

SenseHandle: Investigating Human-Door Interaction Behaviour for Authentication in the Physical World

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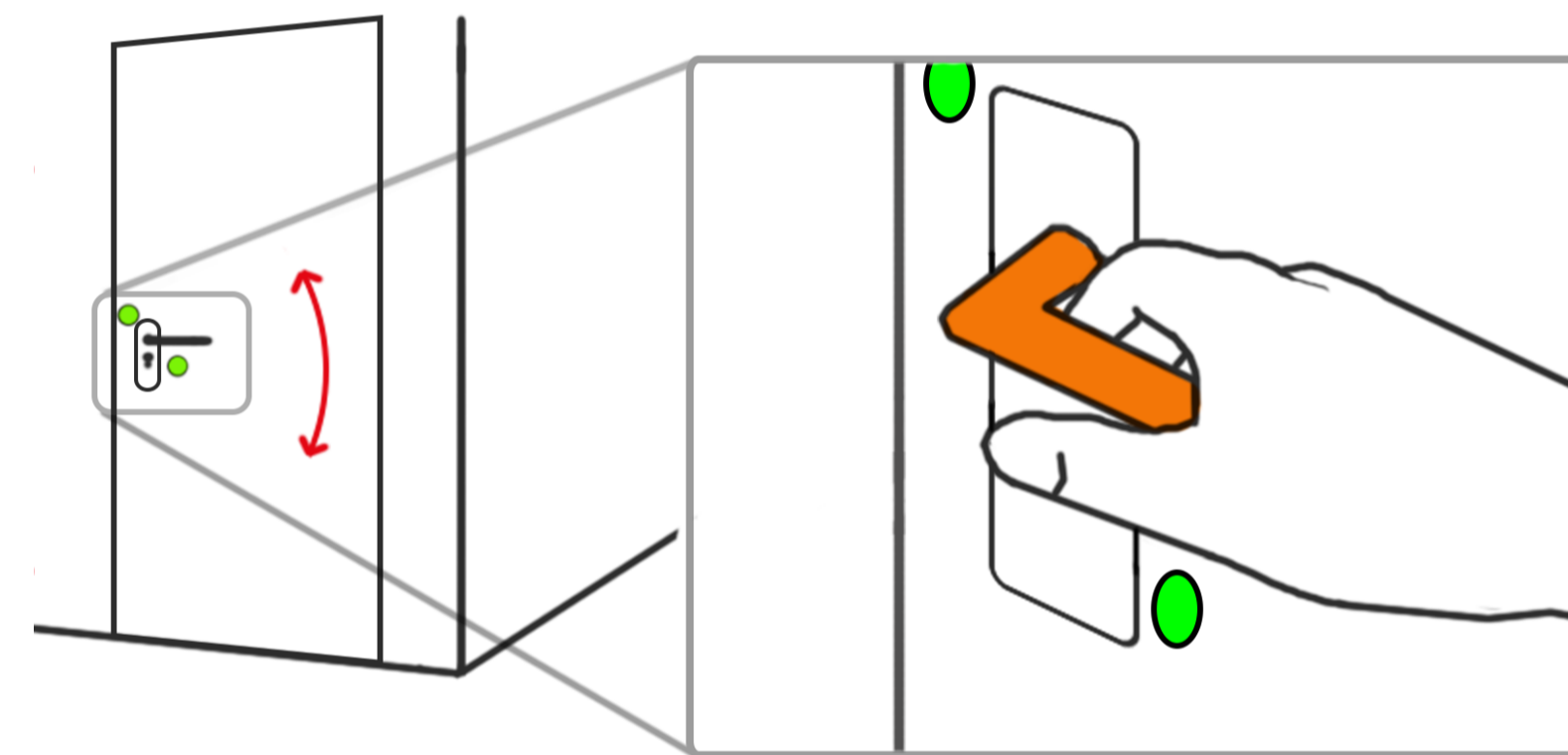
Abstract & Motivation

We developed **SenseHandle**, a system to unobtrusively measure users' interactions with door handles.

Vision: embed authentication in natural interactions with door handles

- **Effortless:** no additional unlocking action necessary
- **User is in Control:** authentication is triggered only if the user is physically interacting with the door handle

Contribution: development of a prototype and pilot test of user identification with different sensing technologies



1. Inertial Measurement
2. Swept Frequency Capacitance
3. Acoustic Sensing

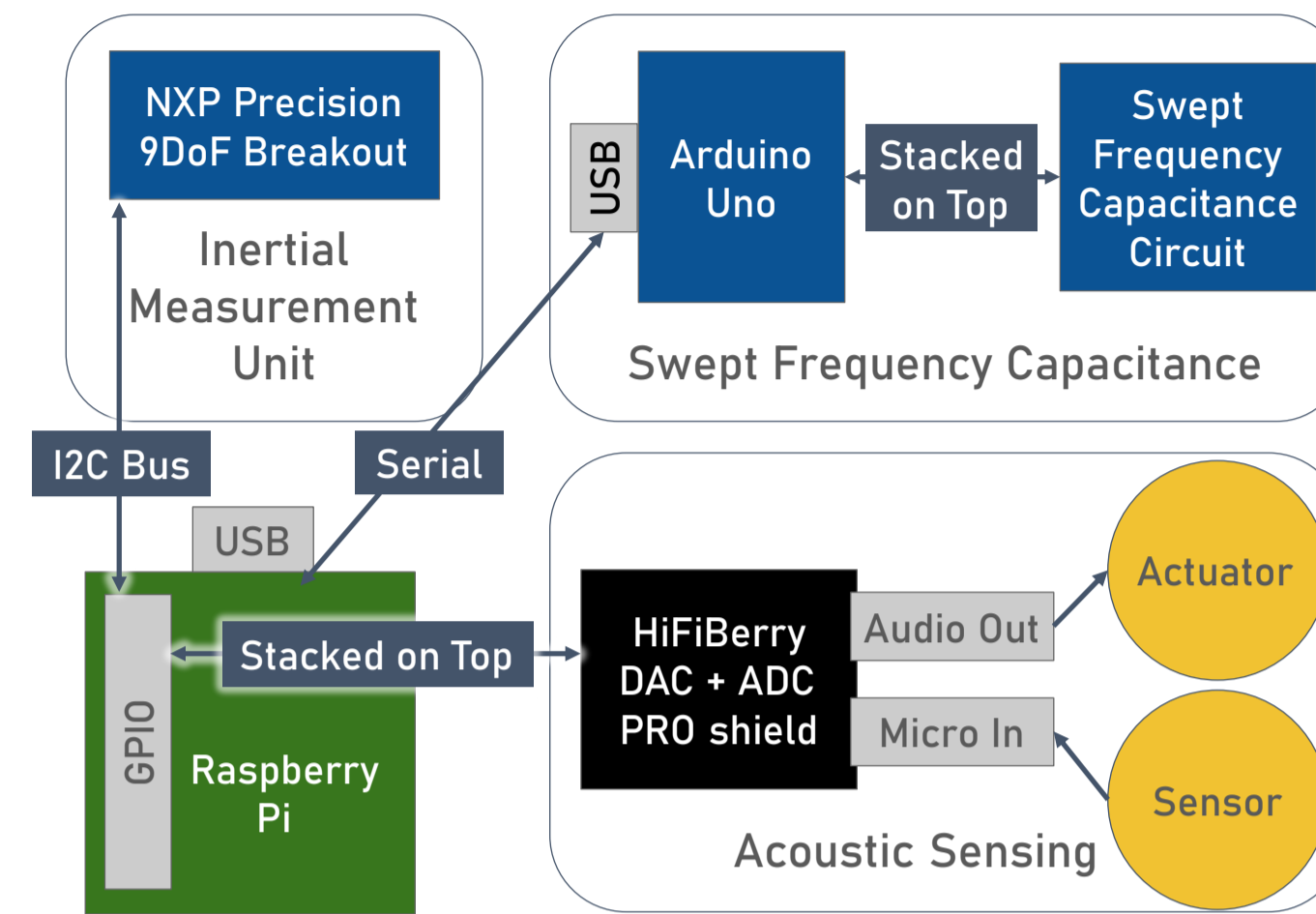
Sensing Technologies

- **Movement - Inertial Measurements¹:** angular velocity, acceleration and magnetic field in all 3 axis
- **Touch - Swept Frequency Capacitance²:** sweeping signals from 0.6kHz to 4MHz (189 irregular steps in 130ms)
- **Force - Acoustic Sensing³:** sweeping sinusoidal waves from 100Hz to 5kHz (91 steps in 310ms)

1. Gupta et al. SmartHandle: A novel behavioral biometric-based authentication scheme for smart lock systems. ICBEA'19

2. Sato et al. Touché: Enhancing touch interaction on humans screens, liquids, and everyday objects. CHI'12

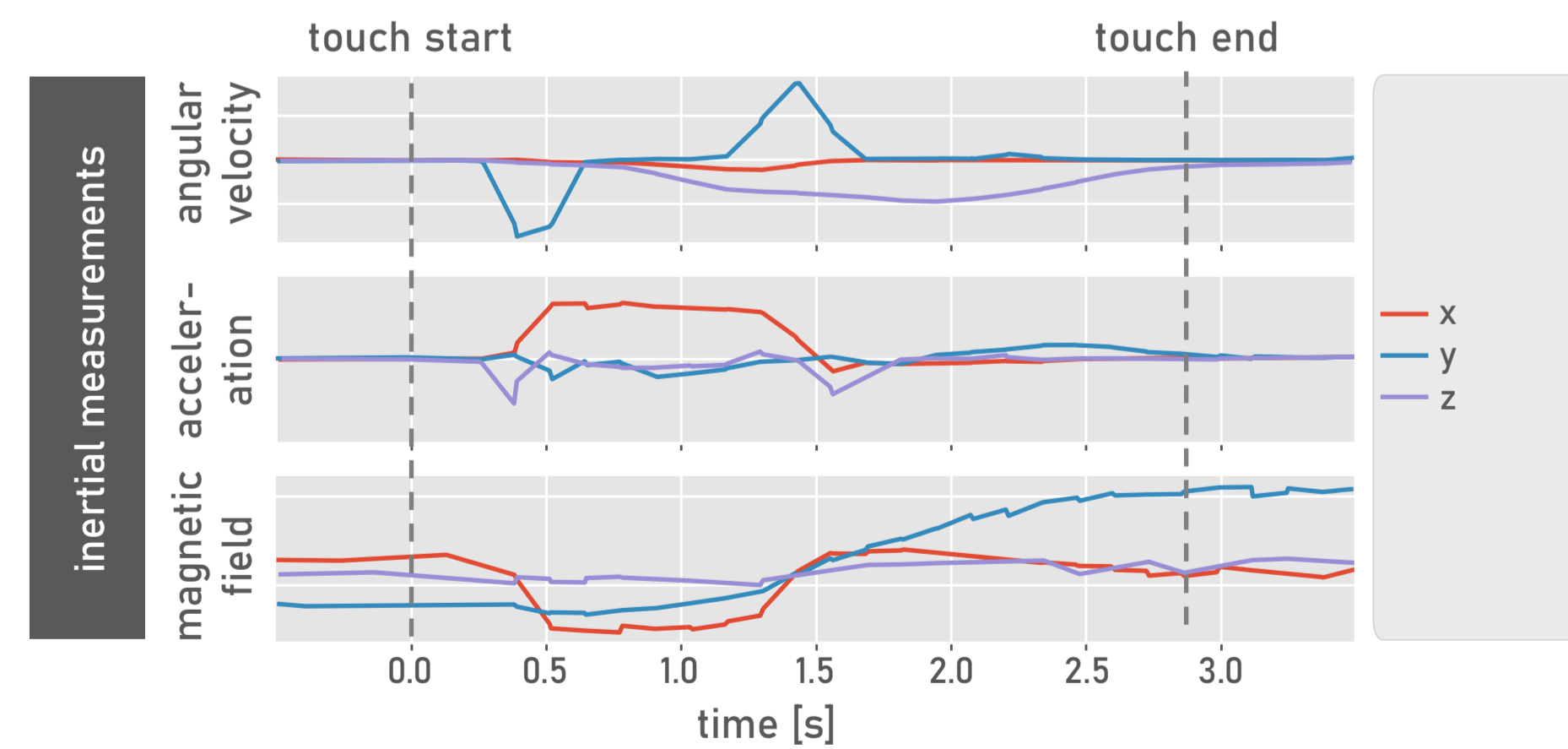
3. Ono et al. Touch & Activate: Adding interactivity to existing objects using active acoustic sensing. UIST'13



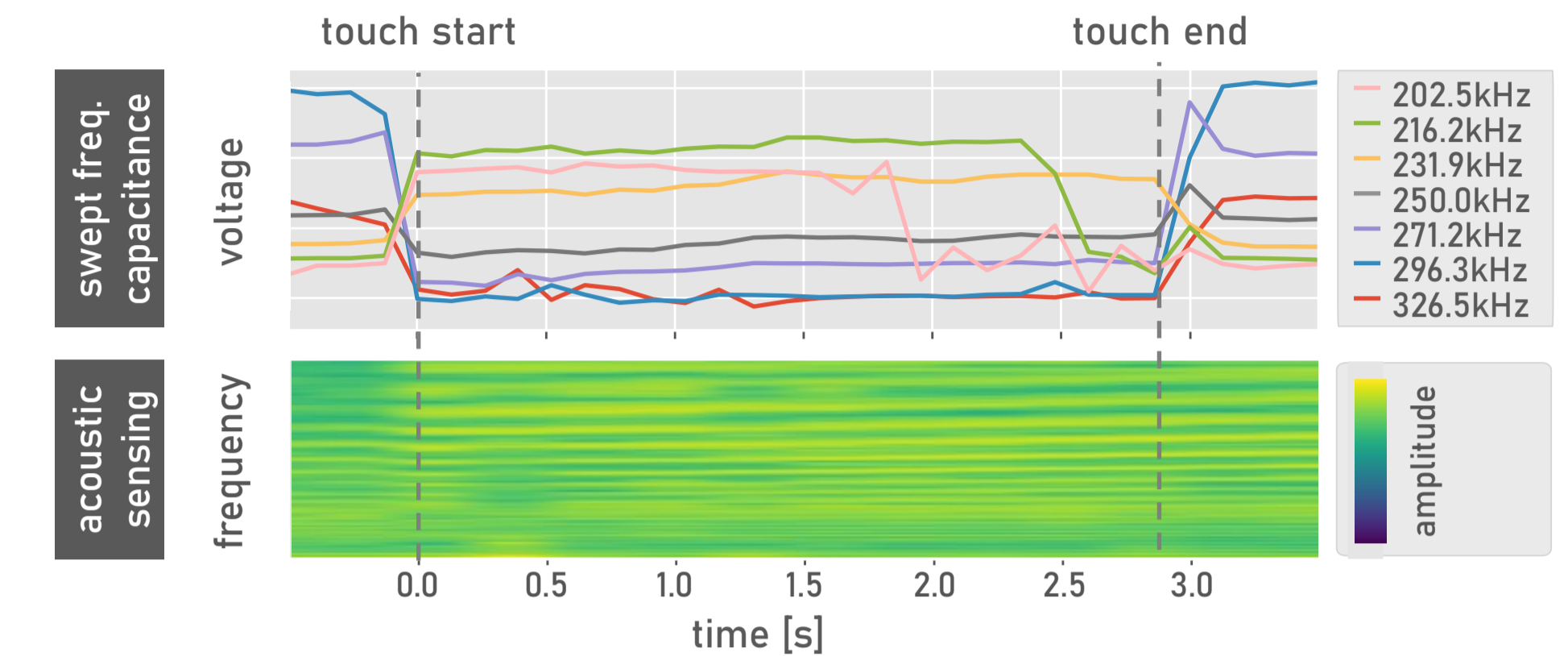
SenseHandle is based on consumer electronics for easy replicability.



Our system can be non-invasively situated on lever-style door handles.



Plot of IMU values measured when opening the door.



Plot of capacitance (selection) and fft-transformed acoustic signals.

Pilot Test (N=4)

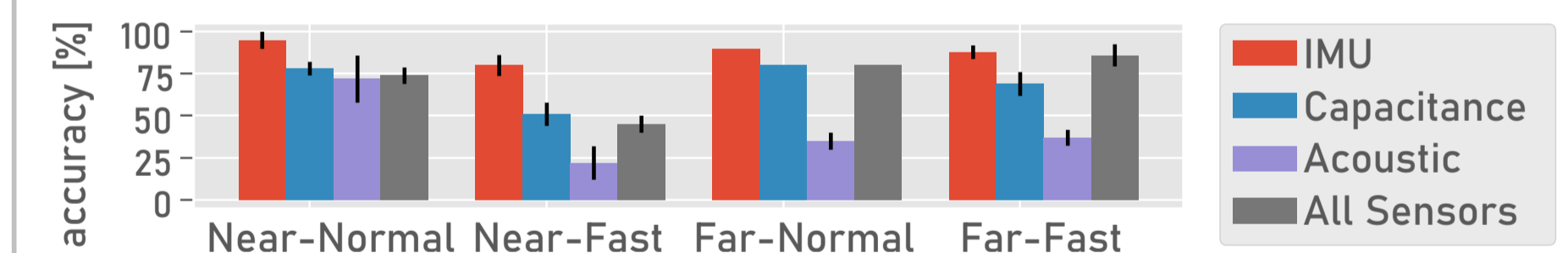
Conditions

- previous walking distance - near (25cm) and far (5m)
- interaction speed - normal and fast aka. "Your phone is ringing!"

Random Forest Classifier

- trained on 75% of all full repetitions
- final classification decision is based on winner-takes-it-all

Findings: inertial measurements performed best, followed by capacitance and acoustic sensing



Identification accuracies when opening the door.

Discussion & Future Work

- **Technical improvements:** integrate force sensitive resistors to gain reliable data on the grip strength
- **Robust Authentication:** compare different models trained with data from large-scale studies and test performance in the wild
- **Use Cases Beyond Security:** personalization of smart devices, detection of the physiological state of users or explicit interaction method

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Paper & Supplementary Materials



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