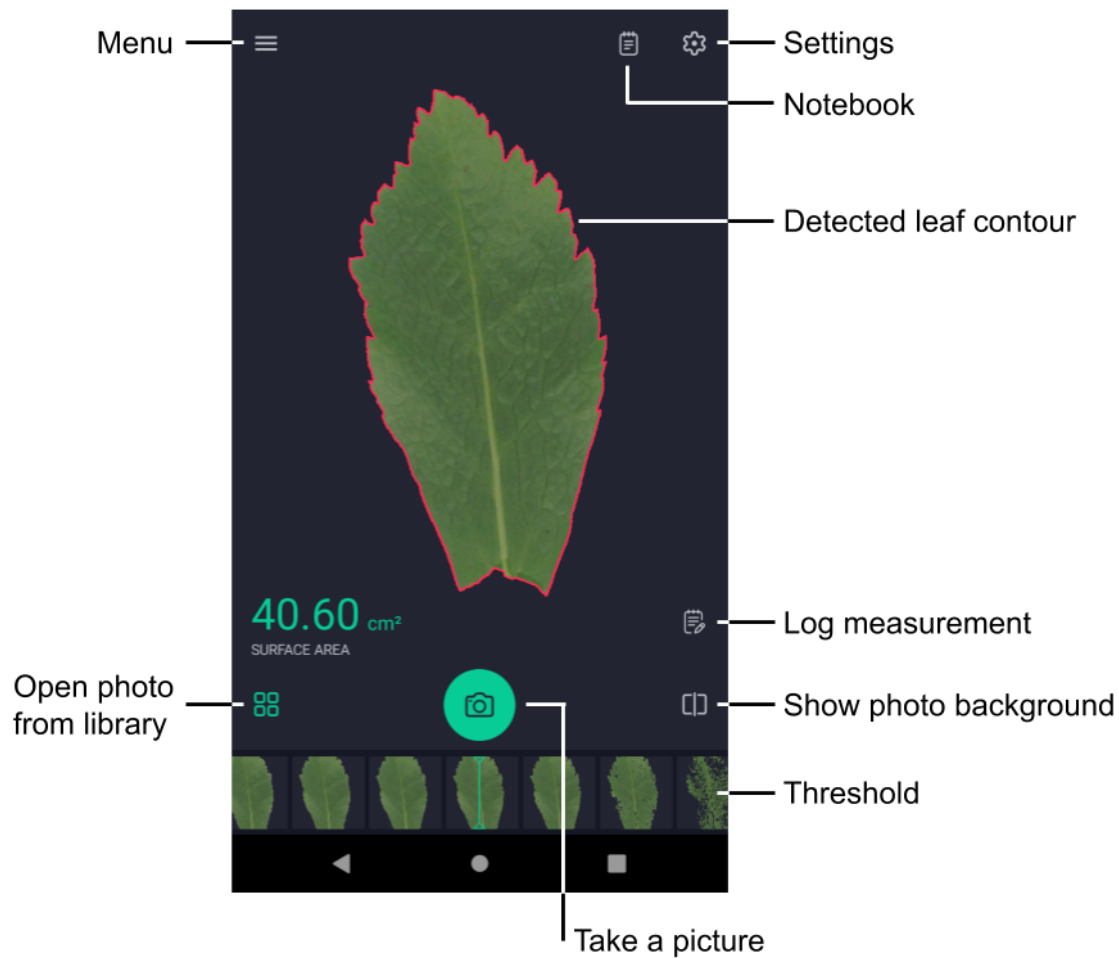# Leafscan
User Guide

Release version 2.1.0

August 30, 2020

Overview

Leafscan is a mobile app that measures the area of a leaf (or leaves) from a picture. It lets you take a picture with your mobile device or load one from your photo library. Leafscan helps you keep track of your measurements and export them as a CSV file.
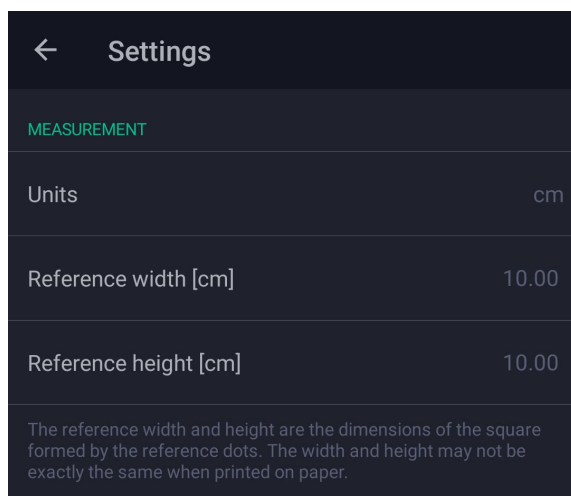
Additional features:

- Measure multiple leaves (one at a time) in one photo
- Automatically correct for pictures taken at an angle
- Adjust the detection threshold for better accuracy
- Include or exclude leaf holes
- Customize the measurement units (mm, cm, or in)
- Summarize leaf area statistics

Set up the leaf

Obtain the reference sheet. In order to determine the scale of the photo and correct for the perspective, Leafscan uses four *reference points* arranged in a square on a white background. The last page in this document contains reference points you can use.

Enter the reference width and height. Measure the width and height of the square formed by the reference points. There's usually a small difference between the width and height when the points are printed on paper. It's easier to measure the distance between the edges of the points than between the centers. Enter these values in the app's settings.

← Settings	
MEASUREMENT	
Units	cm
Reference width [cm]	10.00
Reference height [cm]	10.00
The reference width and height are the dimensions of the square formed by the reference dots. The width and height may not be exactly the same when printed on paper.	

> **Note.** Even though the default reference width and height is 10 cm, you should always measure them yourself after printing the reference sheet. The actual reference width and height are often affected by different paper sizes and printer settings.

Position the leaf. Place the leaf (or leaves) you want to analyze on the white reference sheet, preferably within the reference points. To avoid shadows, flatten the leaf using a clear, non-glare acrylic sheet.

Set up the leaf nondestructively. If the leaf you want to measure is attached to the plant, it may be best to clamp a clear plastic cover over the leaf and background. Use a thick base, such as a clipboard.

Take a picture and measure leaf area

Take a picture. Tap the camera button and position the phone to take a good picture. All four reference points must be visible. Steady the camera and take a picture.

Measure the area. After taking a picture, a thin, red contour appears around the detected leaf. If no contour appears, tap on a leaf. Leaf holes are shown with purple contours. Below the leaf, the calculated area is displayed.

Improve leaf detection. The leaf should have a good contrast against the white background. Avoid angles where the leaf shines and try to exclude background objects. If the app can't detect all four reference markers, you'll need to take another picture. If the contour is wrong or the leaf is not detected at all, you can adjust the detection threshold (see below).

Measure multiple leaves. If your picture has multiple leaves, tap on the leaf you want to analyze. Its area will be displayed.

Load an existing photo. Tap ⊞ and choose a photo.
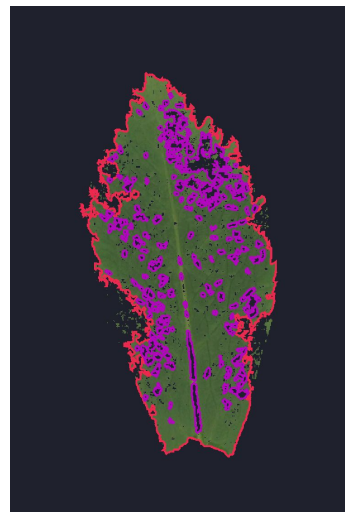
Adjust the detection threshold

If the leaf contour doesn't wrap the leaf correctly, adjust the detection threshold. Drag the thumbnail photos at the bottom of the app to the left or right. As you change the threshold, the leaf contour is updated and a new area measurement is displayed.
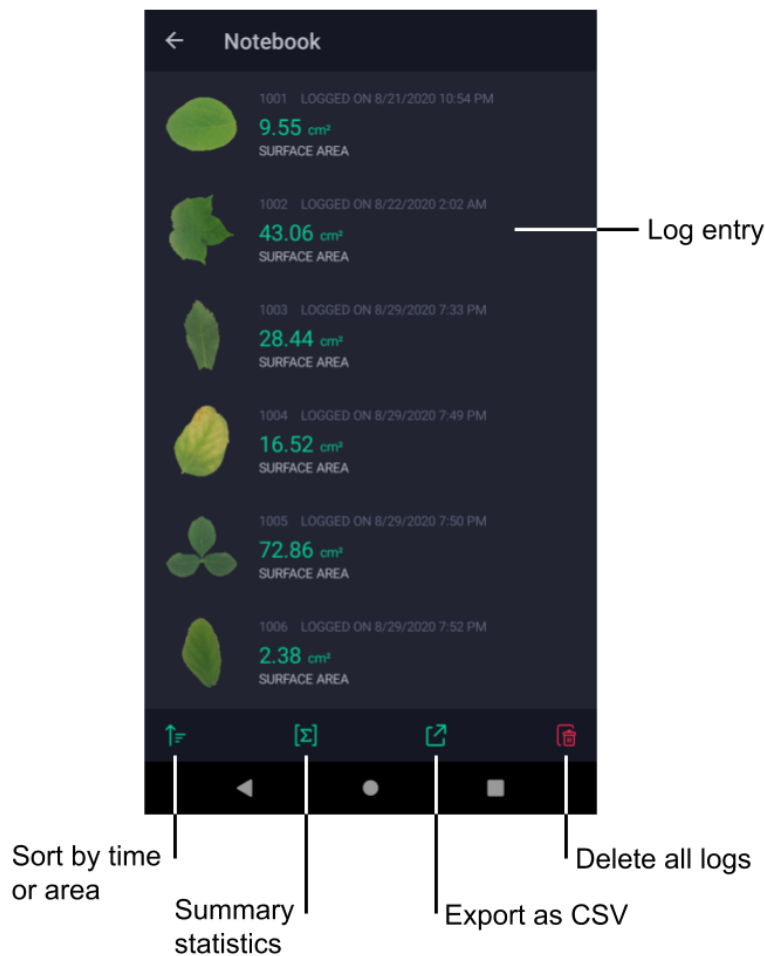

Bad   **Good**   **Bad**

Log area measurements

Log the area. Tap ⊟ to log the current leaf area to the notebook. The log icon changes to ⊠ to indicate that the area was logged.

Show the notebook. Tap ⊟ to show the notebook containing a list of all the areas logged. Each log entry has a Leaf ID, which is automatically incremented after an area is logged. Each entry also shows the timestamp, a small image of the leaf, and the surface area.

Sort by time or area

Summary statistics

Export as CSV

Delete all logs

Sort log entries. Tap ⇡≡ to sort log entries. Choose the property to sort by (timestamp or surface area) and sort order (ascending or descending).

Calculate summary statistics. Tap [Σ] to calculate and show the summary statistics of all the logged leaf areas. Statistics include the count, sum, average, minimum, and maximum.

Export log entries as a CSV file. Tap ⬈ to export all log entries as a CSV file. Enter the optional file name (the default is "leafscan.csv"), and then choose the app with which to export (for example, Gmail or Drive).

Delete log entries. To delete a single log entry, swipe the row to the left and then tap 🗑 and confirm. To delete all log entries, tap 🗑 and confirm by typing "delete". Deleting log entries, whether one or all, cannot be undone.

Settings

Change the units of measurement. Tap on the Units option and choose mm, cm, or in. All measures (area and length) will be automatically converted to the chosen units.

Specify the reference width and length. The reference width and length are the width and length of the square formed by the reference points. It is very important to enter these values in the Settings page before making any measurements of leaf areas. The reason both width and height must be entered is that there's usually a small difference between them when the points are printed on paper.

Change the size of the photo. The photo, whether it's taken with the camera or opened from your library, may be loaded at its original size, half size, or quarter size. If the app feels sluggish with photos at their original size, try loading them at a smaller size.

Ignore leaf holes. The area inside leaf holes is, by default, not included in the surface area of the leaf. Detected leaf holes are shown with purple contours. If you don't want to account for leaf holes, turn on the "Ignore leaf holes" option, which will include the total hole area in the surface area.

Typically, you don't want to ignore leaf holes. But if there's a region within the leaf that is incorrectly detected as a hole (for example, a bright region on the leaf), then you may want to temporarily ignore the leaf holes.