Rotational Speed Sensor Installation and Calibration

1. Package Contents

A single rotational speed (rotations per minute, RPM) sensor package includes:

- 1 Arch Systems® Pod 1-G (battery included),
- 1 sensor armature assembly (with 3extra reed switches),
- 1 permanent, neodymium magnets

Supplies needed that are not provided:

- Phillips head screwdriver or nails
- Small flathead screwdriver or hammer
- Superglue
- Hanging scale and bucket with handle
- Smartphone
- Stopwatch
- Measuring tape

This document provides instruction and methods to install the rotational speed sensor package and background knowledge on package function. The sensor package is a standalone system and is powered solely by the provided by the internal batteries. Data that is logged to the Arch Pod is stored internally until the data are retrieved via smartphone and Bluetooth.

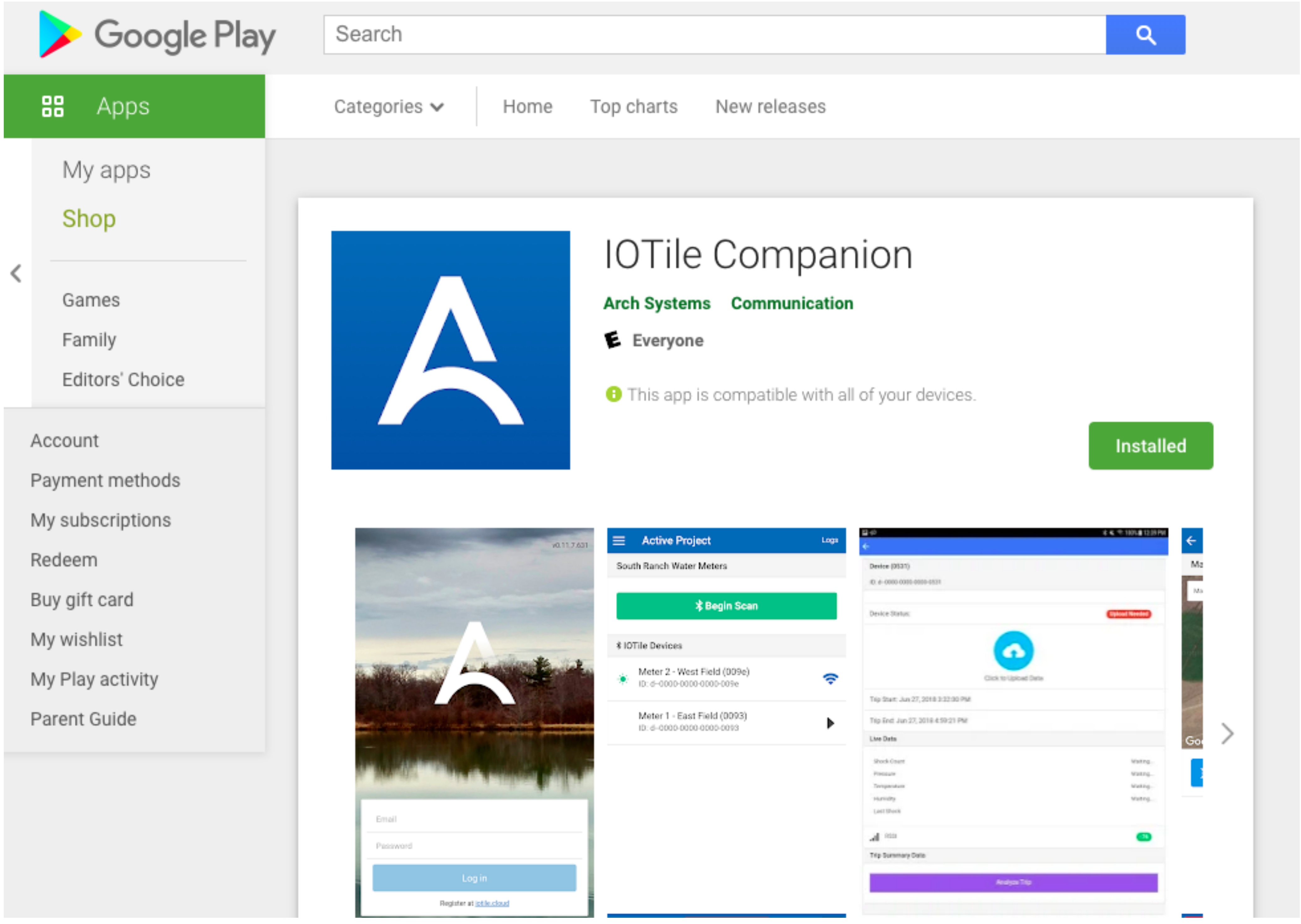
The sensor monitors activity by counting the number of times the magnet passes by the sensor head. One use-application is using the action to record rotations per minute of a pulley wheel of a grain mill.

2. Mounting the Sensor

The RPM sensor must be mounted securely to prevent damage to the device and to help ensure reliability in the data that is collected. Mounting the device to the ground is recommended, rather than mounting to machine elements that may move or vibrate. Mounting to wooden pallets upon which the machine also sits can cause extreme vibrations and cause issues for the sensor armature. Mounting to a poured cement block or the ground itself (via screws or stakes, respectively) may produce better long-term results.

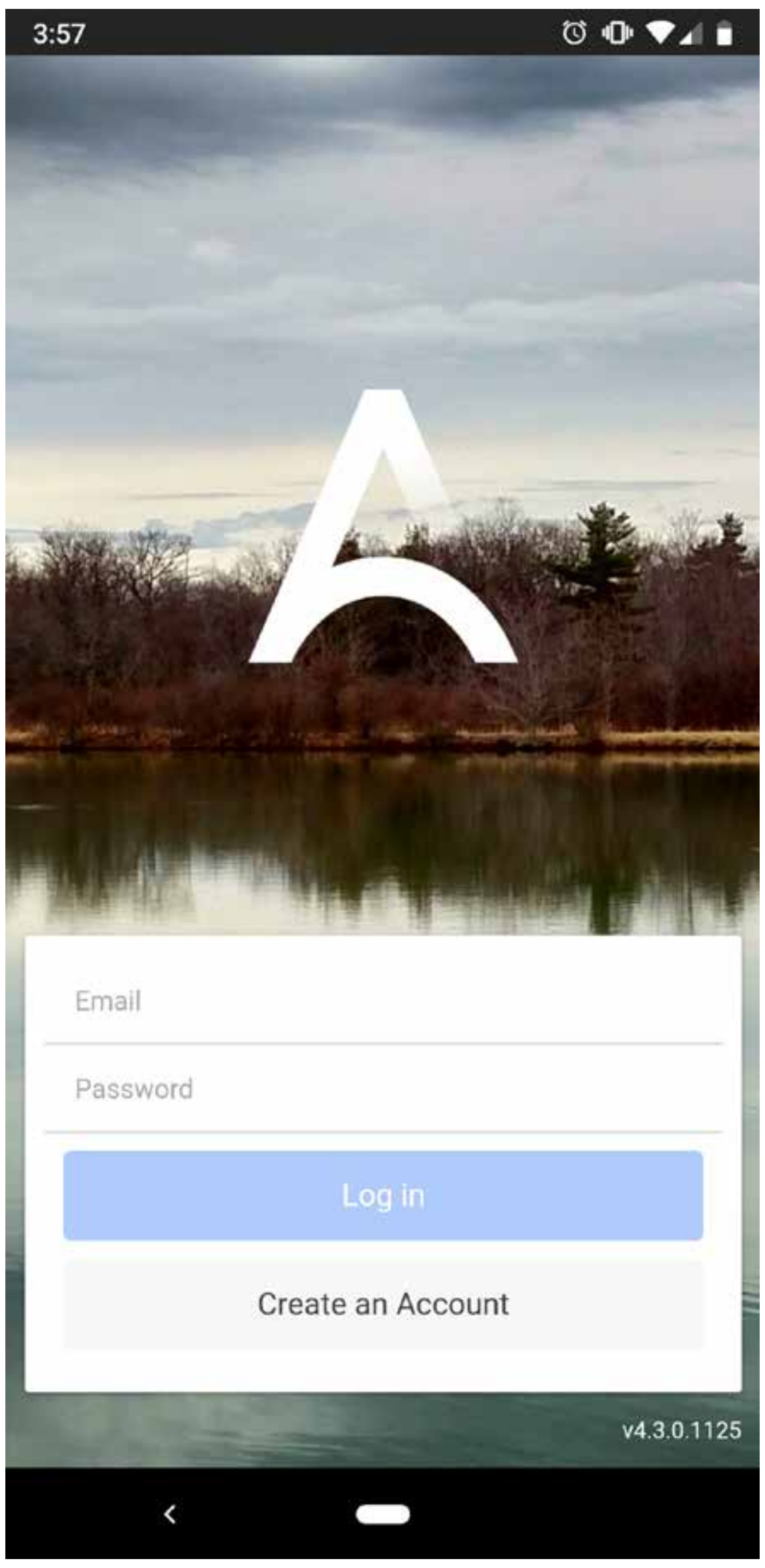
3. Calibrating the Sensor using IOTile Companion App

You talk to the Arch Pod by using the Arch smartphone app called “IOTile Companion”. Search and download the “IOTile Companion” app, available for both Android and iOS

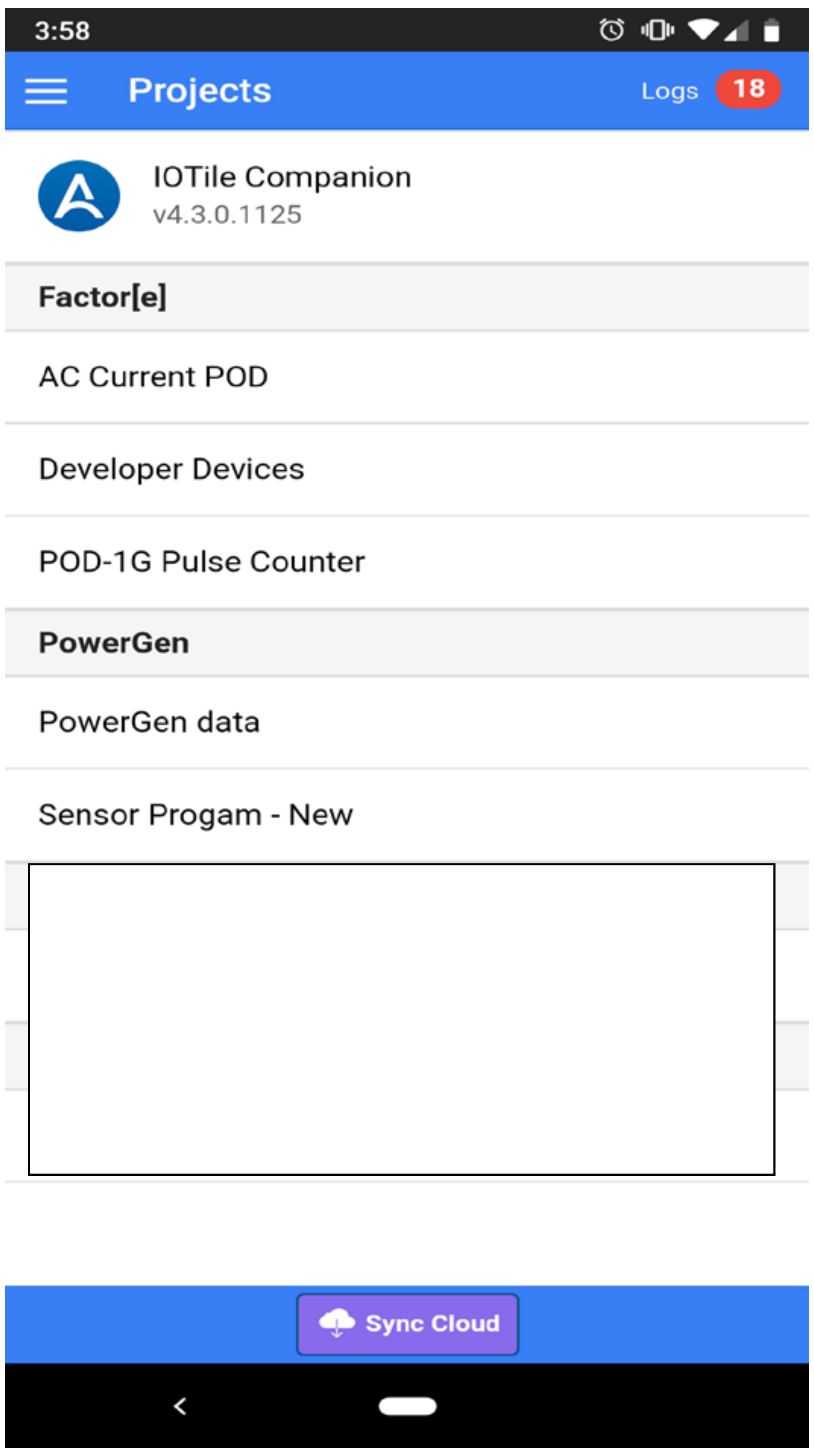


2. Calibrating the Sensor (continued)

When you open the app for the first time, you will need to log in with a username and password provided by an administrator. <u>You will need a data connection every time you log in</u>.

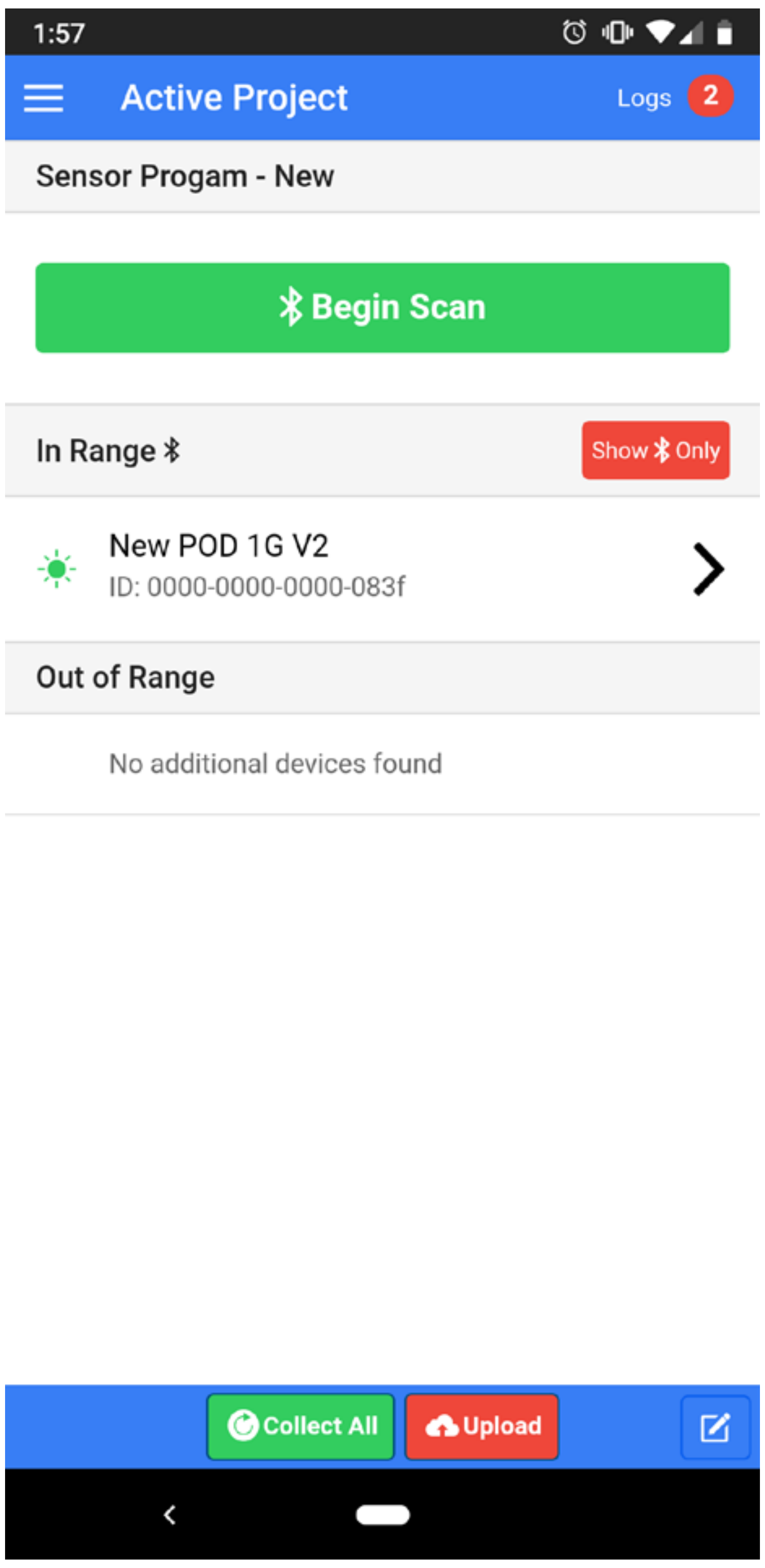


When you seen the “Projects” home screen, select the program you would like to work in.

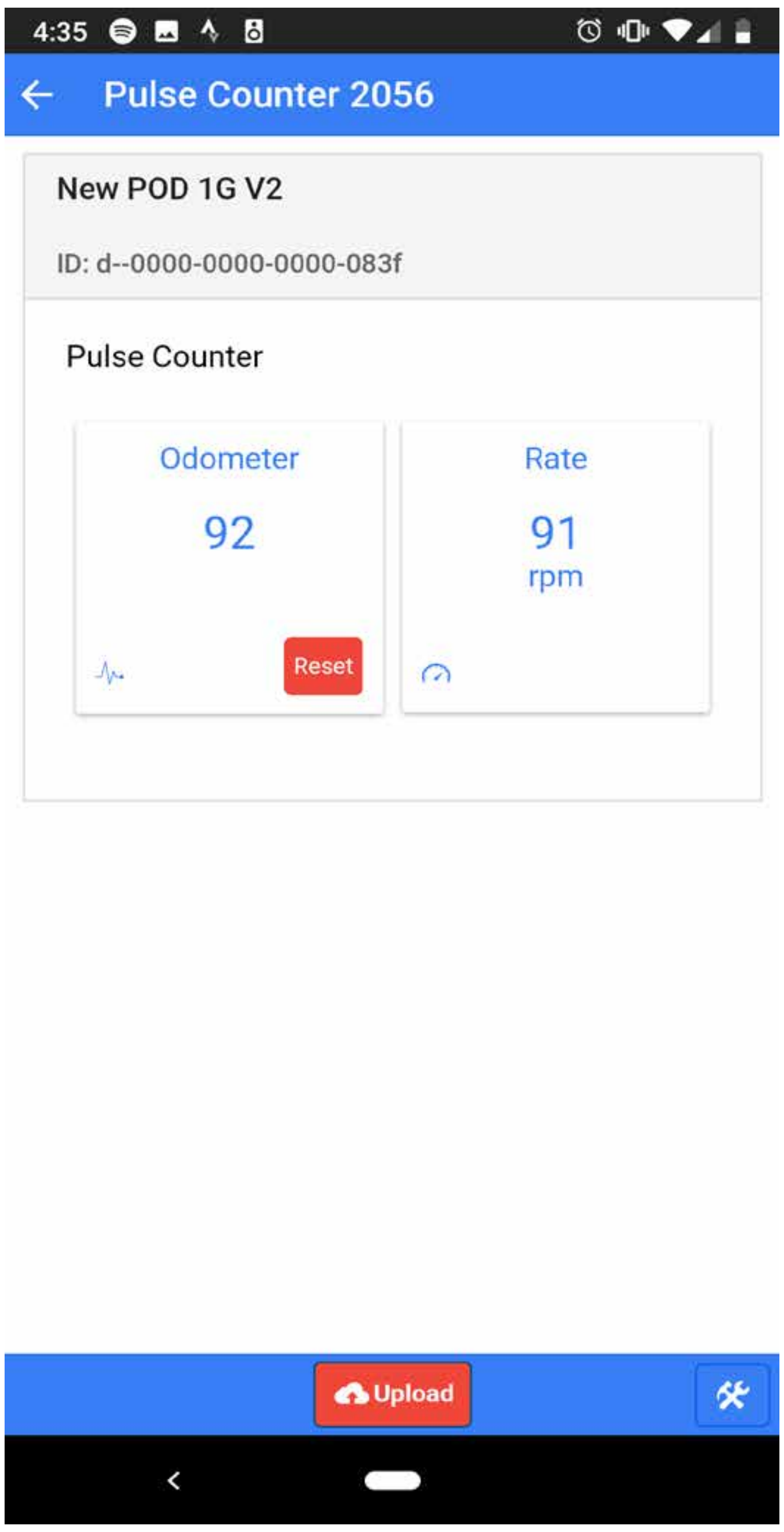


2. Calibrating the Sensor (continued)

Make sure your Bluetooth is on and the Arch battery is plugged in. You should see the Pod show up in your list of available devices.



After selecting the active sensor you should be able to see a live screen of showing counts for “odometer” and “rate”.



Odometer = counts
Rate = revolutions per minute

Test the sensor counting function by slowly passing the magnet by the sensor head. The goal is to have the live Odometer increase by just one count every time the magnet passes by the sensor.

If this is the result you get, the system is calibrated. If the live display shows multiple counts for each pass (usually 2 but could also be less than 1), you will need to modify the sensor settings.

2. Calibrating the Sensor (continued)

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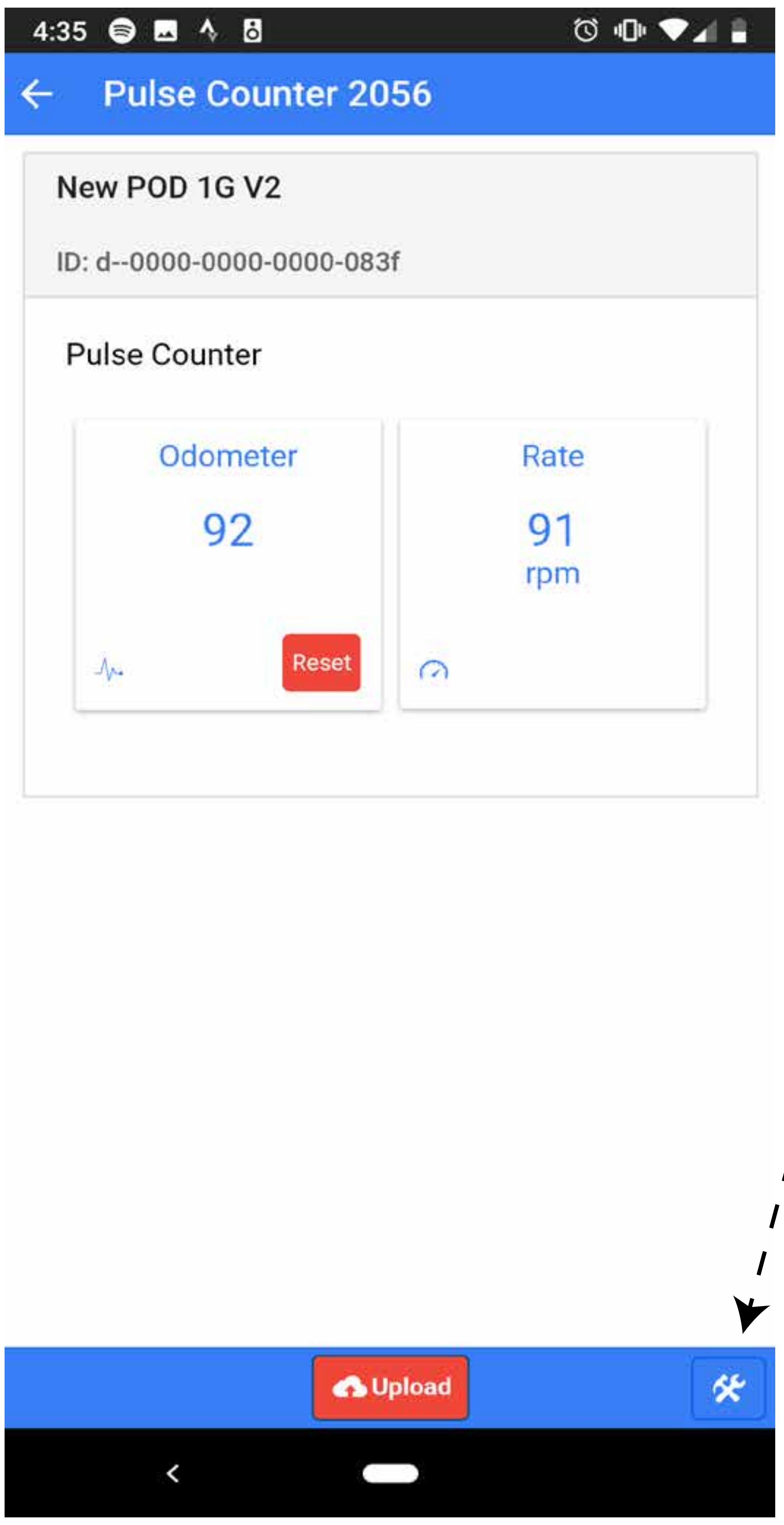
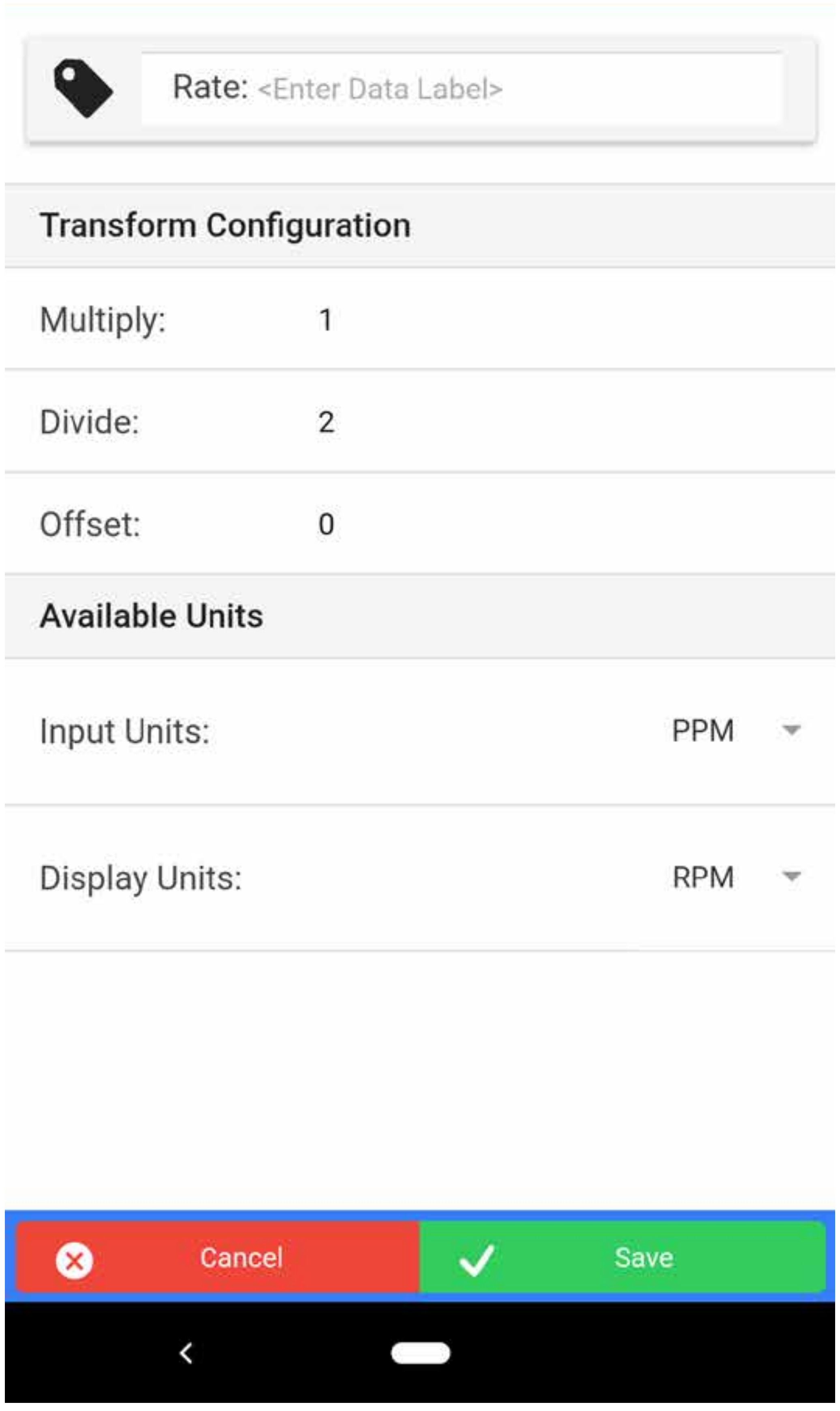
Tap the Tools icon in the bottom right hand corner.



For both Odometer and RPM (Counts and Rate), you will need to adjust the values in either Multiply or Divide. If the sensor records two counts for one pass, make the Divide value 2.



If the sensor doesn't appear to record a count for one pass of the magnet, try reducing the Divide value to 1.

If not already setup, you may change the Display Units as RPM. (Input units will be recorded as PPM - pulses per minute - and cannot be changed.)

Hit the Save button when you are finished.

Confirm that this change results in just one count for each pass of the magnet.

3. Collecting Data and Uploading to the Cloud
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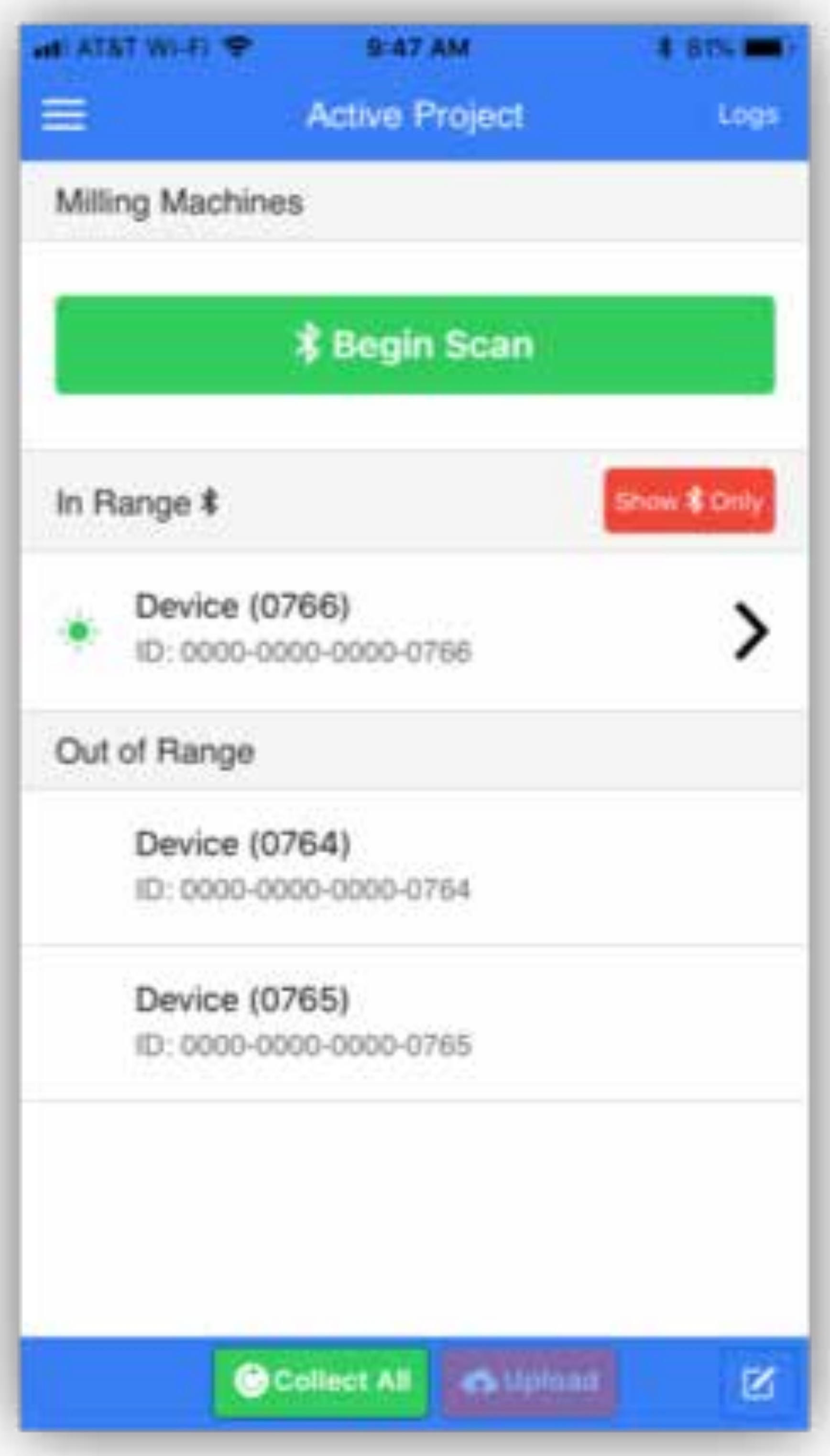
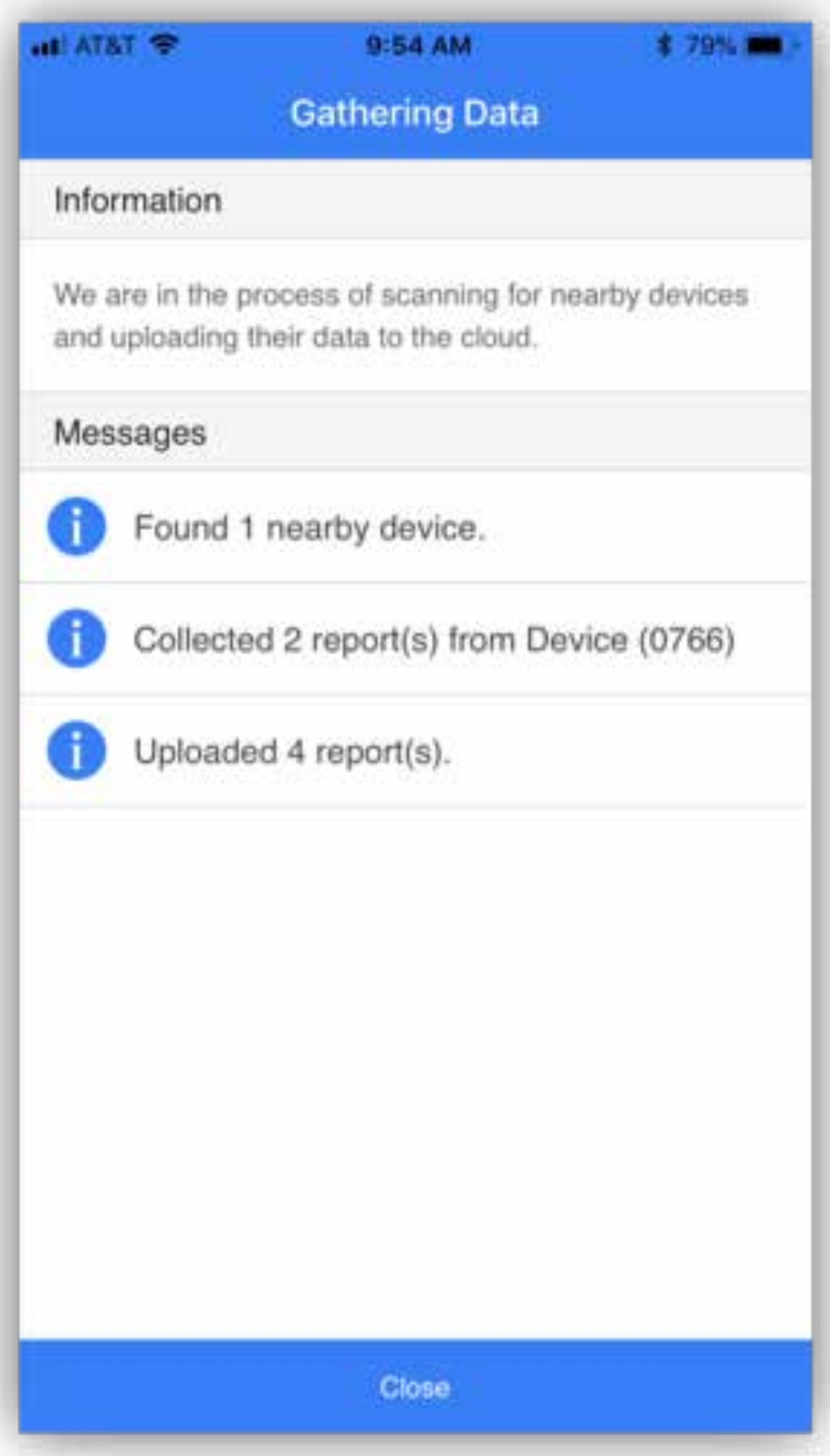
Once a sensor is selected, all the data stored in its local memory will be read by the IOTile app. This may take a few moments.

If cellular connection is available, the next step is to upload this data to the IOTile Cloud servers. This is done by selecting the "Upload" button. Allow the uploading process to complete.

If cellular connection is not available, collect data locally using the collect all function shown to the left. After arriving in an area with connection or wifi, select the upload key to upload all stored data to the cloud.





That's it! You may collect and upload data as many times as you like; the Arch webapp will make sure that all the data are sorted on the back end.

4. Other Data Collection for Successful Productive Use Estimation

Throughput for Grain Mills

Throughput, or the amount of material processed by a machine in a given time, can be determined using a hanging scale with a bucket and a stopwatch. Example throughput units could be grams per second, grams per minute, or kilograms per hour. Steps to record throughput after the sensor package is installed are below.

1. Record the empty mass of the bucket using a hanging scale
2. Turn on the machine and let it run for at least 2 minutes at a constant speed. Running for at least 2 minutes will ensure the RPM value shown by the app is the stabilized value for rotational speed.
3. Record the RPM value from the Arch companion app.
4. Simultaneously start a stopwatch and insert a bucket to receive processed material from the mill. Once the bucket is half to ¾ full, simultaneously remove the bucket and stop the stopwatch.
5. Record the mass of the filled bucket using a hanging scale and
6. Record the time elapsed. (Recommended 5 minute test.)
7. From local interviews, record the average sale price for 1kg of milled product.

The weight of cereal milled and the price can help a microgrid developer understand the economic gain a machine operator will realize.

4. Other Data Collection for Successful Productive Use Estimation (continued)

Fuel Consumption

Fuel consumption of a diesel engine that drives a machine is an important indicator of the energy required to perform that machine's function. Rough volumetric fuel consumption can be determined using fuel reservoir geometric and dipstick level measurements. (This method has not yet been tested.)

1. Measure and record the dimensions of either the main or ancillary fuel tank. Whichever is more accessible.
2. Before - Insert a dry, clean dipstick into the fuel tank. Remove the dipstick, measure the length of the wetted portion of the dipstick and record the value.
3. Simultaneously start the engine and a stopwatch. Run the engine for a set amount of time and record the run time.
4. After - Insert a dry, clean dipstick into the fuel tank to the same depth as initially inserted. Remove the dipstick, measure the length of the wetted portion of the dipstick and record the value.
5. Subtracting the after measurement from the before measurement and using the appropriate volume equation based on tank geometry – will result in a volumetric value of fuel consumed over a set period of time.
6. Inquire about the local price per liter of diesel fuel.

Surveying diesel engine owners about how much diesel they buy and how often may be another tactic to determine spending habits of that machine owner, but results may not necessarily accurate.