CMSC436: Programming Handheld Systems
Location & Maps
Today’s Topics

Location
Location support classes
Maps
Map support classes
Location Services

Mobile applications can benefit from being location-aware

Allows applications to determine their location and modify their behavior
Using Location Information

Find stores near the user’s current location
Direct a user from a current to a particular store
Define a geofence
Initiate action when user enters or exits the geofence
Location Architecture

Location
LocationProvider
LocationManager
LocationListener
Location

Represents a position on the Earth

A Location instance consists of:

- Latitude, longitude, timestamp and, optionally, accuracy, altitude, speed, and bearing
LocationProvider

Represents a location data source

Actual data may come from

- GPS satellites
- Cell phone towers
- WiFi access points
LocationProvider Types

Network – WiFi and cell tower

GPS - Satellite

Passive – Piggyback on the readings requested by other applications
NetworkProvider

Determines location based on cell tower and WiFi access points

Requires either

  android.permission.ACCESS_COARSE_LOCATION

  android.permission.ACCESS_FINE_LOCATION
GPSProvider

Determines location using satellites

Requires

   android.permission.ACCESS_FINE_LOCATION
PassiveProvider

Returns locations generated by other providers

Requires

android.permission.ACCESS_FINE_LOCATION
LocationProvider

Different LocationProviders offer different tradeoffs between cost, accuracy, availability & timeliness
LocationProvider Tradeoffs

GPS – expensive, accurate, slower, available outdoors

Network - cheaper, less accurate, faster, availability varies

Passive – cheapest, fastest, not always available
LocationManager

System service for accessing location data
getSystemService(Context.LOCATION_SERVICE)
LocationManager

Determine the last known user location
Register for location updates
Register to receive Intents when the device nears or moves away from a given geographic area
LocationListener

Defines callback methods that are called when Location or LocationProvider status changes
LocationListener

void onLocationChanged (Location location)
void onProviderDisabled (String provider)
void onProviderEnabled (String provider)
void onStatusChanged (String provider, int status, Bundle extras)
Obtaining and Using Location Information

Start listening for updates from LocationProviders
Maintain a "current best estimate" of location
When estimate is “good enough”, stop listening for location updates
Use best location estimate
Determining Best Location

Several factors to consider

- Measurement time
- Accuracy
- Power usage
LocationGetLocation

Application acquires and displays the last known locations from all providers.

If necessary, acquires and displays new readings from all providers.
Location
Get Location

LocationGetLocation

No Initial Reading Available
GPS data point

Coordinate system: Decimal

Currently reported location:
- Longitude: 44.00000
- Latitude: 38.9847
- Altitude: 0.0

GPS data playback

Table:

<table>
<thead>
<tr>
<th>Delay (sec)</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Name</th>
<th>Description</th>
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</thead>
</table>

SEND

LocationGetLocation

Accuracy: 20.000000
Time: 11/12/2017 18:56:55
Longitude: 44.000000
Latitude: 38.984698
LocationGetLocationServices

The same as LocationGetLocation, but uses newer FusedLocationProvider class

Uses Google Play Services
Battery Saving Tips

Always check last known measurement
Return updates as infrequently as possible
Limit measurement time
Use the least accurate measurement necessary
Turn off updates in onPause()
Maps

A visual representation of area

Android provides Mapping support through the Google Maps Android v2 API
Map Types

Normal: traditional road map
Satellite – Aerial photograph
Hybrid - Satellite + road map
Terrain - Topographic details
Customizing the Map

- Change the camera position
- Add Markers & ground overlays
- Respond to gestures
- Indicate the user’s current Location
Some Map Classes

GoogleMap
MapFragment
Camera
Marker
Setting up a Maps Application

Set up the Google Play services SDK
Obtain an API key
Specify settings in Application Manifest
Add map to project

See: https://developers.google.com/maps/documentation/android/start
Map Permissions

<uses-permission android:name="android.permission.INTERNET"/>

<uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"/>
Map Permissions

<uses-permission android:name= "android.permission.WRITE_EXTERNAL_STORAGE"/>

<uses-permission android:name= "com.google.android.providers.gsf.permission.READ_GSERVICES"/>
Map Permissions

<uses-permission android:name="android.permission.ACCESS_COARSE_LOCATION"/>

<uses-permission android:name="android.permission.ACCESS_FINE_LOCATION"/>
MapEarthQuakeMap

This application acquires earthquake data from a server
Then it displays the data on a map, using clickable markers
MapEarthQuakeMap
public class MapsEarthquakeMapActivity extends Activity implements RetainedFragment.OnFragmentInteractionListener, OnMapReadyCallback {

    ...  

    public void onCreate(Bundle savedInstanceState) {
        // Set up UI and get earthquake data
        ...  

        // The GoogleMap instance underlying the GoogleMapFragment defined in main.xml
        MapFragment map = ((MapFragment) getSupportFragmentManager().findFragmentById(R.id.map));
        map.getMapAsync(this);
    }
}
// Called when Map is ready
public void onMapReady(GoogleMap googleMap) {

    mMapReady = true;
    mMap = googleMap;
    mMap.moveCamera(
        CameraUpdateFactory.newLatLng(new LatLng(CAMERA_LAT, CAMERA_LNG)));

    if (mDataReady) {
        placeMarkers();
        mMapReady = false;
    }
}
// Called when data has been downloaded
public void onDownloadfinished() {
    mDataReady = true;
    if (mMapReady) {
        placeMarkers();
        mDataReady = false;
    }
}
private void placeMarkers() {
    // Add a marker for every earthquake
    for (EarthQuakeRec rec : mRetainedFragment.getData()) {
        // Add a new marker for this earthquake
        mMap.addMarker(new MarkerOptions()
            // Set the Marker's position
            .position(new LatLng(rec.getLat(), rec.getLng()))
            // Set the title of the Marker's information window
            .title(String.valueOf(rec.getMagnitude()))
            // Set the color for the Marker
            .icon(BitmapDescriptorFactory.defaultMarker(getMarkerColor(rec.getMagnitude()))));
    }
}
Next Time

The ContentProvider Class
Example Applications

LocationGetLocation
LocationGetLocationServices
MapEarthQuakeMap