

# *Utilizing VGI & Mobile GIS to Geotag Native Plants in Southern California*

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# What is Mapping Native Plants?

- iPhone application
- Volunteered Geographic Information
- Native Plants
- Indigenous Culture
  - Languages
  - Traditional Uses of Native Plants
- Southern California
- Open to all people with access to the technology



Source: [www.mojavehistory.com](http://www.mojavehistory.com)

# Volunteered Geographic Information (VGI)

- What is it?
- Credibility
- Local knowledge vs. expert knowledge
- Motivation
- Consequences

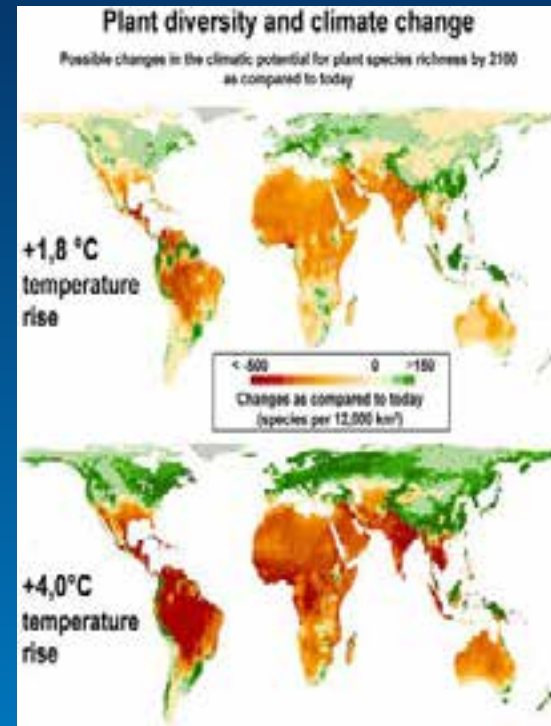


Source: Google Earth



# Native Plant Studies

- Plant geography
- Climate change studies
- Medicine
- Sustainability
- Development




Source: [www.phys.org/news188591033.html](http://www.phys.org/news188591033.html)

# Southern California Tribes

- Chumash and Cahuilla
- Cultural Revitalization
- Diabetes
- Native plants are vital



**People with Diabetes by Race and Ethnicity, 2004–2006\***



Non-Hispanic whites	6.6%
Asian Americans	7.5%
Hispanics	10.4%
Non-Hispanic blacks	11.8%
<sup>^</sup> AIAN	16.5%

\*Adjusted by age  
<sup>^</sup>American Indians and Alaska Natives

Source: Center for Disease Control

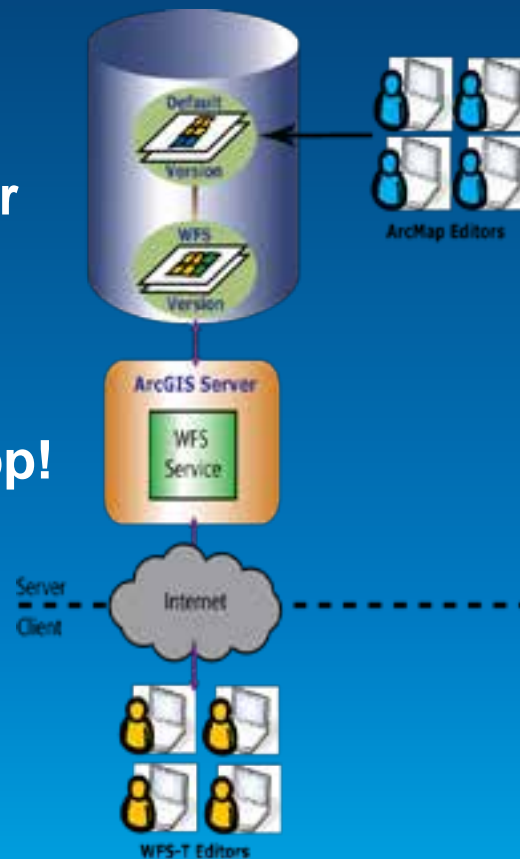
# Similar Smart Phone Apps

- Calflora, What's Invasive?, Audubon Wild Flowers California, Leafsnap
- Mapping Native Plants app is different



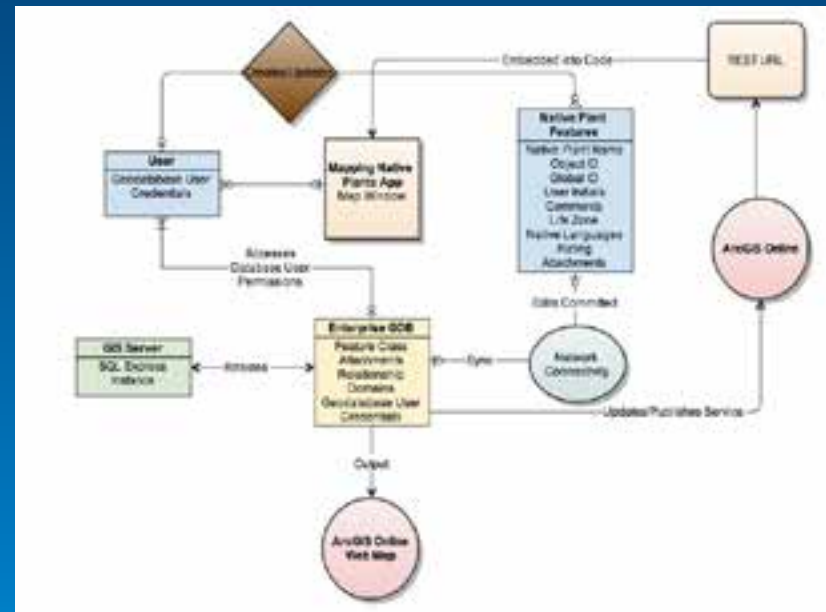
# Needs for Development

- Enterprise Geodatabase
- ArcGIS for Server 10.1
- Become an Apple Developer
- ArcGIS SDK for iOS
- Xcode
- Learn how to develop an app!



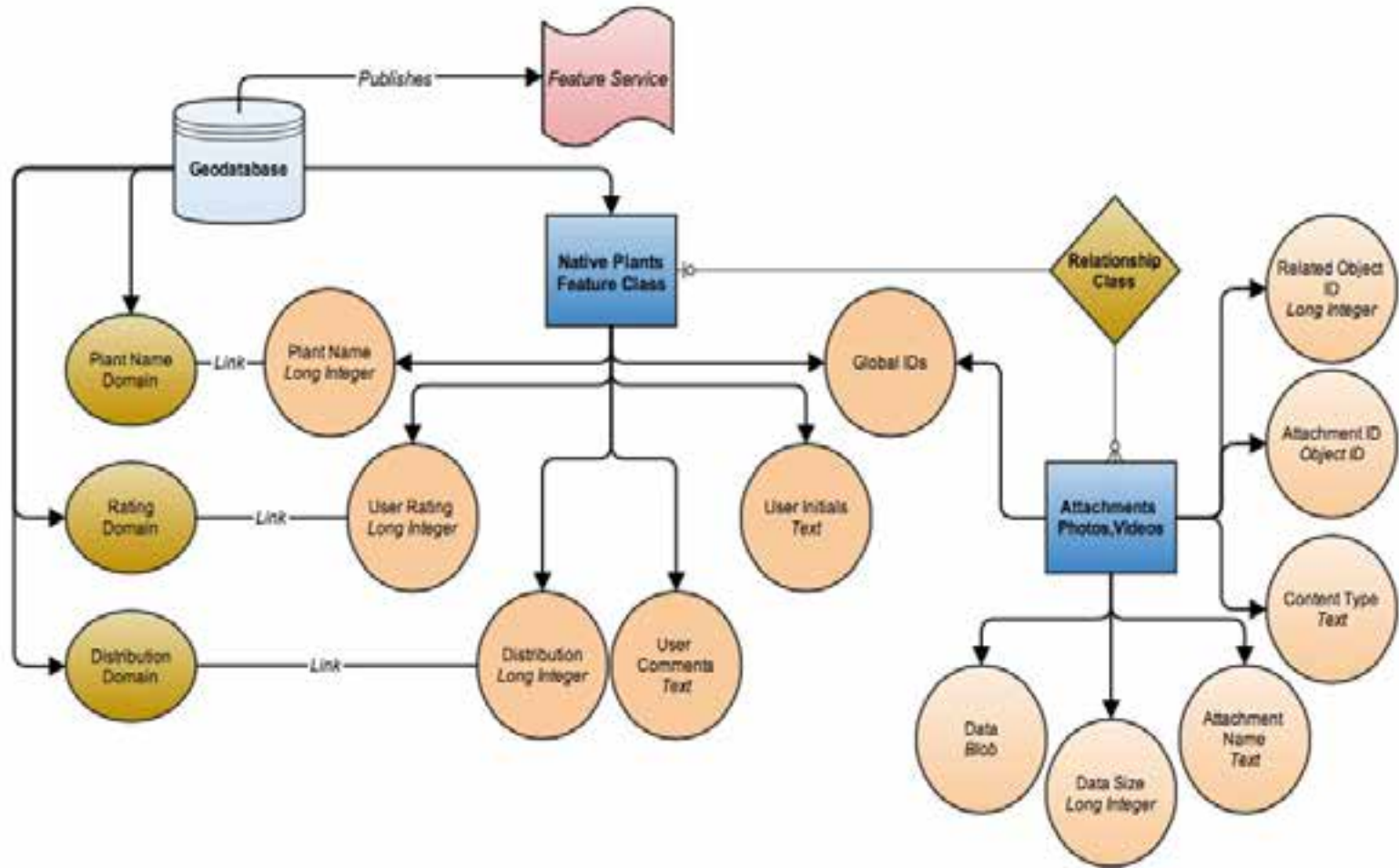
# Database Structure and Data

- Enterprise GDB
  - Database User
  - Domains
  - Versioning
- Native Plants Feature Class
  - Attributes
  - Attachments
- REST services/ArcGIS Online
  - Published Feature Service
  - Shared Web Map

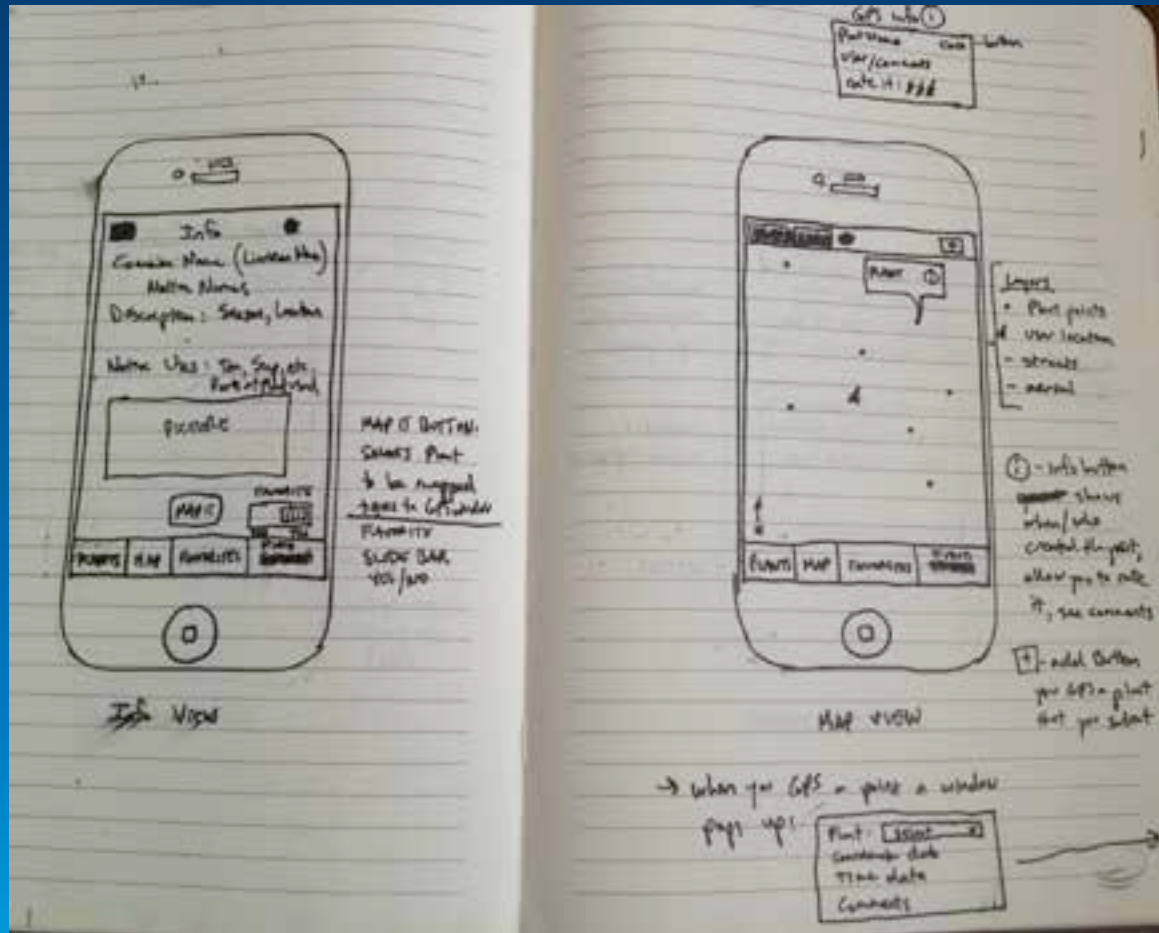




# Entity Relationship Diagram

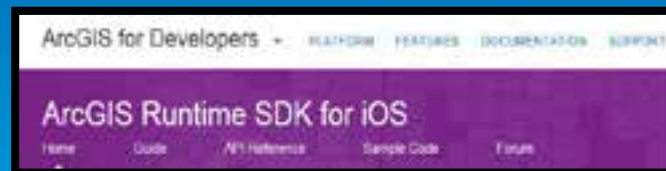
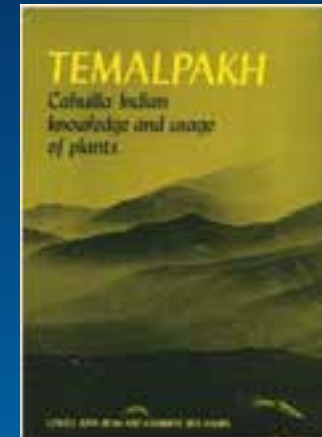
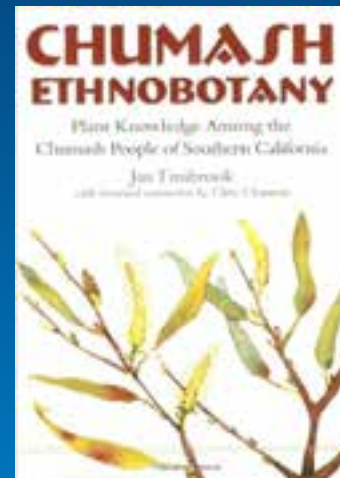


# Visualizing the User Interface



# App Development

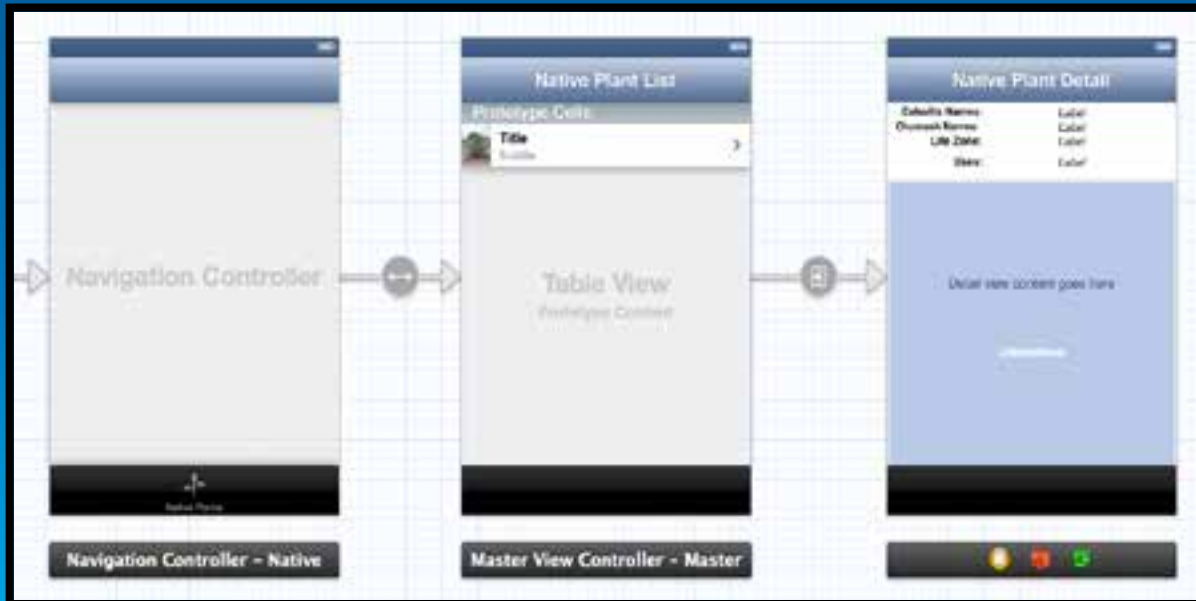
- Xcode
- Objective C
- Find native plant data
- ArcGIS Runtime SDK for iOS



# App Development

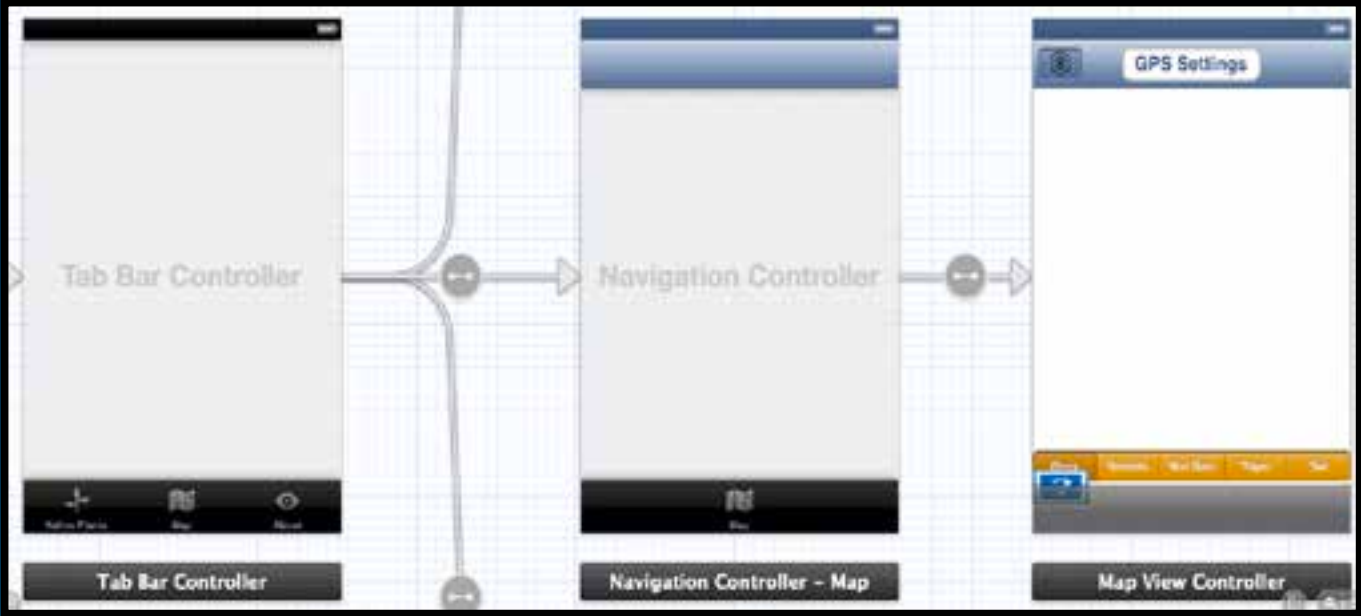
## Native Plant List

```
@objc(IOS) WP23MasterViewController  
  
@synthesize detailViewController = _detailViewController;  
@synthesize nativePlantData, nativePlantSections;  
  
-(void)createNativePlantData  
    NSMutableArray *nativePlantList;  
  
    self.nativePlantSections = [NSMutableArray alloc] initWithObjects:nil, nil];  
    nativePlantList = [NSMutableArray alloc] initWithObjects:nil, nil];  
  
    [nativePlantList addObject:[NSMutableDictionary alloc]  
        initWithObjectsAndKeys:@"Agave, Century Plant",@"name",@"AgaveCenturyPlant.jpg",@"picture",@"Agave americana",@"latin",@"http://  
en.wikipedia.org/wiki/Agave_century_plant",@"url",@"en",@"language",@"en",@"language2",@"Devart",@"life2em",@"feed, fiber for  
clothing, bowstrings, mats, hats and baskets.",@"web", nil];
```



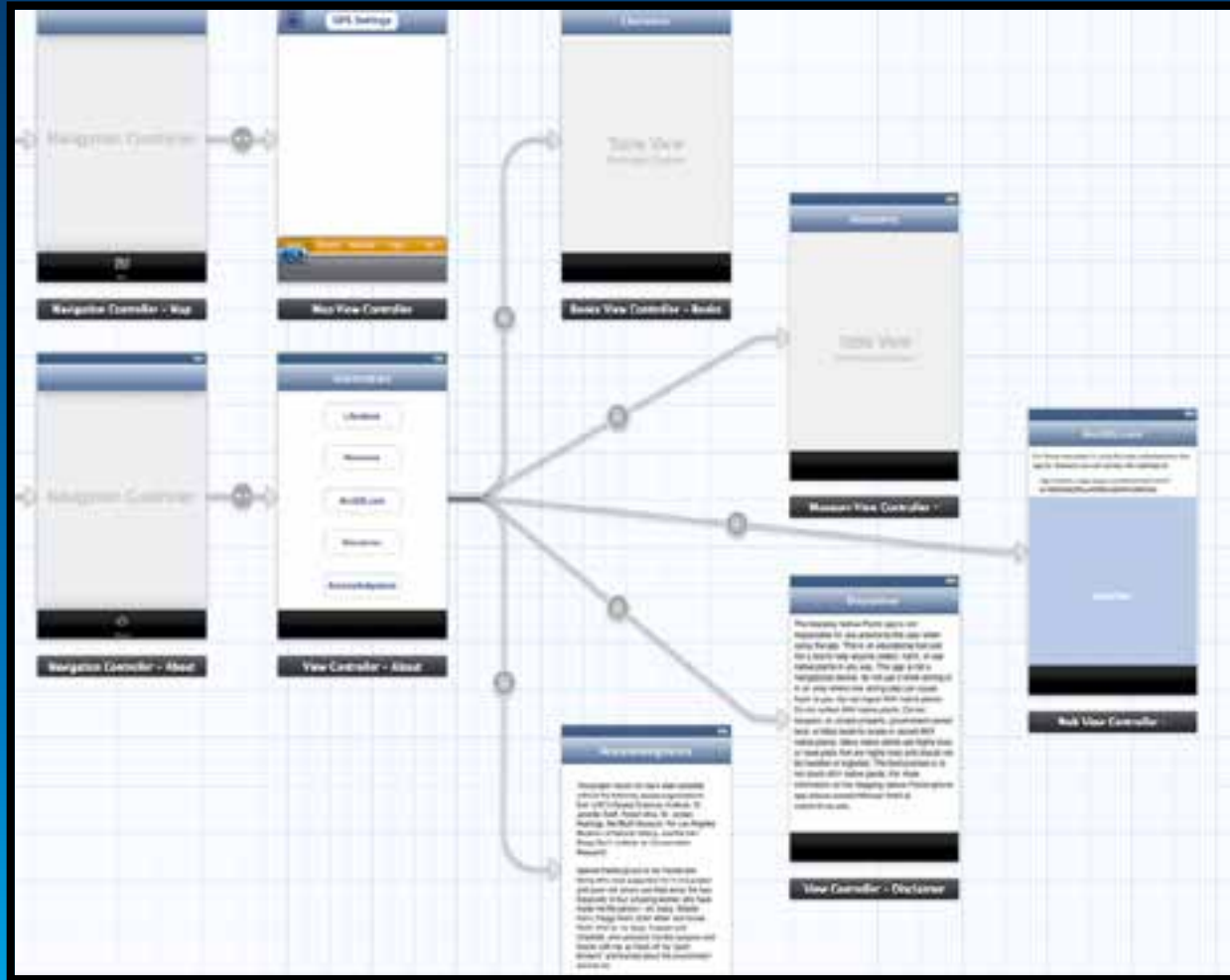
# App Development

Map  
Tab

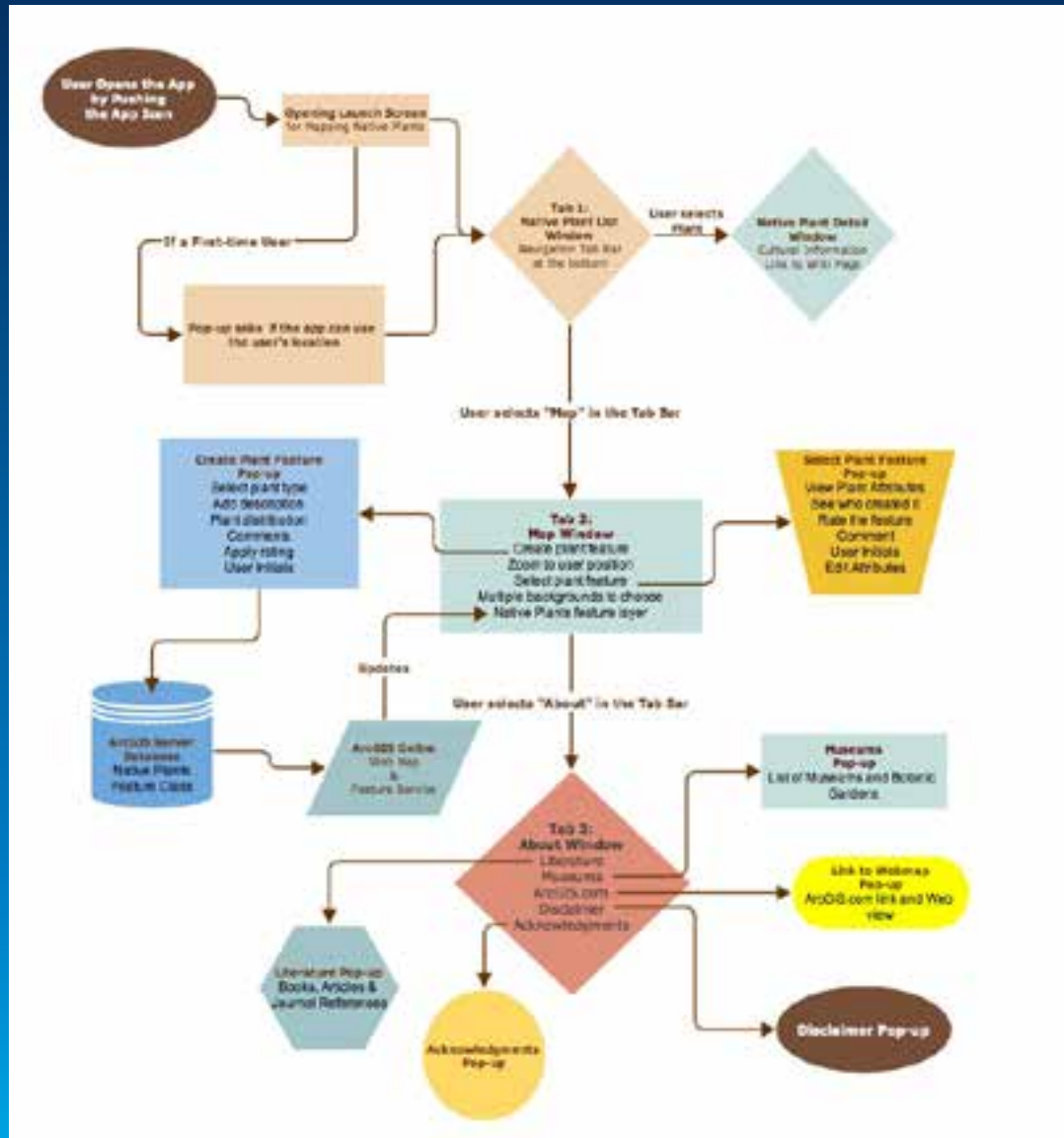


# App Development

## About Tab



# Workflow Diagram







# Evaluating the app

- Performance testing in the field
- Laboratory testing with Xcode Instruments
- Usability testing by users



# Testing: Performance

- Testing in the field
- Test all functions
- Different scenarios



# Performance Results

Connectivity (Factory N)	W-B (100%)	W-S (20%)	W-B (+20%)	4G (100%)	4G (50%)	4G (+25%)	Minimum Load (100%)	Minimum Load (50%)	Minimum Load (+20%)	Average
Do all functions work properly?	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA
Is there lag time during loading?	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA
Avg. time to load app (loading window automatically set to wait 3 seconds)	3 seconds	4 seconds	4 seconds	3 seconds	4 seconds	4 seconds	3 seconds	3 seconds	4 seconds	3.50
Avg. time for features to load	3.66 seconds	5.66 seconds	6.66 seconds	3.16 seconds	5.16 seconds	4 seconds	10 seconds	5.23 seconds	5.66 seconds	6.50
Native (Most Detail Window (with lock) loading)	15 seconds	7 seconds	10 seconds	5 seconds	4 seconds	6 seconds	15 seconds	6 seconds	8 seconds	8.80
Map Window loading	6 seconds	7 seconds	7 seconds	6 seconds	7 seconds	6 seconds	6 seconds	6 seconds	7 seconds	6.66
GPS Tracking	16 seconds	5 seconds	4 seconds	26 seconds	5 seconds	3 seconds	20 seconds	8 seconds	8 seconds	10.50
Settings/Map Elements	7 seconds	7 seconds	7 seconds	7 seconds	7 seconds	7 seconds	7 seconds	7 seconds	7 seconds	7
Loading Feature Details	3 seconds	5 seconds	4 seconds	3 seconds	8 seconds	3 seconds	4 seconds	6 seconds	4 seconds	4.44
Loading Feature Attachments	10 seconds	8 seconds	13 seconds	4 seconds	5 seconds	4 seconds	5 seconds	4 seconds	5 seconds	6.66
How long for 1% of battery to be lost (No other apps open)	3 minutes 20 seconds	3 minutes 30 seconds	1 minute 30 seconds	4 minutes 15 seconds	2 minutes 1 second	1 minute 33 seconds	6 minutes 23 seconds	2 minutes 20 seconds	1 minute 25 seconds	3 minutes 6 seconds
Any functions use more battery than others?	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA
Any functions use less battery than others?	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA
Any error messages?	Error opening attachments to the screen when buttons. Worked on second try (small, low bandwidth)	Error opening attachments to the screen when buttons. Worked on second try (small, low bandwidth)	NO	NO	NO	NO	NO	NO	NO	NA
Does it perform properly when switching between other apps?	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA
Does it perform properly when receiving notifications, text messages and phone calls?	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA
How does app perform when multiple apps are running on the phone?	YES	YES	YES	YES	YES	YES	YES	YES	YES	NA
How does app perform when GPS settings are	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Frequency (1m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Frequency (10m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Frequency (100m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Frequency (1k)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Accuracy (1m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Accuracy (10m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Accuracy (100m)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Accuracy (1k)	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	Normally	NA
Does app crash at all? If so, during which function?	NO	NO	NO	NO	NO	NO	NO	NO	NO	NA

\*App tested under various environmental conditions including city with tall buildings, busy forest canopy, steep canyon, open field, streets, moving car, and beach

# Testing: Laboratory

- **Xcode Instruments**
  - **Memory Leaks**
  - **Energy Diagnostics**
  - **Allocations**
  - **Time Profiler**

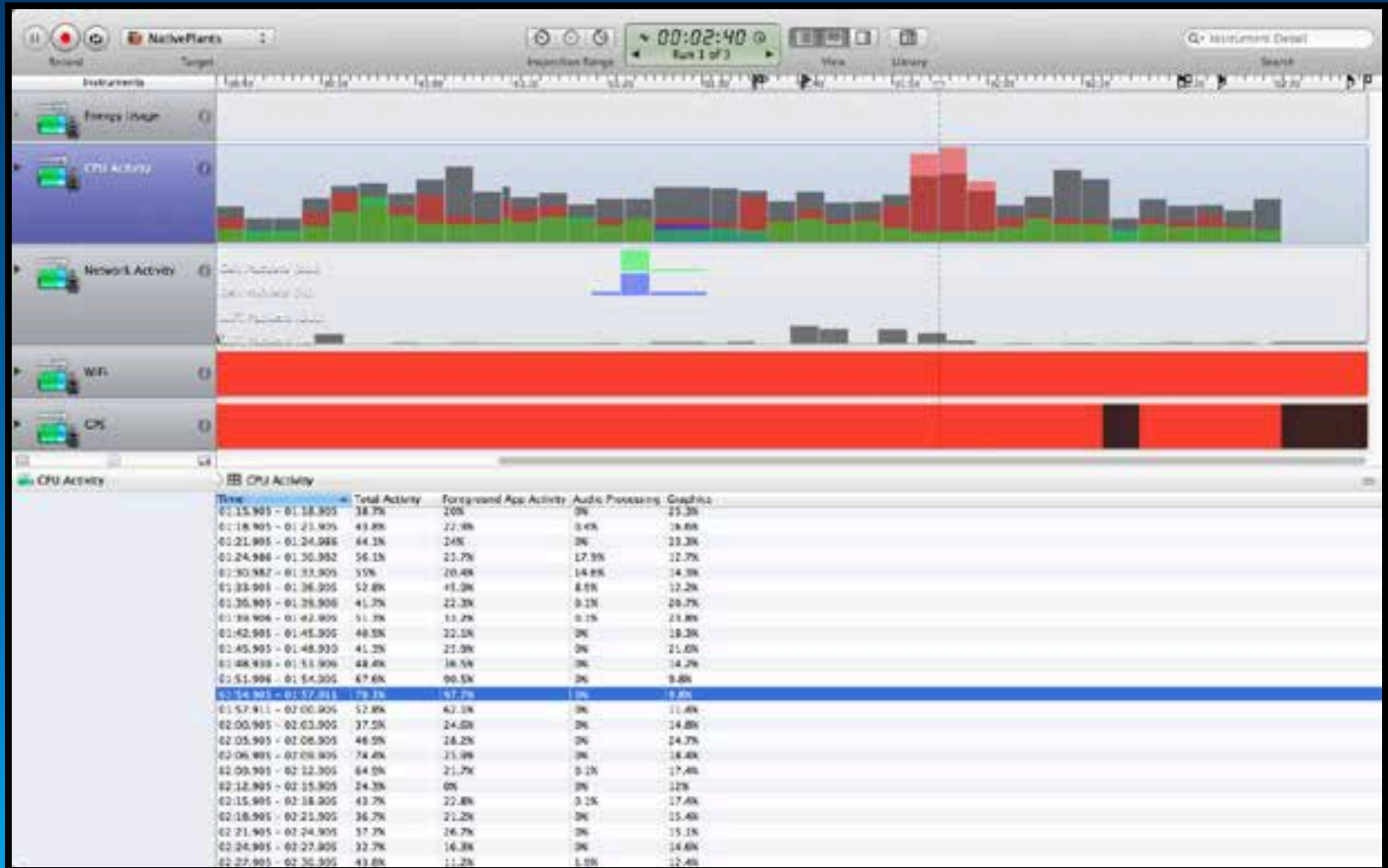


# Lab Results: Memory Leaks

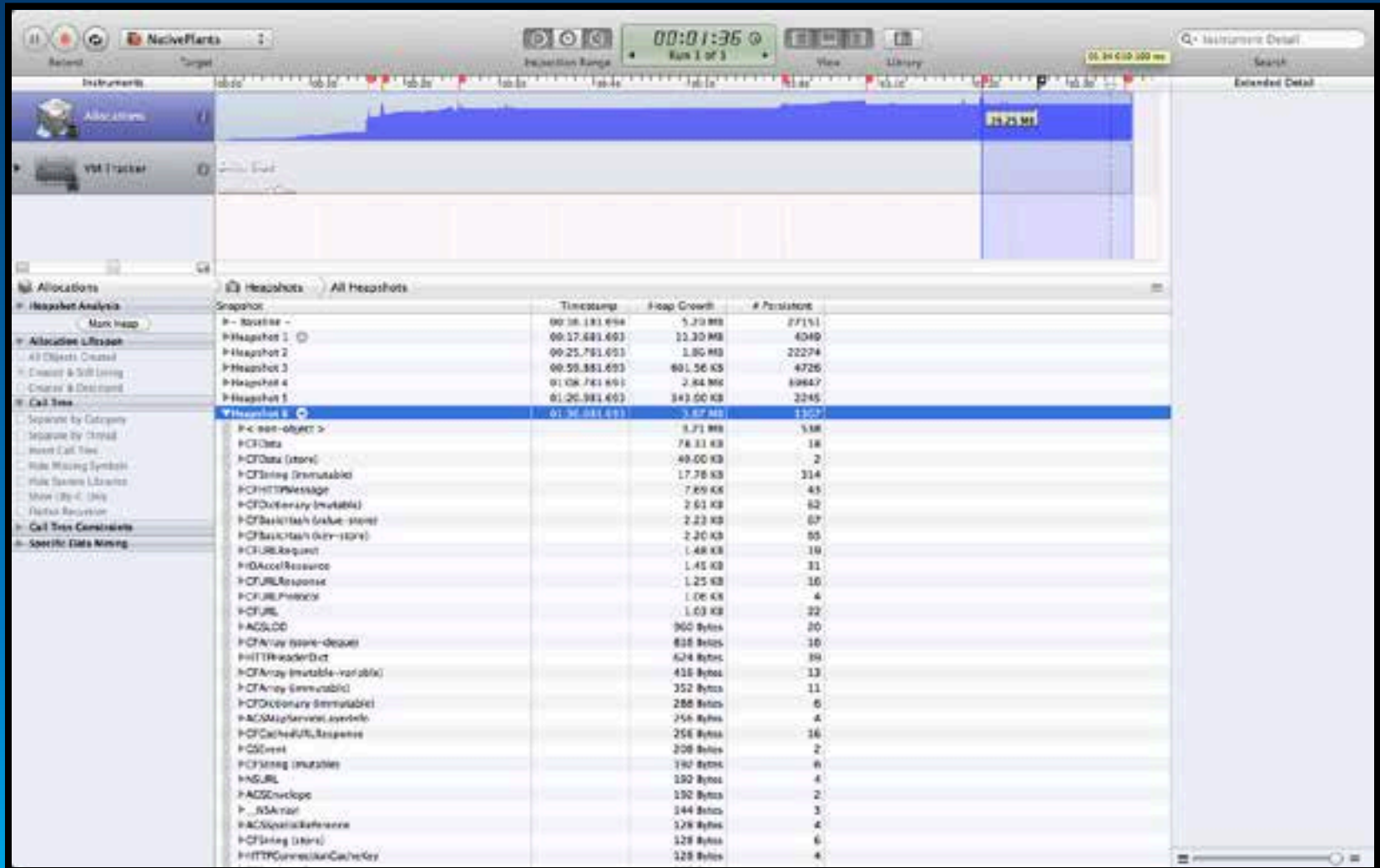
The screenshot shows the Xcode Instruments application with the Leaks tool active. The top toolbar includes buttons for Record, Target, Instruments Range, View, and Pause. The main interface is divided into several sections:

- Leaks Configuration:** Includes options for Automatic Snapshooting (Snapshot Interval: 20.0), Leaks Configuration (Calltree, Locked Memory Contents), Call Tree (Separate by Thread, Show Call Tree, Hide Memory Symbols, Hide System Libraries, Show Obj-C Only, Filter Resolution), Call Tree Constraints (Filter Leaks, Filter), and Specific Data Mining.
- Leaks by Backtrace Table:** A table with the following columns: Leaked Object, #, Address, Size, Responsible Library, and Responsible Frame. The table is currently empty.
- Extended Detail:** Includes a search bar and a 'Mark Trace' button. A message below reads: 'No stack trace available for this block.'

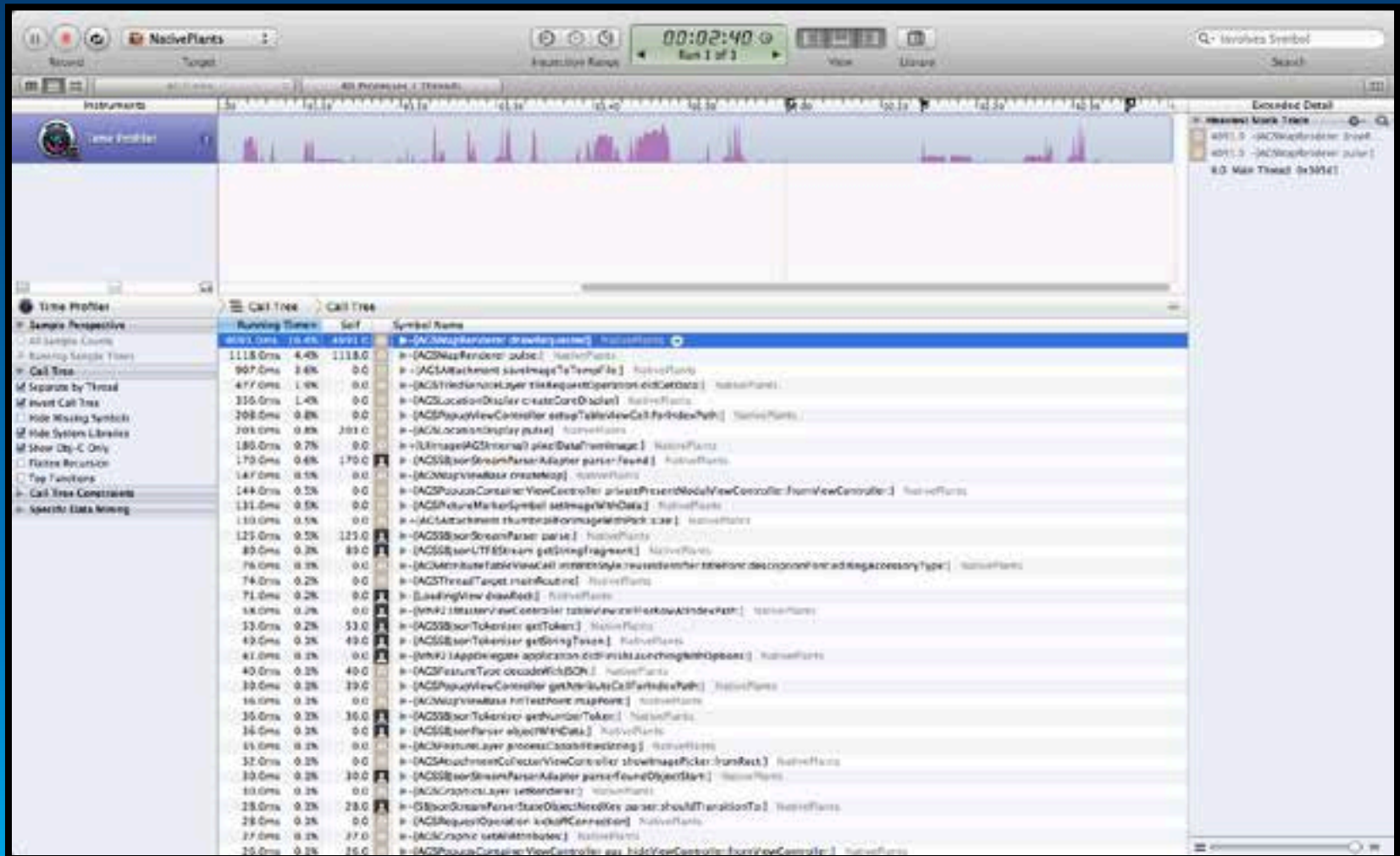
# Lab Results: Energy Diagnostics



# Lab Results: Allocations



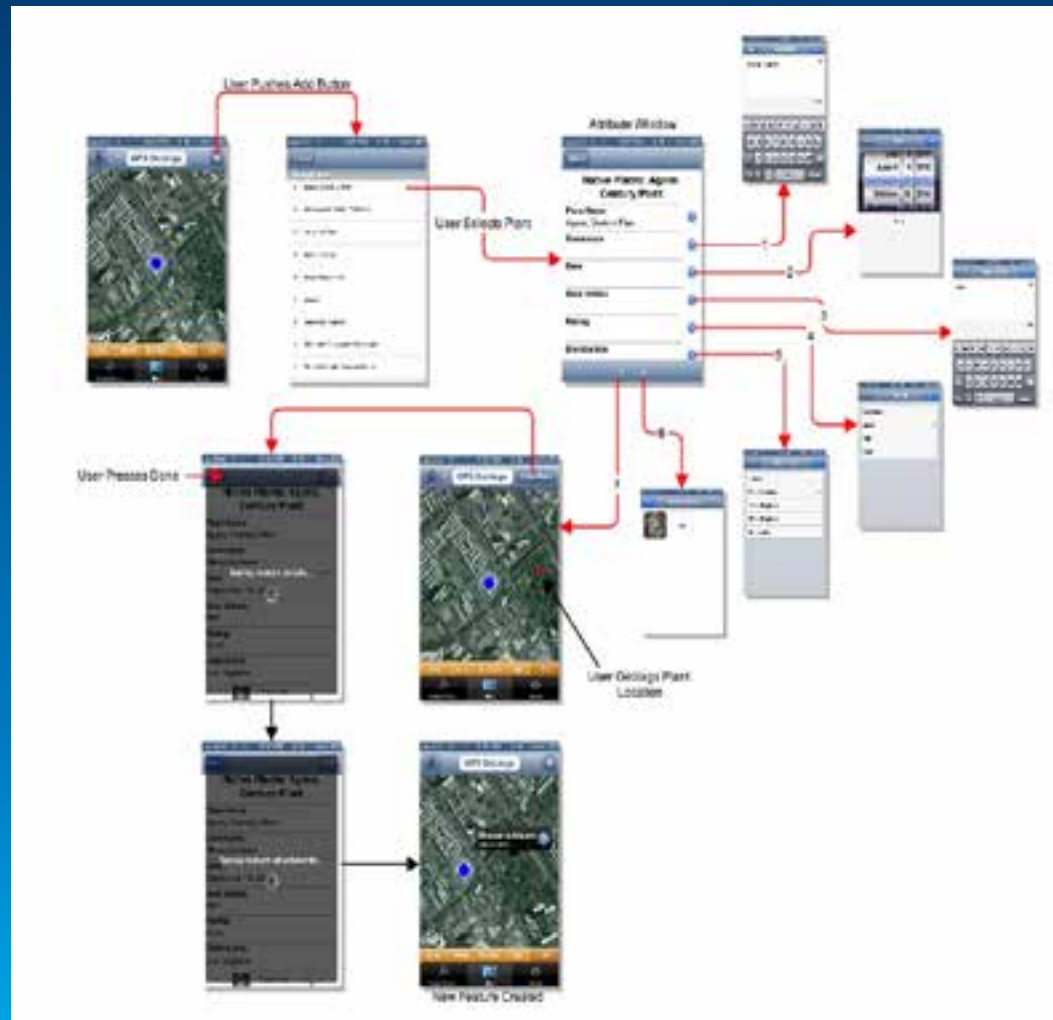
# Lab Results: Time Profiler





# Testing: Usability

- Five archaeologists
- Used all functions
- Questionnaire



# Usability Results

Mapping Native Plants Questionnaire Date:

How easy was it to use the app on a scale of 1 to 10 (10 being super easy, and 1 being super hard)? Explain if you want to.

10

Did the app function correctly? (If not, what was the problem?)

NO - in map view - pop-ups didn't work

Was there anything in the app that was difficult to understand? If so, what?

no. easy to use and straight forward.  
no instructions needed.

Was there a part of the app you really liked? What and why?

Yes. I liked that it was easy to use, it is linked to wikipedia and that there are warnings for toxic plants

Is there anything in the app that you would change or think needs improvement?

- indicate if its endangered, common, threatened
- would be cool if you hyperlinked the museum's website to their names on the list

Overall, how would you rate the app on a scale of 1 to 10 (10 being a good app and 1 being a poor app)? Explain if you want to.

10

Any additional comments, suggestions or questions?

make one for Houston

How would you like to be identified in this study once it is published by USC?  
(anonymous, use your initials, use your name) Please enter your initials or name at the top of the page, or circle anonymous in the choice above.

Thank you for your participation! TK

# Challenges

- **Cultural**
- **Technical**
- **Strategies**

A network-related or instance-specific error occurred while establishing a connection to SQL Server.  
The server was not found or was not accessible.  
Verify that the instance name is correct and that SQL Server is configured to allow remote connections. (provider: Named Pipes Provider, error: 40 – Could not open a connection to SQL Server) (Microsoft SQL Server, Error: 2)

The connection property set was missing a required property or the property value was unrecognized.  
Bad login user



# Advances Brought by the Mapping Native Plants App

- **Cultural Connection**
- **Communication and Connectivity**
- **Bridge the gap between amateur and professional**
- **Empowers people with knowledge of their environment**
- **Open GIS to more people**

# **Future for the Mapping Native Plants App**

**Expand to more areas, more cultures, more languages, more native plants**

**Element of time**

**User logins**

**Top contributors**

**Geographic threshold**

**Red flag system for endangered species and toxic plants**

**Sound byte to listen to pronunciation**

**Define the rating system better**

**User feedback, app rating**

**More pronounced disclaimer**

**Expand to Android and Windows Phone!**

**ArcGIS MarketPlace for Apps**

# Future Trends for Mobile GIS and VGI

- Focused on the user needs
- Information exchange
- Helping the environment and the people who live in it
- Interactive learning environment
- Expanding the reach of GIS
- Empowering the public with info to make decisions
- Veer away from unethical crowd sourcing
- Better ways to interpret VGI

# Final Thoughts

- Engage the public
- Enhance communication
- Promote Indigenous cultures
- Share local knowledge
- Provide data for future studies
- Mobile GIS and VGI outreach capabilities

# Ahchama – Thank You



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[http://spatial.usc.edu/wp-content/uploads/2014/04/](http://spatial.usc.edu/wp-content/uploads/2014/04/WahlMichael6924MastersThesis.pdf)

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