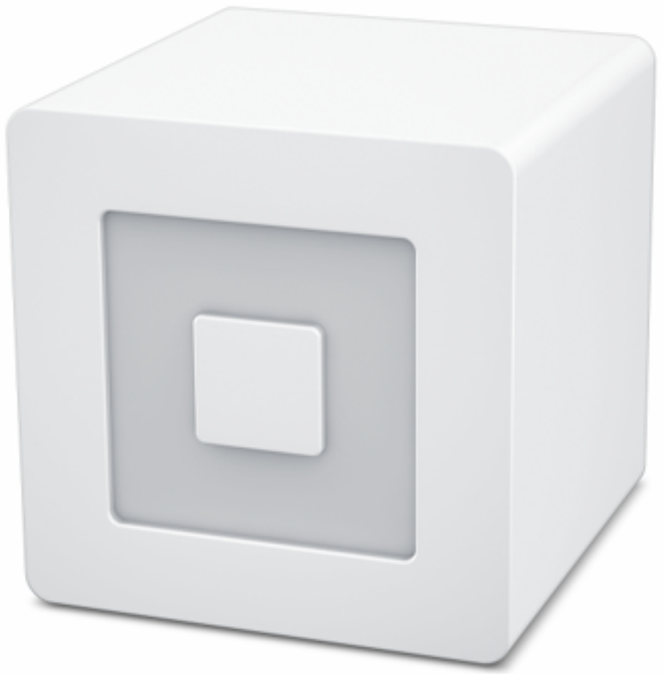


# Android²

Bob Lee & Eric Burke

Square, Inc.

# Square

Pay Eric Burke
$25.00
VISA 1111
Sign here.
Cancel
I agree to pay the above total amount
according to my card issuer agreement.
Continue

>> commercial-archive.com

# Overview

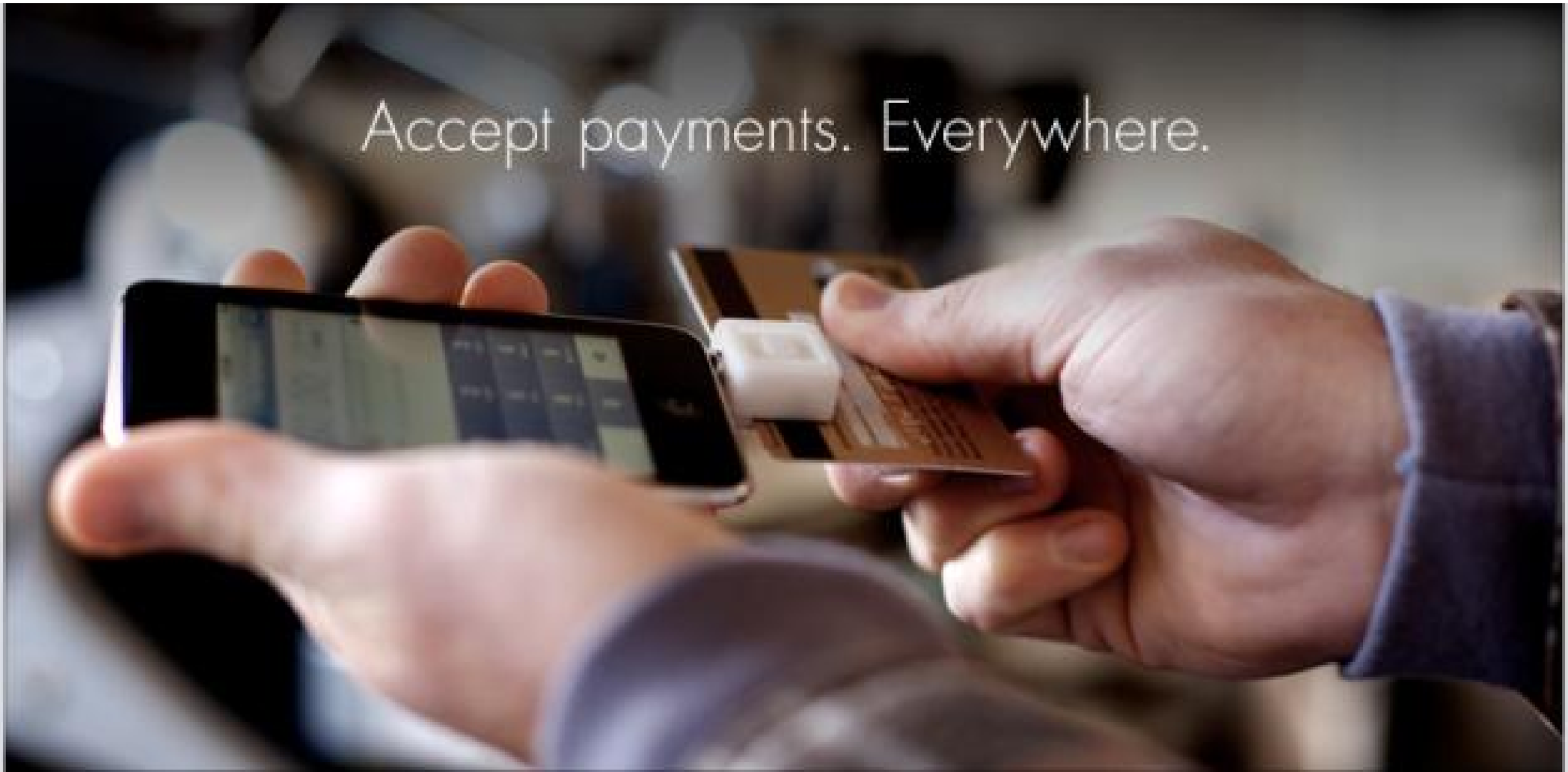
> Squarewave

> Retrofit

- I/O
- Shake detection
- REST

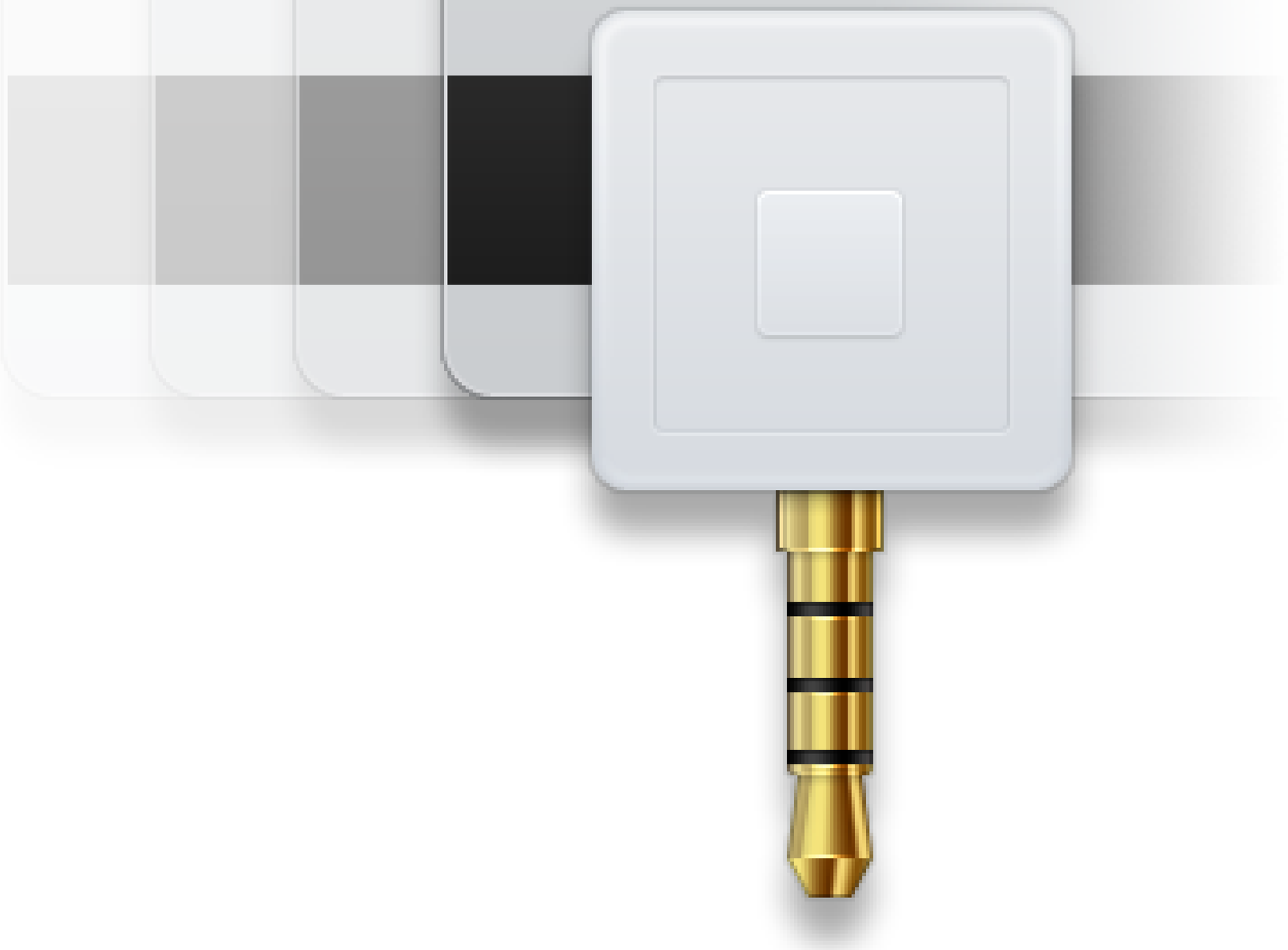
> Point-of-sale API

# **Squarewave:** Magnetic Stripe Decoder

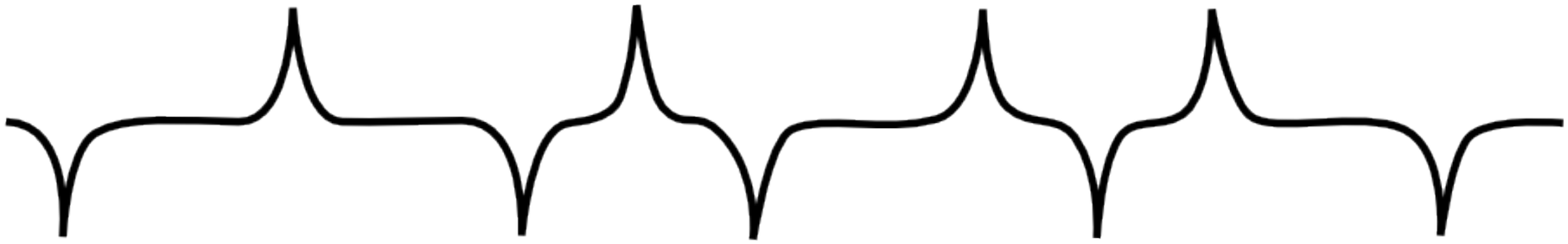


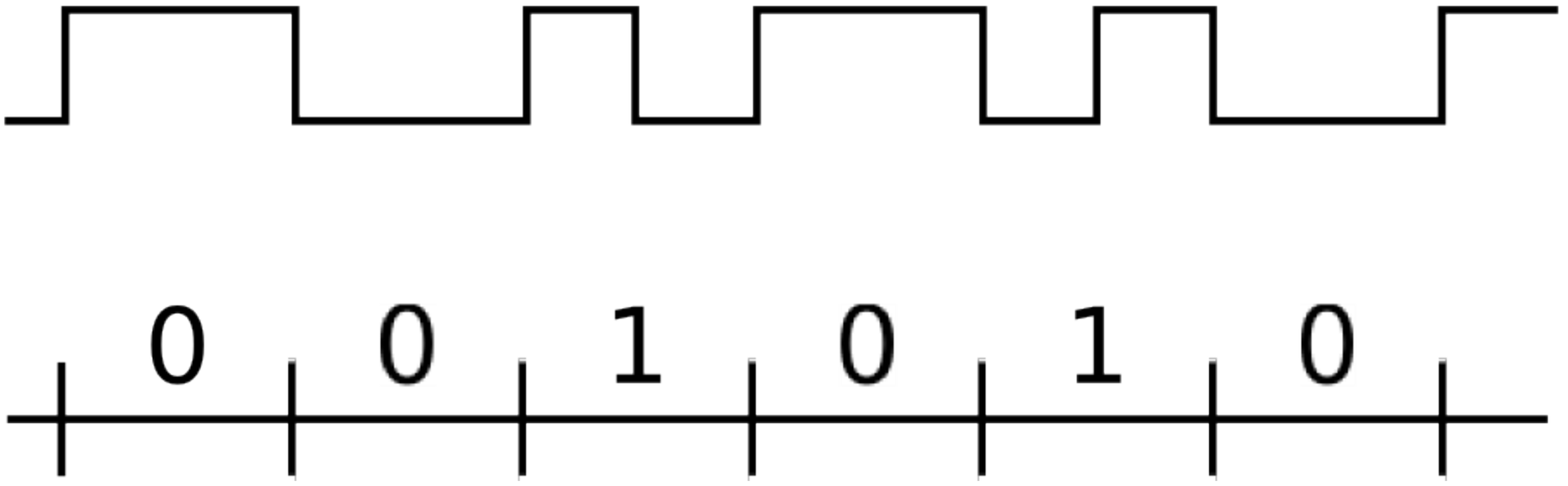
# Square Reader

Acts as a microphone



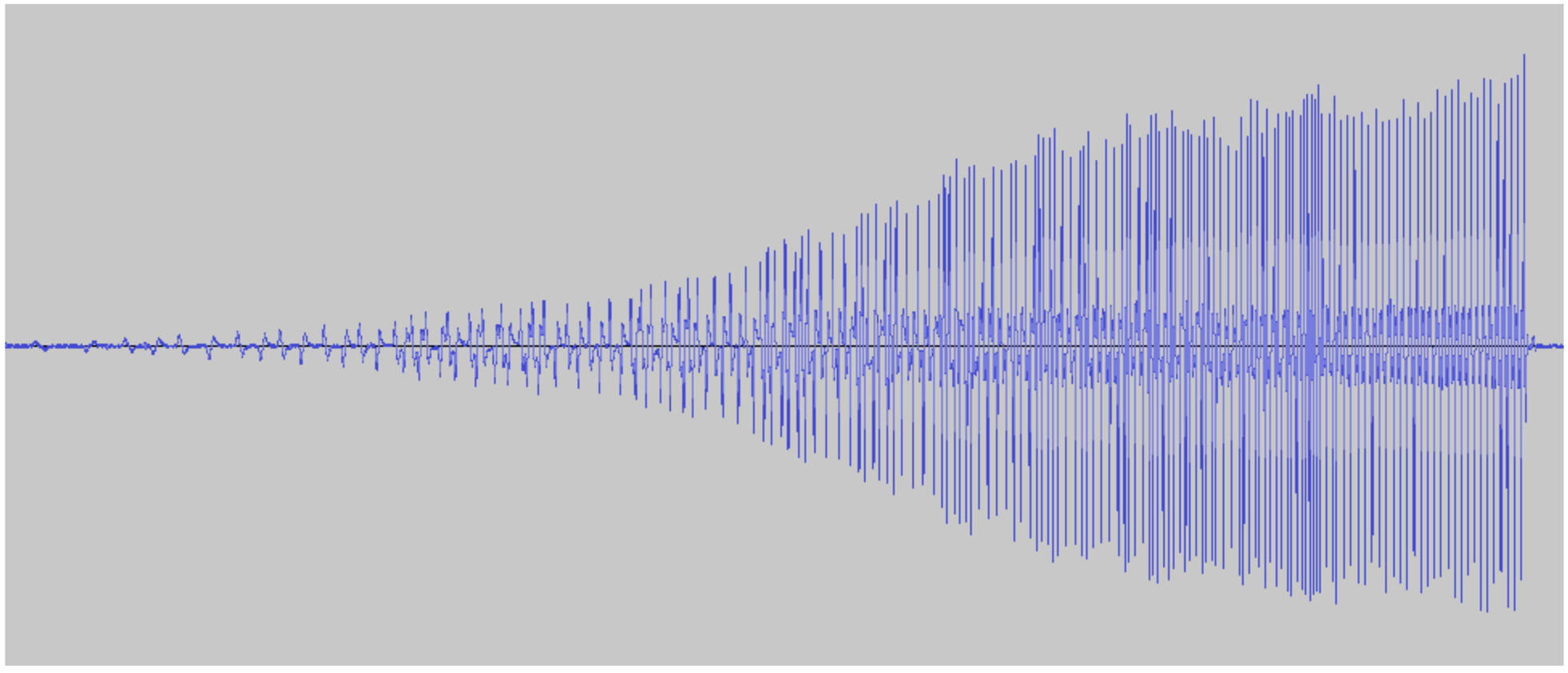
# Ideal Waveform



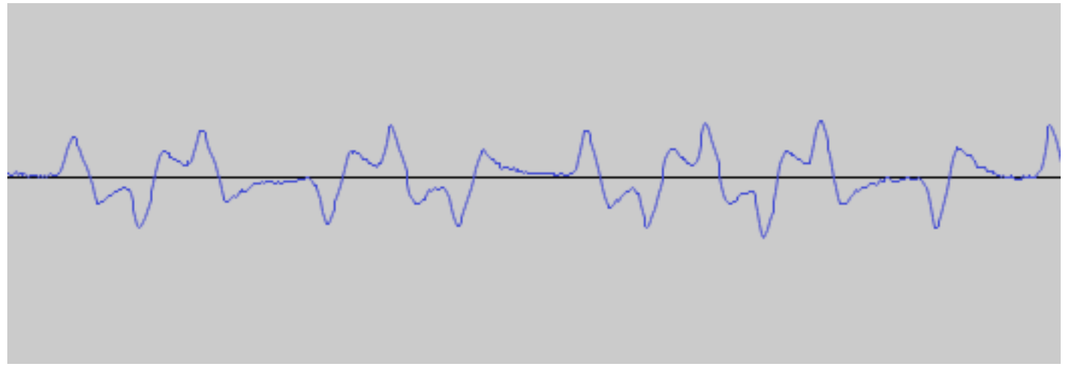


Sprint
11:27 AM
Charge
Doctor Evil
Settings
$10.00
Enter an optional note
Clear
9
8
6
7
5
3
4
2
1
0
00
SAMSUNG

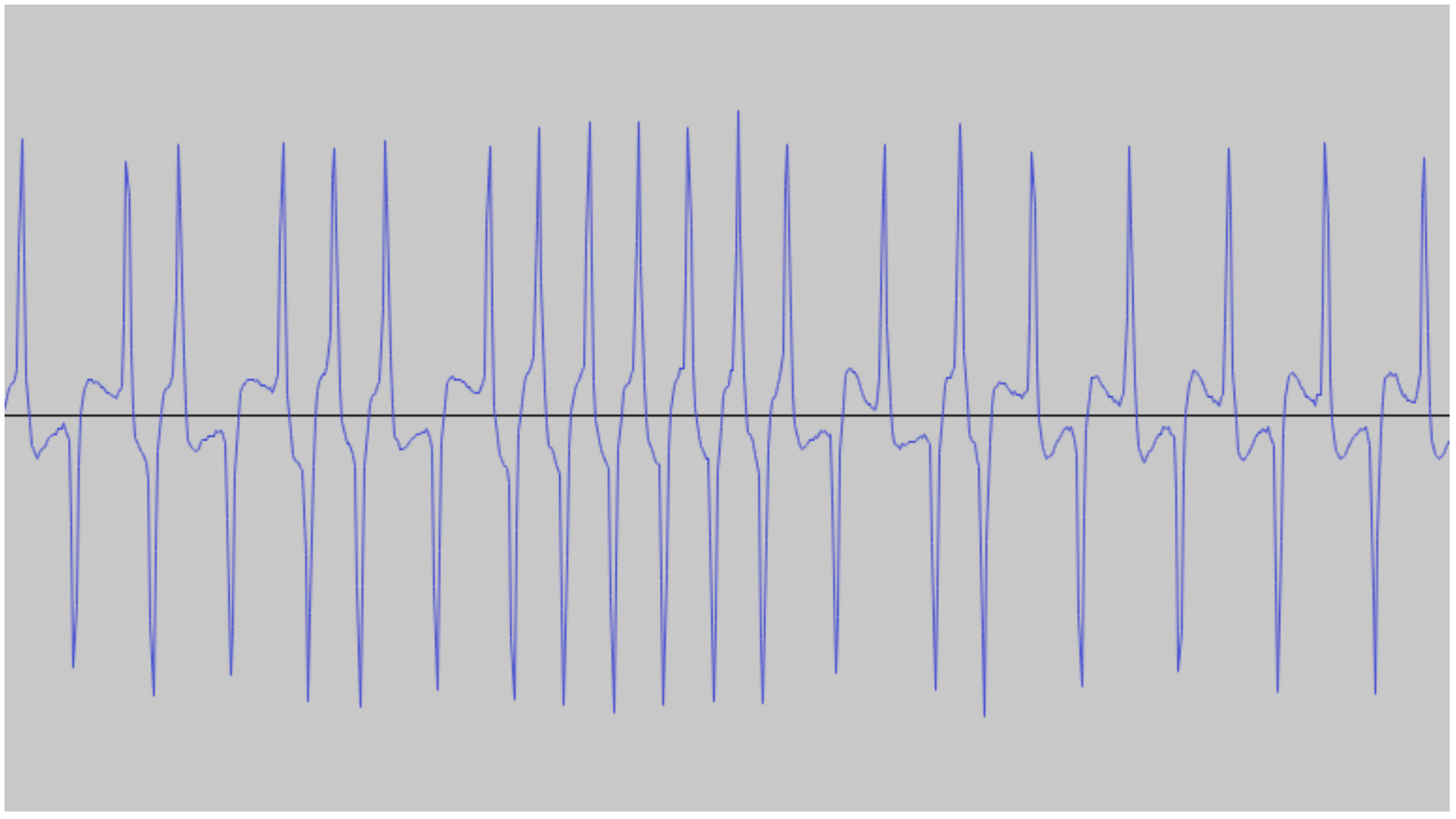
# Actual Swipe Recording



# Swipe Start



# Swipe End



# Challenges

# Challenges

> Swipe speed

# Challenges

> Swipe speed

> Device sample rate

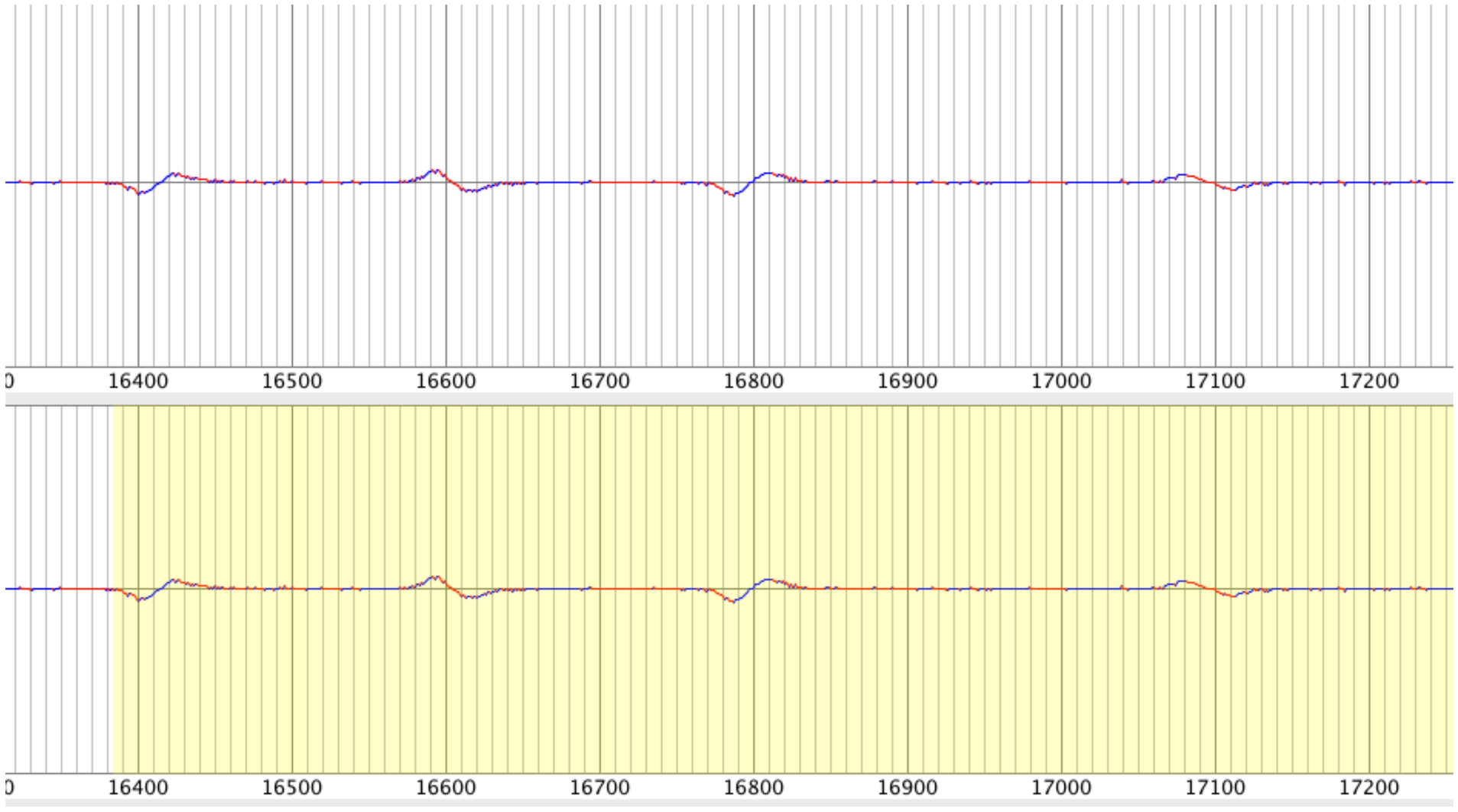
# Challenges

> Swipe speed

> Device sample rate

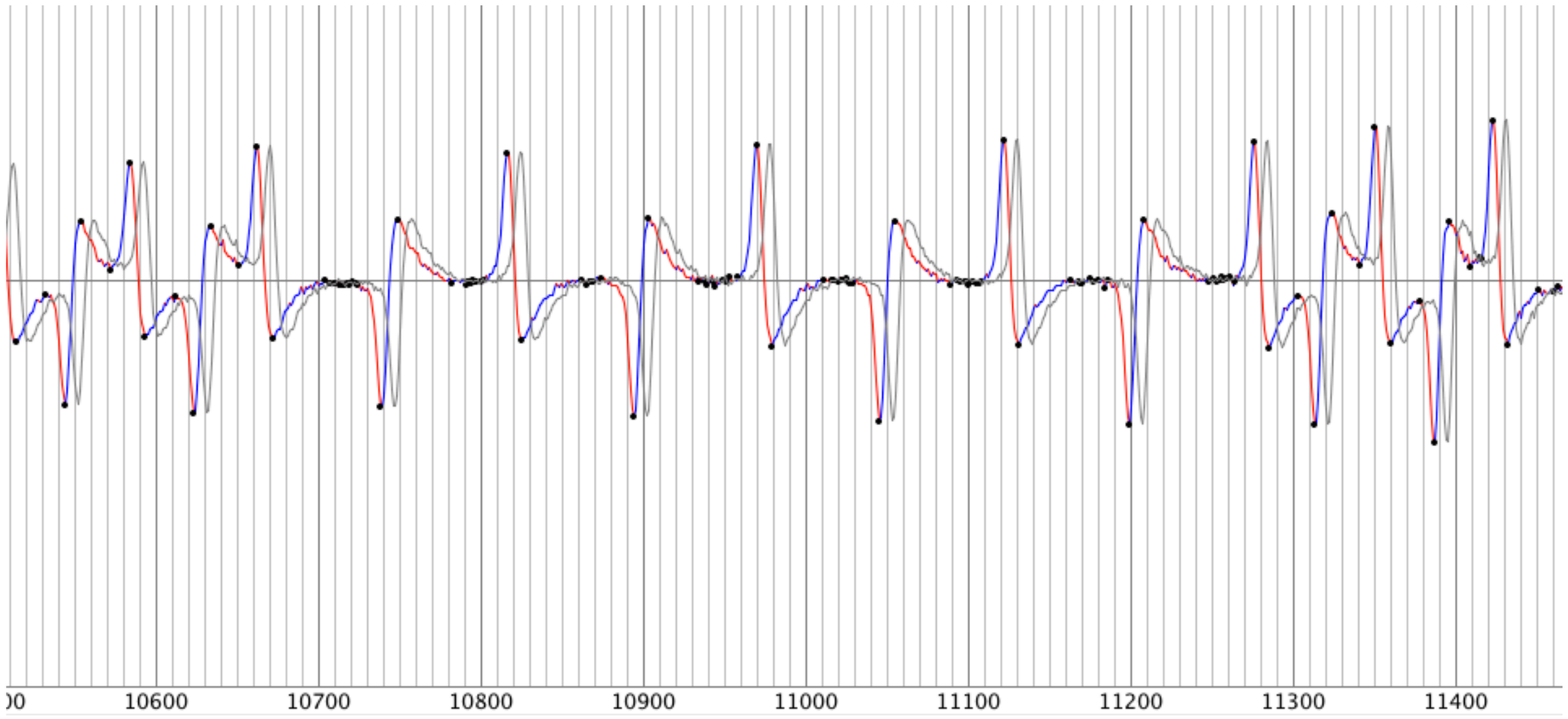
> Audio correction

# Step 1: Swipe Detection

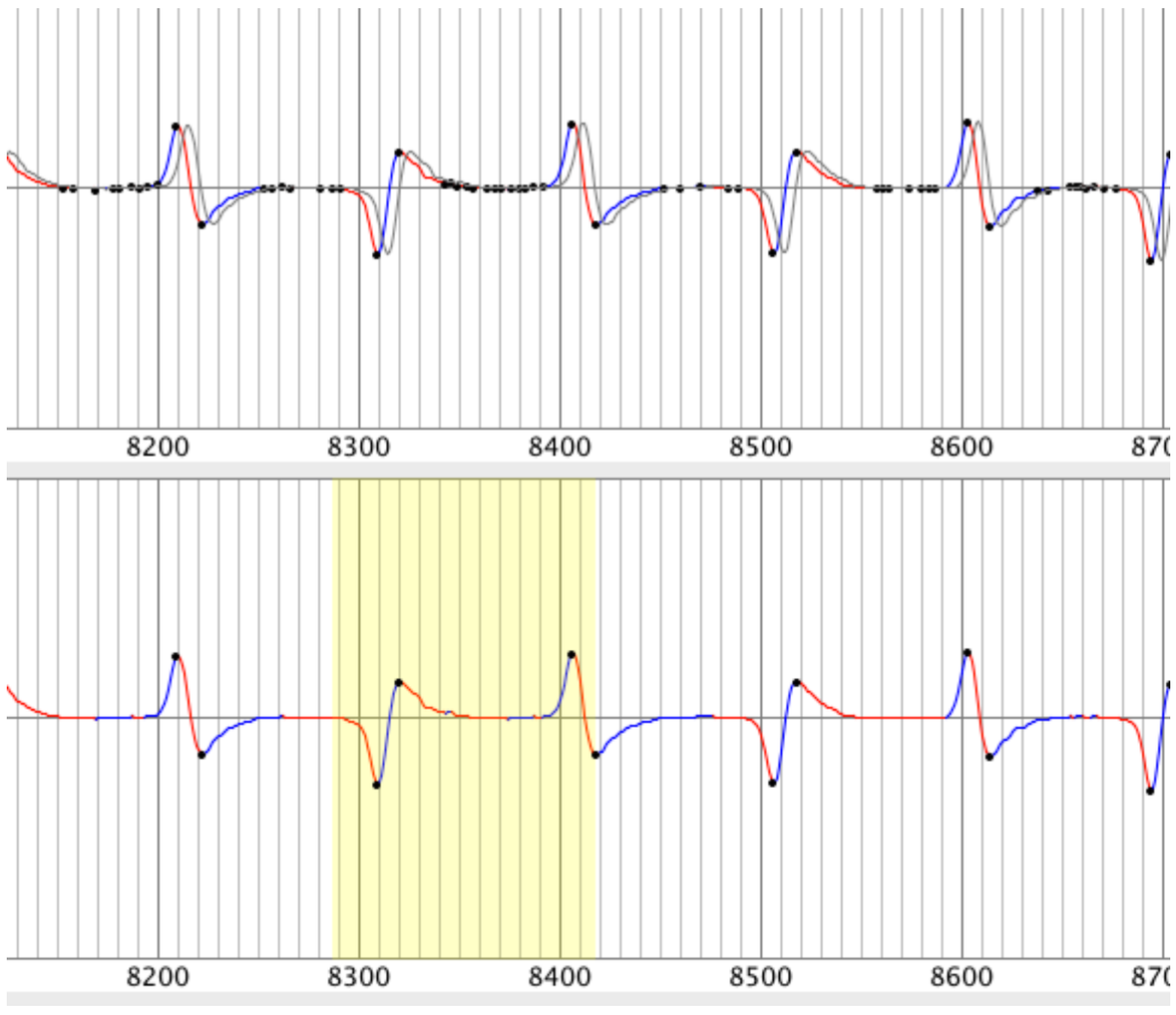


# Step 2: Denoising

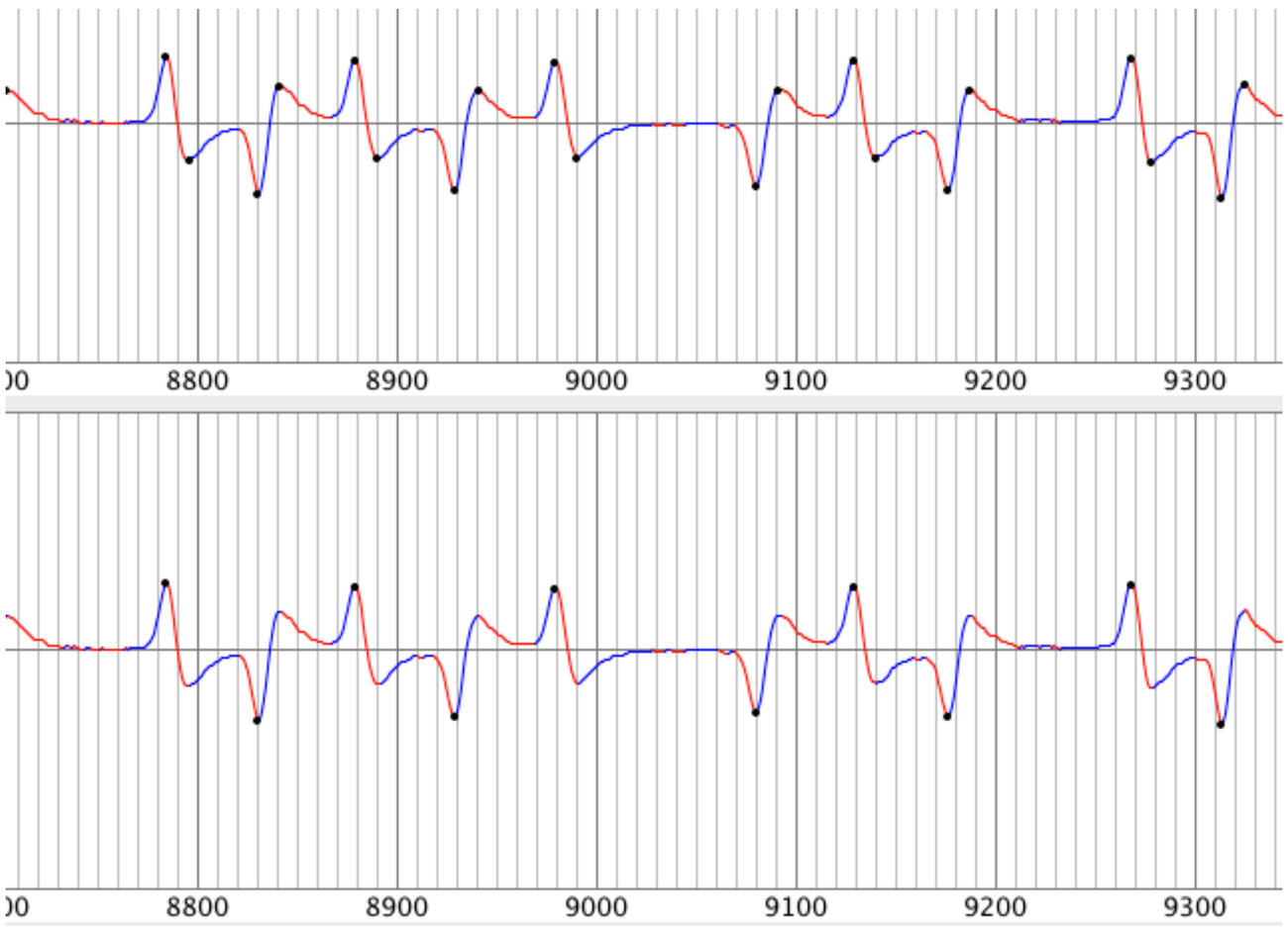
# Step 3: Peak Detection



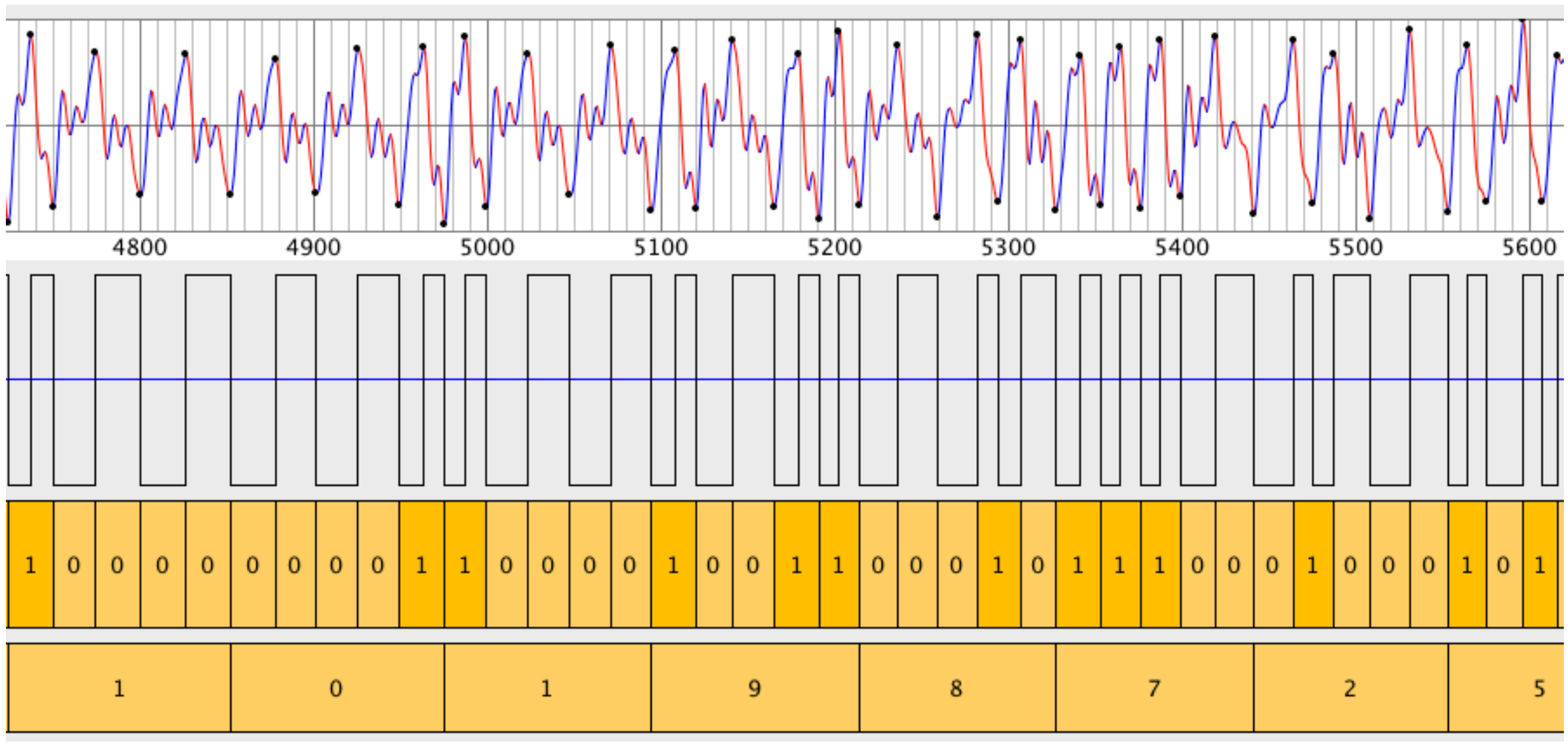
# Step 4: Window Peak Removal



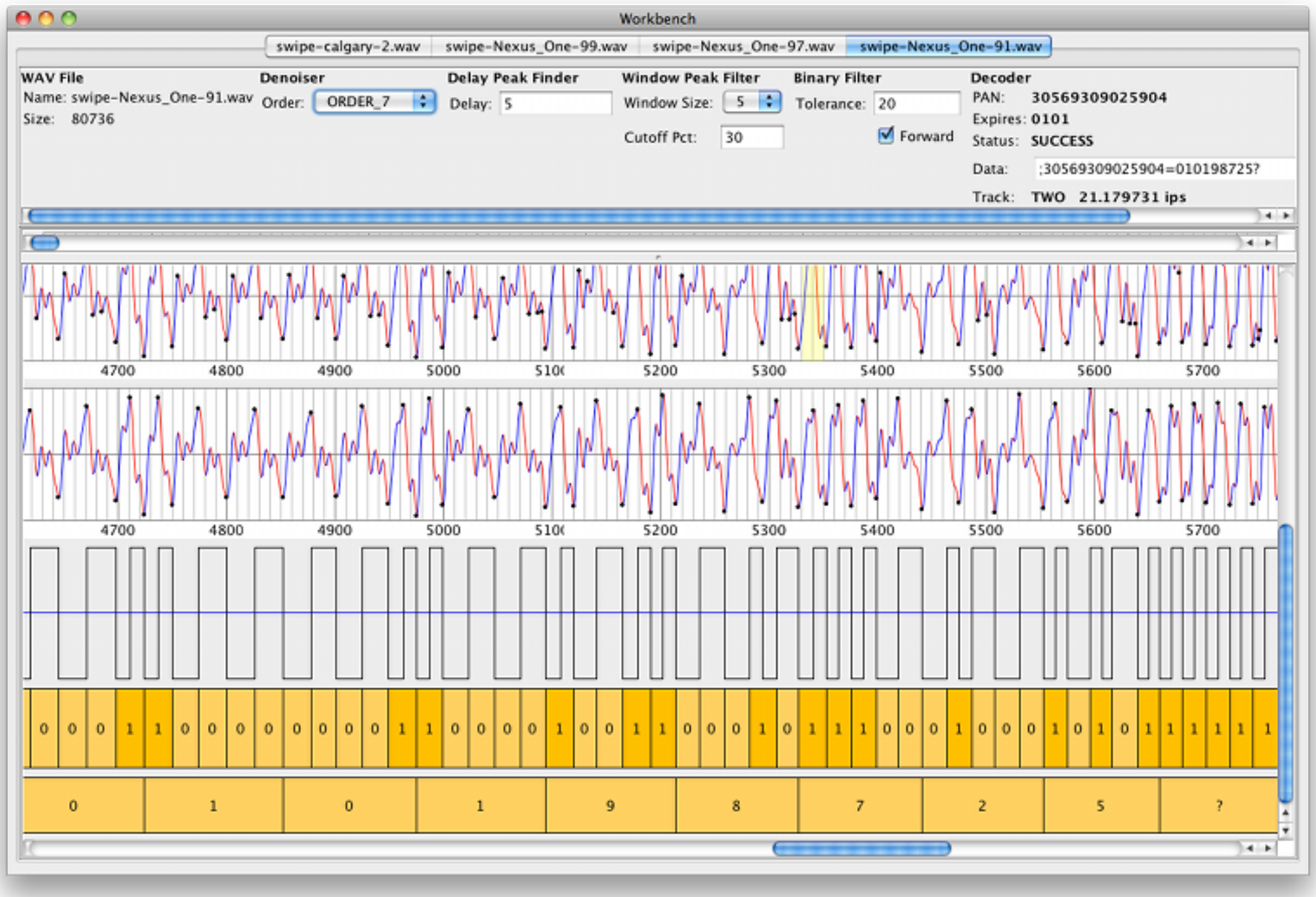
# Step 5: Consecutive Peak Removal



# Step 6: Decoding



# Workbench


Workbench
swipe-calgary-2.wav
swipe-Nexus_One-99.wav
swipe-Nexus_One-97.wav
swipe-Nexus_One-91.wav
WAV File
Name: swipe-Nexus_One-91.wav
Size: 80736
Denoiser
Order: ORDER_7
Delay Peak Finder
Delay: 5
Window Peak Filter
Window Size: 5
Cutoff Pct: 30
Binary Filter
Tolerance: 20
Forward
Decoder
PAN: 30569309025904
Expires: 0101
Status: SUCCESS
Data: ;30569309025904=010198725?
Track: TWO 21.179731 ips
4700 4800 4900 5000 5200 5300 5400 5500 5600 5700
0 1 0 1 9 8 7 2 5 ?

# 95% Accuracy

# 95% Accuracy

> Record hundreds of swipes

# 95% Accuracy

> Record hundreds of swipes

> Decode all, record results

# 95% Accuracy

> Record hundreds of swipes

> Decode all, record results

> Adjust parameters

# 95% Accuracy

> Record hundreds of swipes

> Decode all, record results

> Adjust parameters

> Repeat

# 95% Accuracy

> Record hundreds of swipes

> Decode all, record results

> Adjust parameters

> Repeat

> After finding best options...

# 95% Accuracy

> Record hundreds of swipes
> Decode all, record results
> Adjust parameters
> Repeat
> After finding best options...
> Repeat entire process on failed swipes

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# Retrofit

> Extends Android and Java

> Apache-licensed

> Module

- **`core`**
- **`io`**
- **`http`**
- **`android`**

> **`http://github.com/square/retrofit`**

# I/O

> Squarewave

> Retrofit

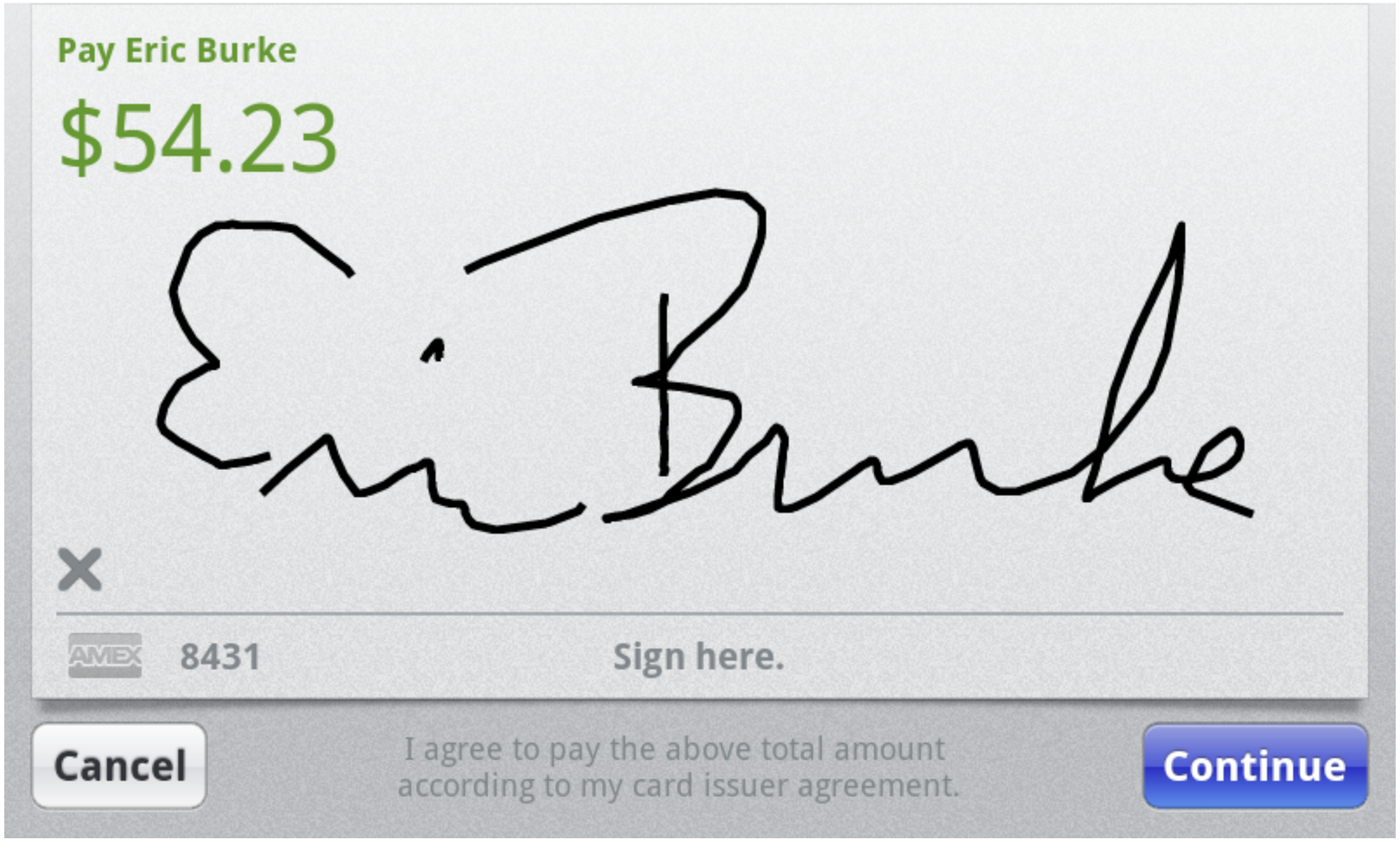
- I/O
- Shake detection
- REST

> Point-of-sale API

# QueueFile

# Shake Detection

# Shake to Clear Signature



# Using the Accelerometer

```
public class HelloAccelerometer extends Activity
    implements SensorEventListener {

  @Override protected void onResume() {
    super.onResume();

    SensorManager sensorMgr = (SensorManager) getSystemService(
        Context.SENSOR_SERVICE);
    Sensor accelerometer = sensorMgr.getDefaultSensor(
        Sensor.TYPE_ACCELEROMETER);

    sensorMgr.registerListener(this, accelerometer,
        SensorManager.SENSOR_DELAY_GAME);
}

public void onSensorChanged(SensorEvent event) {
  float ax = event.values[0];
  float ay = event.values[1];
  float az = event.values[2];
}
```

# Accelerometer Values

# Accelerometer Values

> x, y, and z acceleration

# Accelerometer Values

> x, y, and z acceleration

> Units are m/s^2

# Accelerometer Values

> x, y, and z acceleration

> Units are m/s^2

> Acceleration applied to device *minus force of gravity*

# Accelerometer Values

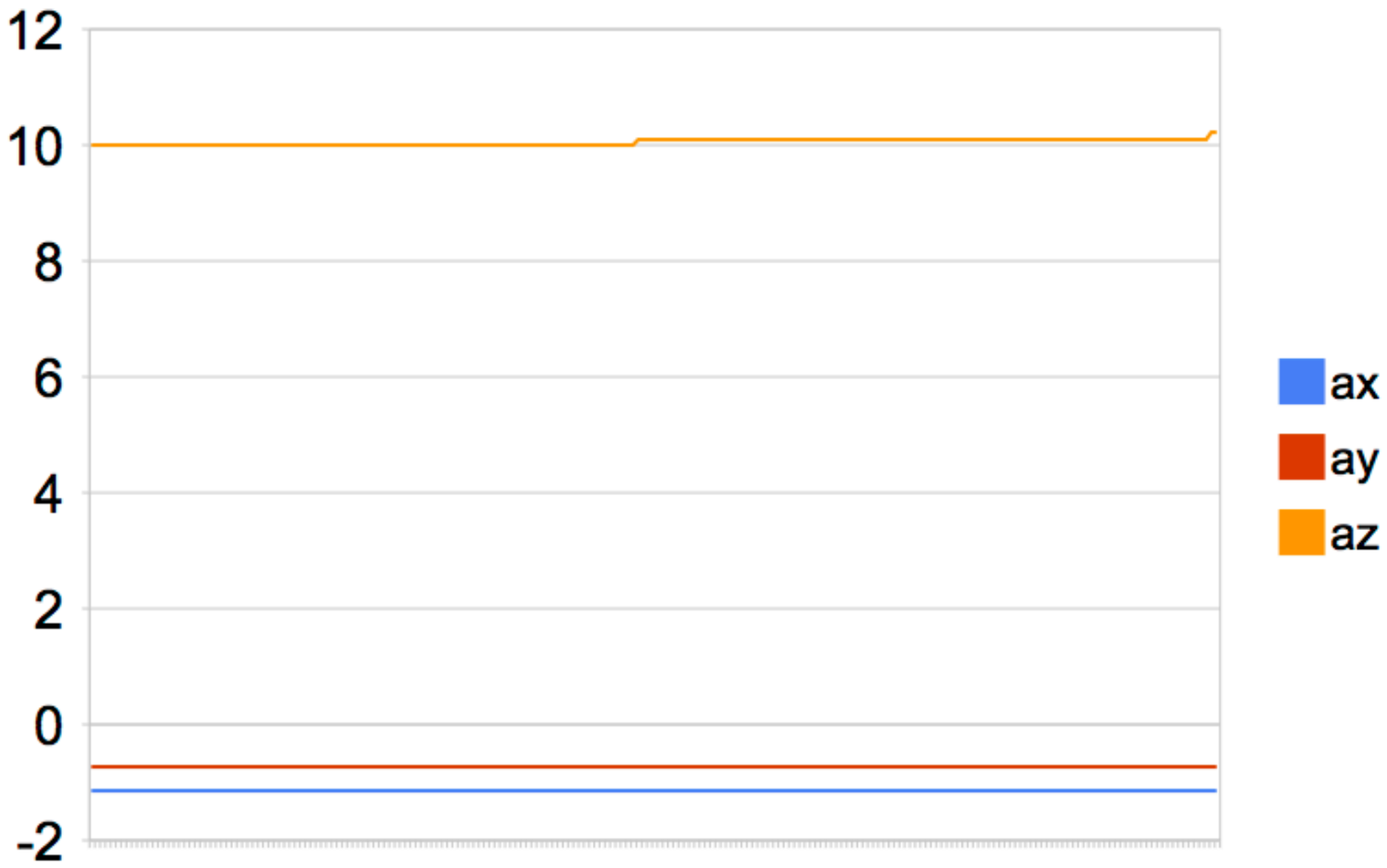
> x, y, and z acceleration

> Units are m/s^2

> Acceleration applied to device *minus force of gravity*

> When flat on a table, Z acceleration = +9.81 (0 - -9.81)

# Device at Rest



# Magnitude (Pythagorean)

```
public class Magnitude extends Activity
    implements SensorEventListener {

  public void onSensorChanged(SensorEvent event) {
    float ax = event.values[0];
    float ay = event.values[1];
    float az = event.values[2];

    double magnitude = Math.sqrt(ax * ax + ay * ay + az * az);
  }
}
```

# Magnitude Graph

# Threshold

# Data Rates Vary by Device

| | NORMAL | UI | GAME | FASTEST |
|---|---|---|---|---|
| Dell Streak | 47 | 47 | 47 | 47 |
| LG Ally | 5 | 5 | 5 | 5 |
| Motorola Backflip | 89 | 89 | 89 | 89 |
| Samsung Epic 4G | 5 | 10 | 19 | 91 |
| HTC Desire | 43 | 43 | 43 | 43 |

# Solution: Variable Size Window

> Did the magnitude exceed the threshold?

> Store true/false readings in a queue

> Queue holds readings from last 500ms

> When 75% of readings are true, shake

# ShakeDetector

```
public class ShakeDetector {
  public ShakeDetector(Listener listener) {
    ...
  }

  public void start(SensorManager sensorMgr) {
    ...
  }

  public void stop() {
    ...
  }

  /** Listens for shakes. */
  public interface Listener {
    /** Called on the main thread when the device is shaken. */
    void hearShake();
  }
}
```

# Using ShakeDetector

```
public class ShakeDemo extends Activity implements
ShakeDetector.Listener {

  private ShakeDetector shakeDetector = new ShakeDetector(this);

  @Override protected void onResume() {
    super.onResume();
    SensorManager sensorMgr = (SensorManager) getSystemService(
        Context.SENSOR_SERVICE);
    shakeDetector.start(sensorMgr);
}

@Override protected void onPause() {
  shakeDetector.stop();
}

public void hearShake() {
  // The phone was shaking...
}
```