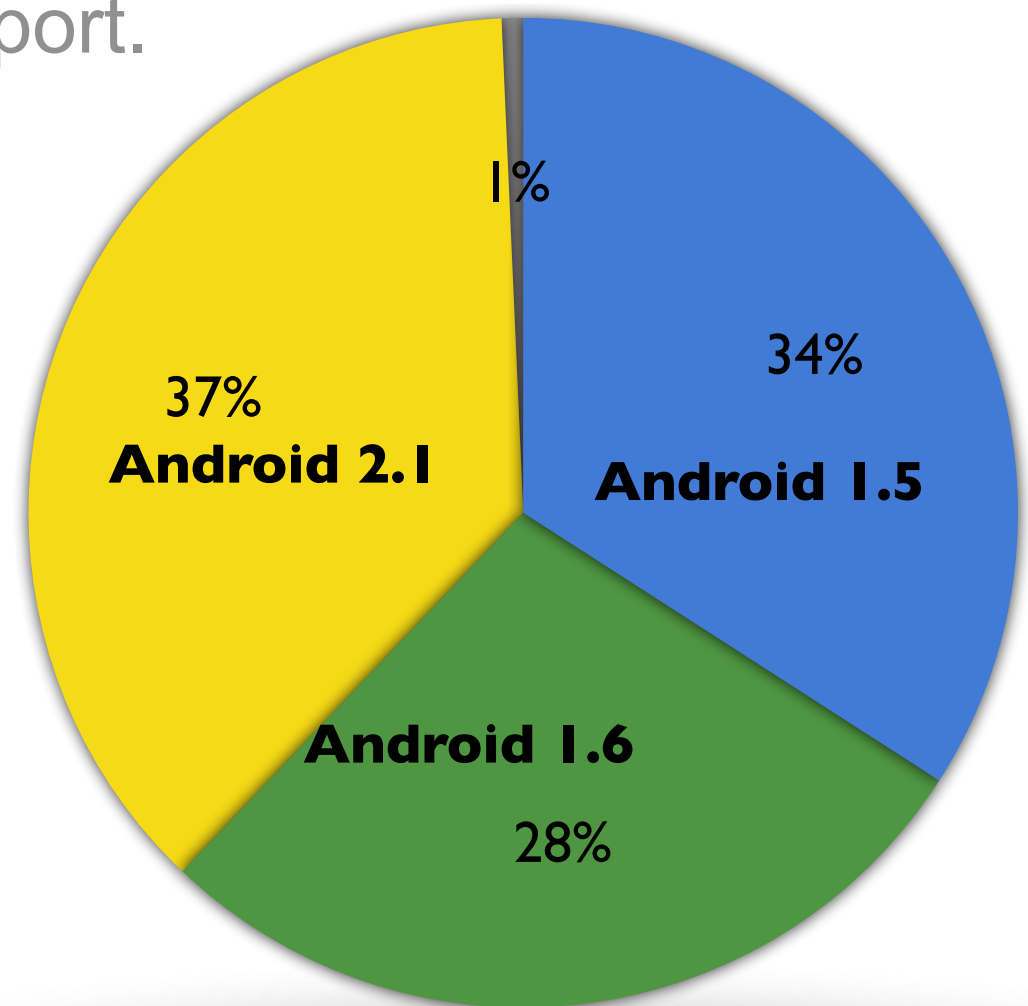
*Textured, unlit, colored verts

Device Diversity

- Screen Size / Density
- Input Hardware
 - Trackball? D-Pad? Keyboard? Multi Touch?
 - Standardized API for input events.
 - Everything is a Motion Event or Key Event
 - All devices have a touch screen, accelerometer, orientation sensor.
- OpenGL Driver
 - Texture Format: ATITC? PVRTC? ETC1?
 - OpenGL 1.1? 2.0?
 - GL_EXTENSIONS content?

Android in the Wild

- Android OS version
 - Android 1.5: all basic functionality.
 - Android 1.6: screen size support.
 - Android 2.0: OpenGL ES 2.0 support.

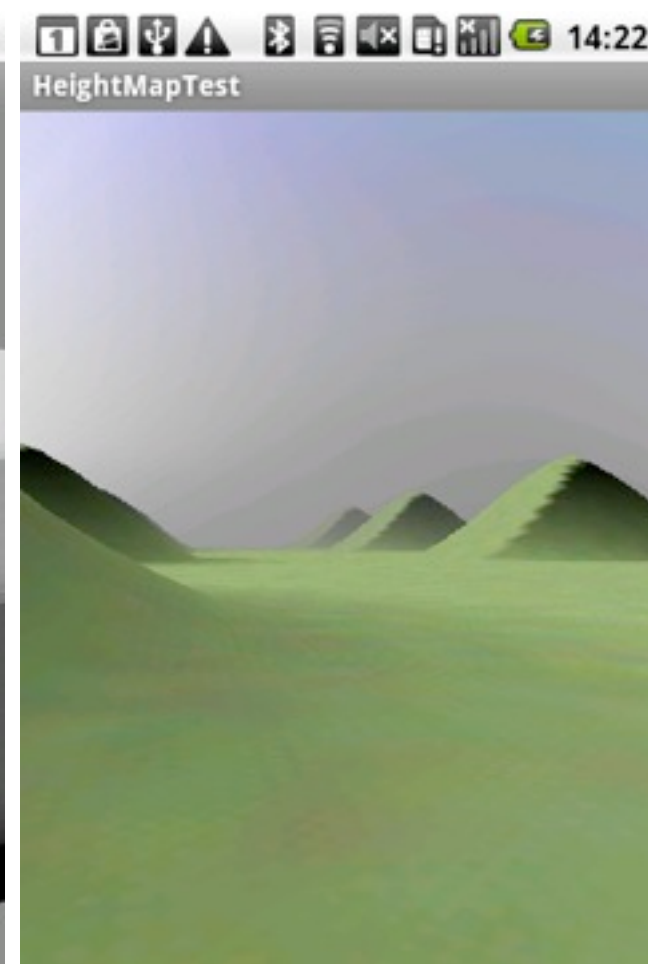
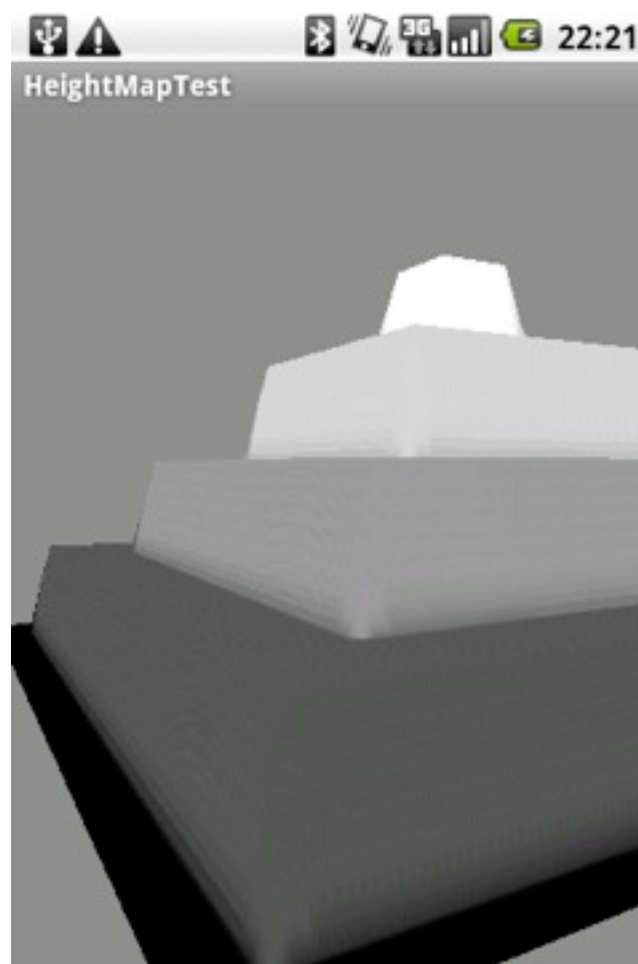
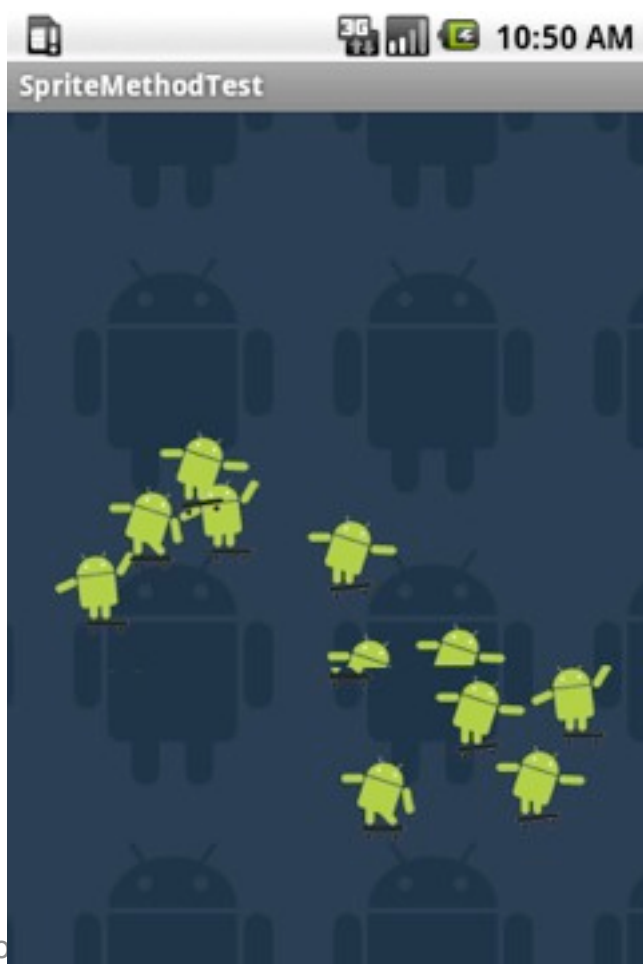


as of 5/12/2010

source: <http://developer.android.com/resources/dashboard/platform-versions.html>

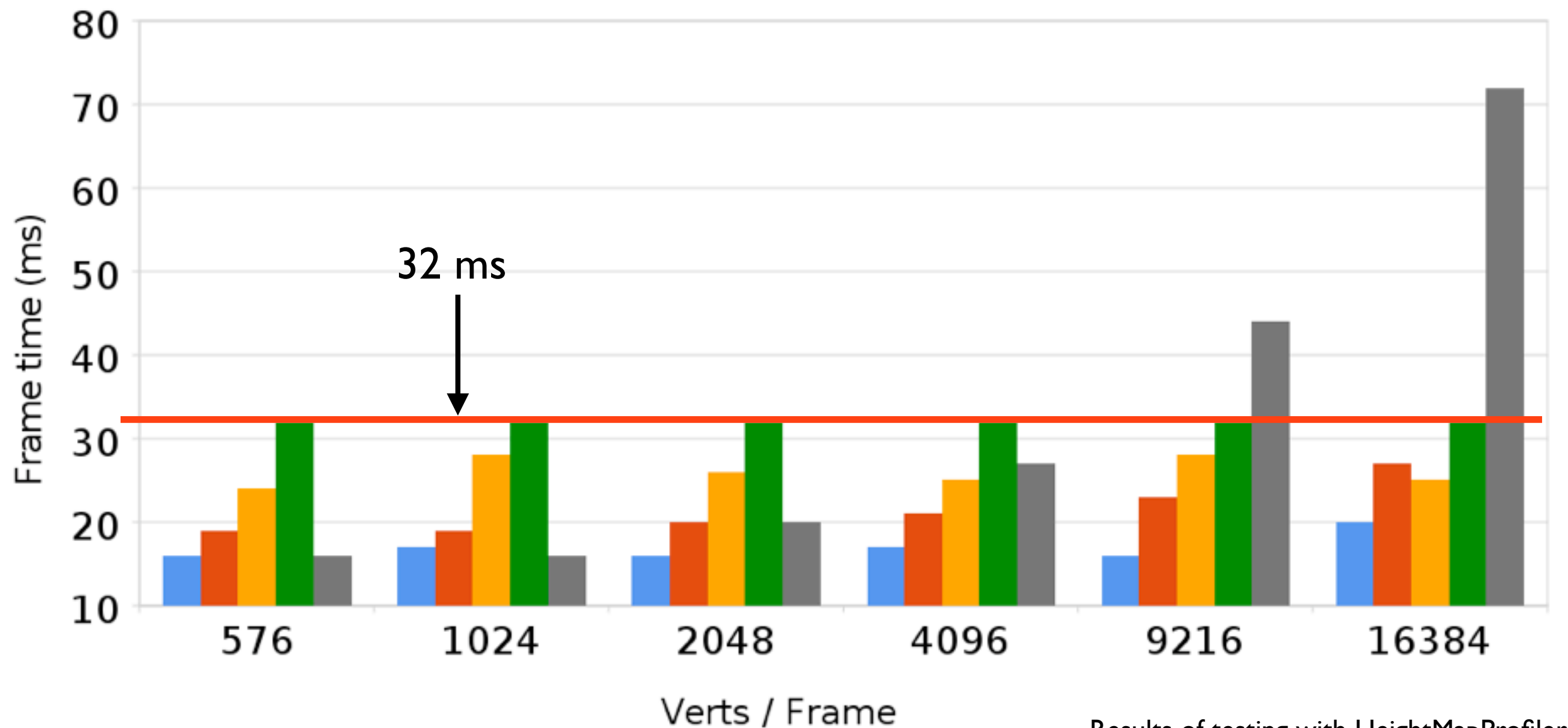
Detailed Performance

- OpenGL ES 1.1
 - Static VBO, floating point units
 - Verts, texture, colors
 - 512x512x16 texture, no mip maps, no compression
 - Variable scene complexity



Cross-Device View

Single Textured VBO Render Time



Results of testing with HeightMapProfiler

Liquid

Nexus One

Magic

Droid

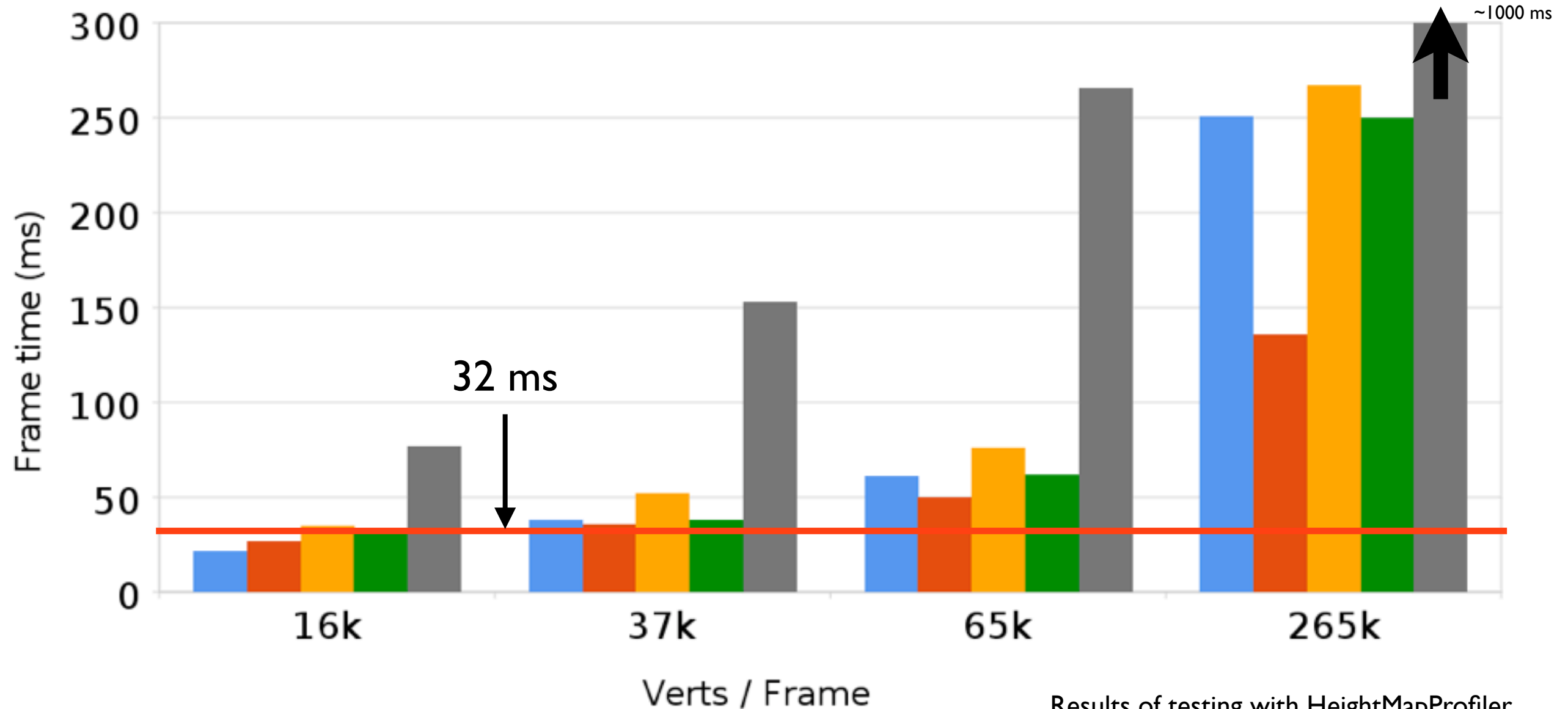
Xperia

14 Google Confidential

Google 10 IO

More Verts!

Instanced VBO Render Time



Results of testing with HeightMapProfiler

Liquid

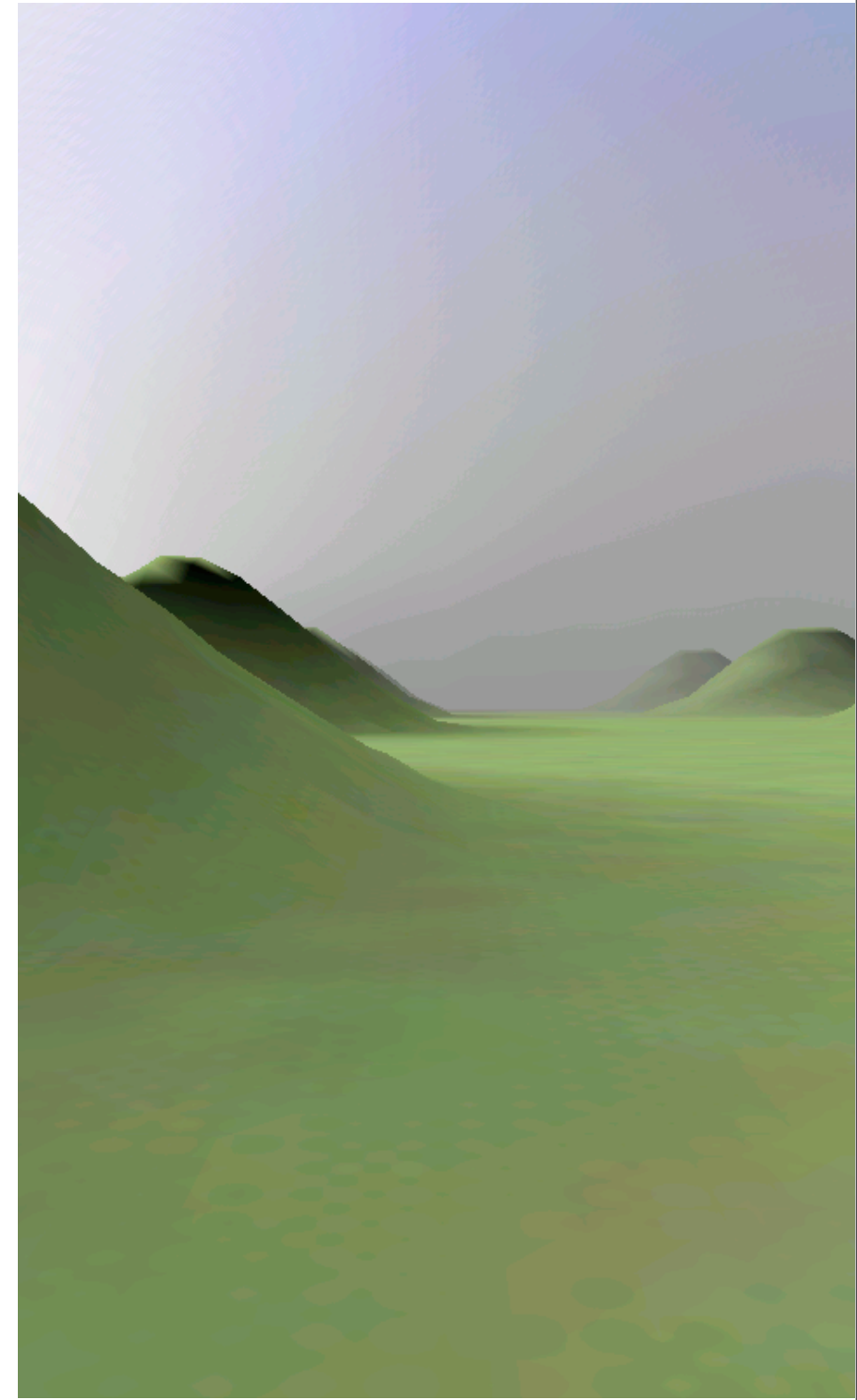
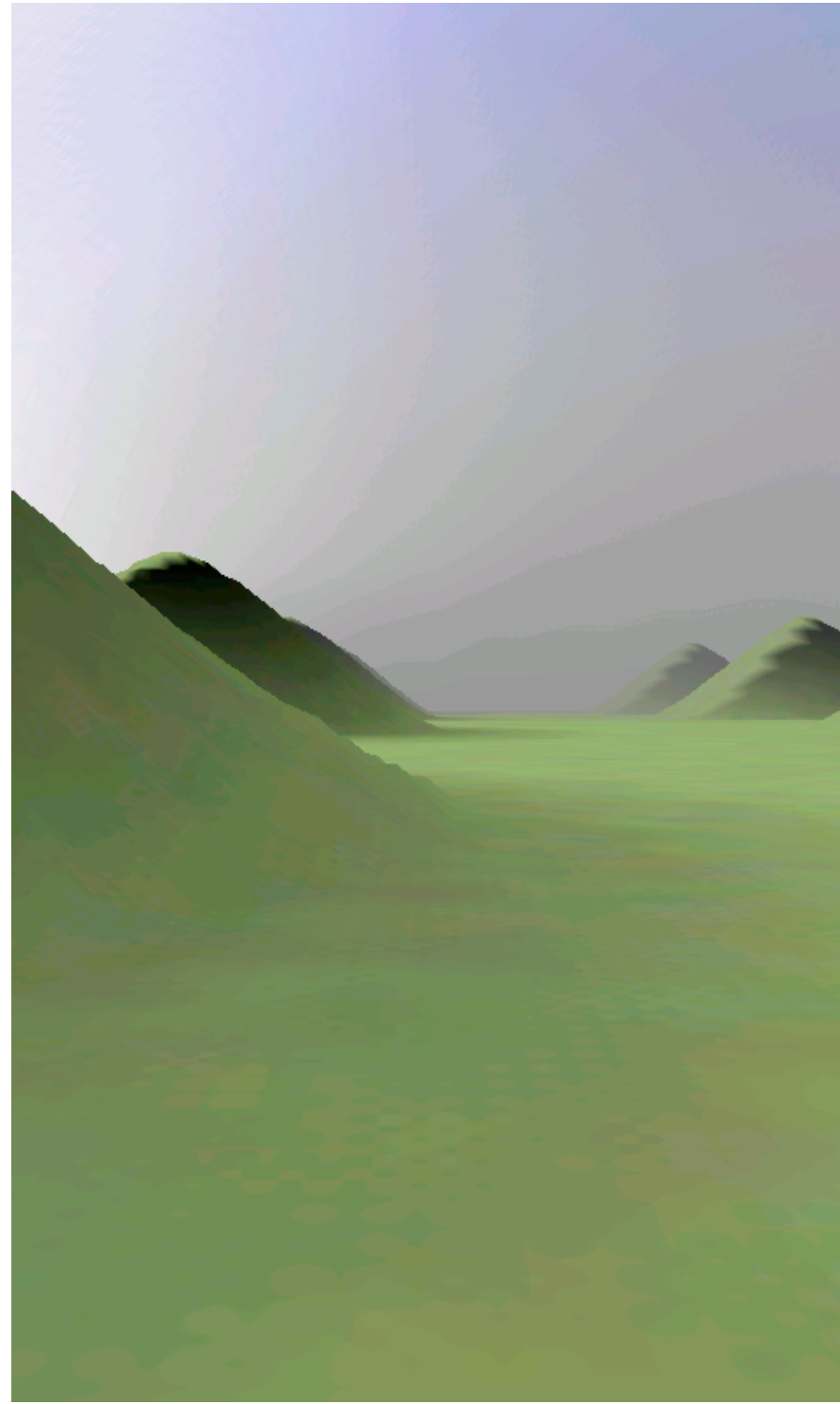
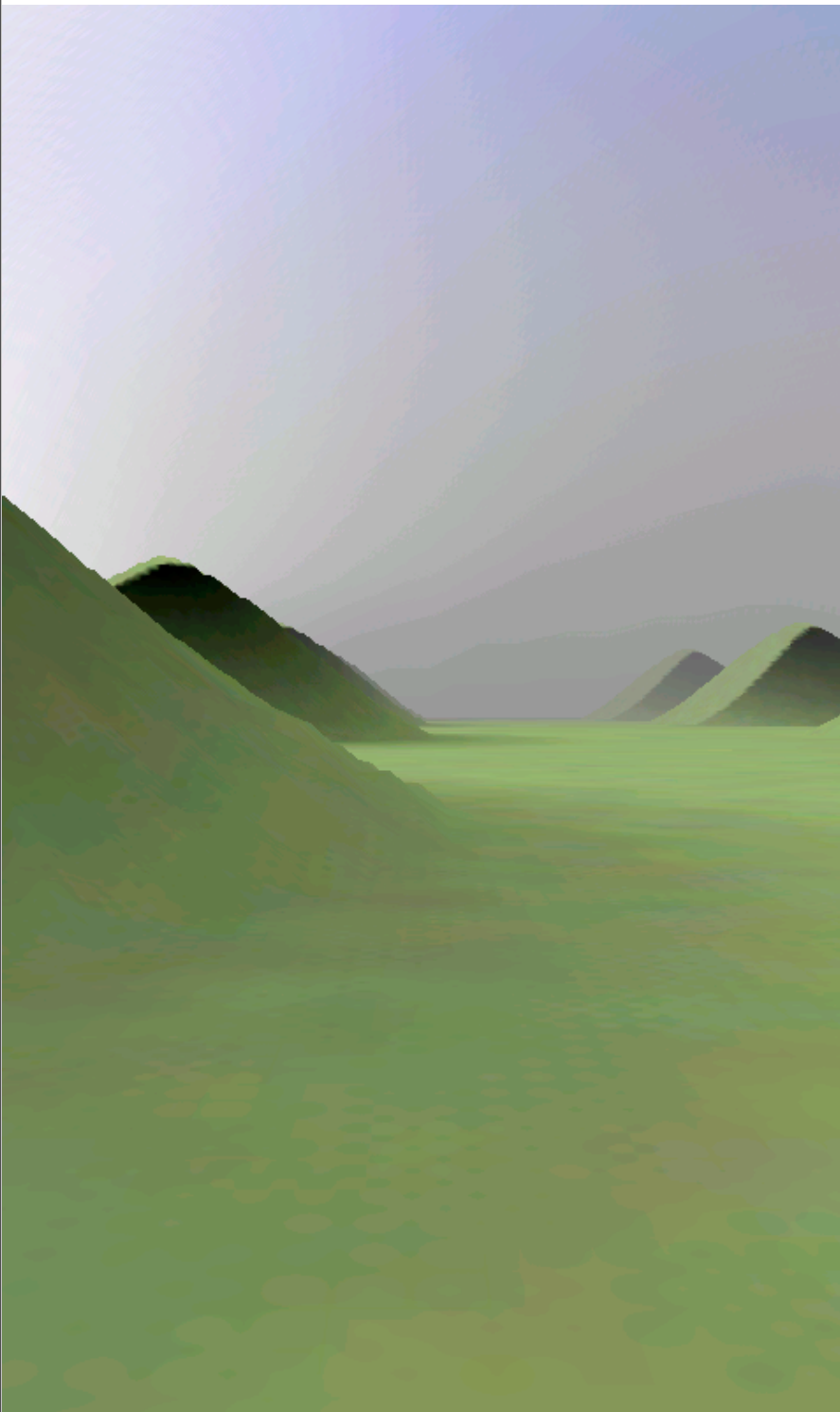
Droid

Nexus One

Xperia

Magic

Level of Detail is Your Friend



Level of Detail is Your Friend

4 FPS

A landscape scene with rolling green hills and a hazy sky. The image is heavily blurred, indicating a low frame rate of 4 FPS. The details of the terrain and sky are lost to motion blur.

16 FPS

The same landscape scene as the first, but rendered at 16 FPS. The motion blur is reduced, and the details of the hills and sky are more visible, though some blurring remains.

35 FPS

The same landscape scene as the first two, but rendered at 35 FPS. The image is sharp and clear, with no visible motion blur. The details of the terrain and sky are well-defined.

Performance Best Practices

- **Use VBOs!**
- Minimize VBO selection. (and, as usual, all state change)
- Use floating point verts.
- ETC1 texture compression is most compatible.
- `draw_texture` is the fast path for 2D, axis-aligned texture blits.
- No point in using the NDK just to issue GL commands.
- Most WVGA devices are all fill bound. Target 30 fps.
- Design to scale between low end and high end.
 - `GL_EXTENSIONS` is your friend.
- Simple 2D games might not need OpenGL.
- GLES2.0 is the faster path on devices that support it.

Drawing in Replica Island

Background: draw_texture



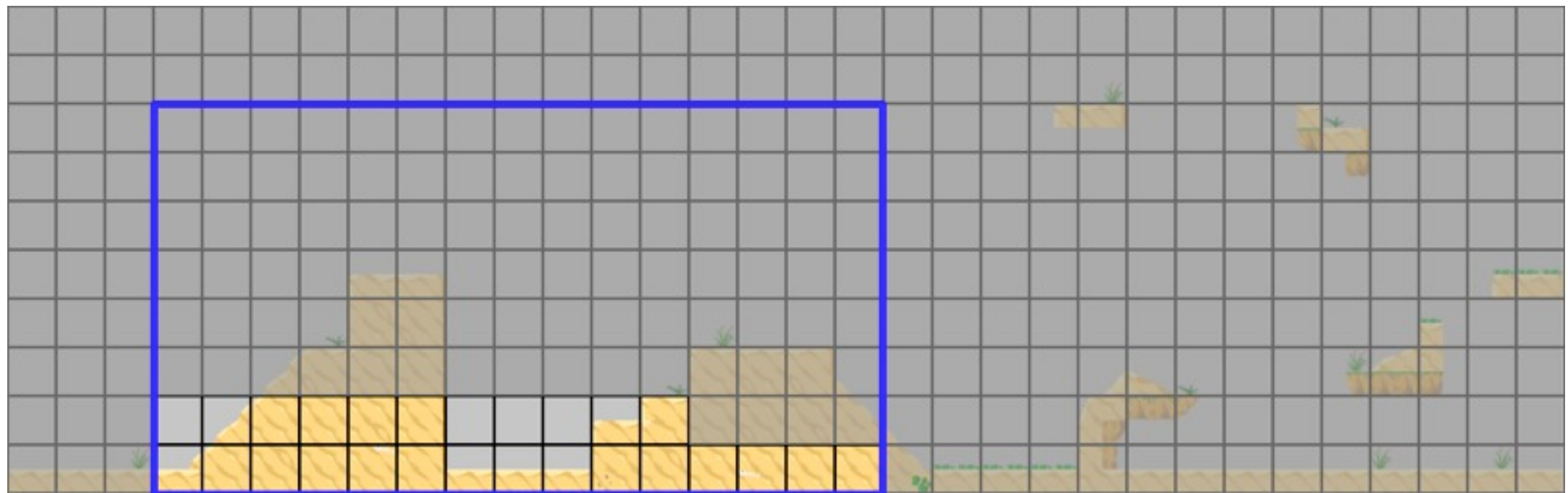
Sprites: draw_texture

Tile layers: VBOs



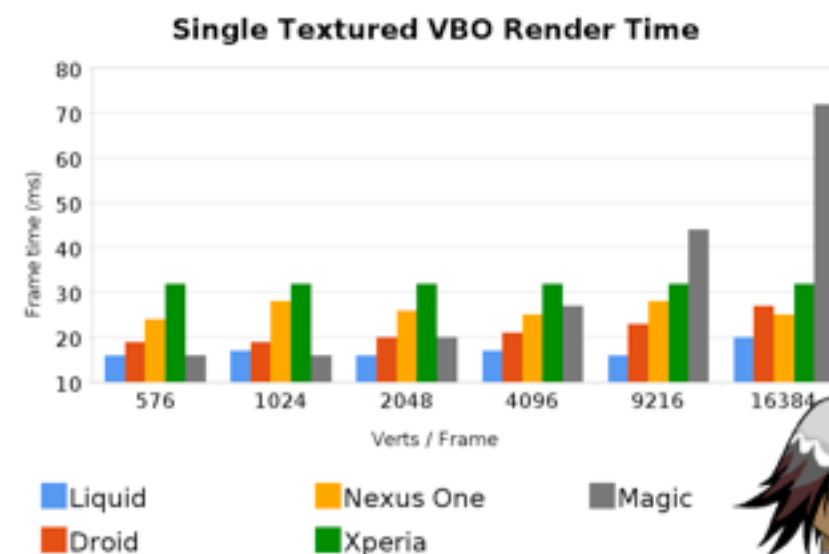
Third Attempt

Single VBO, draw scanlines of tiles

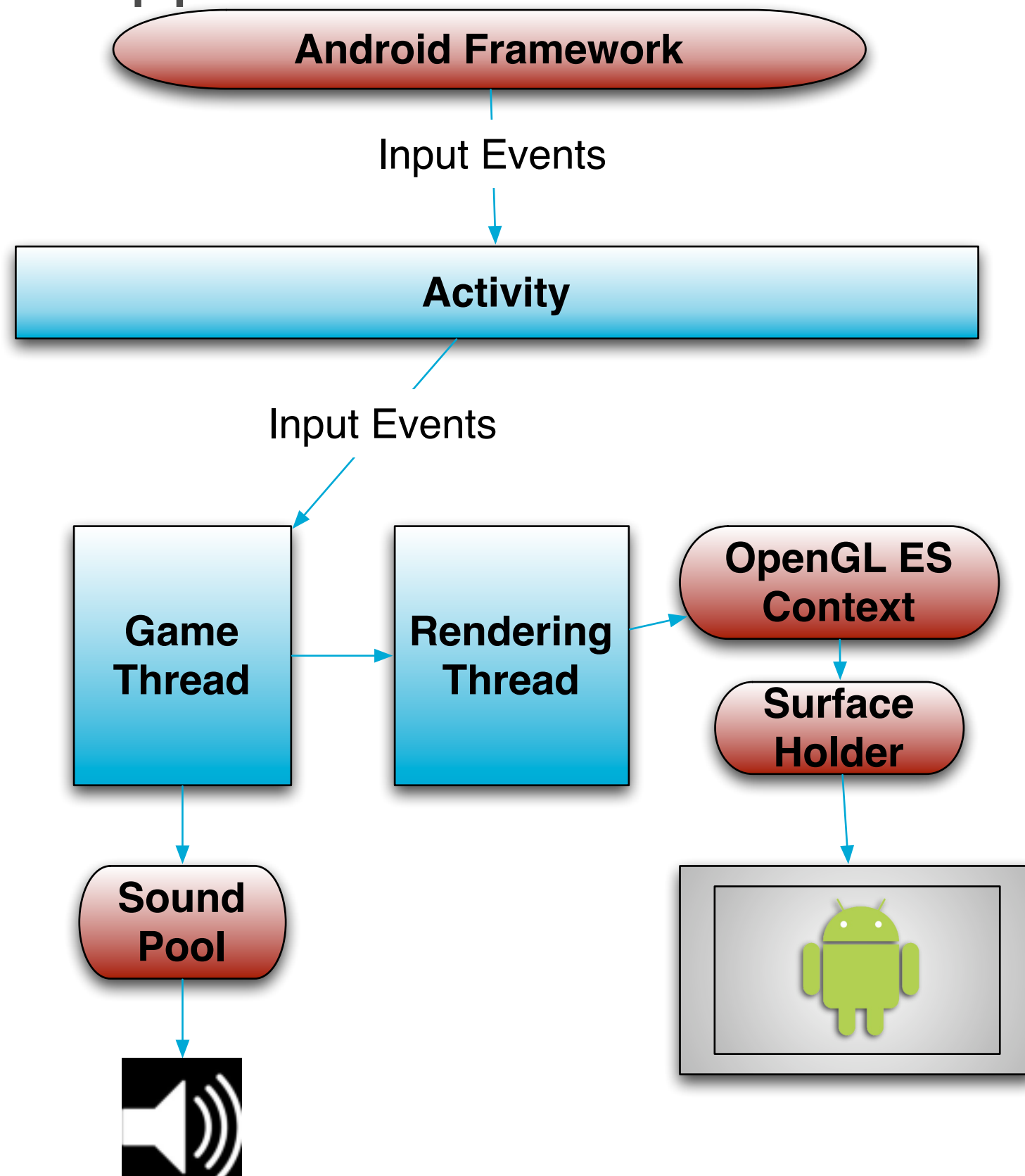


Agenda

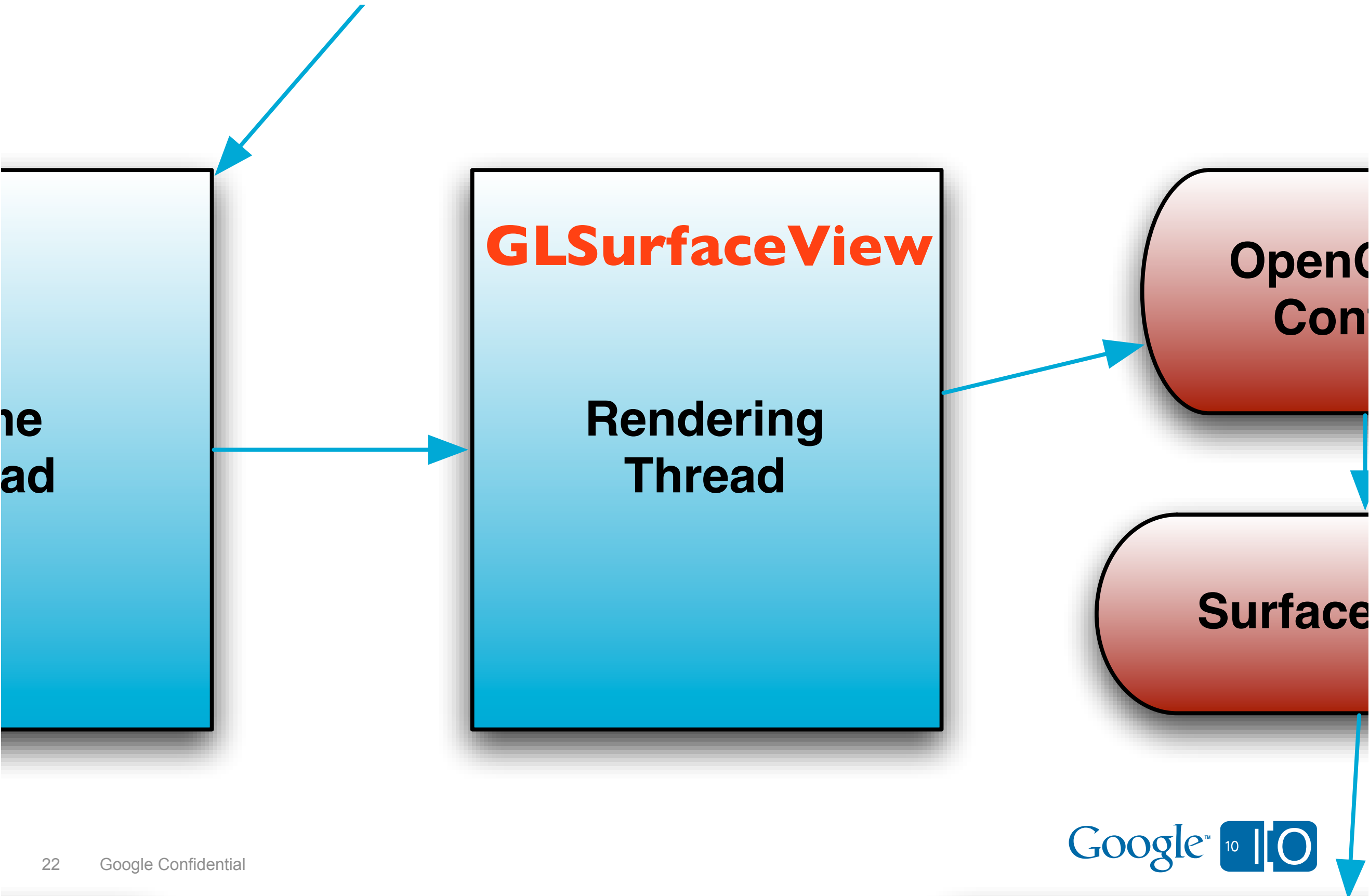
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Dual Thread Approach



Render Thread



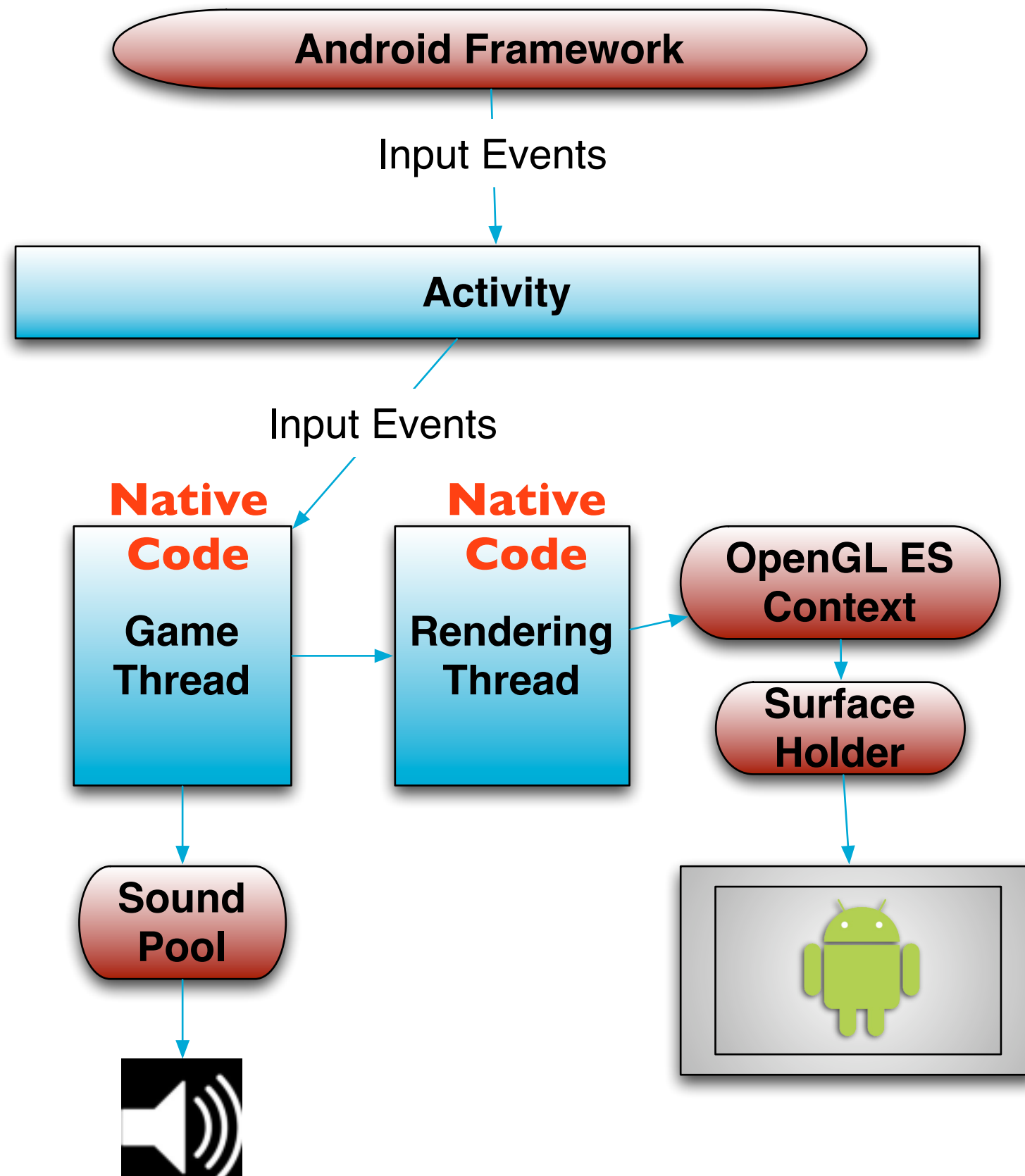
Activity + GLSurfaceView

```
public class GameActivity extends Activity {  
    private GLSurfaceView mGLView;  
  
    @Override  
    protected void onCreate(Bundle savedInstanceState) {  
        super.onCreate(savedInstanceState);  
  
        AwesomeGameRenderer renderer = new AwesomeGameRenderer();  
        mGLView = new GLSurfaceView(this);  
        mGLView.setRenderer(renderer);  
        setContentView(mGLView);  
    }  
  
    @Override  
    protected void onPause() {  
        super.onPause();  
        mGLView.onPause();  
    }  
  
    @Override  
    protected void onResume() {  
        super.onResume();  
        mGLView.onResume();  
    }  
}
```

GLSurfaceView.Renderer

```
class AwesomeGameRenderer implements GLSurfaceView.Renderer {  
  
    public void onSurfaceCreated(GL10 gl, EGLConfig config) {  
        // One-time GL setup goes here  
    }  
  
    public void onSurfaceChanged(GL10 gl, int w, int h) {  
        // Viewport operations go here.  
    }  
  
    public void onDrawFrame(GL10 gl) {  
        // Draw the frame  
    }  
}
```

With the NDK



Rendering Natively

```
class AwesomeGameRenderer implements GLSurfaceView.Renderer {

    static {
        System.loadLibrary("nativegame1ib");
    }

    private static native void nativeGameInit();
    private static native void nativeGameResize(int w, int h);
    private static native void nativeDrawFrame();

    public void onSurfaceCreated(GL10 gl, EGLConfig config) {
        // One-time GL setup goes here
        nativeGameInit();
    }

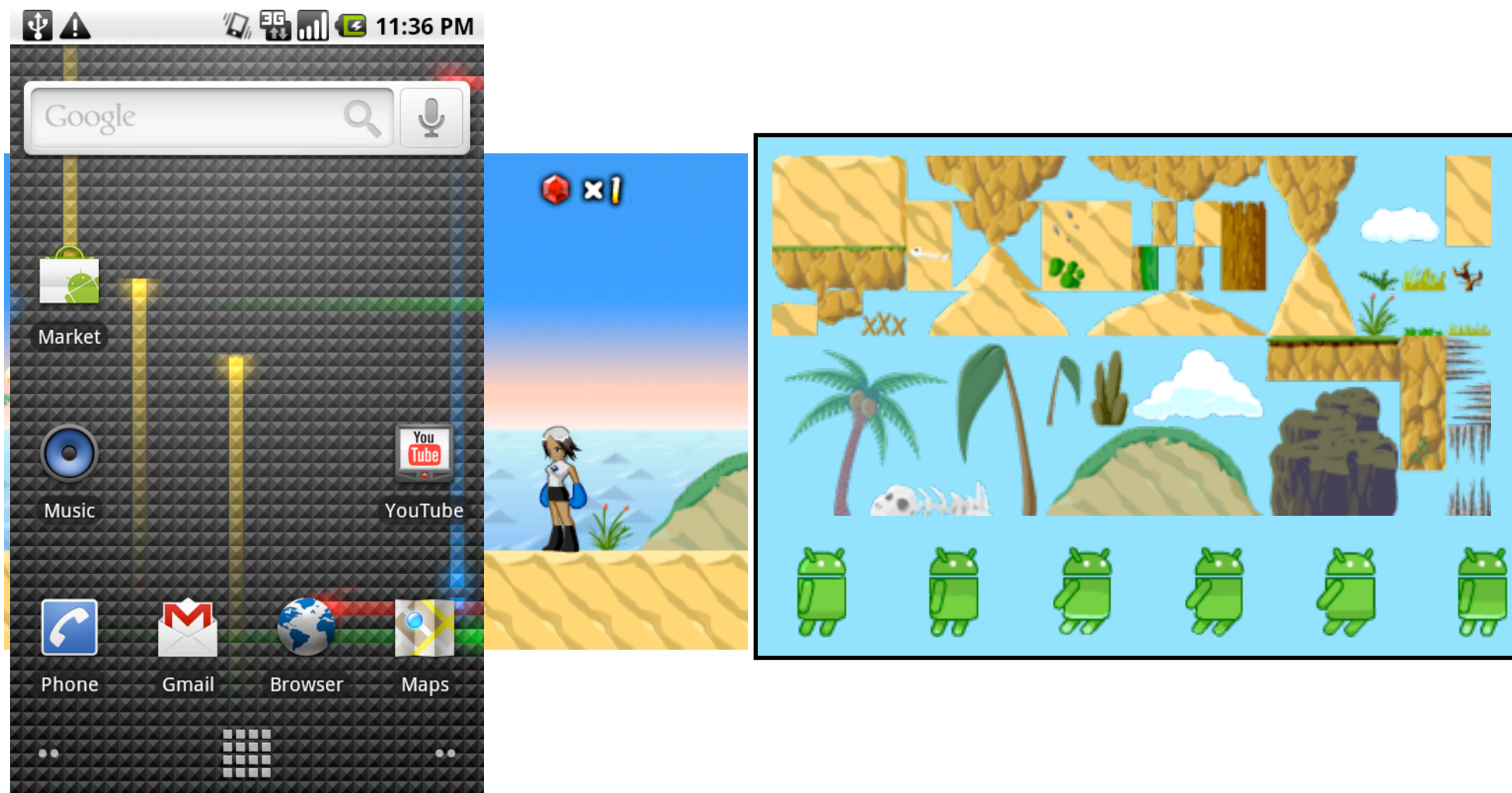
    public void onSurfaceChanged(GL10 gl, int w, int h) {
        // Viewport operations go here.
        nativeGameResize(w, h);
    }

    public void onDrawFrame(GL10 gl) {
        // Draw the frame
        nativeDrawFrame();
    }
}
```

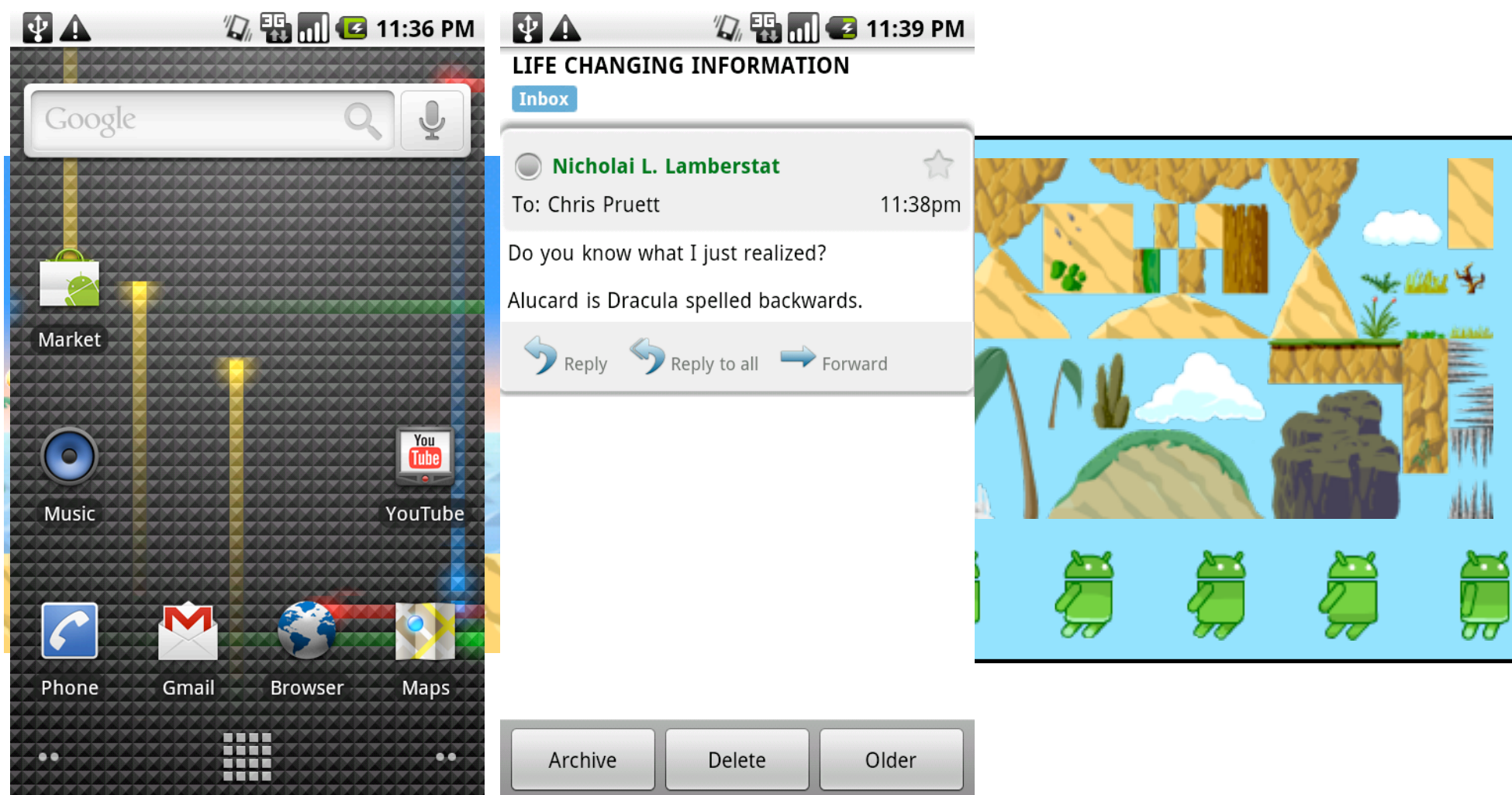
EGL Context and Pausing



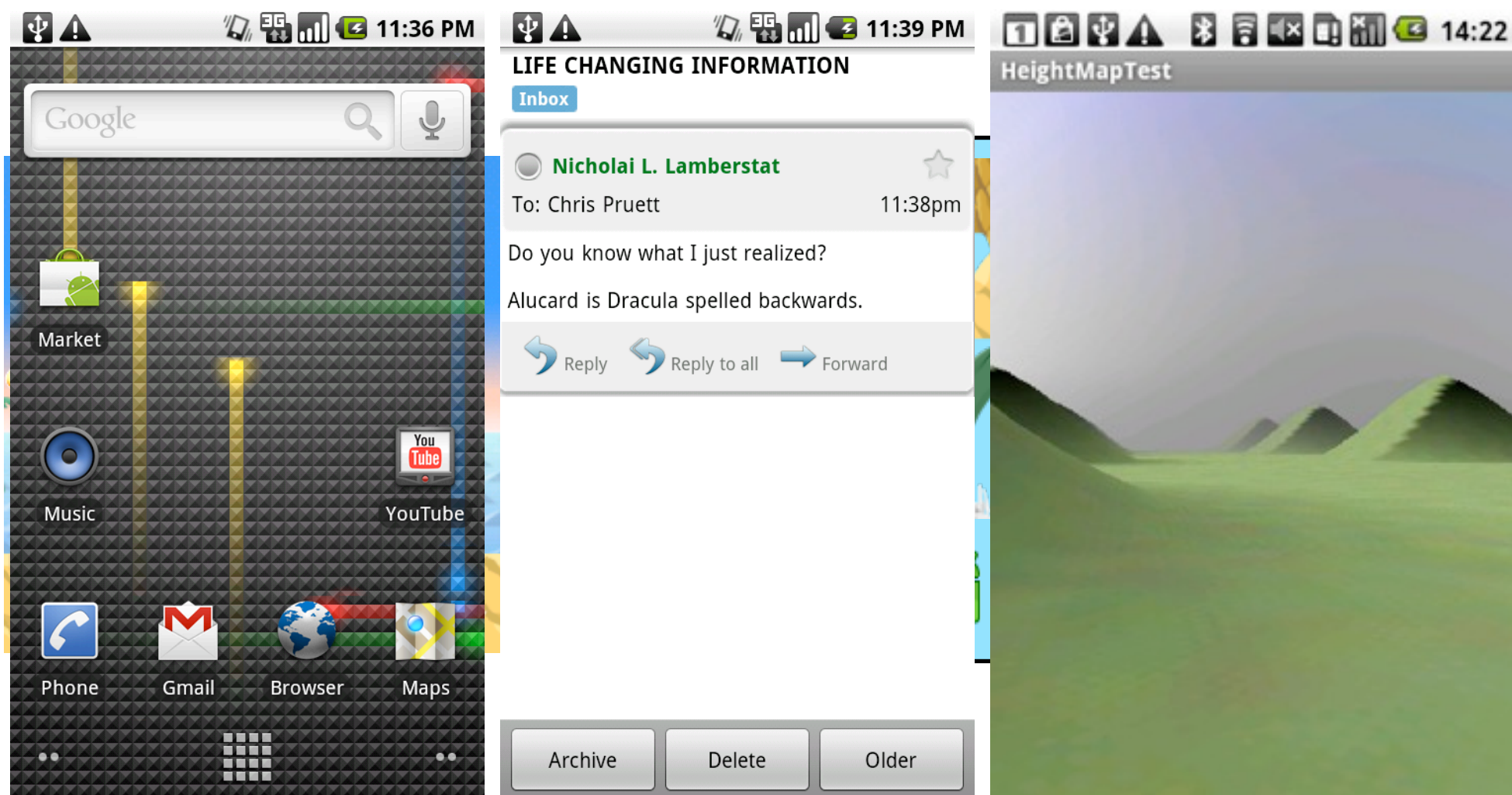
EGL Context and Pausing



EGL Context and Pausing



EGL Context and Pausing



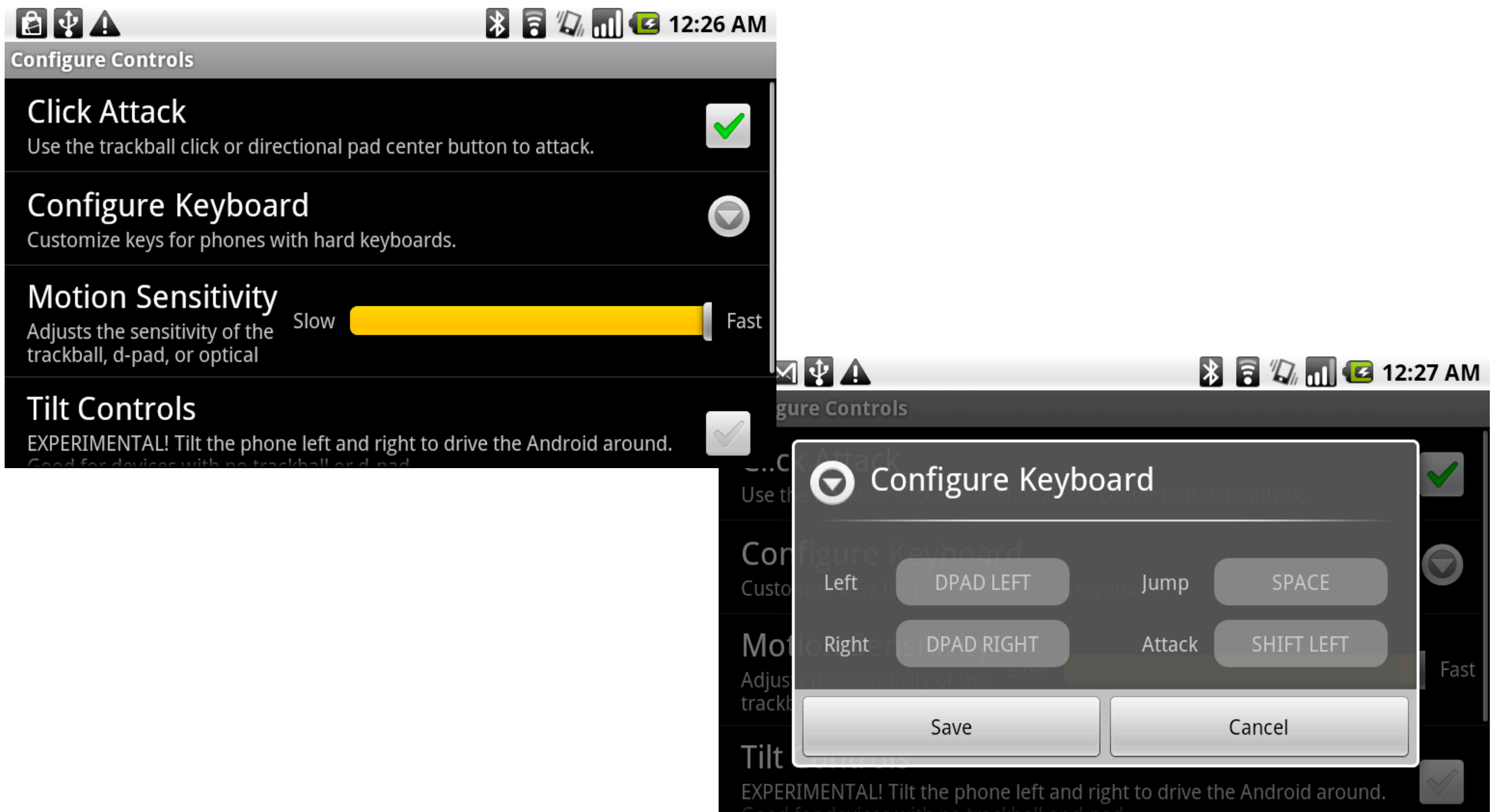
EGL Context and Pausing



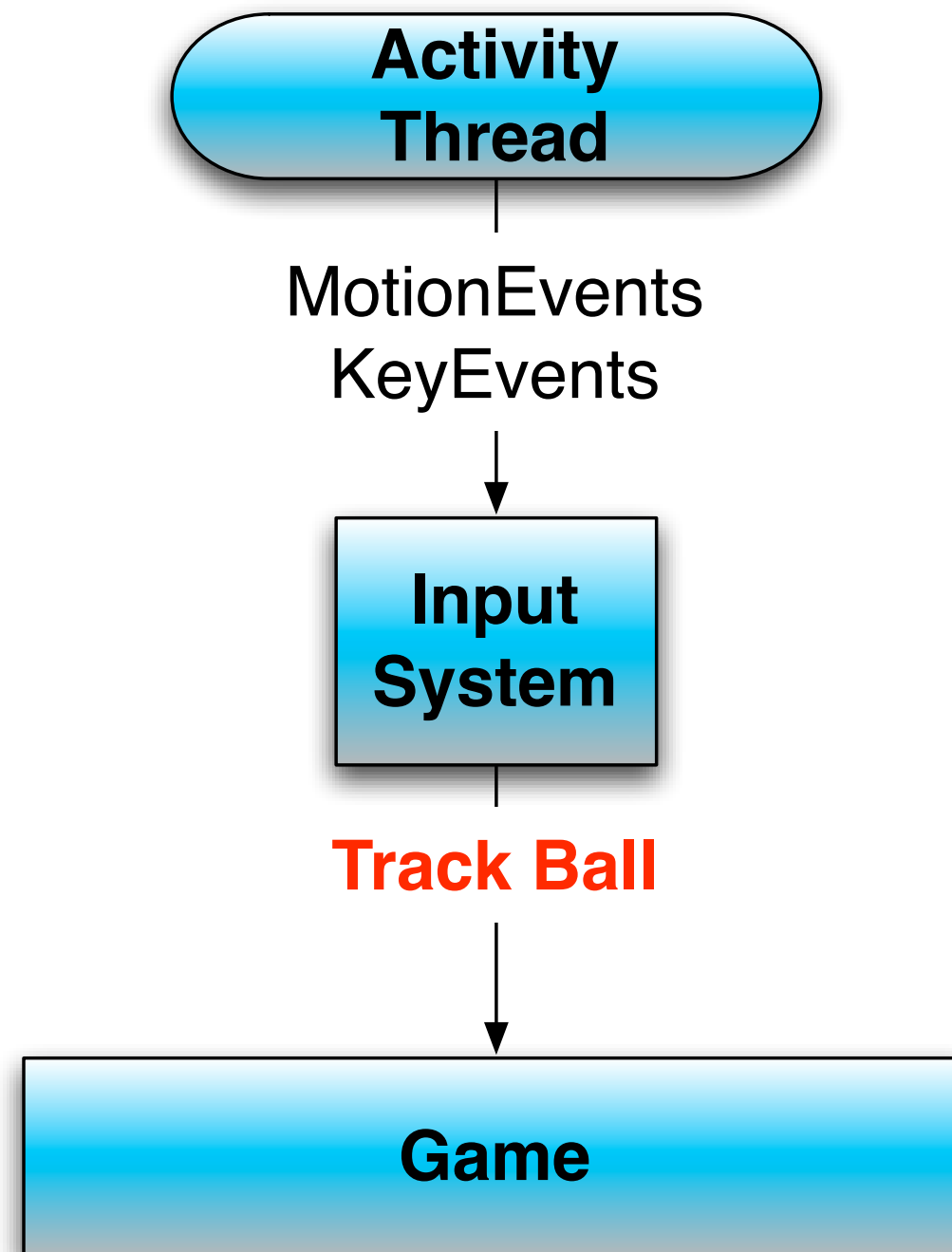
Replica Island Pause Problem



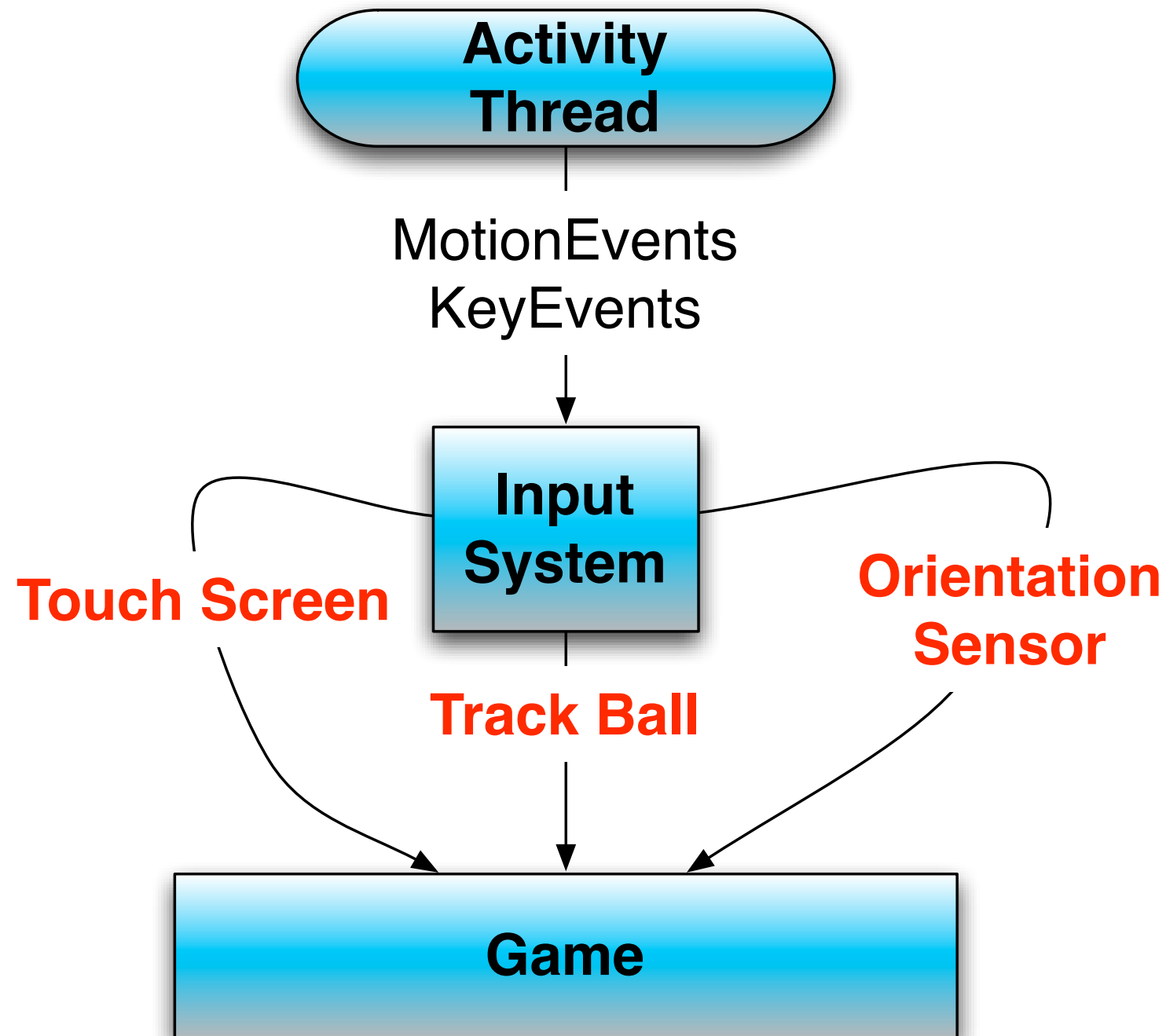
#1 Takeaway: Customizable Controls



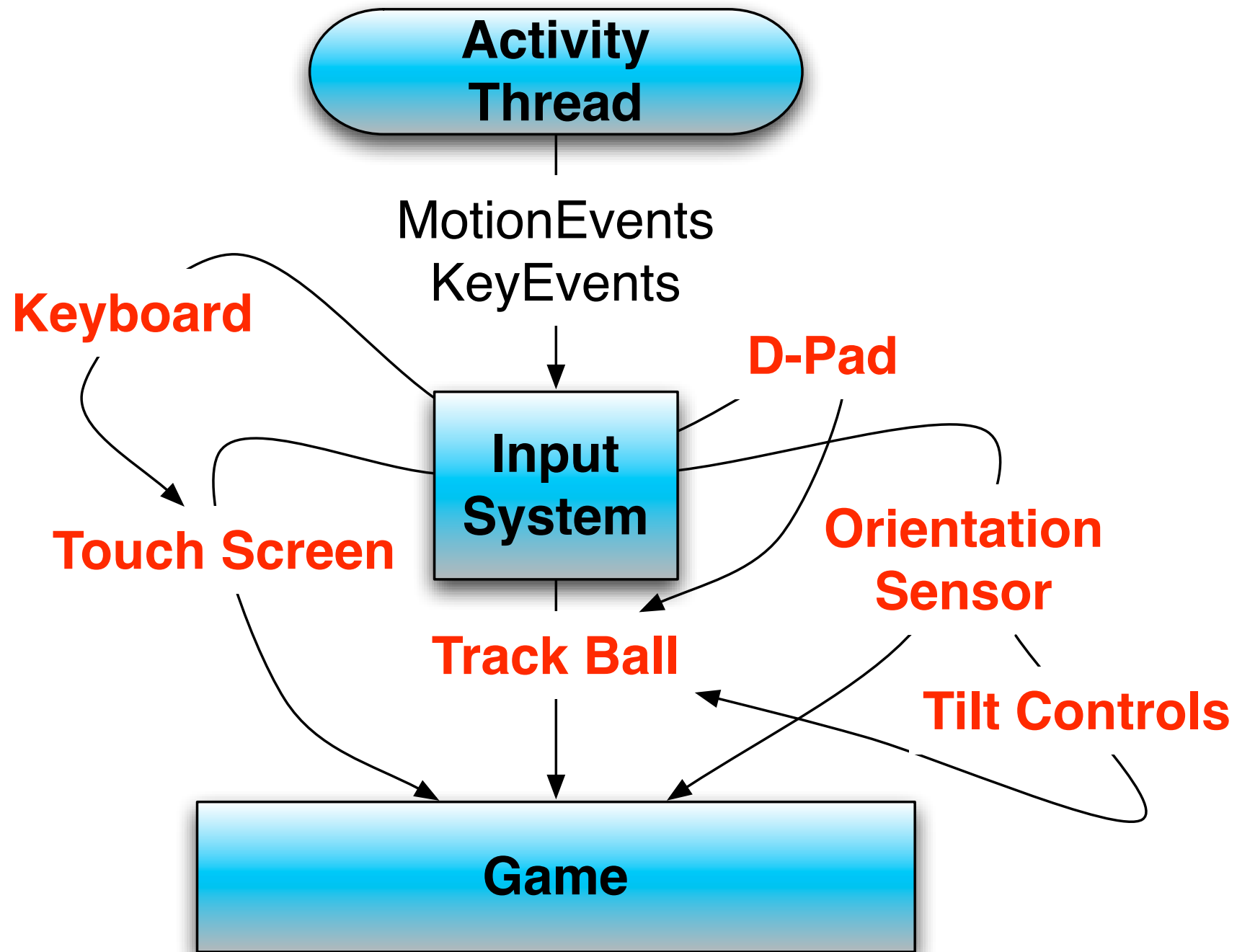
Original Input System



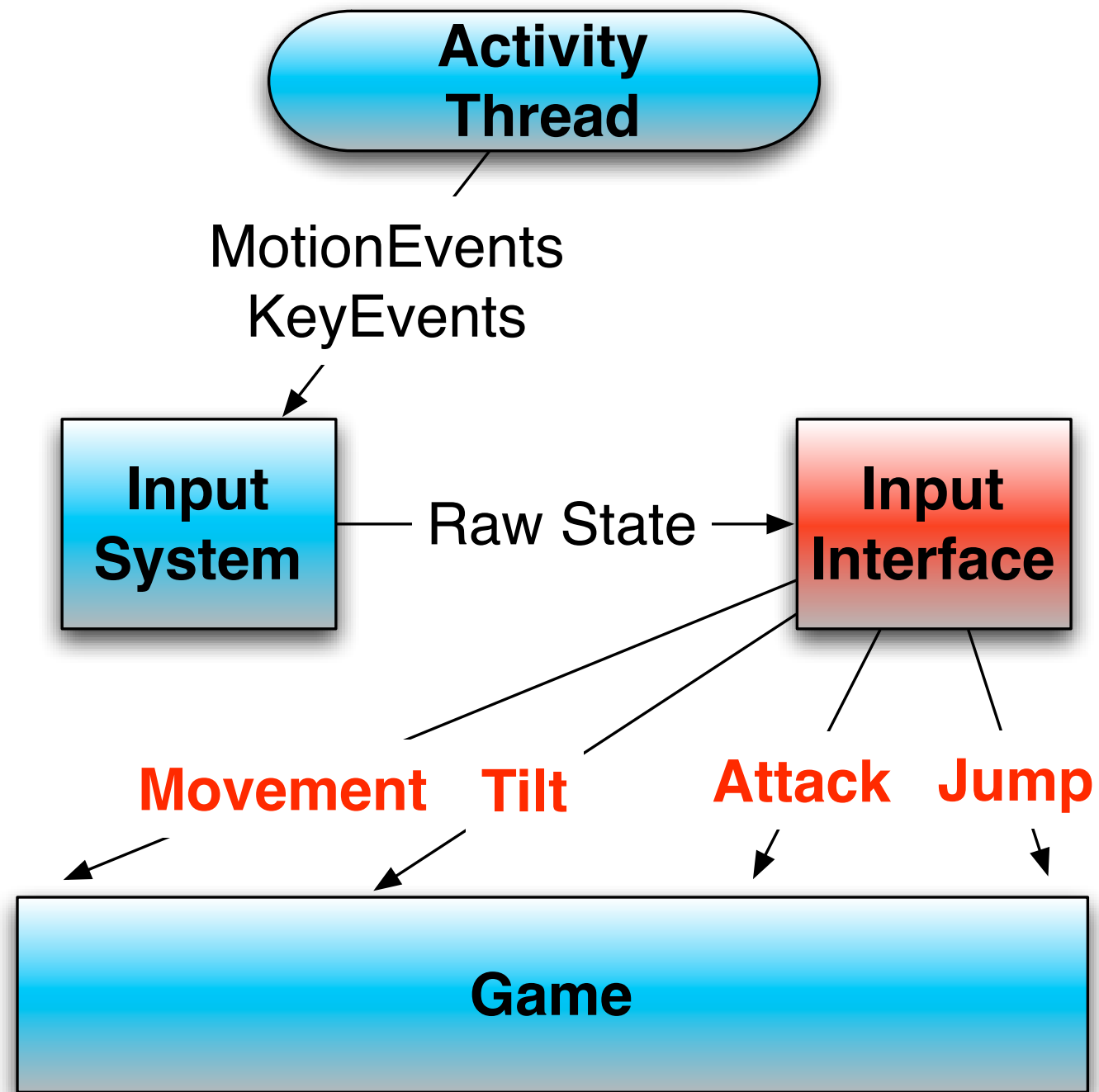
Original Input System



Original Input System



Current Input System



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Traits of the Most Successful Games

	Supports 1.5	Screen Shots	Free Version	Average Price
Most Popular Paid	100%	90%	90%	\$3.45
Most Downloaded Paid	90%	70%	80%	\$3.38
Most Popular Free	100%	60%	-	-
Most Downloaded Free	100%	50%	-	-

Based on top 10 titles across all game categories.

“Almost Done”

Quick Demo



REPLICA ISLAND

Note that this is a work in progress. All bugs are mine.

Google CC 480p

0:12:24 / 1:01:13

“Couple of Months”

$f(\text{May 2009} + \text{“Couple of Months”}) = \text{March 2010?}$

Replica Island Marketing Plan

- Web site
- Blog
- Press releases sent to Android blogs
- Provide download QR Code

Total Marketing Spend: \$0.00

Replica Island Marketing Plan

- Web site
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~~Total Marketing Spend: \$0.00~~

Total Marketing Spend: \$39.95

Replica Island Marketing Plan

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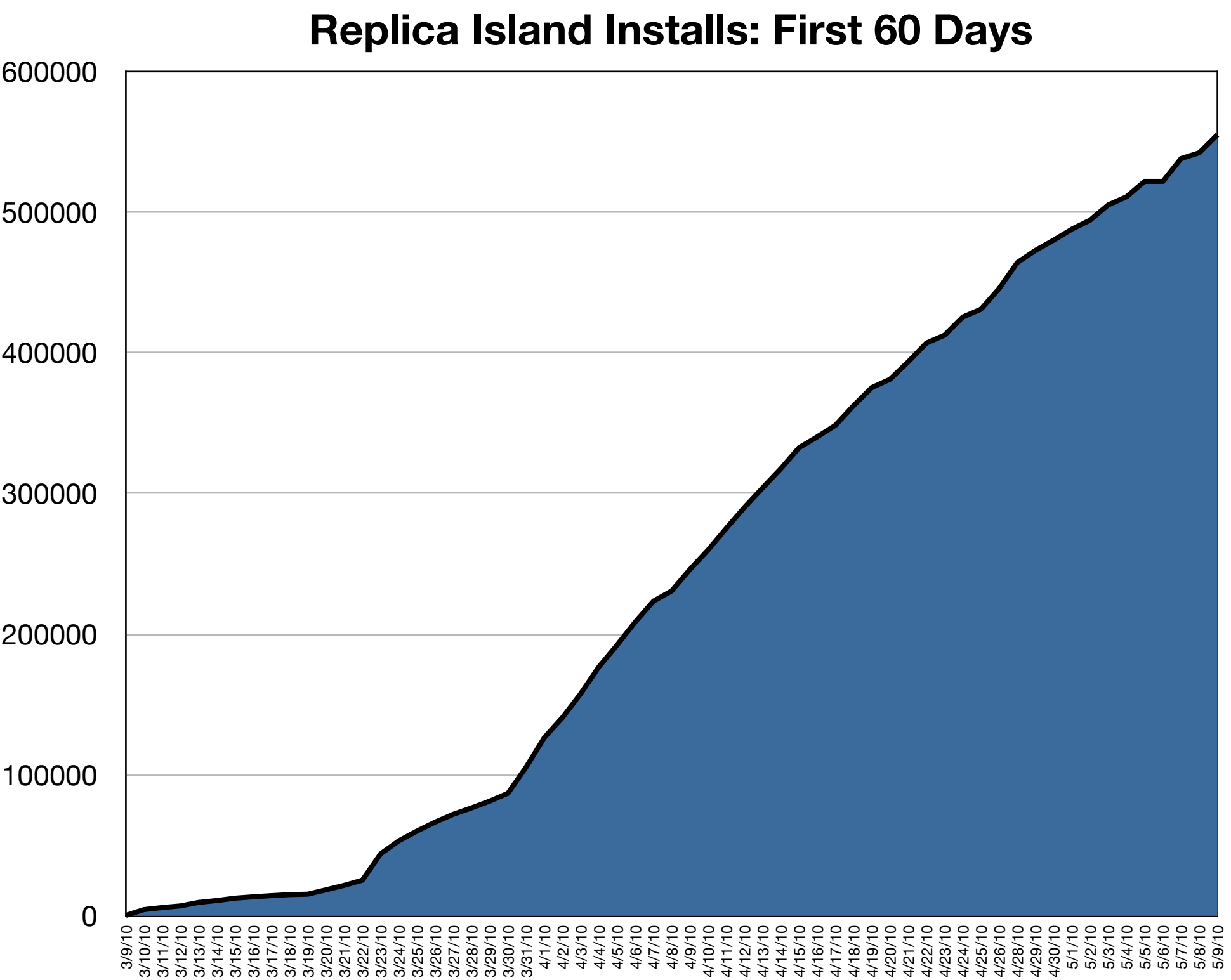
~~Total Marketing Spend: \$0.00~~

~~Total Marketing Spend: \$39.95~~

Total Marketing Spend: \$0.00

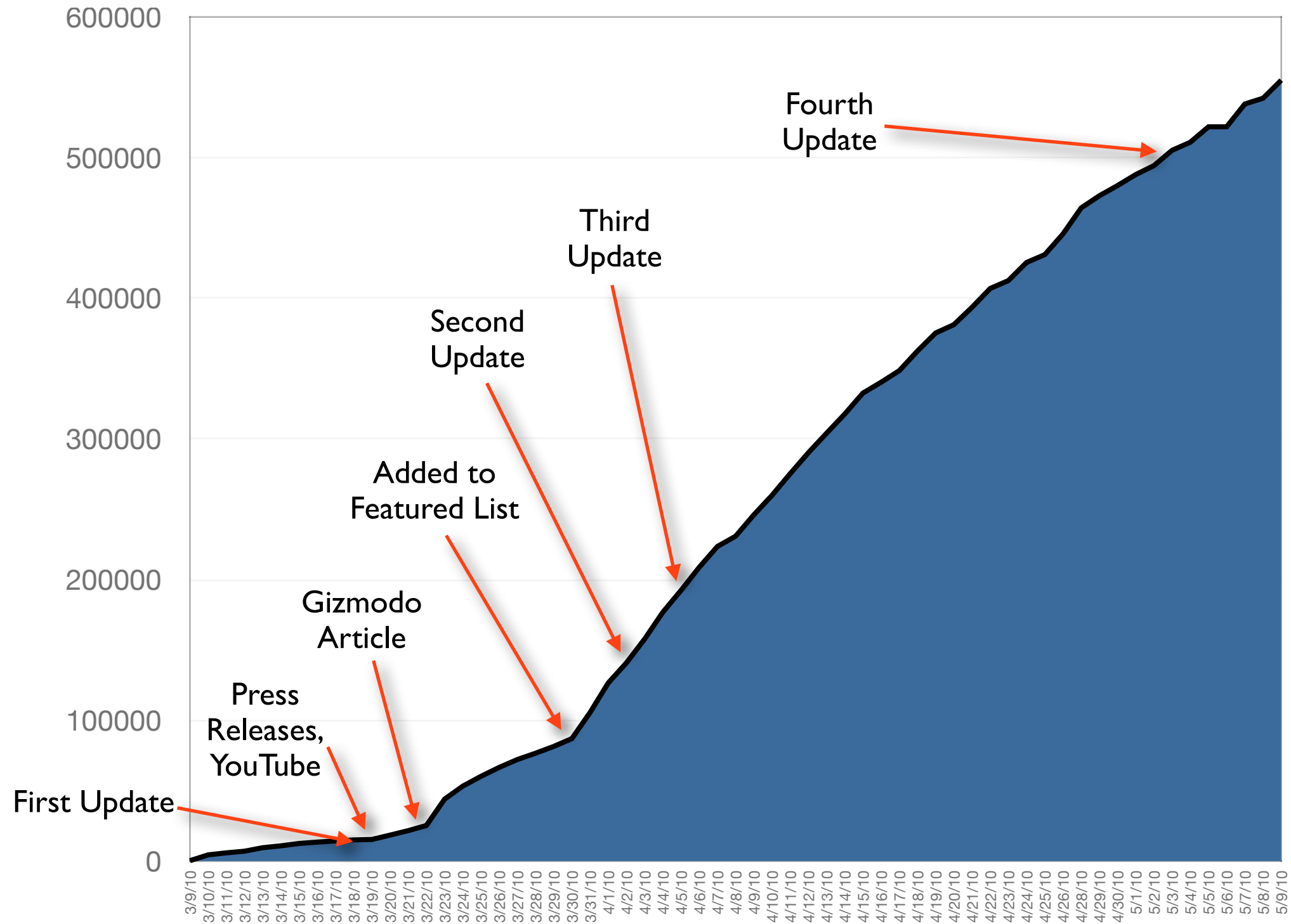
(sorry Nicholai)

Replica Island: First 60 Days



Replica Island: First 60 Days

Replica Island Installs: First 60 Days

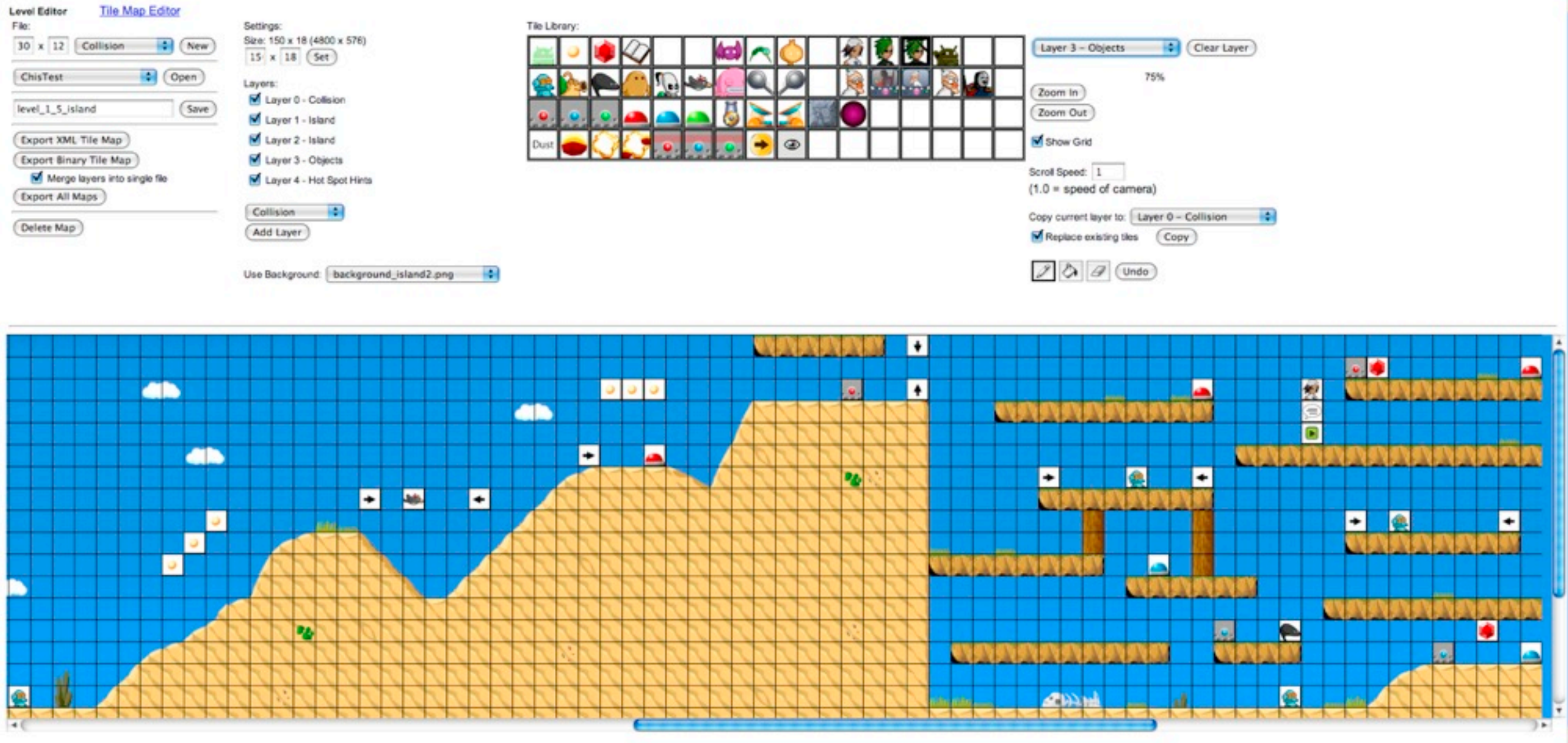


“Couple of Months”

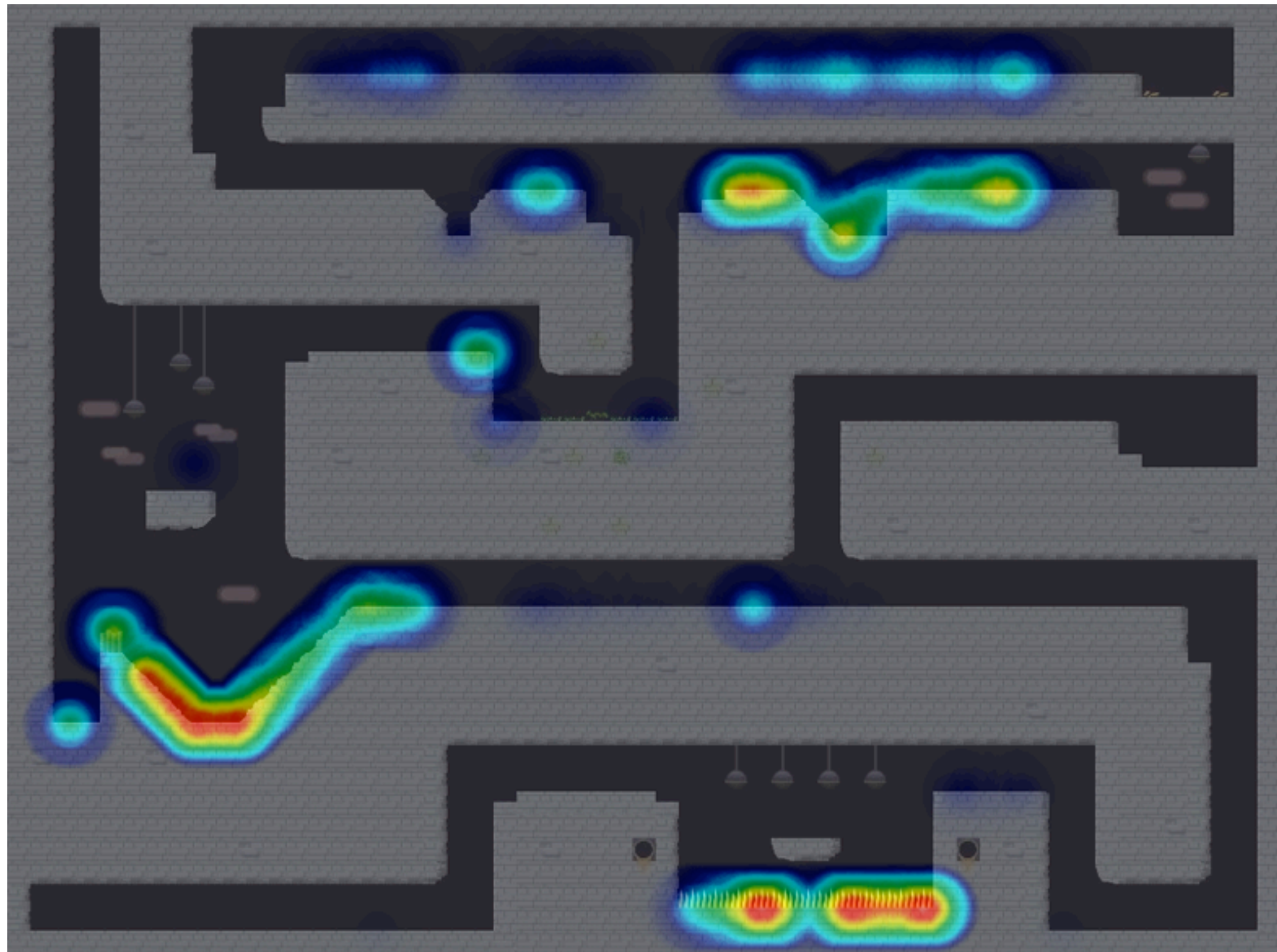
~~$f(\text{May 2009} + \text{“Couple of Months”}) = \text{March 2010?}$~~

$f(\text{May 2009} + \text{“Couple of Months”}) =$
Mediocre Game

Problem: Crappy Tools



Solution: Automated User Feedback



Listen to your users

Ashley 3/24/2010



Awesome!!!!!! 2 things though. 1) want to be able to configure jump button from a to a other letter. 2) developer needs a suggestion box



Matthew 4/19/2010



Pretty good game but the controls could be less sensitive. Storyline is a bit confusing since its not in chronological order.



Martin 4/29/2010



Fun game, would be nice to have multiple save states so i wouldnt have to go through the game again for the other endings.



Listen to your users... they are hilarious

Mike 4/29/2010



2 words:

BOOOOOORRRRRRRRIIIIIIINNNNNGGGGGGGG
G!!!!!!!!!!!!!!!!!!!!



Wojciech 5/5/2010



Ummmmmm..... Exeptible.



Nate 4/8/2010



I hate you robert



robert 4/8/2010



Stuiped



deb 4/26/2010



Its horrible



chad 4/26/2010



Best android game ever!!! *****



donte 5/4/2010



Im a gangsta and i like it.



iestyn 4/27/2010



Brokes your g1 mouse thing



Listen to your users... they are fascinating

katie 4/20/2010



Completed game.... now what? Need more levels or uninstall

Akshar 4/27/2010



I give it 3 caz it force closes after beating a memory on the cliq i am lowering my rating every month caz of this

jon 4/16/2010




Fix level 22 with the spikes and make it so u can play other levels whenever, then I will give 5 stars....


ronald 5/5/2010



Game sucks. Memory 22 or whatever. Robot doesn't come far enough to hit the button. Spikes above. U get through u blow up. Fix it or ##### it. Droid

Listen to your users... they are fascinating


katie 4/20/2010 


Completed game.... now what? Need more levels or uninstall 


Threats?!


Akshar 4/27/2010 

I give it 3 caz it force closes after beating a memory on the cliq i am lowering my rating every month caz of this 

jon 4/16/2010 

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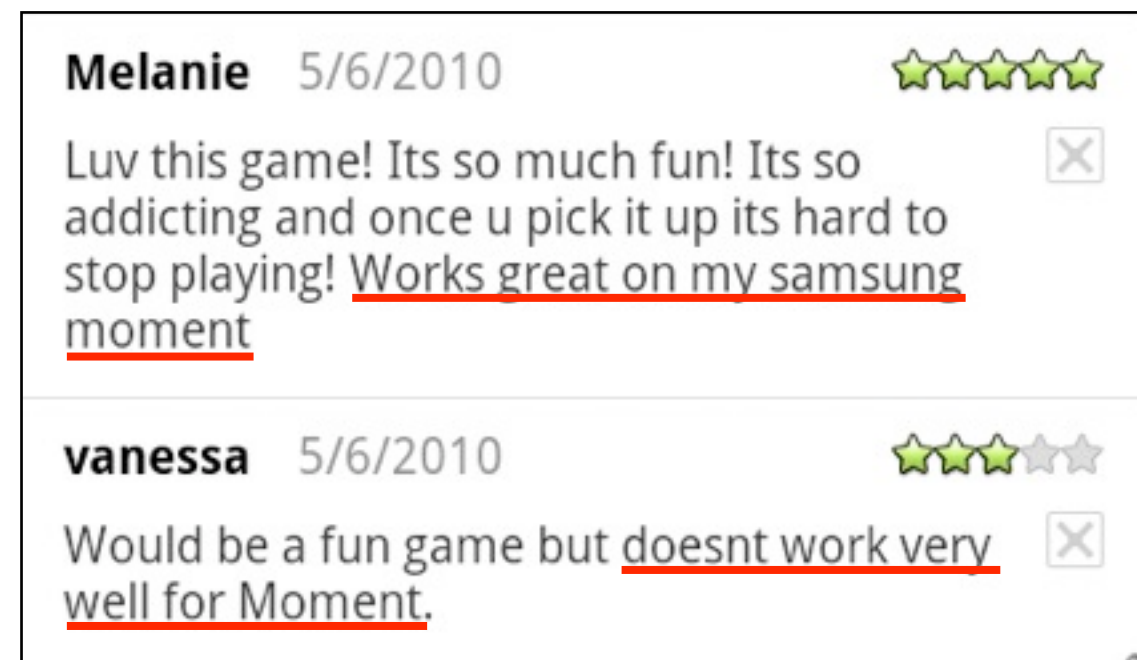
ronald 5/5/2010 

Game sucks. Memory 22 or whatever. Robot doesn't come far enough to hit the button. Spikes above. U get through u blow up. Fix it or ##### it. Droid 

Challenge = Bug?

Other Lessons Learned

- User bug reports are highly unreliable.
- Different Strokes.
 - Extremely Casual
 - Extremely Hard Core
 - Dynamic Difficulty Adjustment?
- Market placement isn't static! Respond to feedback!
- Early Prototype = Good, but don't skimp on testing and tools.
- Communicate in as many ways as possible.





“It’s not really about innovation so much as exploring interestingness.”

Jonathan Blow, author of *Braid*

Useful Links

- <http://bit.ly/c5nm4w>
 - Hot Wave Technology, Live Now!
- <http://developer.android.com>
 - The start.
- <http://code.google.com/p/apps-for-android/>
 - Home to SpriteMethodTest, HeightMapProfiler, and other samples.
- <http://replicaisland.net>
 - Game, blog, source, etc.

