



## A. Overview

Sensor Data allows you to investigate hardware sensors that are present on your device, while simultaneously recording these sensors. Sensors supported include accelerometers, gyroscopes, magnetometers, pressure, proximity, light, humidity, and/or temperature. Furthermore, composite sensors such as rotation vectors, gravity, linear acceleration, and uncalibrated sensors can be recorded and saved.

If data is saved, post-processing can be performed through the use of power spectral analysis, re-sampling, interpolation, or filtering techniques.

## B. Installation

Sensor Data is an Android app which can be installed via the Google Play Store:

<https://play.google.com/store/apps/details?id=com.matlabgeeks.gaitanalyzer>

Currently, Sensor Data can only be found for Android. Android versions 4.1 and newer (API 16+) are supported.

### i. Permissions

The application requires two permissions in order to work to its full extent. On installation, you will be asked to approve and confirm the following:

1. Write External Storage – This permission permits saving of raw sensor data locally to a tab-delimited file.
2. Get Accounts – This permission allows for the saving of your phone’s sensor data to your Google Drive account.

## C. User Information

The Sensor Data app requests no user information, with no PHI is collected or stored. No identifiable information will be requested, stored or used in any way.

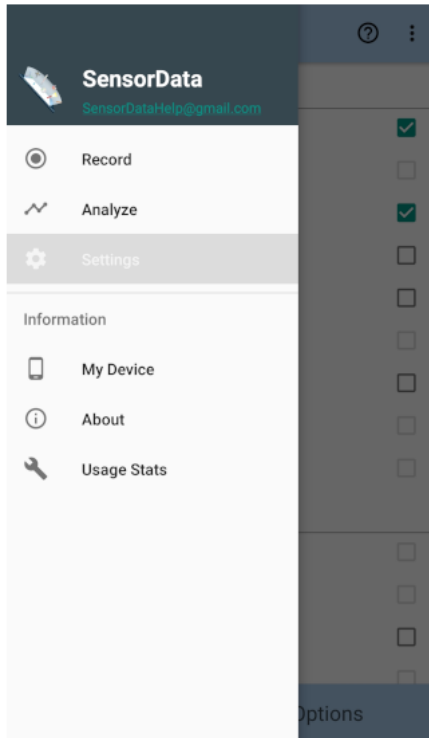
For additional information please don’t hesitate to contact us or browse our privacy policy:

<https://www.gaitanalyzer.com/privacy-policy>

## D. Navigation Drawer

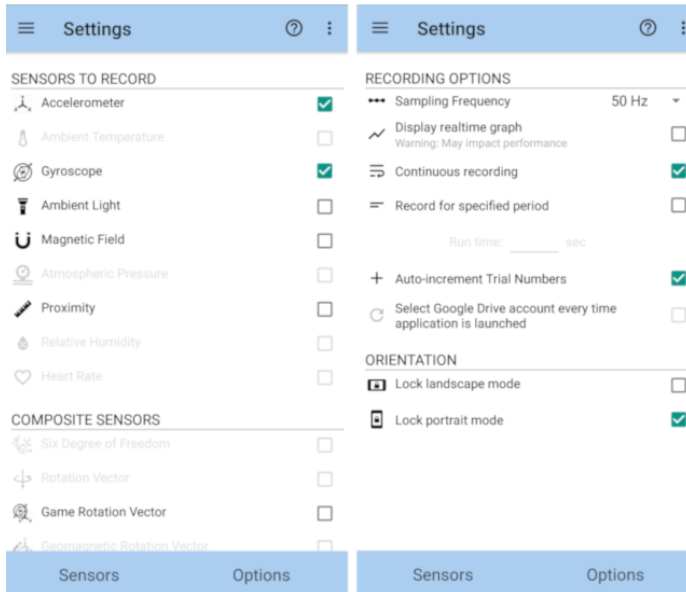
In order to navigate through the app, click the three bars found at the top left or right swipe from the left side of the device.





### E. Settings

On first launch, in the settings, please select the sensors you would like to collect from. If the sensor is present on the phone it will be enabled and in bold. If not, the sensor will be greyed out.





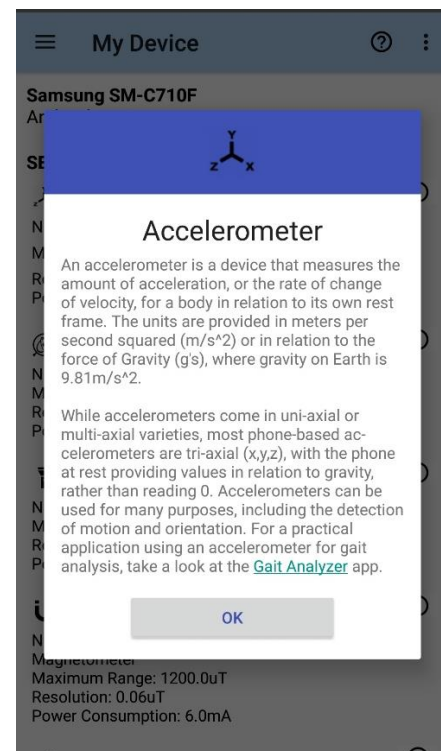
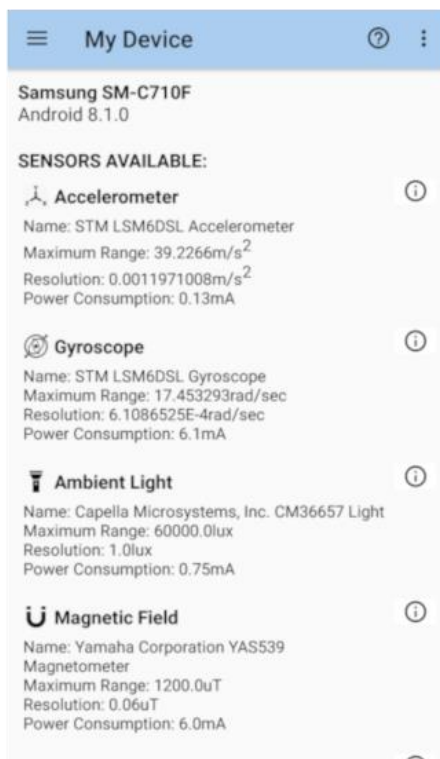
You can also configure your options by selecting the “Options” tab. Options include the sampling frequency requested for each sensor, displaying a real-time graph of the sensor data, recording until manually stopped (Continuous recording), recording for a specified number of seconds, and setting the orientation of the phone.

NOTE: Selecting the real-time graph can slow down your device and result in the app crashing if you are recording for long periods of time, have selected a large number of sensors, and/or you have a high sampling frequency selected.

## F. My Device

On this screen you can investigate the sensors found on your device.

By clicking on the information icons, you will be presented with additional information for each sensor:



## G. Recording

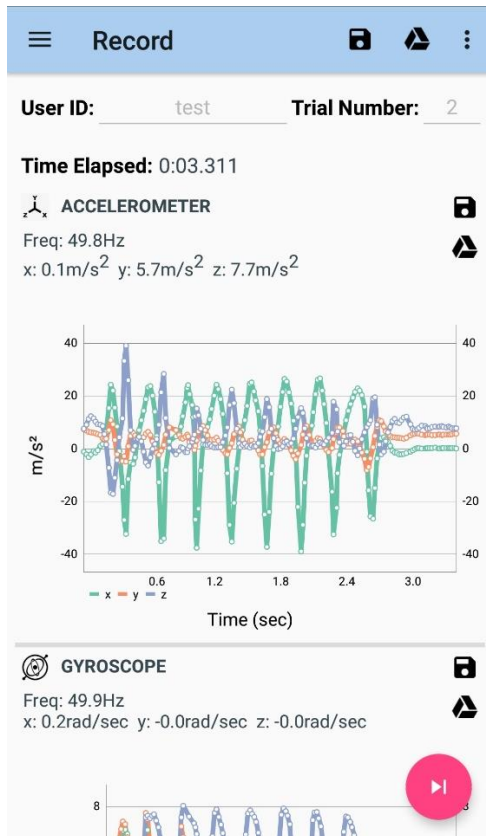
Enter a user id and trial number, and click record when ready:



When your trial is complete click stop (or wait for trial to automatically stop if in specified period recording):





After the recording is stopped, you will be presented with a graphical view of each sensor, along with options for saving:



## H. Saving

NOTE: While all other features are free, saving the data to a txt file locally and/or to Google Drive requires an in-app purchase.

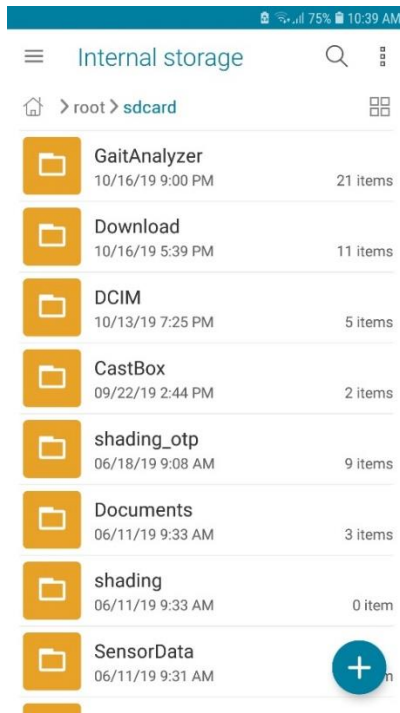
Upon completion (after the recording is stopped), you will be presented with the raw sensor data for each sensor selected.

Currently, you are able to save computed gait and cognitive data to the phone locally  as a tab-delimited txt file or to Google Drive  (requires internet connectivity), by clicking on the respective save icons for each sensor.

You can also “Save All” sensors with a single click on these same icons on the toolbar at the top.

### i. Saving locally

Data will be saved to your /Sensor Data/ folder on the phone. To find your outcome file(s) consider installing a file manager app on your phone if you do not already have one:



**ii. Saving to Google Drive**

The first time clicking save, you will be prompted to choose your Google account to use. All data will be saved into a Google Drive titled “SensorData”.

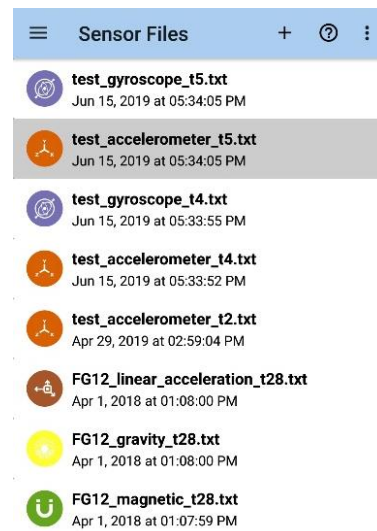
**iii. Don't save**

If you would like to continue to the next trial, click the next trial button:



**I. Analyzing Data**

Select the “Analyze” option in the navigation tab. You will be presented with a list of sensor files that have been saved locally:





Select your file of interest. If you would like to upload different data files from other locations, click on the + symbol at the top right.

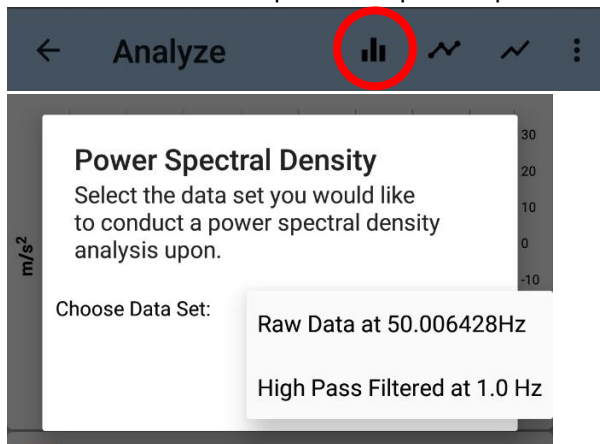
Note: at this point only raw data collected from the applications Sensor Data or Gait Analyzer can be parsed appropriately. If you have additional data files you would like to have supported, please contact me.



At this point you will be presented with a graph of the raw data, and a few analysis options.

i. Power Spectral Density

Select the first icon to perform a power spectral density analysis.



The power spectral density (PSD) is obtained from a Fast Fourier Transform, based on the techniques described by Mathworks (<https://www.mathworks.com/help/signal/ug/power-spectral-density-estimates-using-fft.html>). As the signals obtained are real-valued, only the power estimates of the positive frequencies will be returned.

Note: As a test of the frequency analysis, try to perform a PSD on raw acceleration data and on high-pass filtered data. You should see different values at 0Hz for these two analyses.



ii. Cubic Interpolation

Select the middle icon to perform cubic interpolation.



**Cubic Interpolation**  
Enter the new frequency at which you would like to re-sample the data.

Note: Implements a cubic Hermite spline interpolation.

Choose Data Set: Raw Da.. ▾

Re-sampling Freq (Hz):

CANCEL OK

The interpolation will create (or remove) data points, while generating a new sample which has equally spaced data points at the given re-sampling frequency.

NOTE: As smartphones have several processes being performed in the background, your raw data will be collected at approximately the sampling frequency (sf), but each data point is not necessarily collected at 1/sf intervals. Thus, performing an interpolation can give equally spaced data points.

iii. Butterworth Filtering

You can perform Butterworth filtering by selecting the third graph icon:



**Butterworth Filter**  
Enter options:

Note: Utilizes a zero phase-lag filter

Choose Data Set: Raw Da.. ▾

Filter Type: low pass ▾

Filter Order:

Cutoff Frequency 1 (Hz):

Cutoff Frequency 2 (Hz):

CANCEL OK



Options include

- 1) a lowpass filter (where frequencies below a given cutoff frequency are retained)
- 2) a high pass filter (where frequencies above a given cutoff frequency are retained)
- 3) a band pass filter (frequencies between two given cutoff frequencies retained)
- 4) or a stop band filter (frequencies between two given cutoff frequencies are removed).

The filter order can also be specified (with lower orders having more gradual roll off, and higher orders providing a steeper cutoff).

## **J. Troubleshooting**

While all attempts to remove errors/bugs have been made, some might have slipped our notice. If you happen to see an error, please let us know, and we will attempt a hotfix ASAP.

In case of error, please close other applications, and restart the Sensor Data app.

Common Issues:

1) The Application runs slow during data recording

- **Resolution:** Modify your recording options to include a smaller number of sensors, reduce the sampling frequency, and/or disable real-time graphing of results.

2) Data analysis is running slow.

- **Resolution:** This might occur if the data set that you are analyzing is very large (> 120 seconds at 100Hz for example). It might be best for larger data sets to perform your analysis offline, in something like MATLAB or Python for example.

## **K. Contact Us**

The best way to contact us is via email at [SensorDataHelp@gmail.com](mailto:SensorDataHelp@gmail.com).

We welcome any suggestions, bug reports, or additions you would like to see to the application.

If you are satisfied with the product, please also consider sharing the application with your colleagues and/or leave a review or rating at:

<https://play.google.com/store/apps/details?id=com.matlabgeeks.gaitanalyzer>