Mobile Device User Interfaces

June 26

Mobile Design Implications

Limited resources (memory, storage, battery)

- more reliance on cloud for storage, processing

Single application model (one foreground app, single window)

- managing state becomes very important
- cannot easily multi-task

Small screen (different sizes, different orientations supported)

- layout challenges

Touch input

- multiple fingers great, but less precise
- often used one-handed

→ Big implications for UI programming

Design is 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

Touch Input

Advantages

- **Absolute + Direct** input (& Direct Manipulation)
- Tracks touch and movement on the screen
  - Up to 10 points of contact simultaneously!
- We can *sort-of* detect finger pressure (Apple 3D touch).
- We can combine widgets with (multi-figure) gestures.
  - Not everything has to be a gesture! Touch-activation works too.

Disadvantages

- Your finger is not a high precision input device (e.g., try drawing)
- We cannot track which finger is being used, which limits input
- User activity (e.g., running, walking, sitting) affects data reliability.

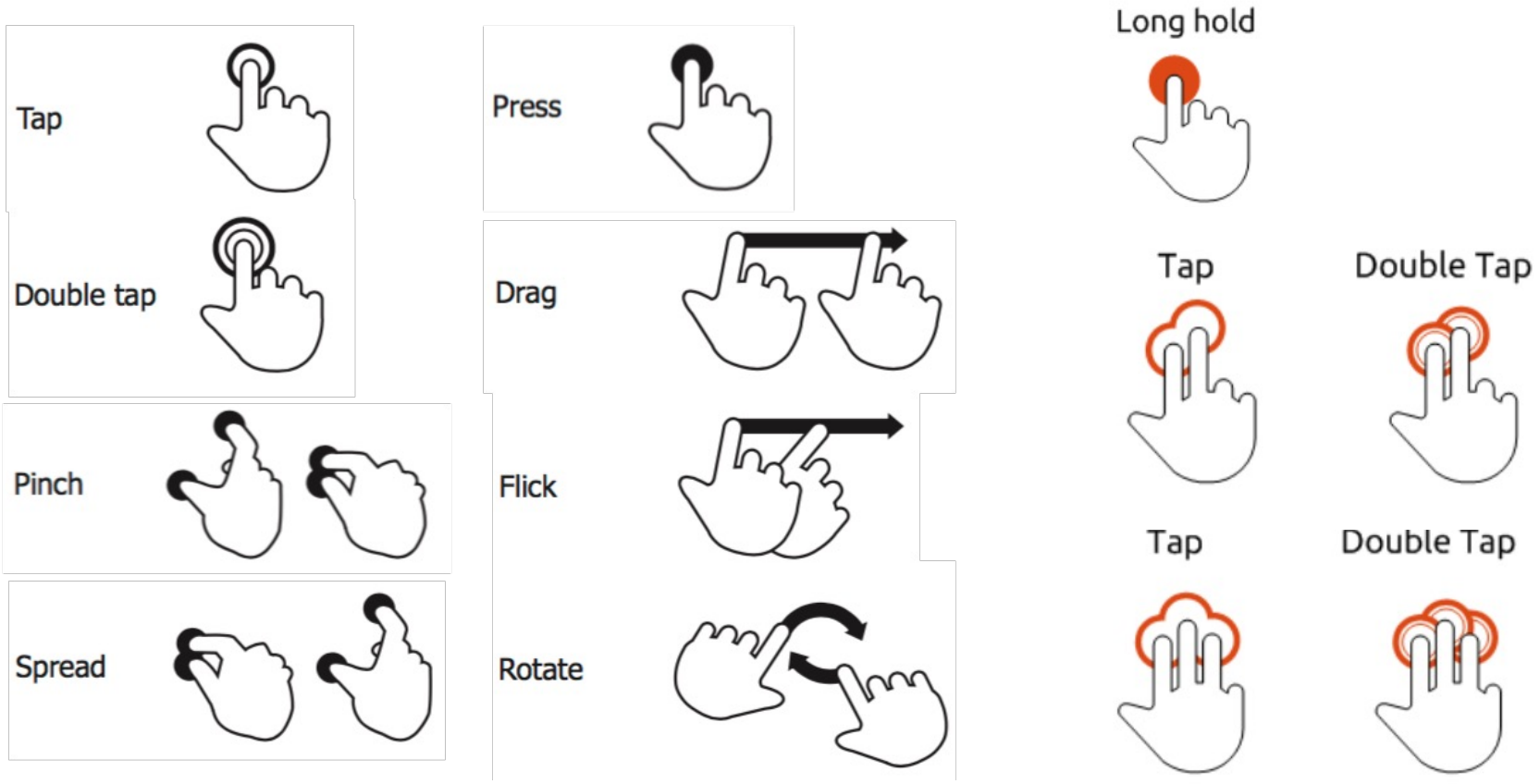
Jeff Han’s Seminal Ted Talk on Multitouch Interaction (Feb 2006)

– https://www.ted.com/talks/jeff_han_the_radical_promise_of_the_multi_touch_interface

Touch Gestures

Taps and swipes with 1, 2, or more fingers

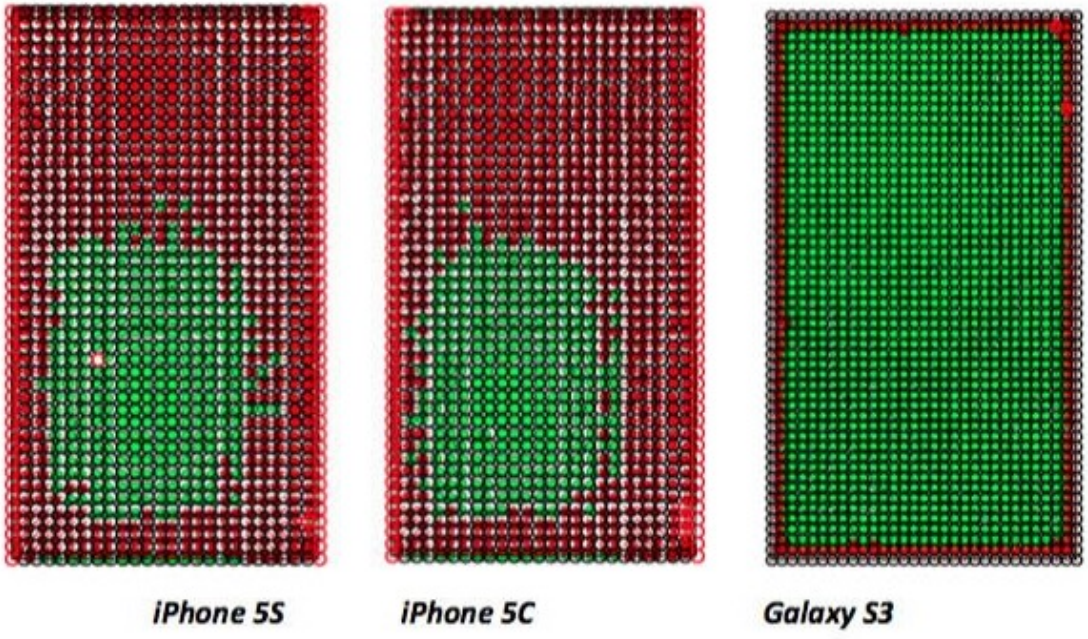
Uses various characteristics of low-level touch screen events, e.g., position, time, number of contacts

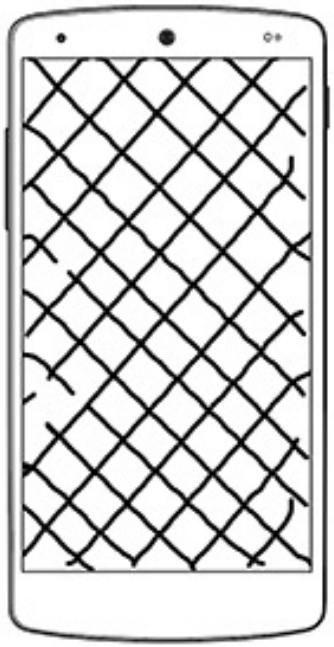


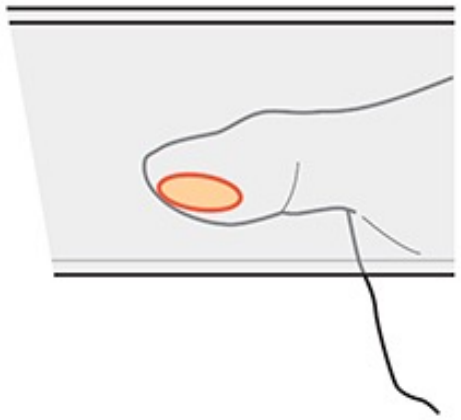
Touch Sensing Accuracy

Touch screen input is noisy

- Sensors vary in their accuracy
- Estimates for “pressure” very noisy
- Large input (finger) relative to target size







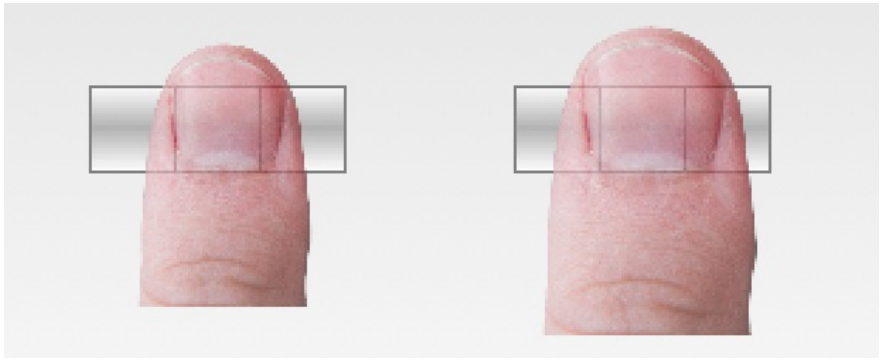
Design for Fingers, Touch and People, Steven Hoober (https://www.uxmatters.com)

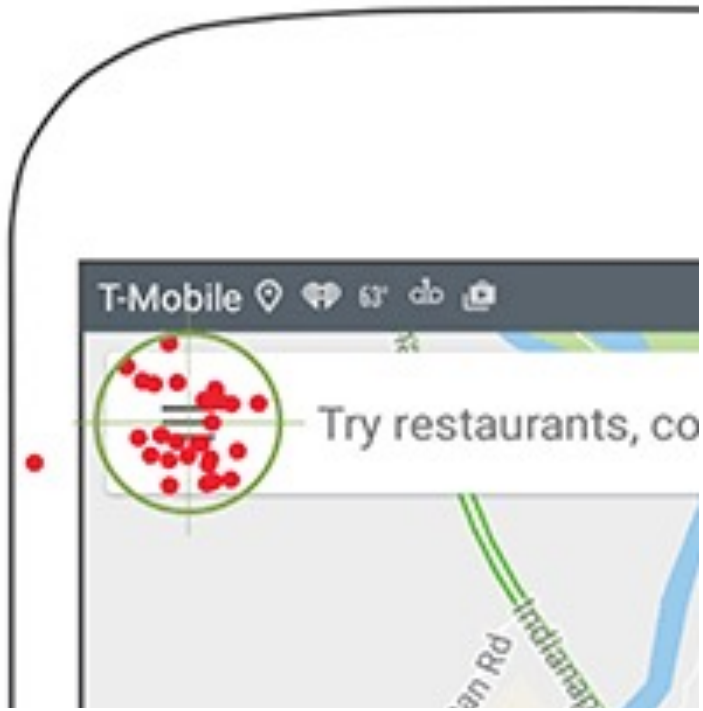
Challenge: Human Accuracy

“Fat fingers” lead to occlusion and precision issues

Touch targets need to be large

- Apple / iOS recommends 15 mm
- Google / Android recommends 9 mm (min 7 mm, min 2 mm apart)



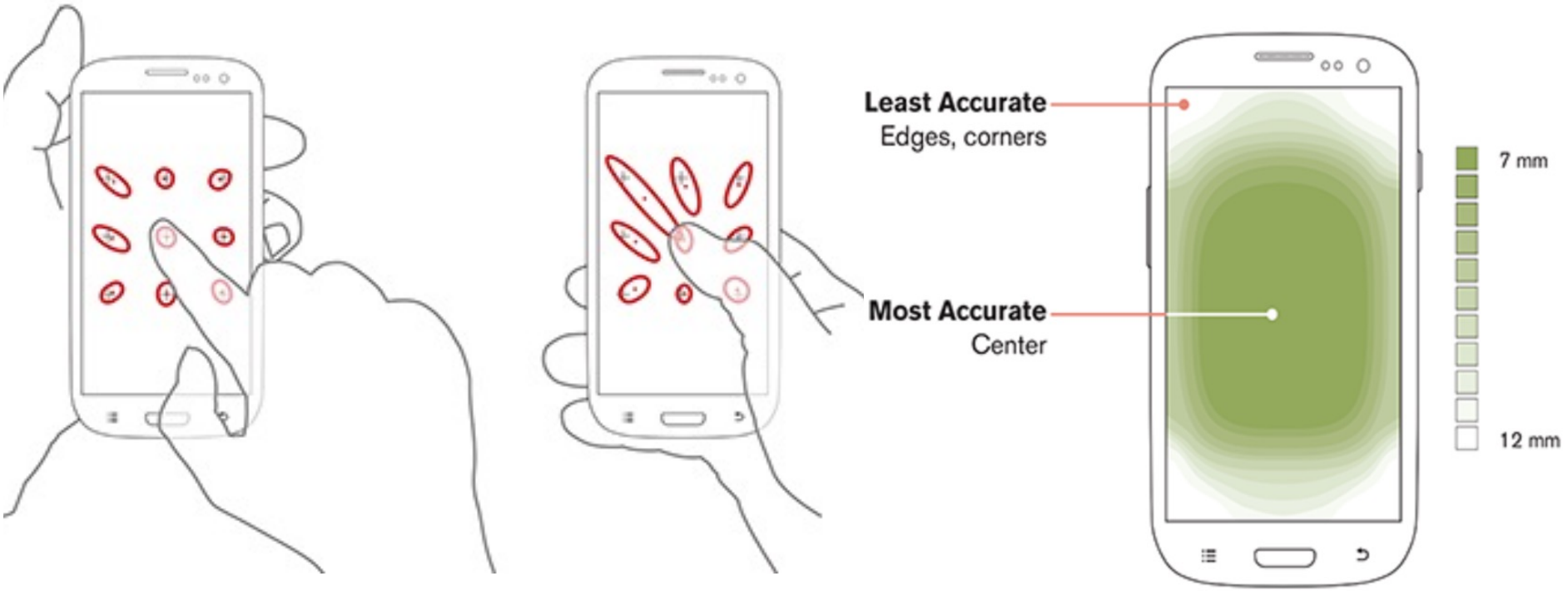


Design for Fingers, Touch and People, Steven Hoober (https://www.uxmatters.com)

Challenge: Human Accuracy Varies By Position and Grip

Accuracy affected by

- Hand posture (i.e., which hand is holding, which used to interact)
- Finger vs. thumb interaction
- User activity: stationary vs. moving



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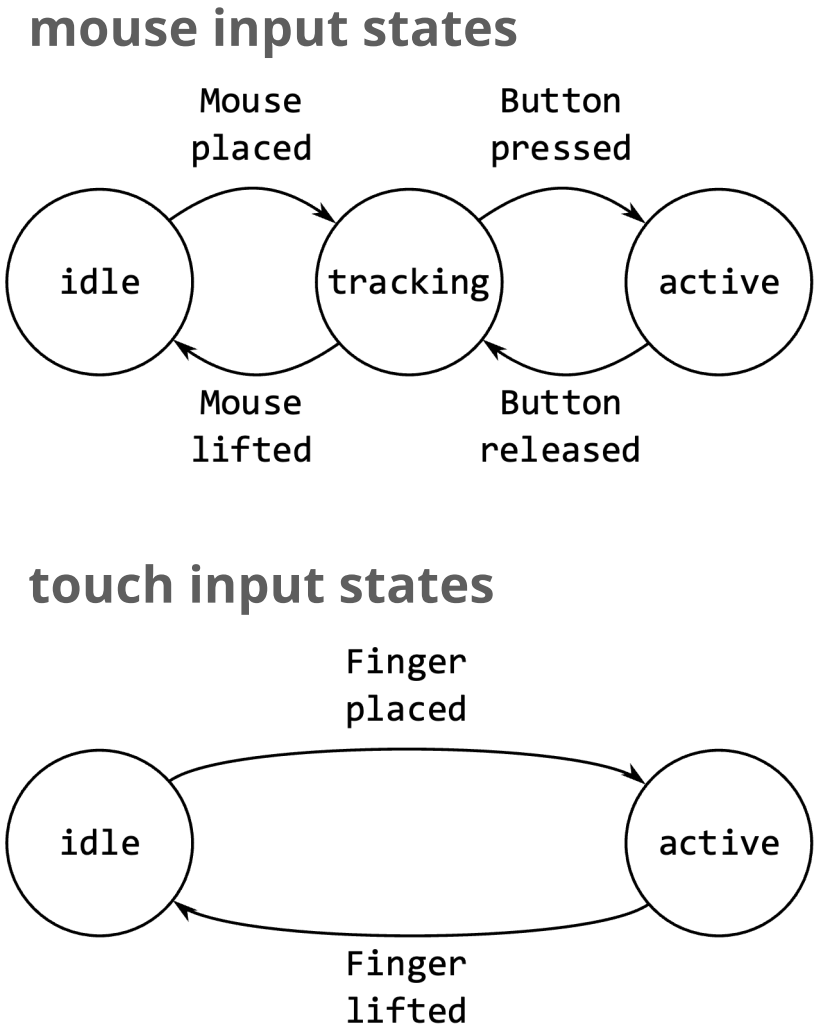
Challenge: No Hover State in Touch

Having a middle “tracking” input state allows for hover (e.g., mouse).

Users can preview an action before committing

- Mouse input typically supports 3-states (i.e., mouse off table, moving mouse cursor, dragging mouse)
- Touch input only supports 2-states (i.e., no touch, touch).
  - What are the implications for a device that relies on touch? What can you not easily do on this device vs. a desktop?



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

Challenge: Multi-touch Dispatch Ambiguity

In multi-touch, multiple fingers may hit a control simultaneously, leading to ambiguity

When is click event generated? There are a number of possibilities:

- Interaction is invoked only when the last finger is lifted from the control (`TOUCH_RELEASED`), or
- Interaction is invoked every time a finger presses a control (`TOUCH_PRESSED`), even if another finger still makes contact, or
- 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.)

Challenge: 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). This breaks immersion, and the sense of working with a physical object.

Solution: Elastic effects that mimic physical responses (e.g., Apple iPhone scrolling past a list, “snaps” back)

Device Characteristics: Summary

Assume 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

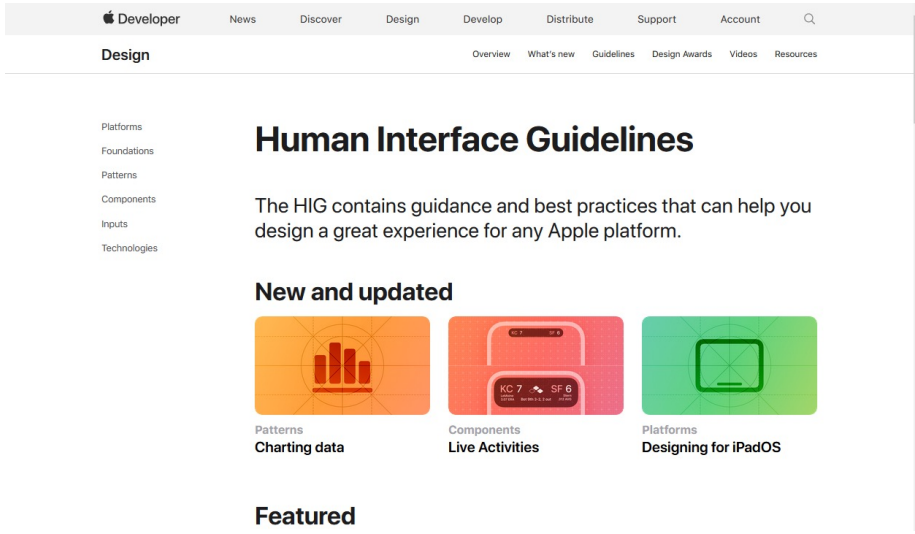
Do not expect users to switch between applications:

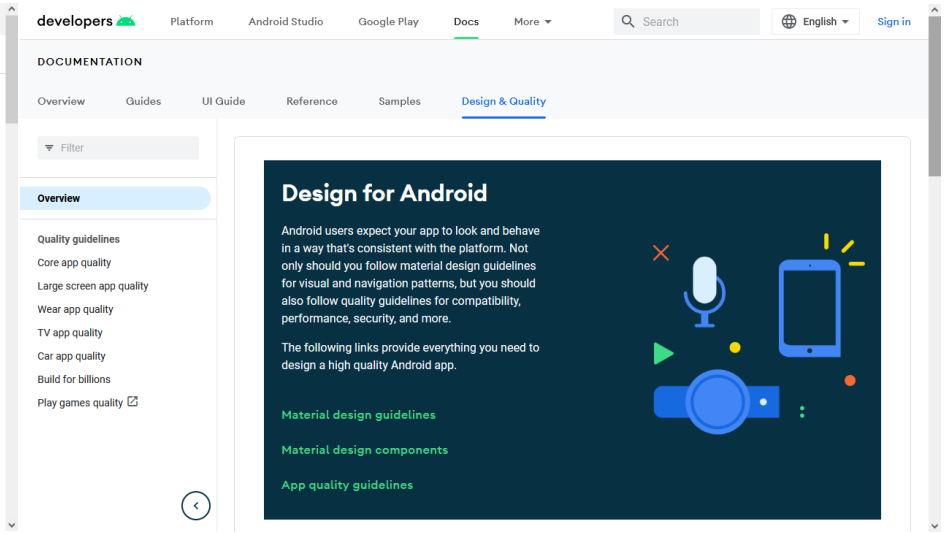
- difficult to lookup data in a different app

Controls need to be large to overcome occlusion and precision issues. They also need to be selectable while moving (walking or running).

Standards: Interface Guidelines

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





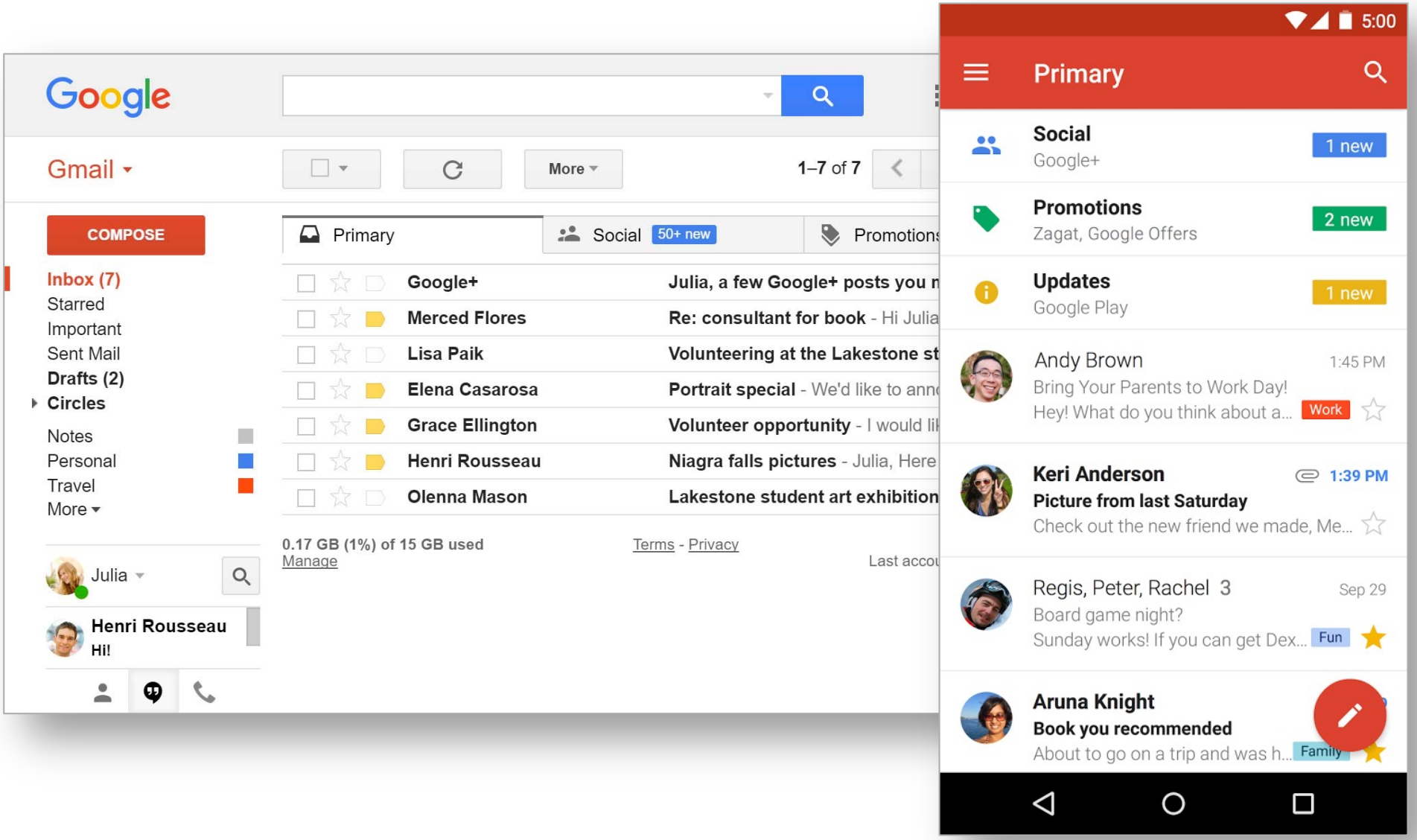
IOS Design Guidelines

https://developer.apple.com/design/human-interface-guidelines/

Android Design Guidelines

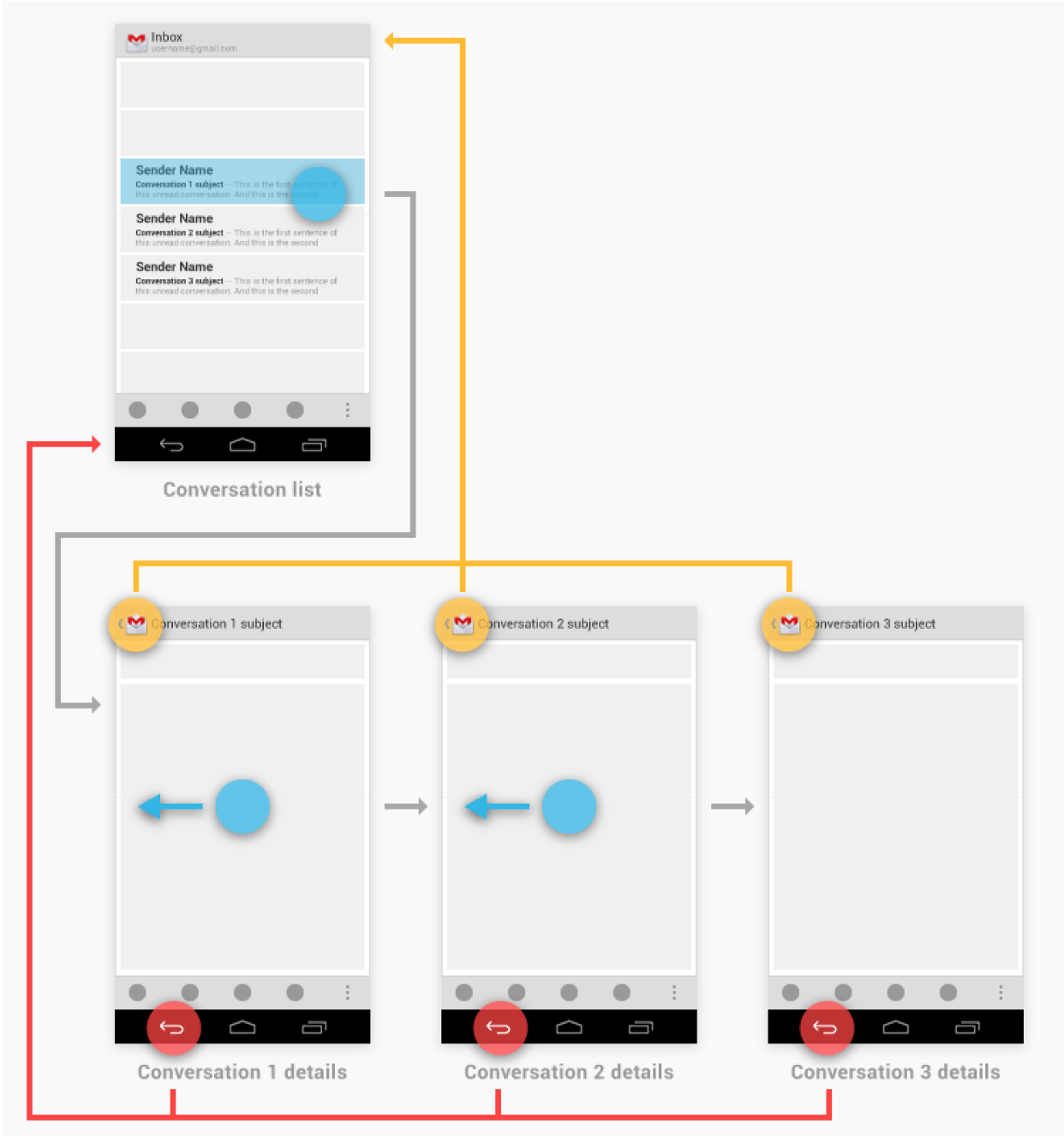
https://developer.android.com/design

Desktop *vs.* Mobile



Navigation

Critical due to ordering of screens in most applications.



up

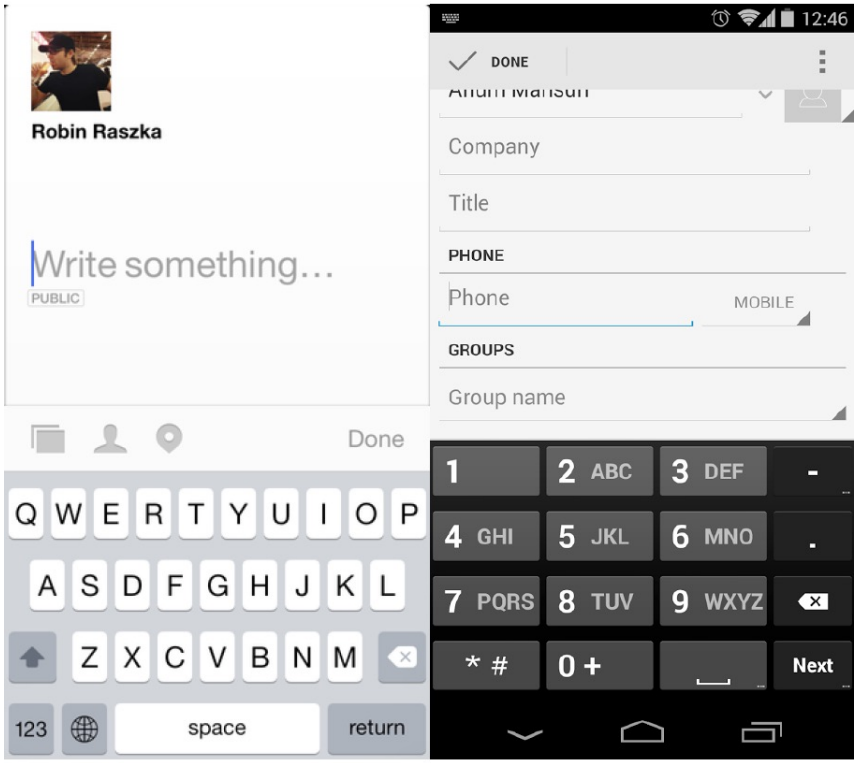
back

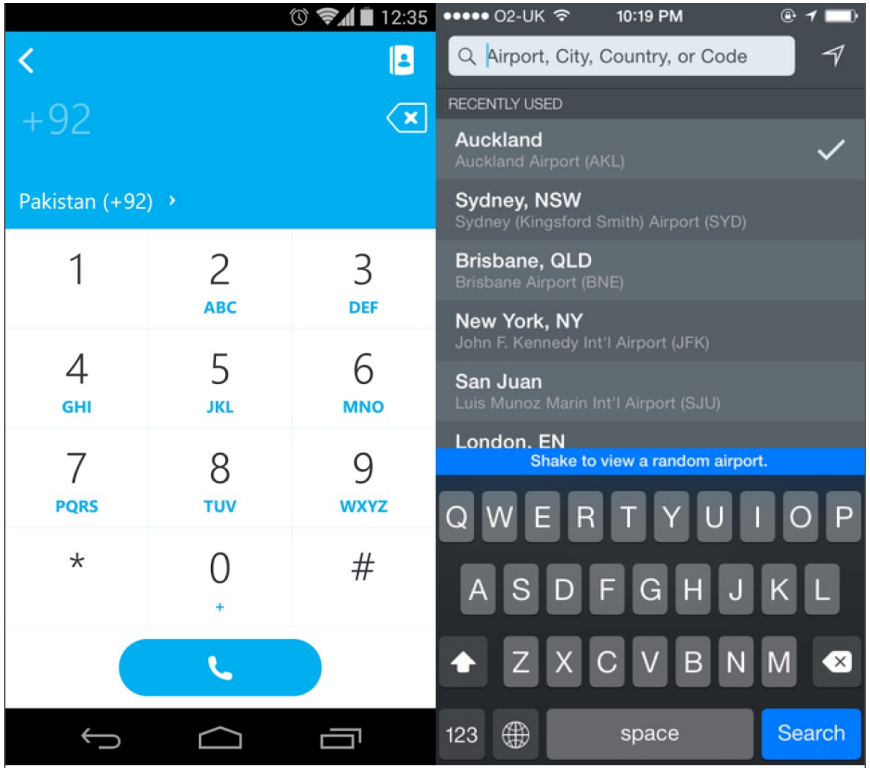
gestures

Help Users to Enter Information

Provide the right data entry tool

Anticipate and predict input



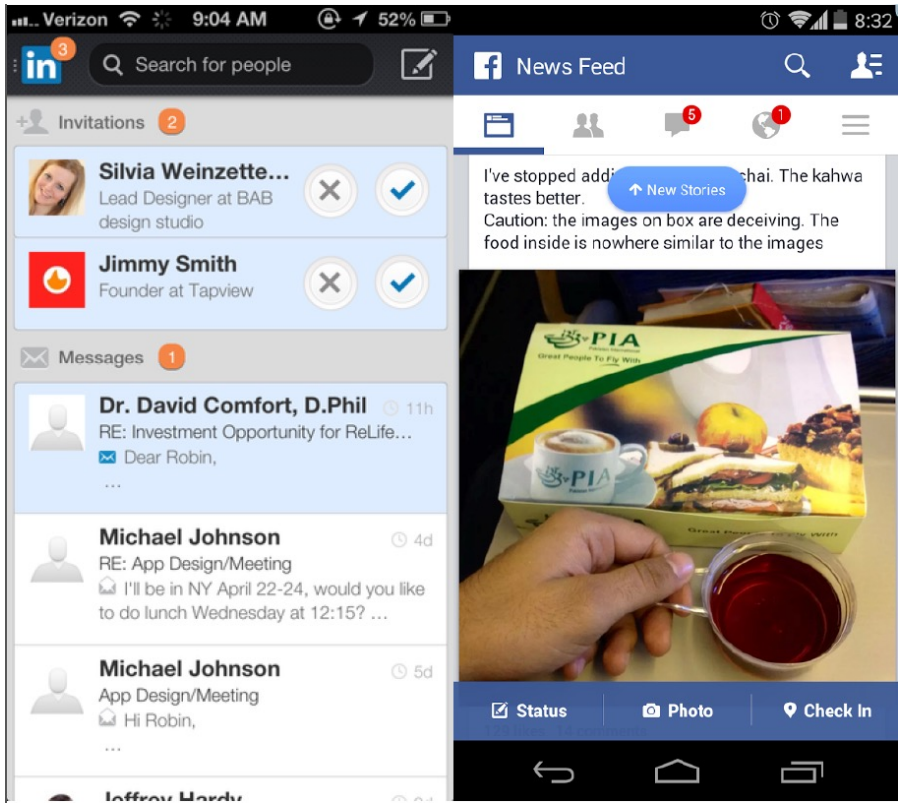


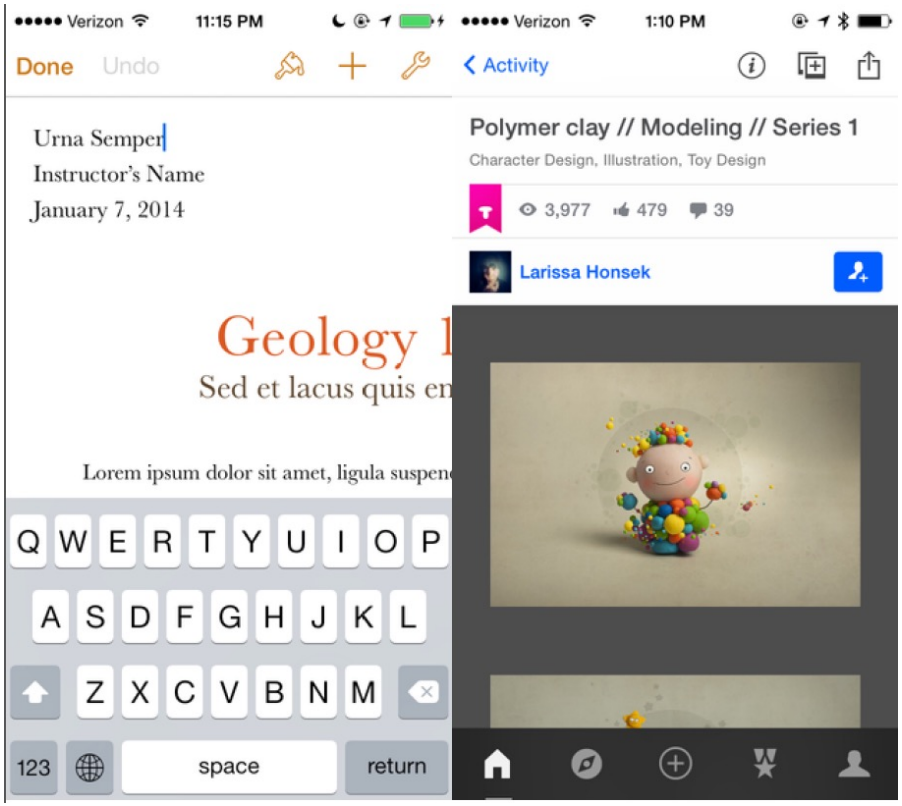
"Mobile UI Design Pattern" (Bank and Zuberi)

Help Users Find Correct Actions

Highlight new content

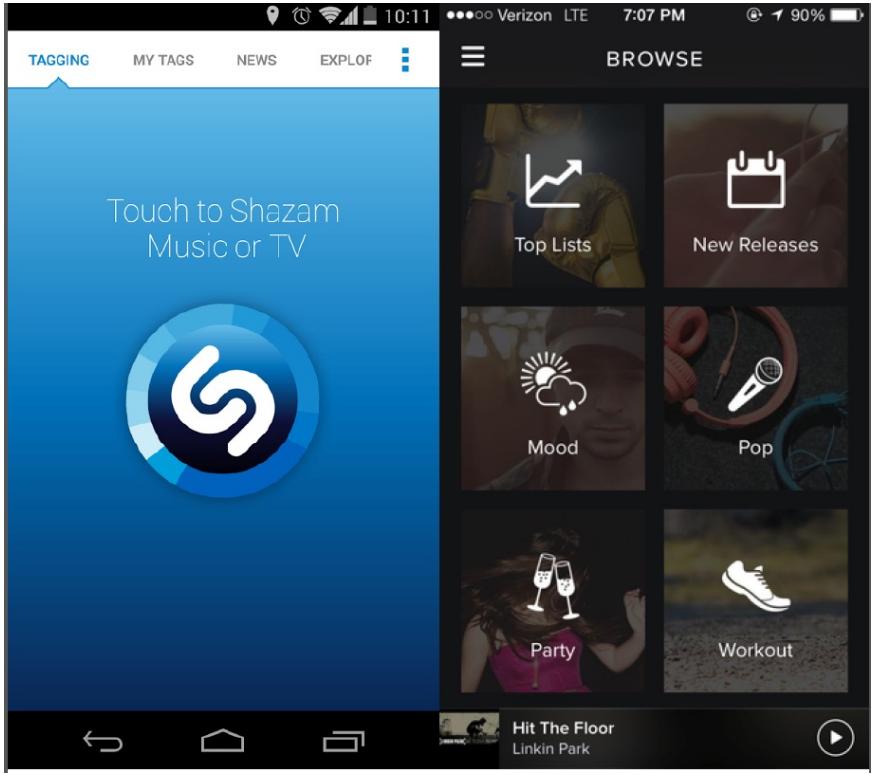
Quick access to frequent actions



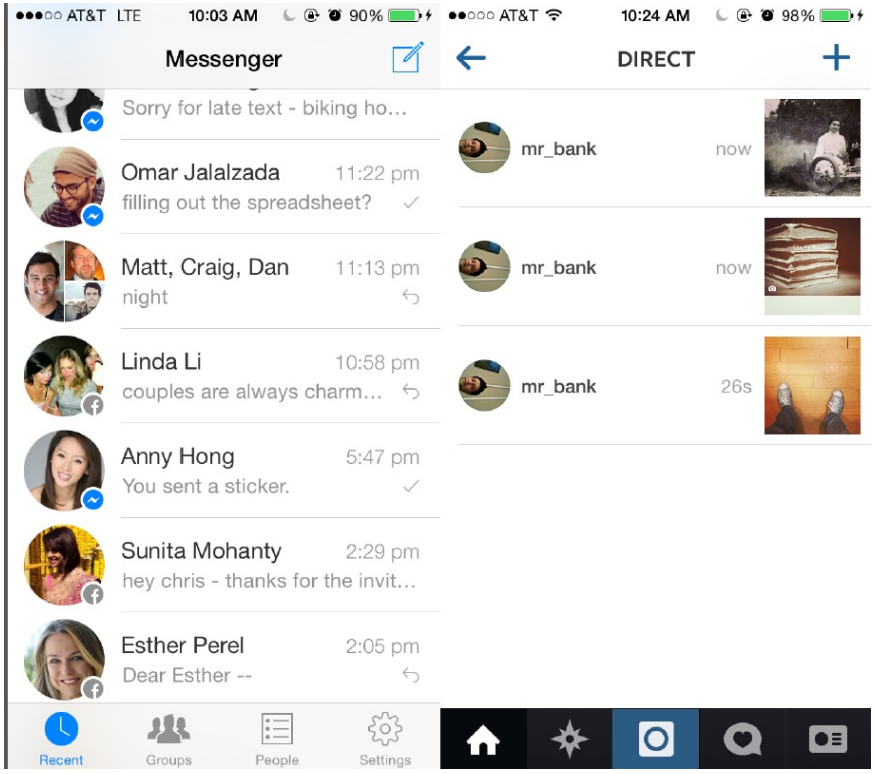


Help Users Find Correct Actions

Make actions obvious

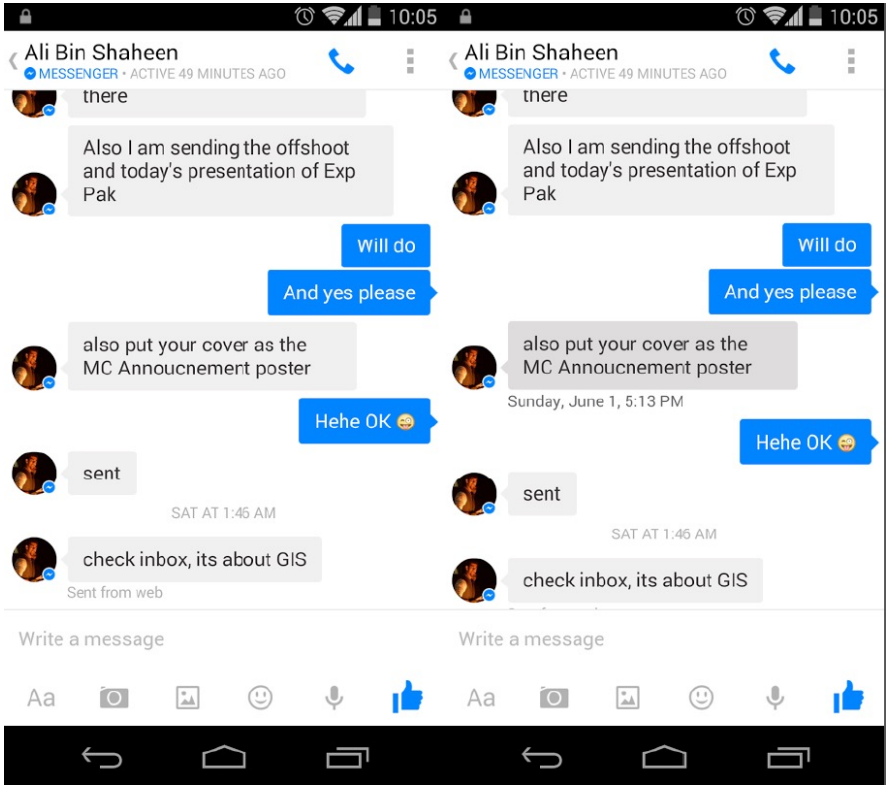


Distinguish between controls and content

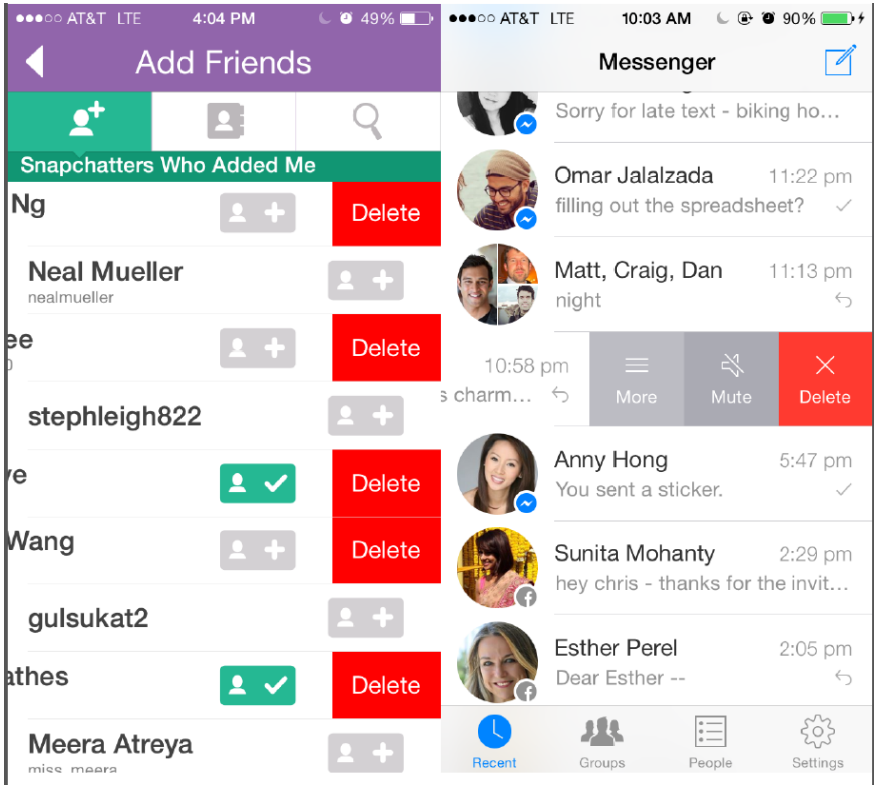


Avoid Clutter

Hide meta-data



Hide secondary menus



End of the Chapter

Any further questions?