



Field Pad

An Introduction

1 Introduction

Field Pad is an app for environmental mobile data collection. Developed for the scientific community for gathering observations in the field, it has all the functionality required for the job. Field Pad is fully configurable with variables, species lists, data validation rules, and GIS functionality. It can be used stand-alone off-line or by a team syncing data between the members.



1.1 Contents

This document outlines the key concepts and functionality of Field Pad. It is not a detailed description of the configuration and the text is intended to provide an overview.

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2 Overview

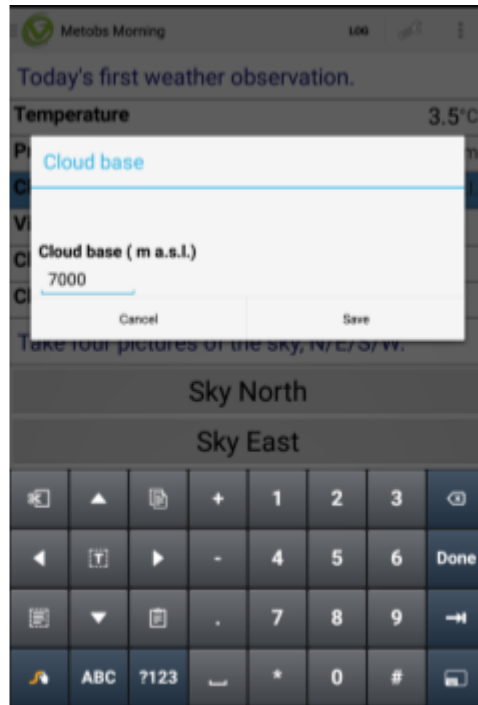
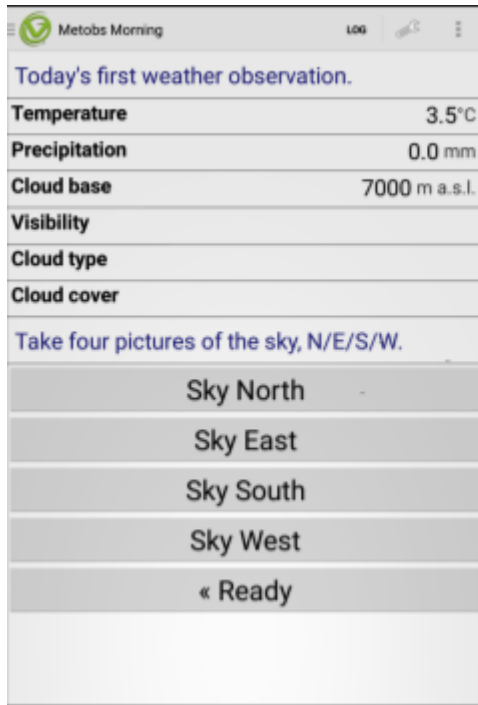
Field Pad is a generic data collection app for Android-based tablets and smartphones. While it knows nothing about specific data entry forms, it has primitives for data entry of variables, species, and Geo-locations. At its core is a workflow engine that can execute instructions for setting screen layout, selecting map areas, drawing data entry or display fields, or running data validation rules. Sequences of instructions define the data entry forms. The instructions are stored in control files. These files describe what variables will be collected, in what order, and how the entered values will be verified. The engine reads the files, builds an internal representation, and executes the instructions. This architecture makes Field Pad highly flexible and able to handle arbitrary forms with a data-driven content rendering.

The idea is that anyone with a spreadsheet can generate a simple data-entry app. With some basic skills in XML, the app's block language can be used to extend the the simple app's user interface, the variables to collect, verification rules to apply, and page layout to use.

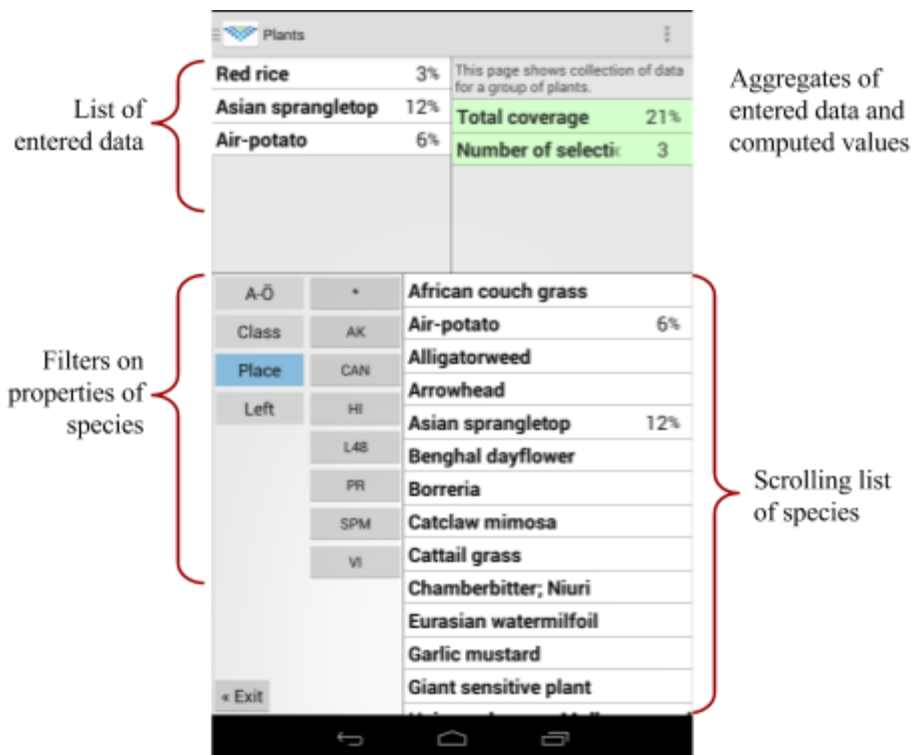
2.1 Data Entry Forms

The workflow engine instructions describe components that build up dynamic data entry forms. There can be any number of top level forms. Each can have a number of sub-forms. The "dynamic" part means that the forms can have alternative parts depending on entered data. The workflow engine renders a form as far as possible. It pauses when it needs data to decide which alternative path to follow. Once the data is entered, the rendering of the form continues. If the entered data is changed, the workflow engine re-renders the form as far as possible, possibly erasing previously rendered parts.

The collected data can be numeric, text, truth valued, or multiple choice format. Each type has its associated editor. Number entry is done using a number keypad or a slider, text entry is done using the standard keyboard, and multiple choice data entry field pops up a dialog with the alternatives. Truth valued data is entered directly in-field.



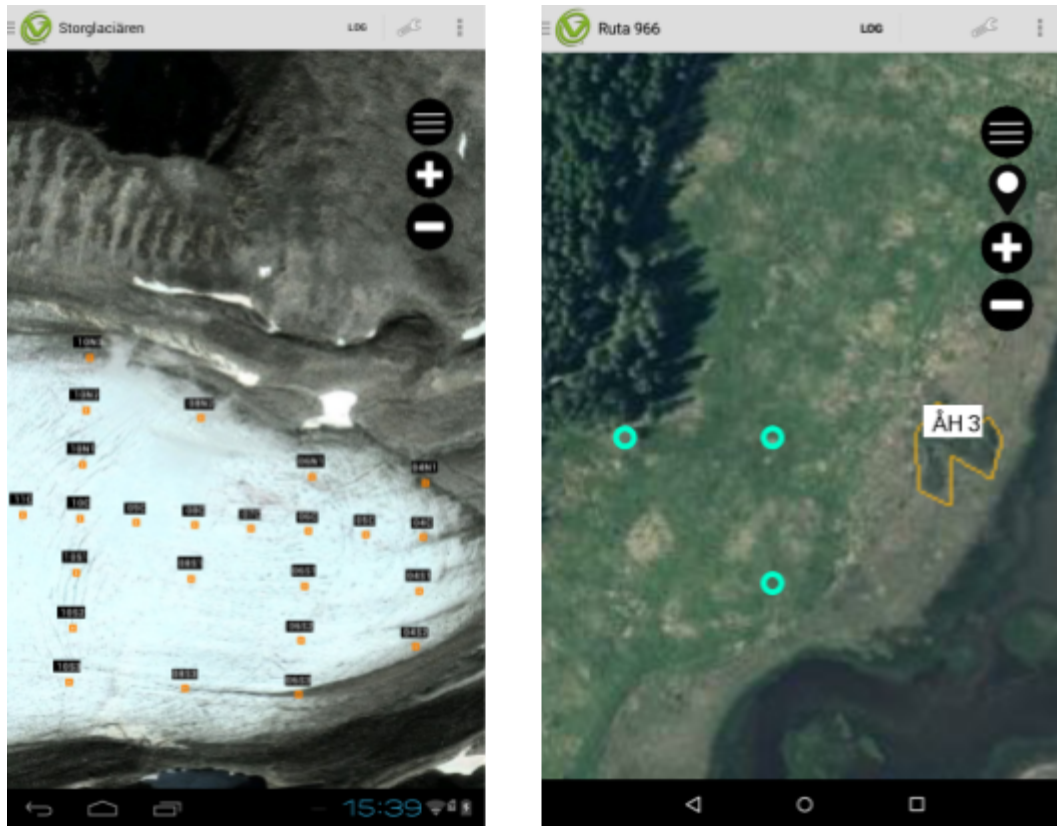
Of special interest may be forms for species-related data entry that allow the use of pre-configured lists of species and associated variables.



The form can aggregate entered data and can host dynamic filters on the displayed species list to ease the search in the list.

2.2 GIS Forms

Data entry can also be based on map positions – either entered manually or loaded using specially-formatted control files. Map positions (“shapes”) can have either more detailed maps or regular data entry forms associated with them.

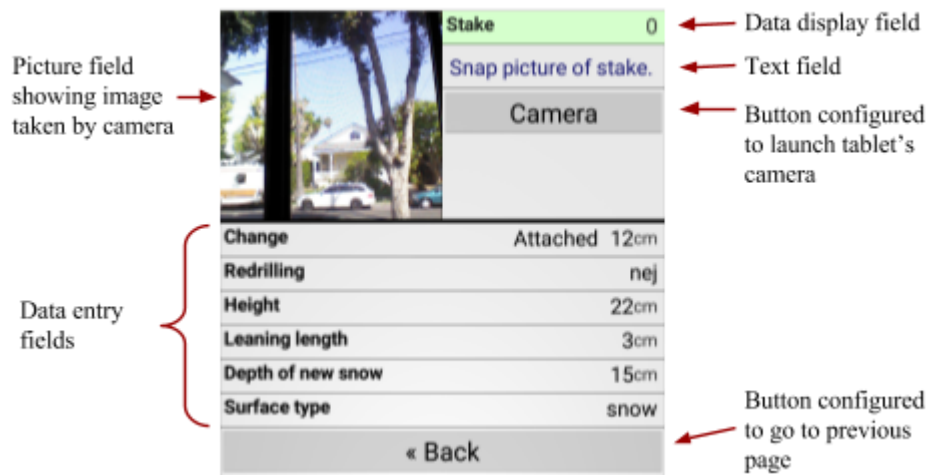


GIS objects from Esri’s ArcGIS or other GIS systems that can generate GeoJSON-formatted files can be imported and used in Field Pad and also, when exported from Field Pad be imported back into the systems that accept GeoJSON-formatted data.

2.3 Form Components

A data entry form is built up from a number of components. The components are arranged vertically on the page, top-to-bottom. Field Pad’s workflow engine knows, among others, the following components.

- Data entry fields – used to enter values for variables.
- Data display fields – used to display the value of an expression.
- Text blocks – display formatted text.
- Buttons – start an action, e.g., to validate the current form and return to the previous one, to go to next form, take a picture, get GPS position, or scan a barcode.
- Pictures – showing a static picture or a picture taken by the tablet’s camera.



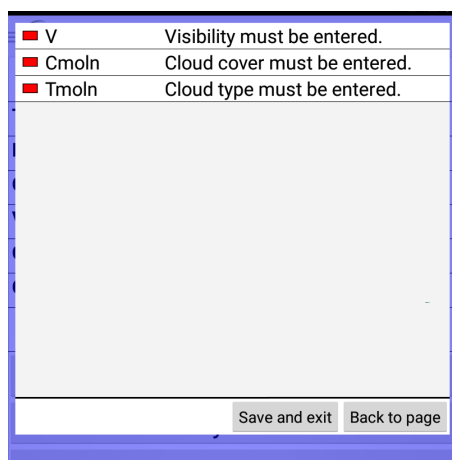
Above is a sample picture showing a form with a number of components.

2.4 Data Validation

Data is validated in several levels. In the variables list, the *Limits* field controls the data type and the numerical values or range and the *List* field contains the allowed answers for multiple choice data entry.

A second level of control is implicit by the construction of a dynamic form, in that the variables that appear in entry fields are controlled by the workflow. In this way, only data for relevant variables is collected.

A third form of validation can be done after a variable receives a value or, at the end, when the form is completed. The variable values can be checked against each other in arbitrary combinations. Rules contain a logical expression with one or more variables and an error text that appears in case the expression is false.



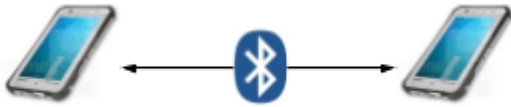
This picture shows what it looks like when rules post error notifications. In this case, alerting that three of the required variables have not been entered in the form.

The user can go back to the form and correct the errors or can decide to leave form "as is". In that case, the button that launched the form will have a red coloring indicating the error condition.

Higher-level rules can propagate the error conditions to the top.

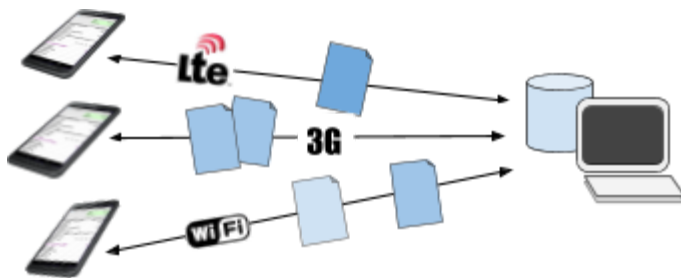
2.5 Synchronization

When collecting data, several people can cooperate on the same object or area. Whenever the users come within a few meters of each other, the tablets can exchange the collected data and completion status, so that both users can see the status of the other.



This synchronization uses a point-to-point Bluetooth protocol that is both power-efficient and does not require any external infrastructure. This allows the process to work when offline and internet access is not possible.

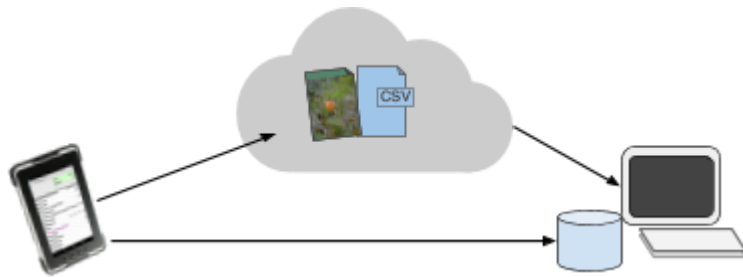
As an additional benefit, this functionality also allows backing-up to a secondary tablet or smartphone that a single user may carry. In this way, when in the field and far away from support, a broken tablet does not mean that work has to stop.



Field Pad can also synchronize data over internet via WiFi or cellular networks (2G/3G/4G). In this case a team of users can stay in sync. Both data and completion status is transmitted between the apps. A team manager in the field or at home can stay abreast of the inventory progress. As a safety precaution, the team members' positions are also shared and can be observed in the app.

2.6 Data Reporting

All data that is collected is stored in the Field Pad's internal database. The data can be exported from the app to be stored or post-processed. Field Pad currently supports these export formats – [csv](#), [JSON](#), [GeoJSON](#), and database. The exported data contains, besides the variable names and values, a timestamp indicating when the data was entered. If team and user names have been entered, they will also be listed on a per-variable basis. This allows for precise tracking of who entered what data and when.



To report data while in the field, the export folder contents can be synced to a cloud service or to a local WebDAV server. Third-party software exists that can automatically transfer the exported data to a receiving server as soon as there is internet connection. Data can also be exported to a SD-card for backup or manual transfer or mailed as an attachment to a pre-configured email address.

3 Configuration

Field Pad is fully configurable using a number of control files. When Field Pad starts up, it reads the files that control the appearance and content of the screen pages. The files define variables, multiple-choice values, variable groups, rendering instructions (workflows), and for GIS forms also maps to use when offline.

3.1 Variables

The variables used by Field Pad are defined in one, two, or three files:

1. A list of variables,
2. a list of groups and group members (species) that the variables can belong to, and
3. a list of multiple-choice values for selected variables.

These files are created using spreadsheets. This allows for an easy-to-use, single place for maintenance.

For simple data collection, and automatic form generation, only the first file is needed. To use species lists, the second file is also required. Finally, the third file is used for advanced multiple-choice value cases.

3.1.1 Configuration Using Variables

In the simplest example, a csv file¹ is created in a spreadsheet listing the variables of interest when collecting data in a stream. Each variable occupies one line and the lines contain the name, label, type, unit, description, and limits (for numerical values). Multiple-choice variables contain also the answer alternatives.

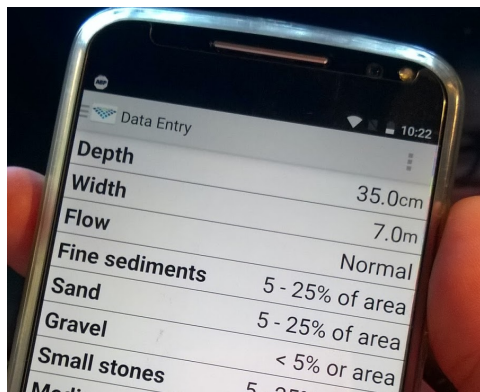
The variable depth has the label “Depth”, is of type number, and is measured in cm. Its description is “Depth of stream” and the range of values is 0 to 150. There are a few more fields, but these are left

¹ Comma or semicolon separated values.

for a more detailed description.

Version	0.001								
Key Chain	Group Name	Variable Name	Variable Label	Type	Unit	List Values	Description	Scope	Limits
år		depth	Depth	number	cm		Depth of stream	global_sync	0-150
år		width	Width	number	m		Width of stream	global_sync	0-20
år		flow	Flow	list		Extremely low Low Normal High Extremely high	Flow velocity	global_sync	
år	substrate	fineSediments	Fine sediments	list		{Missing=0}}{< 5% or area=1}}{5 - 25% of area=2}}{25 - 50% of area=3}}{50 - 75% of area=4}}{> 75% of area=5}	(< 0.2 mm)	global_sync	
år	substrate	sand	Sand	list		{Missing=0}}{< 5% or area=1}}{5 - 25% of area=2}}{25 - 50% of area=3}}{50 - 75% of area=4}}{> 75% of area=5}	(0.2-2 mm)	global_sync	
år	substrate	gravel	Gravel	list		{Missing=0}}{< 5% or area=1}}{5 - 25% of			

Starting with this Variables.csv file, the remaining control files are generated. Field Pad loads these when it starts up.



You are done!

3.1.2 Species Example

As a more general example, consider a group “moss”, with the members “creeping feather moss”, “icy rock moss”, and “spreading earth moss”, and the variables “coverage” and “moisture”, where moisture can have the pre-defined (multiple choice) values “dry”, “moist”, or “wet”.

Version	0.002								
Key Chain	Group Name	Variable Name	Variable Label	Type	Unit	List Values	Description	Scope	Limits
år	moss	moisture	Moisture	list		dry moist wet		global_sync	
år	moss	coverage	Coverage	number	m2			global_sync	

The above picture shows the first control file, listing variables. The Group Name, moss, references the second control file, list of groups. There the species belonging to the moss group are specified along with additional information used by the app:

version	0.02			
Member Label	Member Description	Group Name	Variable Name	Internet link
creeping feather-moss	Amblystegium serpens	moss	creepingFeather	https://en.wikipedia.org/wiki/Amblystegium
icy rockmoss	Andreaea frigida	moss	icyRockMoss	https://en.wikipedia.org/wiki/Andreaea_frigida
spreading earth moss	Physcomitrella patens	moss	spreadingEarthMoss	https://en.wikipedia.org/wiki/Physcomitrella

These two kinds of control files – variables and groups – can be used to either collect observations of

the species, i.e., enter any number of data points, or to enter existence of species in an area, i.e., one data entry per species found.

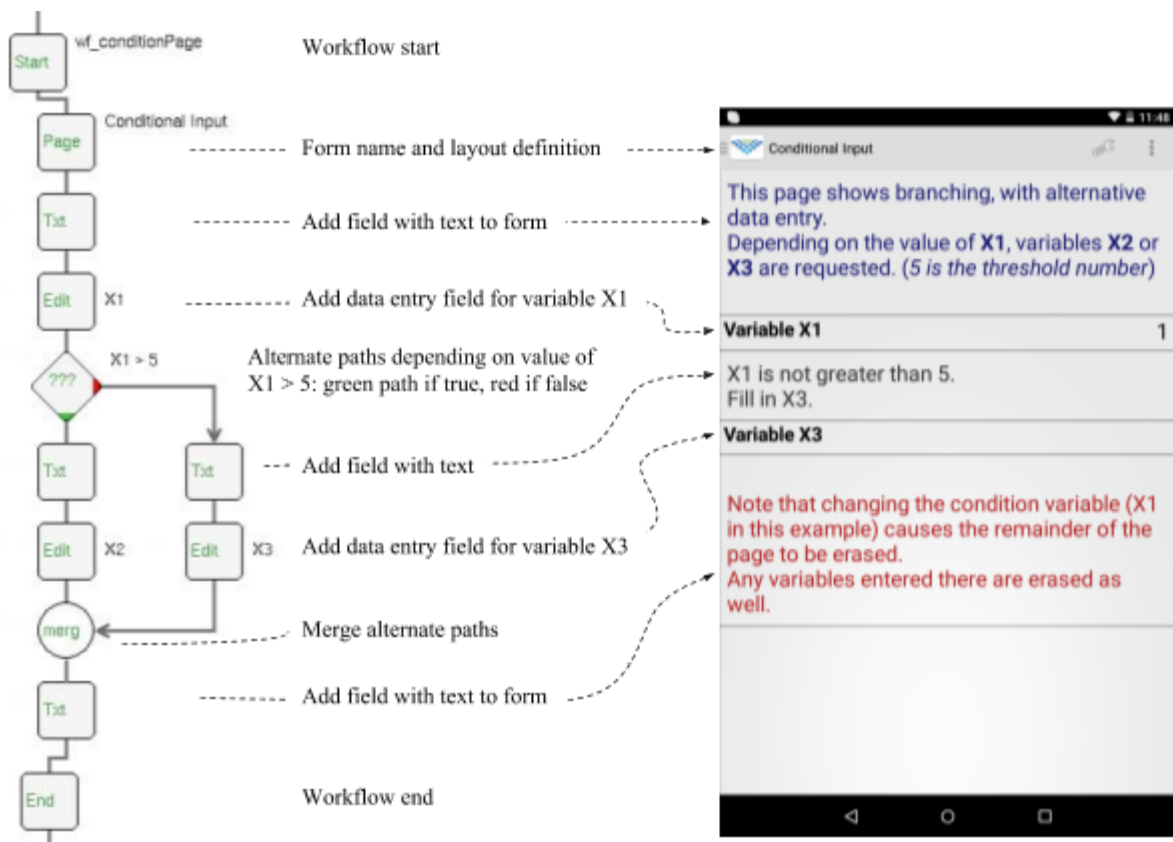
3.2 Workflows

Workflows contain instructions for Field Pad’s workflow engine – instructions for setting screen layout, drawing data entry or display fields, or running data validation rules.

For simple data collection forms, the workflow can be auto-generated from the variable list. For more complex forms or for GIS-based data collection, the workflow file has to be created manually. The idea is that anybody with basic knowledge of XML can use the app’s block language to write a workflow.

The figure below shows the blocks of a workflow on the left and resulting form on the right. While the instructions are encoded as XML sequences, the figure illustrates these in a graphical format. Note that the workflows can contain optional parts and alternate paths for UI content generation.

In this example, the Page block selects a simple linear page layout and assigns it the name “Conditional Input”. The subsequent blocks add components to the page. The picture on the right shows what the screen looks like after data has been entered for the variable X1.

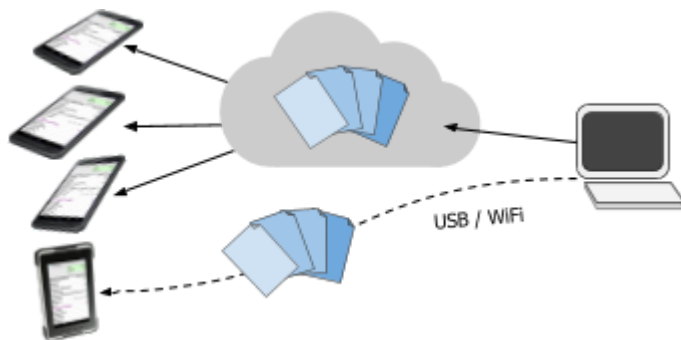


Note that, in the form, the workflow initially stopped at the condition block (???), requiring the variable X1 to have a value. Once the value 1 was entered, the condition could be evaluated and the correct (right) workflow path could be chosen. The screen was captured at that time.

3.3 Centralised Deployment Management

The control files, that configure Field Pad, can be transferred to the tablets in several ways. For small, single-tablet deployments, the control files can be copied to the tablet over a USB cable or WiFi.

For group deployment, the control files can be stored on a server reachable via the internet. When Field Pad reads the files, it stores them in an internal format on the tablet. After that, internet access is not required. However, each time the app starts, it will try to check for new versions of the files. In this way, the configuration of all tablets in the field can be managed centrally.



Coincidentally, the tablets can also deliver the collected data at these times. So, while 100% on-line access to internet is by no means required, periodic access is useful.

4 Next Steps

Read the [Getting Started](#) document. Download Field Pad from Google Play Store and try out some example applications. Check out our sample configuration files. Modify them to suit your data collection needs. Run on your Android tablet or smartphone.

Of course, while you can configure Field Pad according to your data collection needs, we can also help you with this, working from your paper forms or other design documents.

We can also help with even more specialised requirements. Want to collect data via a bluetooth-connected device? We'll fix it. Want a page with custom look or functions? We'll add it. Want to export data to your exotic data warehouse or import the phase of the moon from some web source? ... well, you've got the picture.

Contact us at info@teraim.com.

Happy data collection!