An Overview of Mobile Applications for Field Science

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Abstract

This report summarizes the capabilities and features of existing mobile applications for field science. The goal of the report is to assess current infrastructure available to geoscientists to collect data in the field.

1. INTRODUCTION

When in the field, geologists gather different types of information including samples, photos, notes, sketches, and measurements from instrument readings such as compasses and clinometers. Traditionally, a field notebook is used to annotate all the information collected in the field. Today, it is possible to gather field data using applications (apps) available on mobile devices such as smart phones and tablets.

The notes and measurements gathered from the field are essential to a geologist's understanding of the land -- not knowing a sample's location of origin or its bedding orientation opens up the opportunity of taking information wildly out of context. However, the collection of such data is not very efficient with a field notebook -- manually importing dozens or hundreds of such data points into a GIS program or equivalent takes countless hours to do. Understanding that data by plotting the points on a map or a stereographic projection (i.e., a *stereonet*) is an extra step geologists need to go through back in the lab after returning from the field. If it were possible to get that understanding of the landscape while in the field, geologists would have a better understanding of what data to collect next or where to go next. Immediate, on-line availability of the data they collect may help geologists make their time more effective while in the field and consequently back in the lab.

Mobile applications provide an interesting solution to these challenges of data collection and manipulation. By providing a way to digitally capture information almost immediately while in the field, a mobile application can allow a geologist to significantly reduce the time s/he spends in importing data to a GIS program or other data manipulation system, as information captured in the app itself is already in digital form. Having such an application requires no additional hardware, as it makes use of the smartphone's internal sensors to gather data, and costs very little compared to dedicated instruments such as GPS systems and clinometers. As the smartphone is a device with computing power, it also has the capability to process data during data collection, allowing a geologist to understand the data as it is being collected in real time. Mobile applications have the potential to streamline a geologist's workflow in the field.

Unfortunately, the adoption of mobile apps and mobile technology in the field is not very widespread. This report gives an overview of existing mobile apps that offer useful functionality, and analyzes their capabilities in order to gain a better understanding of the limitations that they have that make them have limited utility for geologists.

2. MOBILE APPS FOR FIELD SCIENCE

We identified twelve popular applications for mobile devices, tested them, and reviewed their functionality. These and other apps are available from the Apple App Store as well as Android Apps.

These mobile applications offer different functions to capture and present measurements and other data. We focused on the potential utility of the application to a geologist in the field. For example, application functionality such as the ability to record GPS coordinates and support for certain types of data are crucial to the work a geologist does.

Figure 1 shows the front matter from the app store for three of these applications, just to illustrate the different kinds of data captured and interfaces offered by each.

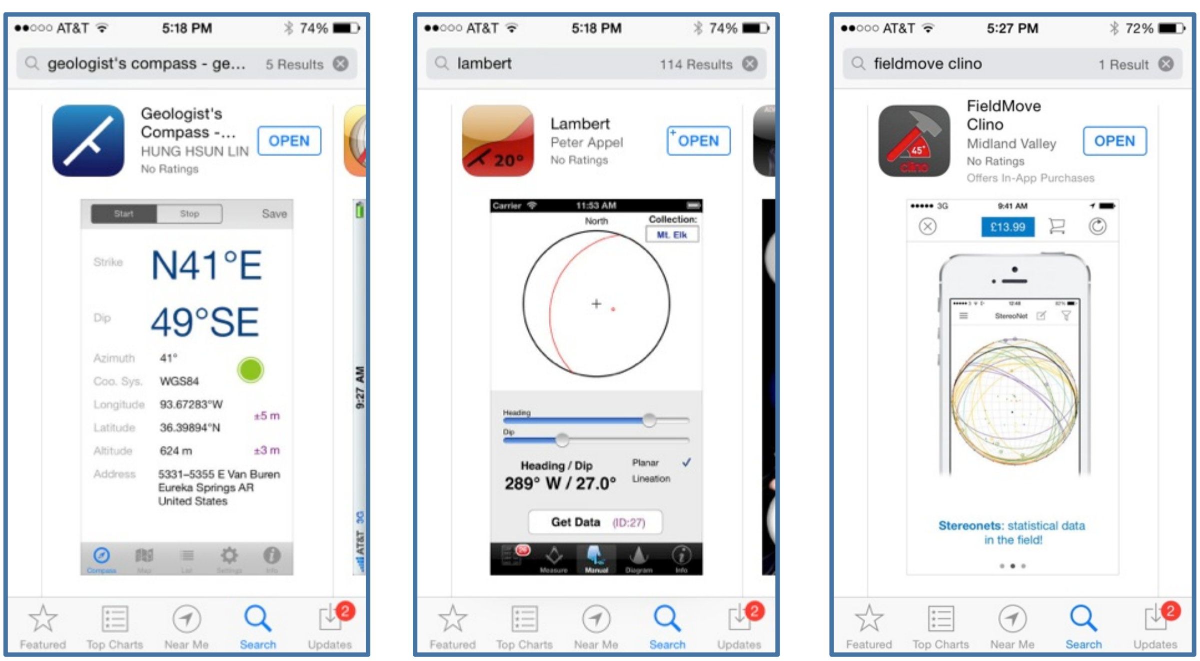

Figure 1. Some selected apps for field science available for mobile devices.

3. CRITERIA FOR ASSESSMENT OF MOBILE APPS

We identified seven major criteria to evaluate these mobile applications:

1. **Platform** indicates whether the application is built for Android or iOS, and whether it runs on specific devices.
2. **Connection Assumptions** asks if a data connection is required for the application to work. While in the field, geologists usually work offline due to having little or no phone signal available and to reduce battery consumption. We divide this category into two columns: whether the application requires a connection the first time a user runs the app, and whether the application requires a connection for normal app use.
3. **Metadata Collected** concerns the measurements that an app can collect or hold about a sample or site. All types of information mentioned in this category must be collected from sensors or entered by the user; after saving an entry, the user must be able to view that information. This category was split into two fields: the core set of metadata, which encompasses the basic information an app should collect, including GPS coordinates, time of collection, and simple orientation information such as strike and dip, and other metadata that the application supports.
4. **Data Export** highlights the various ways an app is able to export the data it holds. CSV is identified as its own column in the table because it is a versatile, widely-used format that can be imported to several different software packages. Other export formats are mentioned in the second column of the category.
5. **Maps** pinpoints an app's ability to display data in a visual geospatial format. Use of mapping functionality while off the grid is crucial for a geologist, so the app's ability to work with maps offline is highlighted in its own column within the category. The visualization of rock orientation data, most commonly in stereographic projections, is particularly useful in the field, so we checked each app for stereonet support in a second column. In the third column of the category, we looked for what type of geographic map format is supported by the app.
6. **User Input** concerns how much control the user has over the information collects through the application. Because the smartphone sensors are often inaccurate, it is importnat to edit data and override values added by the application with values obtained from more accurate instruments. Some geologists may want support for new fields in order to capture additional information specific to his/her project, so the second field of the category is reserved for that flexibility.
7. **Usability** asks if an application is helpful and easy to use. The category covers any other dimensions of the application that may improve or disrupt the geologist's work by using the application.

Table 1 shows how the apps meet these criteria. Green cells indicate that the app would likely satisfy a geologist's needs, red cells highlight a negative behavior or an important but missing feature, and yellow indicates that a feature is only available for payment.

Table 1. A comparison of selected apps for field science available for mobile devices.

		Connection Assumptions		Metadata Collected		Data Export		Maps			User Input			
App Name	Platform	On Start	To Use	CORE (GPS, strike, dip, timestamp)	other	CSV	other	Offline	Stereonet	Format	override	fields	Usability	Comments
Lambert	iOS	0	0	1	heading, magnetic field, plane/line, 5 color choices	0	stereonet export in pdf, data export in plaintext	1	1	Google Maps	1		can delete data points on stereonet panel (most recent point in red)	comments enabled in edit mode
FieldMove	iOS			1	rock type, data type (plane/line), comment, locality (all editable except timestamp & gps coord)	1	Move (.mve)	1	paid	Google Maps, Mapbox	1	0	easy to navigate, convenient export button; data sorted by locality, but cannot match photo to readings	hard to save
Rocklogger	Android		0	1	rock type, plane type, comments; modes: magnetic field, dip direction, photo	1		1		Google Maps; saves in a cache			easy to export due to use of native sharing menu; export file easy to find; easy to calibrate	not allowed to edit records; copying records strictly Paid-Only
GeoCompass	iOS	0	0	1	azimuth, coordinate system, altitude, address; not shown: magnetic declination, strike accuracy, x/y coordinates, hoizontal/vertical accuracy, photo/video/voice, comment	1	via email	0		Apple MapKit	0		easy to navigate, options about photo/video quality, deletion of media after deletion of data, colors, type of map	denotes uncertainty of measurements; can add media/comments though
Geology Sample Collector	Android	1	0	1	person recording the sample; photo/audio/video, rock/mineral name, theodolite, rock age, geologic age, temp/pressure, fossils, etc.	0	can create website for export	1		Google Map		1	define collections by site; tons of bloatware	
Strike and Dip	Android	1	0	1	plane/line type, name, magnetic field, theodolite, audio/video/photo, notes, temp/pressure	0	can create website for export	1		Google Map		1	readings very jittery; easy to use, but not useful; tons of bloatware	
GeoID	Android	0	0	no strike, has dip direction		0	cannot export	1		Google Maps (outdated API does not work)	0	0	can organize readings into projects	all readings are recorded under a shared plane/line type, project, and location
GeoAssist	Android	0	0	1	rock unit, rock type, mineral descriptions, contact, fold, fault, joint, vein, picture w/ descriptions, notes (not sure how to get that working?)	0	email PDF	0		Google Maps	1	0	Not very intuitive; no help button or instructions on what buttons do. Hard to navigate. UI could use some improvements to make it less of an eyesore.	
FieldNotesLT	iOS	0	0	0		0	fieldnotes (.fnz), Google Earth (.kmz), text/zip file, PDF (PAID ONLY); exports via email, iTunes (PAID), DropBox (PAID), FTP (PAID)	1		Google Maps			lacking features, not easy to navigate or use	can edit location by dragging the pin
GeoClino Free	Android	0	0	1		1	emails raw csv text	0					readings jittery, no organization	not clear how to save, input data uneditable
eGEO Compass GS	Android	0	0	no strike, has dip direction		0	cannot export	0				0	straightforward, but lacking key features	
Qgis	Android	0	0			0		1					Very elaborate installation process	does not take samples or data -- seems to be a tablet port of the desktop application

3. APPLICATION HIGHLIGHTS

Overall, none of the applications meets all the criteria that are important for geologists doing work in the field. We highlight in this section the highest-rated apps that we evaluated.

Lambert has a well-organized interface, collects basic metadata (eg, GPS location, strike and dip), allows the user to override recorded values or add comments, and provides a stereonet display with several different views. The application even allows deletion of data points directly in the stereonet. However, the application does not support export in CSV, it only exports plaintext.

FieldMove captures basic metadata, has easy export to CSV, allows overriding of measurements and geographic mapping, and has a compatible desktop application that allows visualization and manipulation of data. However, its stereonet functionality is a paid-only option, and the full desktop application costs quite a pretty penny.

Rocklogger captures basic metadata, has support for photos, CSV export through the native sharing menu, and Google Maps functionality. However, the application does not support editing of records for overriding values. Copying records is a paid-only option.

GeoCompass supports a very complete set of metadata, with good accuracy of measurements. In addition, the application supports CSV export via email, the use of photos and video, and various information management options like video or photo quality. The organization of the user interface is quite clear, making it easy to navigate through. However, the application does not support offline mapping due to use of Apple MapKit. Users cannot override values or add new fields.

Qgis has very extensive functionality and superb integration with GIS mapping functions. However, it is very hard to install and requires the use of GIS software which is not freely available.

Overall, the best applications are Lambert and FieldMove, which made the most effective use of the smartphone's capabilities. Aside from a few small areas of improvement, both applications supported the basic features a geologist would need in a good data collecting mobile application: basic metadata support, easy export capability, offline geographic mapping and stereographic projection rendering, the ability to override data, and clear organization of the application's features.

4. DISCUSSION

Some general observations:

- None of the apps are available open source. This makes it impossible to extend them when they have a severe limitation.
- The majority of the apps are free or had nominal cost. Some of the free apps offered functionality for an extra cost.

- The offerings from both the iOS App Store and the Android Play Store are comparable.
- Most of the applications can operate completely offline, with the exception of the two applications by Major Forms (Geology Sample Collector & Strike and Dip) that require an Internet connection.
- A number of different applications offer various modes of data export, though only four of the twelve supported CSV export -- all but one supported nothing else. The FieldNotesLT application offered the most number of different types of data export formats, but the majority of them are paid options only.
- Most applications support offline mapping, but it seems to be due to Google Maps' ability to save offline maps automatically; the only app that uses Apple's MapKit is unable to do so. However, the stereographic projection plotting functionality is available for free only in the Lambert application.
- Only three applications allow the user to override recorded values, and the only two applications that could add new fields are the ones created by MajorForms (Geology Sample Collector & Strike and Dip).

5. CONCLUSIONS

We surveyed several mobile applications currently available for field work in official application stores. Each of these applications addresses different aspects of the geologist's data collection workflow. The existing mobile applications are an important step towards improving data collection for geologists on the field and have functionality that could help geologists become more efficient. Unfortunately, all of the mobile applications have significant shortcomings that have prevented them from becoming more widely used. Our analysis was focused on twelve selected applications. As new versions of these applications or entirely new ones are developed over time, these shortcomings may be addressed. However, none of these applications are open source and cannot easily be extended to incorporate desirable new features, leaving geoscientists at the mercy of the application developers. These shortcomings may explain the lack of uptake from field scientists, and suggest the need for the development of new software to support field science.

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