DES535
Ubiquitous Computing

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Google Classroom Code : pcwnf5t

Ambient & Context-Aware Computing

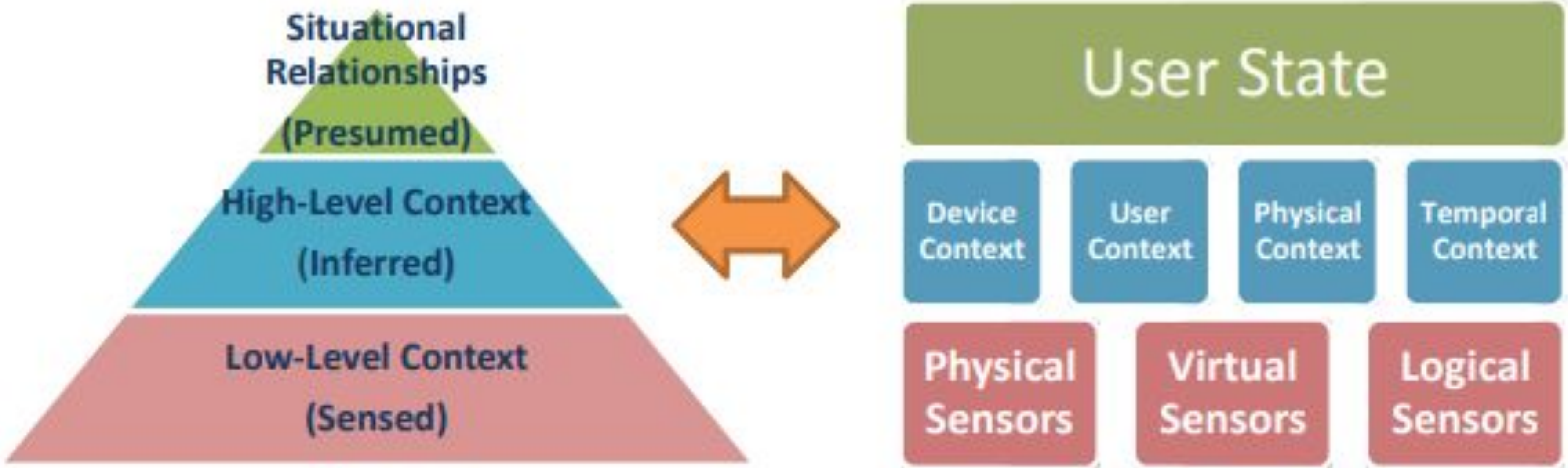
Module III

Types of Sensors for Context Sensing

- Physical sensors refer sensors that can capture any physical world belonging data (e.g., GPS: location, accelerometer: activity etc.).
- Virtual sensors imply a source from software applications and/or services, and a semantic data obtained through cognitive inference (e.g., location info by manually entered place pinpoint through social network services or computation power of devices etc.).
- Logical sensors define combination of physical and virtual sensors with additional information obtained through various sources by user interactions (e.g., databases, log files etc.).

Ö. Yürür, C. H. Liu, Z. Sheng, V. C. M. Leung, W. Moreno and K. K. Leung, "Context-Awareness for Mobile Sensing: A Survey and Future Directions," in IEEE Communications Surveys & Tutorials, vol. 18, no. 1, pp. 68-93, Firstquarter 2016, doi: 10.1109/COMST.2014.2381246.

Hierarchy of Context Representation



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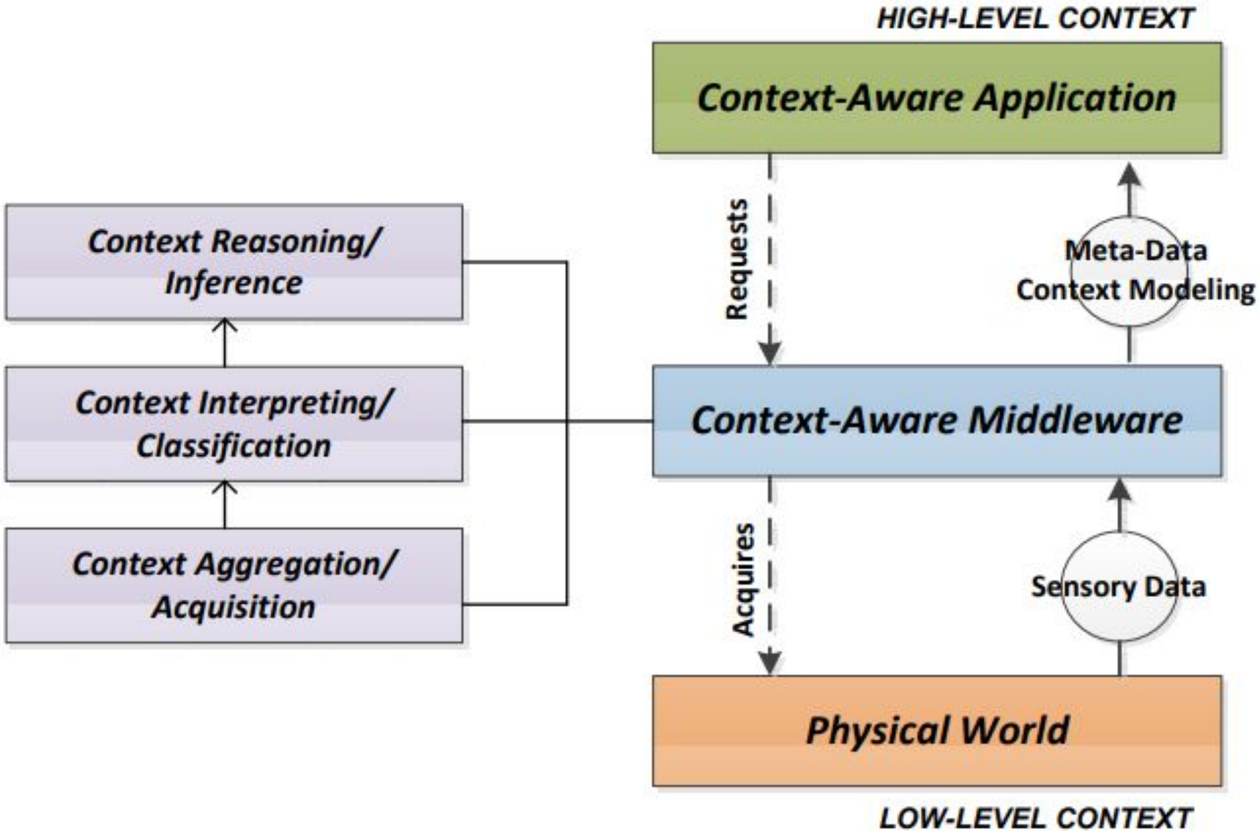
Architecture of Context-aware Systems



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Case Study 1

CHI 2018 Best Paper Award

Wall++: Room-Scale Interactive and Context-Aware Sensing

Yang Zhang[1,2] Chouchang (Jack) Yang[1] Scott E. Hudson[1,2] Chris Harrison[1,2] Alanson Sample[1]

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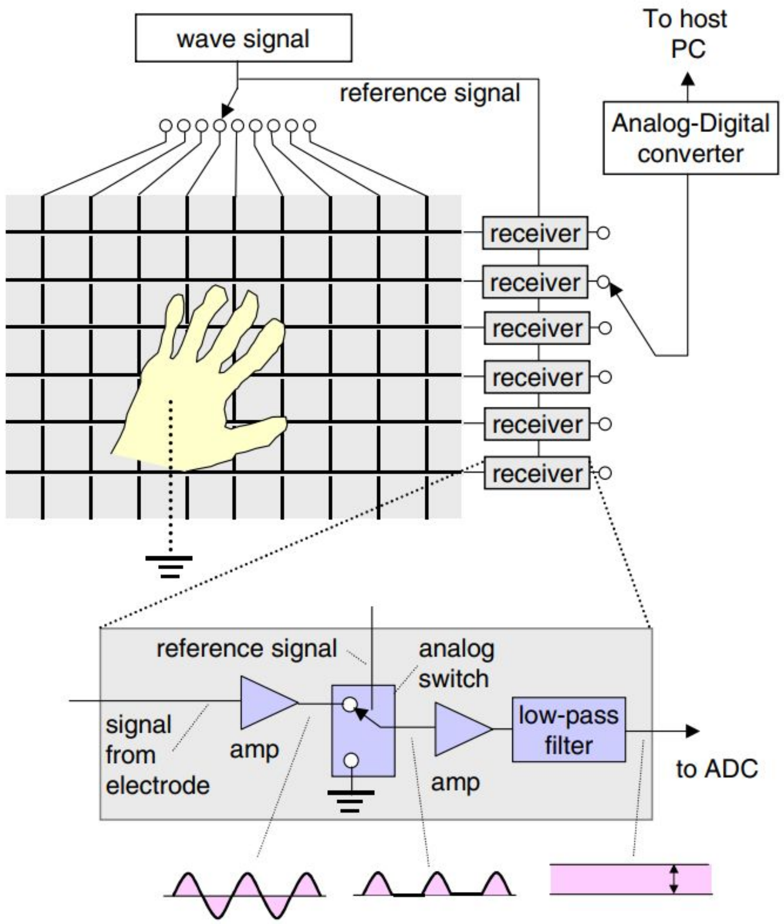
Capacitive Sensing : The pioneers (SmartSkin)

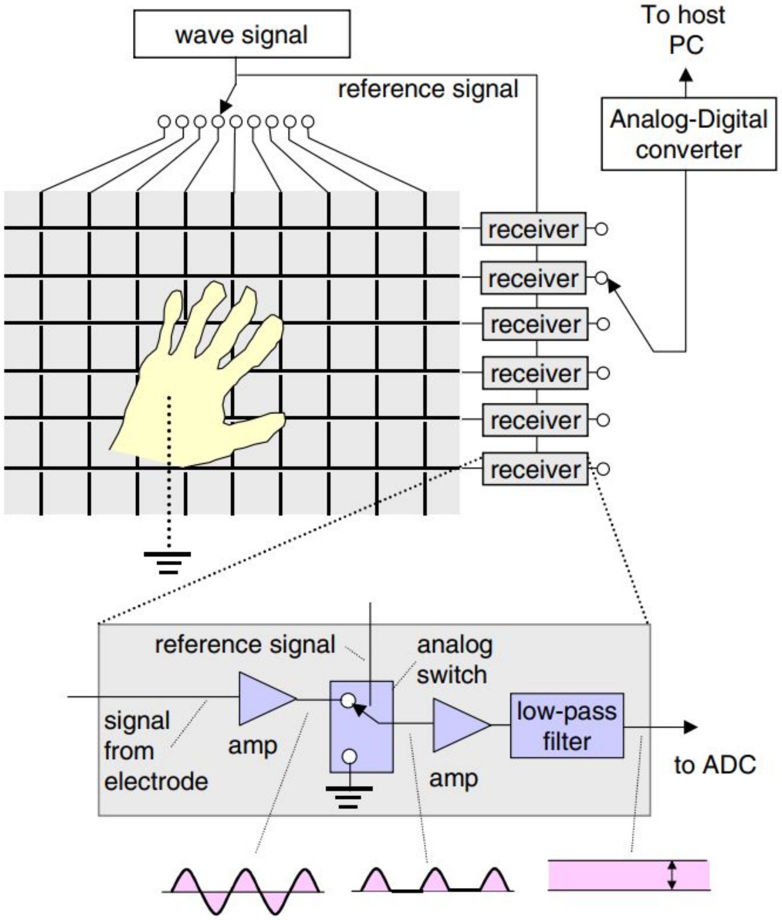
- The sensor consists of grid-shaped transmitter and receiver electrodes (copper wires).
- The vertical wires are transmitter electrodes, and the horizontal wires are receiver electrodes.
- When one of the transmitters is excited by a wave signal (of typically several hundred kilohertz), the receiver receives this wave signal because each crossing point (transmitter/receiver pairs) acts as a (very weak) capacitor.



Rekimoto, Jun. "SmartSkin: an infrastructure for freehand manipulation on interactive surfaces." Proceedings of the SIGCHI conference on Human factors in computing systems. 2002.

Capacitive Sensing : The pioneers (SmartSkin)

- When a conductive and grounded object (finger) approaches a crossing point, it capacitively couples to the electrodes, and drains the wave signal.
- As a result, the received signal amplitude becomes weak.



Rekimoto, Jun. "SmartSkin: an infrastructure for freehand manipulation on interactive surfaces." Proceedings of the SIGCHI conference on Human factors in computing systems. 2002.

Capacitive Sensing : Smartscreens

Typical diamond pattern of a mutual-capacitance touch sensor. Approaching fingers couple to the lines and cause a drop in capacitance between them.

Watch this video : https://www.youtube.com/watch?v=IdWXT391FJE

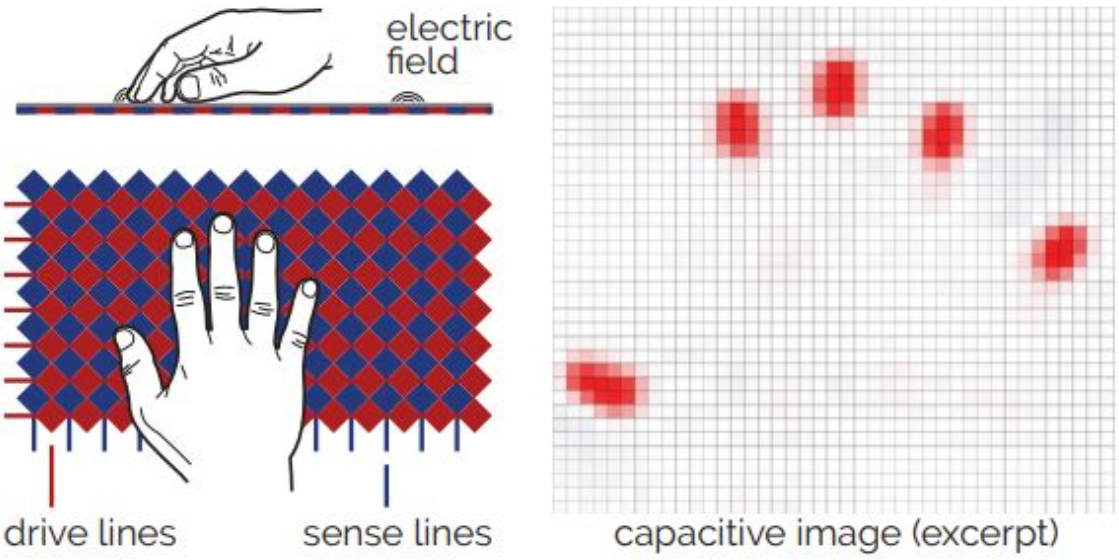


Image Source: https://siplab.org/projects/TouchPose


HOW DO
TOUCHSCREENS
ACTUALLY
WORK?
TEDEd

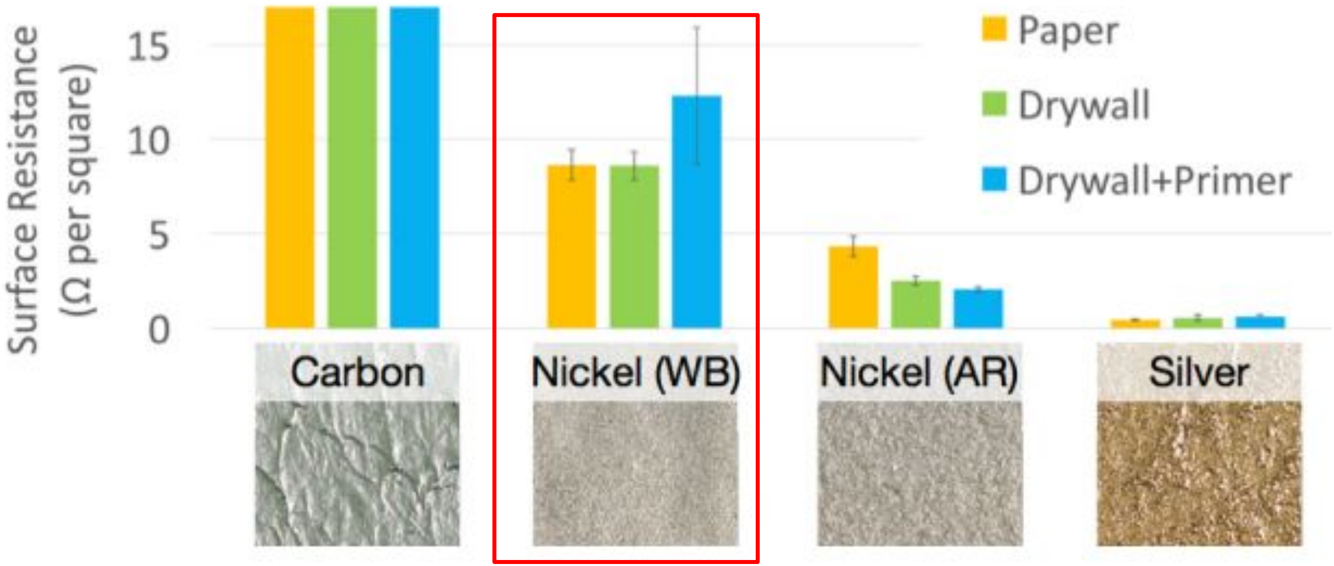
Capacitive Sensing : Other Applications

https://siplab.org/projects/Bodyprint#:~:text=Bodyprint%20compensates%20for%20the%20low,rejection%20rate%20of%2026.82%25%20to

Phases of Wall ++

Phase 1: Paint and Backing Materials

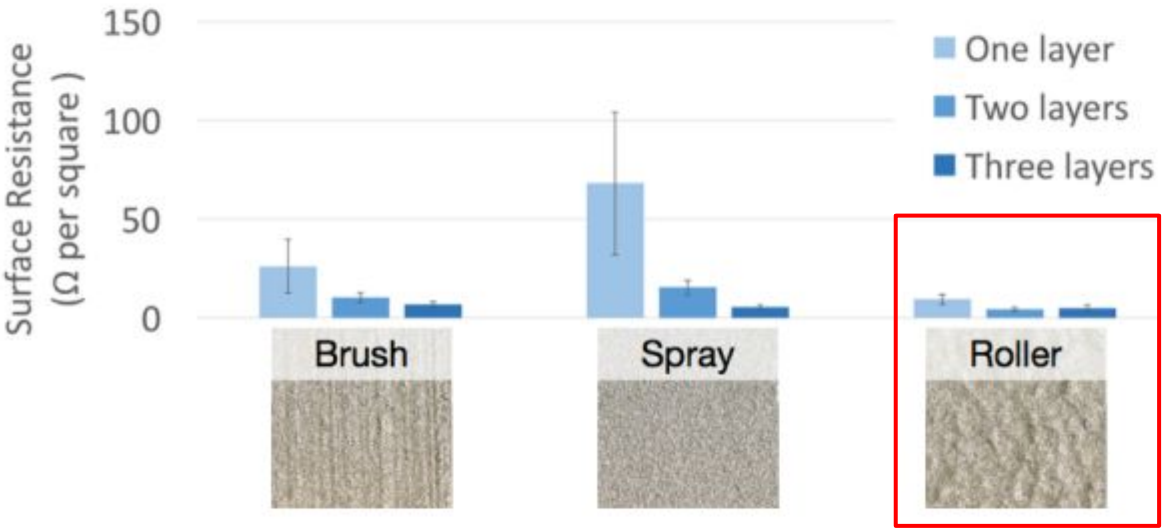
- carbon
- water-based nickel
  acrylic-based nickel
- silver



Phases of Wall ++

Phase 2: Application Method and Number of Coats

- brush
- spray
- roller

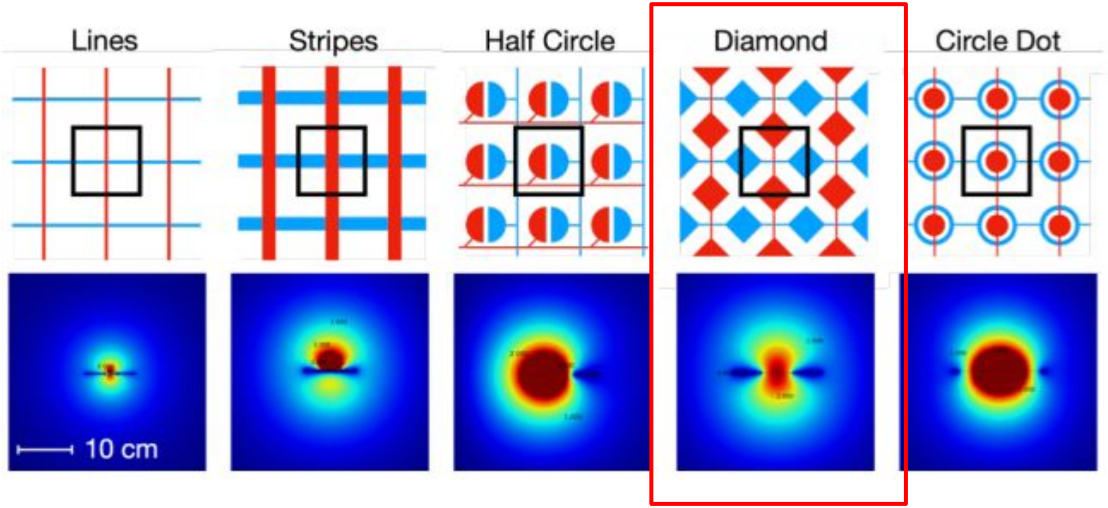


Phases of Wall ++

Phase 3 & 4: Topcoat, Traces & Insulation : Latex overcoat, copper traces with vinyl stickers

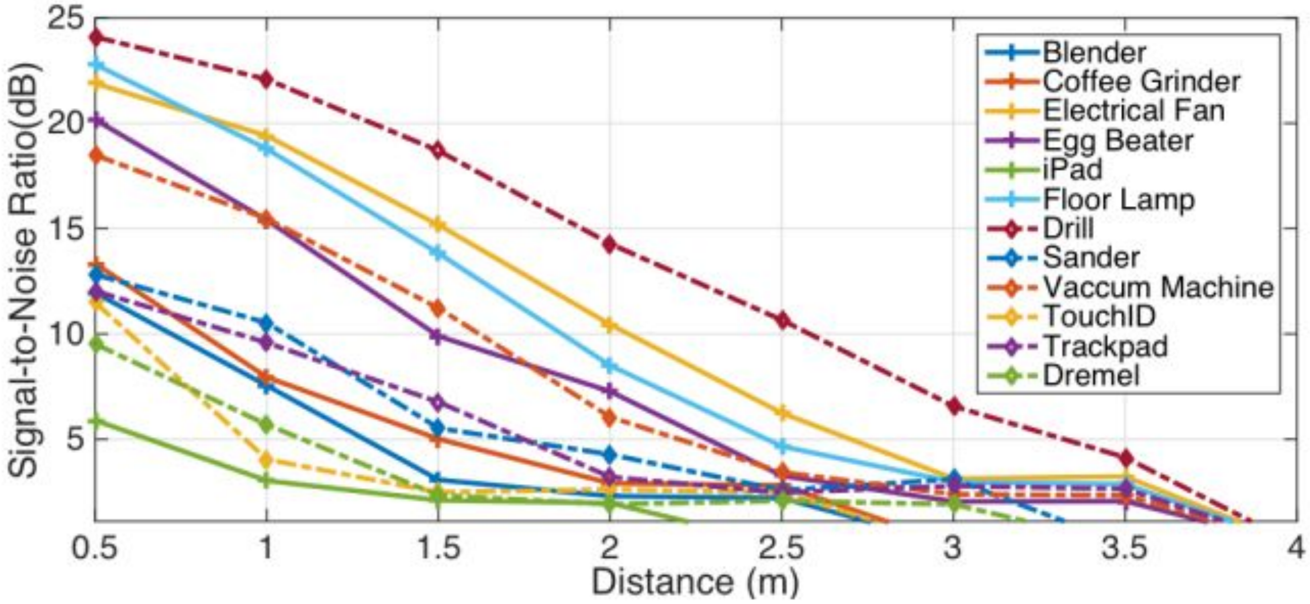
Phase 5 & 6: Electrode pattern and optimization

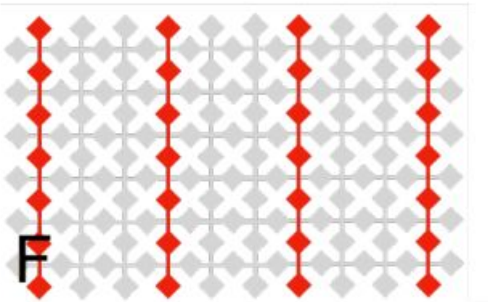
1) projected an electric field as far as possible, so as to provide the largest interactive volume, while also
2) offering sufficient resolution to enable fine-grained interactions



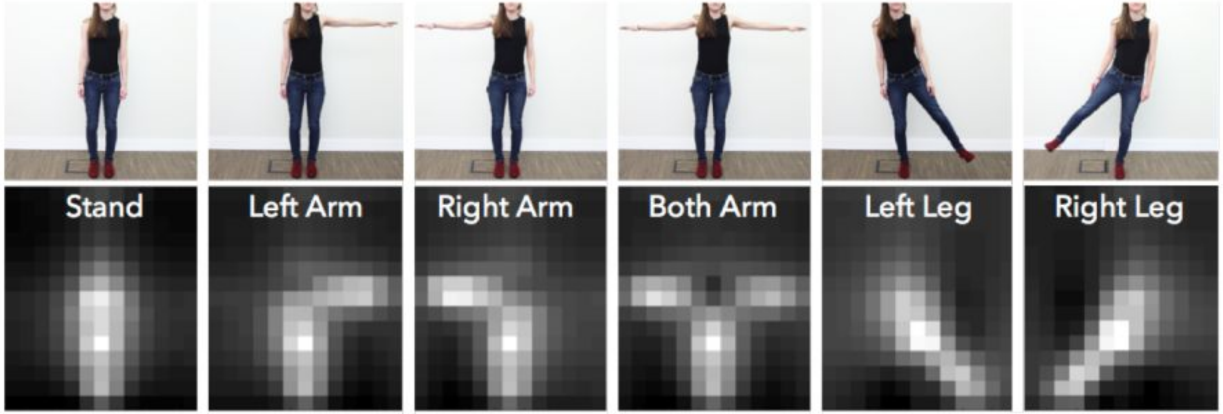
Phases of Wall ++

Phase 7: Antenna for Electromagnetic Signals (Environment Sensing)





Results of Wall ++ : Pose Estimation



Actual Class (%) / Predicted Class (%)

Actual \ Predicted	Stand	Left Arm	Right Arm	Both Arm	Left Leg	Right Leg
Stand	99.6	0.3	0.1	0.0	0.0	0.0
Left Arm	1.9	98.0	0.0	0.1	0.0	0.0
Right Arm	2.0	0.0	97.0	1.0	0.0	0.0
Both Arm	0.6	3.9	4.1	91.4	0.0	0.0
Left Leg	15.3	0.0	0.7	0.0	84.0	0.0
Right Leg	15.2	3.0	0.0	0.0	0.0	81.8

Results of Wall ++ : Tracking distance error at three test locations


Wall++
Interactive & Context Sensing Walls

Derived Idea

Can we build Smart Papers with Capacitive sensing capabilities? If so, can you develop a conceptual model ?

Activity 2 : Time bound activity on Capacitive Sensing

Develop a simple mobile application that displays your touch points on its screen.

Hint: Use canvas element in MIT App Inventor