

Interface and Interaction for IoT

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new interfaces

- point-and-click and touch screens less likely to be used on embedded devices
 - cost
 - space
 - context

Input through	<i>Used in...</i>
Touch, Press	<i>Physical controls, Touch screens</i>
Move & manipulate	<i>Tangible UIs</i>
Speech	<i>Speech recognition</i>
Whole body	<i>Gesture recognition, Proximity sensing</i>
Galvanic skin response	
Thoughts	<i>Brain-computer interfaces</i>
Heart rate	<i>Determine stress, anxiety, sleep,...</i>

Receive output through	
	<i>LEDs, Screens</i>
	<i>Sound, Voice output</i>
	<i>Vibration, Force feedback, shape</i>
	<i>Scent messaging</i>
	<i>Temperature output</i>

Physical controls

- button, switches, sliders, rotary knobs, ...
- not just input (position indicates state)
- haptic, tactile: operating force, stroke (distance that button travels when pressed)
- **GOOD FOR:** direct and fast controls, when finer adjustment is required, accessibility for visually impaired users
- **LESS APPROPRIATE:** on products that are software updated frequently, when functions or settings can be controlled from different places

Lights

- LEDs,....
- color coding, blink patterns,
- require few attention
- GOOD FOR: glance-able and non-intrusive information output
- LESS APPROPRIATE: for conveying complex information



Displays and Screens

- segment displays, monochrome and color displays and screens, Electronic-ink
- cost
- feature creeping. Can it still work w/o a display?
- GOOD FOR: making physical objects dynamic (e.g. dynamic labels), keeping products flexible (sw updates)
- LESS APPROPRIATE: for keeping the UX simple

Audio output

- sounds, text-to-speech
- pervasive; carry emotions
- no need to look at the device nor to be near the device
- GOOD: for urgent and time-critical alerts; to give emotional qualities to product; to give complex information; when other channels are occupied (e.g. car navigation);
- LESS APPROPRIATE: where it becomes annoying; where it could disturb other people

Voice input

- still unreliable; recall instead than recognize (list of commands?)
- GOOD: when other channels are occupied; when there's good connectivity and low noise; when complex data input is required; for hands free interaction;
- LESS APPROPRIATE: when commands and terms are hard to pronounce and recognize; for many different localisations (cost)

Tangible and tactile

- moving or placing physical objects; physical manipulation; vibration; force touch;
- easier to learn and understand
- both input and output
- ambient representation of data
- GOOD FOR: don't feel to interact with a computer; demand less attention; educational products;
- LESS APPROPRIATE WHEN: it's critical to keep parts together; no time to learn; reliability is required



Gestural input

- swipe, pinch, mid-air gestures, body movements...
- GOOD FOR: video games; wearable devices; short interactions;
- LESS APPROPRIATE WHEN: precision and lengthy interaction required; false positives are not acceptable;

Context-sensitive interaction

- being in a room, place, or near a product
- demand less user attention
- designer needs to interpret the context
- GOOD: to manage complexity with little interaction; when there is straight relationship between context and device features
- LESS APPROPRIATE: when it may be perceived as patronizing when system limits user or take actions based on context)

Computer vision and bar codes

- facial recognition; biometric interfaces; bar codes; QR codes; OCR;
- GOOD FOR: replacing manual cumbersome input
- LESS APPROPRIATE: when it requires other interaction more complex than its alternatives