

# **Android: Your Next Surveying Instrument**

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## **Abstract**

*A discussion of the evolution of computer hardware and software leading up to the compact mobile devices running the Android Operating System (OS) followed by a look ahead at the potential for this OS in terms of applications in Land Surveying. The author will attempt to make the argument that a good knowledge of the history of computing will allow Land Surveyors to “think-outside-the-box” to see the possibilities in Surveying for what can be perceived as otherwise everyday consumer electronic devices.*

## **1.0 What Do Land Surveyors Do?**

Unless you land a job monitoring the millimetre-order movements of a hydro-electric dam, chances are that your job as a Land Surveyor consists of:

1. Measuring
2. Computing
3. Drawing
4. Communicating

with the final deliverables being the client’s plans. For items 1-4 above you use some instruments including Handheld GPS Receivers or Printed Map, Watches, Ephemeris Tables, Calculators, Cameras, Computers and Telephones: each a separate and distinct object. Mobile devices like “Smartphones” and Tablets are changing all that by amalgamating them into one device.

## **2.0 Jack-of-All-Trades (and Master of Some)**

The following is a non-exhaustive list of consumer items that can be replaced by a Smartphone/Tablet:

- Alarm Clocks / Watches
- AM/FM Radios
- Cameras / Video Cameras / Voice Recorders
- Computers / Calculators / Modems / Hard Drives / Pendrives
- Flashlights
- Handheld GPS / Compass
- Hardcover/Paperback Books / Newspapers / Magazines / Dictionaries / Encyclopedias
- Kindles / e-Readers
- Landline Phones
- MP3 Players / CD Players / DVD Players
- Pagers
- Printed Maps
- Scanners / Fax Machines
- TV Sets / Cable TV / Satellite TV
- Walkie Talkies

### 3.0 How Did We Get Here?



*Fig.1 A Smartphone Running Android OS version 4.0 [Ice Cream Sandwich]*

Fig.1 shows a Smartphone running the Android OS. It can Measure, Compute, Draw and Communicate (see Section 1.0). A device like this running the Android OS did not “just appear” overnight; it is the result of a long chain of events starting, interestingly enough, with the Textile Industry at the beginning of the 19<sup>th</sup> century.

In 1801, Joseph Jacquard (French), invented the Jacquard Loom which was a mechanical method of making complex patterns in fabric based on punched cards which was the genesis of coding information by means of binary digits (bits) where a punched hole was a “1” and the absence of a hole was a “0”.

In 1937, John Atanasoff (American), conceived of the idea of solving complex equations by means of a digital computing (but not programmable) machine which he built in 1941. Atanasoff shared his idea with John Mauchly (American) who went on to build the first programmable computer called the ENIAC in 1943 which led to the UNIVAC in 1947. In the interim, John von Neumann (Hungarian) developed the concept of the “stored program” (later called the “von Neumann architecture”) and the field of Computer Science was born.

Two groundbreaking technical papers, “On Computable Numbers” by Alan Turing (English) published in 1936 and “A Mathematical Theory of Communication” by Claude Shannon (American) of Bell Labs in 1948 (where he coined the term “bit”), laid the foundation for digitizing information and electronic data transmission. Turing’s paper dealt with *what can and cannot be computed* while the latter paper gave “Shannon’s Law” which stated that *the amount of error-free data that could be transmitted over a channel of any given bandwidth was limited by noise*. This theory governs the limits for the speed at which data can be transmitted via Cellular 3G/4G networks today.

Later at Bell Labs, Dennis Ritchie (American) created the C (procedural) programming language (1972) from which the C++ (object oriented) programming language was further developed by Bjarne Stroustrup (Danish) in 1979. Both these languages were used to program UNIX (a proprietary OS owned by Bell Labs) running on mainframe computers such as the DEC PDP-7. LINUX was created as an open-source (free) version of UNIX in 1991 by Linus Torvalds (Swedish) to run on personal computers (PCs). The open source aspect of LINUX unleashed a wave of Application development not previously found with the proprietary UNIX OS. Another UNIX offspring is Apple’s proprietary iOS which runs on iPhones and iPads.

LINUX was the basis for the Android OS created by Andy Rubin (American) in 2003 for running on Digital Cameras. Android was acquired by Google Inc. in 2005 and adapted for mobile phones with the first cell phone running Android being released in 2008. Andy Rubin worked for Google as lead developer for Android until March 2013 when he was replaced by Sundar Pichai (Indian) who also heads up Google’s “Chrome” web browser development, yet another indication of the amalgamation of emerging technologies.

Returning to the story of programming languages: in 1995 a new language first called “Oak” then “Java” was developed by James Gosling (American) at Sun Microsystems which was based on the syntax of C/C++ but modified to run on small devices like cell phones. At the time Java was being conceived, there were no applications for it. Then along came the internet/world-wide-web in the mid 1990s and Java found a home in “Applets” running within web browsers. Today Java is the programming language used to write Applications (Apps) for Android devices. The warehouse-filling ENIAC/UNIVAC machines of the 1940s led to the room-filling UNIX mainframes of the 1970s which ultimately gave us the Android OS/iOS and the Java Programming Language that power smartphones which can be held in one hand.

#### **4.0 Land Surveying Mobility**

The hardware components available in Android devices which should be of interest to Land Surveyors are the GPS Receivers for general location ( $\pm 5\text{m}$ ), CPUs for computations and the Communication aspects for uploading/downloading data, sending/receiving Short Message Service (SMS) texts and email. In combination with dedicated Applications (Apps), the possibilities are far-reaching especially with regard to mobility. The Land Surveyor no longer has to make a distinction between “Field” and “Office” work, we can take the GPS, PC, Hard Drive, Flatscreen, Modem, FAX, Spreadsheet, CAD and Phone with us everywhere we go in the form of an Android Smartphone/Tablet.

## 5.0 Commercial Android Apps for Land Surveyors

### 5.1 AutoCAD WS & Cloud Computing

In the mid 1980s in order to run AutoCAD 10 on a PC, it would have to be outfitted with an additional math co-processor chip because the CPUs at the time like the Intel 286 were not capable of complex floating-point computations required by the software; it was also a memory hog. Users at that time would not be able to envision the same CPU/RAM-hungry program running on a handheld device using the Android OS. “AutoCAD WS” (Web Service) is a free App from Autodesk (the original makers of AutoCAD) that allows users to open and edit AutoCAD DWG/DXF files on Android. Users must create an account with Autodesk although the App is free. All drawings are accessed online from a Cloud Drive managed by Autodesk.

Cloud Drives are virtual drives that are accessed online with the data being stored in physical “server farms” with redundant mirror sites to ensure data access speed and security. With the introduction of Broadband Digital Subscriber Lines (DSL), uploading files to a Cloud Drive is now a viable way to store everyday work data. The advantages are many: security from hard drive crashes and access from any computing device from anywhere in the world being the best two. Two popular Cloud Drive services are Dropbox and Microsoft Skydrive. In late February 2013 the CEO of Dropbox stated that their servers were receiving 1 billion files a day from 500 million devices. By the end of 2013, Dropbox expects to have 650 million devices connected to their service.

### 5.2 MS Office: Word and Excel Files on Android

Unlike Autodesk, Microsoft Inc. is no fan of Android mainly because it has its own competing OS: Windows 8. Therefore other third-party software companies have stepped in to fill the gap such as Quikoffice, makers of “Quikoffice Pro” which allows users to open and edit MS Office files on Android devices.

## 6.0 GPS on Android Devices

The table in Fig.2 shows the results from testing three Android devices against a Garmin Handheld GPS Receiver conducted by the author in April 2013.

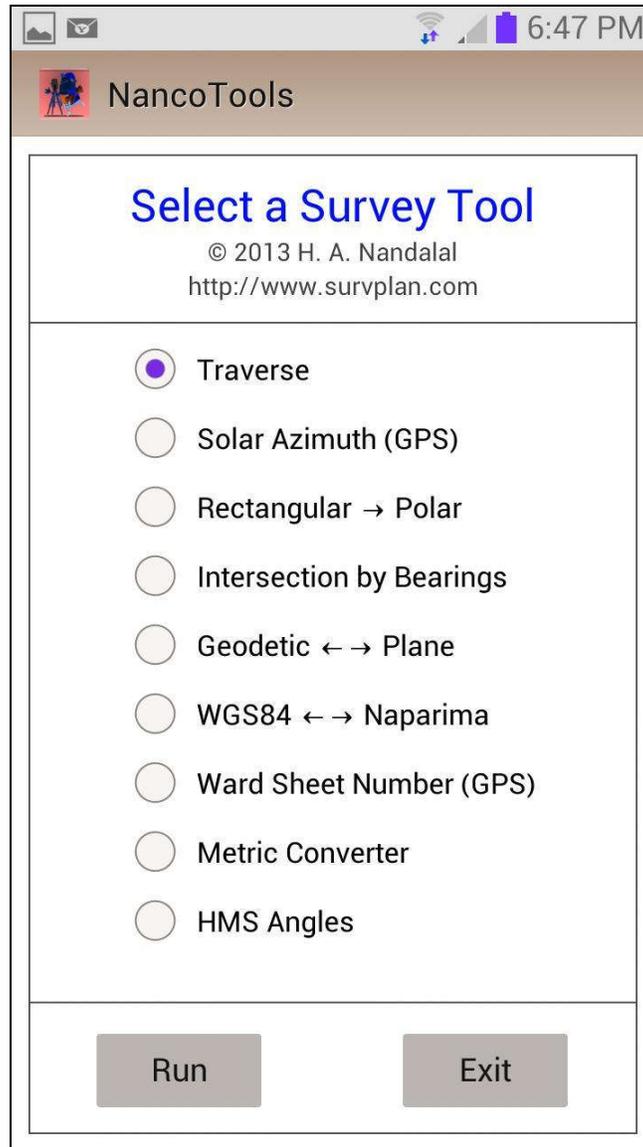
Device	Eastings	Northings
Garmin GPSMap 76CSx Handheld	667025	1185883
Samsung Galaxy Tab 2 10.1 Tablet	667026	1185887
Google Nexus 7 Asus Tablet	667025	1185887
Samsung Galaxy SIII Phone	667024	1185885

*Fig.2 GPS Results from Four Different Devices*

Given that the Garmin device has a SiRF high-sensitivity GPS chip which makes it one of the most accurate dedicated handhelds available, these results are impressive for general locations such as positioning for solar observations and determining cadastral ward sheet numbers.

## 7.0 Programming Android to Make Surveying Apps

Surveyors with a knack for Java Programming will find that writing Android Apps is a fairly straightforward process after an initial steep learning curve. Because Java has the same syntax as C/C++/JavaScript, programmers familiar with those languages would already be at an advantage in producing custom Surveying Apps.

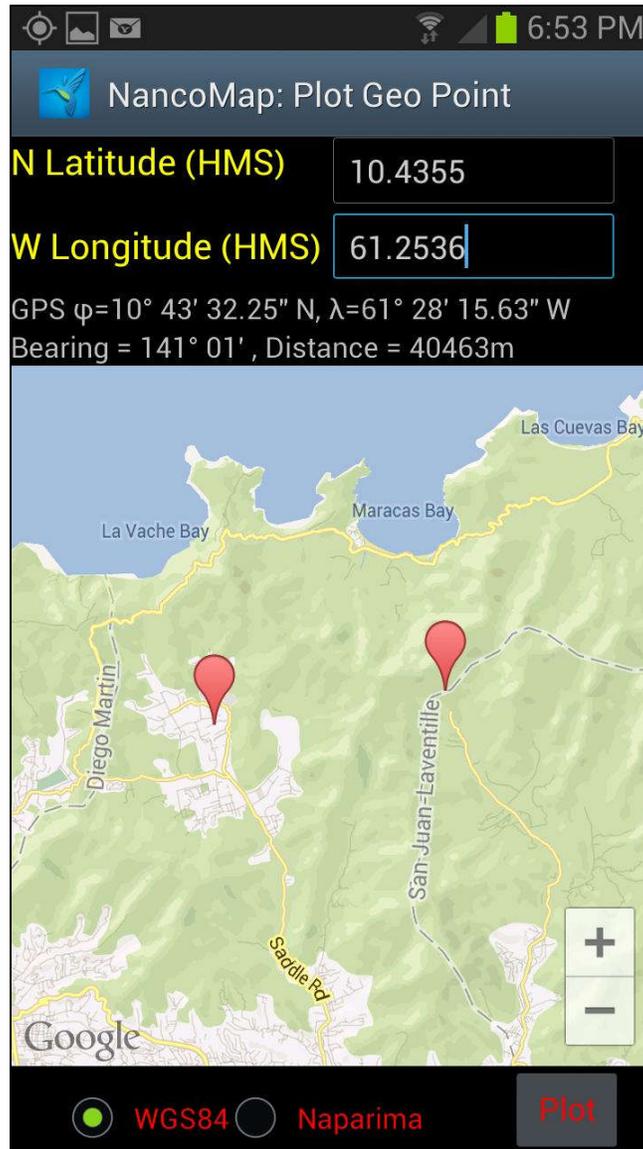


*Fig.3 NancoTools: An Android App Written by the Author*

The Android Software Development Kit (SDK) is available for free download and there are many websites with free information and tutorials on programming Android. The number of different Apps is limited only by the imagination of the programmers. Having access to location data from the computing device which can also access the internet and send/receive texts/emails makes for some interesting Apps not possible on platforms like Windows XP/7/8 and LINUX.

## 8.0 Google Maps on Android

One of the advantages Google Inc. has over Apple Inc. is the fact that Google owns both Android and Google Maps. Programmers and App users have free access to this powerful resource. The map data is downloaded from Wi-Fi (if available) or 3G/4G networks provided the user has a data plan with a provider.



*Fig.4 NancoMap: Another Android App Written by the Author*

## 9.0 Summary

There is a lot of potential for applying devices running the Android OS in Land Surveying making them instruments for measurement, computation, drawing and communication. Land Surveyors have to learn to adapt these emerging technologies to their work. ■