Android Forestry
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No, this article is not about robots working in the woods (not exactly, not yet). This is about the growing number of forestry-friendly computer applications available on Android, an operating system used on many smartphones, tablets and other mobile devices. Apple's IOS and Microsoft Windows are also used on mobile devices, but currently Android has lots of applications ("apps") that are useful in the woods, so that will be the focus here (some of the apps discussed here are also available on iOS and Windows).

The Evolution of Mobile Forestry Computing

Over the last thirty years, natural resource professionals collecting field data have been shifting from paper plot sheets to field devices that store data electronically. Initially these devices just stored data for later use on another computer. But over time, they gained more power to do calculations in the field, integrated global positioning systems (GPS), and improved screens and computing speed to use aerial photos and geographic information system (GIS) data more effectively.

One of peoples' first concerns about taking electronic devices outdoors is whether they will stand up to water and other abuses likely to befall them from extended field use. Most mobile computing devices designed for forestry are "ruggedized", with heavy plastic shells and other features to protect the electronics. Unfortunately, ruggedized devices are not cheap; prices range from $1000-$4000.

Enter Smartphones and Tablets

The first personal mobile computing devices came into wide use in the 1990s (e.g. the "Palm Pilot").

Gradually these devices merged with cell phones to become the smartphones that are so widely used today. Over the last ten years, these devices have followed the familiar path of adding ever more computing power, better internet access, GPS, and larger, sharper screens. In more recent history, tablet computing has been added to the mix.

Compared to ruggedized forestry mobile devices, smartphones and tablets have some features that make them attractive to family forest owners (and not a few foresters). They are relatively inexpensive - anywhere from $100 to $700, depending on your cell service plan. They are light. They have current operating systems. They can be used for tasks in addition to forestry work (e.g. telephone calls with smartphone).

These devices are not usually built for field use. But they have become more durable over time, and one can usually purchase cases to protect them. Even if they are damaged in the field, you could burn through two or more of these devices and still pay less than a ruggedized device cost. Their lower price also makes it less painful to upgrade to a newer device for significant improvements.

Apps Galore

The Android operating system is "open source", meaning the system software is freely available for use and/or modification from its original design. This approach creates a fertile environment for innovation. Currently there are over 800,000 apps for Android.

GPS

The inclusion of GPS (from satellites, not just cell towers) is what started many thinking of forestry possi-

bilities for android devices. Some of the newer devices can even access GLONASS (Russian GPS satellites), as well as American satellites - more satellites often means more GPS accuracy, especially under forest canopies or in canyons where line-of-sight to satellites can be challenging.

At least a dozen apps will bring up screens on an android device similar to what you would find on a GPS receiver (e.g., *GPS Essentials, GPS Status,* etc.). *Google Maps* will even give you turn by turn, audible driving directions over your device, just like automotive GPS devices do.

Mapping, GIS

Some of the best android apps integrate the device's GPS capabilities with aerial photos, maps or other data loaded to the device from the internet. Such features are increasingly being described as "augmented reality" a view of the real world augmented or supplemented by computer-generated sensory input such as graphics or GPS data (source: Wikipedia). Mapping and GIS apps typically show your location relative to some type of map. So when you see your live location on the map you may also see nearby roads, forest cover, the soil type you are standing on (an app called *SoilWeb*), topography, or any other information delineated on the map.

Most people are familiar with *Google Earth* and *Google Maps* for their home computer. These programs are also available as android apps. There are also several other apps that do some similar things including *Oruxmaps*, and *BackCountry Navigator*. Even ESRI, a dominant U.S. GIS software provider, has an android app now (*ArcGIS*). There is a range of sophistication in these apps; *Google Maps* is pretty useful to most people immediately, whereas the *ArcGIS* app may require more familiarity with GIS to use fully.

If cellular data isn't available where you are working, you will not have live access to those maps. However, many of these apps allow saving maps or other geo-referenced data (data tied to a location) to the device; you can download that data ahead of time for field use.

Field Guide Apps

Field guide books can be heavy to lug around. Increasingly there are apps to help you identify trees, understory plants, and weeds. One of the better apps

of this kind is *1,100 Weeds of North America*, which helps you identify weeds using plain language rather than arcane plant taxonomical terms, and includes access to over 4,000 color photos to help you along the way. There are also a variety of books to identify, plants, trees, mushrooms etc. that can be downloaded to and read on a mobile device with "reader" apps such as *Adobe* or *Kindle* apps.

Timber Cruising

One of the first electronic device uses in forestry was to collect forest measurement data. Many basic spreadsheet programs can be used for this purpose. You can enter plot data into some cells, then enter formulas into other cells to turn those measurements into usable information, such as trees per acre, tree or stand volume, or other stand characteristics. There is also a timber cruise app that does some of this for you - *Plothound* stores geo-referenced plot data from a mobile device to a "cloud" (a computer network accessed through the internet), from where you can retrieve it from another computer.

Citizen Science

More people are being engaged in the effort to collect more data to support better science. For example, the *EDMapsS West* app allows anyone to contribute geo-referenced data (data that is tied to a location) about observations of exotic invasive species (e.g., noxious weeds) they run across.

Phenology is the relationship between a periodic biological phenomenon (flowering, migration, etc.) and climate. An app called *Natures Notebook*, allows you to enter all kinds of phenological data for a given location for use in the scientific community and for your own interest.

If you like checking your rain gauge, the *CoCoRaHs* app helps you to store your records in a cloud and share them with others (you need to sign up as a *Co-CoRahs* volunteer first – go to www.cocorahs.org).

There's an App for That . . .

Many other apps can come in handy for a forest owner. For example

- Want to know the forecast for burning slash piles tomorrow? Try the *Weather Channel*, *Weatherbug*, or other weather forecast apps.

- Want to convert feet to meters or chains? *gUnit* helps you convert over 30 kinds of measurements.

- Want information on the current snowpack near you? Install the *SnoTell NRCS & RFC* stations app.

- Want to estimate tree height? Try the *Measure Height* app (results are in meters).

- Want to know the slope of a road or hill? Try the *Clinometer* app.

- When will the sun be in the best place to take a picture at a given site? Try *LiteTrac*.

Don't Forget your Device's Web Browser

For example, if you use *SoilWeb* to determine soil type you could go to the web soil survey to get more details about the capabilities and limitations of that soil type for building roads, tree plantability, etc. There are also many good web sites for tree identification and other resources that aren't necessarily channeled through a dedicated app (e.g. Oregon State University's tree identification site (http://oregonstate.edu/trees/)

Devices and Data Access

Smartphones have the obvious advantage of allowing you to make and receive phone calls in addition to the apps. But for mapping apps, a bigger screen makes viewing larger scale maps easier, making a tablet more attractive. Many people who really get into using apps get both. You may or may not need to have data plans for more than one device. If your smartphone can act as a hotspot, you may be able to use the phone for the data access and get data for the tablet through your phone.

Apps are typically either free or relatively inexpensive (usually less than $25). A more difficult issue may be the cost of data plans and where you have data service. Some of these applications require real-time access to data to work correctly (e.g. mapping applications). Since family forests tend to be a little closer to towns and cities, you may have more access to data in the woods than you think. Check to see which cellular service providers have the best data coverage in your area.

Even if you have field data access, consider downloading maps or other large data sets via connection to your home wireless network. It may be faster and you won't generate extra data costs if you have a limited data wireless plan.

Accessories

There are several accessories to consider when taking mobile devices outdoors. For example, GPS reception can often be improved with an external GPS receiver. Garmin makes a small external GPS receiver that links to a phone or tablet via Bluetooth. Placing the device where the signal is better (e.g., above your head, or away from the base of a tree canopy) should increase accuracy.

Consider buying a case that will protect your device if it is dropped or exposed to water. If you plan to be in the woods more than a day, look into additional power options such as extra battery packs or portable chargers. There are also a growing number of solar-devices that can charge phones, tablets and other portable electronic devices. Finally, if you plan to store a lot of maps, photo-filled field guide apps, or other large data sets on your device, consider purchasing an SD flash card for additional data storage.

Conclusion

A growing number of android apps can be used in forestry. Many of these applications are works in progress. For a given application, you may find bugs that keep you from doing exactly what you would like to – that is one of the simultaneous strengths and weaknesses of open source software. Fortunately, multiple apps are often available to accomplish a given task. If an app isn't working the way you like, try another similar app. The more successful apps are frequently updated to fix bugs and improve functionality, so a future upgrades may handle what you want better.

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