A report to offer engineering solutions to reduce noise levels in Arada Kebab Restaurant

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ENG401-08

Intoduction

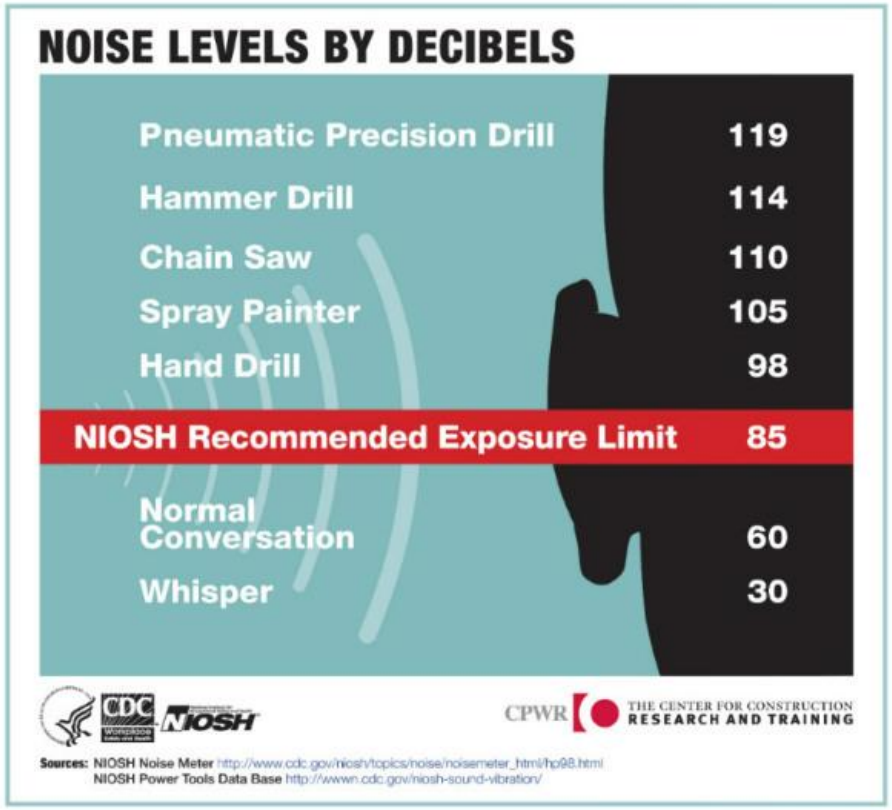


Figure 1: Noise Infographic by CDC [1]

Zagat's 2018 Dining Trends Survey of nearly 13,000 diners in the United States, the most irksome issue when it comes to dining out at was

- noise (24%)
- service (23%)
- crowds (15%)
- high prices (12%)
- parking (10%) [2]

Introduction

In a survey,

- 30% found their last dining experience too loud
- 24% regularly have to raise their voices to be heard
- 44% will choose a restaurant based on whether it is noisy or not
- 81% will not stay as long in a noisy restaurant
- 5% of responders suggested that they are more likely to use a takeaway than eat-in as the noise in restaurants has become uncomfortable [3]

Lombard Effect

In a noisy environment people speaks louder. Which creates a noisier environment.

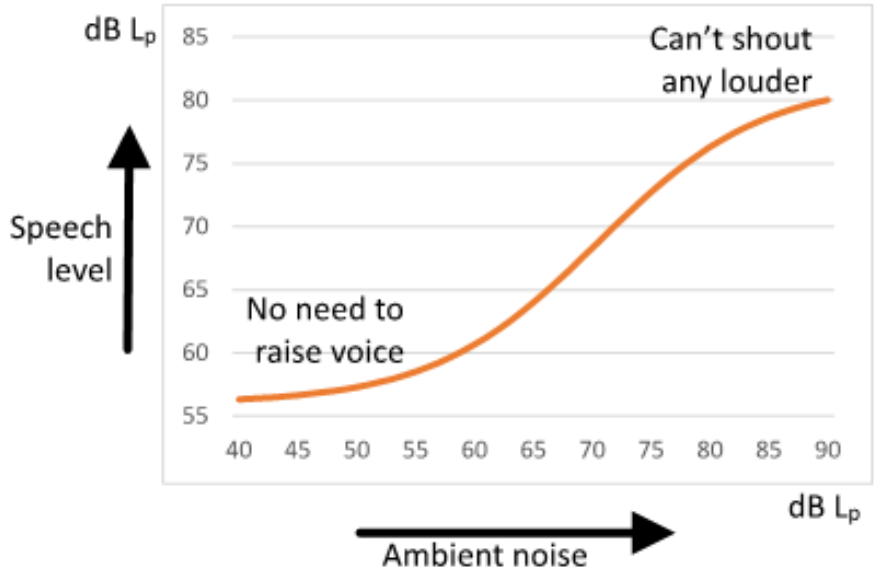


Figure 2: Lombard Effect [3]

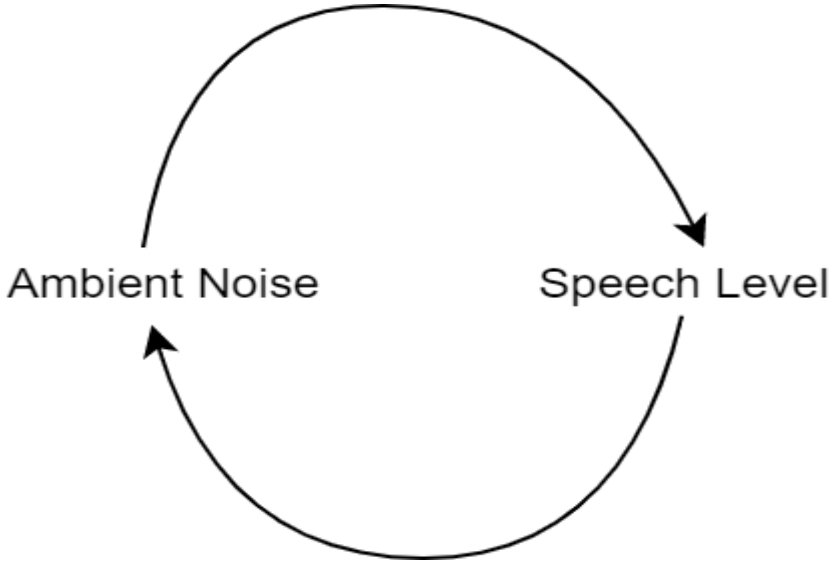


Figure 3: Lombard Effect Causation Diagram

Reverberation Time

How long a sound stays in the room without fully absorbed (Simplified). One of the main contributors of ambiant noise.

Recomended «Acoustical Capacity» is calculated with

Volume and Reverberation Time[4]

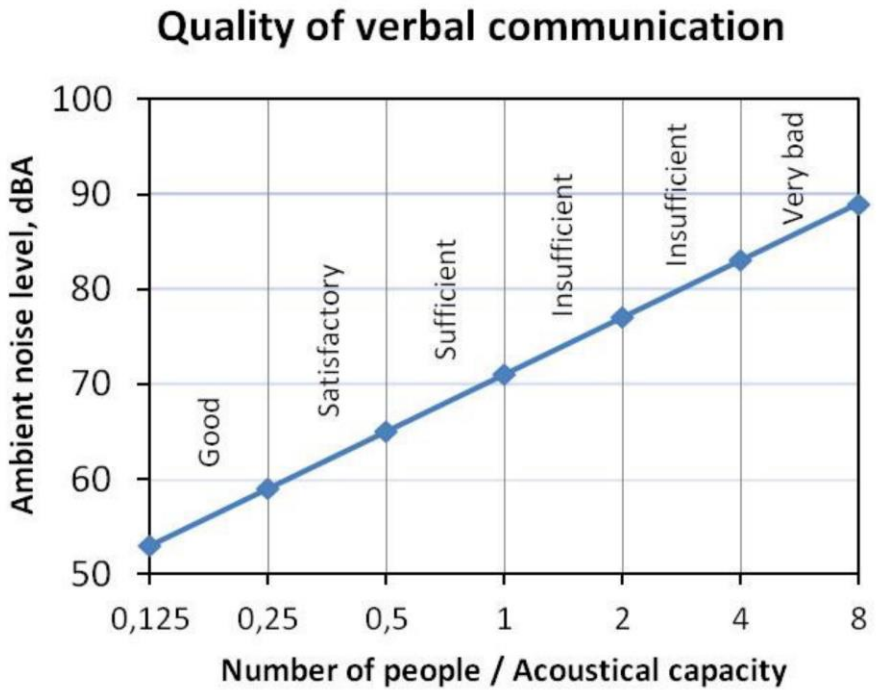


Fig 4: Ambient noise level and quality of verbal communication as functions of the number of people relative to the Acoustical Capacity. [4]

Introduction

Purpose

- Reduce the noise levels in Arada Kebab Restaurant.

Impact

- Create a good environment for conservation quality.

Significance

- Create a much more enjoyable dining experience in dining establishments.

Problem Definition

Study Area: Arada Ocakbaşı Bahçelievler (Kebab Restaurant)

Has 20 tables. Approx **~ 100 Person**

Peak: 93 dB, Average: 78-82 dB

Problem: Too much ambiance (environmental) noice creates a low quality communucation for customers and staff.

Problem Definitition

Causes of the problem:

- Reverberation time
- Loud Music
- Loud Air Conditioning Units

Proposed Solutions

1. Acoustically Absorbent Wall Panels and Flooring

2. Smart Music Control System

3. Quieter Air Conditioning Units

Acoustically Absorbent Wall Panels, Flooring

Figure 5: Sound Panels Disguised [5]

Aim: Reduced Reverberation Time
Flooring: Epoxy, Vinyl, Cork

Figure 6: Vinyl Flooring [6]

Smart Music Control System

Controls music sound level considering current loudness and customer count.

Microphones, proximity sensor and software

Why not turn it down completely?

- Background music and background noise provides privacy. [6]

Figure 7: Installed Microphones in a dining area. [6]

Quieter Air Conditioning Units

Currently the resaurant is equiped with very noisy fans, which are trying to take out smoke and other odors.

Figure 7: Cassette AC Unit.[7]

Also, has a loudly working huge two Air Conditioning units and one heater fan in the service area.

Evaluation Criteria

Cost

- Cost of the flooring and wall panels
- Cost of the microphones, sensors and software
- Cost of the Air Conditioning Units

Feasibility

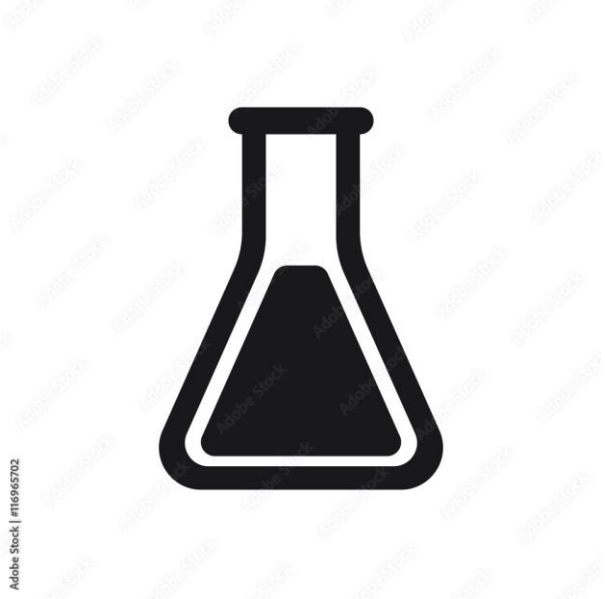
- The architectural permittable of new wall panels
- The feasibility of installing microphones around the restaurant.
- The architectural permittable of new AC units

Efficiency

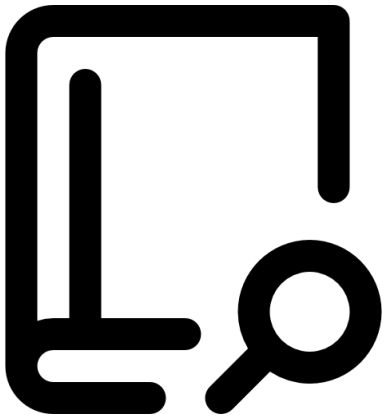
- The difference of reveb. time if walls and floor are applied.
- The efficiency of the software to control music to reduce sound levels of environment.
- The Difference between sound levels of old AC and new planned AC

Proposed Research Methodology

Experiments



Literature research



Market Search

Cost - Wall Panels

Figure 8: Ege Acoustic Panel [9]

Ege Acoustic: 3 cm thickness 50*50 cm sound absorbent panel.
166.7₺ per panel

NRC (Noise Reduction Coefficient) Value: 0.95 (Very Good Quality)[8]

Approximately 32x needed.

Total: 5.300 + 200 (installation cost) = 5.500₺

Cost - Flooring

Cost of the flooring cannot be exactly found, because:

- Due to the installation cost is varied place to place (time, logistics, etc.)
- Cost per area changes with the how big the applied area.

It is impossible to estimate a cost without, bringing expert from a flooring company.

Between 1000$ and 3000$. 10000₺ and 30000₺

Cost – Smart Music Control System

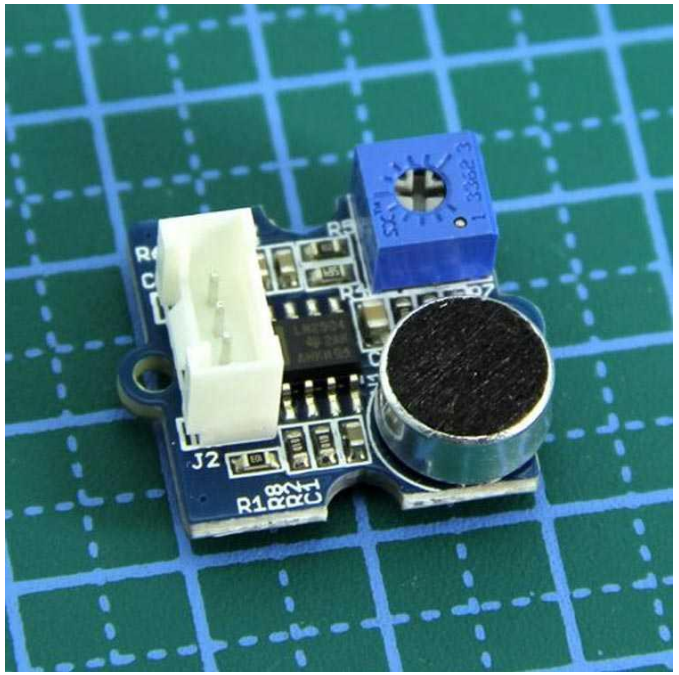


Figure 9: Grove Voice Level Sensor [11]

Arduino UNO 95₺ [10]

Grove Voice Level Sensor 137 ₺ per unit – 5x to measure everywhere 685₺ [11]

Cables – Resistors Negligable

Control Software (From freelance Indian programmer) 20$ - 287₺

Total: approx. 1100₺

Cost – AC Units

Figure 10: Bahçıvan BMFX-SL200 [12]

Replace ventialtion fans with quieter and better flow rate.

Bahçıvan BMFX-SL200 [12]

Flow – 840 m^3 / h **Voice Level - 35 dB**

Replace 3 existing fans with this.

3 x 2460 = 7380₺

Feasibility

Wall Panels	Flooring	Smart Sound	AC Units

The architectural permittable of new wall panels

Partially Concrete walls – OK

Partially Dry Wall – Needs extra considirations

The feasibility of installing microphones around the restaurant.

Microphones are very small and light - OK

The architectural permittable of new AC units.

The Bahçıvan BMFX-SL200 is choosen with considiration of feasability.

Feasibility - Flooring

Carpet

Cork Flooring

} Cannot be used due to cleaning issues

Possible Option:

Vinyl Tiles

Efficency – Wall Panels

The choosen Ege Acoustic Panels has %95 absorption rate.

8 m^2 of walls are covered.

Considering the **shape of the room** and **how much wall is covered** makes a very complex equation. Further evaluation by a sound engineer can give a approximate answer about how effective absorbtion will be.

Expected Efficency: High

Efficency – Flooring

There are Vinyl Acoustic Flooring available in market and products that claims to drop sound levels by 19 dB exists.[13]

Expected Efficency: High

Efficency – Smart Music Control System

Experiment 1:

11.11.21 (Saturday Night)

with one hour interval,

music is closed and customer's noise levels response is measured for 5 minutes.

Observed average drop: 1.32 dB

Not effective

Efficency – AC Units

Experiment 2:

4.11.21 (Saturday Night)

with one hour interval,

AC units are closed and customer's noise level's response is measured for 5 minutes.

Observed average drop: 2.24dB

Not effective

Efficency

Wall Panels	Flooring	Smart Music	AC Units

Efficency is the most importent criteria when deciding.

CONCLUSION AND RECOMMENDATIONS

	Wall Panels	Flooring	Smart Music	AC Units
Cost				
Feasibility				
Efficency				

Conclusion:
Only installing wall panels are **recomended**.
Flooring needs an **expert opinion** on cost and efficency.
Music control and replacing AC Units, further **academic research** is necessary before recomending.

Action Plan

If Wall panels and Flooring are found applicable by experts.

	D1 Monday	D2	D3	D4	D5 Friday	D6 Saturday	D7 Sunday	D8	D9	D10
Expert Opinion and price research										
Wall Panels Installation										
Flooring Applicaton										

Referances

[1] «NOISE INFOGRAPHIC - LEVELS BY DECIBELS» *Centers of Disease Control and Prevention. [Online].* Available: https://www.cdc.gov/niosh/topics/noise/infographic- noiselevels.html. [Accessed: November 1, 2021]

[2] https://restauranttechnologynews.com/2019/09/how-sound-panels-can-reduce-restaurant-noise-levels-protect-employees-hearing-and-improve-the-guest-experience/

[3] https://www.harmoniaconsulting.co.uk/noisy-restaurants

[4] https://odeon.dk/pdf/C116-BNAM_2012_Rindel_29.pdf

[5] https://sound-zero.com/acoustic-panels-for-restaurants/

[6]https://journals.sagepub.com/doi/full/10.1177/1351010X19897232

[7] https://nymag.com/intelligencer/2020/05/that-office-ac-system-is-great-at-recirculating-viruses.html

[8] https://www.sciencedirect.com/topics/engineering/sound-absorption-coefficient

[9] https://urun.n11.com/studyo-ve-sahne-ekipmanlari/3cm-kalinlikta-akustik-kumas-kapli-panel-5050-cm-P503073247

[10] https://www.robotistan.com/arduino-uno-r3-klon-usb-kablo-hediyeli-usb-chip-ch340

[11] https://www.direnc.net/grove-loudness-sensor-seeedstuidio?language=tr&h=7e7a5193

[12] https://www.elektromarketim.com/bahcivan-bmfx-sl200-yuvarlak-karma-akisli-kanal-fani

[13] https://www.forbo.com/flooring/tr-tr/uruenler/heterojen-vinil/modul-up-19db-serbest-doesenebilir-vinil/bz7bzs#panel_104