

# Designing Connected Products

## **Embedded Interface Design**

with **Bruce Montgomery**



# Learning Objectives

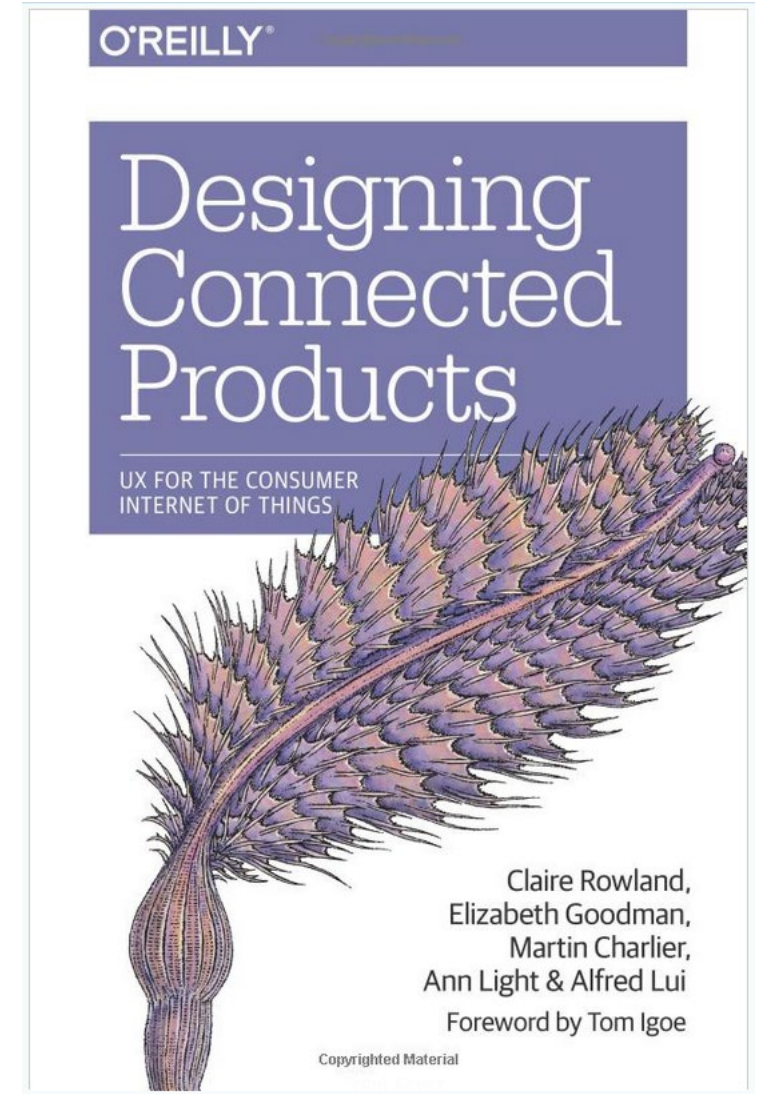
Students will be able to...

- Consider the impact of data on embedded designs
- Consider the various aspects of design and how they impact embedded devices



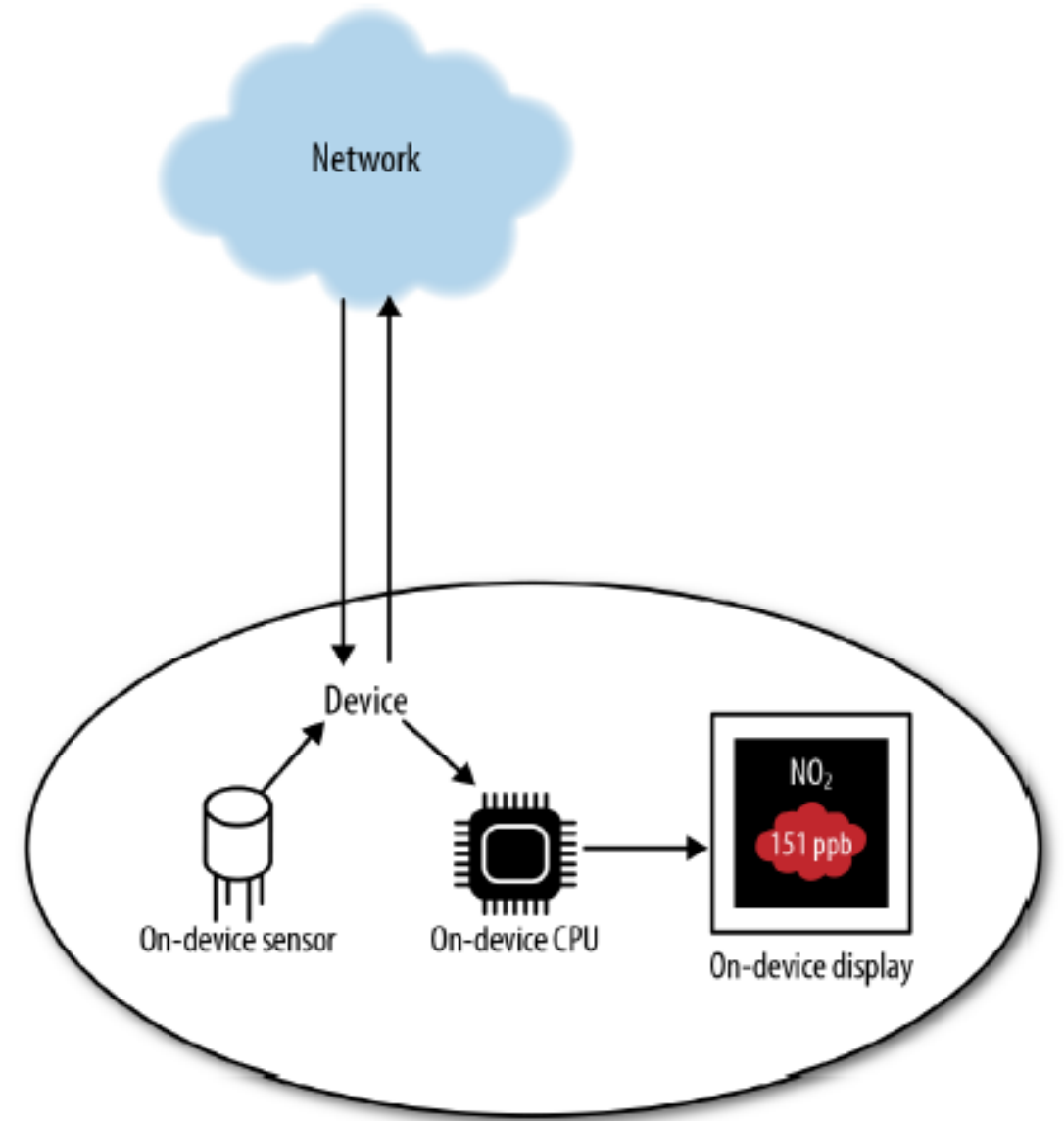
# Designing Connected Products

- Rowland et al., 2015, O'Reilly
- Great overview of UX for IoT and connected devices
- Rare to see this focus
- UX approaches
- Case studies
- Data, context, usage
- Embedded device design
- Reference [1]



# Flow of Data in IoT

- Generally, we think of IoT data moving from devices to networks, such as the cloud
- In the Fog model, the data may be processed locally (at the edge) before going elsewhere
- For complex devices (ex. A robot vacuum cleaner), data may be largely collected and acted on by the device, with little external contact except for diagnostics or activity reports
- Figure 13-5 Reference [1]



# Types of data in IoT

- Types
  - Information about the physical environment
  - Information about things; location or states
  - Biometrics – heart rate, respiration, etc.
  - Human behavior – physical activity level or actions being taken
- Static vs. Dynamic Data
  - Static data usually provides context for dynamic data (a name mapped to heart rate)

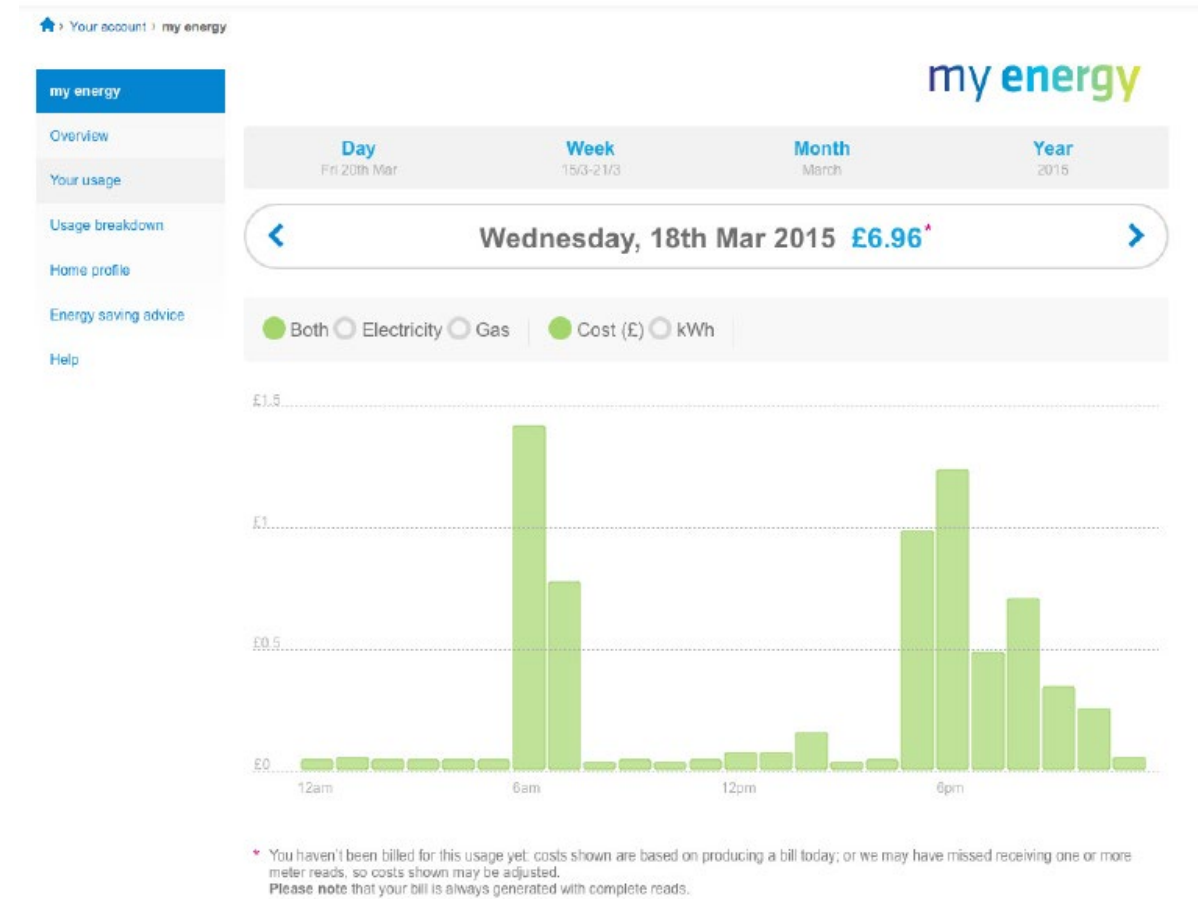


Figure 13-10 Reference [1]

# Types of data in IoT

- Direct vs. Inferred Data
  - Direct – measuring speed or location or temperature
  - Inferred – deciding if a home is occupied based on electrical use
- Big Data vs. Small Data
  - Usage patterns in a city vs. your FitBit data
- Real-time vs. Historical
  - Tracking a car's movement vs. tracking all cars movements for a month on a highway
- Time and frequency of Data Collection

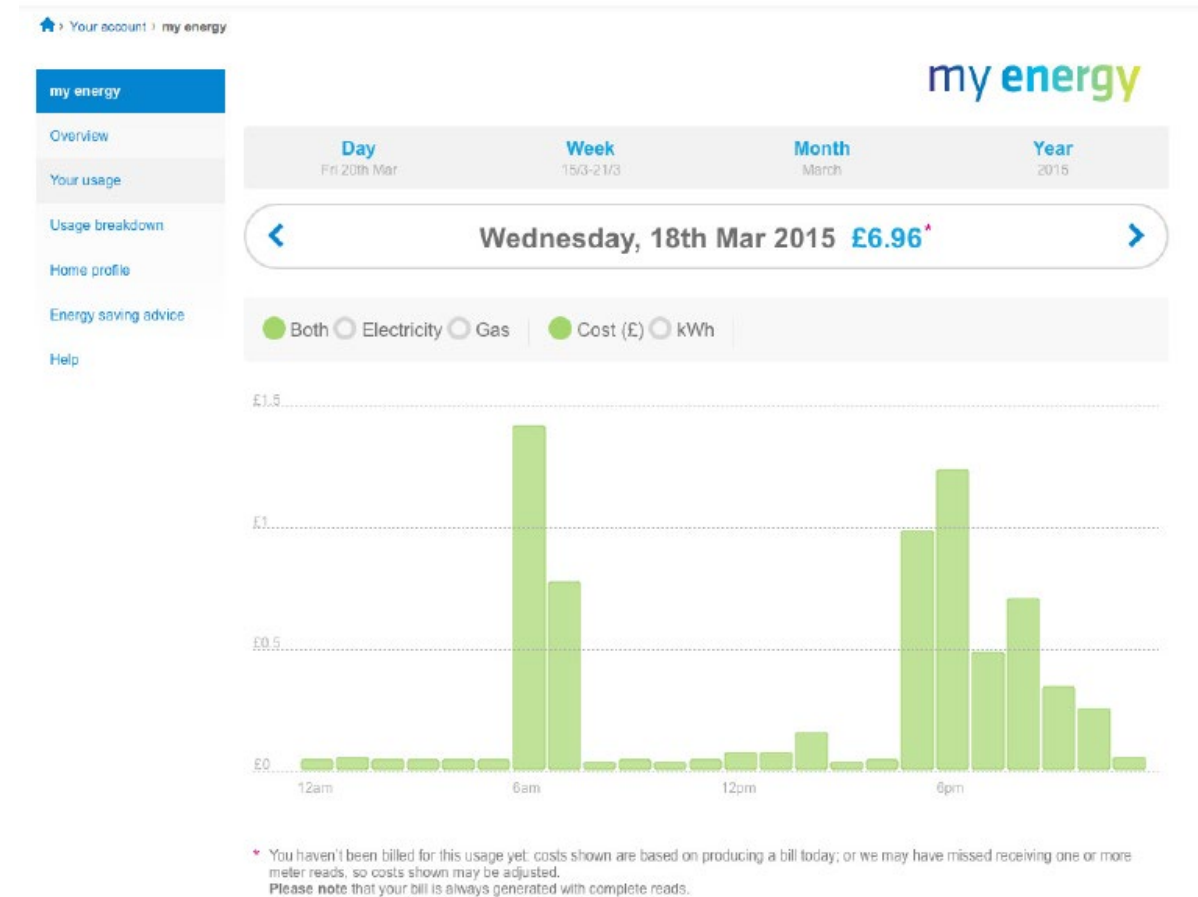
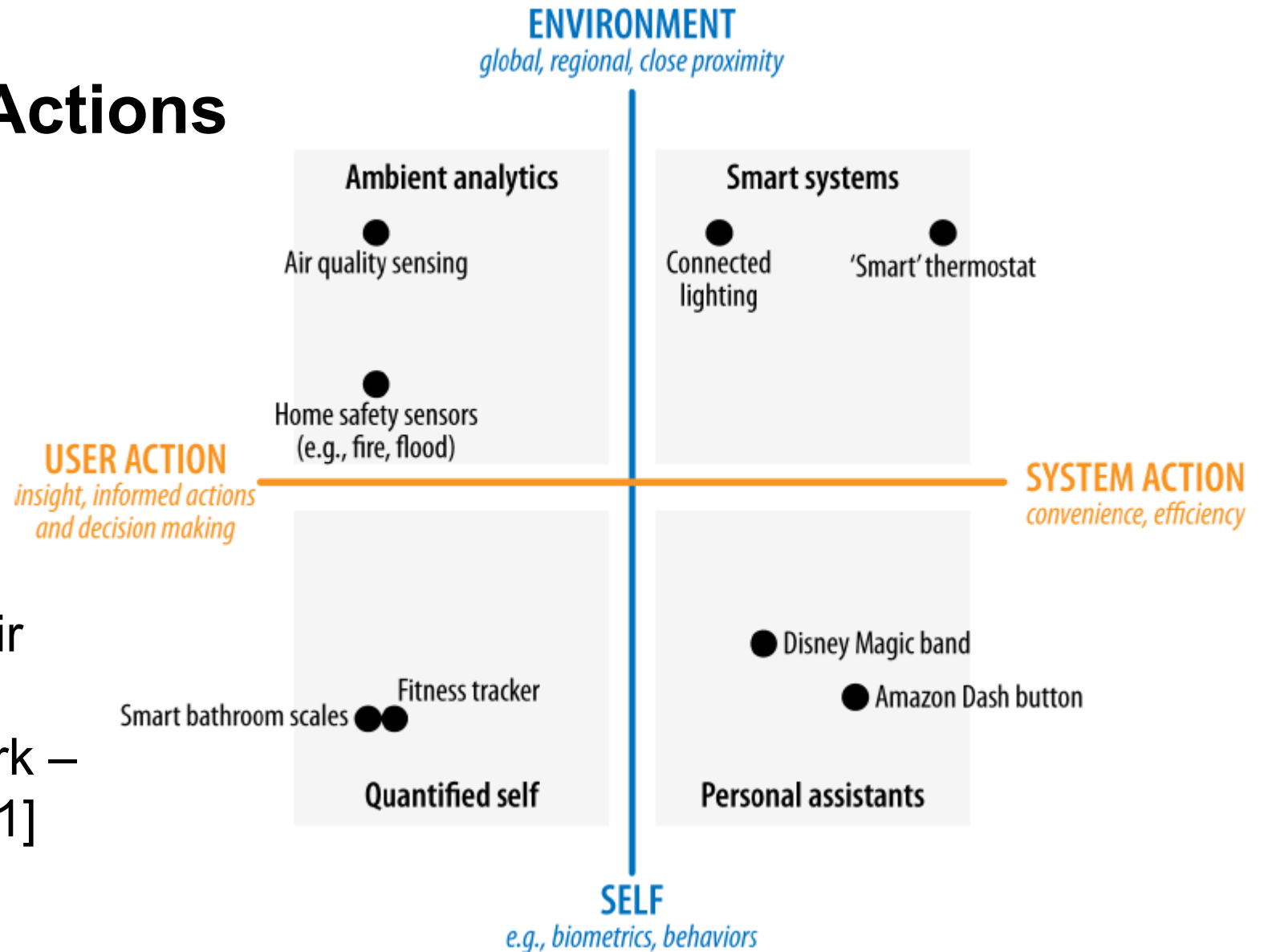


Figure 13-10 Reference [1]

# Data: Context vs. Actions

- Actions: What is the data used for?
- Context: What is the relationship of the data to the user?
- A way to classify types of devices and consider their role and contribution
- Context-Action Framework – Figure 13-11 Reference [1]



# Types of User Needs: Context for Data

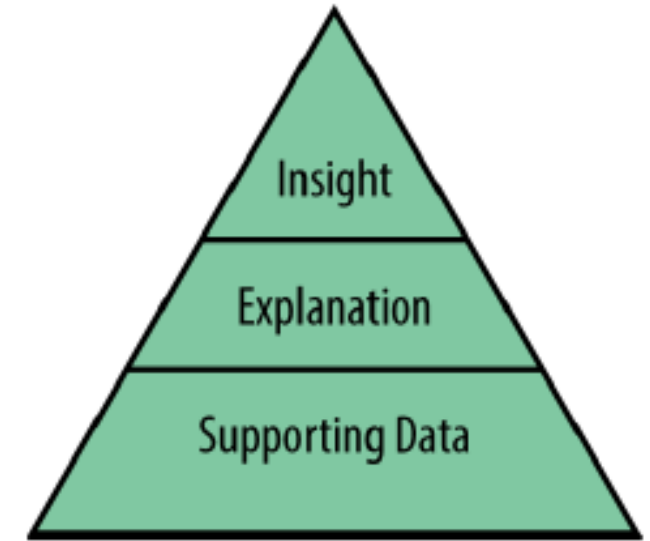
- Device or group of devices
  - Turn off all house lights
- Location
  - Turn off garage lights
- Function
  - Turn on the sprinklers
- Activity
  - Reminders for tasks in the morning
- Person
  - Tell me when my son is home from school
- Authorization
  - Unlock the porch door for the package delivery
- Time
  - Run the sprinklers from 6 AM to 8 AM
- State
  - Disable notifications if I'm driving
- Optimization
  - Lower house temperature when unoccupied





# UX and Data

- Making meaning and enabling action from data
  - Make data meaningful to users
  - Make data actionable: enable something of value to happen given the data
- Understand the user's motivation and goals
- Provide context and explanations
  - Trends, relation to other measures
- Provide actionable insights, explanations, and data
- Be transparent about what data is collected and why; what is done with the data
- Pyramid of progressive disclosure (Reference [1], Figure 13-16)



Using data in a feedback loop:

- Evidence – data captured
- Relevance – create user insights
- Consequence – outcome of user behavior
- Action – encourage user to take action

# Embedded Device Design

- Don Norman – 3 Levels of Emotional Design
  - Behavioral
    - Usability, how the design makes us behave
  - Visceral
    - Attractiveness, effect on senses, an enjoyable design
  - Reflective
    - The image the design portrays, how it makes the owner feel, what it says about the owner
  - Reference [2]
- Device Interaction and Placement as Design Drivers
- Visual Brand Language
- Three Faces of Physical Products



The Juicy Salif lemon squeezer by Phillippe Starck - “It’s not meant to squeeze lemons, it’s meant to start conversations.” [3]

# Device Interaction and Placement as Design Drivers

- Devices that are hidden away and rarely interacted with beyond initial setup
  - Example: a router or a remote hard drive
  - Interaction – Rare, Placement – Inconspicuous
  - The rare interaction should be facilitated (e.g. a clear reset button)
- Devices that are interacted with occasionally, but are more conspicuous and abundant due to what they do
  - Example: a smart plug or a motion detector
  - Interaction – Rare, Placement – Relatively Conspicuous
  - Higher focus on aesthetics, brand language
- Reference [1], Chapter 7





# Device Interaction and Placement as Design Drivers

- Devices that are interacted with frequently and that are likely to be on display
  - Example Amazon Dash Button or a remote control
  - Interaction – more often, Placement - conspicuous
  - Has to blend aesthetics with a clear statement of function

Reference [1], Chapter 7



# Visual Brand Language

- Immediate recognition of brand by visual characteristics of devices
- Product line unified by design language (Ex. Korea Telecom)

Reference [1], Chapter 7

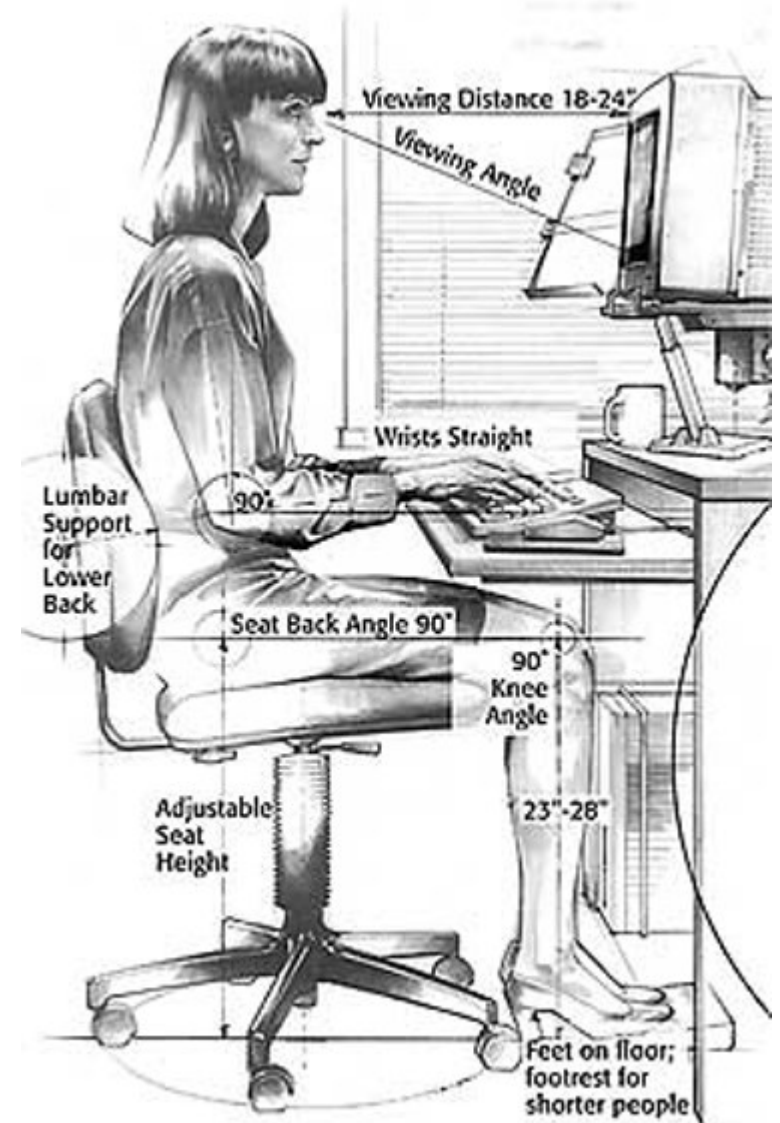


# Three Faces of a Physical Product

## 1. Form, function, and usability

- What does it do? How is it used? What does the way it works tell us?
- Ergonomics – human factors
- Affordance – how something is used or what it might do
- Practicalities – example: need for a replaceable battery compartment
- Functionality and interfaces – form and function

Reference [1], Chapter 7



# Three Faces of a Physical Product

## 2. Aesthetics and appearance

- How does it look? What color does it have? What's the surface finish?
- Consistency and cohesion – how well do products go together
- Conveying the brand image – brand language
- Personality and character – making the product enjoyable
- Multisensory – weight, texture, temperature

Reference [1], Chapter 7



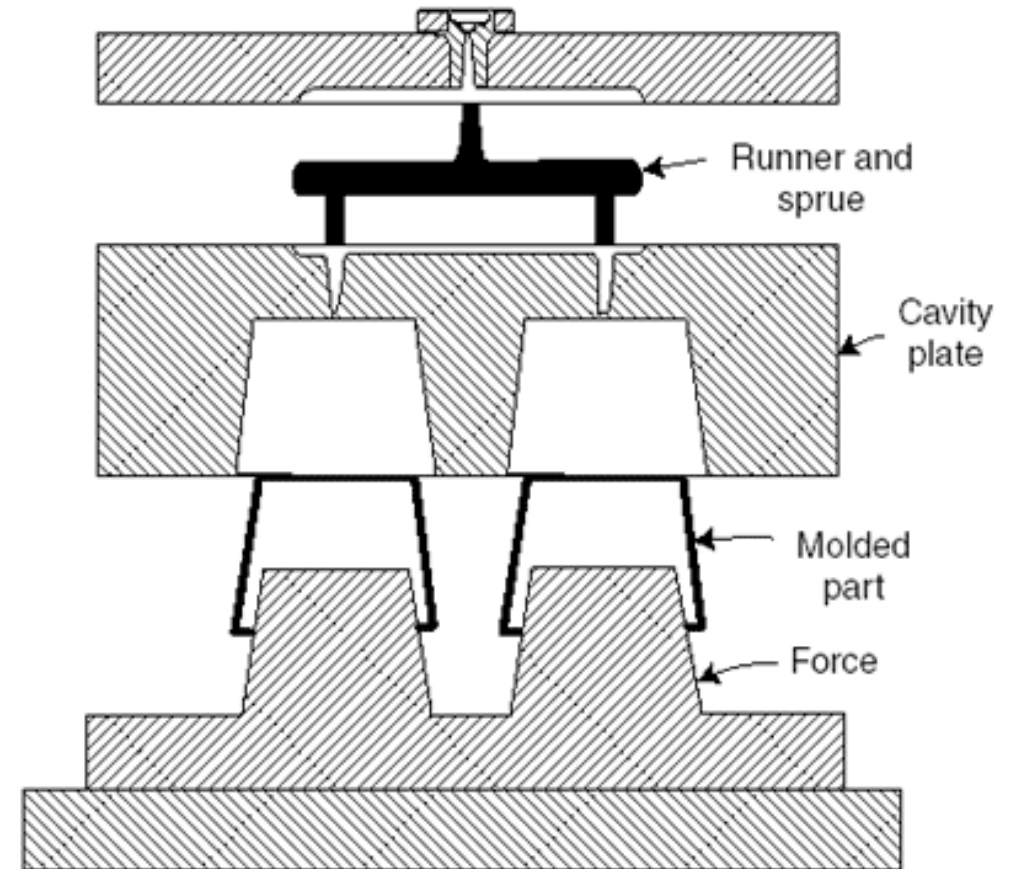


# Three Faces of a Physical Product

## 3. Materials, manufacturing, and maintenance

- What is it made of? How is it made or assembled? How is it maintained?
- Operating environment and maintenance
- Manufacturing constraints
- Sustainability and recycling
- Part cost versus future-proofing

Reference [1], Chapter 7





# Summary

- Flow, types, contexts, UX for data in IoT Devices
- Embedded device design considerations
  - Device interaction and placement
  - Visual Brand Languages
  - Three faces of physical products
    - Form, function, use
    - Aesthetics, appearance
    - Materials, manufacturing, maintenance



# Next Steps

- Project 4 is active...
- Most of the gear is in, I'll bring it in Wednesday
- This week: Prototypes to Product, Project 5, more...
- New Quiz is up – assignment is on Canvas
- Class staff available to help
  - Shubham - Tues 12-2 PM, Fri 3-5 PM in ECEE 1B24
  - Sharanjeet - Tues 2-3 PM, Thur 2-3 PM in ECEE 1B24
  - Bruce - Tue 9:30-10:30 AM, Thur 1-2 PM in ECOT 242
- Final Exam is set
  - Tuesday Dec 17 7:30 PM - 10 PM ECCR 1B51
  - Final will be open notes and Canvas based, you'll need a PC



# References

- [1] Designing Connected Products, Rowland et al., 2015, O'Reilly
- [2] <https://www.nngroup.com/books/emotional-design/>
- [3] <https://www.independent.co.uk/property/interiors/the-secret-history-of-philippe-starcks-lemon-squeezer-1972849.html>

