IN4MATX 133: User Interface Software

Lecture:
Device Resources & Sensors

Local Storage

```
ionic cordova plugin add cordova-sqlite-storage

npm install --save @ionic/storage
```

- Don’t forget to add it to your module and inject it!

```
storage.set('name', 'Max');

  // Or to get a key/value pair
  storage.get('age').then((val) => {
    console.log('Your age is', val);
  });
```

https://ionicframework.com/docs/building/storage#ionic-storage

Before We Get Started

- Update on local storage

```
import { Plugins } from '@capacitor/core';
const { Storage } = Plugins;

Storage.get({key:’keyName’}).then((data) => {
console.log(data.value);
});

Storage.set({key:’keyName’, value:’value’}).then(() => {
console.log(“set value”);
});
```

https://capacitorjs.com/docs/apis/storage

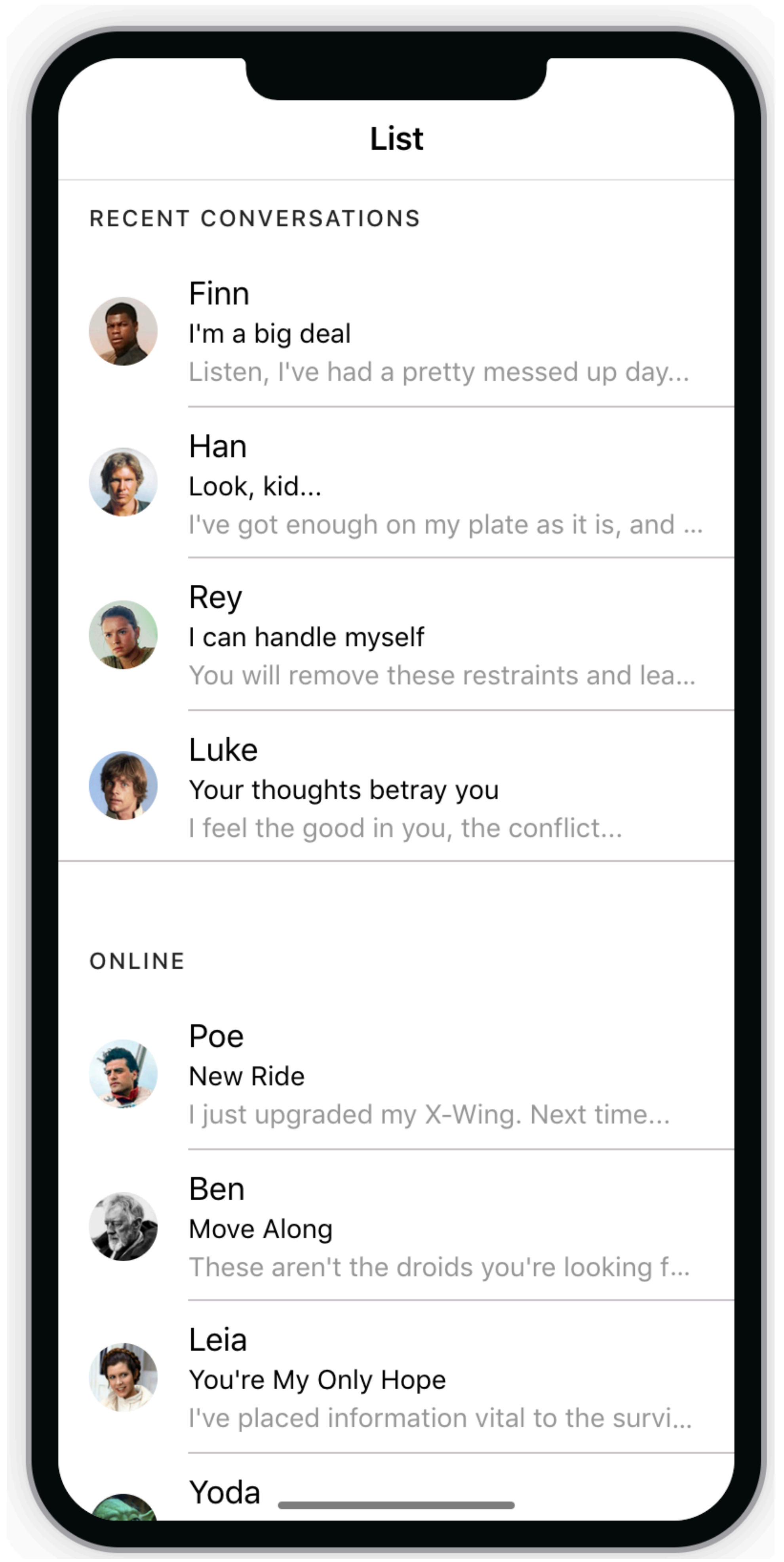
Today's goals

By the end of today, you should be able to…

- Deploy an Ionic project to test an app on a mobile device
- Access device resources using a Capacitor Plugin
- Describe some of the sensors on modern smartphones
- Describe some ways in which sensors can be used

Ionic components

- Ionic provides Angular-style components for a lot of interface elements common in mobile interfaces
  - Lists, buttons, sliders, tabs, modal dialogs, search bars, much more



List

RECENT CONVERSATIONS

Finn
I'm a big deal
Listen, I've had a pretty messed up day...

Han
Look, kid...
I've got enough on my plate as it is, and ...

Rey
I can handle myself
You will remove these restraints and lea...

Luke
Your thoughts betray you
I feel the good in you, the conflict...

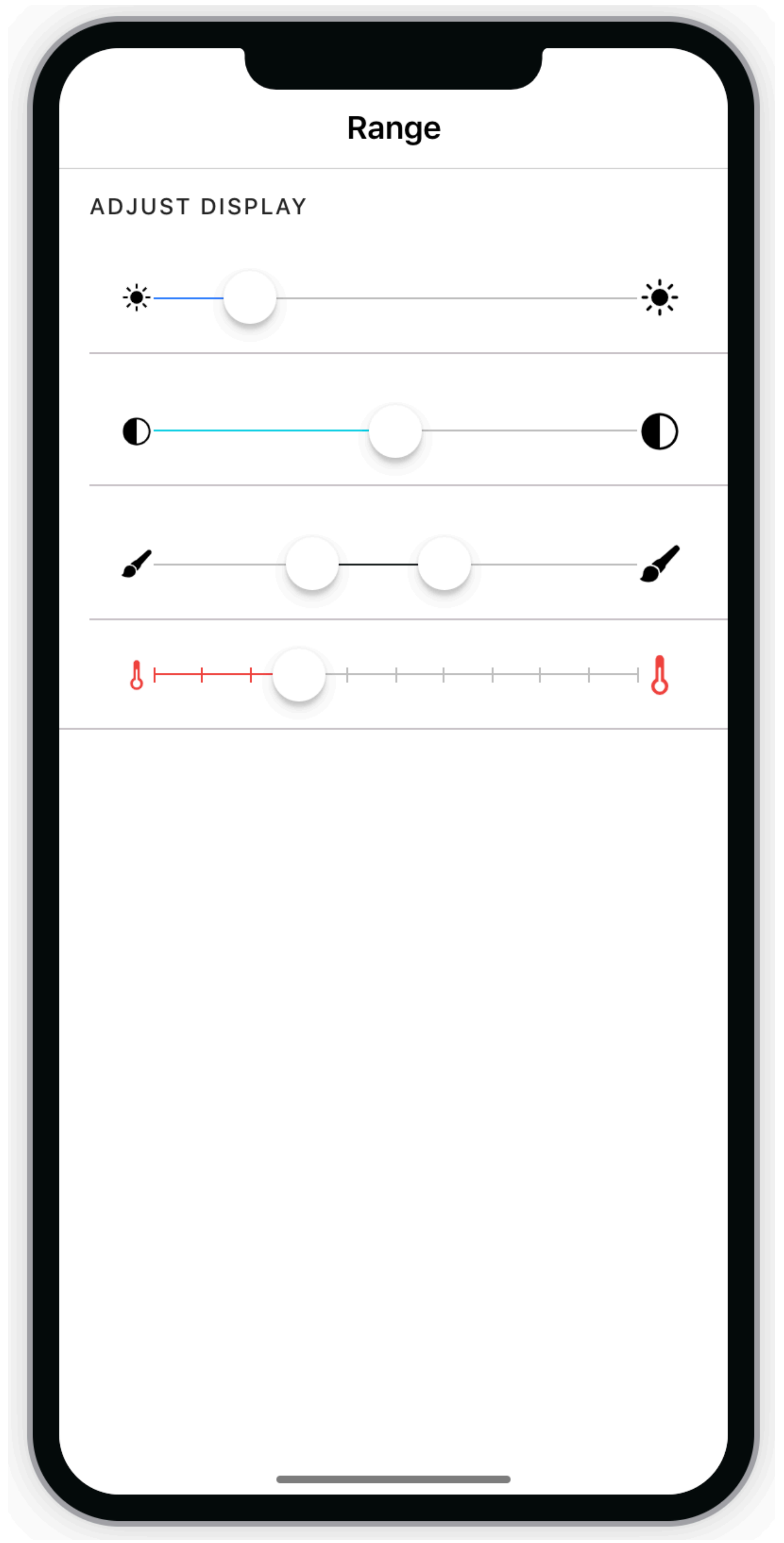
ONLINE

Poe
New Ride
I just upgraded my X-Wing. Next time...

Ben
Move Along
These aren't the droids you're looking f...

Leia
You're My Only Hope
I've placed information vital to the survi...

Yoda



Range

ADJUST DISPLAY

https://ionicframework.com/docs/components/

Ionic + Capacitor

- Capacitor Provides libraries for connecting to device resources in the form of **plugins**
- Possible to use Capacitor alongside ionic native wrapping Cordova plugins
- hundreds of plugins
  - official or community
  - some with known issues

https://ionicframework.com/docs/native/

Capacitor Setup

- Adding capacitor to an existing Ionic project:

  > cd [project folder]

  > ionic integrations enable capacitor

- Capacitor builds native “projects” based on web build (folder www)

  > ionic build

- After Ionic builds, use Capacitor to create native projects

  > ionic capacitor add [android or ios]

- After each significant code change, need to update native projects:

  > ionic capacitor copy [android or ios]

Ionic and Capacitor Deployment

- The sync command will both copy and update plugins and dependencies for both Android and iOS. Also, “cap” can be used instead of “capacitor”:

  > ionic cap sync

- Commands to open native projects using native IDEs

  > ionic cap open [android or ios]

- Live reload keeps native IDE in sync with ionic project and updates deployed emulators:

  > ionic cap run [android or ios] -l --external

Platform

- Ionic has an injectible service for detecting what platform(s) the app is running on
- Platforms are not mutually exclusive
  - Mobile, iOS, Android
  - iPad, tablet

https://ionicframework.com/docs/angular/platform

Capacitor Plugins

- Some (few) are maintained officially
- Others are maintained by the community
- As a result, quality varies immensely
- Features may not work as expected
- Still…depending on plugin, likely better than using Ionic Native or Cordova, which also tend to lag in updates and compliance with newer mobile platform versions

Three Official Capacitor Plugins

- Camera
- Local Notification
- Sharing

There are others, but we will just cover these three.

Taking a Picture

- To use webcam, install PWA lib:

  > npm install @ionic/pwa-elements

- Import PWA lib in main.ts

```
import { defineCustomElements } from '@ionic/pwa-elements/loader';

// Call the element loader after the platform has been bootstrapped
defineCustomElements(window)
```

https://ionicframework.com/docs/angular/your-first-app/2-taking-photos
https://capacitorjs.com/docs/web/pwa-elements

Taking a Picture

- Import plugins from Capacitor

```
import {
  Plugins,
  CameraResultType,
  CameraPhoto,
  CameraSource,
} from '@capacitor/core';

const { Camera } = Plugins;
```

Taking a Picture

```
import { Plugins, CameraResultType } from '@capacitor/core’;

const { Camera } = Plugins;

async takePicture() {
  const image = await Camera.getPhoto({
    quality: 90,
    allowEditing: true,
    resultType: CameraResultType.Uri
  });
  // image.webPath will contain a path that can be set as an image src.
  // You can access the original file using image.path, which can be
  // passed to the Filesystem API to read the raw data of the image,
  // if desired (or pass resultType: CameraResultType.Base64 to getPhoto)
  var imageUrl = image.webPath;
  // Can be set to the src of an image now
  imageElement.src = imageUrl;
}
```

https://capacitorjs.com/docs/apis/camera

Local Notification

- Goal: send a notification to the phone
- Could be used to remind someone to journal their sleepiness, for example

https://capacitorjs.com/docs/apis/local-notifications

Local Notification

- Import Plugin in a service or component

```
import { Plugins } from '@capacitor/core';
const { LocalNotifications } = Plugins;
```

- Prompt user to authorize notifications:

```
async ngOnInit() {
    await LocalNotifications.requestPermission();
}
```

https://capacitorjs.com/docs/apis/local-notifications

Local Notification

```
import { Plugins } from '@capacitor/core';
const { LocalNotifications } = Plugins;
const notifs = await LocalNotifications.schedule({
  notifications: [
    {
      title: "Title",
      body: "Body",
      id: 1,
      schedule: { at: new Date(Date.now() + 1000 * 5)
},
      sound: null,
      attachments: null,
      actionTypeId: "",
      extra: null
    }
  ]
});
console.log('scheduled notifications', notifs)
```

Can schedule for the future

https://capacitorjs.com/docs/apis/local-notifications

Sharing

- Goal: export data from your app to a social app on the device
- Could be used to share photos to Facebook
- Could be used to share text in a text message
- Uses Web Share API

https://capacitorjs.com/docs/apis/share

https://web.dev/web-share/

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https://capacitorjs.com/docs/apis/share

https://web.dev/web-share/

Sharing

- Support is “nuanced”
- Use feature detection rather than assume a particular method is supported
- Check out the compatibility list here:
  - https://developer.mozilla.org/en-US/docs/Web/API/Navigator/share#browser_compatibility

https://capacitorjs.com/docs/apis/share

https://web.dev/web-share/

Sharing

- Import Plugin

```
import { Plugins } from '@capacitor/core';
const { Share } = Plugins;
```

- Call Share.share() method with content to be shared:

```
let shareRet = await Share.share({
  title: 'See cool stuff',
  text: 'Really awesome thing you need to see right meow',
  url: 'http://ionicframework.com/',
  dialogTitle: 'Share with buddies'
})
```

https://capacitorjs.com/docs/apis/share

https://web.dev/web-share/

Demo

Plugin Issues

- There are many issues with Capacitor plugins (see link below)
- Only a limited set of functionalities are enabled
- Plugins may be unreliable

https://github.com/ionic-team/capacitor/issues

Premier Plugins

- The company behind Ionic maintains a set of plugins
  - Ionic’s team is behind Capacitor
- They are presumably more reliable, but this comes at a cost

https://capacitorjs.com/enterprise

Comparing to React Native’s Plugins

React Native Libraries

- React Native includes a few libraries for accessing device resources
- Examples:
  - CameraRoll
  - AsyncStorage (device storage)
  - Geolocation (GPS)
- The rest are installed through plugins which look similar to Ionic's

https://reactnative.dev

React Native Plugins

- Used and installed in roughly the same way: install and link
  - `npm install react-native-sensors`
  - `react-native link react-native-sensors`
  - `npm install react-native-notification`
  - (notifications require manual linking in Xcode or Android build)

https://github.com/react-native-sensors/react-native-sensors
https://github.com/wix/react-native-notifications

Question

When might developing a hybrid app be preferable to a native app?

- A When you need to access a lot of native device resources
- B When you don’t need any native device resources
- C When you can use well-maintained libraries to access native resources
- D When you need high performance
- E I don’t know, this lecture has scared me away from making hybrid apps

Thoughts on native resources

- The state of native support is okay, but improving year to year
- You could fork (copy) a broken or incomplete plugin and patch it yourself
- Is this better or worse than having to write the plugin yourself?
- This is the clear downside to building hybrid apps rather than native
    - Device libraries can’t be used directly
    - Either need to rely on community libraries or fill in the missing pieces

Thoughts on native resources

- Hybrid apps and PWAs are already popular for development
- I wouldn’t be surprised if it becomes easier to access native resources in the future

Strengths of hybrid apps

- Can share a codebase between web and mobile
- Can save time and effort (sometimes)
- Easily design for various form factors
- Access to some device capabilities

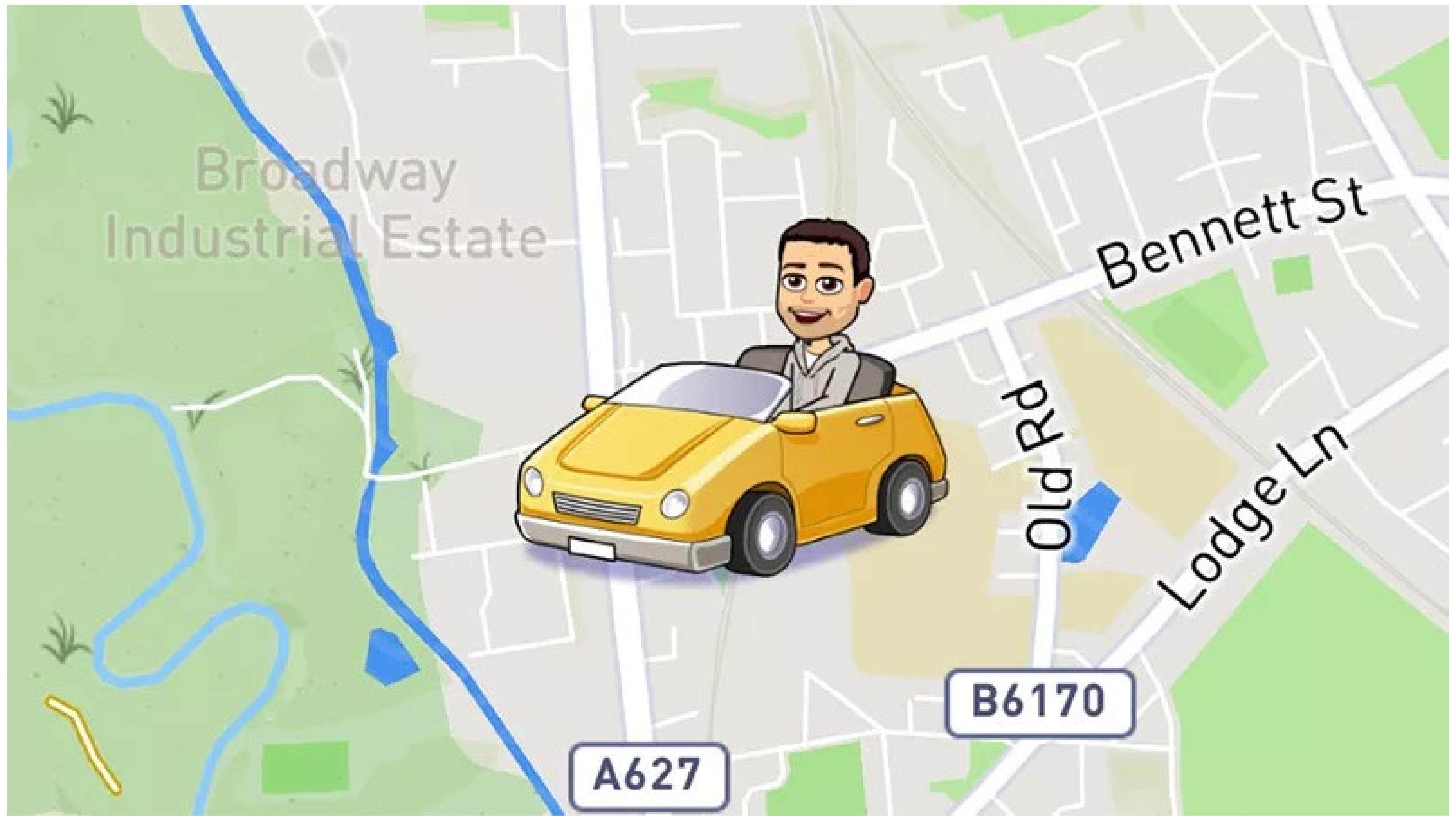
Weaknesses of hybrid apps

- Performance issues
- Inconsistency with platform
- Limited access to device capabilities

Modern phones include a lot of sensors

Sensors

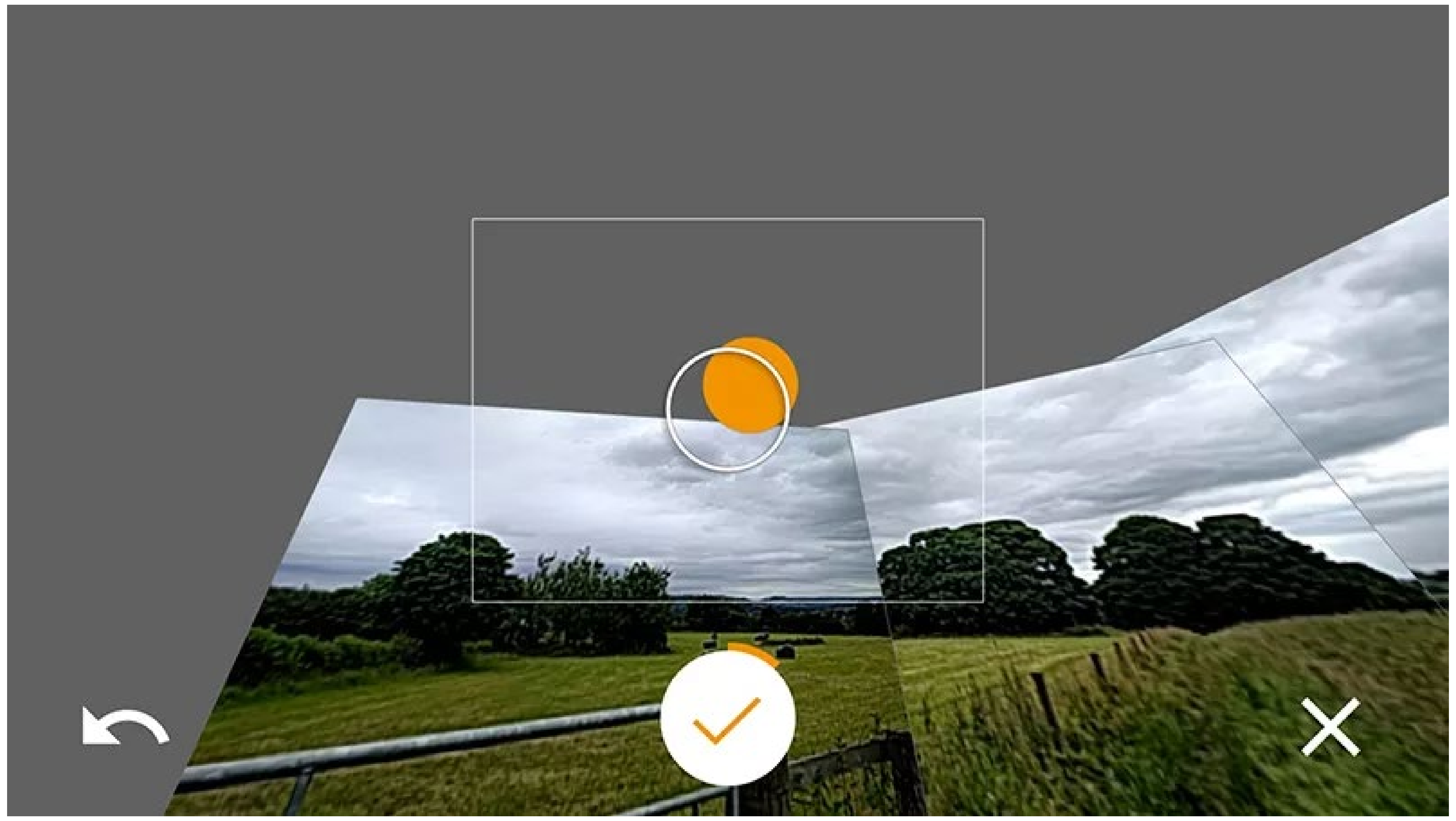
- Accelerometers
  - Axis-based motion sensing
  - Measures acceleration in a particular direction



https://gizmodo.com/all-the-sensors-in-your-smartphone-and-how-they-work-1797121002

Sensors

- Gyroscope
  - Measures device orientation
  - Can measure device rotation, where accelerometer cannot



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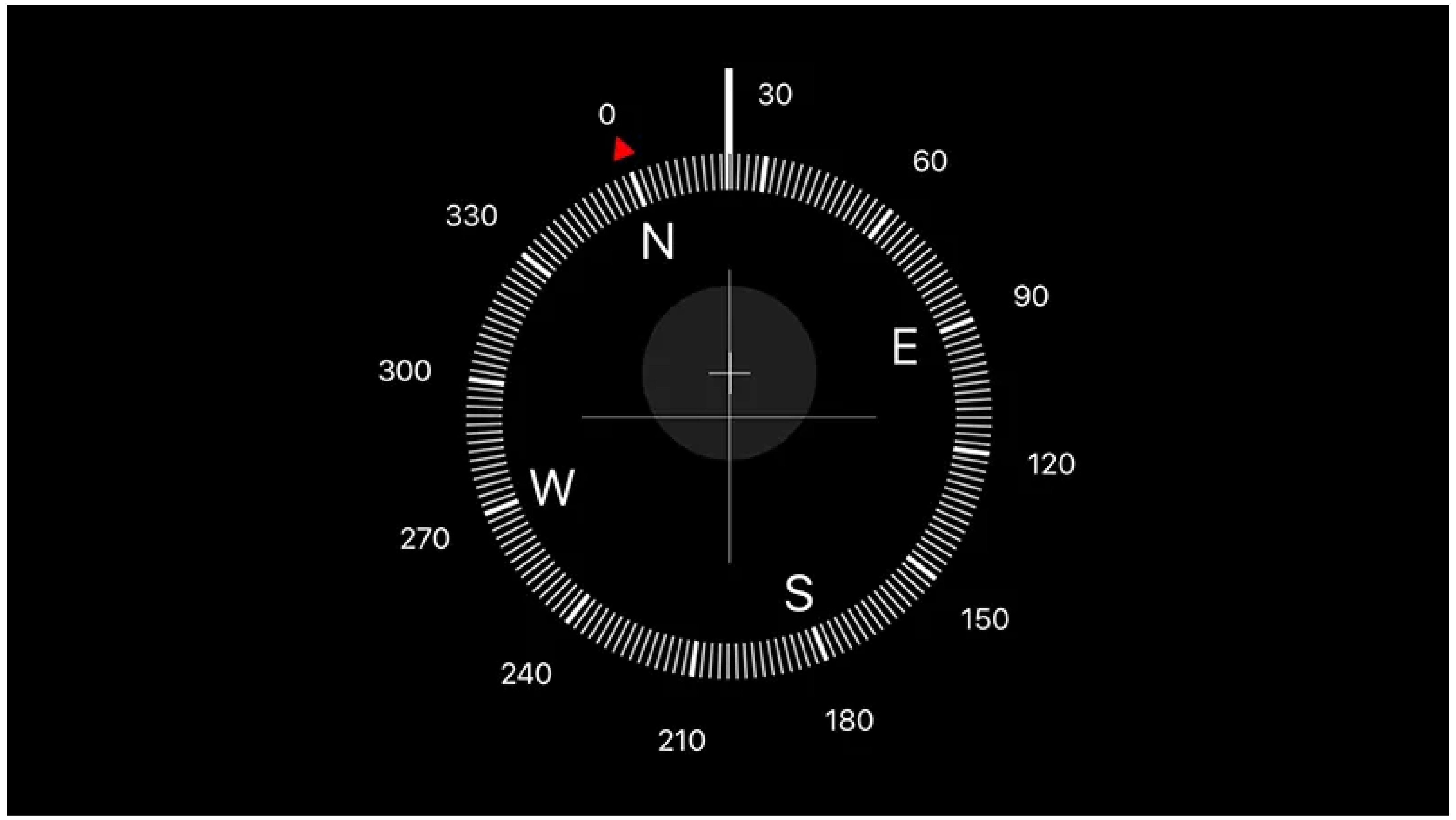
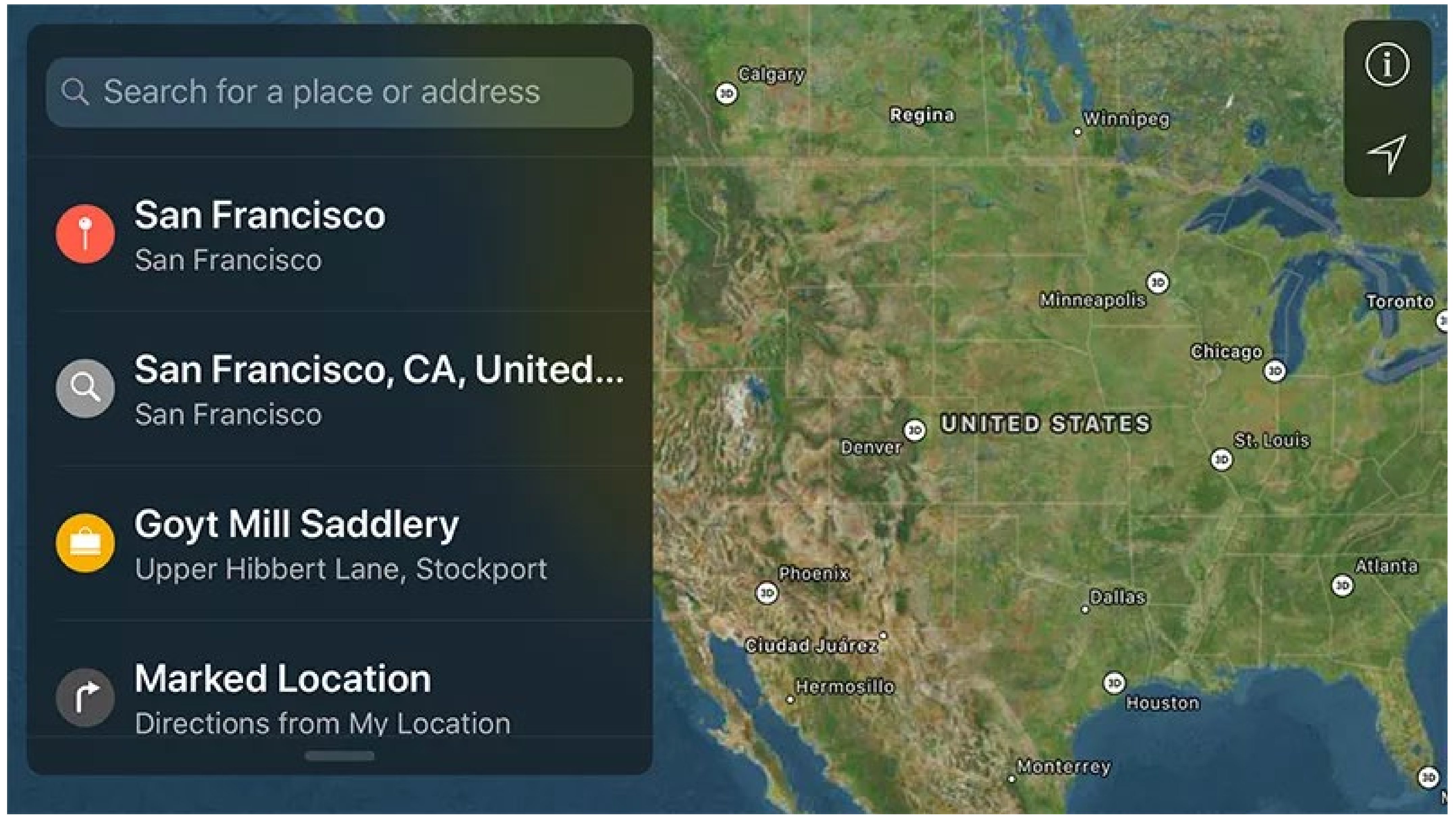
Sensors

- Magnometer
  - Identifies cardinal direction
  - Can be used together with Gyroscope to create a compass



Sensors

- Global Positioning System (GPS)
  - Identify where on the planet you are
  - Navigation in Apple Maps, Google Maps, etc. combines all four sensors



Sensors

- Proximity sensor: how close/far an object is
  - Switches off your screen when it’s in your pocket/backpack/purse
- Ambient light: measures how bright a room is
  - Changes screen brightness to accommodate
- Near field communication (NFC): allows nearby objects to communicate
  - Powers Apple Pay, etc.

Sensors

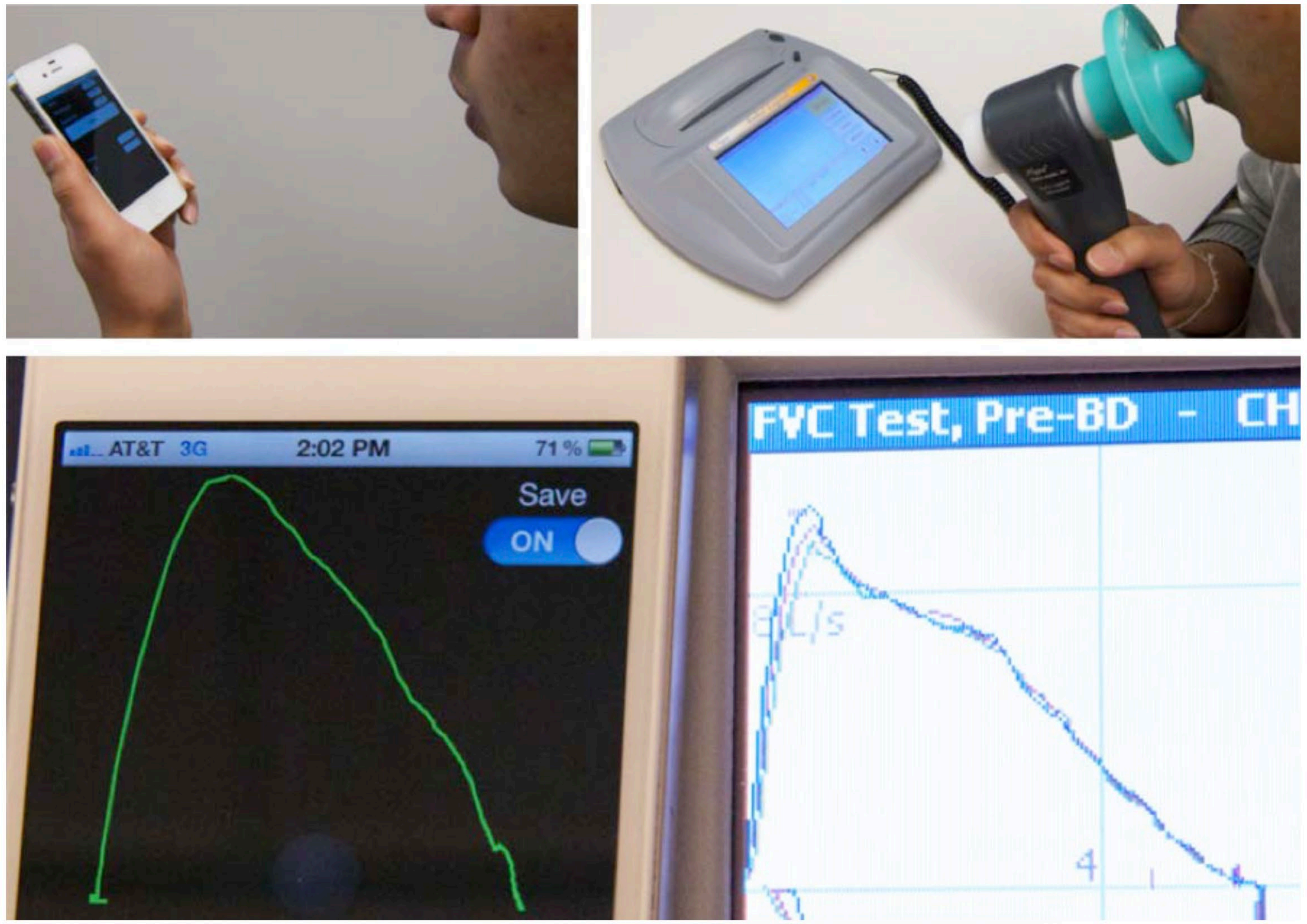
- Sensors can also be re-appropriated
  - Microphone: measure noise, such as for sleep quality
  - Camera: barcode or QR scanner
  - Accelerometer: pedometer
  - Touchscreen: pressure

Appropriating Sensors in Research

Appropriating Sensors in Research

SpiroSmart

- Lung function (asthma/blockage) via a microphone

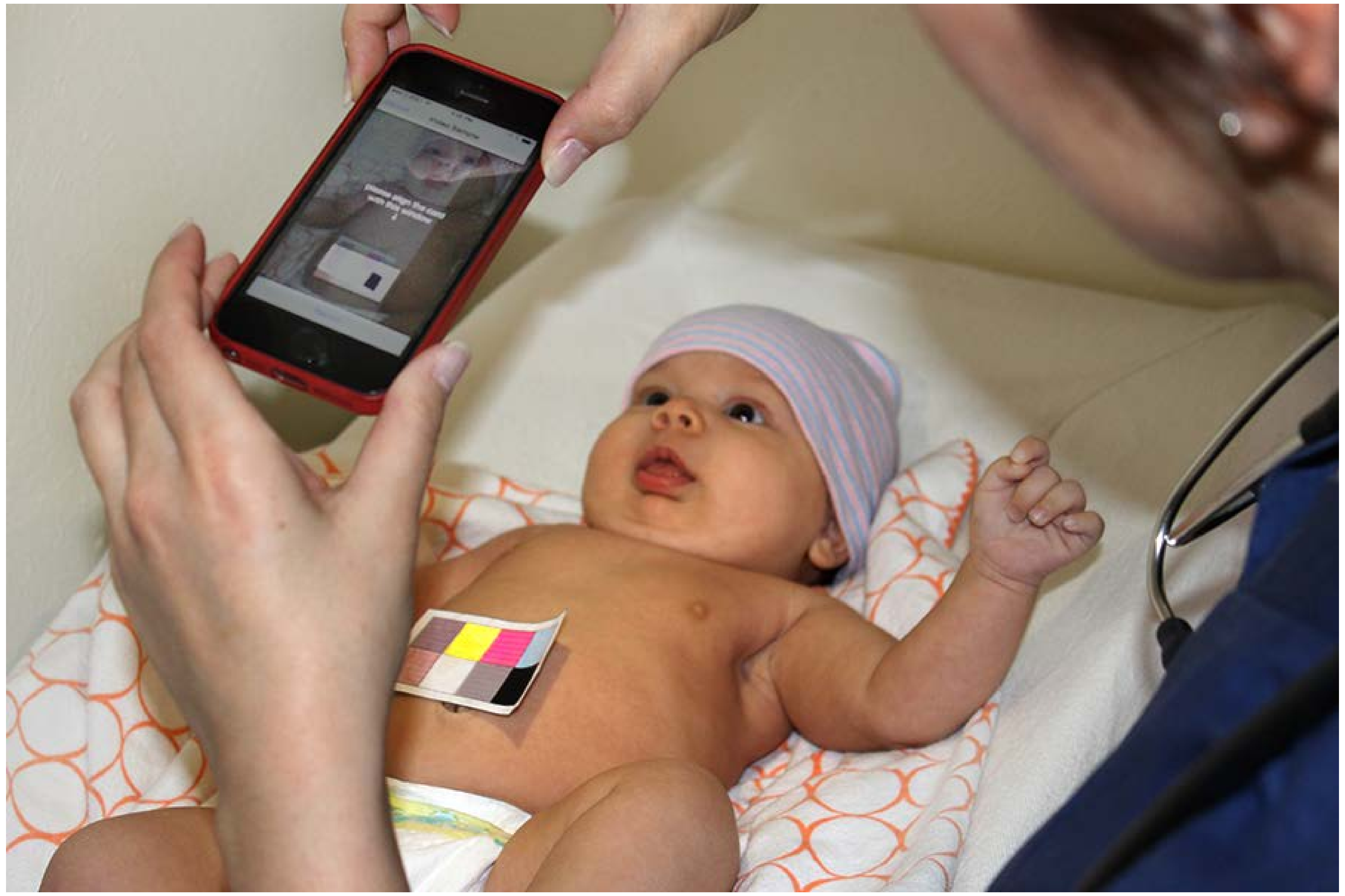


https://dl.acm.org/citation.cfm?id=2370261
Eric C. Larson, Mayank Goel, Gaetano Boriello, Sonya Heltshe, Margaret Rosenfeld, Shwetak N. Patel.
SpiroSmart: Using a Microphone to Measure Lung Function on a Mobile Phone. UbiComp 2012

Appropriating Sensors in Research

BiliCam

- Jaundice in newborns via camera and a calibration card



https://dl.acm.org/citation.cfm?id=2632076
Lilian de Greef, Mayank Goel, Min Joon Seo, Eric C. Larson, James W. Stout, James A. Taylor, Shwetak N. Patel.

BiliCam: Using Mobile Phones to Monitor Newborn Jaundice. UbiComp 2014

Appropriating Sensors in Research

Why?

- Medical devices are expensive and inaccessible
- Phones are widely available
    - ~40% of the world owns a smartphone today
    - Can enable these tests in lower-resource countries or counties
    - Can enable at-home tests and continuous monitoring
- Regulation is a separate and important issue

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