Lab 1: Sapphire Sound Monitoring

Shawn Maybush

CS 411

Professor Thomas J. Kennedy

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1 Introduction

Living in close quarters like apartments and dormitories can lead to conflict when noise becomes an issue. Loud music, late-night parties, and even everyday activity can become a source of contention. As a result, there is a growing need for reliable, privacy-respecting technology that can objectively monitor noise.

1.1 Current Process

Currently, property managers struggle to resolve noise complaints efficiently. A tenant will complain, and the property manager will have to take account of the complaint through tenant testimony and voluntary information of those involved and those around them. The acceptable noise level is left up to tenants and individual perception or preference.

1.2 Current Process Challenges

The current process for handling noise complaints is inefficient and presents significant challenges for both property managers and tenants. These issues stem from a lack of objective data and reliance on subjective accounts. Key challenges include:

- **Proof of complaint:** Tenants have no way of objectively proving their complaint or defense without the support of other tenants.

- **Tenant dissatisfaction: The lack of a clear process and objective data can lead to increased dissatisfaction and contention between tenants.**

- Health impacts: The American Public Health Association notes 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). This highlights the serious health risks associated with unresolved noise issues.

1.3 Solution - Sapphire Sound Monitor

Sapphire Sound Monitor is a software solution that gives tenants and property managers an objective, automated way to track and report noise. It closes the gap between personal accusations and reliable evidence by using a privacy-focused monitoring system. The decibel monitor uses a specialized sensor to track decibel levels, respecting privacy by never recording audio. It automatically logs any noise event that exceeds a pre-set threshold, creating timestamped reports that are sent directly to property managers for fair and verifiable resolution. Tenants can access their personal noise history through a simple mobile or web app. The system even offers real-time alerts to notify tenants when they are being too loud, encouraging them to self-correct before a complaint is even made. An optional rewards system can also be used to promote and positively reinforce quiet behavior.

2 Sapphire Sounds Product Description

Sapphire Sounds is a mobile and web application that, when connected with a small sensor, tracks and reports the noise levels of tenants without recording any audio. The generated reports help property managers and owners resolve complaints and allow tenants to self-regulate their own behavior through rewards to promote a peaceful shared living environment.

2.1 Key Product Features and Capabilities

Sapphire Sounds is a mobile and web application that connects with a decibel monitor that both monitors the noise level and generates reports for sustained noise levels. The lack of audio recording and storage ensures the tenant's privacy is maintained and secure.

2.1.1   Privacy First Monitoring

The sensors only collect decibel level readings that are filtered based on preset configurable tolerances. There is no audio recording storage. This ensures tenant privacy while still allowing for sound level monitoring and reporting, there is no

2.1.2   Data Driven Dispute Resolution

Individual perception of what is a tolerable noise level differs from person to person. With decibel level monitoring and reporting, individual perception is no longer a part of the decision-making process. This allows disputes to be handled objectively with evidence and documentation.

2.1.3   Positive Reinforcement

Tenants will be offered rewards for maintaining consistent acceptable noise levels. This gives incentive for respectful and conscientious behavior, reducing the number of disputes within a property.

2.1.4   Smart Alerts

Real-time alerts to tenants and escalations to managers allow for quick behavior modifications before disputes get out of hand or tenants suffer high levels of dissatisfaction and contention with neighbors.

2.2 Major Components

The system is composed of both hardware and software components that work together to measure and display real-time noise levels.

2.2.1   Hardware

The hardware components are integral to the system's ability to collect data and communicate wirelessly. They include:

- Raspberry Pi Zero 2 W will be used as the controller for the sensors.

- Infineon CYW43439 chip for wireless communication. (Embedded in Raspberry Pi).

- I2C Decibel Sound Level Meter: Measures real-time noise levels in decibels. Configurable frequency weighting is based on usage purpose. Will default to A-weighted.

2.2.2   Software

The software stack manages the data collected by the hardware and presents it to the user

through a user interface. Key software components include:

- Frontend: React.js Web/Mobile UI hosted on Firebase.

- Backend: Node.js backend hosted on Render.com.

- Database: PostgreSQL.

- Version Control: GitHub.

3 Identification of Case Study

The purpose of Sapphire Sound Monitoring is to address the conflict and inefficiency that occurs

from subjective noise complaints in shared living spaces. By using objective, data-driven

evidence, the product aims to transform the current dispute/resolution process.

3.1 Primary Customer

The primary customers for Sapphire Sound Monitoring are property managers. The products core

design is intended to solve the challenges property managers face when handling noise disputes.

The system allows them to fairly investigate complaints, monitor ongoing issues, and ultimately

maintain peace across their properties.

3.2 The Beneficiaries

The beneficiaries of the system are the property manager's tenants. The privacy-first monitoring

provides tenants with the assurance that noise is appropriate for the living arrangement. It also

allows them to monitor their own noise, giving them objective proof to defend against frivolous

complaints.

3.3 Secondary Markets and Potential Customers

While the product is focused on commercial property managers, potential markets are vast. Any shared living space can benefit from the sound monitoring technology.

- College and University Dormitories

- Short-Term Rentals/Hospitality

- Healthcare Facilities

- Shared Work Office Spaces

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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