# SonicPrint: a generally adoptable and secure fingerprint biometrics in smart devices

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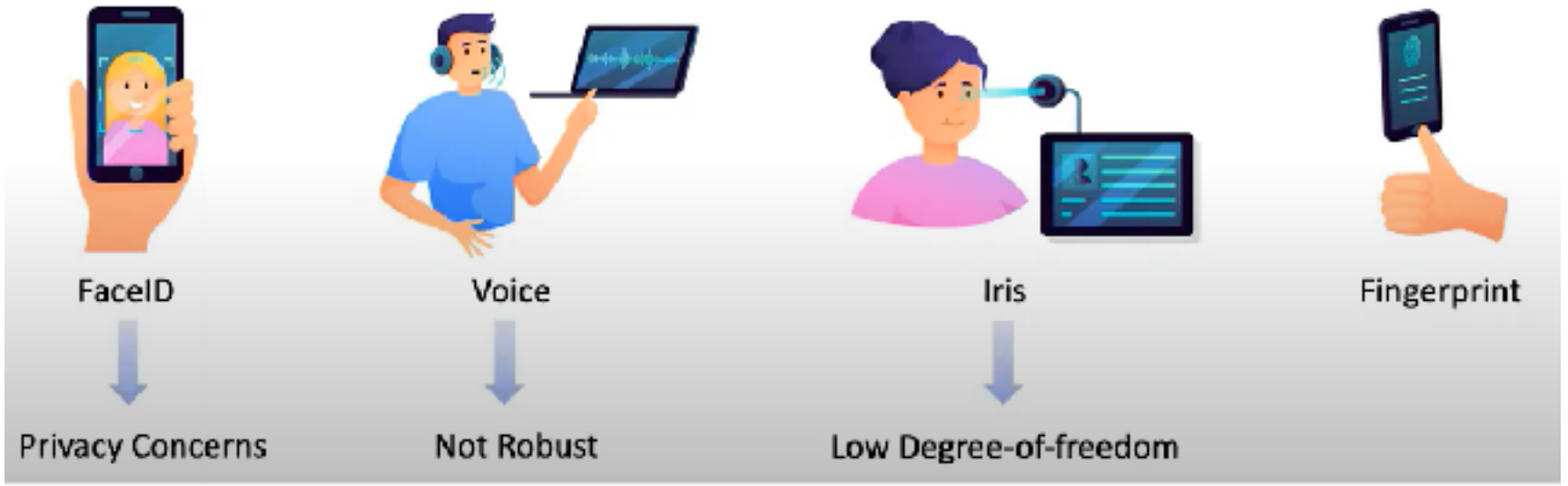
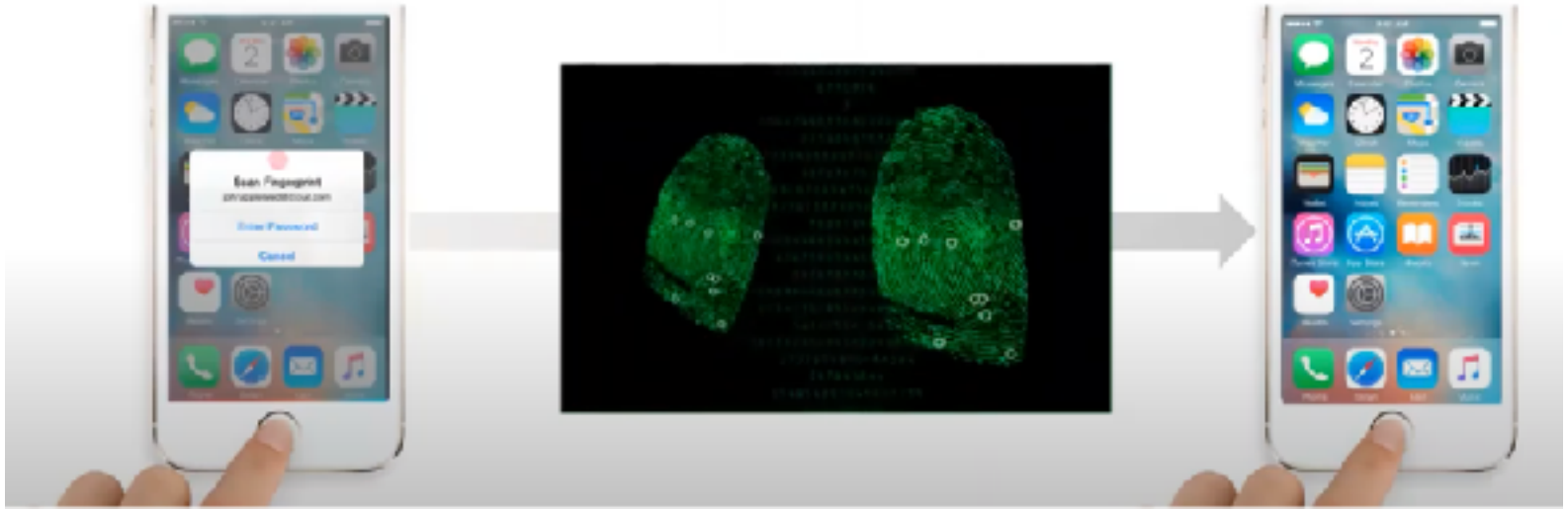
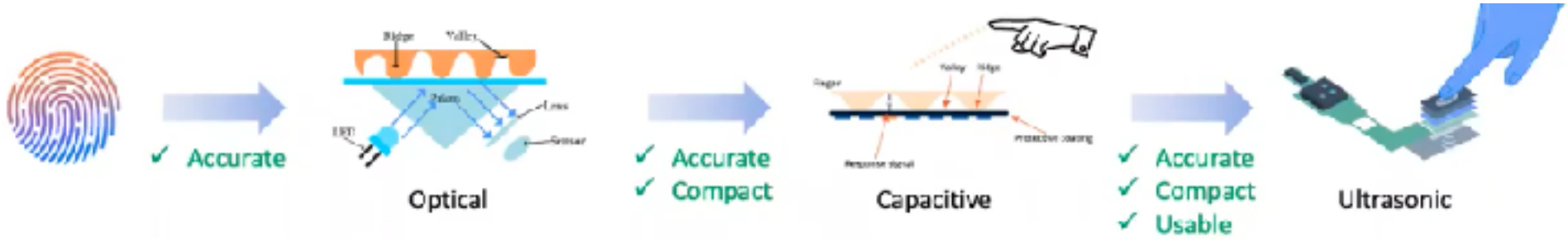
# Promising Biometrics



# Fingerprint: Touch-based access



# THEORY BEHIND

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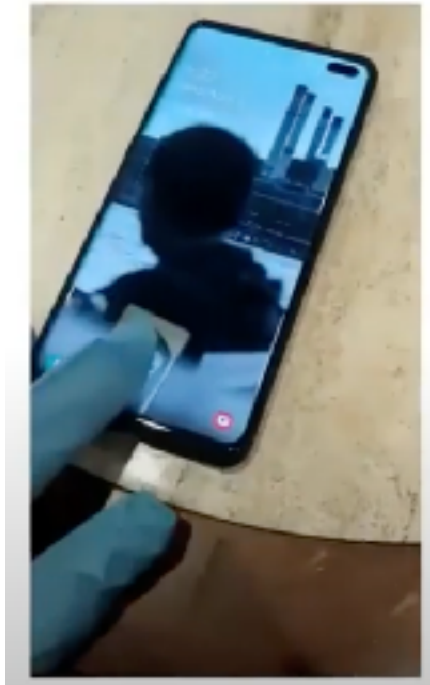
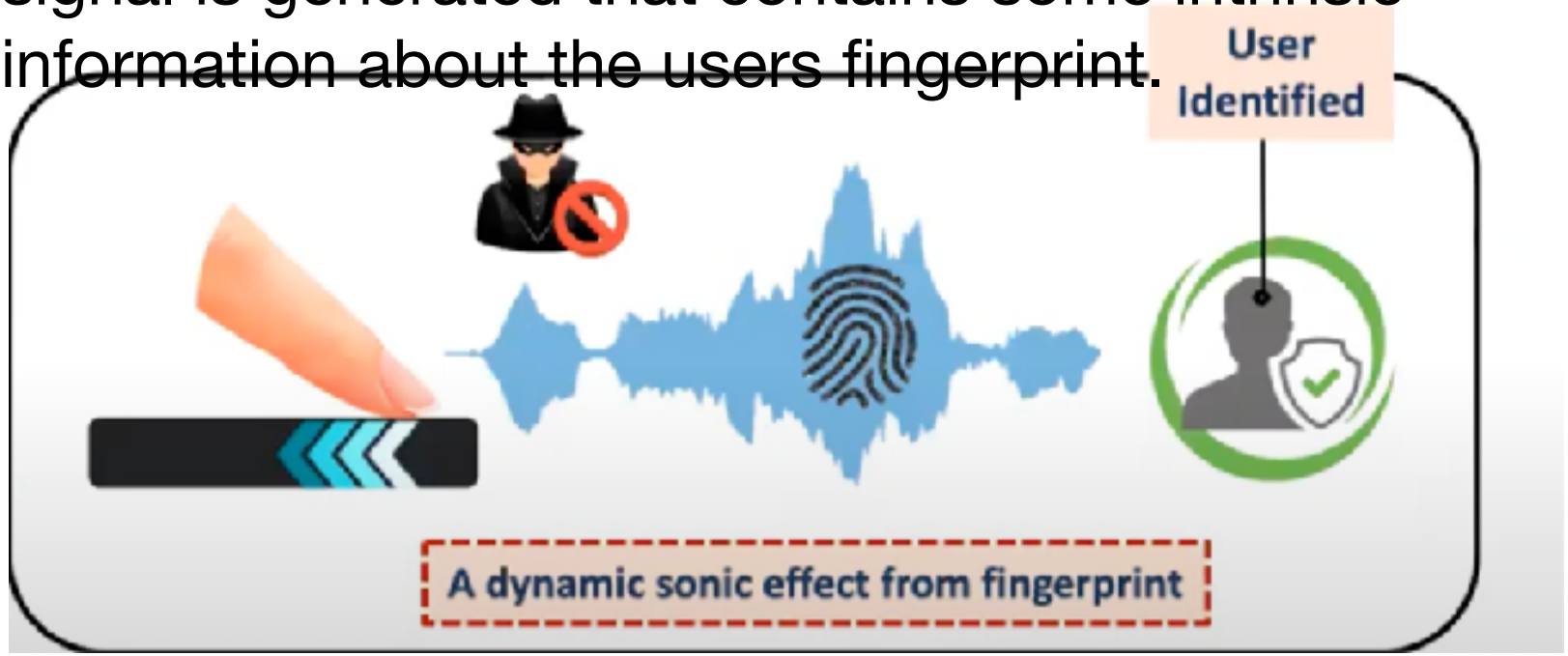
# FINGERPRINT VULNERABILITY



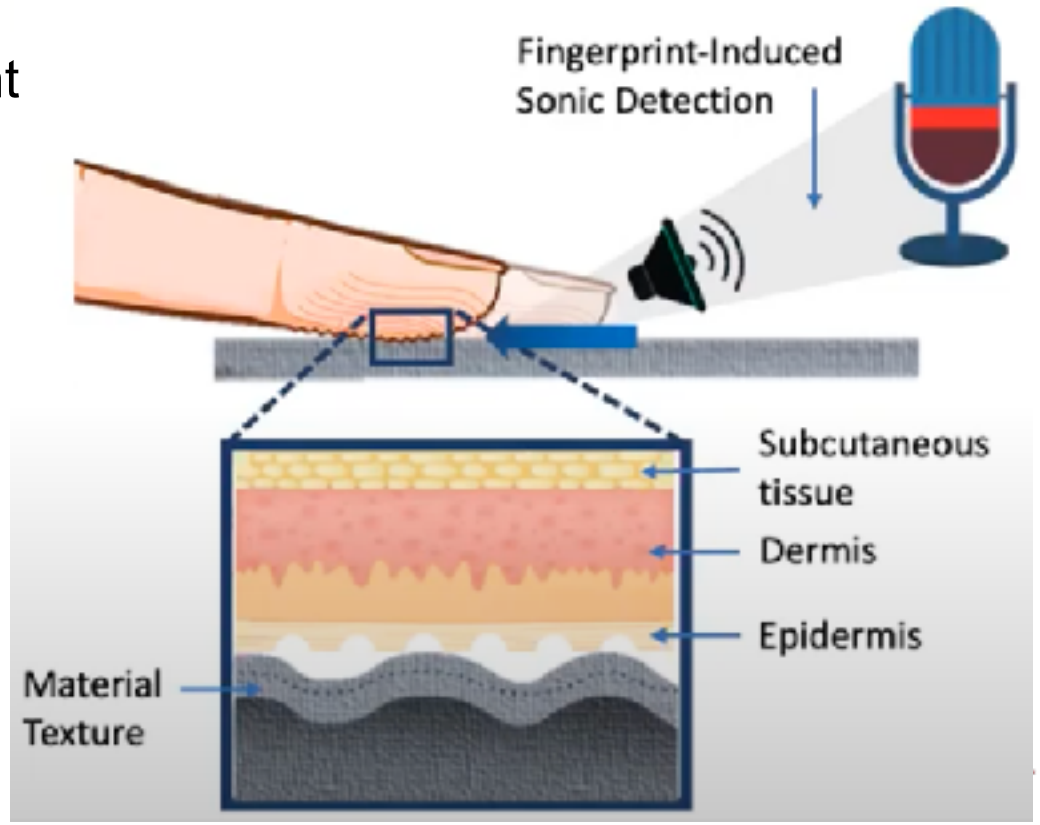

- Fingerprint is externally visible
- Can be sensed remotely (>1m)
- Fingerprint anti-spoofing relies on outer skin features

The interaction is in the form of swipe action.A unique signal is generated that contains some intrinsic information about the users fingerprint.



# FINGERPRINT-EXCITED SONIC EFFECT(FISE)

Secure:  cannot be recorded by a conventional microphone
Unique:  unique fingerprint
Accessible:  surface independent

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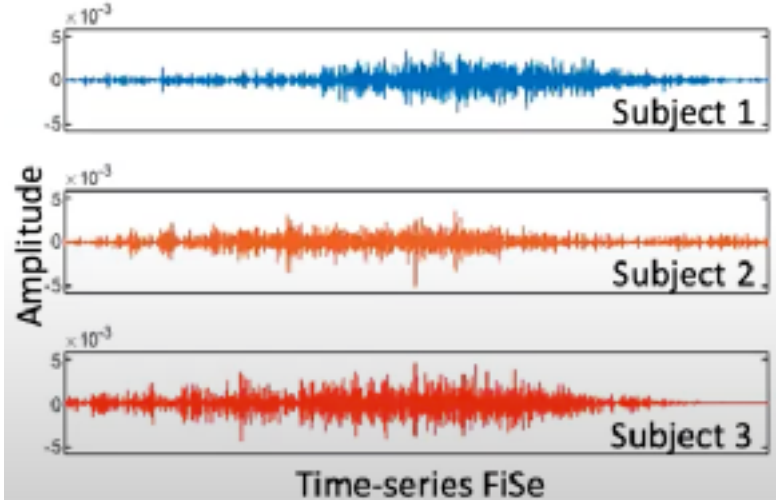
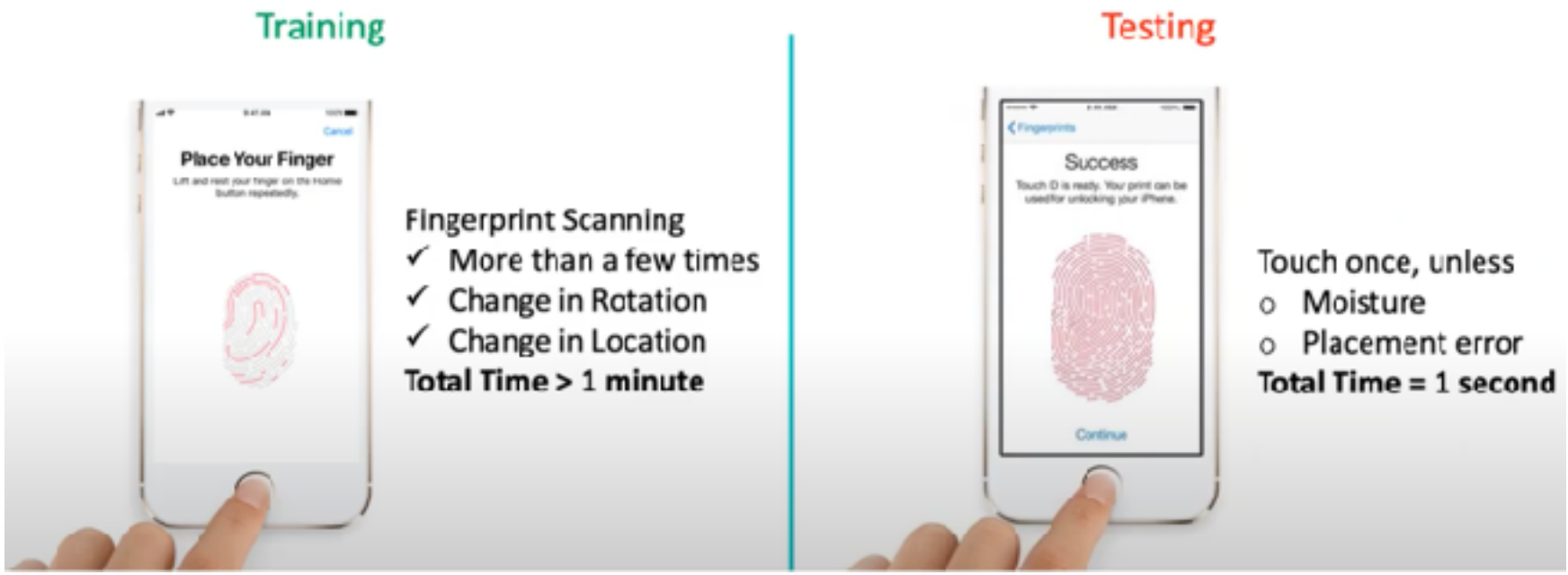
# A FEASIBILITY STUDY

| Experimental Setup | |
|---|---|
| Subjects | 3 |
| Device | Google Pixel 2 |
| Sensor | In-built Microphone |
| Sampling rate | 44.1KHz |
| Room temperature | 21C |
| Action | Perform 15 swipes |

# USER PERSPECTIVE: TRADITIONAL FINGERPRINT



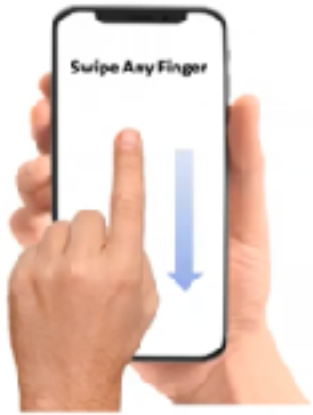
# USER PERSPECTIVE: PROPOSED APPROACH

## Preparation


- ✓ Download the Software App
- ✓ Permit Microphone Access

**Total Time < 1 minute**

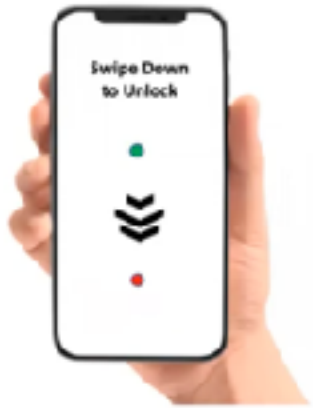
## Training




- ✓ Swipe 60 times
- ✓ Location near microphone
- ✓ Different human dynamics

**Total Time = 1 minute**

## Testing

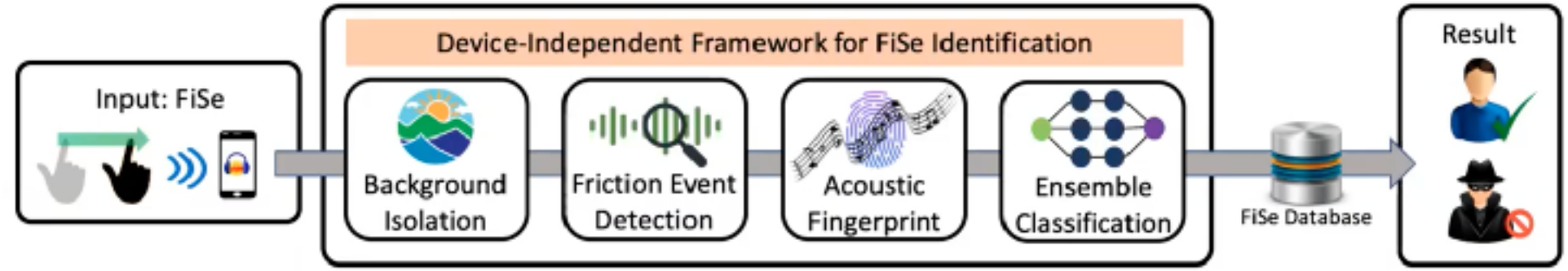



- ✓ Swipe 3 times
- ✓ Location near microphone

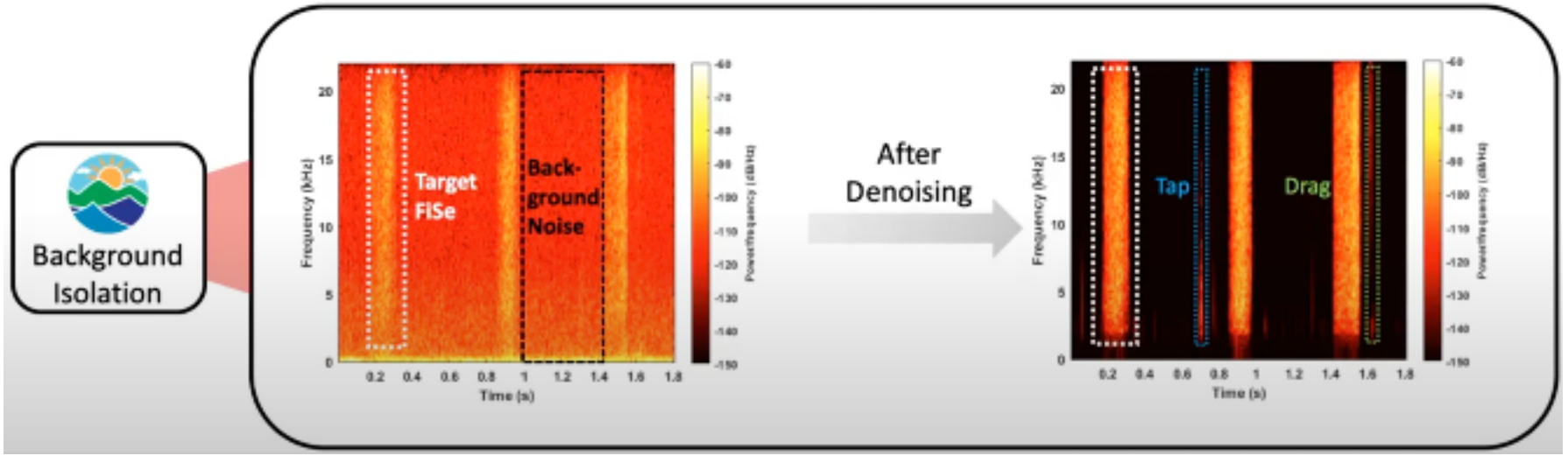
**Total Time < 3 second**

# SONICPRINT: AN END-TO-END BIOMETRIC

- Background isolation
- Friction event detection
- Acoustic fingerprint
- Ensemble classification
-



# Background isolation

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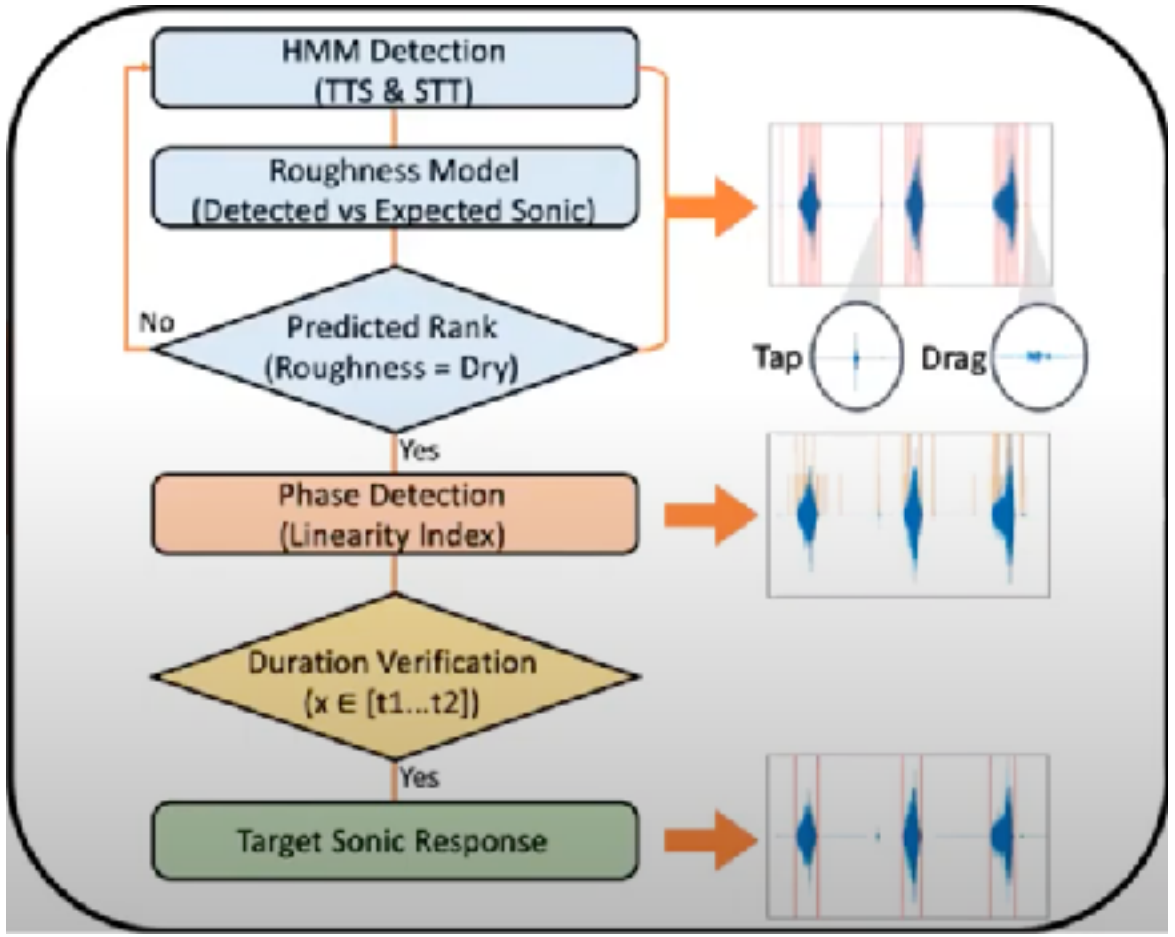
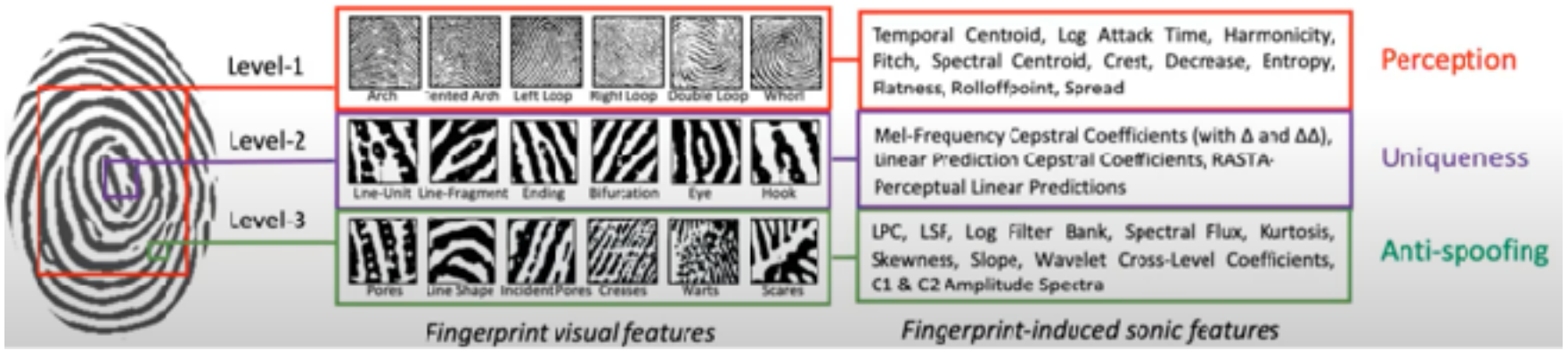
# FRICTION EVENT DETECTOIN

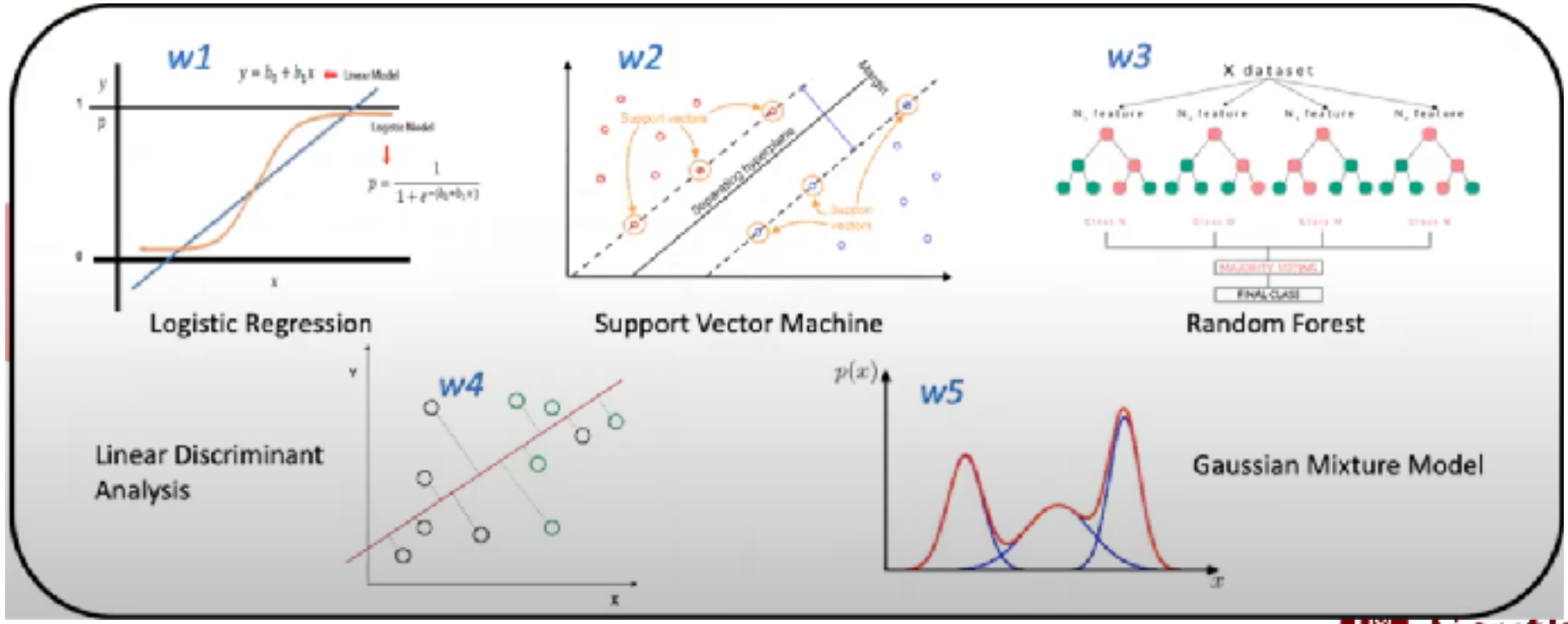


# TAXONOMY OF ACOUSTIC FINGERPRINT



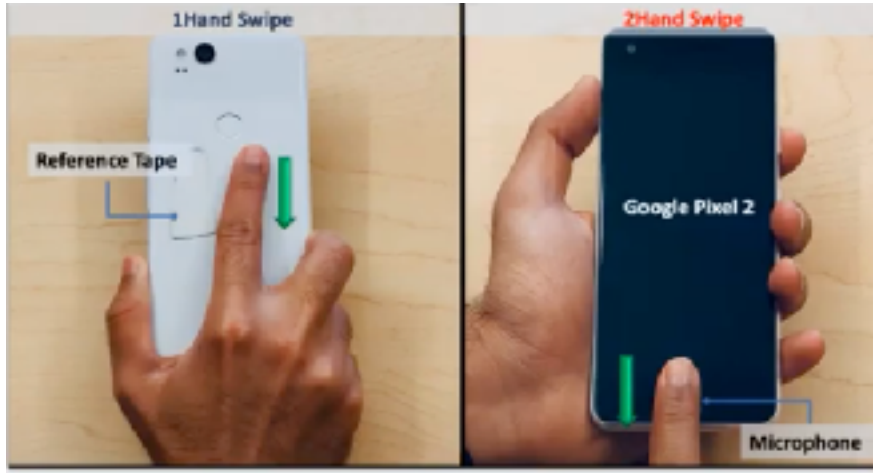

Boruta's algorithm to determine all-relevant features

# ENSEMBLE CLASSIFICATION



# EXPERIMENTAL SETUP

Subjects(users) : 31
Device: google pixel 2
Sensor: in-built microphone




| Swipe Action | |
|---|---|
| Action Type | 1Hand and 2Hand |
| Location | Back and Front of Smartphone |
| Material | Aluminum and Glass |
| Sensing Distance | 1cm, 7cm and 11cm |

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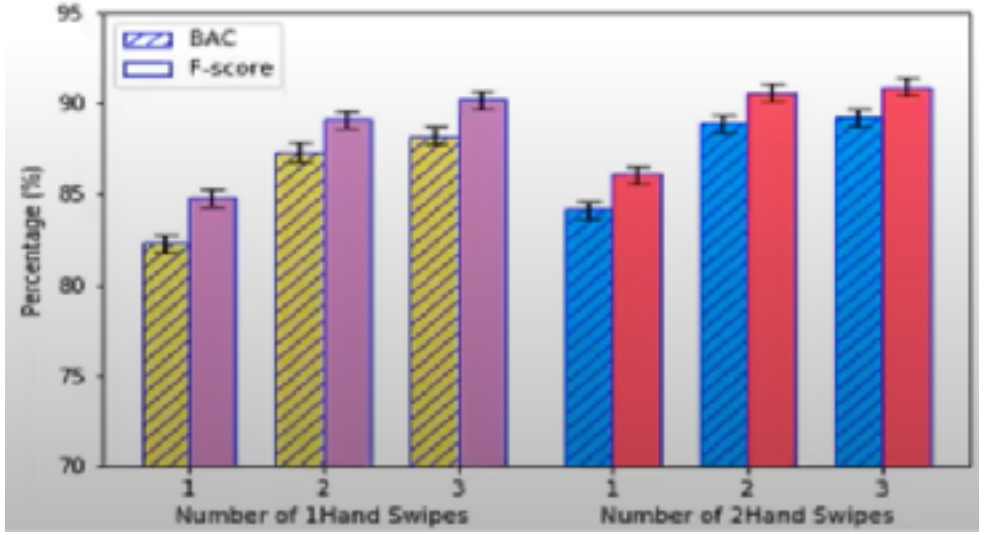
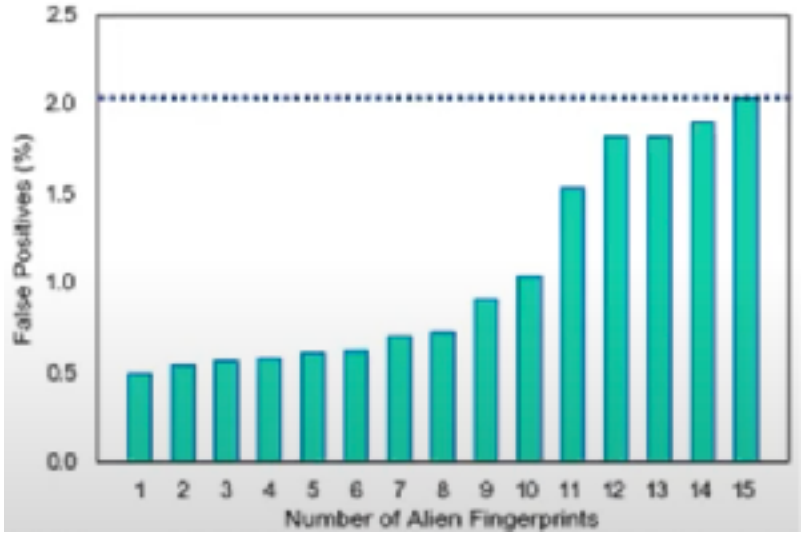
# EVALUATION: ACCURACY



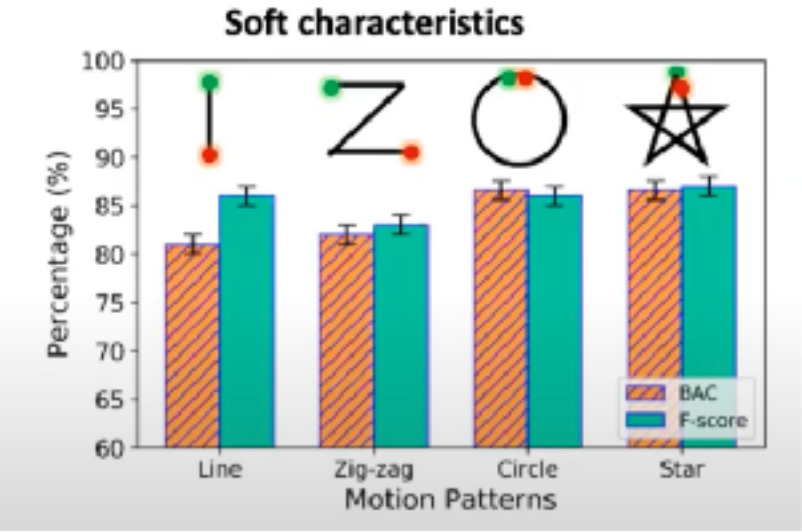




1Hand
7cm
Aluminum

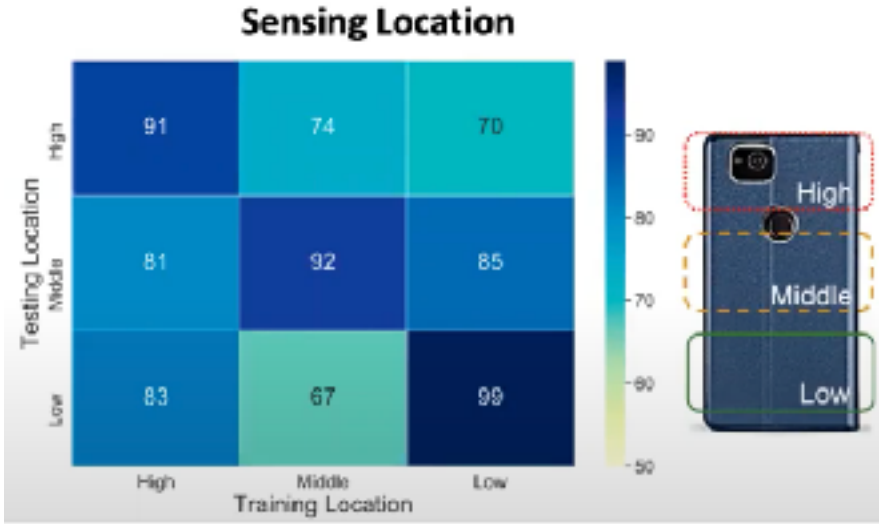
2Hands
1cm
Glass

Train: 15 subjects
Test: 16 subjects(not in the training)

# SWIPE DYNAMICS




complexity of the swipe action



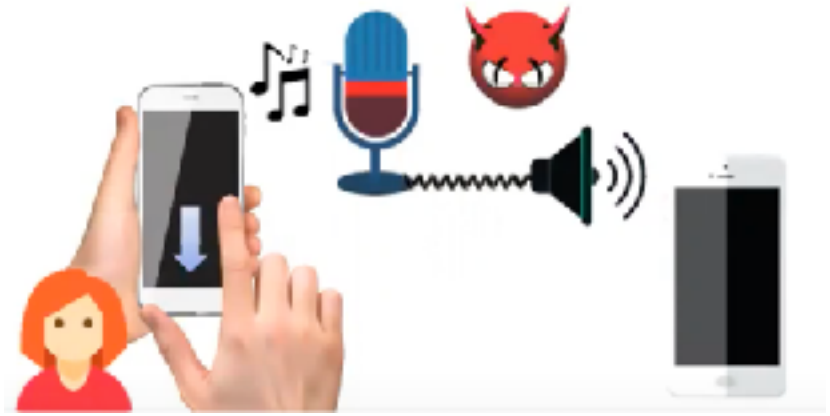

Distance to microphone

# VULNERABILITY: FINGERPRINT PHANTOM ATTACK

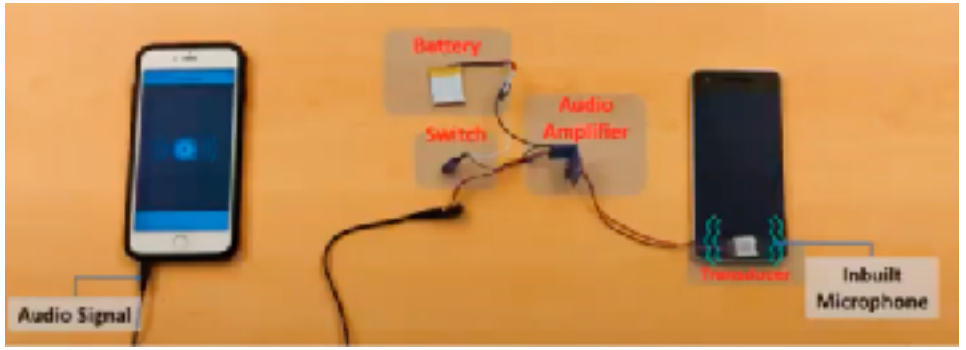
Similar to traditional fingerprint, the attacker wants to breach the sonic print using fake fingers.

| Subjects | 5 |
|---|---|
| Action Type | 2Hand and 1Hand |
| Count | 100 (each) |
| **Spoof rate** | **4.2%~6.4%** |

# VULNERABILITY: REPLAY AND SIDE-CHANNEL ATTACK



Attack via microphone




Attack via vibration channel

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# INSIGHTS AND FUTURE EFFECTS

1. Would using 2+ fingers to swipe improve the performance?
2. Can we build a “Sonic Engine” that can detect anything that a finger touches?
3. Is it possible to enable a gesture recognition approach from FiSe?