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USING BUILD-IN MIC TO DETECT AIRPLANE MODE BY HEARING BACKGROUND NOISE

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Title: Using build-in Mic to detect airplane mode by hearing background noise

Abstract:

A mobile device such as notebook need to modify its operation in airplane, at least turning off wireless transmitter. Other operational changes include reduce significantly battery charging rate if AC is available. That is due to airplane's limited power capability while airborne.

The current airplane mode is handled manually. The write-up described to use build-in mic-phone for airplane mode detection. By listening to unique background character inside airplane cabin during airborne, the notebook device with its build-in mic can detect airline mode, then adjust device operation automatically.

Problems Solved:

The write-up described a method to enable notebook enter airplane mode smartly. To comply FAA and airline limited power source, device modifies its ext. power draw behavior such as significantly reduce battery charging rate, or reduce high demand application power footprint. With notebook smart device adapting to its environment and changing operational mode, it improves user experience.

Description

Acoustic in airplane cabin is caused by engines whirring, whizzing wind and air condition pumping. Its acoustic inside an airplane cabin during plane journey has some unique property.

First, acoustic frequency domain contains every frequency within the range of human hearing (generally from 20 hertz to 20 kHz) in equal amounts, close to white noise as shown below. Secondly, amplitude level in each acoustic frequency is much higher than any other environments. While take-off and landing are the loudest moments, cruising still has noise at least ~85 dB in commercial plane and about ~50 db in private jet. After FFT frequency conversion for each data capture, DSP can check amplitude in each frequency band if at least 50 db amplitude. If so, airborne signature detected. Thirdly, this acoustic behavior lasts the whole journey from plane taking off to landing, the real-time sampling rate can be slow and processing mic capture can set as low priority. So, the whole action does not take so many CPU power and time.

White noise waveform

Notebook has build-in digital mic phone and audio Pre-processing engine, and they are only power off when system in off state. With audio active in standby and on state, background noise can be listened by mic, so the data can captured and processed all the time. Once three airborne acoustic signatures detected, notebook can trigger airplane mode automatically. Vice versa for exit airplane mode.

The three unique airborne acoustic noise signatures are:

1). White noise: minimum magnitude across most frequency domain.

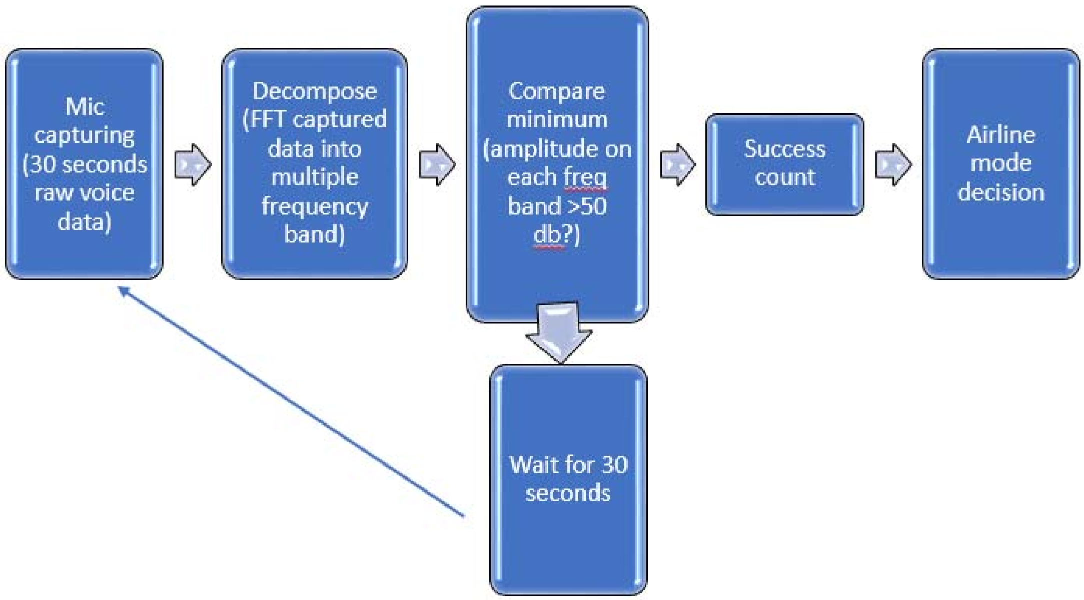
2). Noise minimum magnitude at least 50 db in every frequency band.

3). Noise lasts continuously over multiple hours.

Mic processing diagrams is shown as the below, build-in mic capture a 30 second long raw data, then the data get decomposed into multiple frequency band and analyzed by DSP. Then DSP sorts out minimum amplitude in every frequency bands.

If minimum amplitudes on all frequency bands above 50 db, “success count” increased by 1. Otherwise, state machine increases “success count” by 1. The “success count” is cap at 0 as minimum and 10 as maximum value.

Other state machine checks the “success count” value each 30 second. If over 5, airplane mode entered. If below 3, airplane mode exit.



Advantages

Without adding any extra hardware cost, the idea essentially creates an airline detection sensor into system by using existing build-in Mic.

With that, notebook can adjust its operational behavior by itself to comply some unique requirement on airplane. Stopping battery fast charging is one example, other actions such as activate privacy panel or turn off system speaker in favor for headset automatically. These are to protect privacy and security.

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