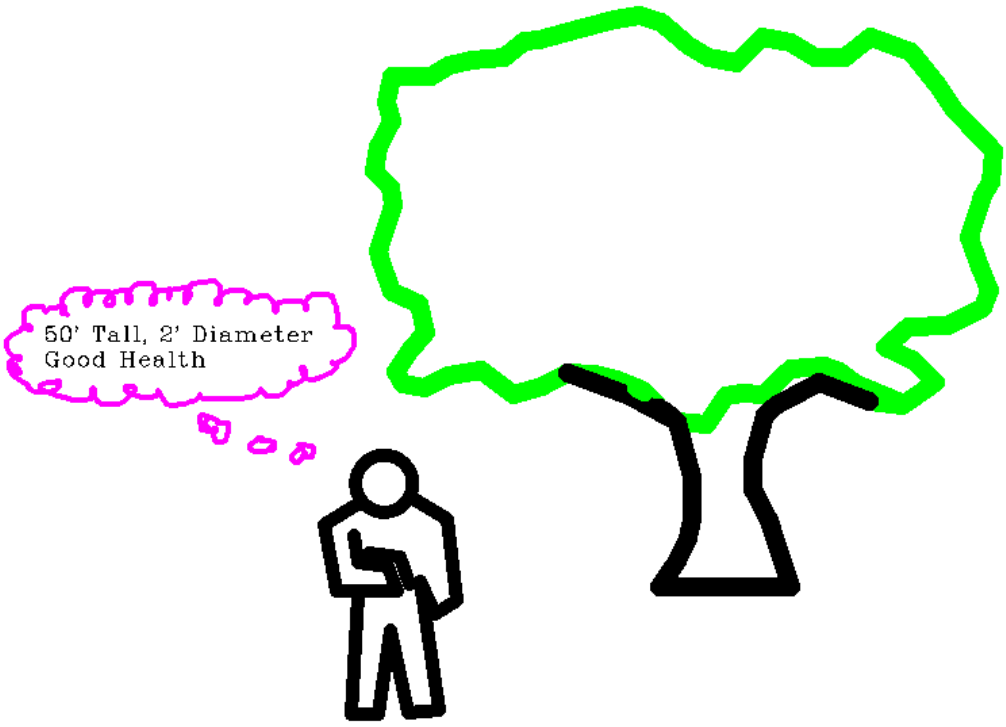
Evaluating Prototypes in Context

ASSIGNMENT 3

Liam Osler | CSCI 3130 | November 5th 2021



Background

Arboreal surveying is the process of observing various tree characteristics, which may include species, age, size, health, and damage factors. Surveying the quantity and quality of trees is useful for the forestry industry when estimating the cubic amount of timber that can be extracted from a wood lot. A tree survey may also be conducted to identify protected species or identify and quantify the effects of illegal logging. Arboreal surveying is important to municipalities for making decisions related to the planting and maintenance of street and park trees. It is also important tool for provincial and federal wildlife offices to measure the health of the forests. Regardless of the purpose of a tree survey, a standardized method must be used to ensure the integrity of the data collected.

We began to envision how this application would be used by a person conducting a tree survey/ordinance. A tree survey involves a person going about a certain area and recording the specific of the trees found within it. This data could then be entered into a record collection system, mostly likely some form of Geographic Information System (GIS). Using a digital device like a smartphone increases the efficiency and accuracy of the data collection process by reducing data input requirements and leveraging GPS positioning. In the past the specific geographic location of trees in latitude and longitude may not have been recorded due to time and financial constraints. These constraints

are diminished by GPS surveying. There exists a number of methods for performing a tree survey. These often involve what is called a “transect”. A transect is a path that describes a coverage area. There are two methods of transecting, one involves running straight lines through the interior of a polygon. The path is followed by the surveyor, and all notable features (in our case, trees) are recorded and typified along that line. Another method of transect may involve the surveyor at stationary position, turning about that point and counting and measuring all of the trees in a radial fashion. The collected data is then either exported from the data collector or manually entered in to a computer database or spreadsheet. This data can then be used to create maps, estimate the volume of timber, record temporal changes to the condition of the lumber, monitor the effects of things like invasive species, among many other applications.

Conceiving of the application:

In order to conceive of how such an application would be used in the field, I endeavoured to conduct a tree survey in a small park near where I live. Excellent resources on the methods and characteristics for tree surveying were found from “Guidelines for Developing and Evaluating Tree Ordinances” from Phytosphere.com:

http://phytosphere.com/treeord/ordprt3d.htm

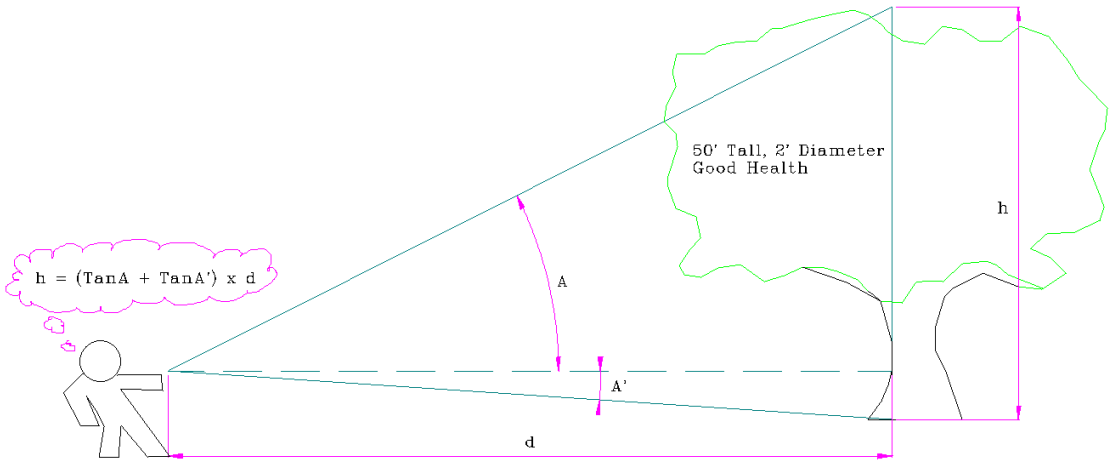
In order to prepare for the simulation, I created a lo-fi model of the application using drafting software, printed the various screens/modals of the application on to a piece of paper, and then brought the printed model with me as I conducted a tree survey using traditional means, using a clipboard and a pencil and estimating the height of the trees. I began the order of the survey by recording the date and time, the current location, the atmospheric conditions and the equipment I was using. Since I do not have a clinometer, I will have to estimate the height of the trees or use smartphone application. For expedience, I decided to try estimating the height of the trees using a smartphone application, using what's called a "clinometer". I would estimate the distance to the tree, then confirm it with a measuring tape.

A man using an example of a mechanical style of clinometer.

https://www.youtube.com/watch?v=EahhlAazK1Y

A man using a more modern clinometer with an integrated laser distance measure.

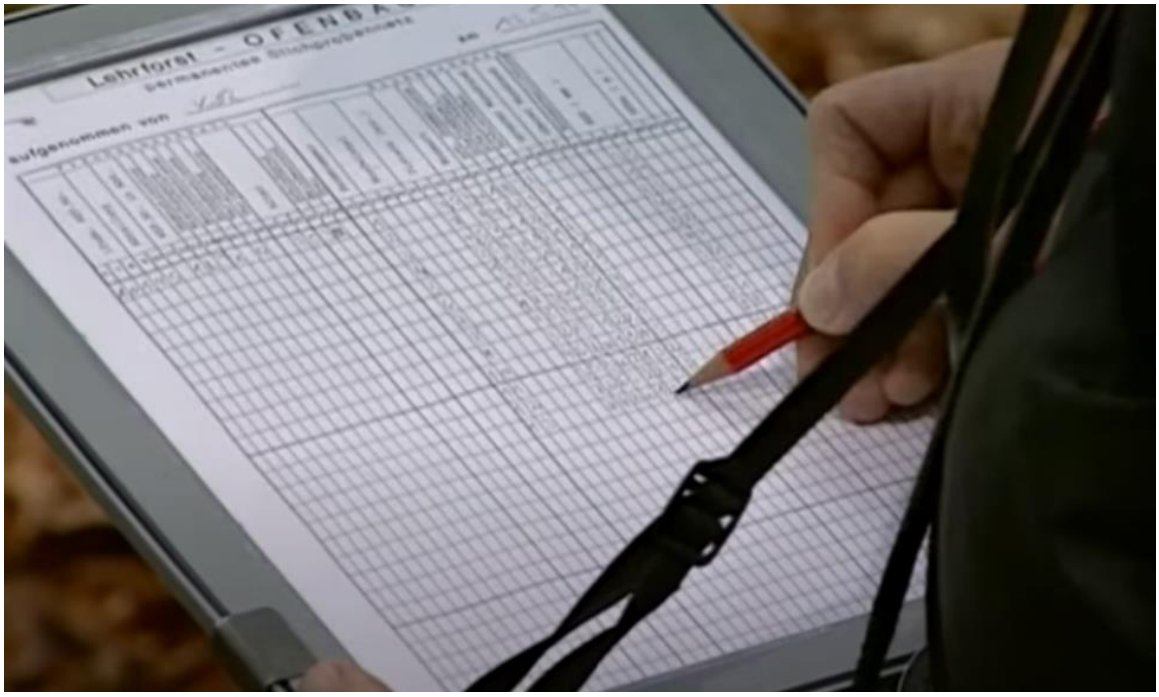
There are some smartphone clinometer applications available as shown in this picture.



The trigonometric principle on which a clinometer functions- by measuring the angle from horizontal to the bottom and the top of the tree, if we also know our distance to the base of the tree, we can then use trigonometric principles to calculate the height.

In some conceptions of the clinometer as a smartphone application, it is sometimes sighted down the side of the phone. We could instead use the camera's video feed on screen as a sight to align the top and bottom of the tree, measuing the angles using the device's accelerometers. We could also include a timer that prompts the user to align with the top of the tree, waits one to two seconds, records the position of the accelerometers, then prompts the user to slew the camera to the base of the tree, then repeats the process. The purpose of using a timer in this setting is to minimize the possibility of shake being induced to the camera by the person reaching to press a button on their screen. After the positions are recorded, the photographed

position can then be displayed to the user so they can confirm that they have placed the crosshairs with sufficient accuracy.



Field observations are written on to a tabulated sheet.

For recording my own field observations, I wrote down the column headers of my page in advance. On the first page of the notes, I drew a field map of the location and labeled the locations of the observation I took with their row number. I have included these notes with this report. I also created an Excel Spreadsheet saved to OneDrive that I could edit using the Android version of the application in the field. This way I could have the observed data backed up remotely while it was created, and I could investigate the how well and application that deals with tabular data. I would see how well my smartphone (A Moto G Stylus) performed for this task, and whether the included stylus was of any use to make

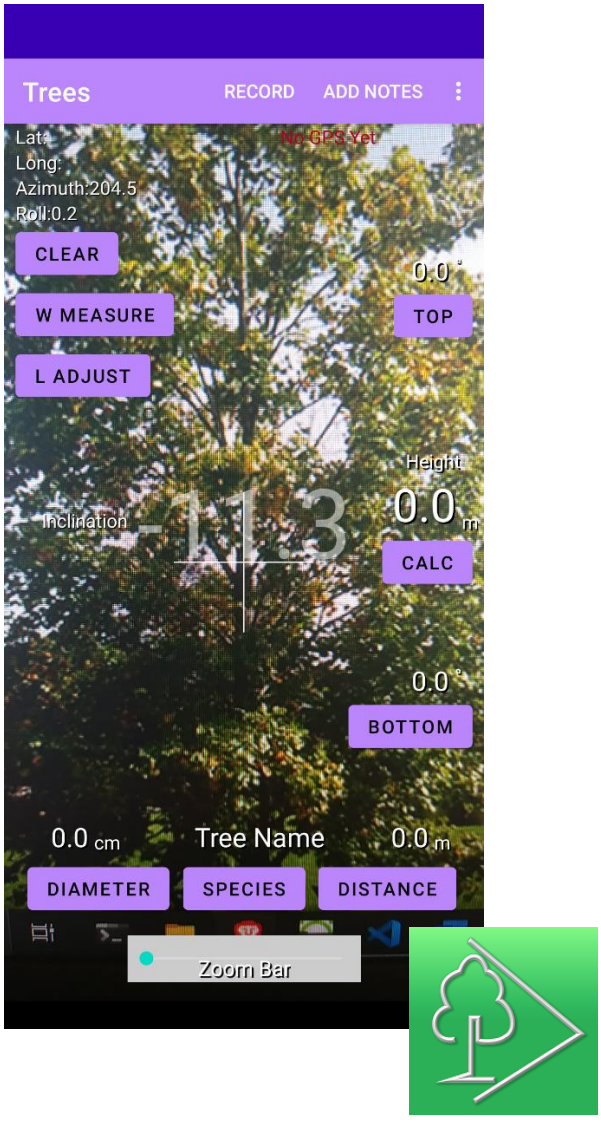
the process of entering data easier. I brought with me a measuring tape so I could confirm my horizontal distance from the tree as well as measure the diameter of their trunks.

My current smartphone and companion for this conceptual test.

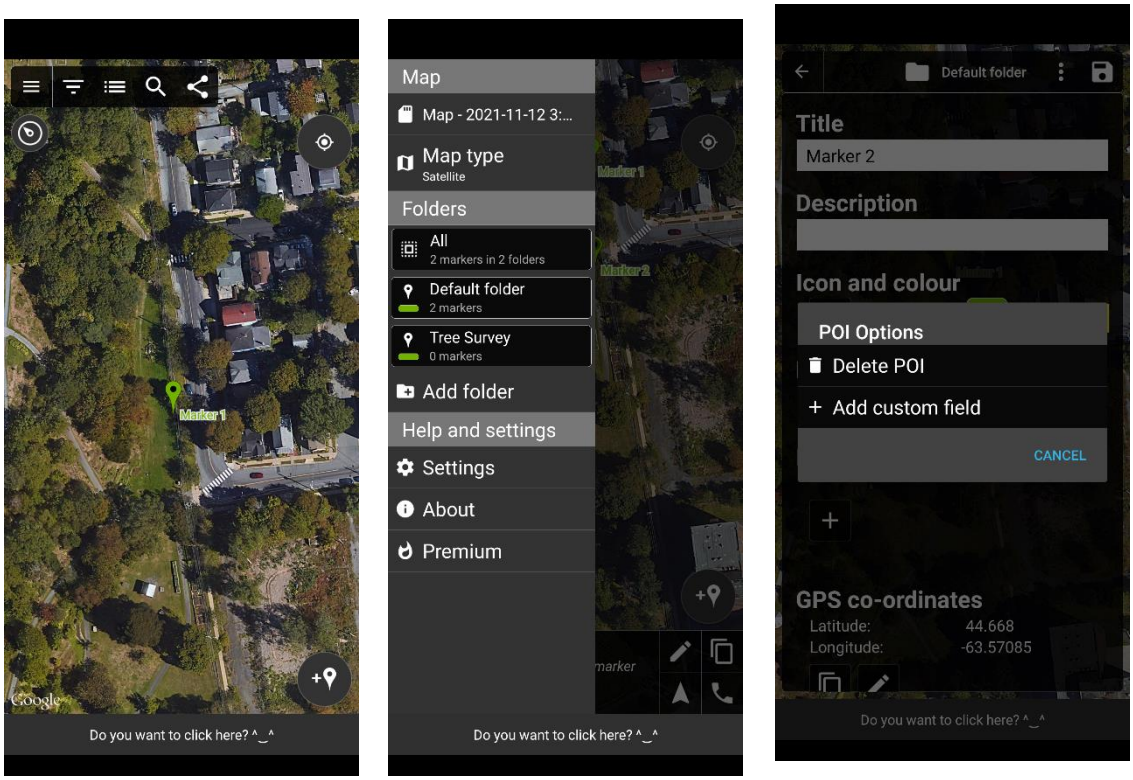
Smartphone applications with similar features:

I tested some applications that I hoped would be able to capture the tree height and diameter quickly and easily. The best free comprehensive tree surveying application that worked in a methodical manner that I could find is simply called "Trees", by the author Forest Monitoring Tools on the Google Play Store:

https://play.google.com/store/apps/details?id=com.forest.tree



Trees is unfortunately limited in Some other applications that offer features that would be ideal were also tested and critiqued in the video that accompanies this assignment.



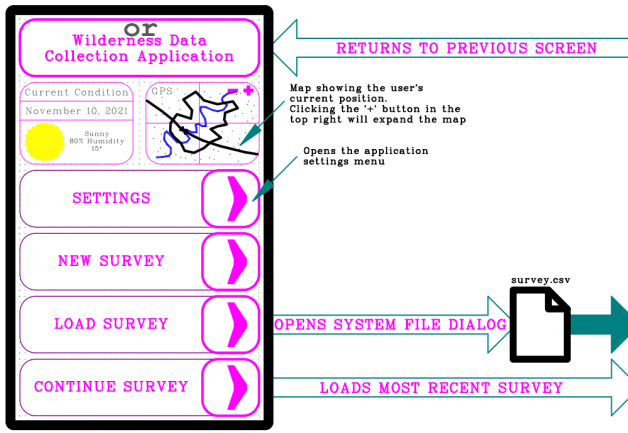
"Map Marker" From Left to Right: 1. The map marker viewer. Background map can be toggled between Google Street View and other imagery sources. 2. The application's sidebar menu, which uses the name "Folders" for what are effectively files with the map marker points. Polygons and lines can also be created. 3. Editing a point- custom fields must be created for each point and there is no way obvious way to create a custom field that is automatically included for all points.

https://play.google.com/store/apps/details?id=com.exlyo.mapmarker

Our concept integrates these functionalities comprehensively:

Point Collection Process

Application Homescreen



Map showing the user's current position. Clicking the '+' button in the top right will expand the map

Opens the application settings menu

RETURNS TO PREVIOUS SCREEN

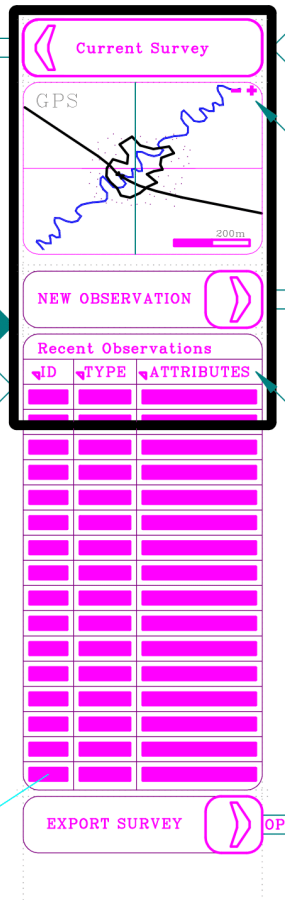
OPENS SYSTEM FILE DIALOG

survey.csv

LOADS MOST RECENT SURVEY

Survey In Progress

Loading a survey or choosing 'continue survey' will bring the user to the 'current survey' screen



Navigable map, by default centered on the user's obseved position, will include a 'zoom extents' button to allow the user to see and navigate around the full extents of their survey area.

NEW OBSERVATION MODAL

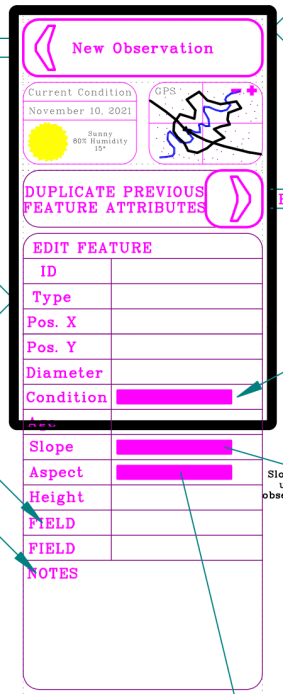
User can sort columns

OPENS SYSTEM FILE DIALOG

survey.csv

Survey observations can be exported to various file types (xls, csv, shp, etc)

Add New Observation



Populates tabular data by autofilling content using previous observations.

Shown as a modal.

RECENT OBSERVATIONS

Field populated from table, modal closes.

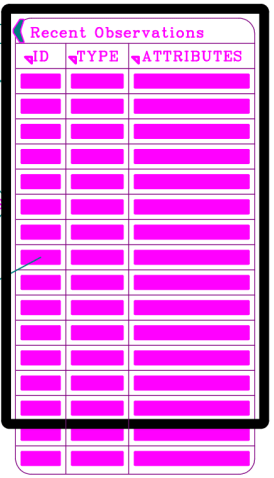
User can customize fields as required

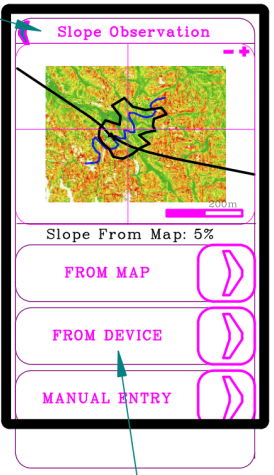
Area for general notes

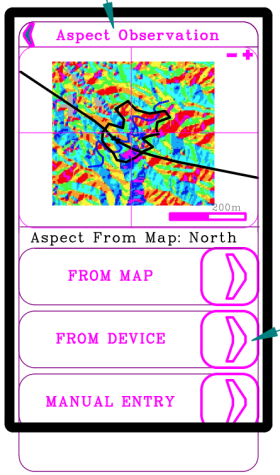
Slope can be extracted from map using user's current location, observation from the user's device, or manual input

Aspect can be extracted from map using user's current location, observation from the user's device, or manual input

Recent Observation Modal





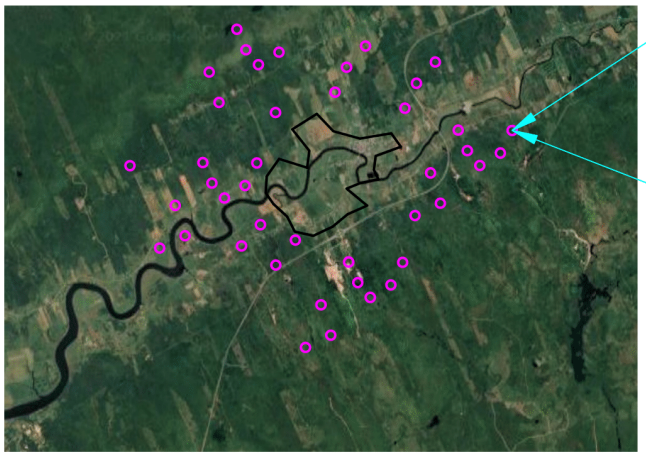


Uses the device's acceloremeter and magnetic compass/GPS positioning to determine the slope and aspect of the current position. May be from the sensors onboard the device, or a paired device.

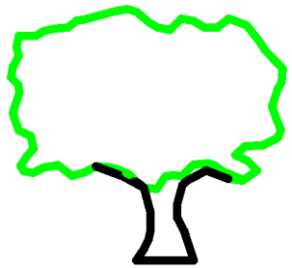
Application Description

The purpose of designing this application is to define a user-friendly interface for the collection and attribution of natural features in a wilderness environment. The intended audience for such an application would be a someone involved in the collection of data related to plants,animals or geologic features. For this particular concept, I have decided to conceptualize the use of this application in an arboreal/timber context. Some particular attributes of a tree that a researcher or scientist may be interested in quantifying and recording. This may include attribute such as the age of the tree, the height of the tree, the diameter of the trunk, the condition (signs of disease, wind damage, etc) and things such as the stage of bark molting. We would also want to record spatially intensive attributes such as the position (determined via GPS or manual input), the degree of the slope (how steep is the slope) and the aspect of the slope (what direction it's pointed in).

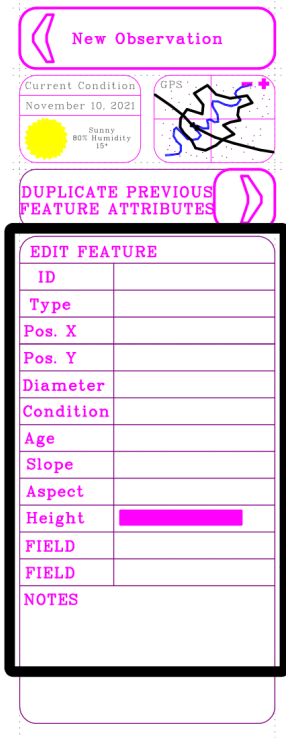
Conceptual Map

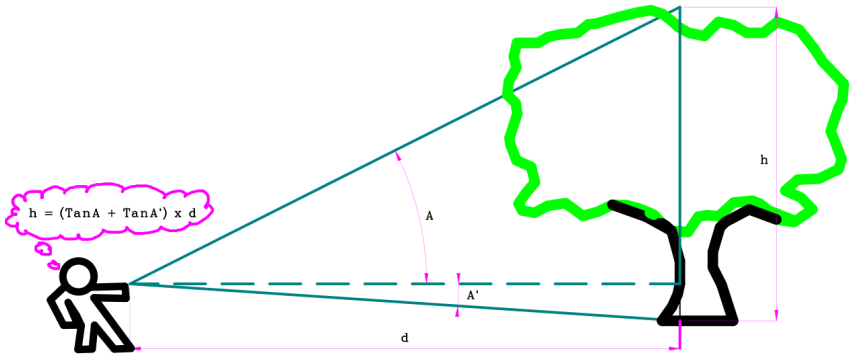


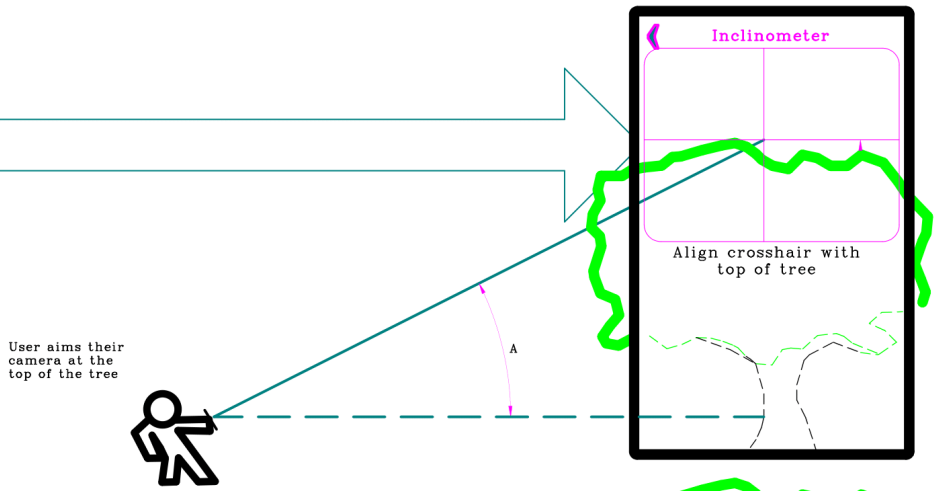
ID	TYPE	ATTRIBUTES
01	MAPLE	50' Tall, 2' Diameter Good Health

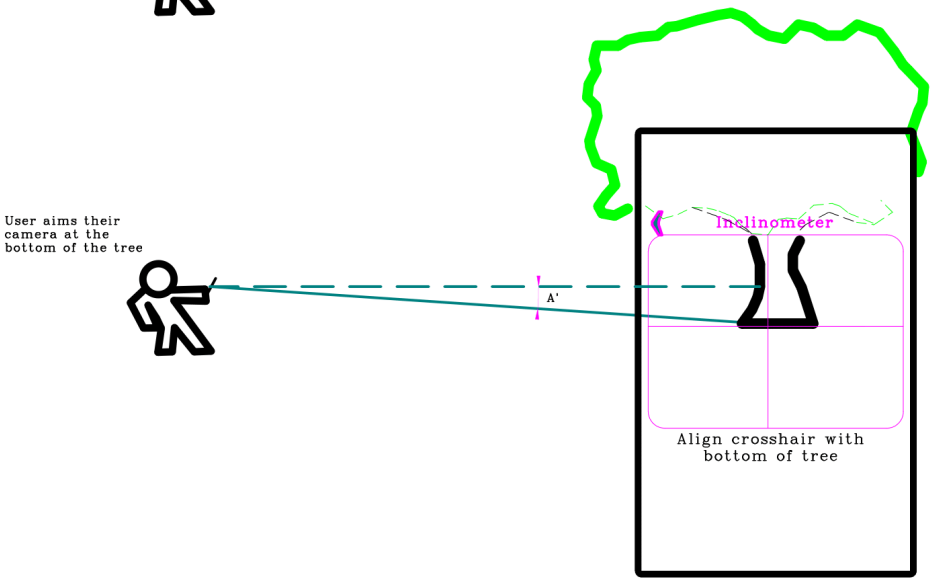


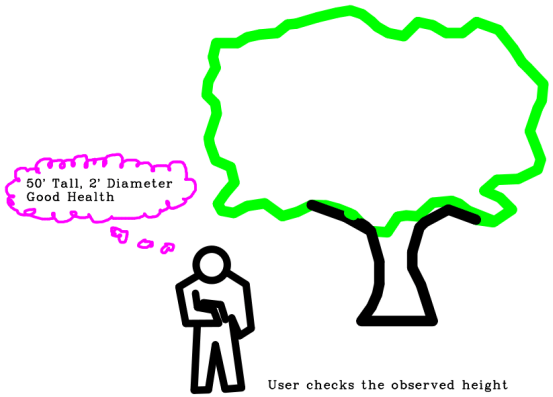
Clinometer Functionality











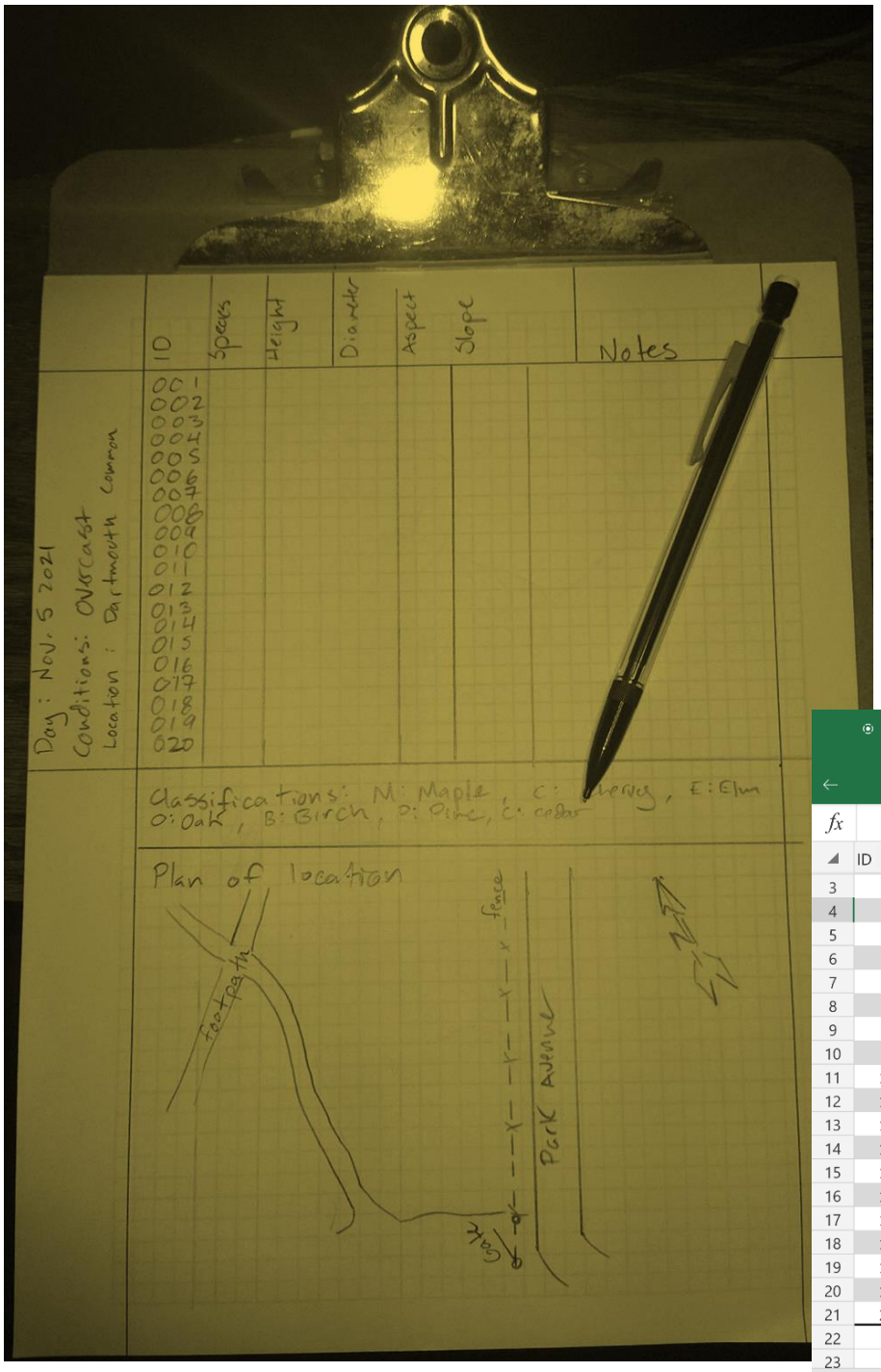
PREPARING THE SIMULATION:

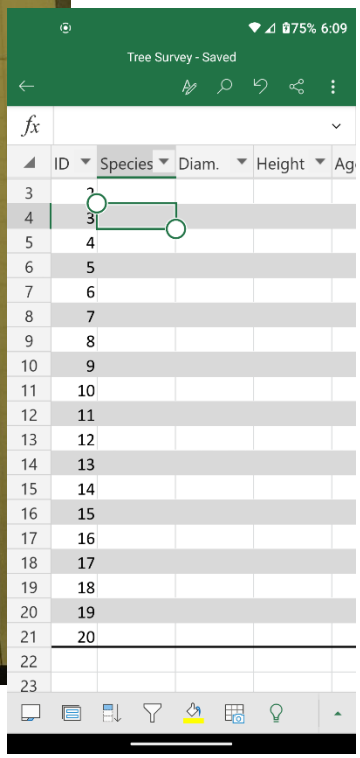
To prepare the simulation, several tasks needed to be undertaken:

1. Install and experiment with existing software that could measure and record tree height with and Android phone.

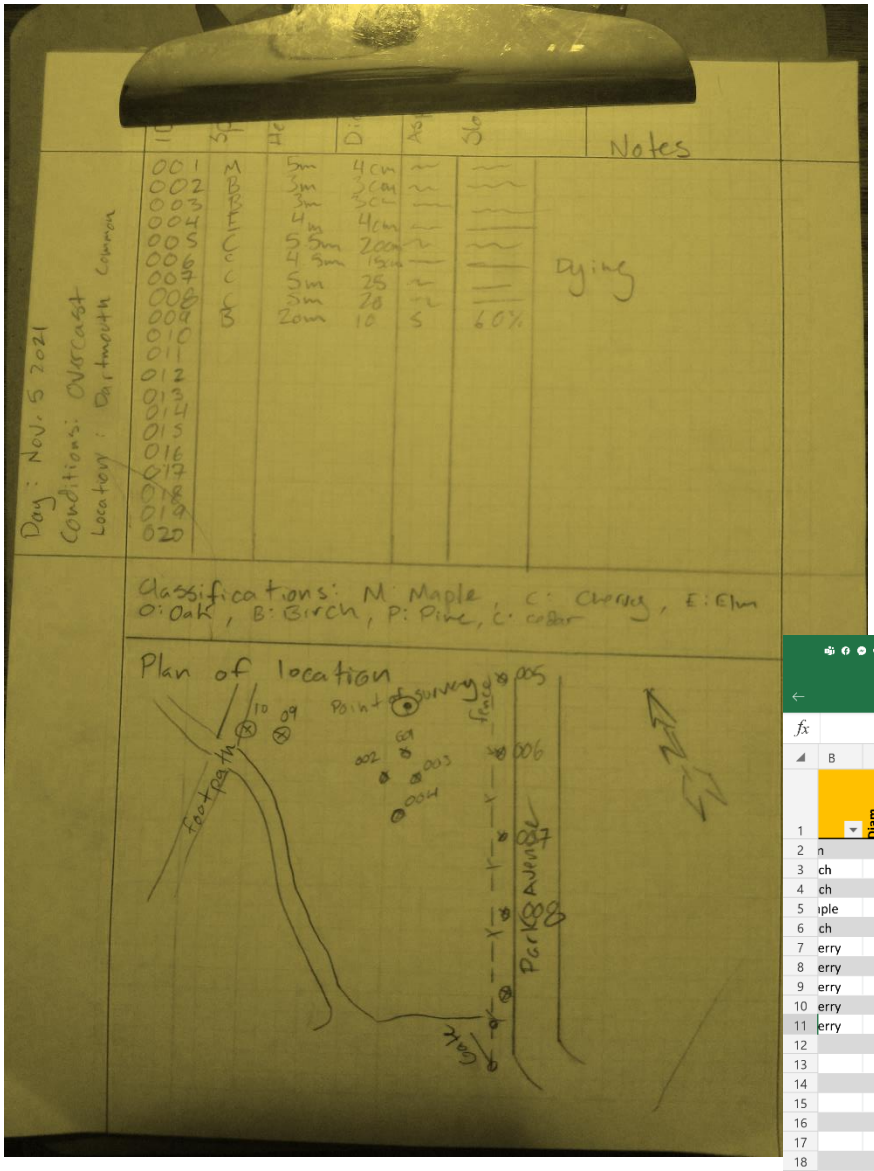
2. Choose an appropriate survey location. I decided to partially survey the trees an area on the south eastern side of the Dartmouth Commons, shown here on Google Earth:

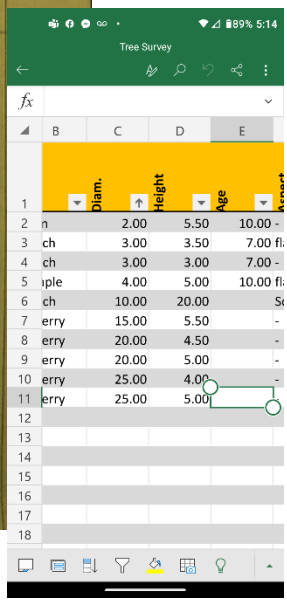
3. Prepared a notebook to record the observations in. I filled out a notebook and made a sketch of the area the night before I simulated the survey. It looked like this:





4. I went to the chosen location and counted and recorded the features of 10 trees. Concurrently, I used the forementioned applications to record the position of the tree and estimate its height, diameter, species, and the other considered attributes. After doings so, my notes looked like this:





5. I entered the data in to an excel spreadsheet. I entered some of the values in the field using the mobile version of excel and recorded the process. The spreadsheet looks like this:

ID	Species	Diam.	Height	Age	Aspect	Slope
1	Maple	4.00	5.00	10.00	-	-
2	Birch	3.00	3.00	7.00	-	-
3	Birch	3.00	3.00	7.00	-	-
4	Elm	2.00	5.50	10.00	-	-
5	Cherry	25.00	4.00		-	-
6	Cherry	15.00	5.50		-	-
7	Cherry	20.00	4.50		-	-
8	Cherry	25.00	5.00		-	-
9	Cherry	20.00	5.00		-	-
10	Birch	10.00	20.00		South	70%

6. I recorded the process using screen capture on my phone and included the results with this report.

Conclusions:

I came to several conclusions with respect to the data entry and collection processes. Some notable items I observed included:

1. Difficulty in creating a new survey with specific requirements in a mapping focused application.
2. None of the clinometer applications on the Google Play store that I tried to a particularly good job with respect to user experience and UI design, all of them leaving much

to be desired with respect to explaining the process of using the clinometer, or in recording the spatial information of the observed point.

3. The mobile version of Excel (or Google Sheets) ended up being the best interface for writing in information and reading through previous observations. The difficulty in using these applications for the purposes of the tree survey is that they don't take advantage of the phone's sensors to record data and the user then must switch between something like a clinometer application where they make their observation, memorize the observed height and then switch applications and write it in to cell in the spreadsheet program. Ideally you could create these spreadsheets in the field using data gathered from the phone's sensors that is inputted directly into the cell, saving the user time, and preventing recording errors. I noticed when I went to my desktop computer that the edits I had made on my phone hadn't been automatically saved to the cloud version of the sheet, as I had expected.

4. None of the applications had a social, "citizen science" component to them.

The process that I used to record these observations would not be considered friendly to a casual user. An application that

takes the user through the observation process step-by-step would probably better suited for casual/amateur users interested in participating in a citizen science project. Such an application would begin by having the user observe the slope and aspect of the location they are in. The application would prompt to sight the top or bottom of the hill they are standing on and determine its angle. The application would then change to clinometer mode, allowing the user to measure the height of the tree. The application would then have the user pace the distance to the tree (simultaneously recording their track via GPS) and then use this distance with the clinometer to confirm the height of the tree. The 2D position of the tree is confirmed by the user dragging its location about the map in relation to the position they are. Finally, the user can now enter the data that will go into the tabular fields, such as species and damage and growth factors. The application could be set up in such a way that the user could observe the heights and angles of multiple trees in a radial fashion, then walk the perimeter of the circle formed by this radius while recording the specifics of each tree while standing close to it. There should be some flexibility provided to the user in terms of how they go about the steps in the data collection process, as they may be able to develop field methods that are better suited to their needs.

Research Sources:

Walter Bitterlich: An invention goes around the world:

https://www.youtube.com/watch?v=dMk9jNF-kHo

Discusses the history or tree surveying and the contributions of Walter Bitterlich to the field. Demonstrates several of the devices both modern and historical used for estimating tree height and diameter.

Basic principles of tree height measurement:

https://www.youtube.com/watch?v=XqupMoiafMY

A video showing how to conduct a tree surveying, where a variety of instruments are demonstrated, including both rudimentary and technologically advanced clinometers.

Tree Inventory – City of Windsor: (3:57)

https://www.youtube.com/watch?v=WISfJdTmfvM

Shows a municipal worker conducting a survey of trees in the Windsor Ontario area,

Guidelines for Developing and Evaluating Tree Ordinances:

http://phytosphere.com/treeord/ordprt3d.htm