

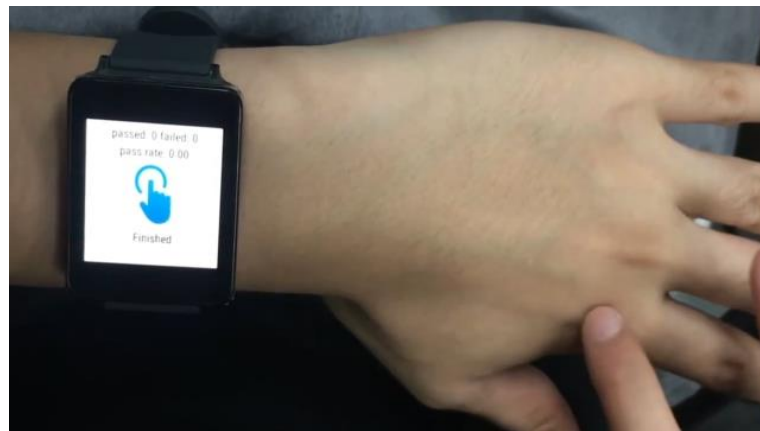
Single tap authentication for smartphone

11930674 李子强

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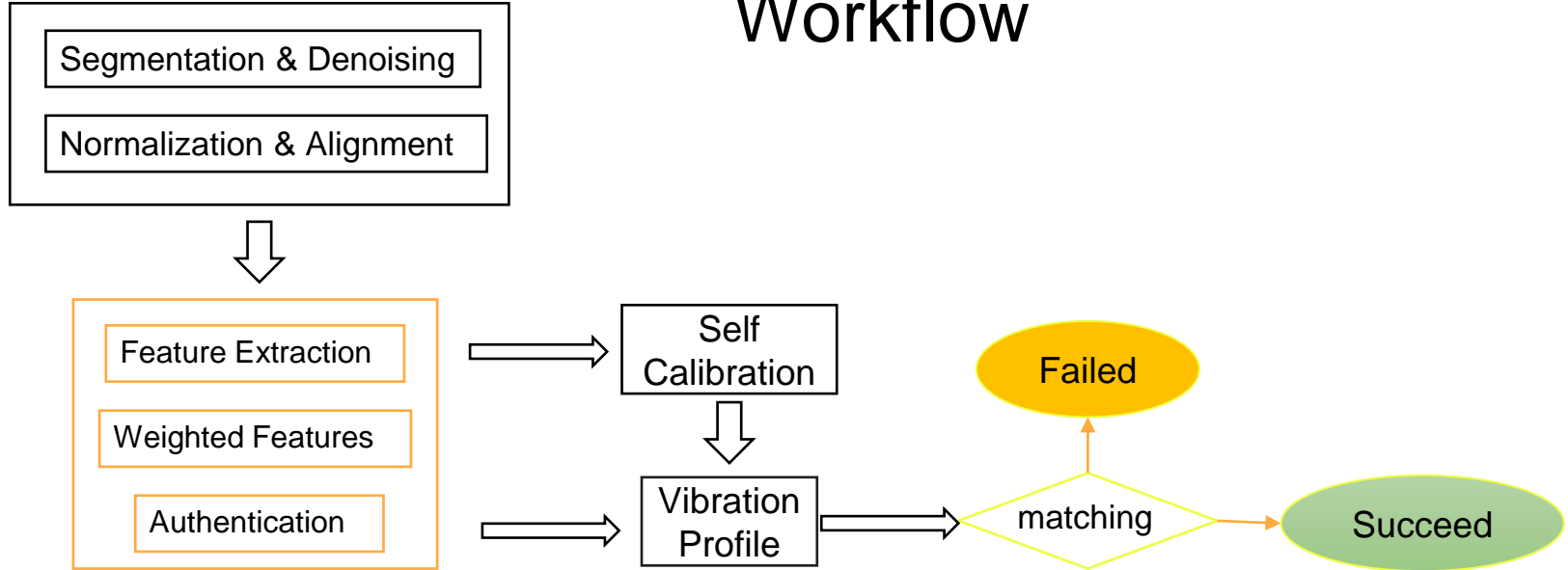
Introduction

- This work is inspired by *Taprint* [1]
- We would like to implement single tap authentication on smartphone.



Chen W, Chen L, Huang Y, et al. Taprint: Secure Text Input for Commodity Smart Wristbands[C]//The 25th Annual International Conference on Mobile Computing and Networking. 2019: 1-16.

Workflow

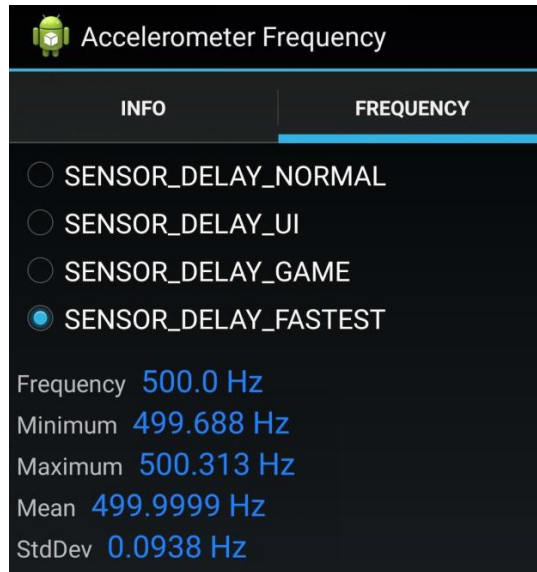


Methodology

- Feature Extraction: amplitude spectral density(ASD).
- Weighted feature: weight frequency points to maximize the difference from different user and minimize the similarity of same user.
- Authentication: density based one-class classifier.

Feasibility

- Sample rate of accelerator devices varies from devices.
- We use an Huawei Mate 30, with sample rate of 500 Hz.



Expected results

- Basically, implement a prototype can authenticate user with fixed tapping location, finger and moderately tapping force.
- Optional, explore the influence of tapping location, finger and force and try to overcome these challenges.

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Data collection (Try 1)

TYPE_LINEAR_ACCELERATION	SensorEvent. values[0]	Acceleration force along the x axis (excluding gravity).	m/s ²
	SensorEvent. values[1]	Acceleration force along the y axis (excluding gravity).	
	SensorEvent. values[2]	Acceleration force along the z axis (excluding gravity).	

获取线性加速度，经过系统校准，且除去重力加速度的影响

https://developer.android.com/reference/android/hardware/Sensor#TYPE_LINEAR_ACCELERATION

Data collection (Try 2)

TYPE_ACCELEROMETER

Added in API level 3

```
public static final int TYPE_ACCELEROMETER
```

A constant describing an accelerometer sensor type.

See [SensorEvent.values](#) for more details.

Constant Value: 1 (0x00000001)

获取线性加速度采样率不够，只有100Hz。

采用含有重力分量的加速度采样，最高可达500Hz。

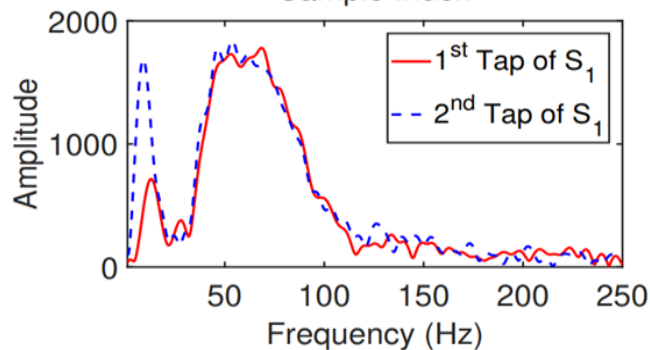
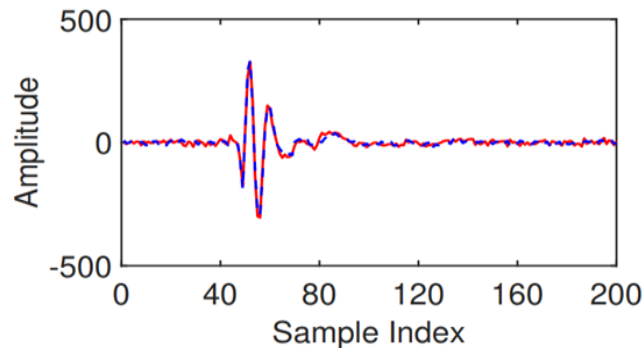
https://developer.android.com/reference/android/hardware/Sensor#TYPE_ACCELEROMETER

数据采集界面



CSV 按人名编号命名

内容为X, Y, Z, 即三个方向上的加速度
1个样本点每行, 共1000行。



timestamp

Added in API level 3

```
public long timestamp
```

The time in nanoseconds at which the event happened. For a given sensor, each new sensor event should be monotonically increasing using the same time base as `SystemClock.elapsedRealtimeNanos()`.

values

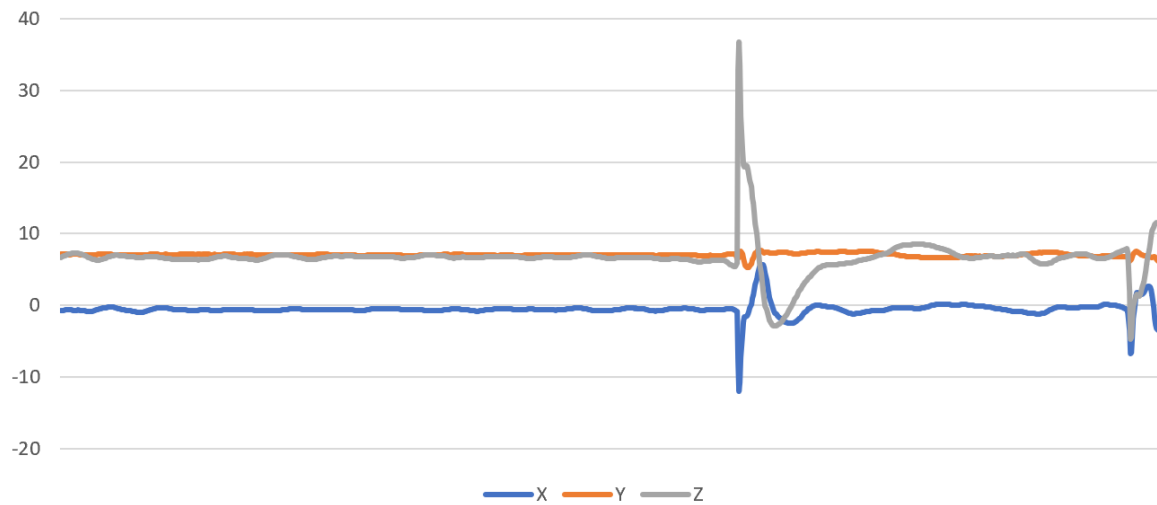
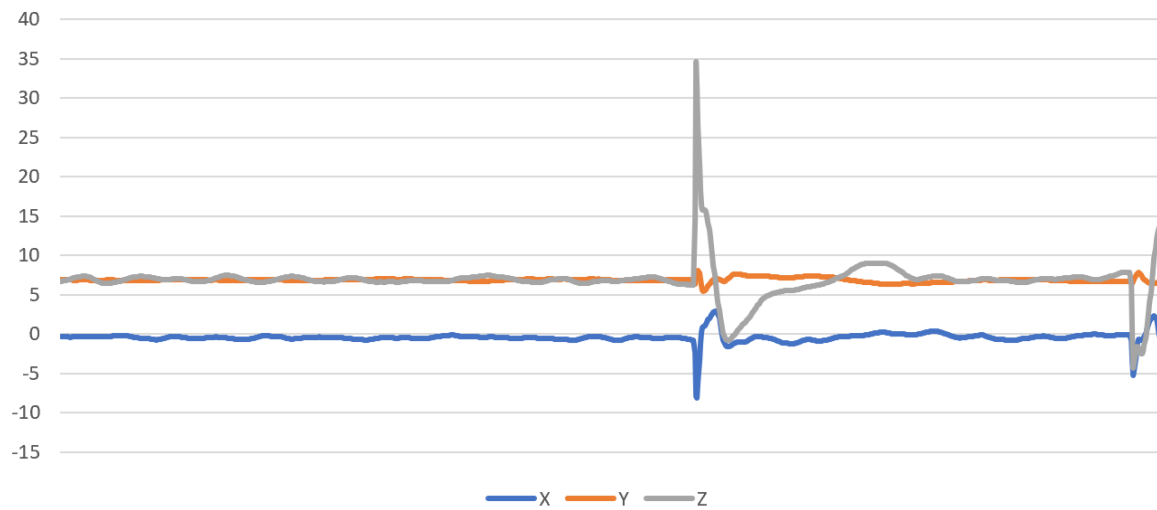
Added in API level 3

```
public final float[] values
```

The length and contents of the `values` array depends on which `sensor` type is being monitored (see also `SensorEvent` for a definition of the coordinate system used).

每次传感器事件回调都会有时间戳和相应的事件数据。

<https://developer.android.com/reference/android/hardware/SensorEvent#timestamp>



后期工作

1. 继续收集多个人的敲击数据
2. 后续数据分析及分类在服务器上进行
3. 进行尝试分类是否可行（能区分），进一步的可靠（准确率）。

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Methodology

- Feature Extraction: amplitude spectrum density(ASD).
- Weighted feature: we use frequency power to maximize the difference from different users and minimize the similarity of same user.
- Authentication: dense based on support vector machine.



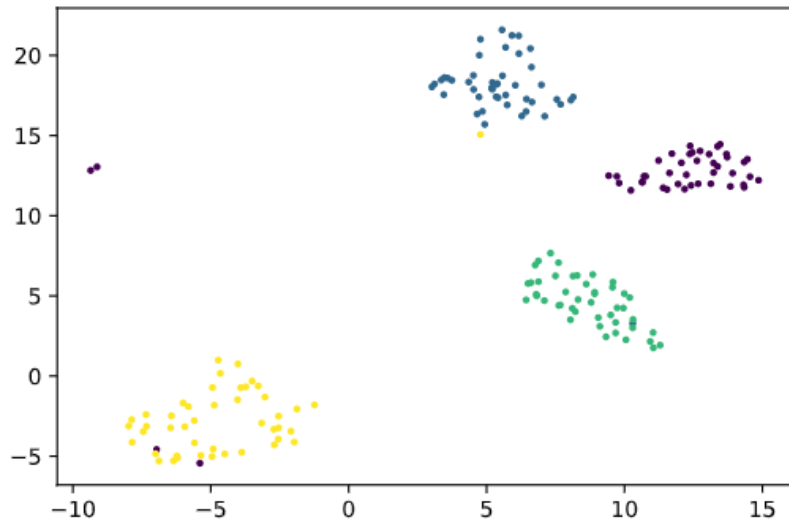
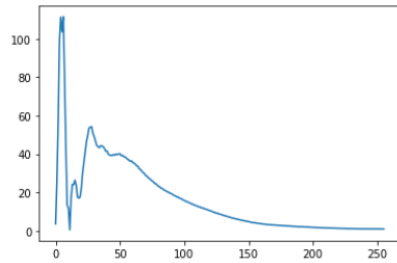
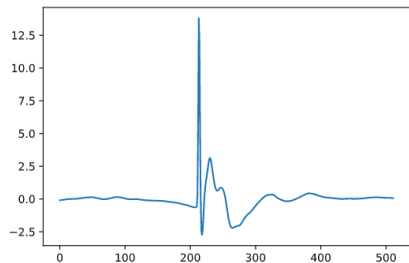
模型架构

信号预处理
标准化、对齐

FFT
频率特征提取

UMAP降维
度量学习

SVM
分类器



Client / Server 架构

Client: 采集数据



Server: 训练模型、认证



采集与测试



模型评价

数据采集：

500HZ采样率， 2个人4只手， 每人采集60个样本， 共240个数据

效果：

Verification Success Rate	92%
Attack Failure Rate	97%

演示视频

局限

样本量较小

采集数据时使用固定不变的姿势和力度