



Android²

Bob Lee & Eric Burke
Square, Inc.

Square





Overview

> Squarewave

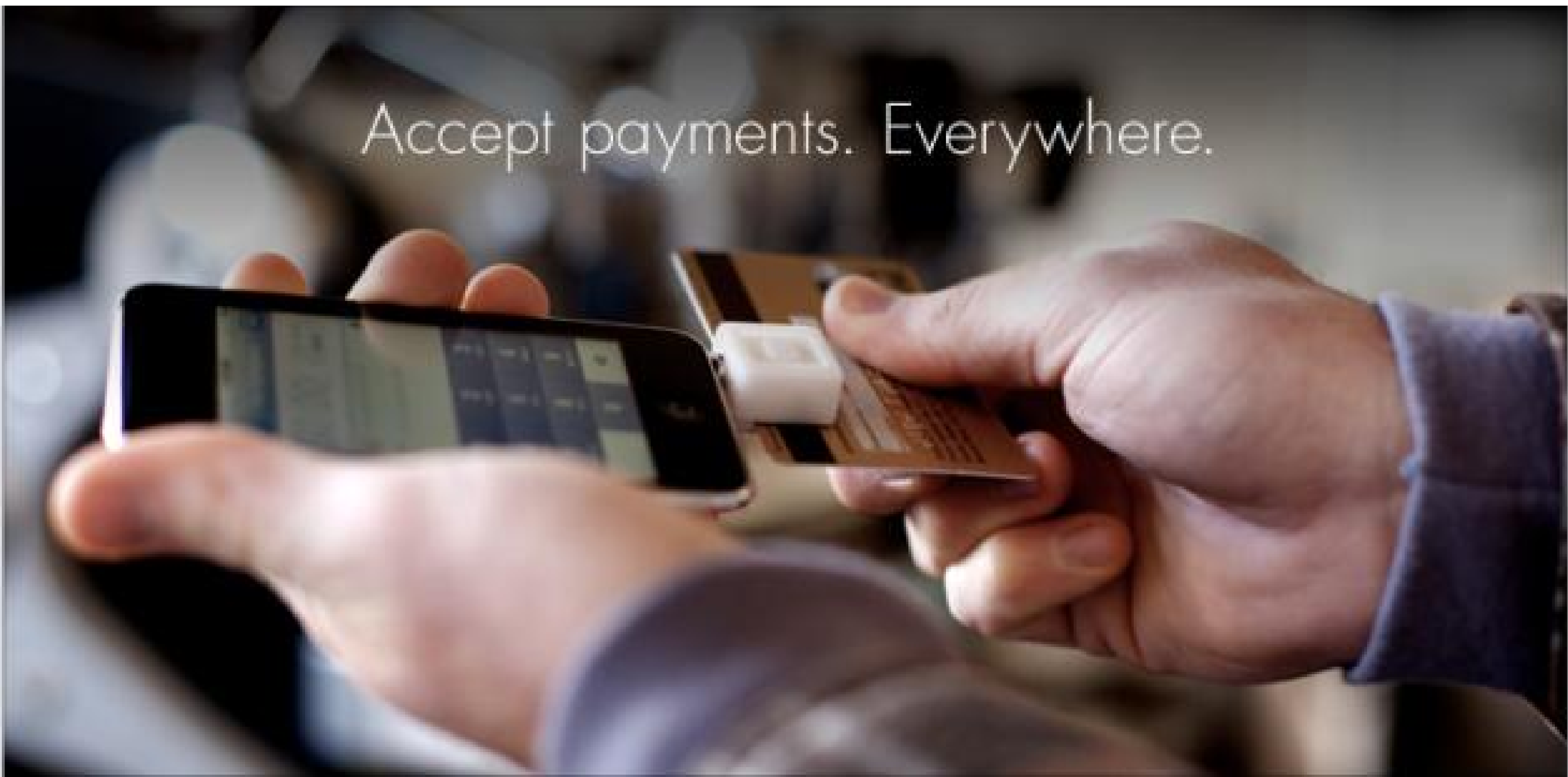
> Retrofit

- I/O
- Shake detection
- REST

> Point-of-sale API

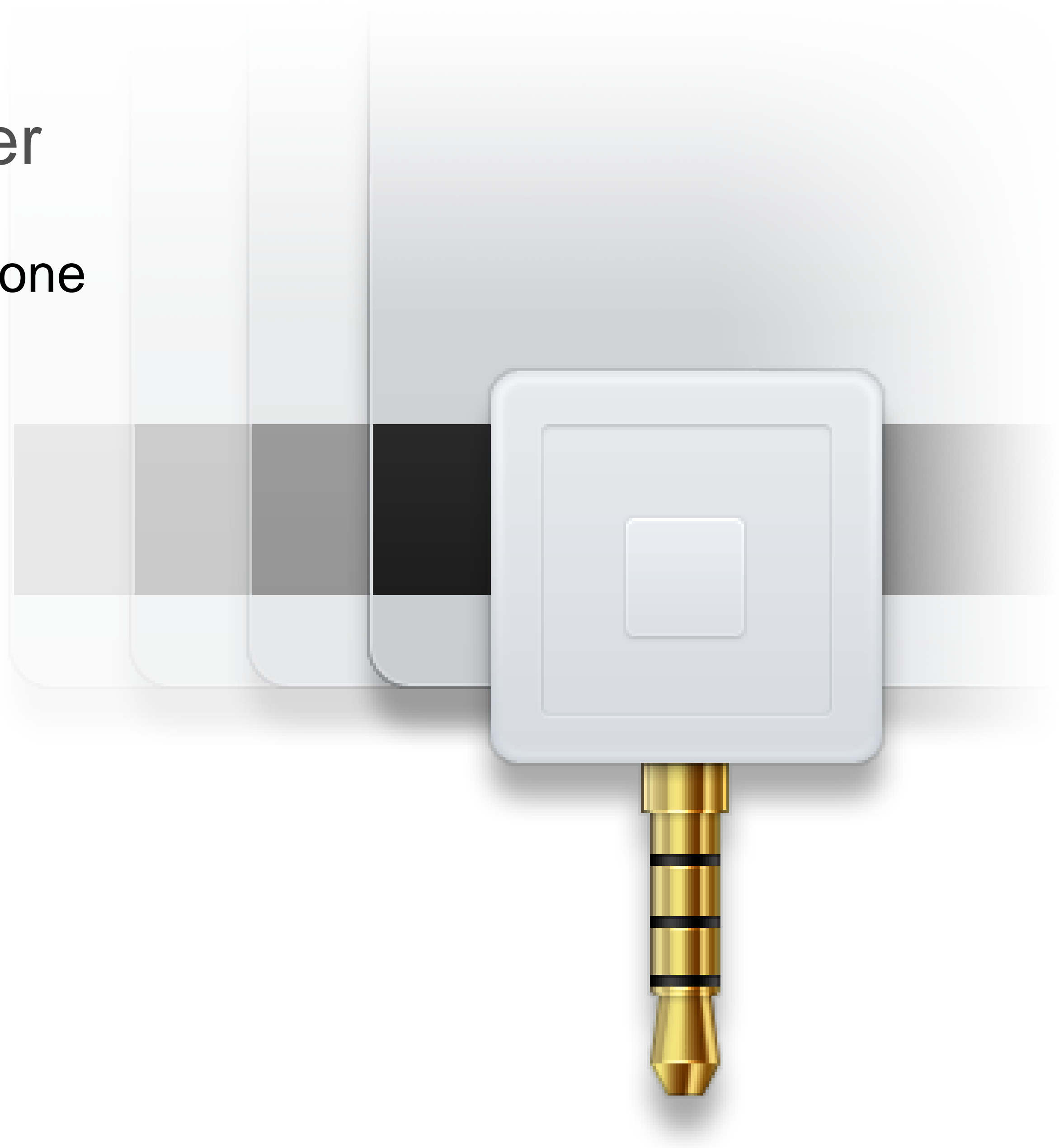
Squarewave: Magnetic Stripe Decoder

Accept payments. Everywhere.

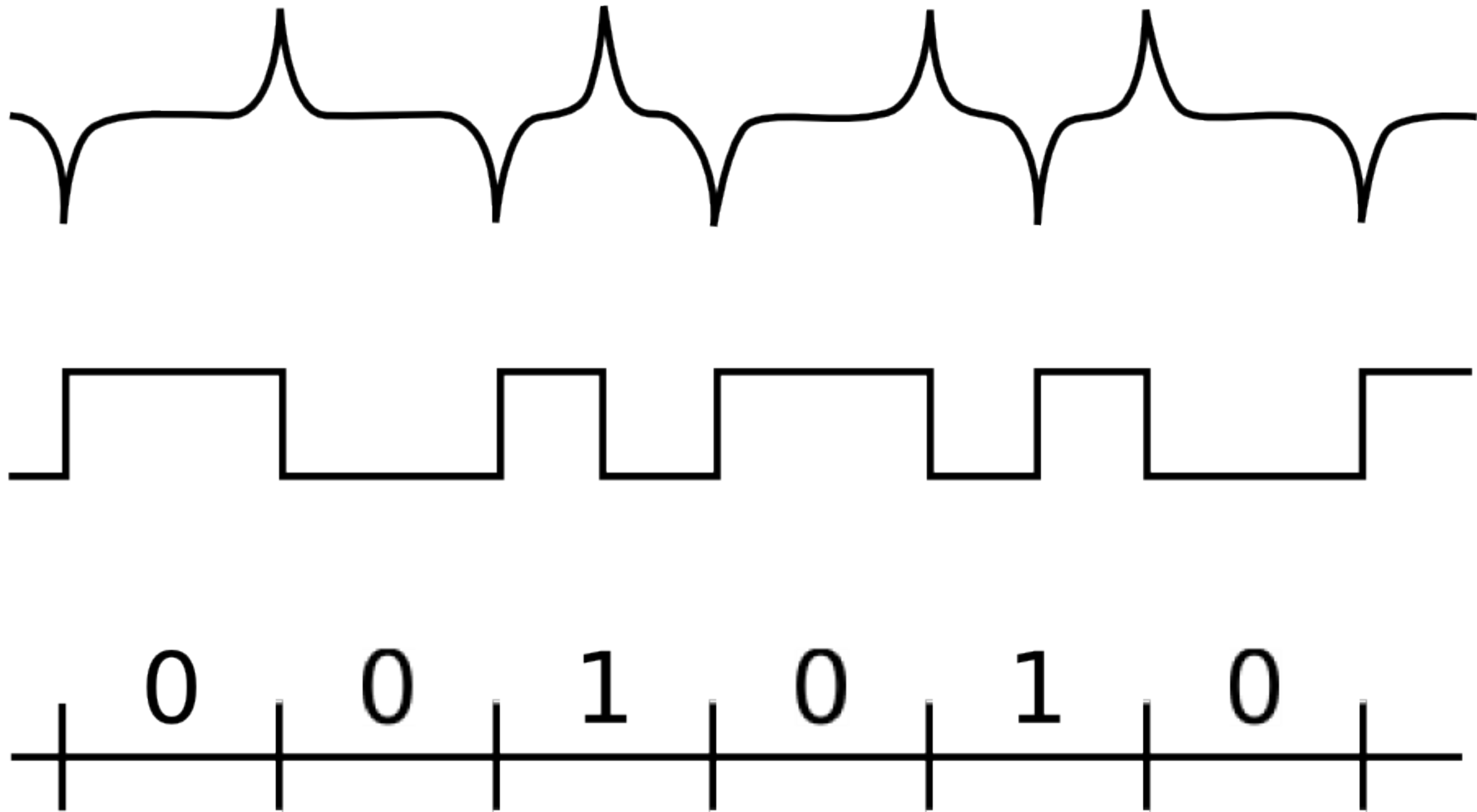


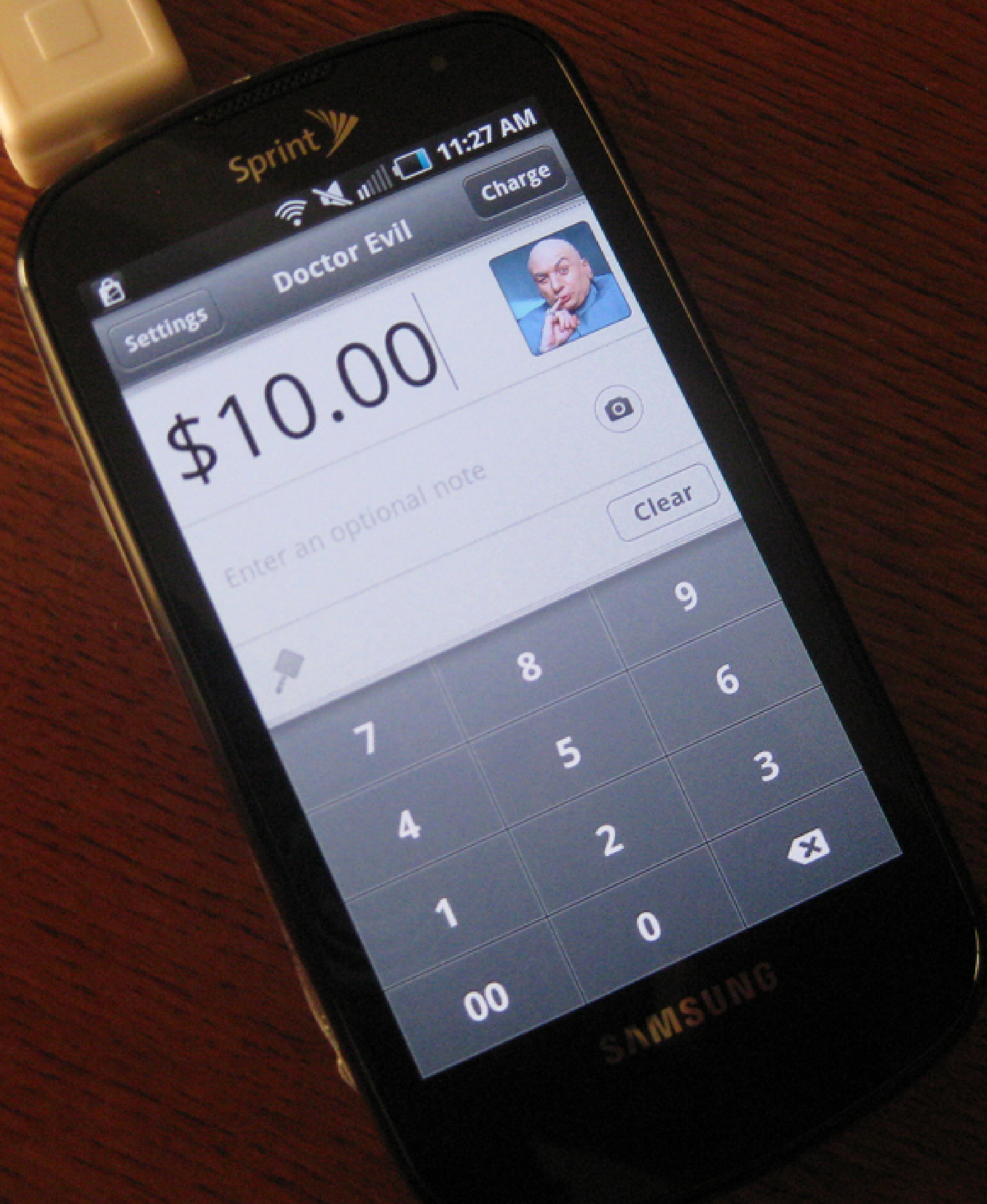
Square Reader

Acts as a microphone

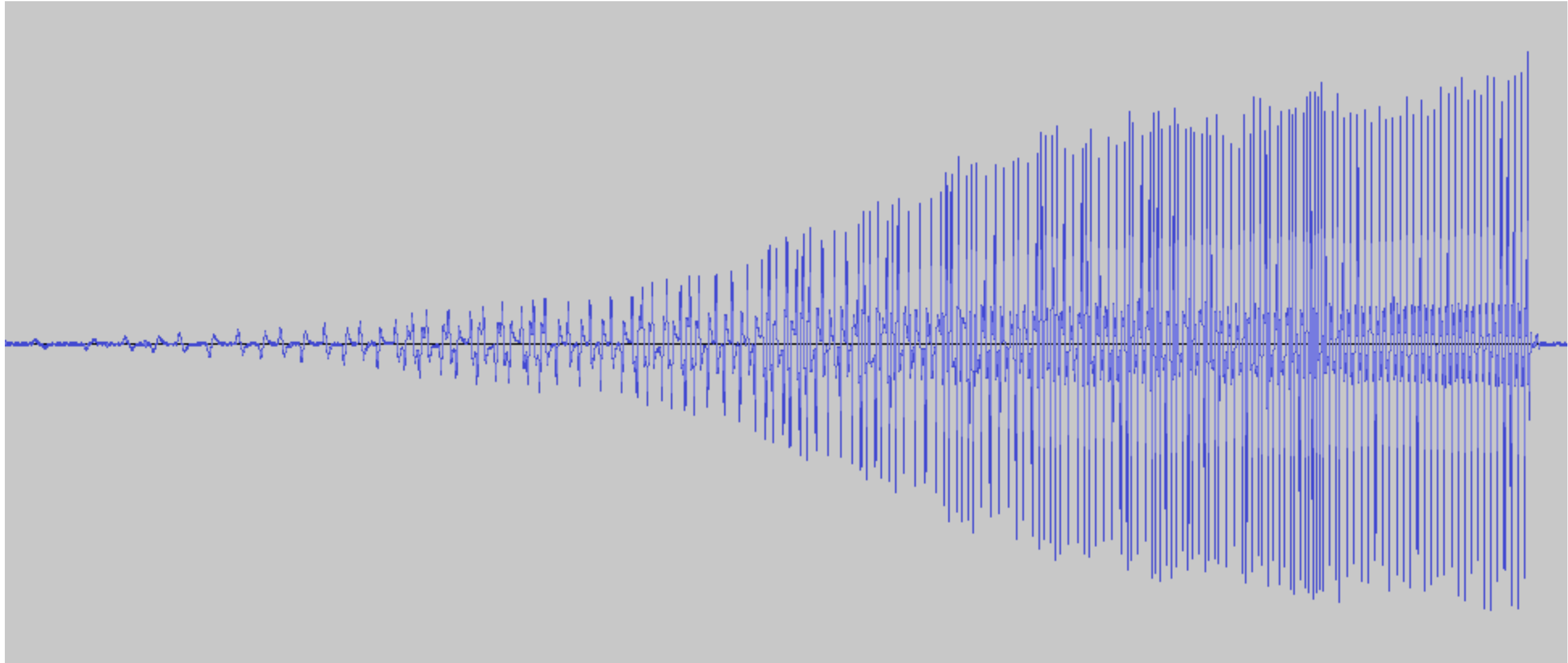


Ideal Waveform

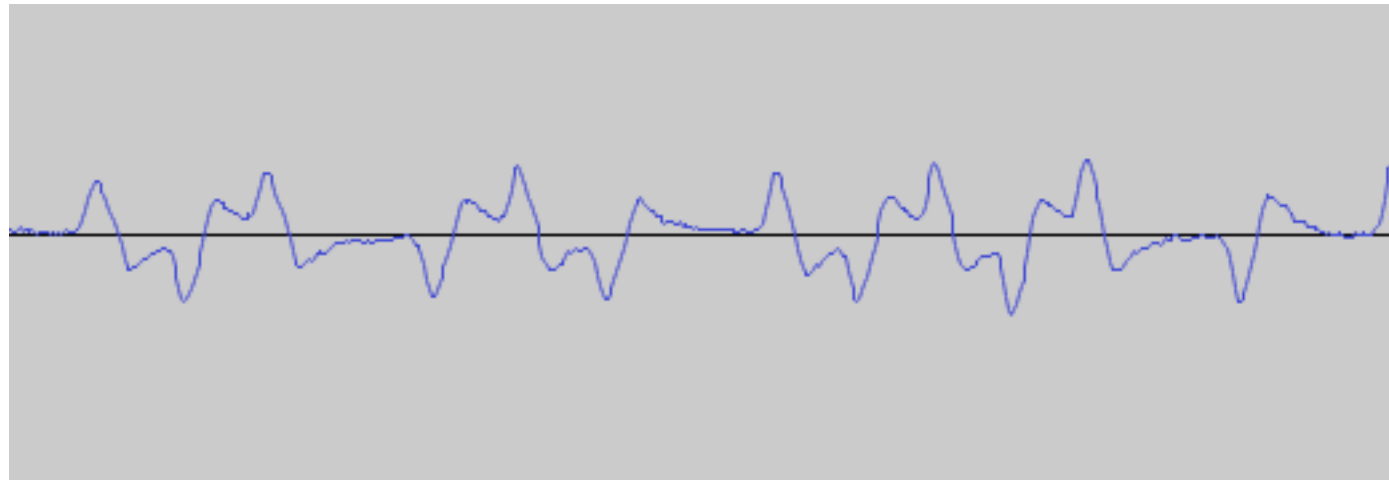




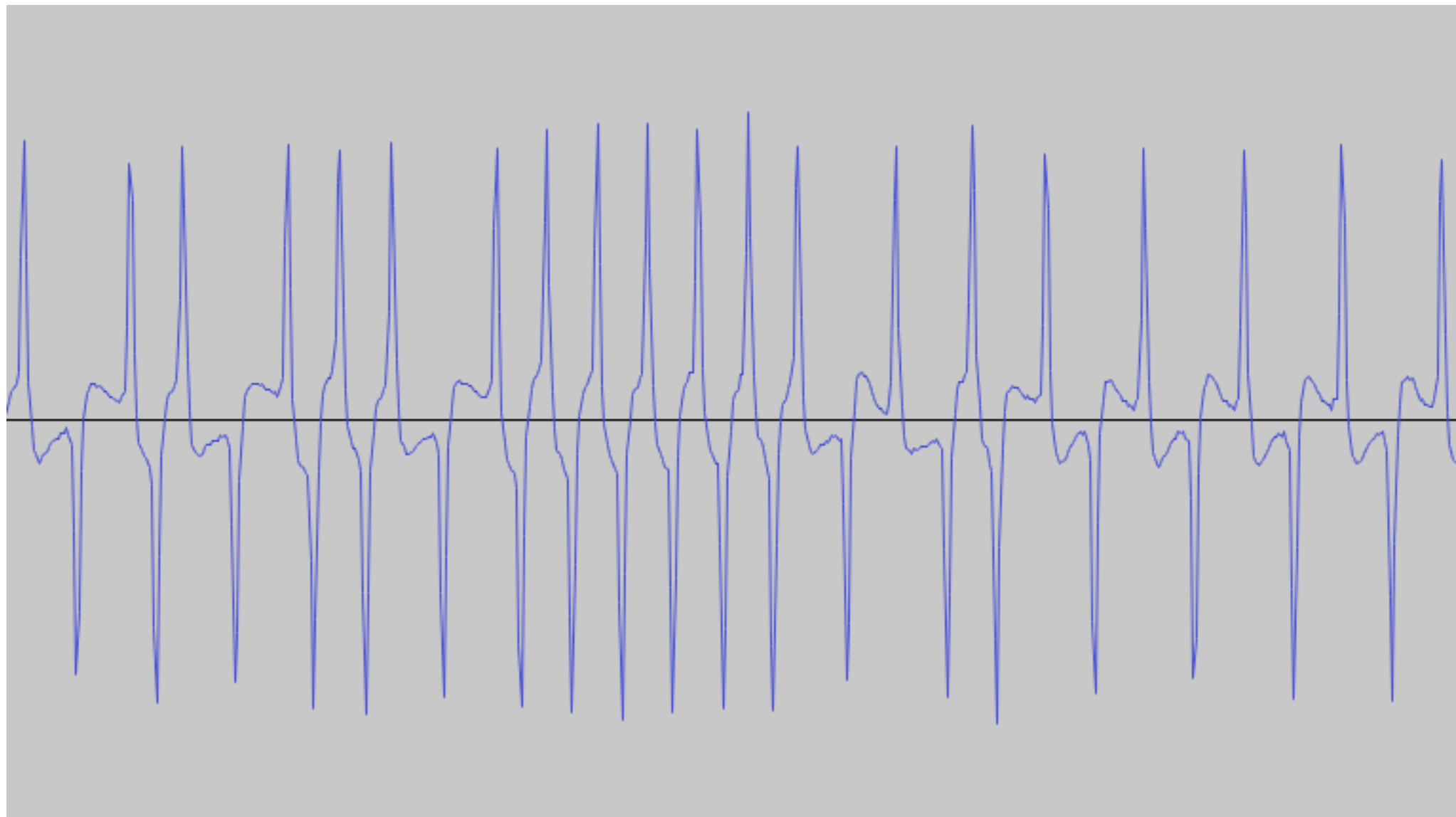
Actual Swipe Recording



Swipe Start



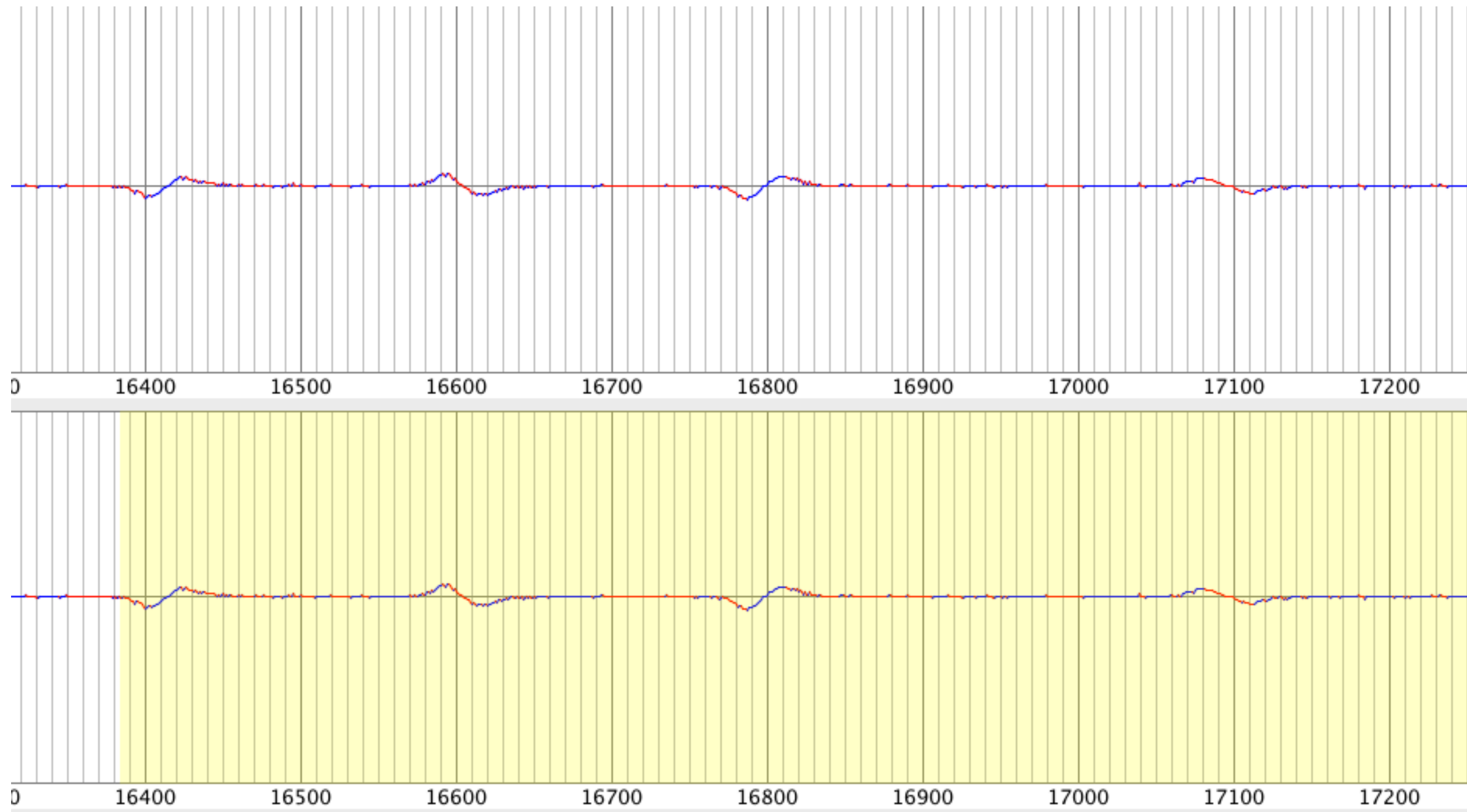
Swipe End



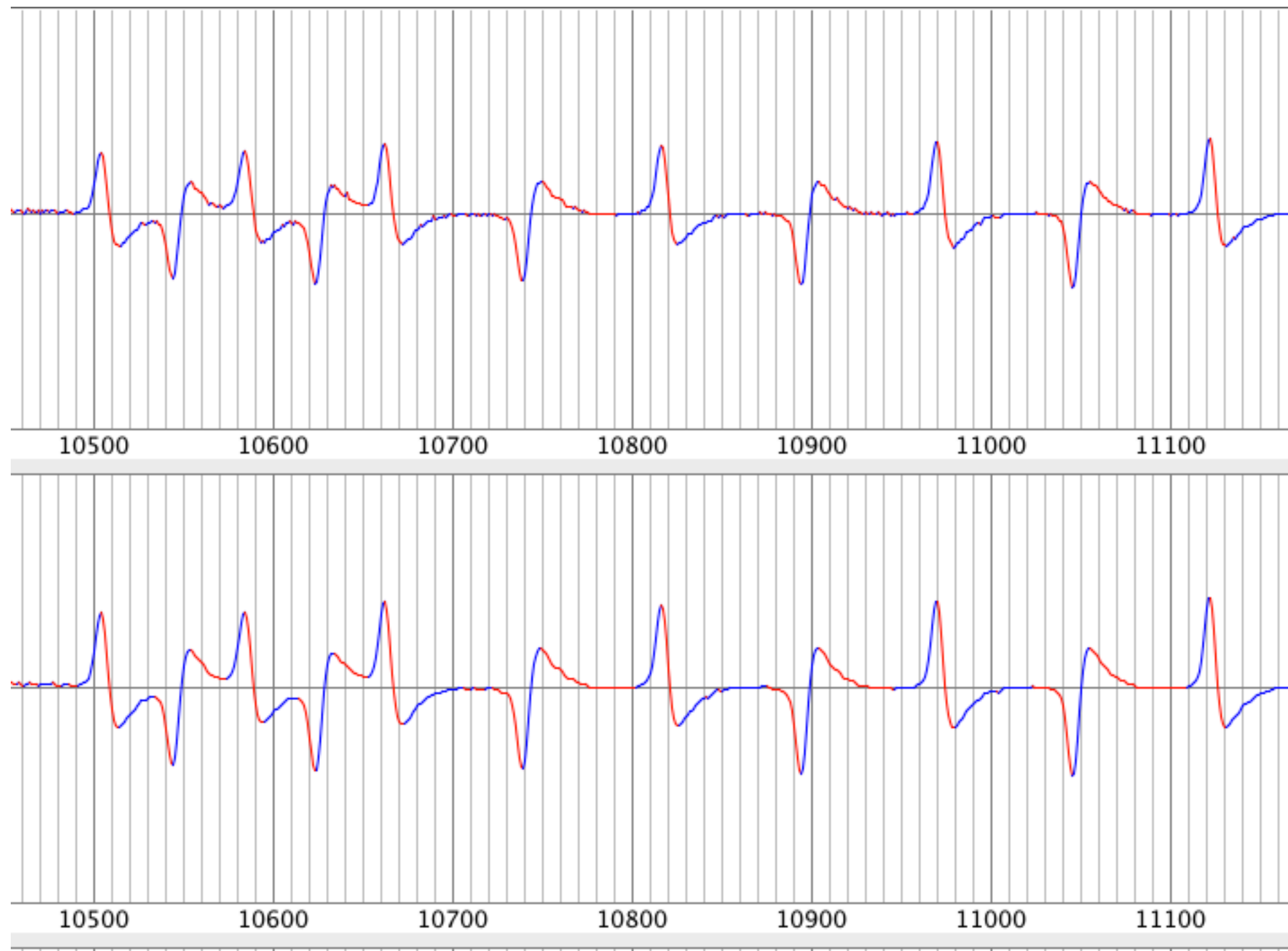
Challenges

- > Swipe speed
- > Device sample rate
- > Audio correction

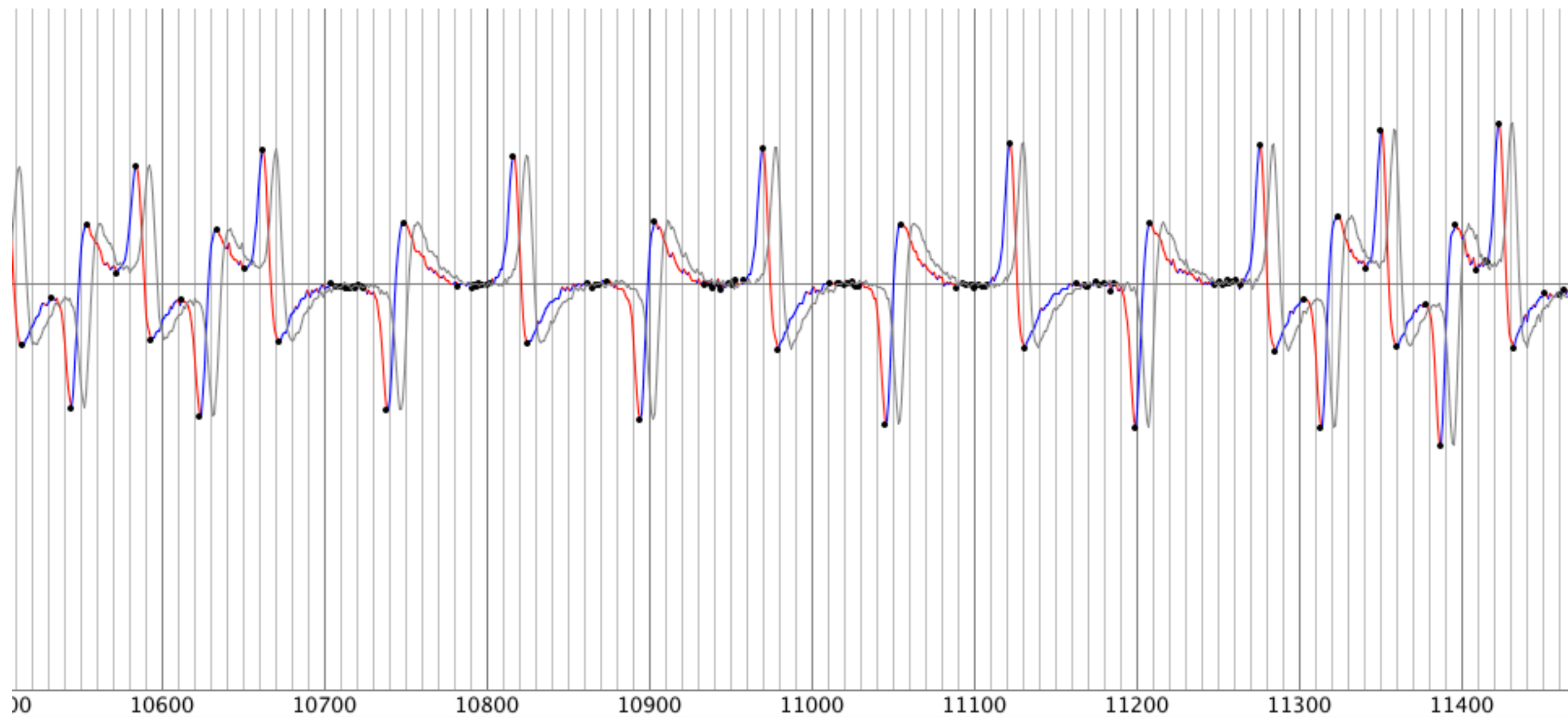
Step 1: Swipe Detection



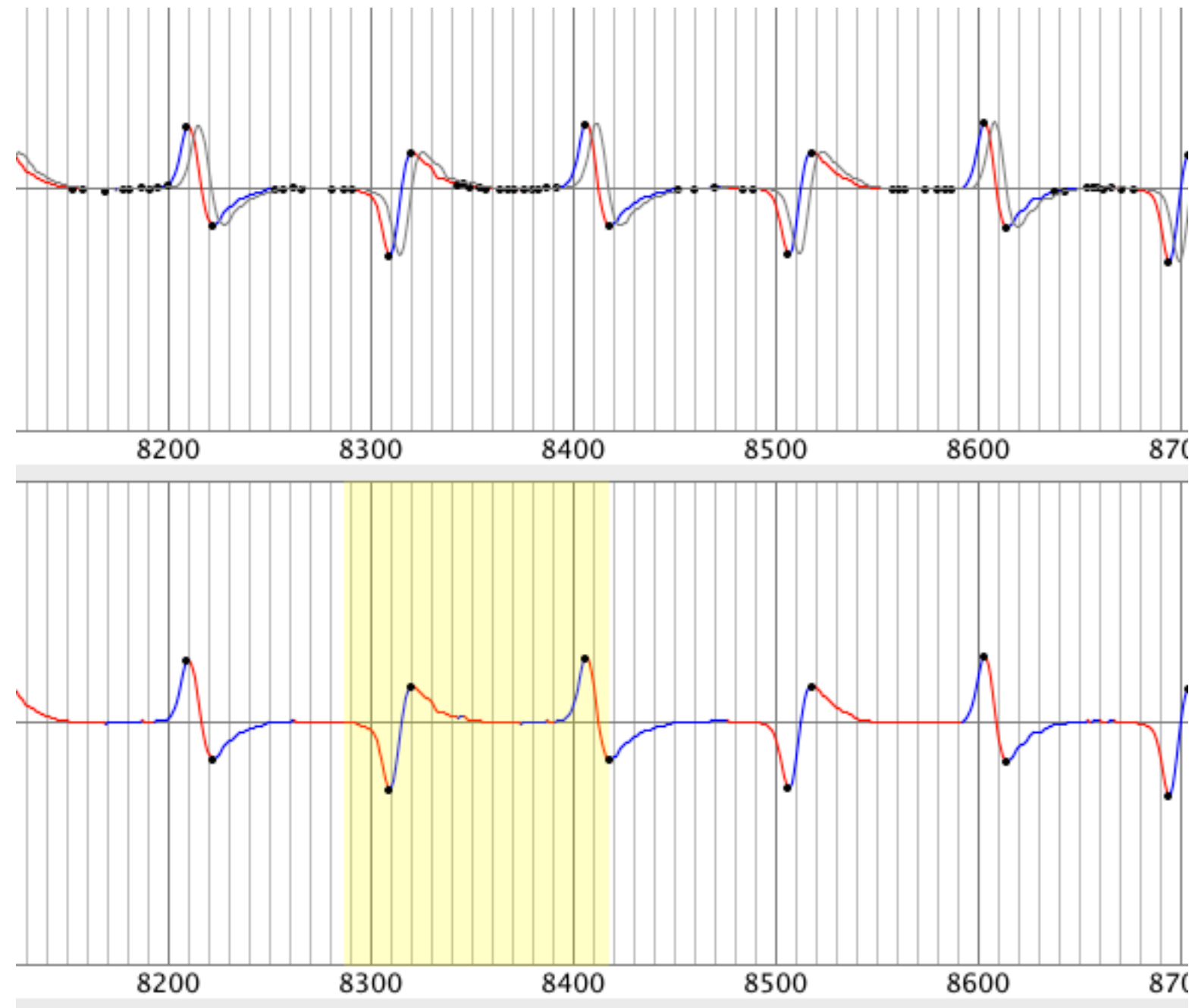
Step 2: Denoising



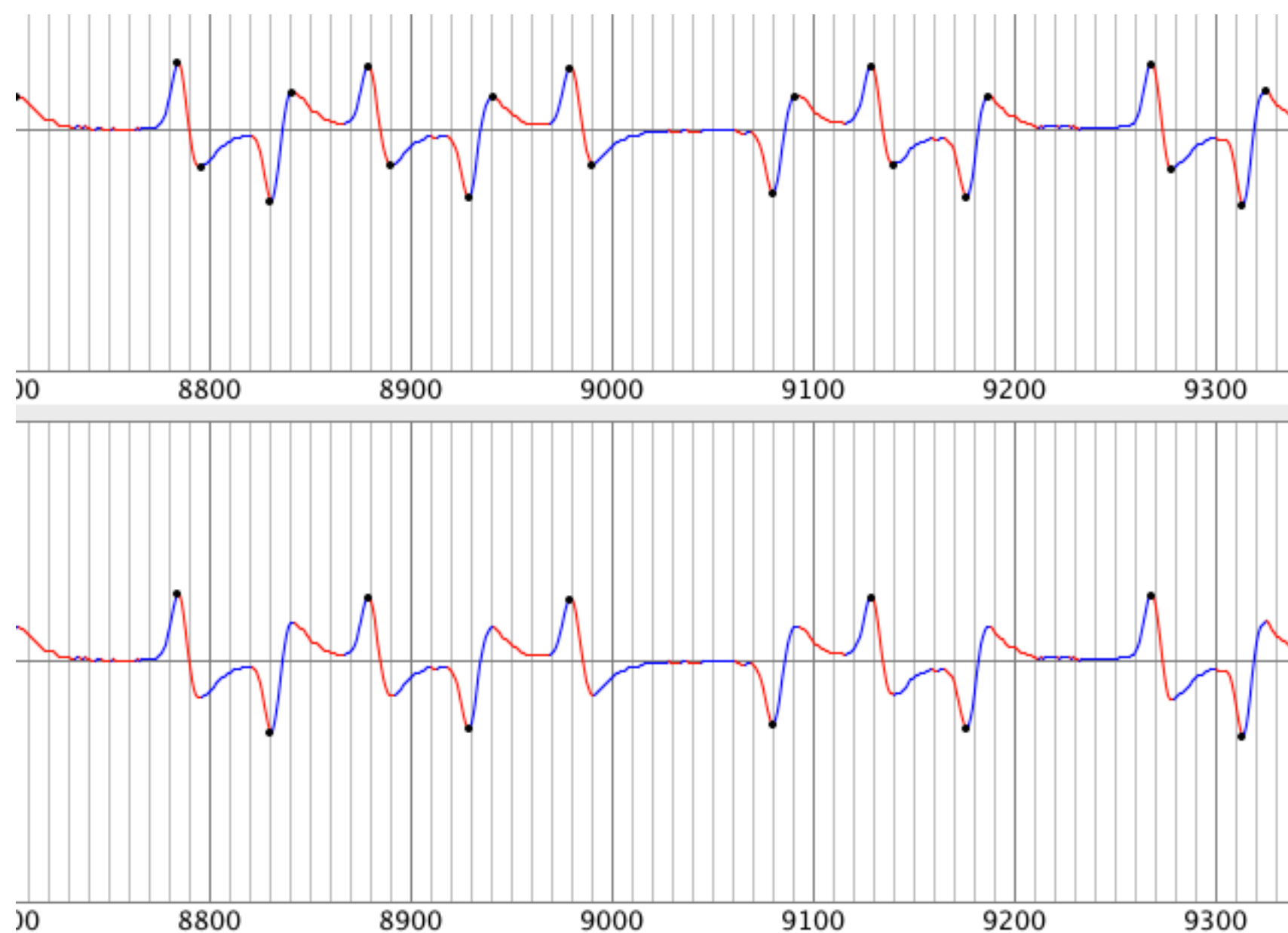
Step 3: Peak Detection



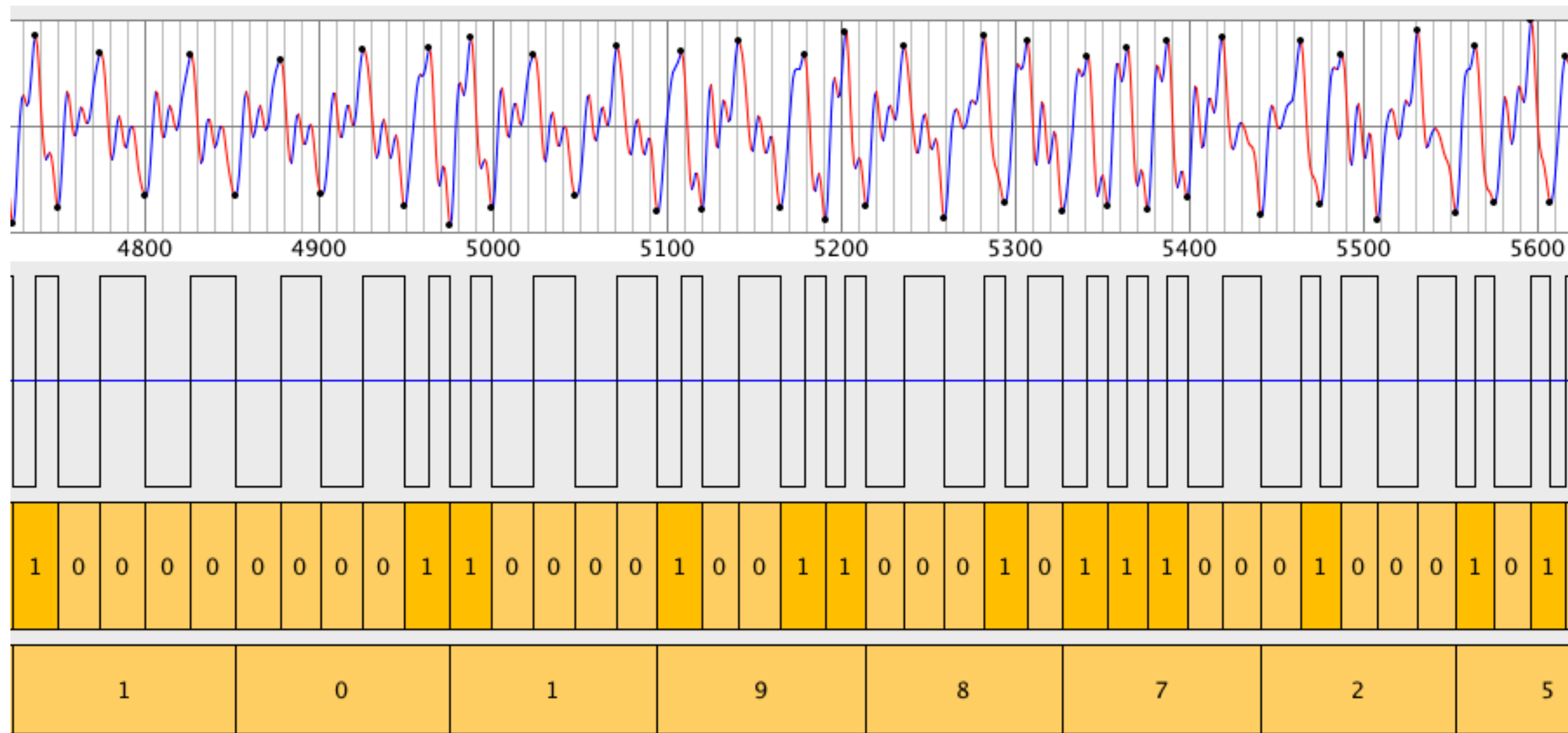
Step 4: Window Peak Removal



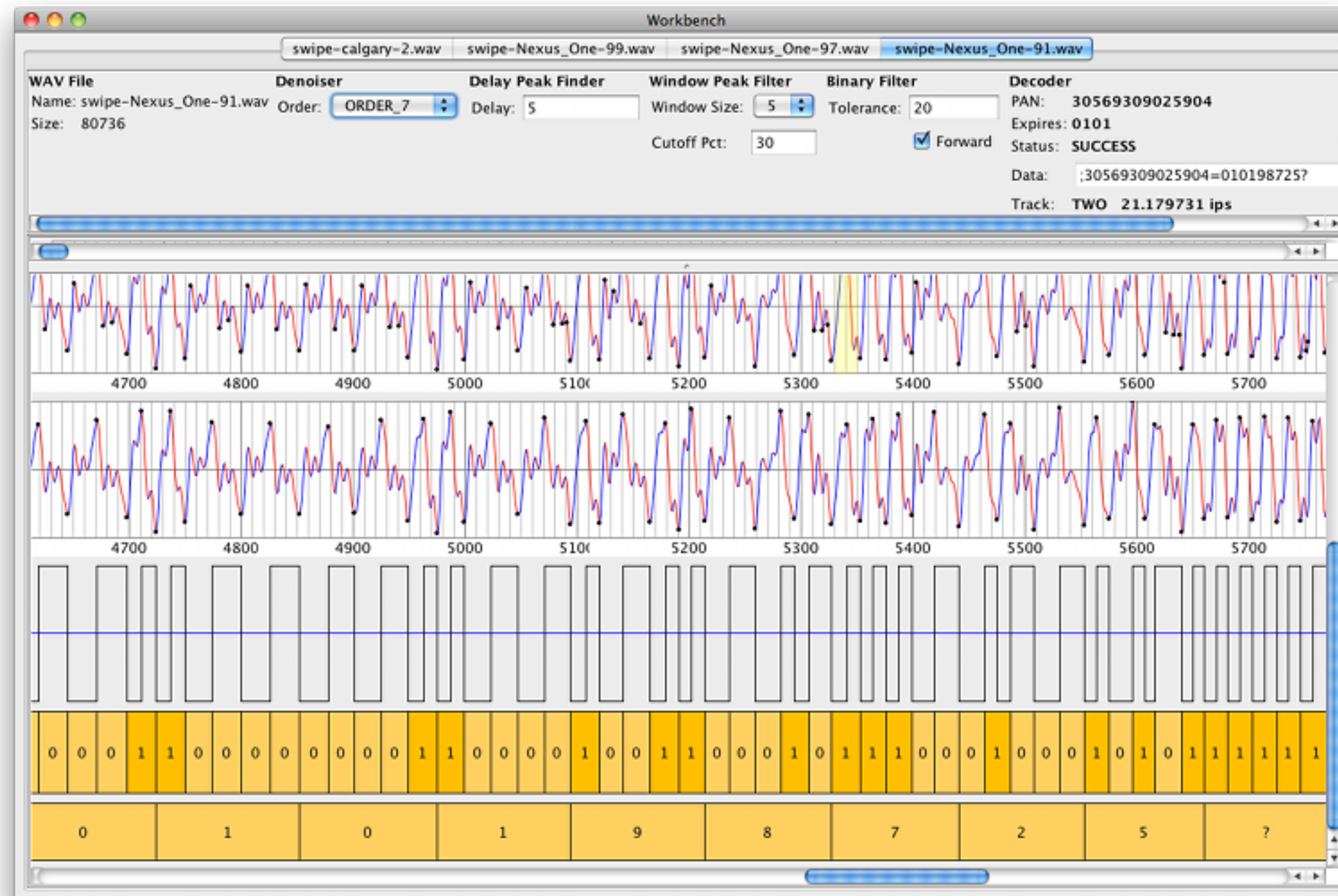
Step 5: Consecutive Peak Removal



Step 6: Decoding



Workbench



95% Accuracy

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



[adultswim.com]

Retrofit

> Extends Android and Java

> Apache-licensed

> Modules

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

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

Square for Android Persistence

- > Queues
- > Key-value pairs
- > No SQL

Persistent Queue

> Sending data to a server

- Emails (Receipts)
- Image uploads
- Payments
- Analytics
- Crash dumps

> Histories

Traditional Approaches

> SQLite

- Operations are $O(\log(n))$
- Rollback journal requires multiple operations
- Write ahead log has other tradeoffs
- **xDeviceCharacteristics**

> File-per-element

- 4k/entry minimum
- Several I/O operations

QueueFile

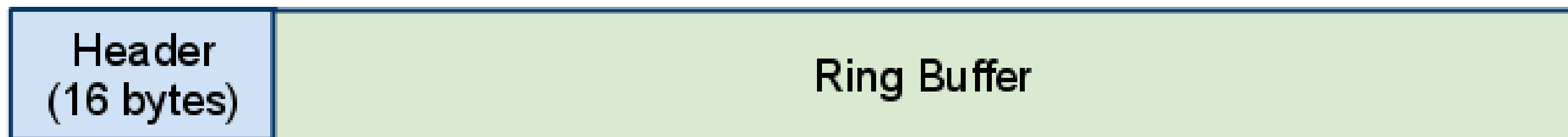
- > All operations are $O(1)$
- > Writes sync
- > Writes are atomic

```
public class QueueFile {  
    public QueueFile(File file) throws IOException { ... }  
  
    public void add(byte[] data) throws IOException { ... }  
    public void add(byte[] data, int offset, int count)  
        throws IOException { ... }  
  
    public byte[] peek() throws IOException { ... }  
    public void remove() throws IOException { ... }  
  
    public int size() { ... }  
    public void clear() throws IOException { ... }  
    public void close() throws IOException { ... }  
}
```

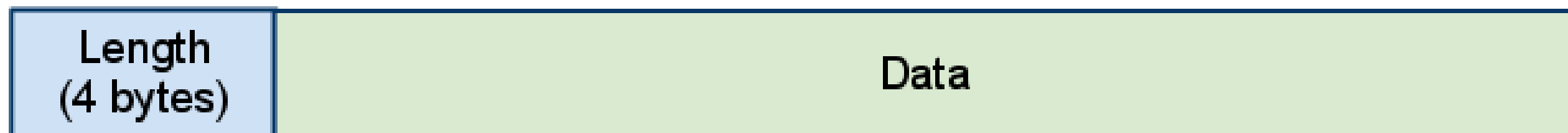
The Implementation

- > Depends somewhat on YAFFS
 - Yet Another Flash File System
 - Android's preeminent file system
 - Supports atomic sector writes
- > Writing the header commits a change

File



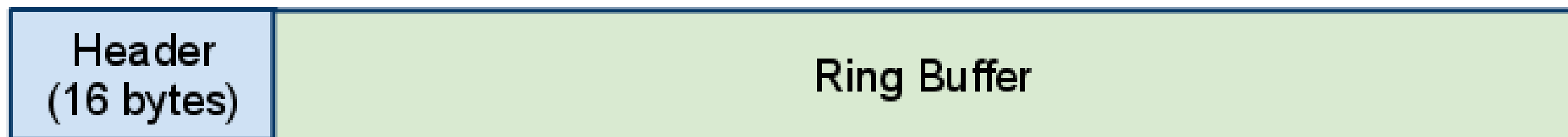
Element



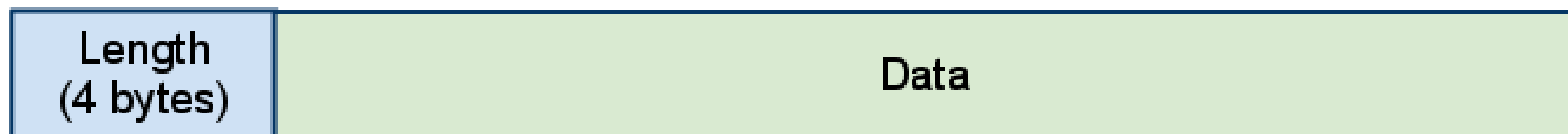
QueueFile.add()

- > Write element data
- > Write header (16 bytes < 4k)
- > Update in-memory state

File



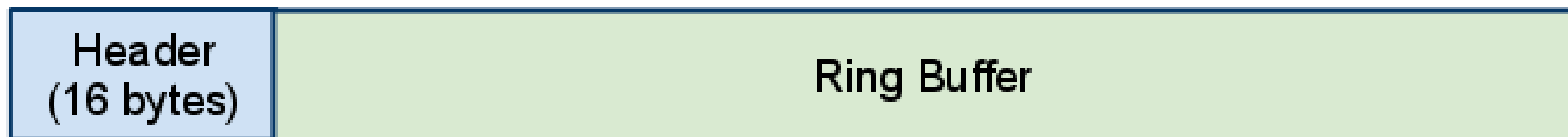
Element



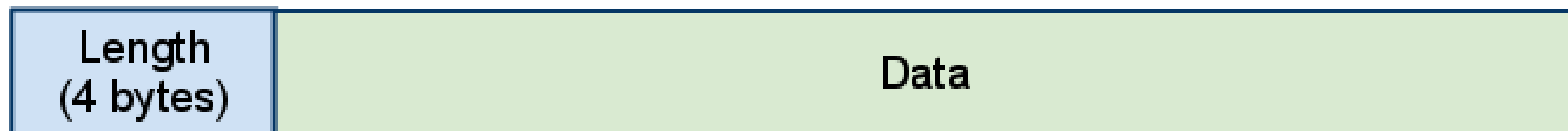
QueueFile.remove()

- > Write header
- > Update in-memory state

File



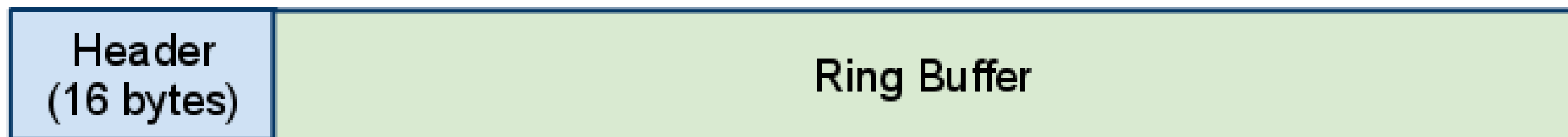
Element



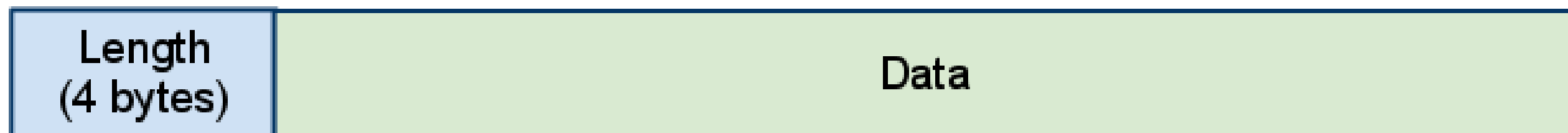
Buffer expansion

- > `file.setLength(oldLength << 1)`
- > Make ring buffer contiguous
- > Write header (including file length)
- > Update in-memory state

File



Element




Future Features

- > Support file systems without atomic segment writes
 - Rollback journal
- > Batch writes
 - Optimistic batching
 - > 3 orders of magnitude throughput




Shake to Clear Signature

Pay Eric Burke
\$54.23



X

 8431 Sign here.

Cancel I agree to pay the above total amount according to my card issuer agreement. **Continue**

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);

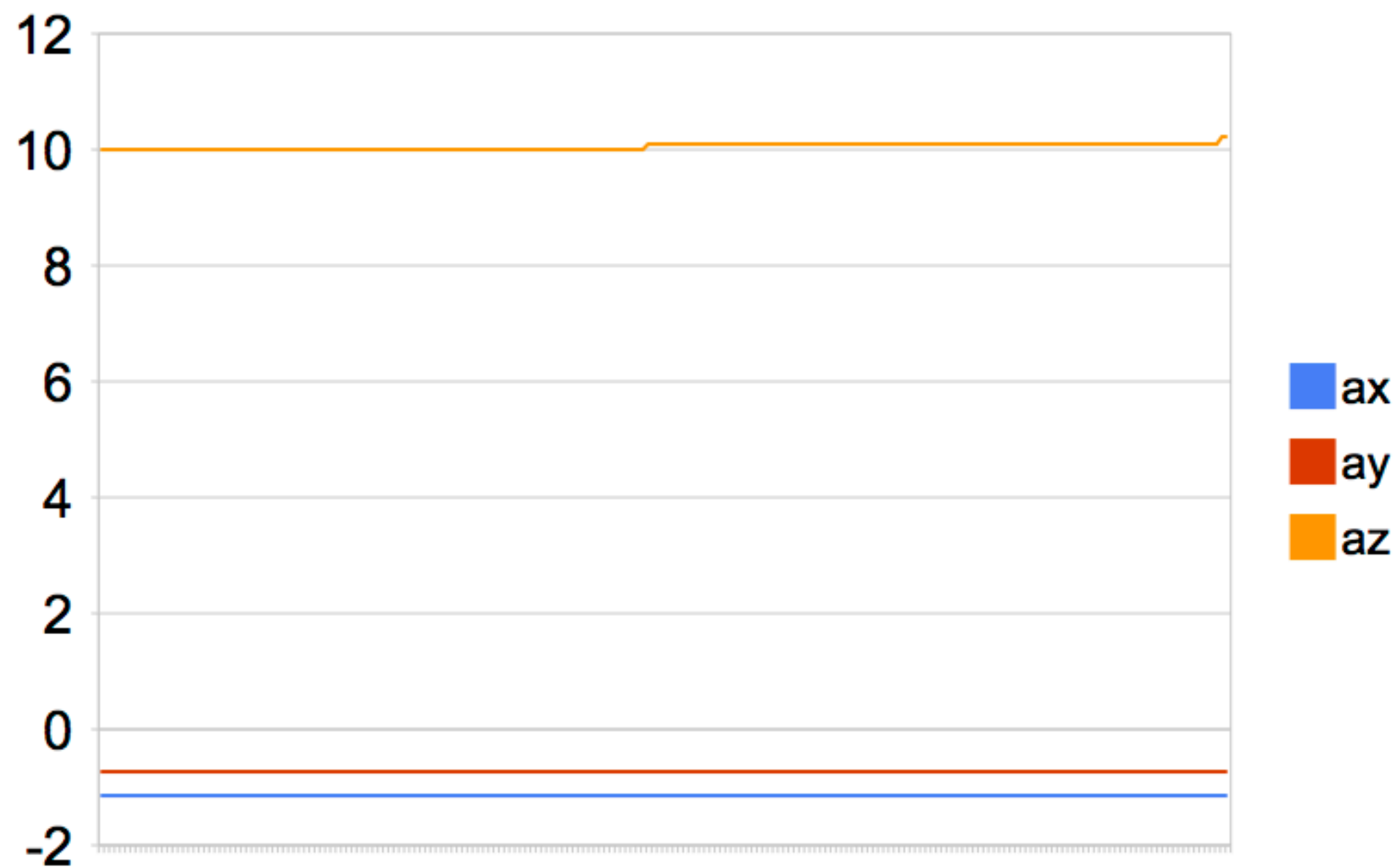
        sensorMgr.registerListener(this, accelerometer,
            SensorManager.SENSOR_DELAY_GAME);
    }

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

Accelerometer Values

- > x, y, and z acceleration
- > Units are m/s^2
- > Acceleration applied to device *minus force of gravity*
- > When flat on a table, Z accel = +9.81 (0 - -9.81)

Device at Rest



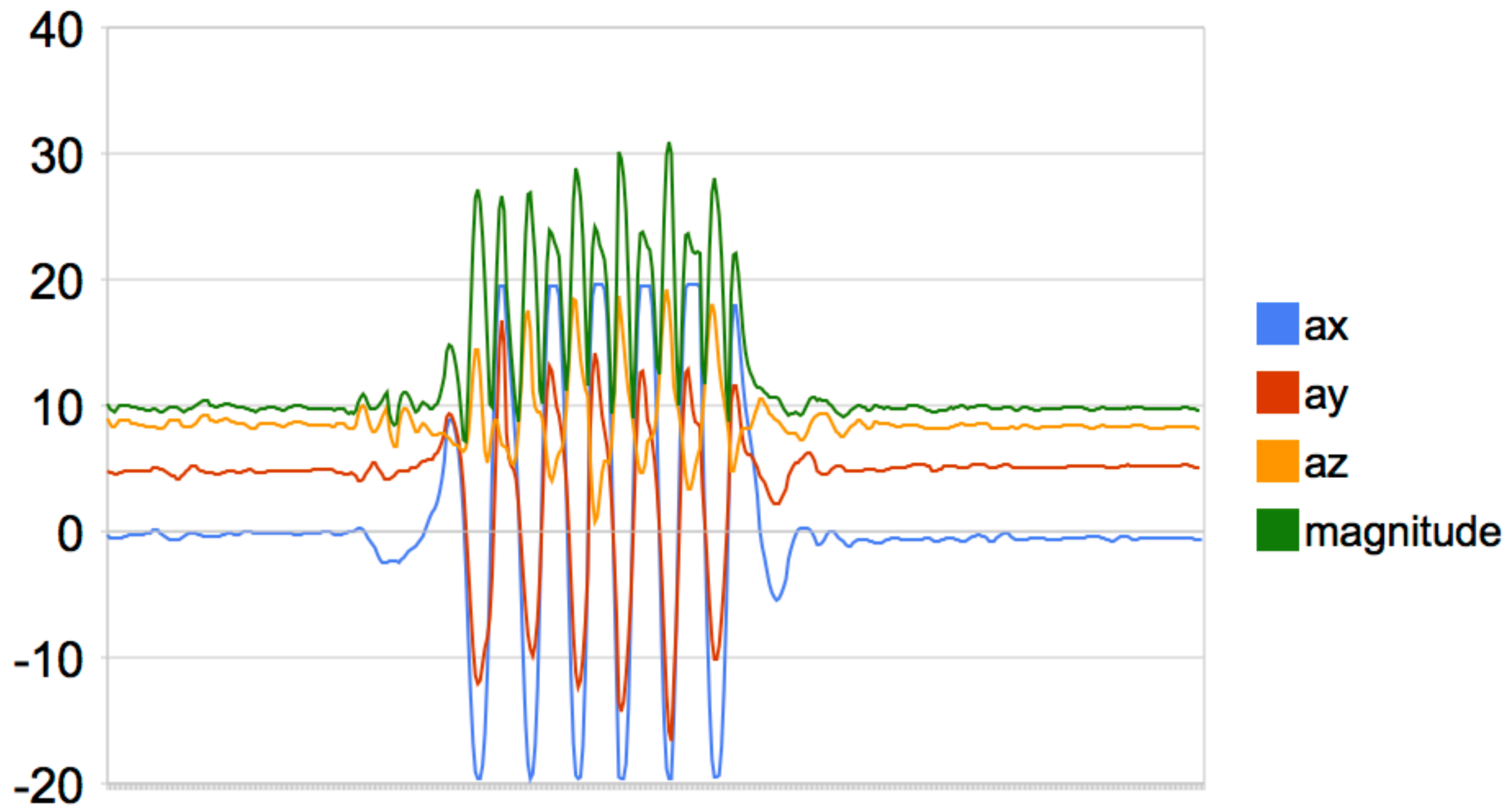
Magnitude (Pythagorean)

```
public class Magnitude extends Activity
    implements SensorEventListener {

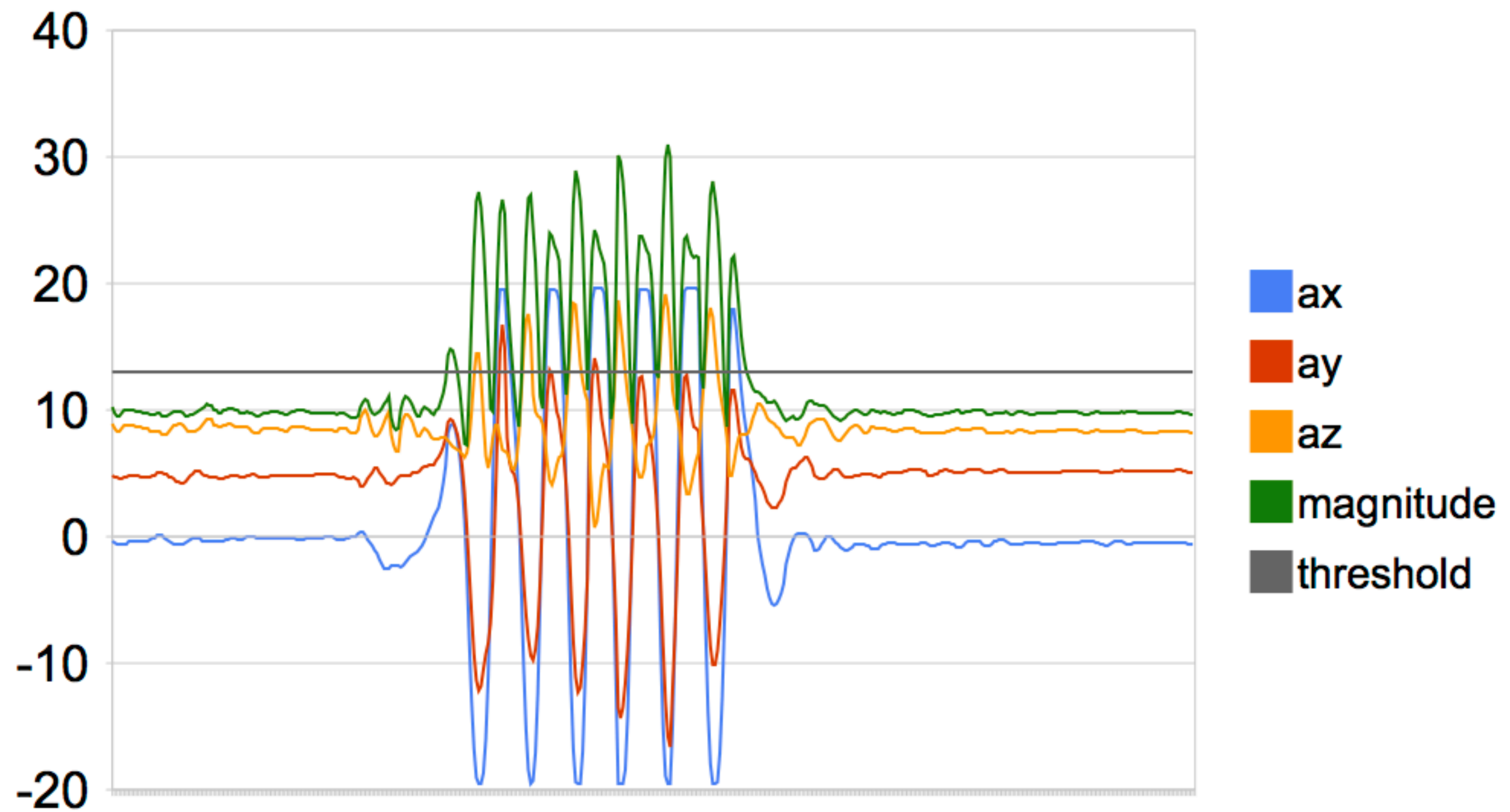
    public void onSensorChanged(SensorEvent event) {
        float ax = event.values[0];
        float ay = event.values[1];
        float az = event.values[2];

        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...
    }
}
```



RestAdapter

- > Makes RESTful clients a breeze
- > Currently supports JSON responses
- > All user code runs in main thread

Example

```
public interface AccountService {  
    @Path("login")  
    void login(  
        @Named("email") String email,  
        @Named("password") String password,  
        Callback<LoginResponse> callback);  
}
```

ServerCall

- > UI handler for server calls
- > Handles all dialogs
 - Progress
 - Operation failed
 - Network unavailable
 - Server unavailable
 - Unexpected error
- > Supports retries

Examples

> Login

> Signup

> Authorization

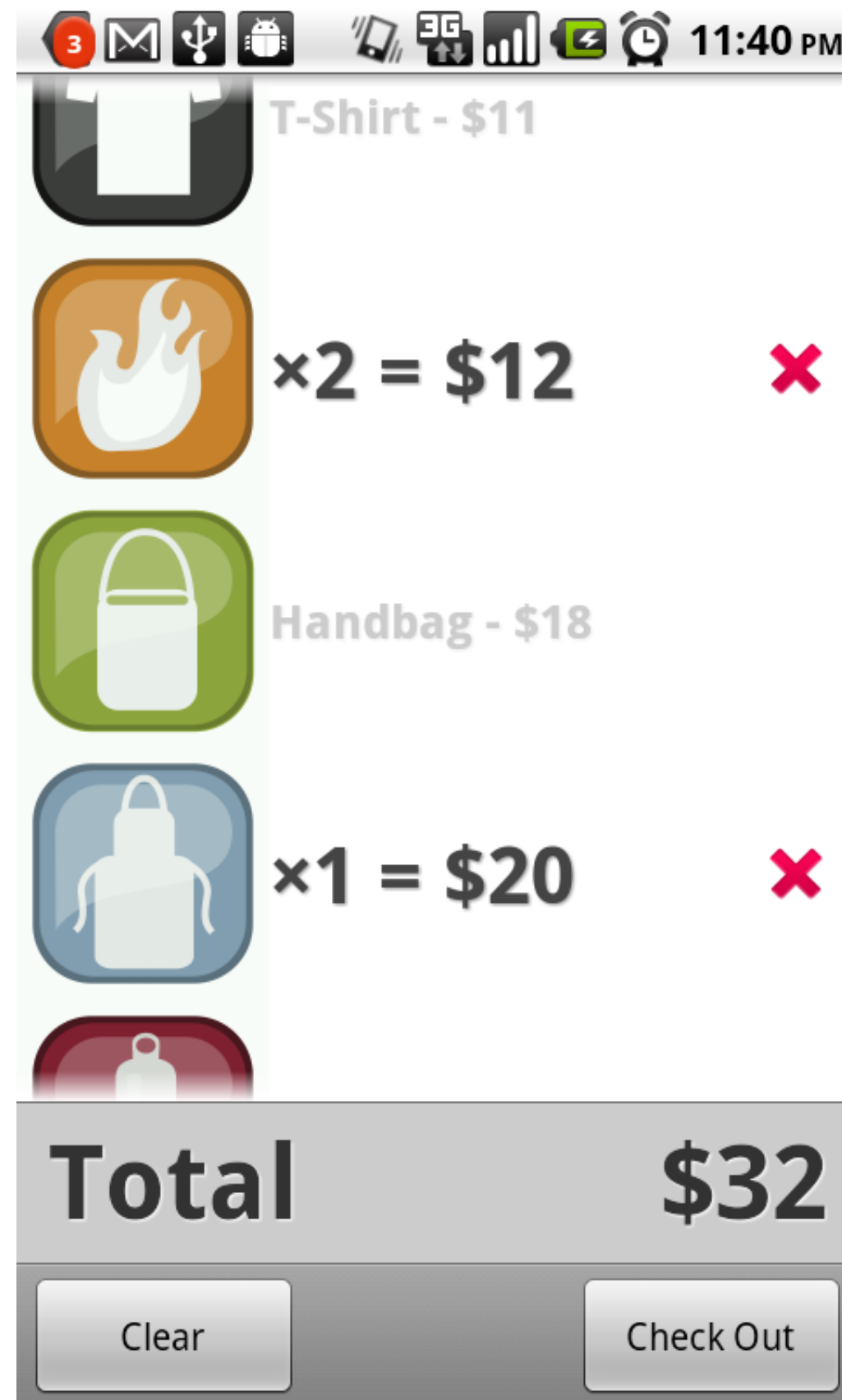
Example

```
public class LoginActivity extends SquareActivity {
    @Inject Session session;
    private Login login;

    @Override protected void onCreate(Bundle state) {
        super.onCreate(state);
        login = new Login(session);
        ...
    }

    public void login() {
        login.call();
    }
    ...
    class Login extends ServerCall {
        private final Session session;
        @Inject private Login(Session session) {
            super("Logging in...", "Login failed.");
            this.session = session;
            manageWith(LoginActivity.this);
        }
        @Override protected void callServer(Callback<SimpleResponse> callback) {
            session.login(getEmail(), getPassword(), callback);
        }
        @Override protected void onSuccess() {
            finish();
        }
    }
}
```

Point-of-Sale API



Example

```
public class TwoCents extends Activity {
    @Override public void onCreate(Bundle state) {
        super.onCreate(state);

        Square square = new Square(this);
        if (square.installationStatus()
            != Square.InstallationStatus.AVAILABLE) {
            square.requestInstallation();
        } else {
            LineItem advice = new LineItem.Builder()
                .price(2, Currency.USD) // 2 cents
                .description("Advice")
                .build();
            square.squareUp(Bill.containing(advice));
        }
    }
}
```


Thank You!

> **`http://squareup.com/`**

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

> **We're hiring!**

Example

```
public class TwoCents extends Activity {
    @Override public void onCreate(Bundle state) {
        super.onCreate(state);

        Square square = new Square(this);
        if (square.installationStatus()
            != Square.InstallationStatus.AVAILABLE) {
            square.requestInstallation();
        } else {
            LineItem advice = new LineItem.Builder()
                .price(2, Currency.USD) // 2 cents
                .description("Advice")
                .build();
            square.squareUp(Bill.containing(advice));
        }
    }
}
```