

IN4MATX 133: User Interface Software

Lecture 18:
Device Resources & Sensors

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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 + 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/>

<https://capacitorjs.com/docs/cordova/using-cordova-plugins>

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:

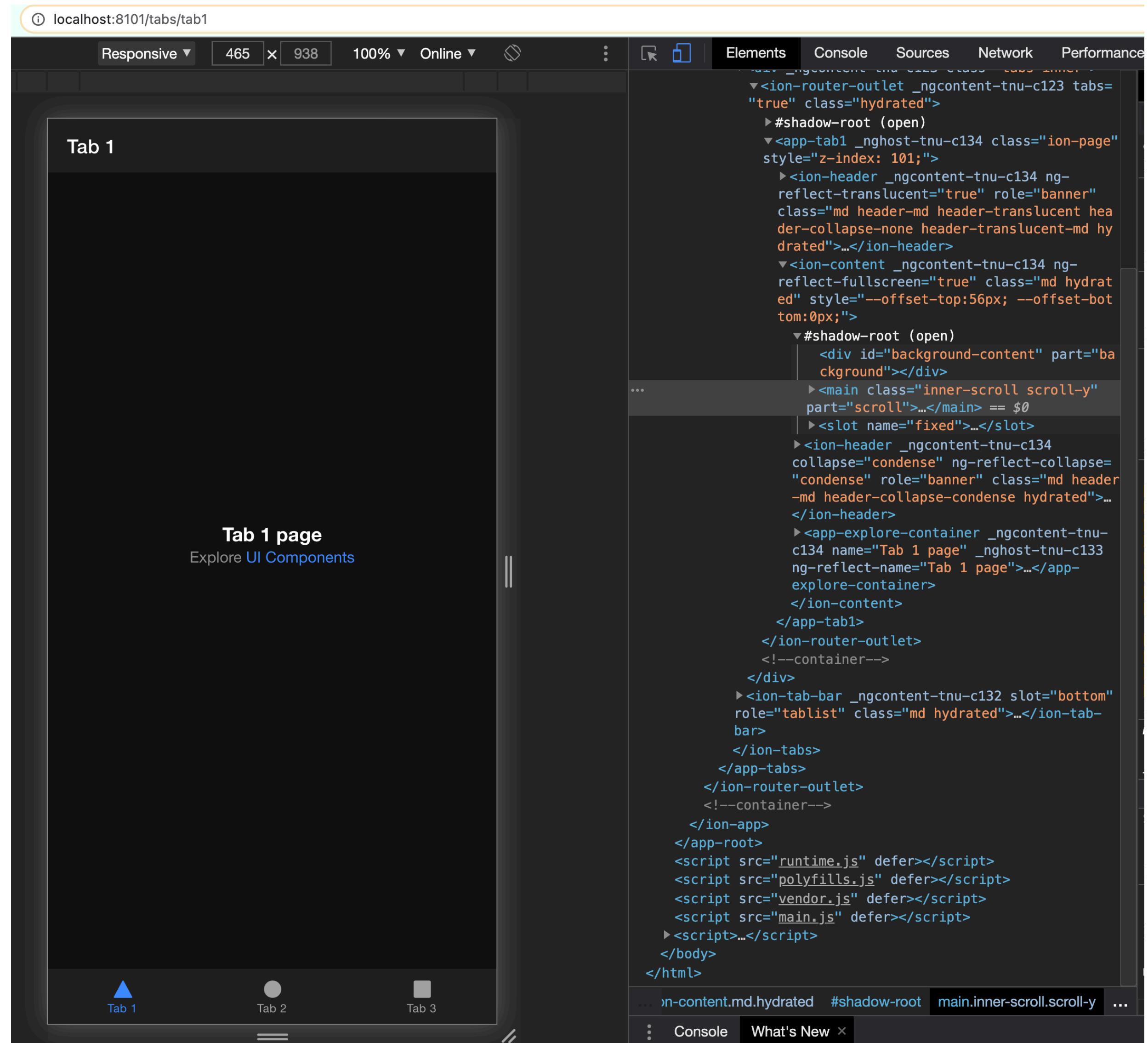
```
$ ionic cap run [android or ios] -l --external
```

\$Ionic Serve

- Deploys the web project to be accessed in the browser
- Capacitor allows for runtime evaluation of platform and available resources
 - Plugins will try to use native features, but revert to web APIs otherwise

<https://ionicframework.com/docs/cli/commands/serve>

<https://capacitorjs.com/docs/basics/progressive-web-app>



Capacitor Plugins

- Some (few) are maintained officially
- Others are maintained by the community
- V3 is on the horizon and will solve some known bugs
- As a result, quality varies immensely
- Features may not work as expected
- Might be better than using Ionic Native and Cordova, these have lagged in updates and compliance with newer platform versions

Three Official Capacitor Plugins

- Camera
- Local Notification
- Sharing
- (There are others, just three we'll go through)

Taking a Picture

- To use webcam, install PWA lib:

- install PWA lib

```
$npm install @ionic/pwa-elements
```

- Import in main.ts

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

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

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

Local Notification

Local Notifications



The Local Notification API provides a way to schedule “local” notifications – notifications that are scheduled and delivered on the device as opposed to “push” notifications sent from a server.

Local Notifications are great for reminding the user about a change in the app since they last visited, providing reminder features, and delivering offline information without the app being in the foreground.

- `schedule(...)`
- `getPending()`
- `registerActionTypes(...)`
- `cancel(...)`
- `isEnabled()`
- `createChannel(...)`
- `deleteChannel(...)`
- `listChannels()`
- `requestPermission()`
- `addListener(...)`
- `addListener(...)`
- `removeAllListeners()`
- `Interfaces`

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

Local Notification

- Import Plugin in a service or component

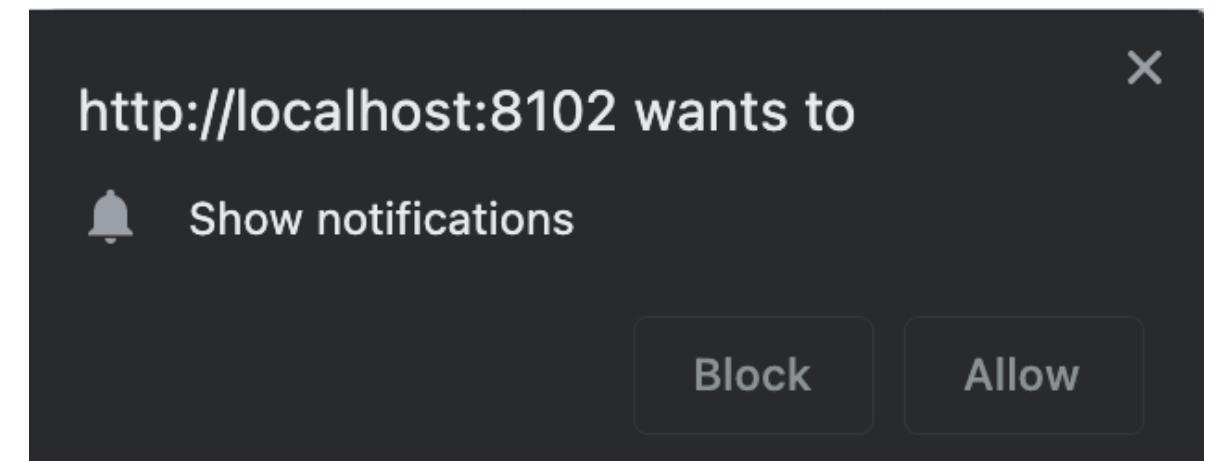
```
import { Plugins } from '@capacitor/core';
```

```
const { LocalNotifications } = Plugins;
```

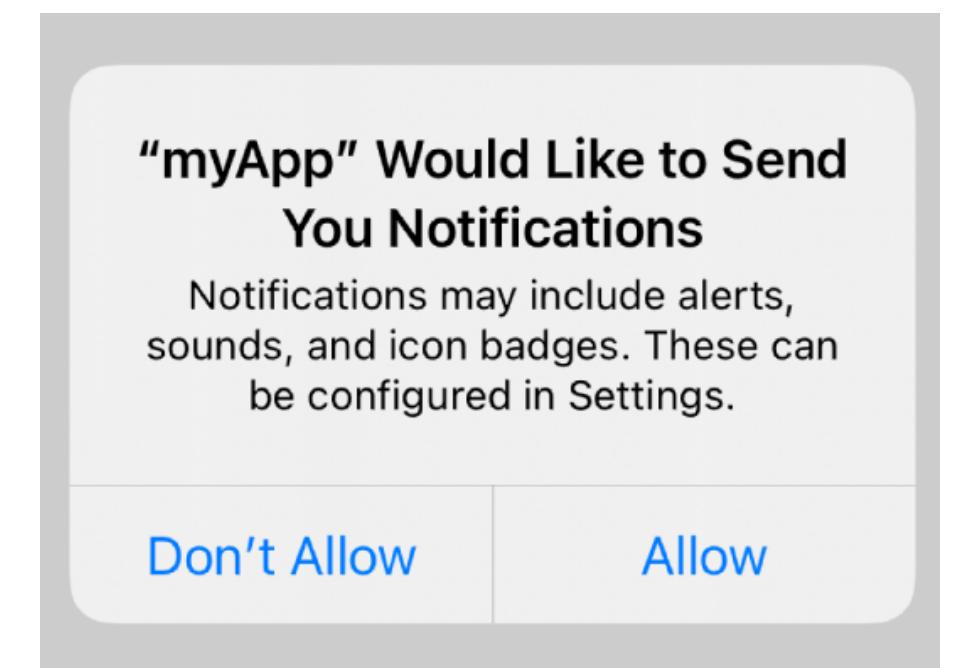
- Prompt user to authorize notifications:

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

Prompt on Web:



Prompt on iOS:



<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) } ← Can schedule for the future
    },
    sound: null,
    attachments: null,
    actionTypeId: '',
    extra: null
  ]
});
console.log('scheduled notifications', notifs);
```

<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
 - “Support is currently spotty”
 - Can share URLs, Text, Files (e.g., picture)
 - Not available in some desktop browsers (but usually on phone’s browser)

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

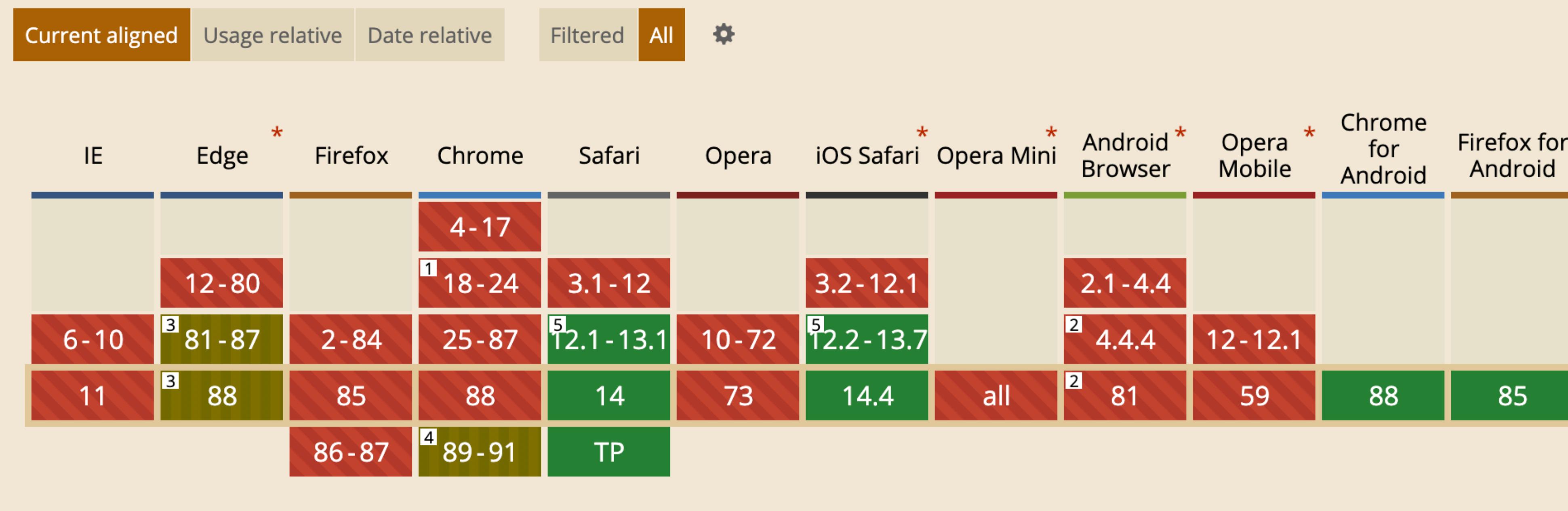
<https://web.dev/web-share/>

<https://github.com/ionic-team/capacitor/i>

Sharing

Web Share API - WD

A way to allow websites to invoke the native sharing capabilities of the host platform



Sharing

- Import Plugin

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

const { Share } = Plugins;
```

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

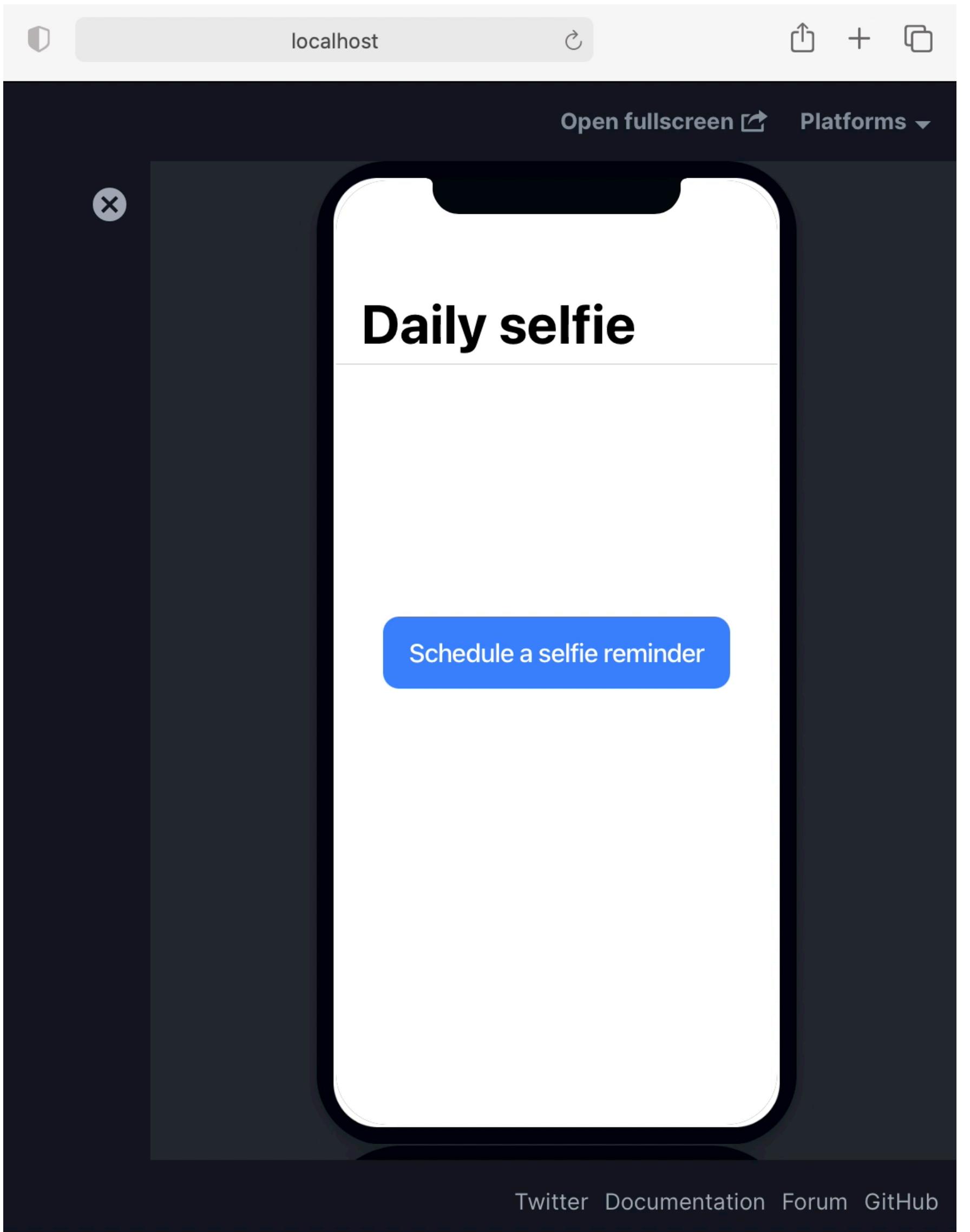
```
import { Plugins } from '@capacitor/core';
const { Share } = Plugins;

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/>

Plugins



Plugin Issues

- There are many issues with Capacitor plugins (as with Cordova)
 - For example, the Motion plugin uses only the web API and has some platform permission challenges
- Only a limited set of functionalities are enabled
 - Can't share a file, for instance
- Plugins may be unreliable
 - It's the reality of relying on open-source tools
- Capacitor V3 is on the horizon and seeks to solve some known issues

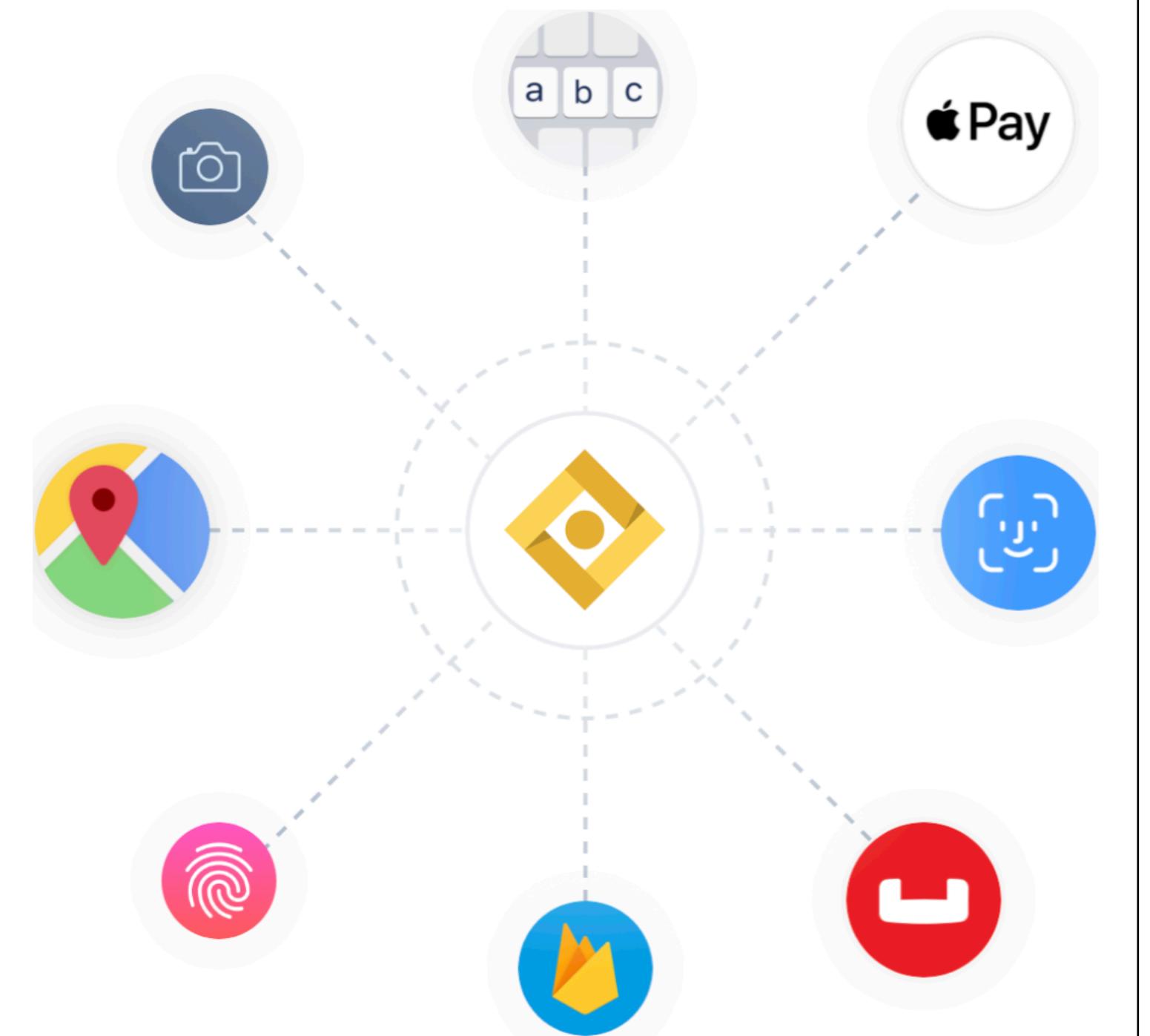
<https://github.com/ionic-team/capacitor/issues>

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

Premier, supported native plugins

Native features maintained by Ionic's team of native experts. Active subscribers get ongoing updates to supported [Capacitor](#) and [Cordova](#) plugins, to keep pace with OS and API changes, and evolving device standards.



<https://capacitorjs.com/enterprise>

<https://ionicframework.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/>

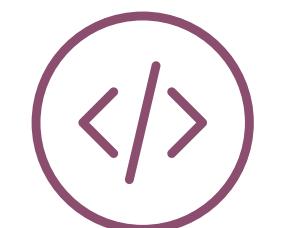
React Native Plugins

- 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)
- Notifications plugin only has 7 open issues,
but also a community-supported plugin

<https://github.com/react-native-sensors/react-native-sensors>

<https://github.com/wix/react-native-notifications>

Question



prefer

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 just okay
- 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 pretty 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

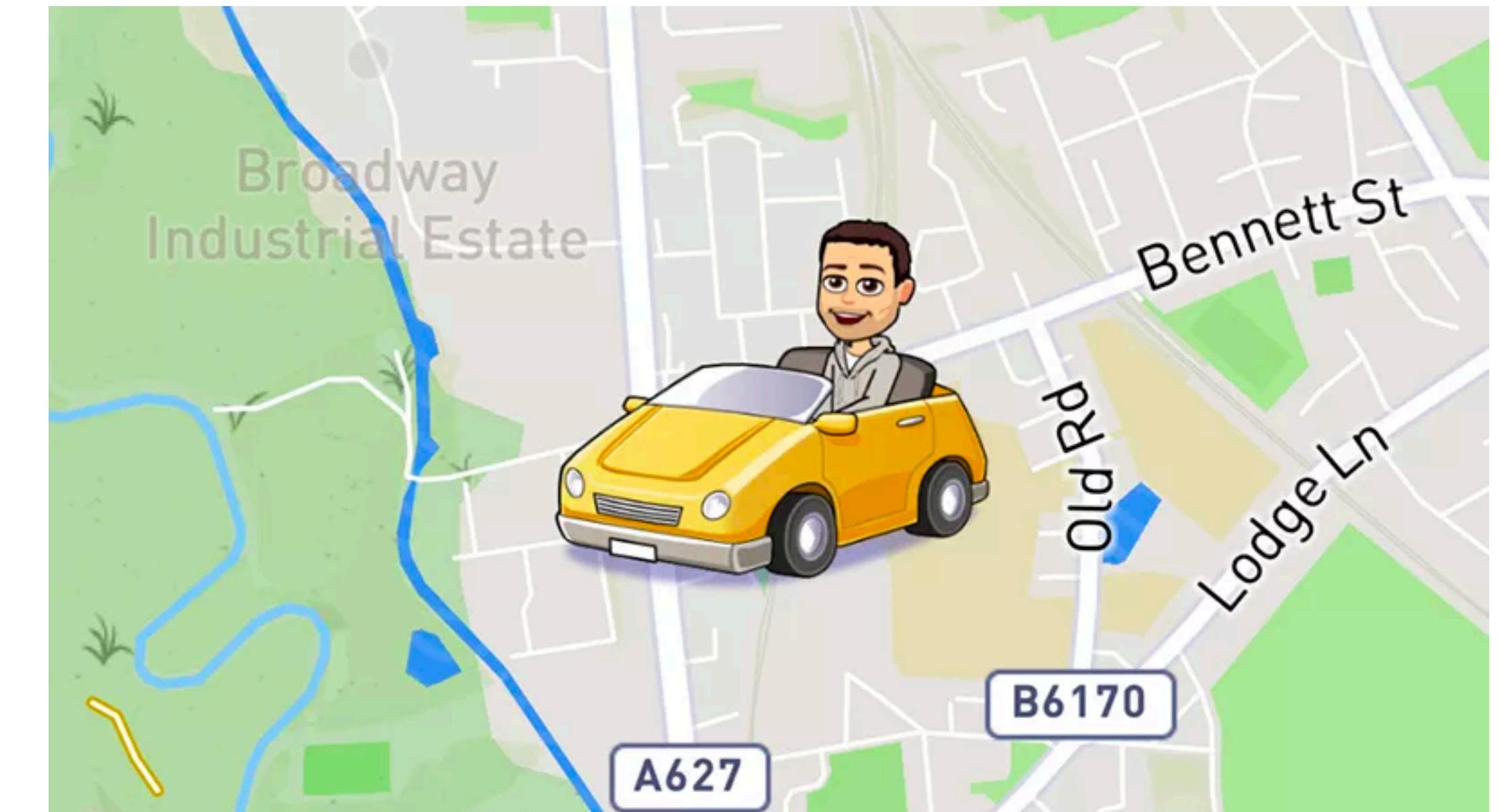
Weaknesses of hybrid apps

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

Modern phones include a lot of sensors

Sensors

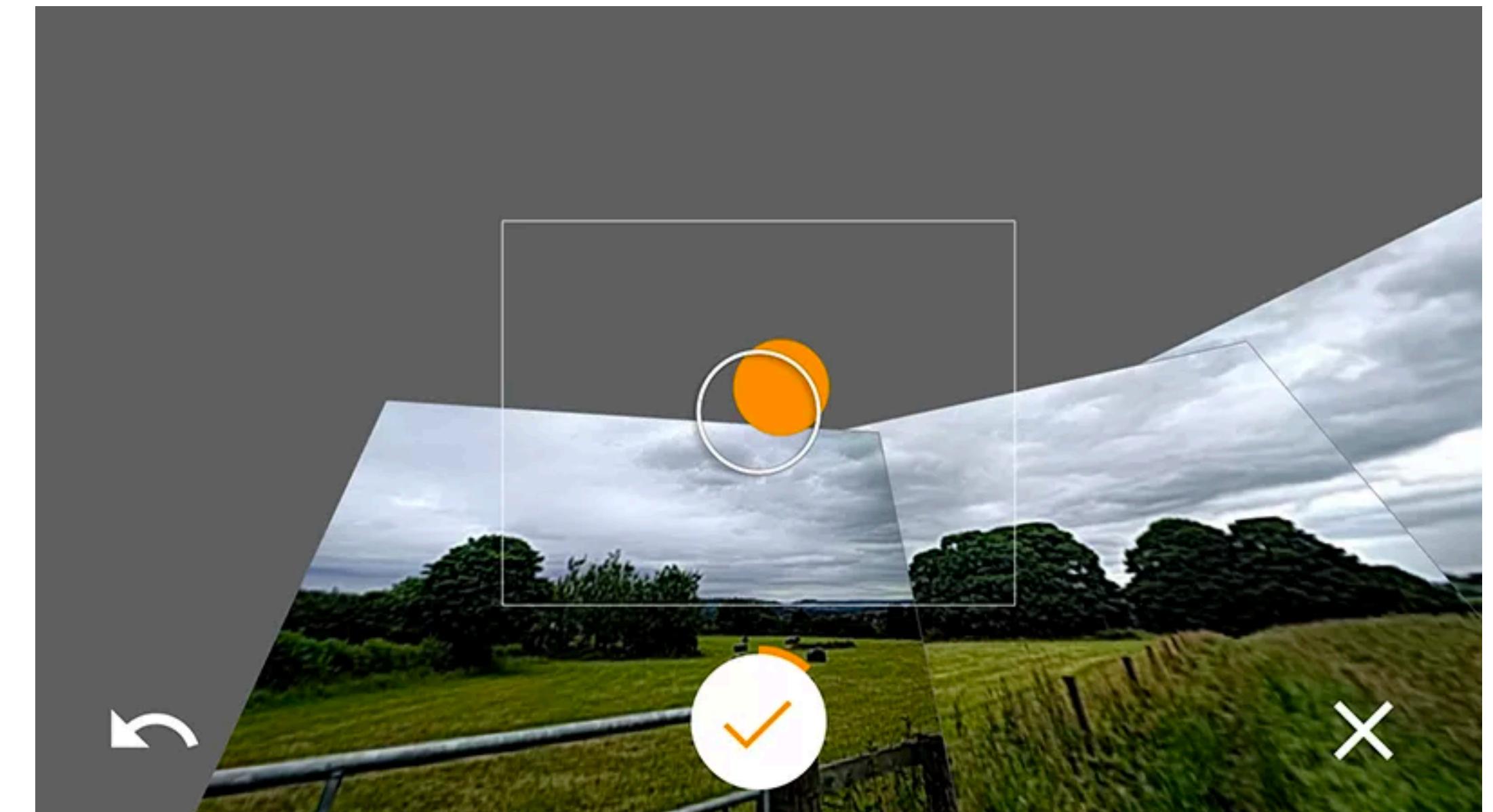
- Accelerometers
 - Axis-based motion sensing
 - Measures acceleration in a particular direction



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

Sensors

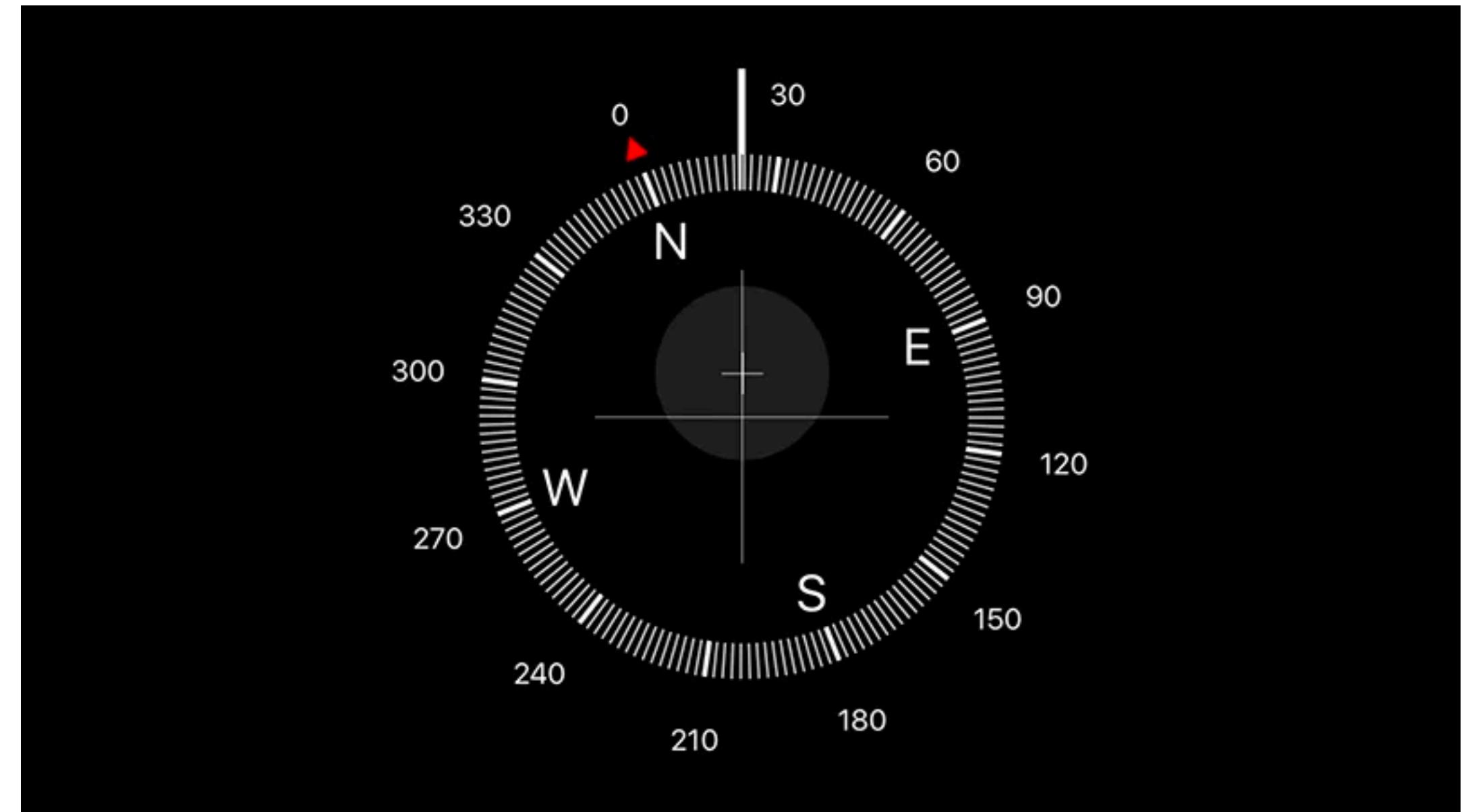
- Gyroscope
 - Measures device orientation
 - Can measure device rotation, where accelerometer cannot



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

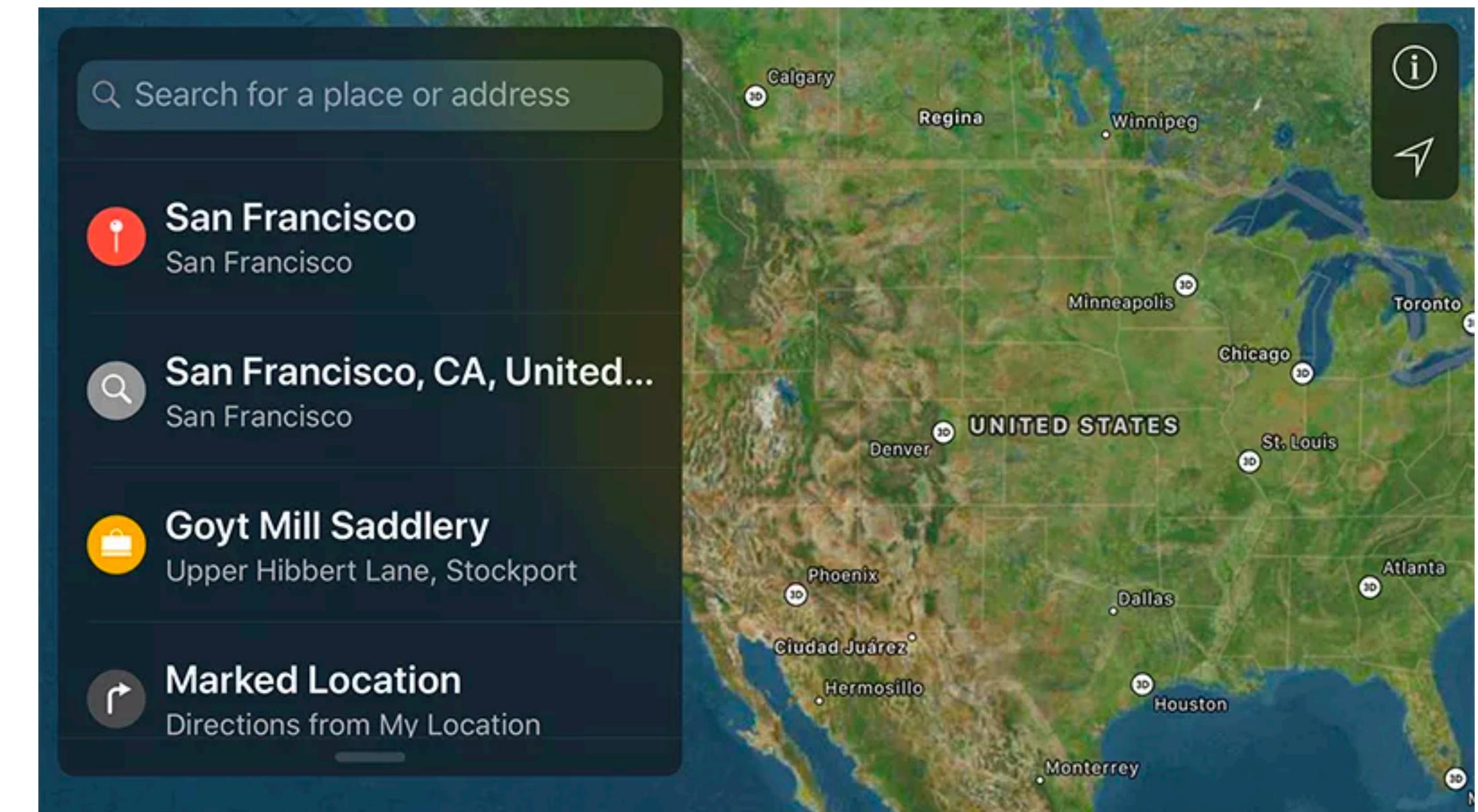
Sensors

- Magnetometer
 - 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

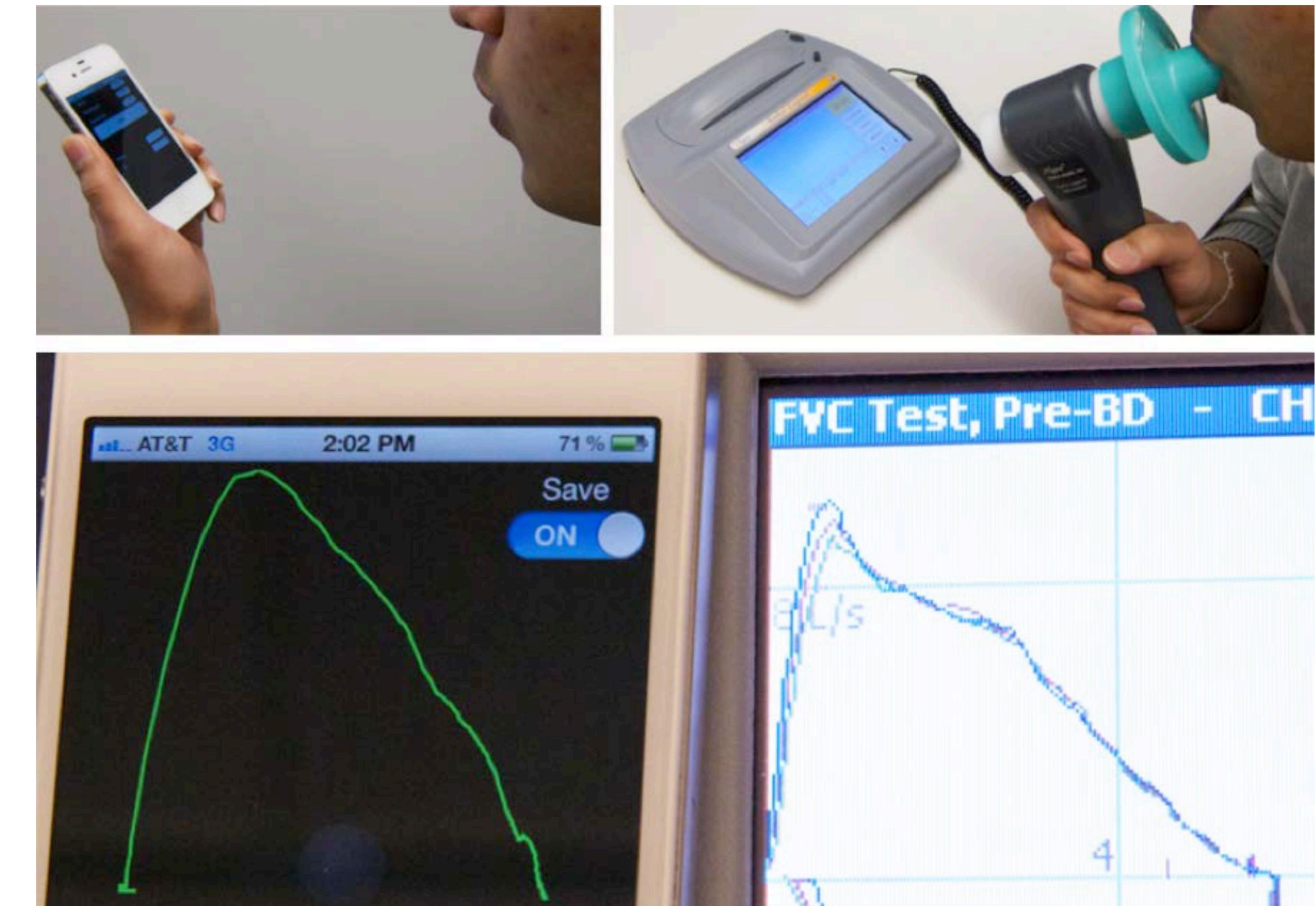
- Sensors can also be re-appropriated
 - Microphone: measure noise, such as for sleep quality
 - Camera: barcode or QR scanner
 - Accelerometer: pedometer
 - Touchscreen: pressure

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 Borriello, 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

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

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