Notes

- Anyone is welcome to comment! Choose Insert → Comment from the pulldown menu.
- If you know of an off-the-shelf system that satisfies these requirements, please let us know!
- If you want to get more involved in this project, please email ericweb@mail.com with your name, email, phone number, and time zone.

Key Unresolved Questions

See “Proposed Minimum Viable Product Implementation,” below.

- What microphone should the physical monitor use? It must be able to function outdoors (e.g. be water and windproof).
- What mbed-compatible hardware board should the physical monitor use to gather audio data and transmit to the mbed servers?
- What power supply should the physical monitor use?
- What waterproof enclosure should the physical monitor use?
- What are the FAA’s requirements for considering data valid for noise study use?

Goal

Make it easy for citizens to accurately monitor aircraft noise, study the noise data themselves, and report noise data to airports and the FAA.

Strategy

Create a low-cost aircraft noise sensor device that citizens can install and use with minimal effort to generate aircraft noise data that both airports and the FAA will accept as accurate.

Constraints

- Legal
    - Resident must accept all risks associated with using the system and indemnify whoever makes the system.
- Safety
    - When used as directed, the device must not create safety hazards for the Resident (e.g. electrocution risk) greater than typical consumer hardware products.
- Regulatory
    - Resident wants the system to generate aircraft noise data (ambient and from aircraft) in compliance with FAA requirements for accepting data for noise studies

so that data can ultimately be incorporated into a formal study whose conclusions the FAA would accept.

- Cost
    - Residents with median family income must consider the fully-loaded cost of the installed system acceptable for them to pay out of their pocket.
- Usability
    - A nontechnical Resident must be able to set up and install the system without assistance.
    - Resident wants the system to function for an extended time without requiring much effort by them (e.g. frequent changing of batteries).

Mini-Personas

- “Sanka,” a fifty-year-old homeowner living near the San Carlos airport,has taught outdoor meditation lessons at her home for many years. Since a commuter air service launched using propeller aircraft, she has found that she can no longer do these meditation lessons outside. She wants to document that these particular aircraft are generating a level of noise pollution in excess of FAA guidelines in order to push for changes to the equipment on the aircraft, the flight schedules or frequency, and/or the model of aircraft.
- “Sunny,” a forty-five-year-old who rents an apartment in Sunnyvale, is annoyed by the level of noise when San Jose Airport runs the Southern approach or commuter airplanes use the Bayside approach to San Carlos and wants to document the noise pollution to push for changes to flight routing. Sunny believes that since the rollout of NexGen technology by SJC, flights on the Southern Approach have been more concentrated during the 6 a.m. - 7 a.m. timeframe and/or geographically and wants to push for the flights to be better spaced out in time or geographically to distribute rather than concentrate noise pollution.

Proposed Minimum Viable Product Simplifying Assumptions

- Run off of household power to eliminate need for solar panels, battery, etc.
- Set up the device in locations like a balcony, a backyard, etc. so the device need not be physically attached to the house or apartment.
- Project manager may assist Residents with initial setup. (At scale, self-setup is necessary.)
- ARM mbed platform will be used for the microphone/monitoring hardware and for data storage because it provides an open ecosystem of supporting hardware options, free secure TLS transmission of data to the servers, and free storage of data for personal use on servers.
- Mbed cloud will be used at free 100-person level and/or residents would set up individual free data storage accounts and would grant access to them to project managers or download and submit the data for initial analysis.

Proposed Minimum Viable Product Implementation User Stories

The user is referred to as “Resident” since they are assumed to live in the area being studied.

- P1: Resident requires the system to function outdoors, exposed to the elements, so resident can monitor outdoor aircraft and ambient noise.
- TBD: Resident wants the system to function indoors so resident can monitor indoor aircraft and ambient noise. (TBD: Does FAA do studies based on indoor or outdoor noise levels?)
- P1: FAA requires that system record both ambient and aircraft noise in order to consider the generated data acceptable for use in an aircraft noise study.
- P1: Resident wants to be able to view the data generated by the system through a desktop web browser.
    - P1: Resident requires the system to permanently store data generated by the system on servers so they don’t have to store and maintain data locally.
    - P1: Resident requires the system to transmit data through their home WiFi network so they don’t need to physically connect the device to their network.
    - P1: Resident requires the system to securely transmit and store the data so the FAA or others can’t claim that data was faked, spoofed, or otherwise altered by a hacker.

Proposed Minimum Viable Product Implementation

- Run off of household power via an outdoor-safe extension cord connected to either an exterior outlet or an interior outlet in a location such as a garage.
- Use the ARM mbed platform in “free personal use” to securely transmit data (via TLS encryption) to servers and store generated data on servers for analysis.
    - mbed compatible hardware TBD:
        - Microphone: TBD
            - How to protect the microphone from the elements? Is an outdoor-safe microphone available?
        - Circuit board: TBD
        - Power supply: TBD
        - Waterproof enclosure: TBD
            - How to protect the circuit board and power supply from the elements? Can they be enclosed in an off-the-shelf consumer enclosure like a Pelican case with holes drilled in for power entry and microphone exit? What off-the-shelf case would make it easy to drill holes for the microphone and power supply?
            - What’s the best way to seal the holes around the wires? Something like caulk?
- Resident can view generated data through their web browser by using standard mbed platform web app data access functionality for their account.

- A sophisticated Resident (or professional data analysts participating in the project) can download data from the mbed platform for local analysis using data analytics tools like R.

User Stories Deferred to Future Releases

- Resident wants the system to operate without requiring a connection to household electrical power so the system can be installed on the roof.
    - Resident wants the system to charge itself via solar power and store power in a battery during the day sufficient to power the system throughout the night under “typical” (TBD) cloud coverage conditions.
- Resident wants to safely and securely attach the system to their roof without damaging it.
- Resident wants to select data associated with an aircraft noise spike and generate a complaint report to the responsible airport with less effort than doing it manually.
    - Resident wants to select the data associated with an aircraft noise spike and see data from an online service like flightrader showing which aircraft were overhead at that time.
    - Resident wants to more easily determine which airport (SJC? San Carlos?) to file a complaint to.

FAA Requirements Analysis

- “The FAA says that a maximum day-night average sound level of 65 dB is incompatible with residential communities.” -- Wikipedia Aircraft Noise
    - Eric’s Note: This appears to be a standard that functions more in the interest of airplanes than residents since it requires an average sound level of 65 dB to be deemed “incompatible.” Since planes are typically spaced out by 90 - 120 seconds at least, you’d need extremely loud noise during the brief overflight to generate an ongoing day-night average sound level of 65 dB.

Reference Documents

- FAA Airport Noise
- Wikipedia Aircraft Noise

To Do

- Analyze FAA noise study requirements to determine what their precise requirements are for accepting data into a noise study.

Author

Eric Krock

Disclaimers

- Participants in this project live in areas where aircraft noise has been a recent topic of discussion.
- Participants in this project do not currently have a financial interest in any IoT product or platform provider, but some participants are interested in Internet of Things applications and are actively exploring the possibility of employment with one or more companies in the IoT hardware and software ecosystem.
- No commercial or noncommercial entity is affiliated with or has endorsed this effort; it's a grass-roots exploratory effort.