CUbiPark Documentation

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Provided is documentation for the CUbiPark demo application that we have developed. CUbiPark is an Android application that that was developed to supplement our paper *CUbiPark: Sensing Parking Availability*. This document serves as a brief introduction into the system and application. Code can be found in the folder this document is located in. All code is thoroughly commented.

There are twelve classes that make up the application.

Accel.java: This class is a class to create accelerometer objects. Each object has a x, y, and z value.

ActivityRecog.java: This class was created to hold activity recognition objects. An ActivityRecog object has a field for each state provided by the Google Activity Recognition API: still, foot, walking, running, bicycle, vehicle, tilting, and unknown.

Constants.java: This class is used to store constants used throughout the application. This includes global names, global variables, and most importantly parking lot information.

Each parking lot has a LinkedHashMap corresponding to the center of the lot, the point of interest for that lot, a loop point, the number of spaces, the last time it was updated, and its current status.

```
public static final LinkedHashMap<String, LatLng> PARKING_LOTS = new
LinkedHashMap<String, LatLng>();
public static final LinkedHashMap<String, LatLng> PARKING_LOTS_ENTRANCE = new
LinkedHashMap<String,LatLng>();
public static final LinkedHashMap<String, LatLng> PARKING_LOTS_POI = new
LinkedHashMap<String,LatLng>();
public static final LinkedHashMap<String, LatLng> PARKING_LOTS_LOOPS = new
LinkedHashMap<String,LatLng>();
public static final LinkedHashMap<String, String> PARKING_LOTS_SPACES = new
LinkedHashMap<String,String>();
public static final LinkedHashMap<String, String> PARKING_LOTS_STATUS = new
LinkedHashMap<String,String>();
public static final LinkedHashMap<String, String> PARKING_LOTS_LAST_UPDATE = new
LinkedHashMap<String,String>();
```

DataLogger.java: The DataLogger class is used to save and store sensor data from the smartphone during a parking instance into a csv file for later analysis. The class both creates the csv file as well as takes in sensor data and writes the data into a new line of the csv file for each accelerometer data, activity recognition data, and location data.
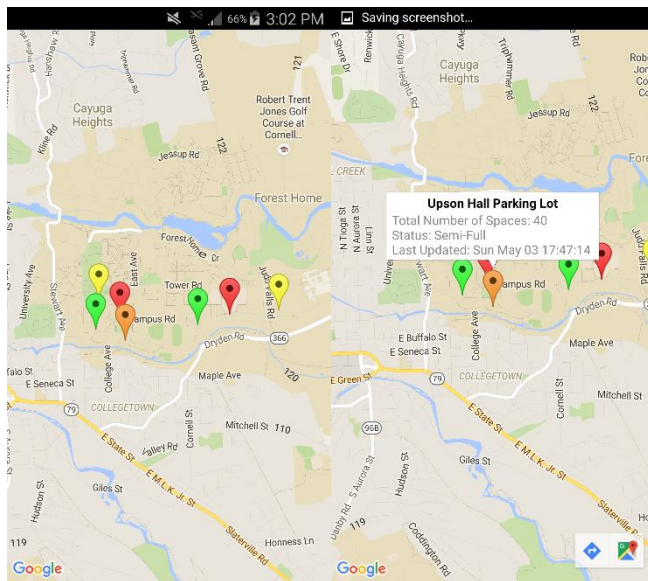
DetectedActivitiesAdapter.java: Primarily used for debugging and display purposes of the Google Activity Recognition API output of detected activities. Populates UI elements with detected activities.

DetectedActivitiesIntentService.java: Intent service to handle incoming intents generated from the Google Activity Recognition API.

GeofenceErrorMessages.java: Helper class for debugging errors associated with Geofence creation.

GeofenceTransitionsIntentService.java: Helper class to act as a listener for geofence transition changes. Works with the TrialActivity to determine when to stop recording.

MapsActivity.java: Main activity that is shown to the user. Shows parking lots as markers on a Google Map. The color of the marker determines the availability. Clicking on a parking lot provides additional information relevant to the parking status.

ParkingAnalyzer.java: Primary class that handles all the estimation of parking availability. Contains all the feature identification and classification.

ParkingParser.java: Helper class used in ParkingAnalyzer.java. Used to take read csv files into usable arrays that can be interpreted in ParkingAnalyzer.java.

TrialActivity.java: Class that was used in testing and collection of data. Saves sensor data into csv files for later interpretation and analysis.

Sample Results Data found in /info4120data:

05-13 20:54:52.044 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-23-06
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: false
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 1.7976931348623157E308
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 8
05-13 20:54:54.764 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Full

05-13 20:54:55.394 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-34-10
05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: false

05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 1.7976931348623157E308
05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 0
05-13 20:54:55.474 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Full

05-13 20:54:56.164 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-29-15
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: true
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 3.7990872859954834
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 2
05-13 20:54:58.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Semi-Empty

05-13 20:54:59.354 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-31-37
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: false
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 18.871692657470703
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 9
05-13 20:55:02.604 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Full

05-13 20:55:03.264 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-18-45
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: true
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 23.710205078125
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 0
05-13 20:55:03.364 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Semi-Full

05-13 20:55:04.384 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-04-30_18-25-30
05-13 20:55:10.104 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:55:10.104 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: true
05-13 20:55:10.114 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 1
05-13 20:55:10.114 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 37.5197868347168
05-13 20:55:10.114 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 0
05-13 20:55:10.114 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Semi-Full

05-13 20:55:11.114 5299-5299/edu.cornell.jjl.info4120final I/VariablesLogFile: log_2016-05-03_17-39-33
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesParkingLot: Sage
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesOnFoot: true
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesLoops: 0
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesDistancePOI: 7.030693054199219
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesNumberOfStop: 2
05-13 20:55:14.704 5299-5299/edu.cornell.jjl.info4120final I/VariablesResult: Semi-Full