

Lab 1 Outline - Team Sapphire

Table of Contents

1. Introduction.....	3
1.1. Societal Problem.....	3
1.2. Solution - Sapphire Sound Monitor.....	4
2. Sapphire Sounds Product Description.....	4
2.1 Key Product Features and Capabilities.....	5
2.2. Major Components (Hardware/Software).....	6
3. Identification of Case Study.....	7
4. Glossary.....	8
5. References.....	9

1. Introduction

1.1. Societal Problem

Living in shared buildings such as apartments, dormitories, and townhomes can be difficult when noise becomes a source of conflict. Excessive noise from neighbors, whether it's loud music, late-night gatherings, or even regular activities, is a leading cause of tenant complaints.

- Noise complaints are typically based on personal accounts, making them subjective and often unreliable.
- Property managers struggle to resolve these complaints fairly without neutral evidence.
- The American Public Health Association states that “*chronic noise, even at low levels, can cause annoyance, sleep disruption, and stress that contribute to cardiovascular disease, psychological disorders, and premature mortality*” (APHA, 2021).
- Tenants face a lack of tools to protect themselves from false accusations or to prove that they’ve been disturbed.
- There is a growing demand for objective, privacy-respecting noise monitoring solutions to improve tenant experiences and conflict resolution.

1.2. Solution - Sapphire Sound Monitor

Sapphire Sound Monitor is a software-enabled solution that empowers tenants and property managers with objective, automated noise tracking and reporting. It fills the gap between personal accusations and verifiable data by providing a privacy-conscious, user-friendly monitoring system.

- Uses a noise sensor to track decibel levels without recording audio to respect privacy
- Automatically logs noise events that exceed a threshold for a set duration
- Generates timestamped reports sent directly to property managers for unbiased resolution
- Tenants can access their own noise history through a mobile or web app
- Real-time alerts notify tenants when they're being too loud, encouraging self-correction
- Optional reward system promotes quiet behavior and positive reinforcement

2. Sapphire Sounds Product Description

Sapphire Sounds is a mobile and web application that connects to a small noise sensor. The sensor tracks how loud sounds are but does not record any audio. If noise levels remain too high for too long, Sapphire Sounds generates a report with the time and noise level.

These reports help property managers resolve complaints fairly.

Tenants can view their own noise history, receive alerts when they're too loud, and earn rewards for maintaining quiet. Sapphire Sounds promotes peaceful shared living by providing clear, unbiased data instead of relying on personal opinions.

2.1 Key Product Features and Capabilities

Sapphire Sounds is a mobile and web application that interfaces with a compact noise-detection sensor. The system measures sound intensity in decibels (dB) without recording actual audio, preserving privacy while objectively logging noise events. When sustained high noise levels are detected, it generates time-stamped reports to facilitate transparent resolution of complaints.

Innovations:

- **Privacy-first monitoring:** This system only collects sound intensity without collecting sound content, ensuring tenant privacy while still tracking disturbances
- **Data driven dispute resolution:** Replaces subjective complaints with clear, time-stamped decibel logs, giving property managers and tenants objective evidence for noise disputes
- **Positive reinforcement:** Offers rewards to tenants who maintain acceptable noise levels, promoting respectful community behavior

- **Smart Alerts:** Sends real-time alerts to tenants and escalates to landlords/managers only when violations persist, allowing early self-correction

2.2. Major Components (Hardware/Software)

Hardware:

- Raspberry Pi Zero 2 W: acts as the controller that collects data from the noise sensor and transmits it over WiFi
- Infineon CYW43439: Embedded WiFi chip that enables wireless connectivity for the Raspberry Pi
- I2C Decibel Sound Level Meter: Measures real-time noise levels in decibels; connects to the Raspberry Pi via I2C protocol

The decibel meter connects via I2C to the Raspberry Pi, the Raspberry Pi continuously samples sound levels and timestamps them, the data is securely transferred via WiFi.

Software:

- Frontend: React.js Web/Mobile UI hosted on Firebase, used by tenants and property managers to view noise logs, alerts, and reports
- Backend: Node.js backend hosted on Render.com that will handle sensor data ingestion, noise analysis, user authentication, and alert logic

- Database: PostgreSQL database that will store timestamped decibel logs, user data, noise patterns, and reward tracking
- Version Control: GitHub will be used for source code management and continuous integration

3. Identification of Case Study

Sapphire Sound's primary users will be both tenants and property managers/landlords. The tenants will be able to monitor their own noise habits, avoid disputes, and potentially earn rewards for staying compliant. The property managers and landlords will be able to fairly investigate complaints, monitor chronic issues, and maintain peace without needing to always be on-site to verify noise levels. This is important because:

- Noise complaints are among the top grievances in shared and multi-unit housing
- Subjective claims often lead to disputes, retaliation, or unfair blame
- Property managers need tools that are fair, consistent, and privacy-compliant

4. Glossary

- dB (Decibel): A unit to measure the intensity of sounds.
- Noise Event: An occurrence when decibel thresholds are reached for a specific duration. Used for reporting.
- Noise Sensor: A physical device that monitors sound levels without recording audio.
- Report: A structured report generated by the system, detailing the noise event.
- Threshold: A predefined decibel level, which if exceeded, will trigger a noise event
- Tenant: A resident or occupant of a shared or multi-unit housing space using the system to manage and monitor noise activity.

5. References

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