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ON APPS AND SOUND LEVEL METERS

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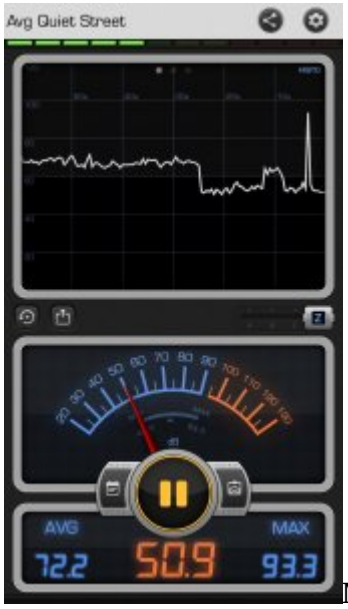
Introduction

It has always been a kind of a dream for many Industrial Hygienists to own a Sound Level Meter, a dream difficult to fulfil because of the high cost of the device. So, the potential of just downloading an App onto a smartphone and converting it into a working Sound Level Meter appears to be an ideal solution; to have a small and free SLM which be carried in the pocket. This could lead to a workplace where not only the IH but almost everyone from the manager down to the operator could walk around and measure noise! And doing it anywhere and at any time?! Sounds great, doesn't it?



Modern smartphones have become a necessary piece of technology amongst adults and teenagers in the developed world. This is evidenced by a U.S. smartphone penetration rate of 82%. With 344 million smartphones being sold in the second quarter of 2016, 86% utilize the Google Android mobile operating system and 12.9% utilize Apple's iOS mobile operating system. Thus, these 2 operating system account for 99% of all worldwide smartphone shipments, with other mobile operating systems constituting the remaining 1%.

There are over 60 Apps that measure sound levels, noise exposures, perform frequency analysis, etc. They appear under different names such as: Sound Meter, Sound Level Meter, Sound Meter Pro, OpeNoise, Sound Spectrum Analyzer, etc. Some have quite extensive explanations, while other are so short in details that it is not clear whether they measure in dB or dBA. There is almost no information about calibration either for some of these apps.

It takes much more time to decide which App to download than to actually have it up and running. So, choosing the right App can be quite serious, especially for a person with little or no training on

sound level meters.

Requirements

The standard that deals with Sound Level Meters is the Acoustical Society of America. ANSI S1.4-1983 (R 2006) Specification for Sound Level Meters 1985;552:1–18. It specifies three types of Sound Level Meters known as Type 0, Type 1 and Type 2. Type 0 Sound Level Meters are designated as laboratory standard. Type 1 Sound Level Meters are for precision use in laboratory and the field. Type 2 Sound Level Meters are for general field use in measuring environmental sounds and are commonly used for environmental and field noise monitoring. They also meet the Occupational Safety and Health Administrations (OSHA) noise monitoring requirements.

A Sound Level Meter has to comply with the requirements set in the above standard and has to show so, by undergoing the corresponding tests performed in certified laboratories.

No combination of smartphone and App claims to being subjected to such tests. Therefore, one should be very careful when using these combination smartphone-Apps to claim that one has an accurate Sound Level Meter. Also, the results of measuring Sound Levels with such a combination have to be taken with extreme caution.

Tests of smartphones-Apps

At Ryerson University, we conducted a series of test (one thousand measurements in total) with the following specifics (A paper on this study has been submitted for publication under the signatures of Travis McLennon, Shivangi Patel, Alberto Behar and Mohammad Abdoli-Ermaki):

Variable	Specifics
Smartphones	5 iOS and 5 Android devices
Sound Signals	White noise, Pink noise, Speech file, Steelmaking and Conveyor Belt
Sound Levels (dBA)	60, 70, 80 and 90
Apps	5 iOS and 5 Android applications

The main objective of the study was to examine the hazard of just downloading an App and accepting the measured values as true.
The summary of the results is that apps and smartphones cannot be used as a reliable source of determining occupational or environmental exposure, especially with regards to compliance testing. They can, definitely be used as screening tools, especially if the measurement results are much lower or much higher than the safe limit of 85 dBA.

Some Results

Following are some partial results from the study.

1. Linearity and dynamic range of the 5 iPhones and 5 Androids being tested (200 results):

Reference	60 dBA	90 dBA
Range	59 - 76	67 - 95

   The wide range of the results shows the danger one could incur using the App as a valid measuring instrument. As an example, while measuring a 60 dBA signal, the reading on the App can be anything between 59 and 76 dBA.
2. Linearity using different sound signals
   Following are ranges of results using different types of sound signals at 60 and 90 dBA levels.

Sound Signal Type	Sound Level, dB	Range, dB
White Noise	60	40 - 76
	90	66 - 95
Pink Noise	60	43 - 75
	90	72 - 94
Speech	60	41 - 75
	90	70 -93
Steelmaking	60	44 - 75
	90	71 - 94
Conveyor	60	42 - 74
	90	72 - 95

It can be observed that not only the range of readings is quite wide, but also it is dependent on the type of signal used.

3. Lack of information
   It was observed that not all Apps provide the information if they are measuring in dBA, or dBZ, nor if the measurement is performed in “Slow” or “Fast” mode.

The Future of the Apps

There is a tendency to explain the underperformance of smartphone – Sound Level Meter Apps on the quality of their microphones. Although they are of the condenser type and, therefore, of high quality, there is definitely no quality control compared to the ones involved with SLM microphones. They are often poorly placed to act as measurement microphones, there can be various algorithms designed to improve audibility by adjusting the sound signal and there are many different manufacturer producing Android phones which may act differently than the ones used by the writers of the Apps. There is, obviously, an issue with the cost, so, one cannot expect the same performance from a MEMS microphone found in a smartphone, as from a precision microphone (It is not a problem of the MEMS per se, but with their quality control). But, even equipped with a precision microphone, will the smartphone perform like a SLM? Again, there is an issue of cost, since it will have to undergo the same tests a SLM is subjected to. Which bring us to the question of are we not asking too much from a device that has to keep its cost low enough as to be accepted by a vast population?

Conclusion

In summary, the probability of downloading a Sound Level Meter App and expecting to perform even as a Class 2 instrument is quite remote. Today’s apps should only be used as a preliminary assessment tool for the noise hazard, but not as a measuring instrument.