IoT Locators for Privacy Awareness

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The Switch

Airbnb refunds guest who found indoor cameras during his family’s stay
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Found Hidden Camera in AirBnb (Seattle, WA) (self.legaladvice)
submitted 1 year ago * by mischief
managed

My bf and I are staying at an airbnb in Seattle, we're basically living in the bottom unit (basement) and there are no walls separating our bedroom from the unit above us. When we were able to finally fall asleep was when we realized there was a strange noise coming from the above unit.

An Airbnb I recently stayed at had hidden cameras in the bedrooms, my friends and I were recorded having sex. Anything I can do to have the footage deleted? (self.legaladvice)

Family finds hidden camera livestreaming from their Airbnb in Ireland

By Emily Dixon, CNN
Updated 1016 GMT (1816 HKT) April 6, 2019

More than 1 in 10 Airbnb guests have found hidden cameras: Survey
But Not Just an AirBnB Problem

- IoT devices are small, unobtrusive, and sometimes look like ordinary real world objects
  - Just knowing “a camera is nearby” not enough
  - Ex. Camera pointed inside vs outside
- Survey we ran on MTurk (N=226)
  - 192 had used AirBnB, 86 searched for devices
  - 8 found undisclosed devices (cameras + voice asst)
  - 21 were informed of devices by host, 10 still searched
  - Devices: Camera + microphones most sensitive
  - Other places: restrooms, hotels, restaurants, houses
Locators for IoT Devices

• Idea: make it easier to physically locate devices
  – Help with physical dimension of privacy
    • Go beyond text-based privacy notices
    • Ex. Can see where camera is and where it’s pointed
  – Help with finding lost devices too

LEDs off

Camera ➔ LEDs on
Example of Locating IoT Devices

• Use smartphone to contact nearby devices
  • Ex. “Turn on nearby locators for devices with a camera”
Design Space

• Used AirBnB scenario as starting point

• Working assumptions
  – Device manufacturers and device owners want this
    • Legal, market, social forces
    • Korean smartphones required to make shutter sounds
  – There is some standard wireless networking + API

• Design goals
  – Cheap (for manufacturers)
  – Easy to deploy (for owners)
  – Effective for locating devices (for users)
Design Space

• Option 1 - Visual
  – LEDs are very cheap (~$0.08)
  – Parallel scanning, easy setup, but can be occluded
  – Pilot tests all preferred blue and blink pattern (a)

• Option 2 - Audio
  – Mini speakers are cheap (~$0.80)
  – Hearing is serial, easy setup, but harder to localize
  – Pilot tests all preferred beep pattern (f) with LED too
Design Space

• Option 3 - Contextualized pictures
  – Taken and annotated by the device owner
  – No extra manufacturer cost, but owner has setup cost and scalability issues
Study 1 – General Performance

- Set up 5 different devices in a single room
  - Different heights, exactly one device occluded
- Asked people to find devices (4 conds, between)
- Changed devices, rearranged room, repeat
Study 1 – General Performance

- Surprisingly, people described all three locators as fun
Study 2 – Scale up to 15 devices

Figure 8. Average time used to find a prototype in Experiment One and Experiment Two (Setting 2) by locators. No statistical significance is observed after pairwise comparisons.
NASA TLX (Cognitive Load) Results

• Self-reported, out of 10 (lower is better)
• Numbers in figure are comparison to study 1
  – So higher cognitive load across the board
Subjective Satisfaction

- Out of 5 (higher is better)
- People generally liked both LED+Beep and picture
Discussion

• Embodied privacy for IoT
  – Physical feedback and control

• Need standards for:
  – Wirelessly pinging for nearby devices (channel limited)
  – Metadata describing devices + sensors (ex. camera)

• Denial of Service attacks
  – Beep... beep... beep... ARGH!

• Find more value for locators to facilitate adoption
  – LEDs for transmitting data (VLC) for AR Support
  – Finding lost devices