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

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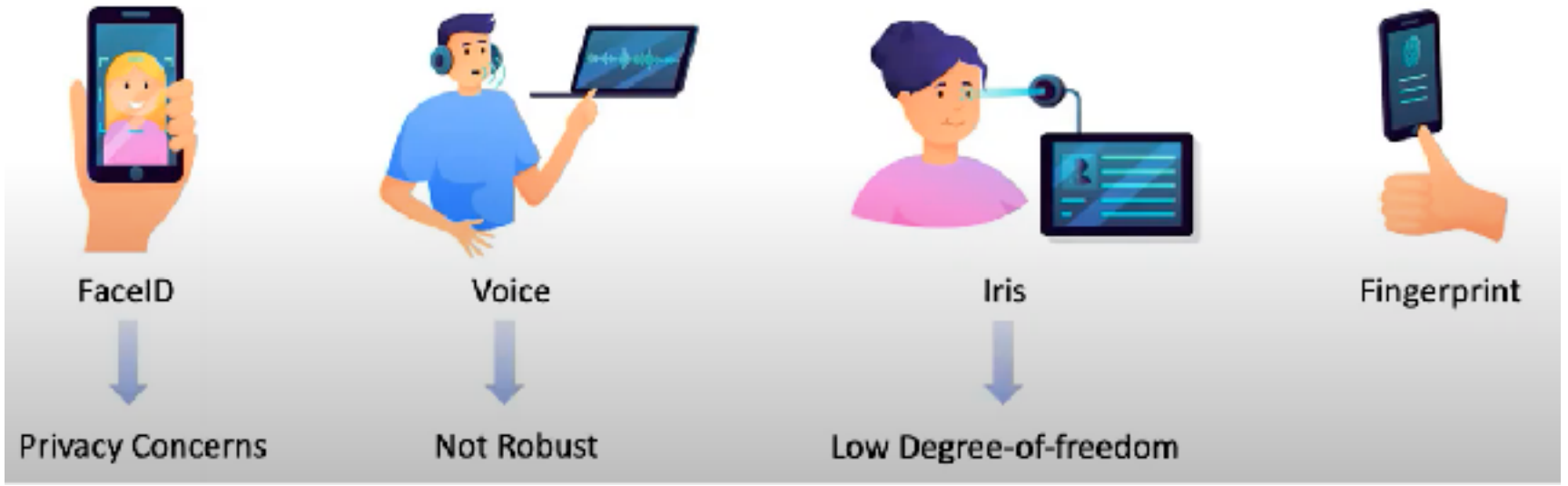
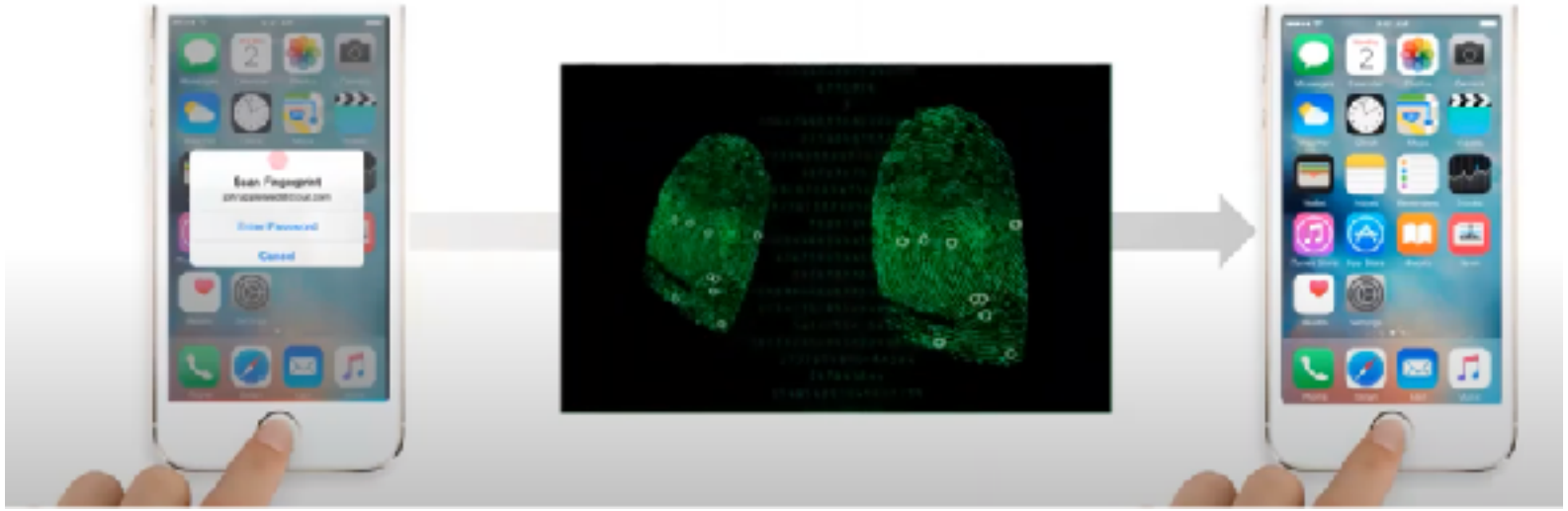
Uof SC. South Carolina

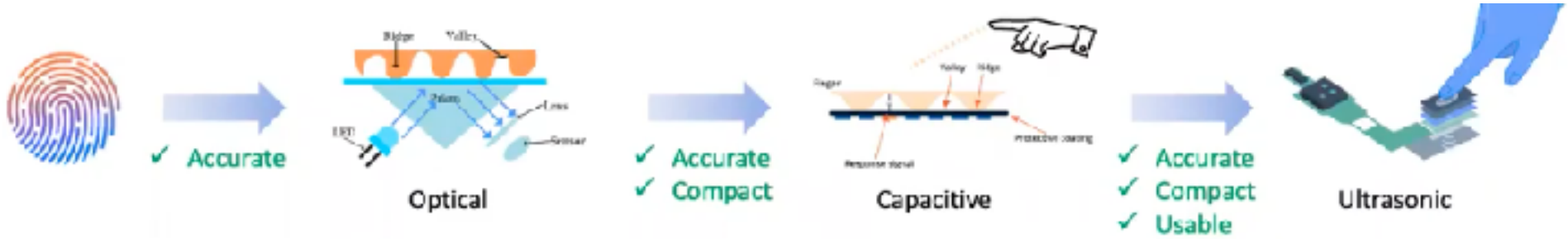
Promising Biometrics



Fingerprint: Touch-based access



THEORY BEHIND



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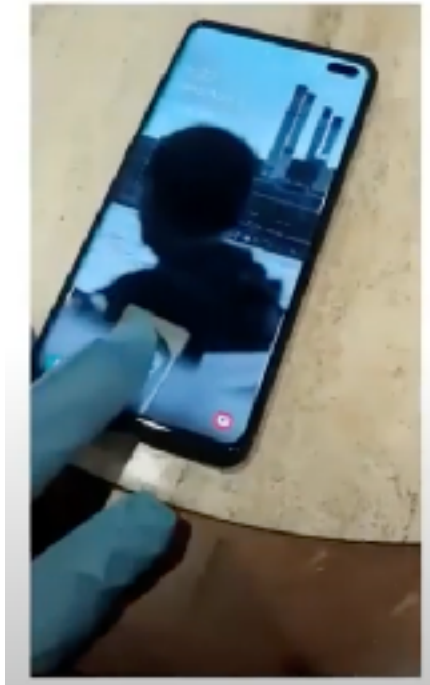
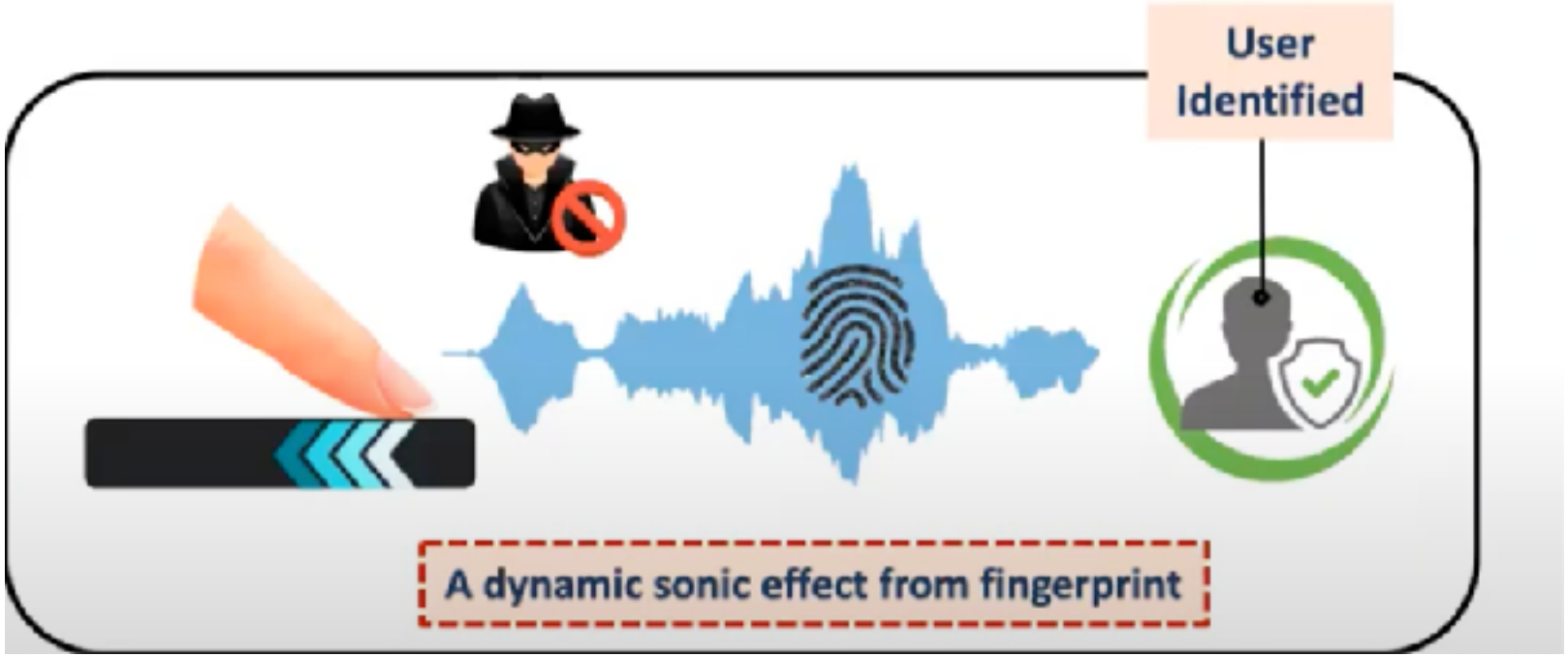
FINGERPRINT VULNERABILITY



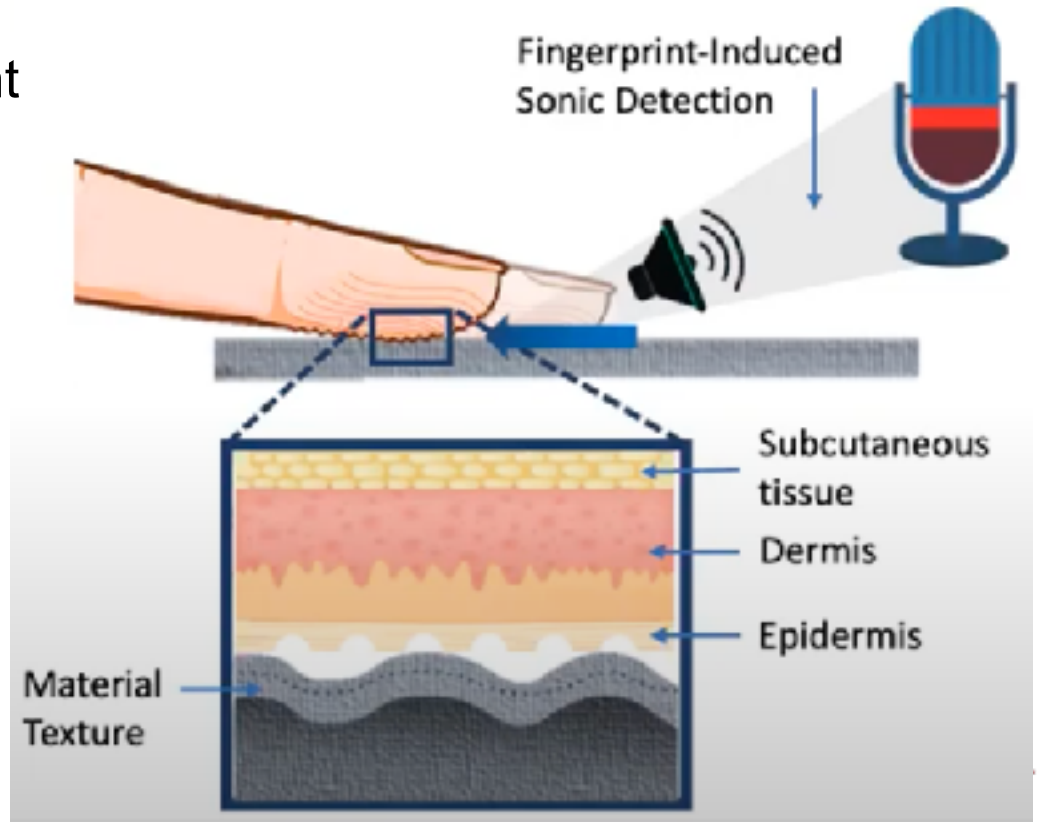
- Fingerprint is externally visible
- Can be sensed remotely (>1m)
- Fingerprint anti-spoofing relies on outer skin features

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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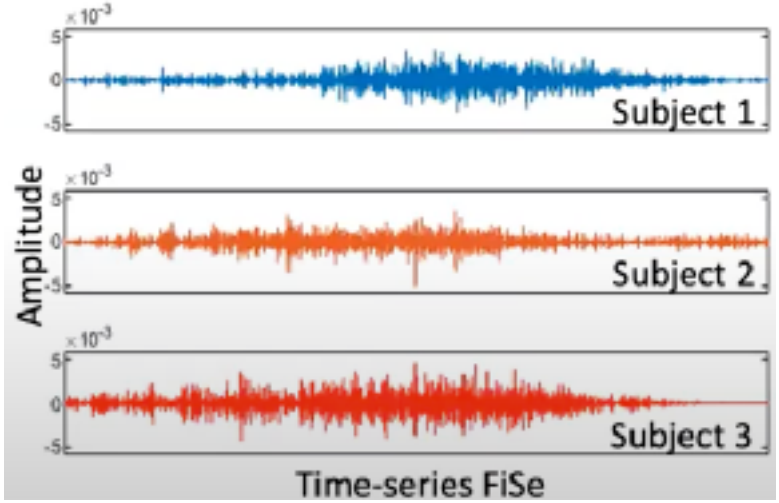
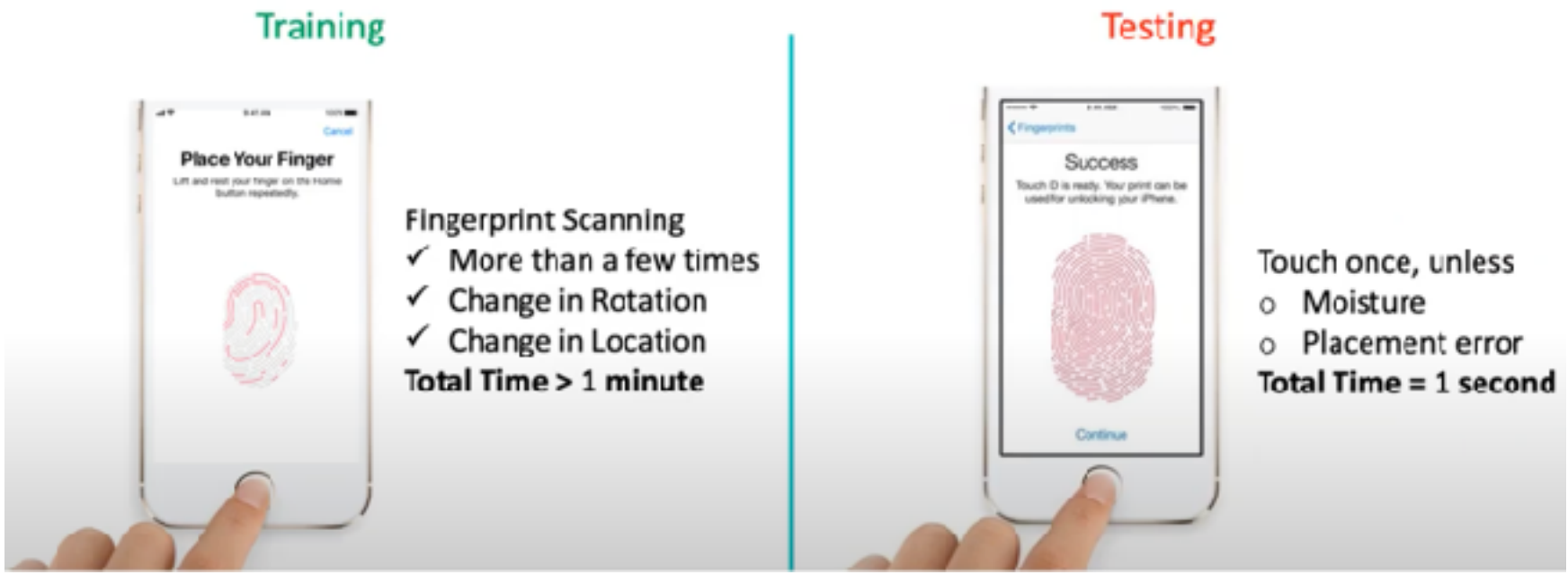
A FEASIBILITY STUDY

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



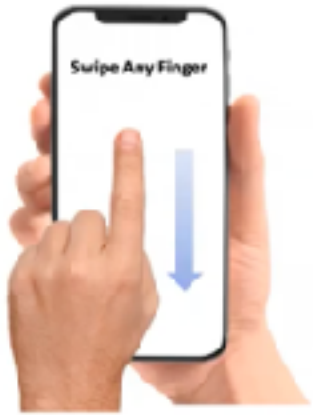
USER PERSPECTIVE: PROPOSED APPROACH

Preparation

- ✓ Download the Software App
- ✓ Permit Microphone Access

Total Time < 1 minute

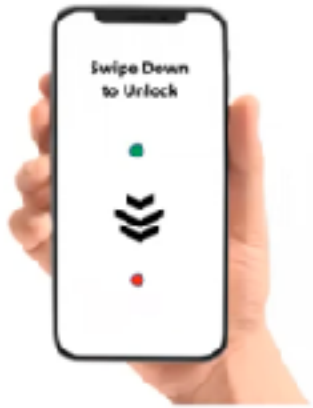
Training



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

Total Time = 1 minute

Testing

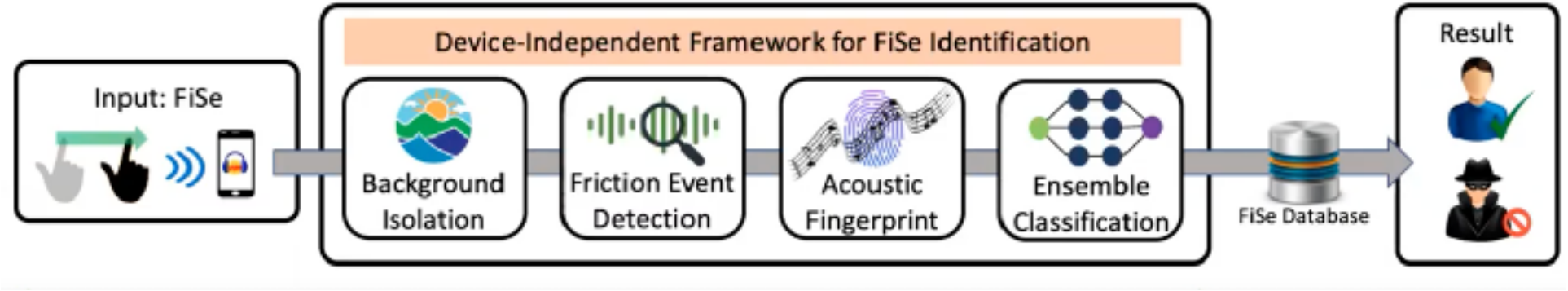


- ✓ Swipe 3 times
- ✓ Location near microphone

Total Time < 3 second

SONICPRINT: AN END-TO-END BIOMETRIC

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



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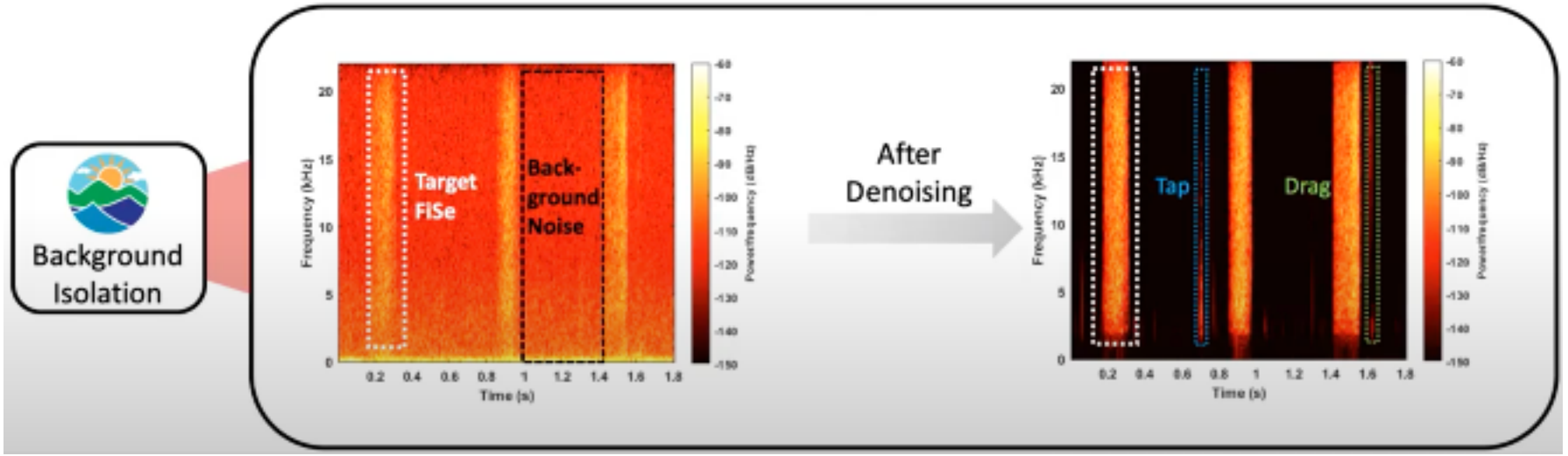
Background isolation



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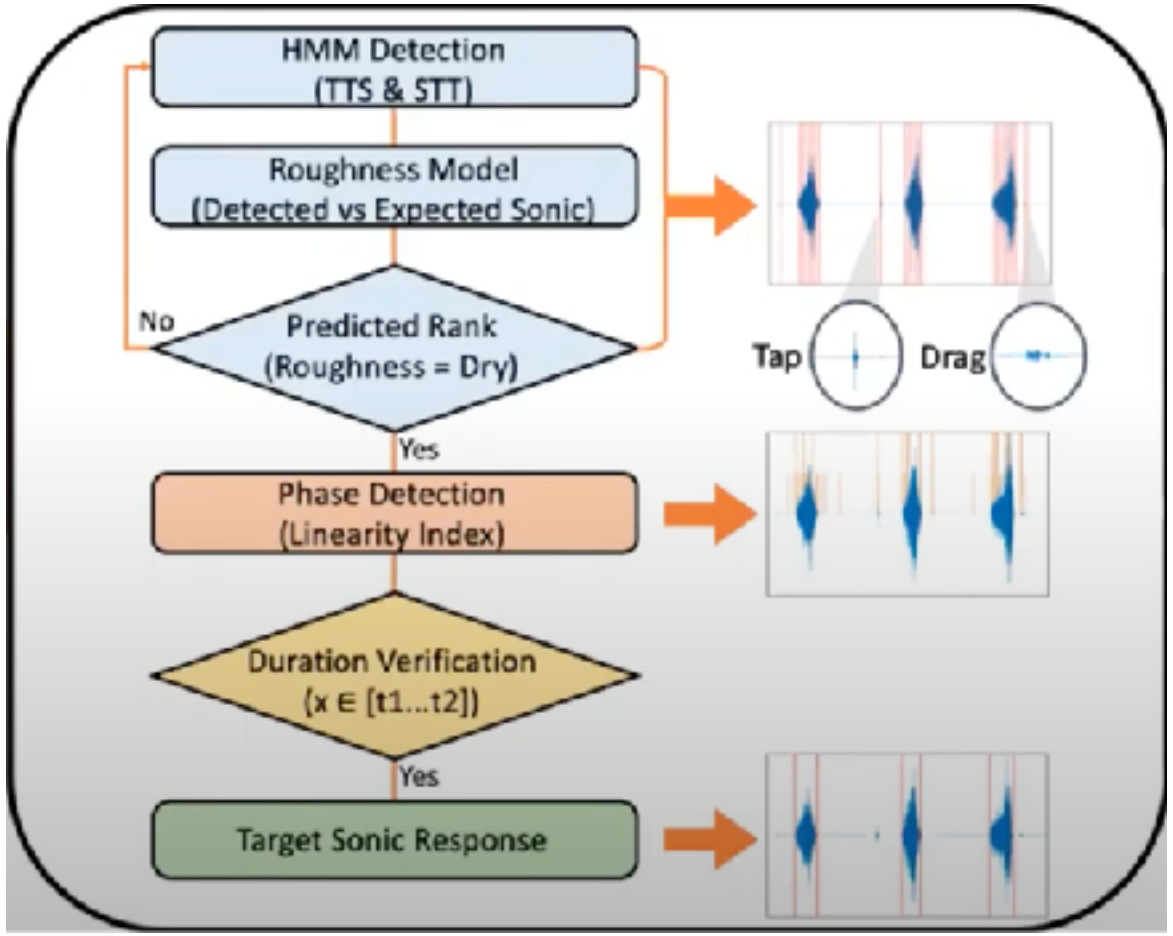
FRICTION EVENT DETECTOIN



0.05 - 0.3 seconds

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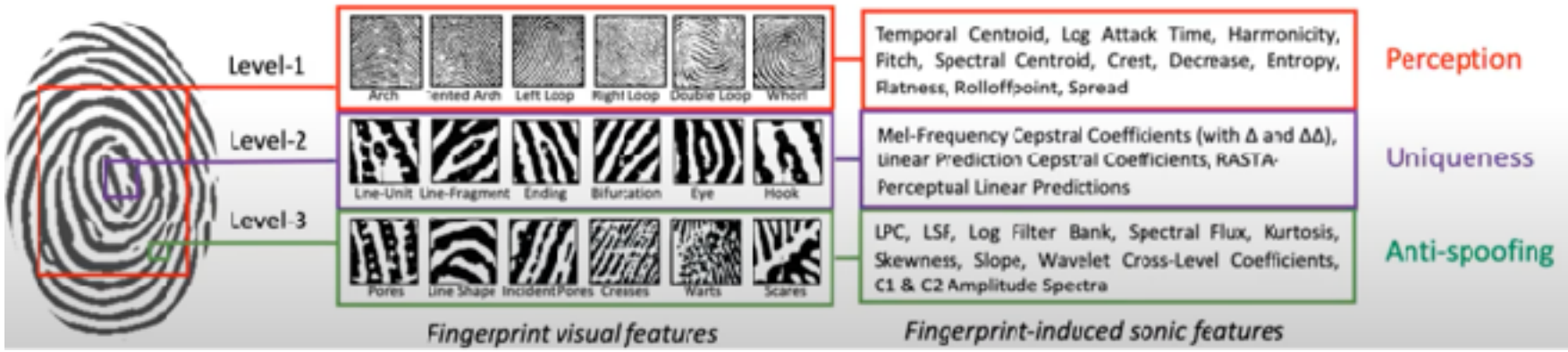
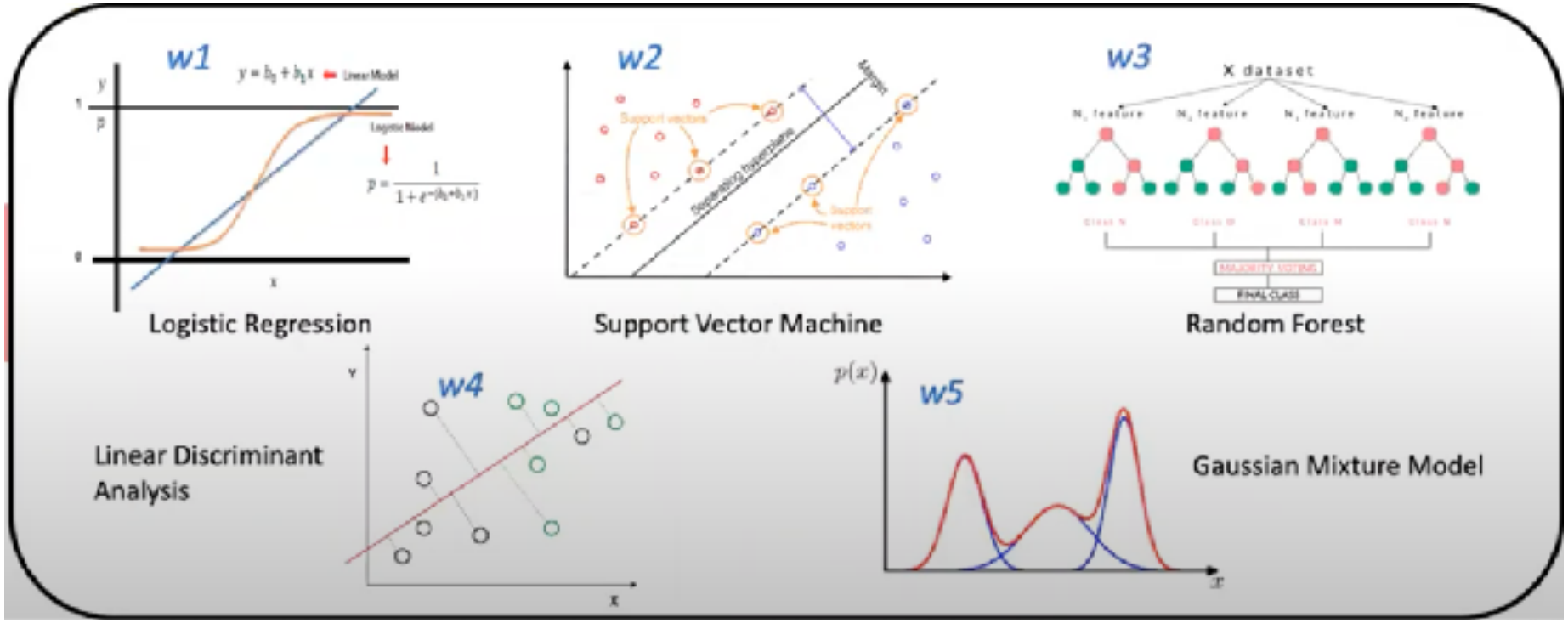
TAXONOMY OF ACOUSTIC FINGERPRINT



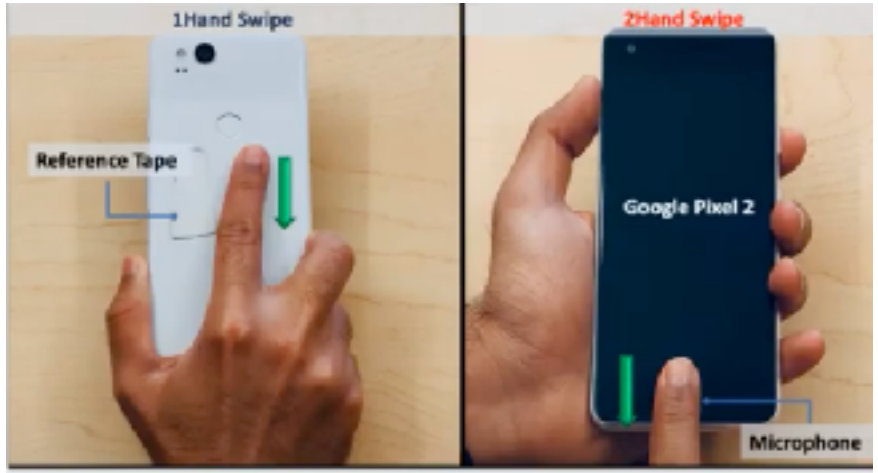
Boruta's algorithm to determine all-relevant features - 128 features in total

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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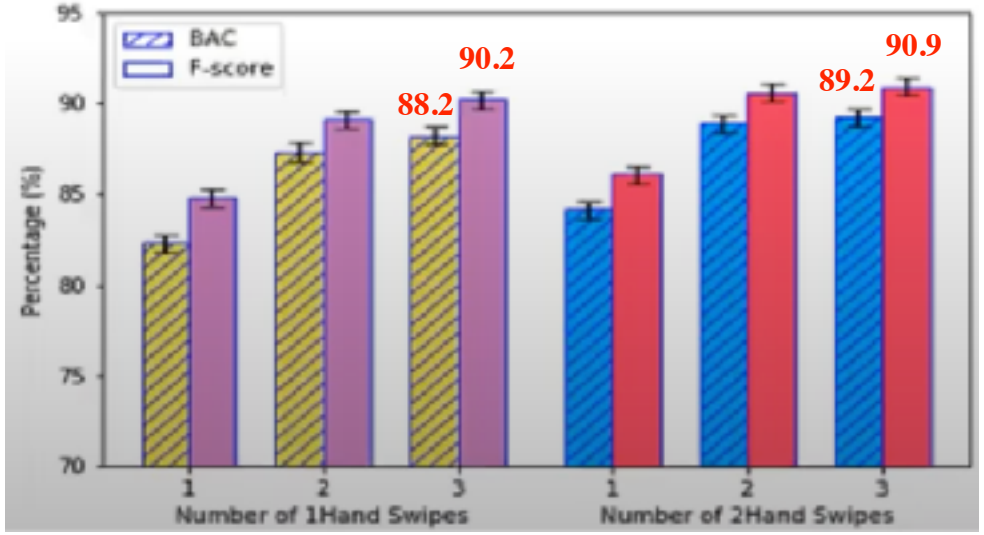
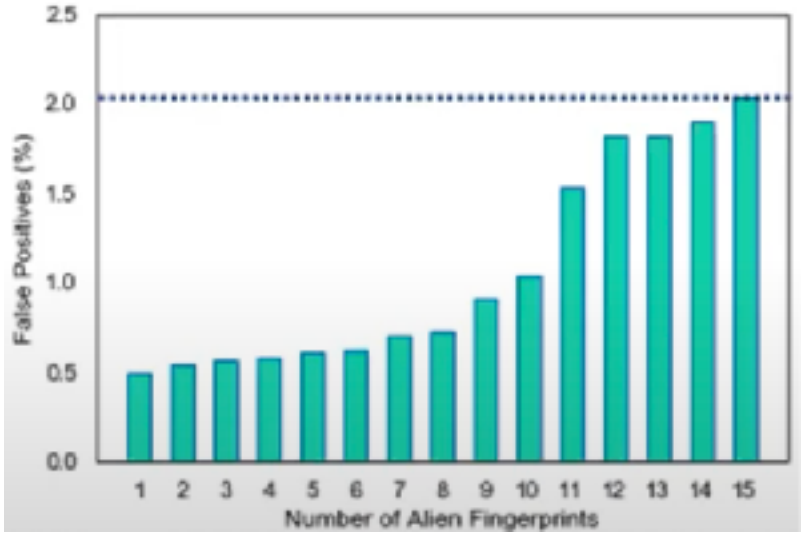
EVALUATION: ACCURACY





1Hand
7cm
Aluminum

2Hands
1cm
Glass

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

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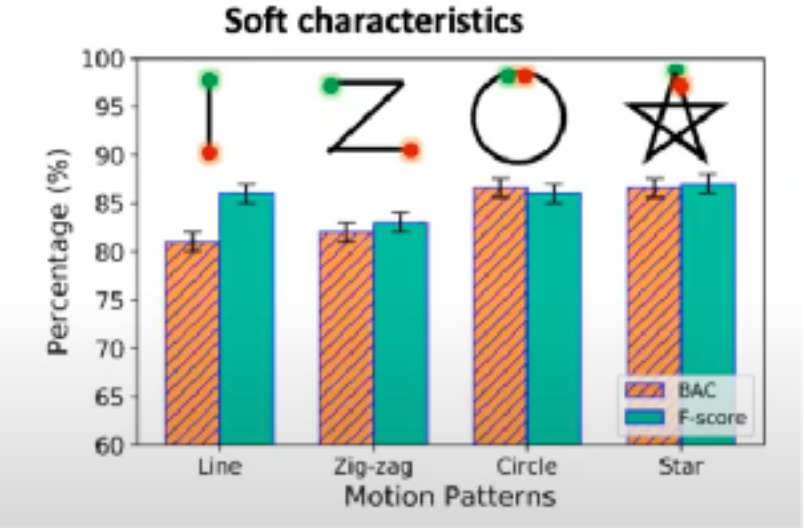
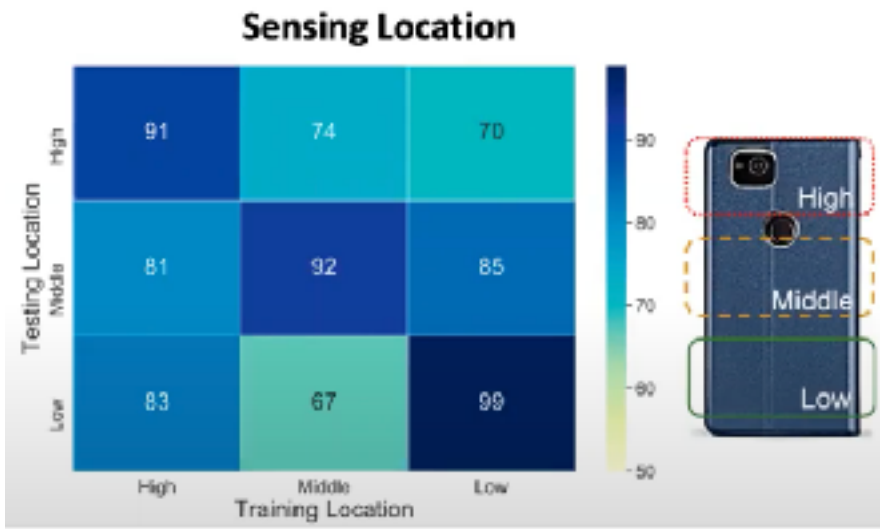
SWIPE DYNAMICS





complexity of the swipe action

Distance to microphone

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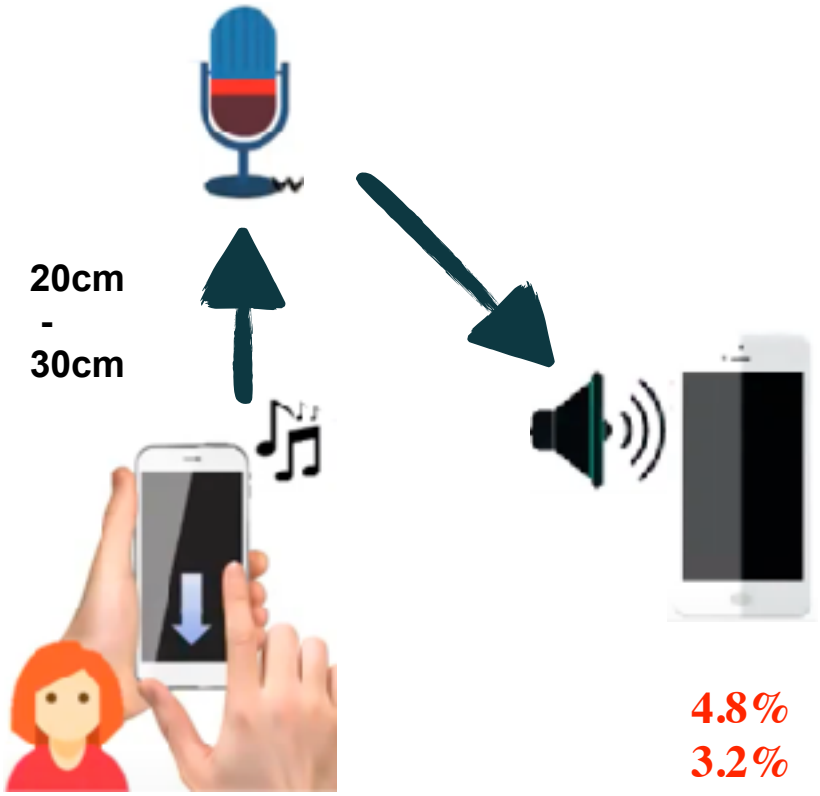
VULNERABILITY: FINGERPRINT PHANTOM ATTACK

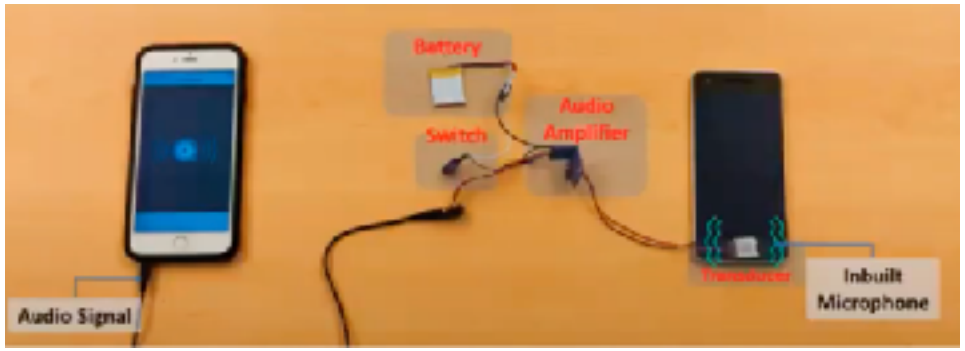
Similar to traditional fingerprint, the attacker wants to breach the sonic print using fake fingers.

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

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?