Mobile UI
Device, Input, Interaction Characteristics
Desktop and Mobile

Device Characteristics

- Limited resources
  - Limited memory
  - Limited processing
  - Battery conservation
- Primarily touch interaction
  - Input capabilities and challenges
- Mobile form factor
  - Small display size
  - Different aspect ratios (orientations)
  - Single application focus
Design is about Constraints

“One way to look at design — at any kind of design — is that it’s essentially about constraints (things you have to do and things you can’t do) and tradeoffs (the less-than-ideal choices you make to live within the constraints).”

- Steve Krug (“Don’t Make Me Think Revisited”)

Limited Resources

- Limited processing capabilities
  - Intensive tasks need to be done offline/preprocessed

- Single application model
  - One app in the foreground, others suspended
  - Few active background processes

- Primarily full-screen apps, consisting of a sequence of screens
  - Limits interaction but also limits processing requirements

- Responsiveness
  - Connectivity, data rates, reliance on server

→ Big implications for UI programming model
Capacitive Touch Screen Technology

- Finger changes material capacitance

- **Surface Capacitance**
  - voltage applied to conductive material creates *electrostatic field*
  - a finger touch creates a capacitor
  - measure effective capacitance at four corners to localize touch

![Diagram of Capacitive Touch Screen Technology](image1)

Capacitive Touch Screens

- Finger changes material capacitance

- **Projective Capacitive (PCT, PCAP)**
  - X-Y grid of thin wires or electrodes (driving lines, sensing lines)
  - a capacitor at each wire intersection
  - measure effective capacitance each point

![Diagram of Capacitive Touch Screens](image2)
Touch Sensing Accuracy

- Touch screen input is noisy
- Estimates for “pressure” very noisy

Automated Touch Screen Testing with Robots
- https://youtu.be/qw3OkC5Ca2U?t=49s
Human Accuracy

- People have “fat fingers”, so touch targets need to be large
  - Apple recommends 15mm
  - Microsoft recommends 9mm (min 7mm; min spacing 2mm)
  - Nokia recommends 10mm (min 7mm, min spacing 1mm)

Human Accuracy Varies By Position and Grip

- (and when walking, etc.)
No Hover State in Touch

- Having a middle “tracking” input state allows for hover
  - users can preview action before committing
- Mouse input typically supports 3-states (not touching, dragging, mouse-down)
- Touch-input only supports 2-states (i.e. touching or not-touching the screen).

“Imprecision, Inaccuracy, and Frustration: The Tale of Touch Input” by Benko and Wigdor

Multi-touch Dispatch

- In multi-touch, multiple fingers may hit a control simultaneously ...
  ... leading to ambiguity
- when is click event generated?
  - “click” events generated for buttons only when the last contact is lifted from the control.
  - “click” events generated every time a user taps a button, even if another finger is holding it down
  - over-capture: multi-touch controls captured by more than 1 contact simultaneously (e.g., selecting the thumb of a slider with two fingers can mean that it will not track directly under a single finger when moved.)
Physical Constraints

- Touch input relies on the principle of direct manipulation, i.e., user places their fingers onto an object, moves their fingers, and the object changes its position, orientation and size to maintain the contact points.
- Direct touch breaks when movement constraints are reached (e.g., moving beyond bounds, scrolling past limits).
- Solution:
  - elastic effects (e.g., apple iPhone scrolling past a list)

Gestures

- Increase expressivity with time-based or contact-based gestures
Direct Manipulation via Gestures

Gesture Example: Clear
- https://youtu.be/DFzjyf2E7KI?t=4s
Display Size

Worldwide Smartphone Shipment Forecast by Screen Size, 2015-2021


Different Ways to Hold

Cradled
Hold and Touch
Two Hands – Landscape

One Hand – First Order
One Hand – Second Order
Two Hands – Portrait

Design for Fingers, Touch and People, Steven Hoober (https://www.uxmatters.com)
Device Characteristics: Interaction

- One app at a time
  - one app in the foreground
  - most apps are suspended when not in the foreground
- Each app has window that fills the entire screen
  - interaction is a sequence of different screens
  - consistent navigation model is key

Mobile Interaction Flow
Navigation

Android Design: Creative Vision

- (circa 2013, but still relevant today)
“Enchant Me”

Delight me in surprising ways
A beautiful surface, a carefully-placed animation, or a well-timed sound effect is a joy to experience. Subtle effects contribute to a feeling of effortlessness and a sense that a powerful force is at hand.

Real objects are more fun than buttons and menus
Allow people to directly touch and manipulate objects in your app. It reduces the cognitive effort needed to perform a task while making it more emotionally satisfying.

“Simplify My Life”

I should always know where I am
Give people confidence that they know their way around. Make places in your app look distinct and use transitions to show relationships among screens. Provide feedback on tasks in progress.

If it looks the same, it should act the same
Help people discern functional differences by making them visually distinct rather than subtle. Avoid modes, which are places that look similar but act differently on the same input.
“Make Me Amazing”

It's not my fault
Be gentle in how you prompt people to make corrections. They want to feel smart when they use your app. If something goes wrong, give clear recovery instructions but spare them the technical details. If you can fix it behind the scenes, even better.

Make important things fast
Not all actions are equal. Decide what's most important in your app and make it easy to find and fast to use, like the shutter button in a camera, or the pause button in a music player.

Help Users to Enter Information

Provide the Right Data Entry Tool
Anticipate and Predict Input

“Mobile UI Design Pattern” (Bank and Zuberi)
Help Users Find Correct Actions

Highlight New Content

Quick Access to Frequent Actions

Tip: Help Users Find Correct Actions

Make Actions Obvious

Distinguish Between Controls and Content
Avoid Clutter

Hide Meta Data

Hide Secondary Menus

Standards: Interface Guidelines

- Platform-specific design guidelines can provide specific usage examples and hints, beyond these basic guidelines

IOS Design Guidelines

Android Design Guidelines