Sensors

Mobile Application Development in iOS

School of EECS

Washington State University

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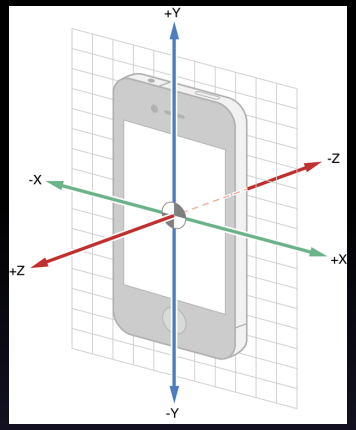
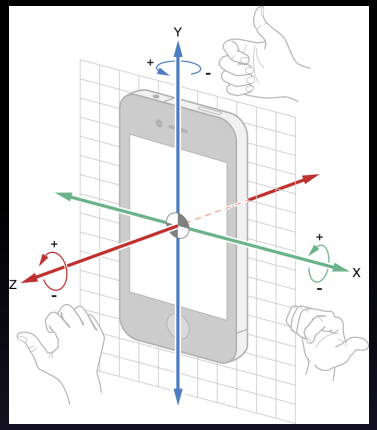
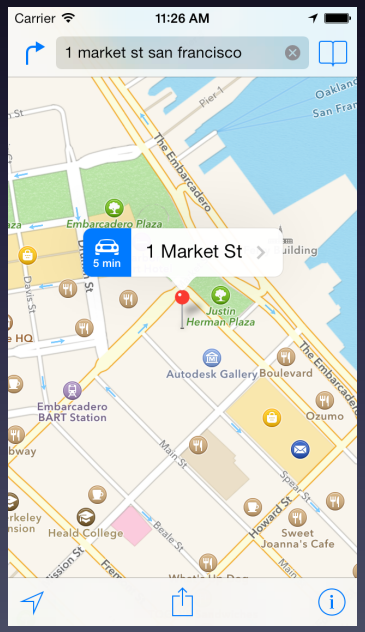
Outline

- Sensor types
- Sensor availability
- Accessing sensor data
- Core Motion
- Core Location
- Map Kit

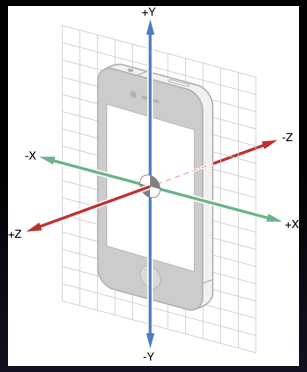


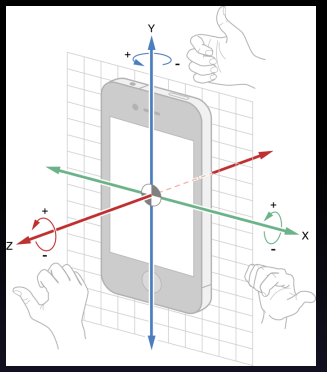


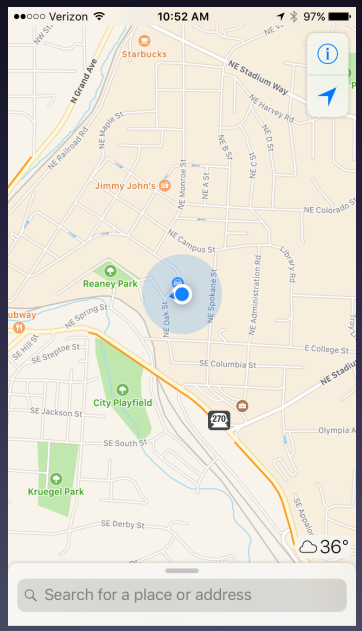


Sensor Types

- Accelerometer – Movement
- Gyroscope – Rotation
- Magnetometer – Direction
- GPS – Location

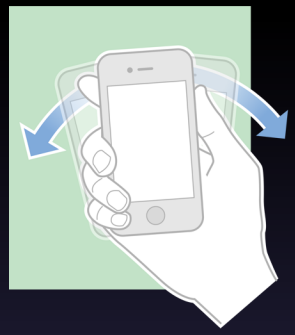






Sensor Types (cont.)

- Device orientation
- Shake motion
- Proximity (to user's face)
- Battery level
- Microphone & cameras
- Bluetooth (proximity to beacon)
- Wifi & cellular radios (IPs, carrier)

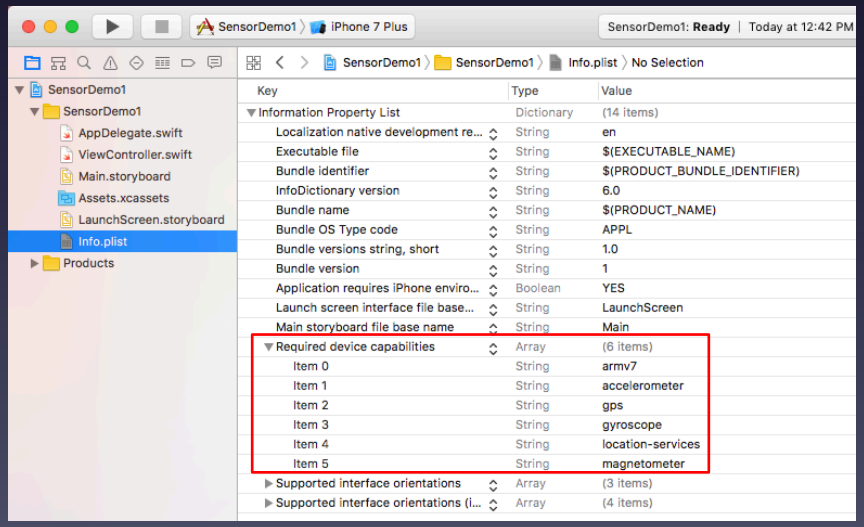


Aggregated Sensors

- Location services
  - Maps, regions (beacon, circular)
  - Geocoders, placemarks
  - Altitude, speed, heading, floor
- Motion services
  - User acceleration (minus gravity)
  - Pedometer, step counter
  - Activity: Stationary, walking, running, cycling, driving

Sensor Availability

- Required device capabilities
  - App Info plist
  - https://developer.apple.com/library/content/documentation/General/Reference/InfoPlistKeyReference/Introduction/Introduction.html
  - App won't install without them

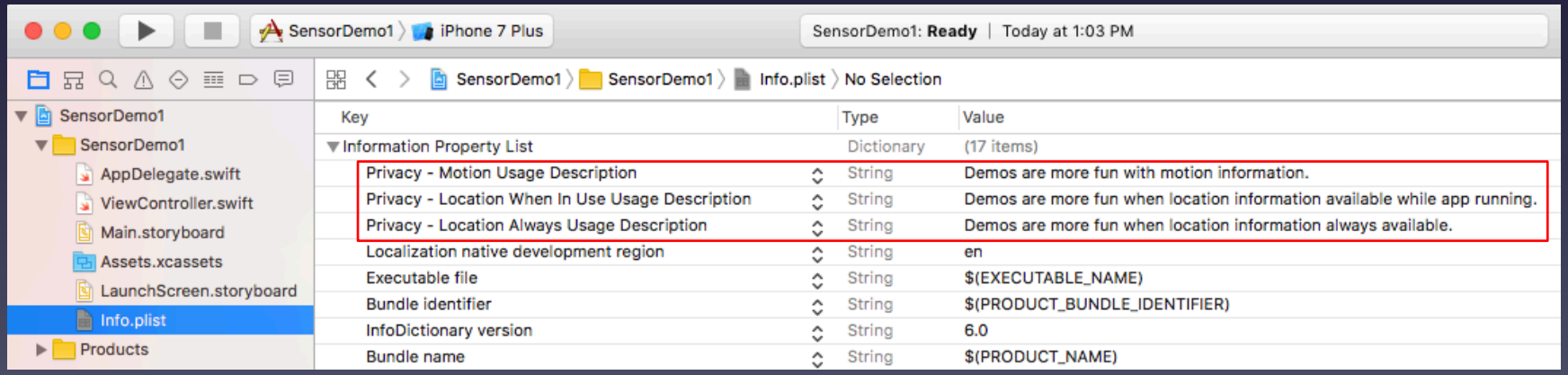


Sensor Availability

- CMMotionManager
  - isAccelerometerAvailable
  - isGyroAvailable
  - isMagnetometerAvailable
  - isDeviceMotionAvailable
- CLLocationManager
  - locationServicesEnabled

Sensor Authorization

- App must provide purpose for using accelerometer and GPS
  - To protect user privacy
- App Info.plist
  - Privacy – Motion Usage Description
  - Privacy – Location Always Usage Description
  - Privacy – Location When In Use Usage Description

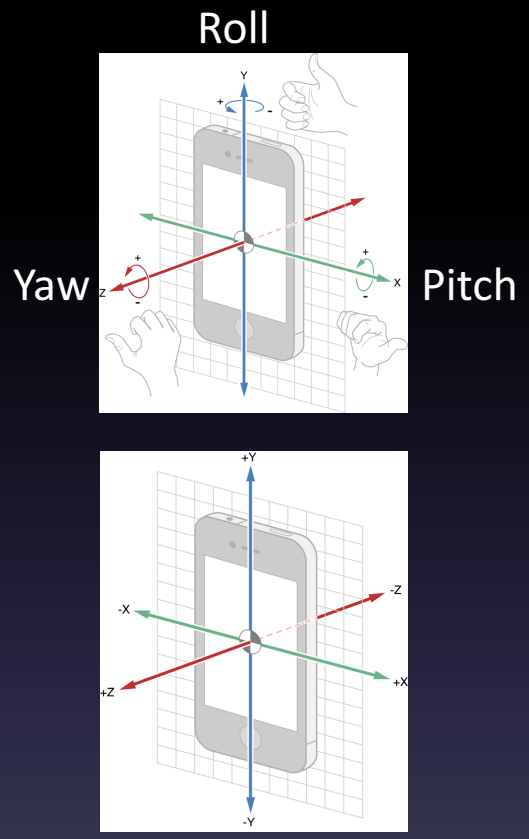


Sensor Authorization

- At this point (iOS 10), no need to ask for authorization to access motion sensors
  - But may become health privacy issue
- Do need to ask for (and monitor) authorization to access location (GPS)
  - requestWhenInUseAuthorization
  - requestAlwaysAuthorization
  - didChangeAuthorization

Core Motion

- Create Core Motion manager
- Set update internal
- Start updates with queue and handler
  - Handler gets CMDeviceMotion structure
    - Attitude, rotation rate, acceleration
- Stop updates
- See https://developer.apple.com/reference/coremotion



Core Motion

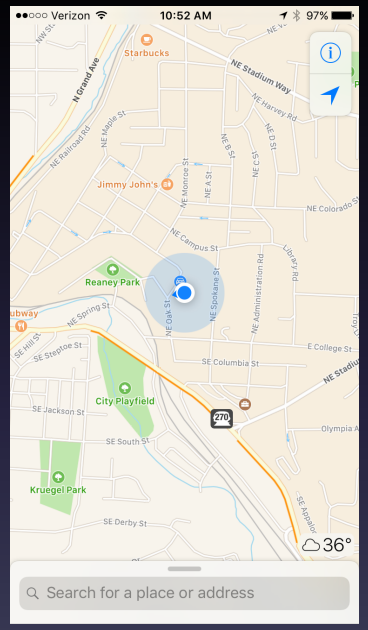
```
import CoreMotion

class ViewController: UIViewController {

  var motionManager: CMMotionManager!

  func initializeMotion() { // called from start up method
    self.motionManager = CMMotionManager()
    self.motionManager.deviceMotionUpdateInterval = 0.1 // secs
  }

  func startMotion () {
    self.motionManager.startDeviceMotionUpdates(
      to: OperationQueue.current!, withHandler: motionHandler)
  }

  func stopMotion () {
    self.motionManager.stopDeviceMotionUpdates()
  }
```

Core Motion

```
func motionHandler (deviceMotion: CMDeviceMotion?, error: Error?)
{
  if let err = error {
    NSLog("motionHandler error: \(err.localizedDescription)")
  } else {
    if let dm = deviceMotion {
      print("Attitude: yaw = \(dm.attitude.yaw),
             pitch = \(dm.attitude.pitch),
             roll = \(dm.attitude.roll)")
      print("Acceleration: x = \(dm.userAcceleration.x),
             y = \(dm.userAcceleration.y),
             z = \(dm.userAcceleration.z)")
    } else {
      NSLog("motionHandler: deviceMotion = nil")
    }
  }
}
```

Core Location

- Conform to CLLocationManagerDelegate
- Create Core Location manager
- Check authorization status
  - Request if needed
- Implement didUpdateLocations delegate method
- Start/stop location updates as needed



Core Location

```
import CoreLocation

class ViewController: UIViewController, CLLocationManagerDelegate {

  var locationManager: CLLocationManager!

  func initializeLocation() { // called from start up method
    self.locationManager = CLLocationManager()
    self.locationManager.delegate = self
    let status = CLLocationManager.authorizationStatus()
    switch status {
    case .authorizedAlways, .authorizedWhenInUse:
      self.startLocation()
    case .denied, .restricted:
      print("location not authorized")
    case .notDetermined:
      locationManager.requestWhenInUseAuthorization()
    }
  }
```

Core Location

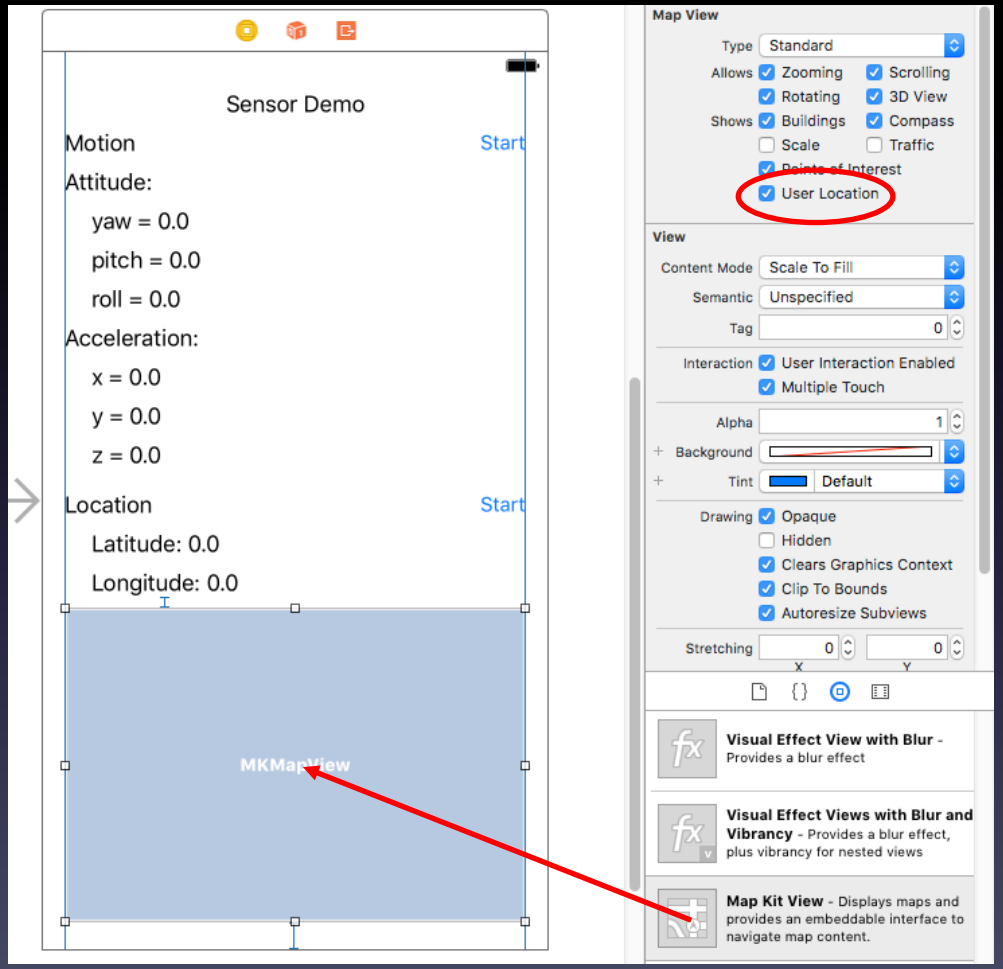
```
// Delegate method called whenever location authorization status changes
func locationManager(_ manager: CLLocationManager,
       didChangeAuthorization status: CLAuthorizationStatus)
{
  if ((status == .authorizedAlways) || (status == .authorizedWhenInUse)) {
    self.startLocation()
  } else {
    self.stopLocation()
  }
}

func startLocation () {
  locationManager.distanceFilter = kCLDistanceFilterNone
  locationManager.desiredAccuracy = kCLLocationAccuracyBest
  locationManager.startUpdatingLocation()
}

func stopLocation () {
  locationManager.stopUpdatingLocation()
}
```

Core Location

```
// Delegate method called whenever location changes
func locationManager(_ manager: CLLocationManager,
       didUpdateLocations locations: [CLLocation])
{
  let location = locations.last
  if let latitude = location?.coordinate.latitude {
    print("Latitude: \(latitude)”)
  }
  if let longitude = location?.coordinate.longitude {
    print("Longitude: \(longitude)”)
  }
}
```

Map Kit

- Import MapKit
- Add Map Kit View in Storyboard
- Enable User Location
- Add IBOutlet
- Set userTrackingMode = .follow



Reverse Geocoding

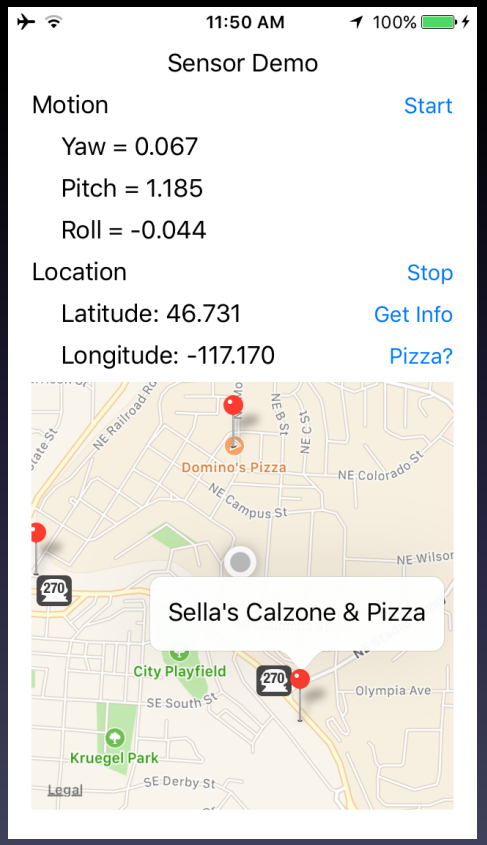
- Create instance of CLGeocoder
- Use reverseGeoCodeLocation
- Handler receives array of CLPlacemark's
- https://developer.apple.com/reference/corelocation/clplacemark

Reverse Geocoding

```
import CoreLocation

var geoCoder = CLGeocoder()
var globalLocation: CLLocation! // set in didUpdateLocations

// Initiate lookup of location
geoCoder.reverseGeocodeLocation(globalLocation,
  completionHandler: geoCodeHandler)

func geoCodeHandler (placemarks: [CLPlacemark]?, error: Error?) {
  if let placemark = placemarks?.first {
    if let name = placemark.name {
      print("place name = \(name)")
    }
  }
}
```

MapKit Annotations

- Create MapKit search request
  - Current region
  - Natural language search query
- Start search
- Results to completion handler



MapKit Annotations

```
let request = MKLocalSearchRequest()
request.naturalLanguageQuery = "pizza"
request.region = self.mapKitView.region
let search = MKLocalSearch(request: request)
search.start(completionHandler: {(response, error) in
  if error != nil {
    print("Error occured in search: \(error!.localizedDescription)")
  } else if response!.mapItems.count == 0 {
    print("No matches found")
  } else {
    print("\(response!.mapItems.count) matches found")
    self.mapKitView.removeAnnotations(self.mapKitView.annotations)
    for item in response!.mapItems {
      let annotation = MKPointAnnotation()
      annotation.coordinate = item.placemark.coordinate
      annotation.title = item.name
      self.mapKitView.addAnnotation(annotation)
    }
  }
})
```

Resources

- Core Motion Reference
  - https://developer.apple.com/reference/coremotion
- Core Location Reference
  - https://developer.apple.com/reference/corelocation
- Map Kit
  - https://developer.apple.com/reference/mapkit