

AP-Sensor User Guide

Secondary school science laboratory utilizing smart phones as detectors:
Physics experimental apps for flipped classroom learning

1. Overview

- Vision: Make physical measurements mobile and easily accessible
- Use built-in physical detectors in mobile devices (e.g. smartphones, tablets) to make physical measurements
- Encourage students to make observations to daily environment
- Encourage teachers to co-create experiments together with students
- Developed by Department of Applied Physics, the Hong Kong Polytechnic University
- Currently only have Android version; iOS version is under development

2. Materials

- Materials are available here: <http://bit.ly/ap-sensor>

“Application” Folder

- 1 x “AP-Sensor_v2.3.apk” file for installation of app

“App Manual” Folder

- 1 x “User Manual of AP-Sensor v2.3.pdf” file for app guideline

“Lab Manual” Folder

- 5 x Lab Manuals

3. Install App

- i. Download the file “AP-Sensor_v2.3.apk”
- ii. Open the “AP-Sensor_v2.3.apk” file and click “INSTALL” (in Fig 1) to start install the app (Fig 2)
- iii. Open the app after successful installation (Fig 3)

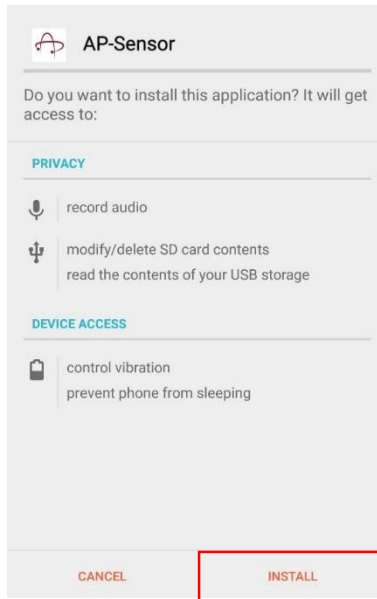


Fig 1

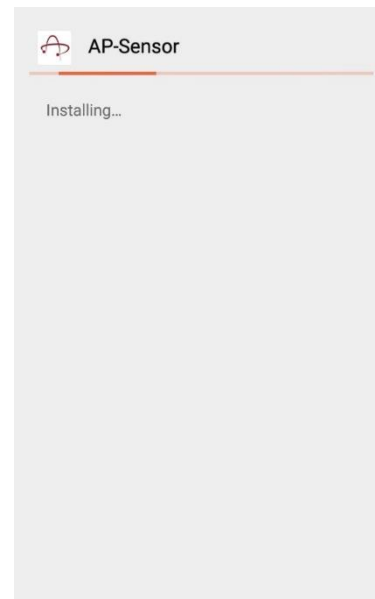


Fig 2

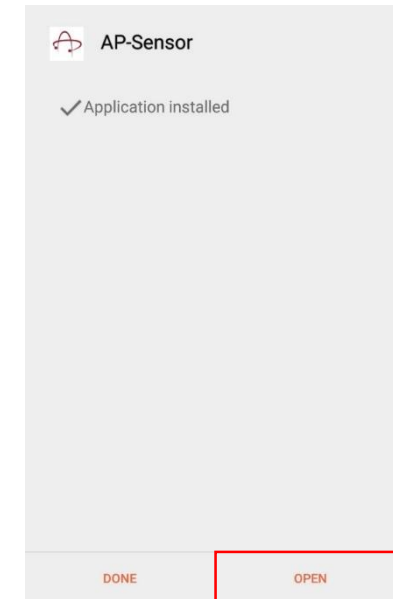
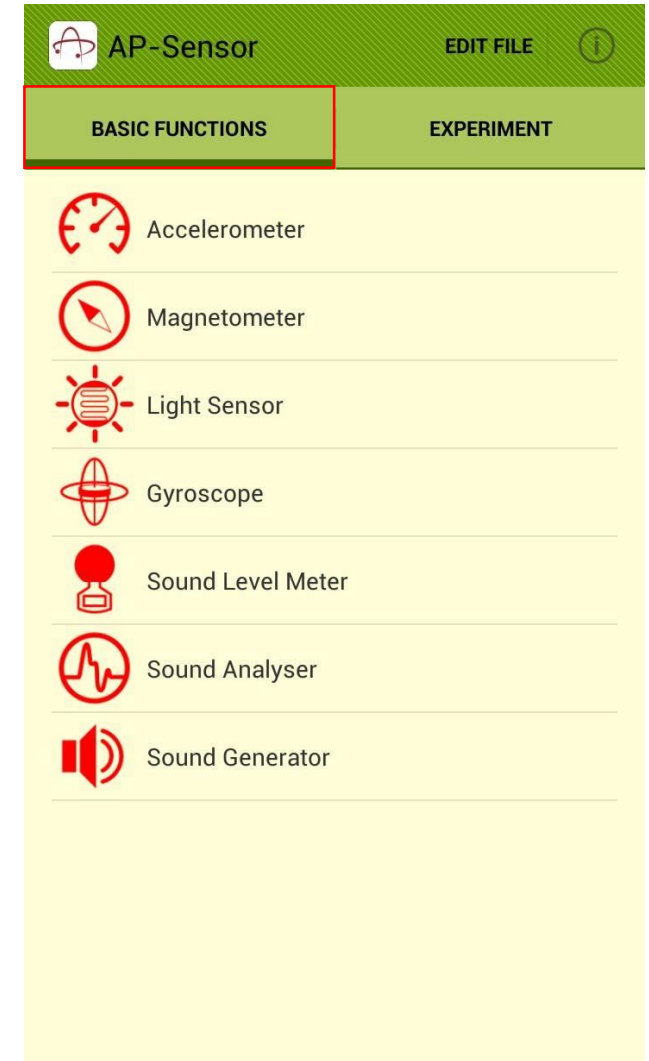


Fig 3

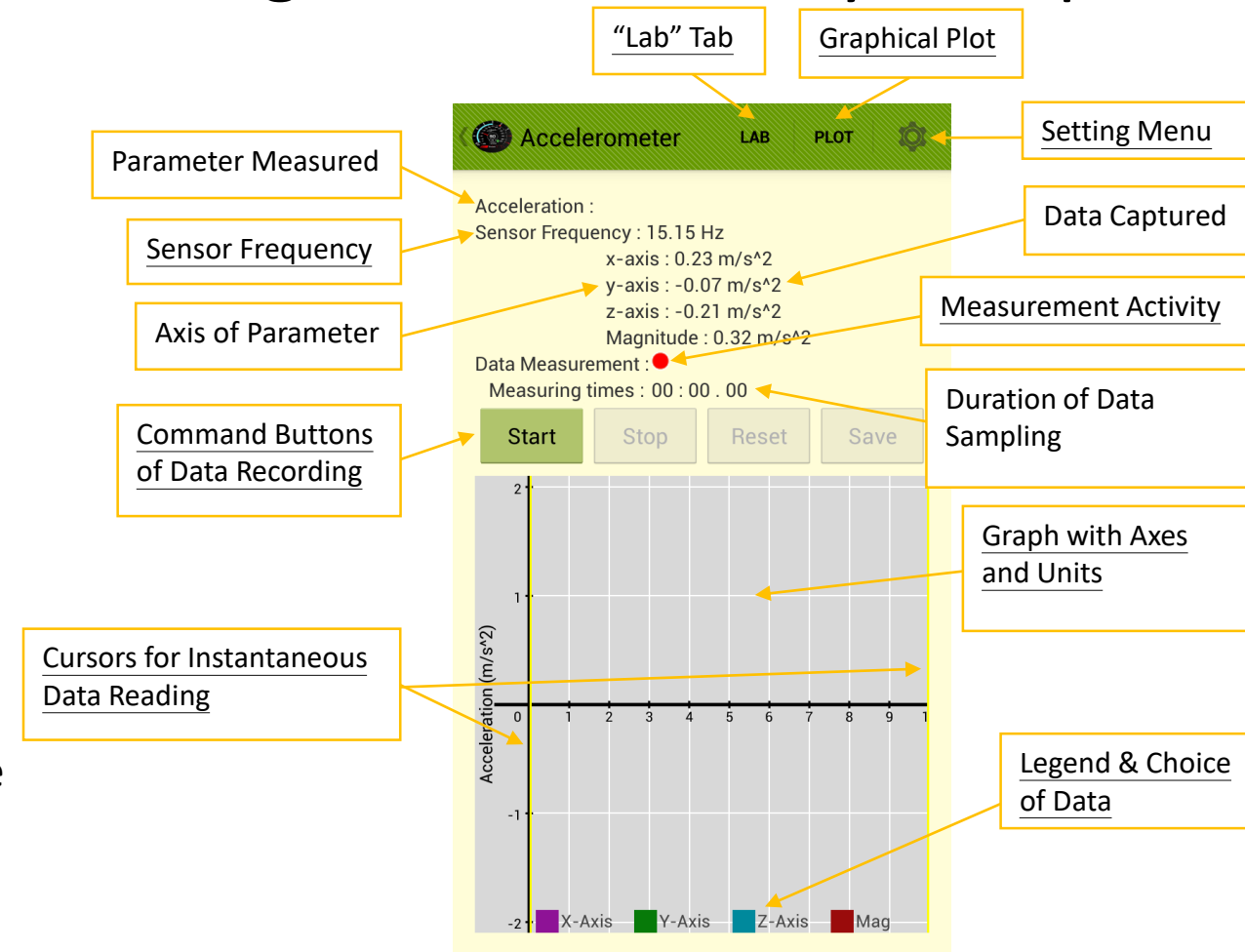
4. Main Menu – Basic Functions

- 7 activities (6 detectors + 1 generator)
 - i. Accelerometer
 - ii. Magnetometer
 - iii. Light Sensor
 - iv. Gyroscope
 - v. Sound Level Meter
 - vi. Sound Analyzer
 - vii. Sound Generator



Use of Accelerometer, Magnetometer, Light Sensor and Gyroscope

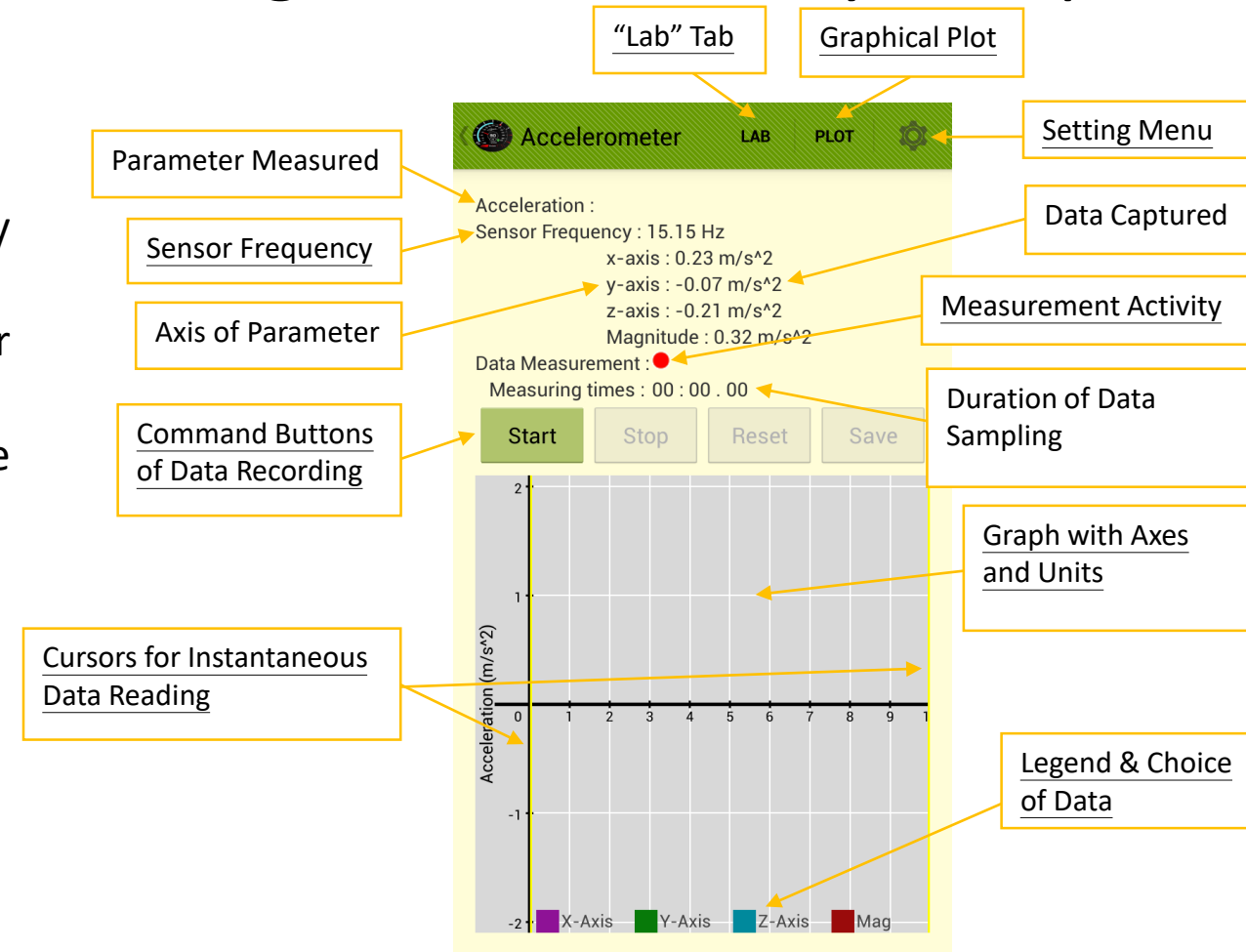
- Sensor Frequency
 - Sampling rate (SR) of sensor
 - Can be set in “Setting Menu”
- Measurement Activity
 - Green light while recording
 - Red light while not recording
- Graphical Plot
 - Full screen graph plotting data over time
 - Cannot be paused or saved
- “Lab” Tab
 - Directory to the experiment sets that are conducted by the sensors



Use of Accelerometer, Magnetometer, Light Sensor and Gyroscope

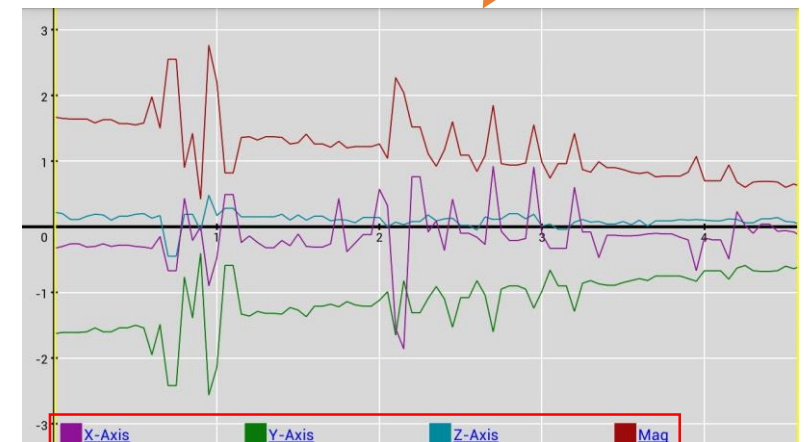
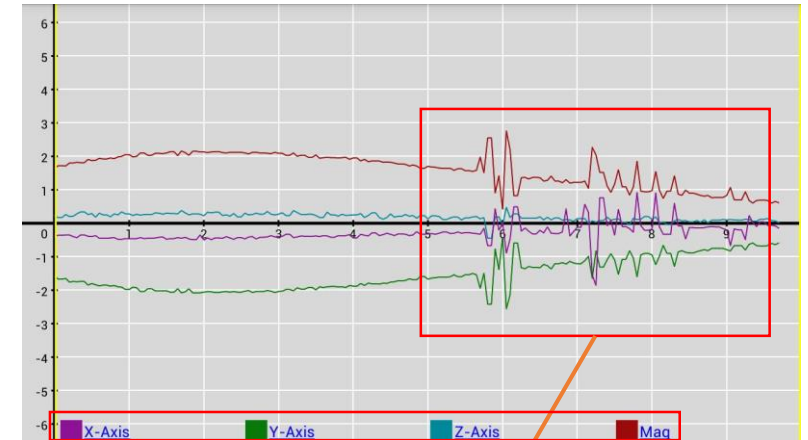
• Command Buttons of Data Recording

- Start Button: Start recording
- Stop Button: Pause recording, can be resumed by pressing “Start Button” again
- Reset Button: Clear the graph and ready for restarting recording
- Save Button: Active after one Start-Stop cycle, see “Data Saving”



Use of Accelerometer, Magnetometer, Light Sensor and Gyroscope

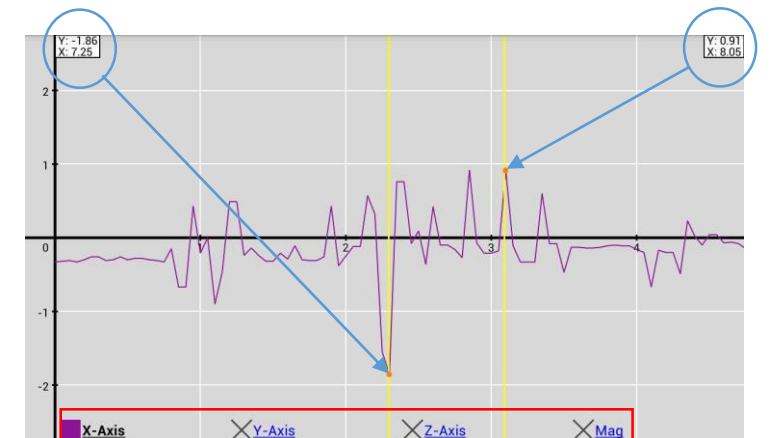
- Graph with Axes and Units
 - Observe captured data when it is paused
 - Zoom in and out the graph in x- and y-axis by sweeping with two fingers
- Legend & Choice of Data
 - Press to show the desired data set and dim out other sets
 - Press another desired set to show that set only
 - Press the same button to return to full plot
 - Only ONE data set can be chosen at the same time
 - Can still zoom the graph in and out when using this feature



Use of Accelerometer, Magnetometer, Light Sensor and Gyroscope

- Cursors for Instantaneous Data Reading

- Cursor is in form of yellow lines, which you can drag it across the graph
- Orange spots represent the data points as indicated by the cursors
- White boxes on the top left and right corner show the readings of x- and y- axes
- Readings will only be shown when ONE data set is chosen
- Can move the cursor to any point in the graph, but left cursor must be on left side of right cursor, and vice versa, they cannot be swapped
- Can still zoom the graph in and out when using this feature



Setting Menu

- 3 options (Fig 1) – 1. Info; 2. Orientation; 3. Setting
 - i. Info → Sensor Info (Fig 2)
 - ii. Orientation (Fig 3): Shows angles of phone to ground
 - Info: horizontal and vertical angles (Fig 4)
 - Calibrate: Set current angles to zero
 - Reset: Cancel calibration
 - iii. Setting: Rate Type and Sampling Rate (Fig 5)
 - Rate Type: Sampling rate (SR) of **sensor**. Default sampling rate is UI, which is usually 15Hz.
 - Sampling Rate: Sampling rate of the **app**. The app will capture data based on this SR, default as 20Hz.

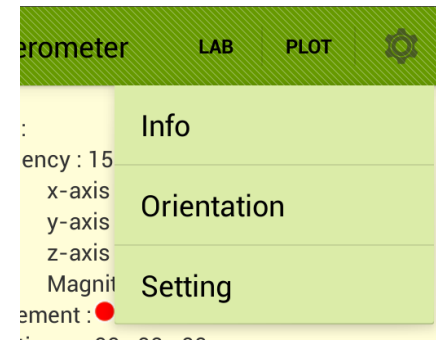


Fig 1

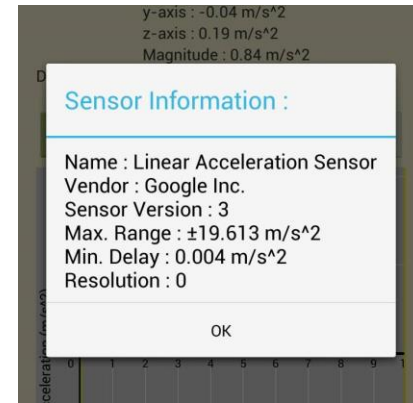


Fig 2



Fig 3

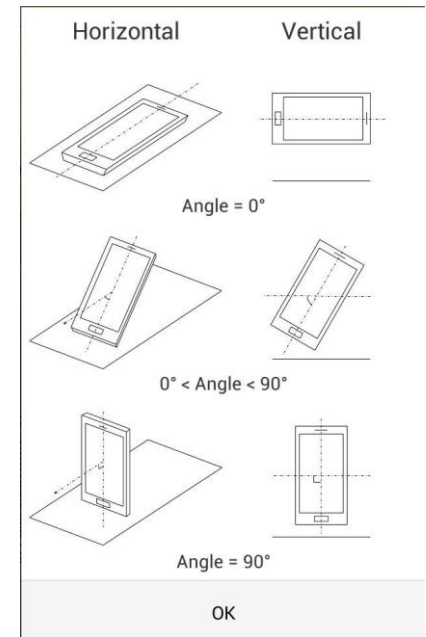


Fig 4

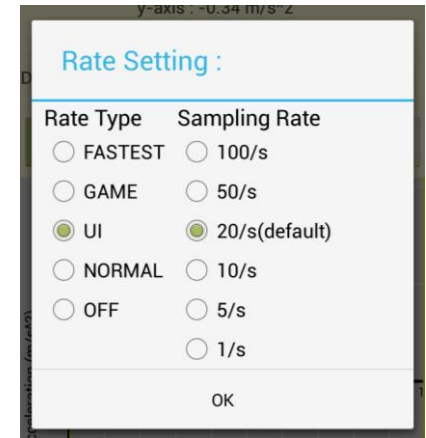
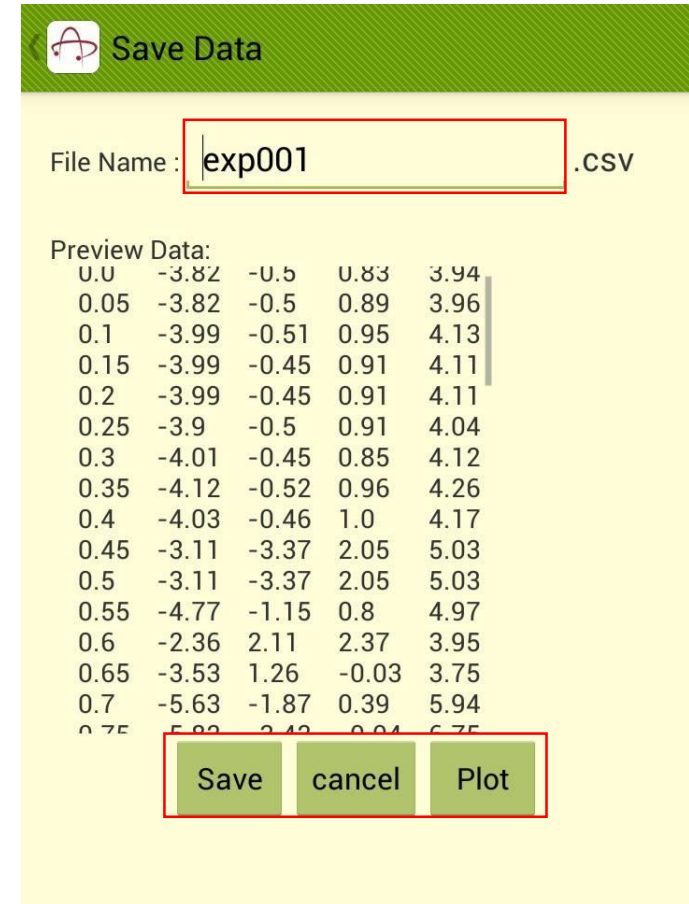


Fig 5

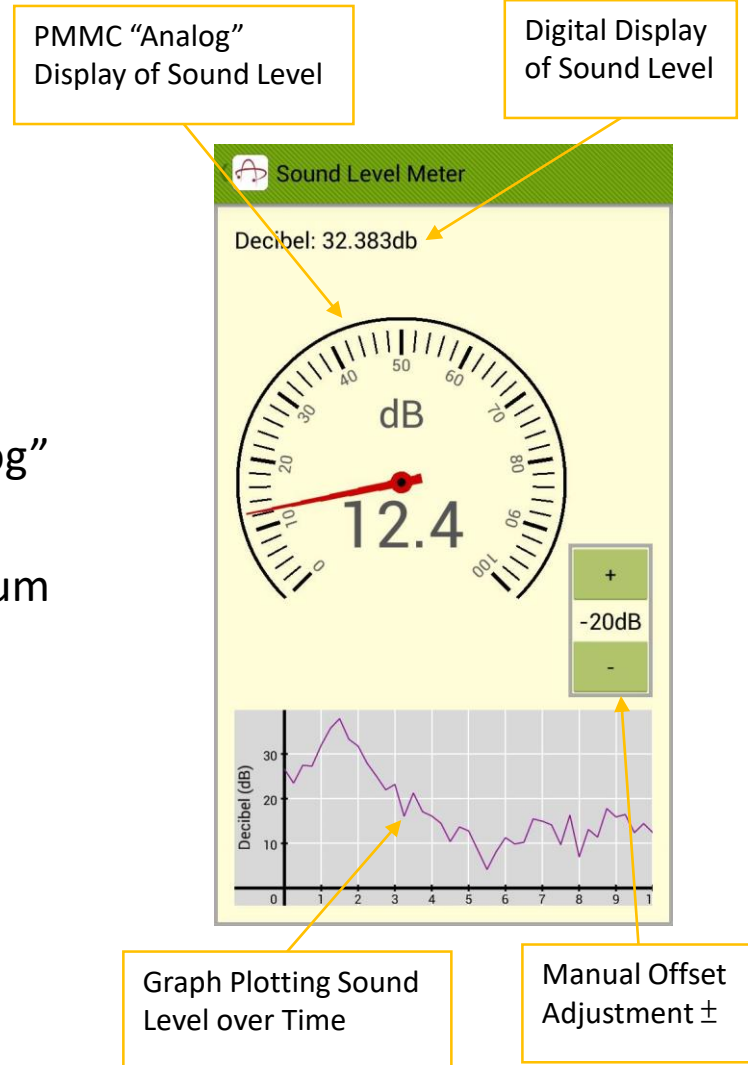
Data Saving

- Preview the data log by scrolling the table
- Name the file and save the data into a .csv file
- Press “Save” to save data. If file with same name is found on storage, there are options to let user change file name or cover old file
- Press “Cancel” to go back
- Press “Plot” to view and use the features of the graph
- To view the saved files, choose “Edit File” in the main menu



Use of Sound Level Meter

- Receives sound by built-in microphone of the device
- Unit of measurement is in decibel (dB)
- Digital display shows 3 decimal places BEFORE offset
- The simulated Permanent Magnet Moving Coil (PMMC) meter shows an “analog” display AFTER offset at a frequency of 4Hz, showing 1 decimal place
- The “± button” allows manual adjustment of the offset of the meter at a maximum of ± 20 dB
- Can be used to normalize the background noise
- The graph plots the variation in previous 10 seconds
- Maximum sound level can be shown is 90.3dB
- The meter cannot be paused
- “File Saving” and “Plot” functions are not enabled in this mode



Use of Sound Analyzer

- Spectrum Mode (Fig 1)
 - “Target Frequency” is not enabled before getting into “Tuner” mode
 - All the peak frequencies over 2 seconds will be sampled with “Allow Sampling”
 - Recommended to disable “Allow Sampling” checkbox at low frequencies
 - Graph can be zoomed in and out
- Waveform Mode (Fig 2)
 - Graph can be zoomed in and out
- Tuner Mode (Fig 3 & 4)
 - Automatically match with the guitar string of the closest frequency
 - Indicate tuning actions

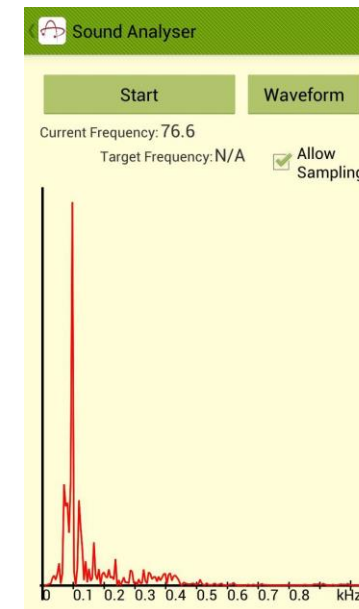


Fig 1

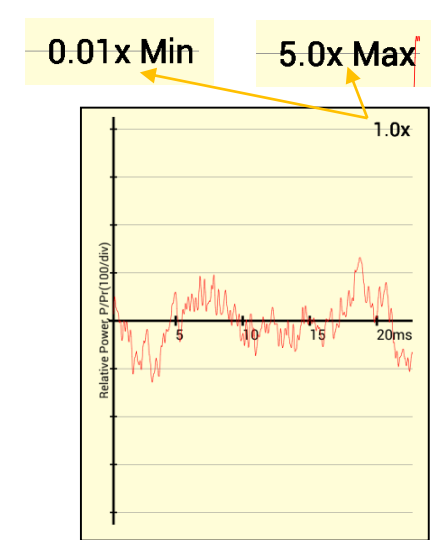


Fig 2

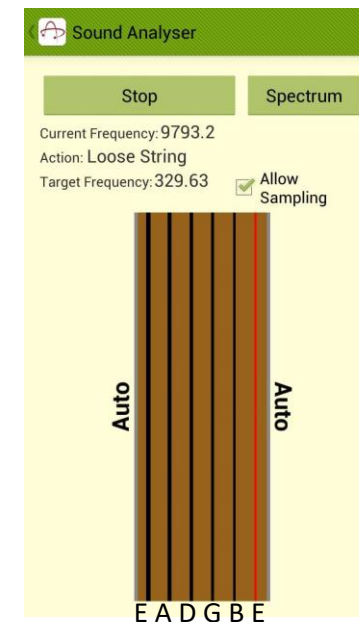


Fig 3

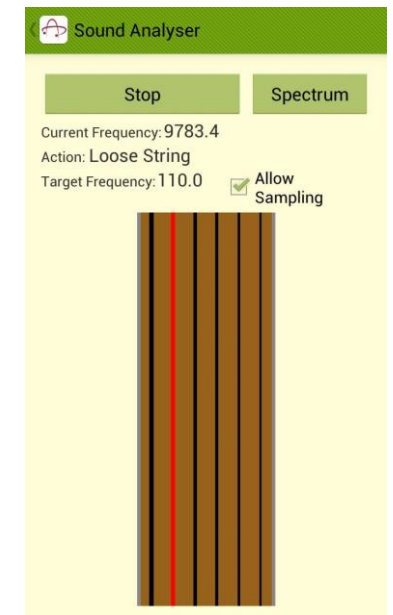


Fig 4

Use of Sound Generator

- Sound Generator generates sinusoidal sound wave with a desired frequency
 - i. Using preset music notes (Fig 1)
 - C, D, E, F, G, A, B for changing notes
 - 8va to increase one octave and 8vb to decrease one octave
 - Defaulted note C at the 4th octave “C4”
 - ii. Manually entering desired frequency (Fig 2)
 - Desired frequency in Hz can be chosen
 - “Current Note” will become “Customize”
 - Press “Gen” button to start generating sound wave
 - Press “Stop” button to stop the sound wave
 - If you do not press the “Stop” button, the sound will still keep being generated even if the app interface is closed

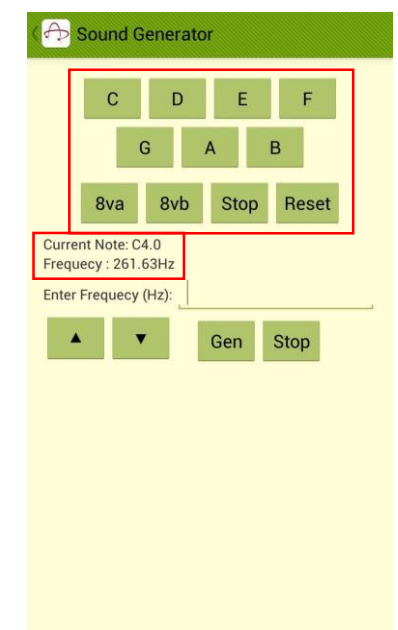


Fig 1

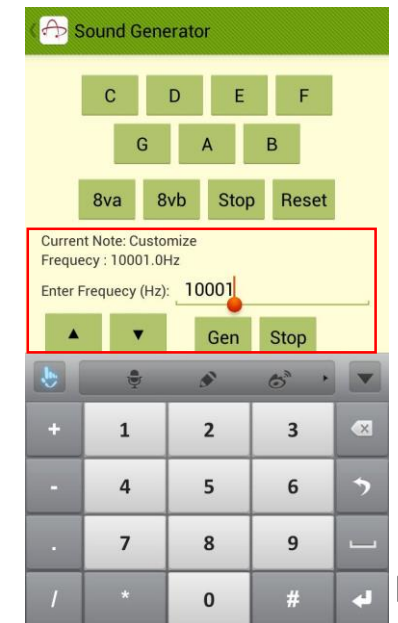
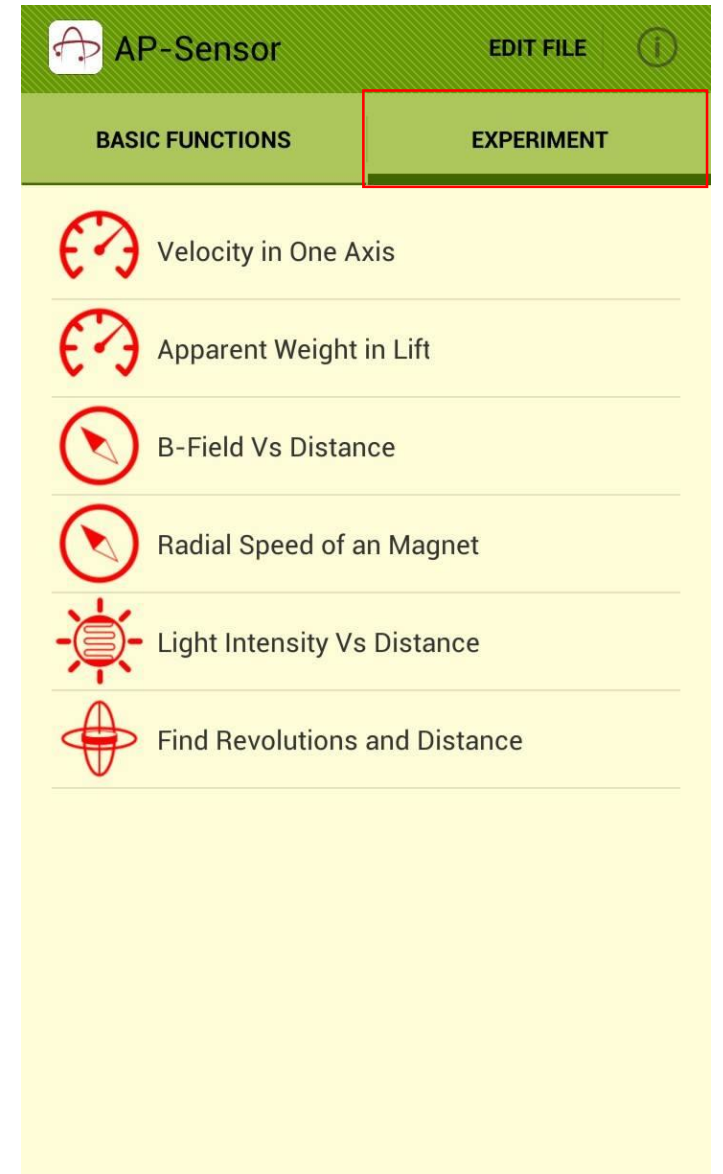


Fig 2

5. Main Menu - Experiment

- 6 experiment sets
 - i. Velocity in One Axis
 - ii. Apparent Weight in Lift
 - iii. B-Field versus Distance
 - iv. Radial Speed of a Magnet
 - v. Light Intensity versus Distance
 - vi. Find Revolutions and Distance
- Refer to the lab manuals



END OF SLIDES