Background: In response to climate change, recent scientific studies using forest inventory data have suggested that climate change impacts can be seen by comparing the northern edge of species ranges for mature trees and younger trees. Younger trees were found farther north than the mature trees, as would be expected if climate is permitting northward range expansion. In this app we will provide a tool for collecting and uploading information about the distribution of mature and young individuals of different tree species. This information will be fed into a central website where they will be collated into a database and map of the range distribution of these two age classes of trees, permitting citizen scientists to contribute to monitoring and research on the effects of climate on tree ranges.

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HU4628: Kerrie Brown, Faye Dompier
CS5760: Haihua Li

Scientists Group Rep: Dr. Erik Lilleskov – Forrest Ecologist
HCI & Usability Instructor: Dr. Robert Pastel
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Project Description: To enable the citizen scientists’ contributions in forest data collection, a mobile Android App is defined, designed and developed by a group of students at Michigan Technological University. The App will enable geo-location and plot-based samplings at the northern US continent. The data collected includes the user levels, geo-forest habitats, and individual trees under the required guidelines to ensure the qualities.
1 Stakeholder Analysis

As the Tree Walkers App project is developed for the citizen scientists who usually have limited or not strong domain knowledge about the trees, forests and USDA Forest services, the full spectrum of the stakeholders was brainstormed within the group and with the professional Forest Ecologist. In the past the US FIA has conducted once every five years of inventory for the tree species particularly in the northern continent. However the insufficient and incomplete data for the analysis were reported in the literatures, with mobile tech’s availabilities more tree samplings become possible by utilizing the power of broad stakeholders. To control the quality of the data with this point of available technologies, based on the initial group discussions this App will focus on the user levels from the following shaded areas (N-L3 to E-L2) in term of their knowledge level about the trees. Ten scales of the novice and expertise levels are quantified as N-L1→L5 and E-L1→L5, the details are described below.

<table>
<thead>
<tr>
<th>Novice</th>
<th>Novice</th>
<th>Novices</th>
<th>Novices</th>
<th>Novices</th>
<th>Expertise</th>
<th>Expertise</th>
<th>Expertise</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>L5</td>
<td>L4</td>
<td>L3</td>
<td>L2</td>
<td>L1</td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>L4</td>
</tr>
</tbody>
</table>

1.1 Onion model of stakeholder and Description of each stakeholder

- **The kit (TreeWalkers App)**
- Park rangers, Hikers, Community members with great interests about trees, App-support and maintaince gurus (N-L3, L2)
- College forest Class Students, Internships, Co-ops (N-L2, L1)
- Forest service new employees and returning employees, USDA field examiners, Critique Gurus, App developer(N-L1, E-L1, L2)

1. **The Kit**: This is our product Tree Walkers App.
2. **Primary Users**: These are the group of users who have great interests about the tree species, nominal levels of field experiences. The group covers Park rangers, Hikers, Community members with the trees in heart. They can be ranked as (N-L3, L2).

3. **Secondary Users**: These are the group of users who have studied the forest, environment, ecology, biogeography, etc domain knowledge. However they do not have field experiences, etc. The group covers College forest Class Students, Internships, Co-ops, App Support and Maintenance gurus. They can be categorized into (N-L2, L1).

4. **Tertiary Users**: These are the group of users who have both field and domain knowledge. However they do not have experiences of reviewing and analyzing a whole picture of data points for its purpose. Although they may have other professional tools helping them with this task in the past, the new App certainly can make their data samplings more enjoyable. The group includes Forest service new employees and returning employees, USDA field examiners, Critique Gurus, App developer, etc. They can be put into (N-L1, E-L1, L2).

### 1.2 Stakeholders' goal-influence table

All Tree Walkers App stakeholders contribute or hold back this product in somewhat different ways.

For the primary users group, they tend to have less domain terms associated with the trees and forest. During their data collecting steps, the measuring and data recording often have large variations among different users or even for the same user. A smart measuring or scanning tool is highly in demand for both the data quality and easiness of use. At this stage, the context based tutorial is helpful. In addition, the language support for the tree species is useful among hikers and forest fans besides the image searches or recognition of leaves. App configuration and maintenance stakeholders belong to this group as they understand best between the ease of interface and the data collection range.

For the secondary users group, they have built up the terms and basic knowledge of typical trees along with their surrounding habitats. However the measuring protocol and advanced discovery of new species are unfamiliar to them. They need to review measuring and confirm common or revised protocols often. Under this circumstance, a regional range map or a full range map will help these future forest scientists understand better range shifts and other concepts.

For the tertiary users group, although they are domain knowledgeable but they are short of strong critical analysis skills. They do not use this App as their main functional tools instead they use this App for data verifications and enrichment. The App developer resides in this group to support the needed new functions.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Goals</th>
<th>Influences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Park/Forest rangers</strong></td>
<td>Collect info, rescue the needed trees, support the recreation activities Viewing, collecting, correcting, note taking</td>
<td>Contributing: Warnings, record the disturbance species Constrains: May or may not have the knowledge about the trees, App widgets</td>
</tr>
<tr>
<td><strong>Hikers</strong></td>
<td>Added value for the hiking fun Viewing, collecting,</td>
<td>Exercises, new hiking or skiing route Seasonal, professional terms</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>Role and Tasks</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Community Fans</strong></td>
<td>Tree lovers, may compete for data collection quality and quantities as a hobby</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tagging, Collecting, note taking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heuristic data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seasonal, App widgets, professional terms, language converting</td>
<td></td>
</tr>
<tr>
<td><strong>App support and Maintenance Gurus</strong></td>
<td>Enhance existing App</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Testing, collecting, note taking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make sure App running as it is defined, gather new interests and needs, themes,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>configure and settings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>May or may not know tree species well</td>
<td></td>
</tr>
<tr>
<td><strong>College Forest Students</strong></td>
<td>Field study with the species, soil, latitude, plot, regions, temperatures, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collecting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Discover new type of migrated and uncommon species</td>
<td></td>
</tr>
<tr>
<td></td>
<td>professional terms, languages</td>
<td></td>
</tr>
<tr>
<td><strong>College Forest-ish Friendly Students</strong></td>
<td>Study forest and trees’ impact on the human, land, policy, nature</td>
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<td></td>
<td>resources management, economy, and climate changes</td>
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<tr>
<td></td>
<td>Collecting, viewing</td>
<td></td>
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<tr>
<td></td>
<td>Reveal the significance of walking trees or other habiting animals, anthropology,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>stories</td>
<td></td>
</tr>
<tr>
<td><strong>Forest New and Returning Employees</strong></td>
<td>Get familiar with the regional strength and local species</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collecting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basic knowledge of local and revival species, need to discover the habitat</td>
<td></td>
</tr>
<tr>
<td><strong>USDA Field Examiners and Auditors</strong></td>
<td>Cross exam the species, and random sample the regional trees</td>
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</tr>
<tr>
<td></td>
<td>Collecting, checking, viewing, note taking</td>
<td></td>
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<tr>
<td></td>
<td>Sampling the species mainly residing in other regions, verifying the</td>
<td></td>
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<tr>
<td></td>
<td>correctness of local data</td>
<td></td>
</tr>
<tr>
<td><strong>App Developers</strong></td>
<td>Add new functionalities, testing</td>
<td></td>
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<tr>
<td></td>
<td>New function, or condensed functions, field signal strength and data caches, gps-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>enabled</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Field touch sensitivities</td>
<td></td>
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</tbody>
</table>


2  Personas

2.1 primary users

As stated in the Stakeholder Analysis section, the primary users are not strong domain experts instead they have great interests about the tree species and hold nominal levels of field experiences. The group covers Park rangers, Hikers, Community members with the trees in heart. They can be ranked as (N-L3, L2). In this section, two hypothetical primary stakeholders are described in detail.

2.1.1 primary Personas 1

1) Name: Dominica Well
2) Attributes: College student 20, male, major in Fine Arts, a big fan of mountain hiking, lives in MN
3) Description:
   Dominica is a Spanish-speaking junior Fine Arts major in a northern woods university. Besides his interests in drawing and painting the trees in nature, either on top of the mountains or along the creeks, he is also a fan of mountain hiking. Every summer or during a long weekend, he often carries up his huge backpack along with camping tools to find a new area to explore. With his newly equipped Android phone, he finds measuring, tagging, and recording a tree’s life stage significantly enhance his tree drawings at the same time contributing to the national Forest data collecting initiative. In his next exhibit, he will show case his unique artist experience by combining the tree paintings, pictures, artifacts, tree profiles and life stories into a coherent demonstration.

2.1.2 primary Personas 2

1) Name: Van Kangmi
2) Attributes: Park ranger 38, a dad of two young school age kids, lives in MI UP
3) Description:
   Van is a native yooper in Michigan’s Upper Peninsula, the place full of abundant forest resources. After discharged from the national army services, he returned to this beautiful area and has since served as a park ranger for many years. Van knows many local tree species and he even collects random leaves for his bookmark collection. In winter time, he especially likes to drive his snow mobile into the woods and rests along with trees although no leaves for him to collect. Other seasons he likes to walk into the woods, listening, breathing and observing the beautiful nature. This Christmas he received an Android mobile phone gift with a preinstalled Tree Walkers. He likes the idea of this app very much, and plans to test it out in the coming break.

2.2 secondary users

The secondary users have studied the forest, environment, ecology, biogeography, etc. domain knowledge. However they do not have field experiences, etc. in that sense they are not the pure scientists yet. The group covers College forest Class Students, Internships, Co-ops, App Support and Maintenance gurus, etc.. They can be categorized into (N-L2, L1).

2.2.1 secondary Personas 1
1) Name: Jean Haughton  
2) Attributes: Biology major 21, female, Marquette University in IL  
3) Description:  
Jean studies vegetables, crops and habitats in northern IL. In her doom she has planted many different flowers, migrated mini-crop samples, and etc. However she doesn’t have enough experiences with the trees and forests. This is her senior year at the university. The biology department recently connects with another institution and jointly funds a research project to study the northern trees along the great lake regions. As a senior project student, she is involved in this field study to sample ten tree species and their changing ranges. Jean owns an Apple phone but without much of experience of Android, will she be successful in mastering this new Android type of phone when collecting the data?

2.2.2 secondary Personas 2  
1) Name: Nina Mackinac  
2) Attributes: female 58, a mom with four college children, works for a USDA’s non-profit agent and lives in MI, likes to watch TV, exercise outdoor and talk about technology along with the college life  
3) Description:  
Nina’s undergraduate major is information technology and she also minored in social science. In her past careers, she has played many roles such as system analyst, web designer and developer, data warehouse analyst and support. In her new role she works with variety of systems customizations and localizations for the non-profit’s field mobile applications. The tree walkers app works perfectly as the agent’s new distribution in sampling regional data. Her task is to get the App fit.

3 Simplified Hierarchical Task Analysis

This simplified HTA style shows the hierarchy with indentation. In this analysis, the group cognitively image the possible steps which the users will see typically or difficulties encountered with the field testing, group them closely for both the design and the usages with touch-selection size-constrained screen in mind. Here the mission, global environment variables, geo-bio-location, user levels are defined on the top level view. The individual tree samples are collected through the lower level view.

Upper level views:

- Mission selection overview
- Mission goals view
  - Find the Regional Plot
  - Find the National Plot
- Users view(Expertise of Trees)
  - Novice (N-L3, L2)
  - Intermediate N-L2, L1
  - Expert (N-L1, E-L1, L2)
- Forest Geo-Bio-Location view
  - Forest ages (using list?)
  - Surrounding Soils
4 Appendix: Your notes from the interview with the scientist

4.1 1/20/2014 @GLRC, 6:00-8:00 p.m. Mon., Get Together

Get to know Erik, Keng, Faye and Kerrie
Previous project – Mushroom mapper
Brief introduction of USFS’s northern research station, function, location, and other confusions of the Forest services
    Nature succession
    Saturation, movement
    Climate envelop northward
    Data quality control and getting others into sciences
Verbal confirmation for the business meeting schedule
Get together Pizzas with square cuttings and Water

4.2 1/24/2014 @USFS-Northern-Houghton, 1:00-2:00 p.m. Mon., Big Picture
Group meet w/Erik at Forest Services Building Conf Room
Self-introduce and get to know Dominick, John, Keng, Matt, Wesley, Brandon, KerrieSTC and FayeSTC, Haihua, majors, college levels, strength, interests, assignments and happiness levels
Erik intros
Air pollution, glaciers, thousands of yrs, green gases, human activities, climate really changes
FIA(USDA FS’s Forest Inventory and Analysis)
Every 5yrs, plot and regional data sets, fuzzing points, personal properties,
Structural, unstructured grounding questions
Functions, variables, interactions, visual aspect
Tree – h,w, d, soil, textures
UP, data uploading, Procedures, data recording, monitoring the distribution
Connecting to the db
Archiving images of the lead images
Constrains of the screen size
Get the gps, geo-locating
Tutorial, specific, species recognition, how to measure
Users, k-12, scientist, classrooms,
Rotate papers re: biogeography, climate change, Forest Inventory and Analysis, latitude, presence/absence, range shift, seedling, tree migration, climate envelope models, life stages, range shift, tree regeneration, Canopy gaps, Disturbance, Tree range retreat, Tree species migration
Seedlings, etc.
Assessing the stability of tree ranges and influence of disturbance in eastern US forests
Failure to migrate: lack of tree range expansion in response to climate change
An indicator of tree migration in forests of the eastern United States
Early indicators of change: divergent climate envelopes between tree life stages imply range shifts in the western United States

4.3 1/27/2014 @USFS-Northern-Houghton, 1:00-2:00 p.m. Wed., Project Scope
Erik refines the project scope w/focus on the App and data sampling interests, FIA serves as background info for this class project
Self-intro roundtable, roles and interests for the project, short QAs after 1/24 project framework meetup
Erik talks
App for citizen scientists, community members, knowledge about trees, k-12, colleges, hikers
Quality control
How to measure, docs about the square measurement, tutorials
Different phones
DB connections,
Website, data control, source, edit, longitudinal
Tree regenerations
After meeting email notes from the scientist
Species list and range maps for the major species in the eastern US:
http://www.fs.fed.us/nrs/atlas/littlefia/species_table.html
Latin names in the pulldown/fillable list and somehow provide the common names as a check for some users if not too cumbersome
Species list with range maps for the entire US: http://esp.cr.usgs.gov/data/little/