Novel

Immersive Sounds Interactivity

using GIS Maps Application

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ISGC Oral Presentation
DATED: **23 OCT 2023**

Under. Aegis of
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LIST OF CONTENTS

During this Thesis Proposal, we shall go through the following segments to identify, understand and prospect the ideas brought forth.

01

INTRODUCTION

ABSTRACT | RESEARCH BACKGROUND

Among the **five central senses** we use to perceive the world around us, nothing is more salient that our **sense of hearing**.

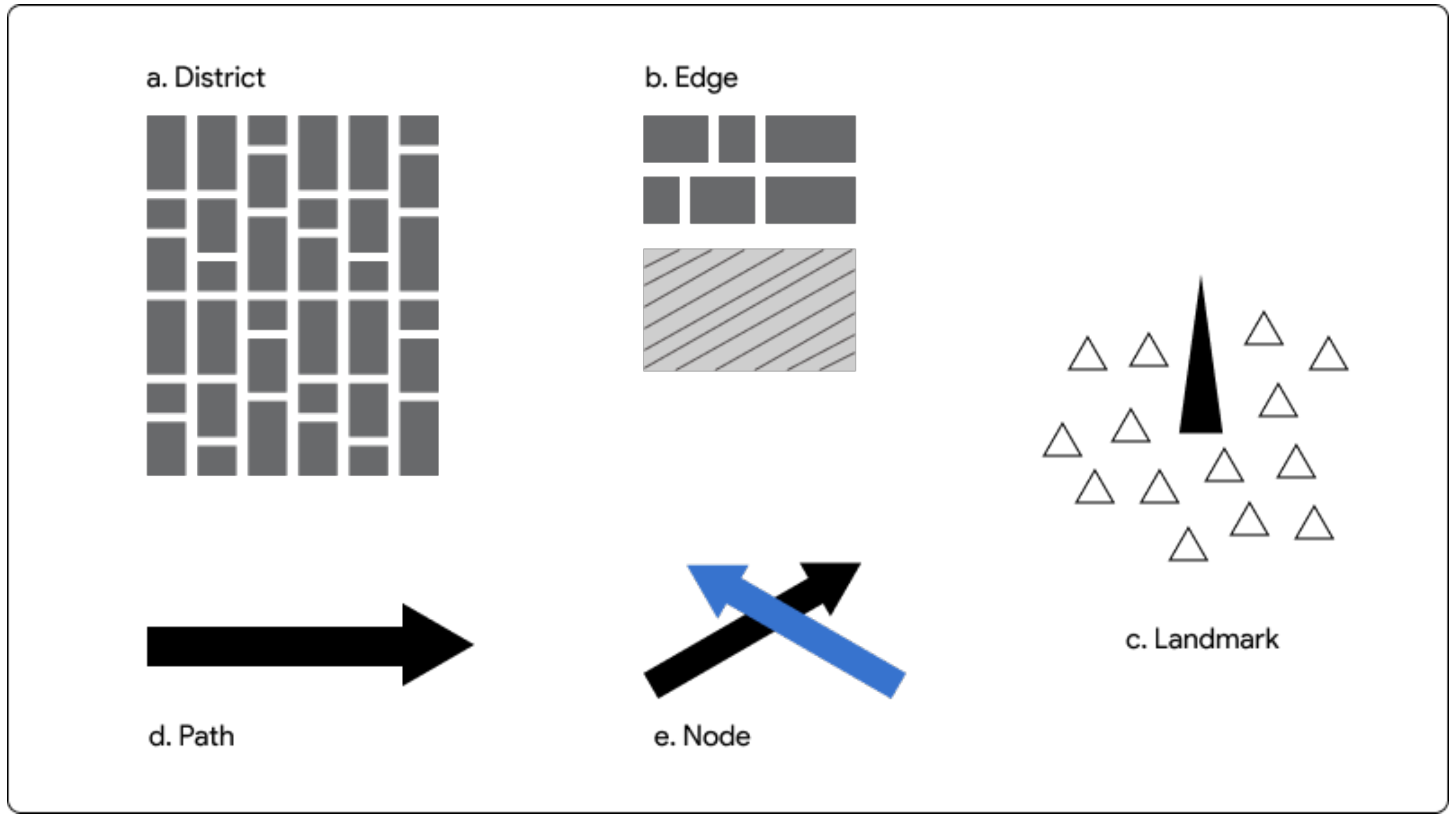
ONE CAN CLOSE THEIR EYES, BUT NEVER THEIR EARS.

Sounds play a very important role in how we understand, behave and interact with the world around us

In this research study, we propose design and development of a **GIS-based maps application** that would allow users to not only navigate, and see pictures of landmark locations in their urban city-environment, but also **enable them to hear the immersive spatial sounds of the area.**

We do not realize, but sounds **play a very critical part** in the feeling of immersion whilst in the digital-scape.

Most **GIS Apps** pay heed - is given to the **visceral (visual) and information part a**nd interaction amongst it, l**eaving behind** the aforementioned critical sound information behind.



Even in the **Academic Field,** most research focus on **noise mapping**, effects of noise over its concerns of traffic , **environmental and physio-psychological implications**

Audio Augmented Reality (AAR) - a significant effect and enhance the experience for **urban tourism and exploring services**

02

GOALS OF STUDY

MOTIVATION | RESEARCH QUESTIONS | OBJECTIVES | LIMITATION

Motivation

(i) The ability for future maps to not only provide basic information about geography and events, but also how a place sounds and "feels" like

(ii) How introduction of a new Immersive Sounds Paradigm would change their behaviours

(iii) Industry Wide: Introducing a whole new paradigm to GIS Map Applications with Immersive Sounds providing new interactivity measure

Understanding how current digital natives use GIS Maps Applications for their day-to-day work

Design and Development of a service which would leverage the novel immersive sounds interactivity in its GIS Maps

Evaluate and Analyse this application service, and future research scopes

Objectives

RESEARCH QUESTIONS

A. How does the Environmental Sounds affect decision-making of users during usage of GIS applications for finding landmark locations in urban environments?

This RQ aims to answer the fundamental question of what and how sounds might affect the process while the users are in the application looking for specific locations / exploring.

B. What factors underline this effect, and how can it be improved for better user immersion, usability and experience?

After understand the underlying factors and they play part in or against overall engagement and experience, we would focus to making best use of these factors to elevate results for the prototype.

C. How can these findings be used for design and development (fabrication) of a service targeted to use sounds as novel interactivity within Maps?

With all results and finding form the previous stages, design a service module around those concepts, and then developed a prototype system. Evaluate this system through usability tests application of questionaries frameworks.

RESEARCH IMPORTANCE

This might be basically divided into three sections.

Immersive Maps of the Future

Environment & Sounds

AR & VR

03

LITERATURE REVIEW

INTERACTIVITY WITH SOUNDS | SD & EVALUATION METRICS

LITERATURE REVIEW

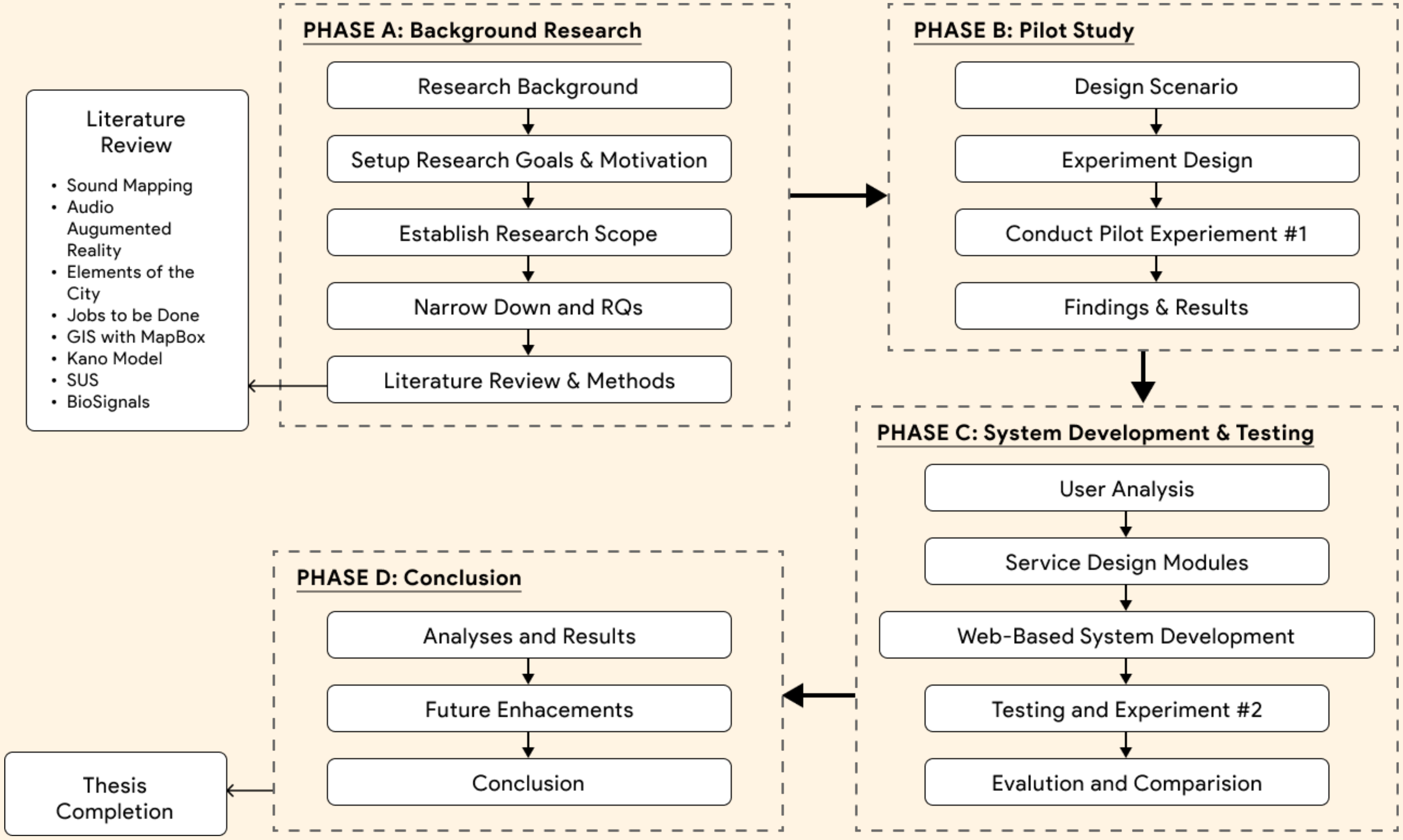
Applied Field	Description	Citation
Interactivity & Sounds	Noise Mapping	(Anachkova et al., 2021; Aumond, Jacquesson, et al., 2018; Gloaguen et al., 2019) (Y. Liu et al., 2020)
	Audio AR	(Bederson, 1995). (Bandukda & Holloway, 2020) (Boletsis & Chasanidou, 2018b) (Mynatt et al., 1997) (Boletsis & Chasanidou, 2018a)
	Elements of a City	Lynch, K. (1964). The Image of the City. MIT Press.
SD, and Evaluation Approach	System Usability Scale	(Lewis, 2018)(Bangor et al., 2008) (Kaya et al., 2019) (Kortum & Bangor, 2013).
	Analytical Hierarchy Process	(Khan & Ali, 2020, pp. 2000–2019). (Hammami et al., 2019) (Elshafei et al., 2022). (Leal, 2020)
	Kano Model	(A Holistic Approach to Manage Environmental Quality by Using the Kano Model and Social Cognitive Theory - Dace - 2020 - C - Wiley Online Library, n.d.)
	DEA & MapBox Development & Others	(Peykani et al., 2020) (Charles et al., 2021). (Mapbox GL JS, n.d.; Mapbox GL JS, n.d.) , (Eriksson & Rydkvist, 2015)(Mete & Yomralioglu, 2021)(S. Liu et al., 2016)

04

RESEARCH FRAMEWORK

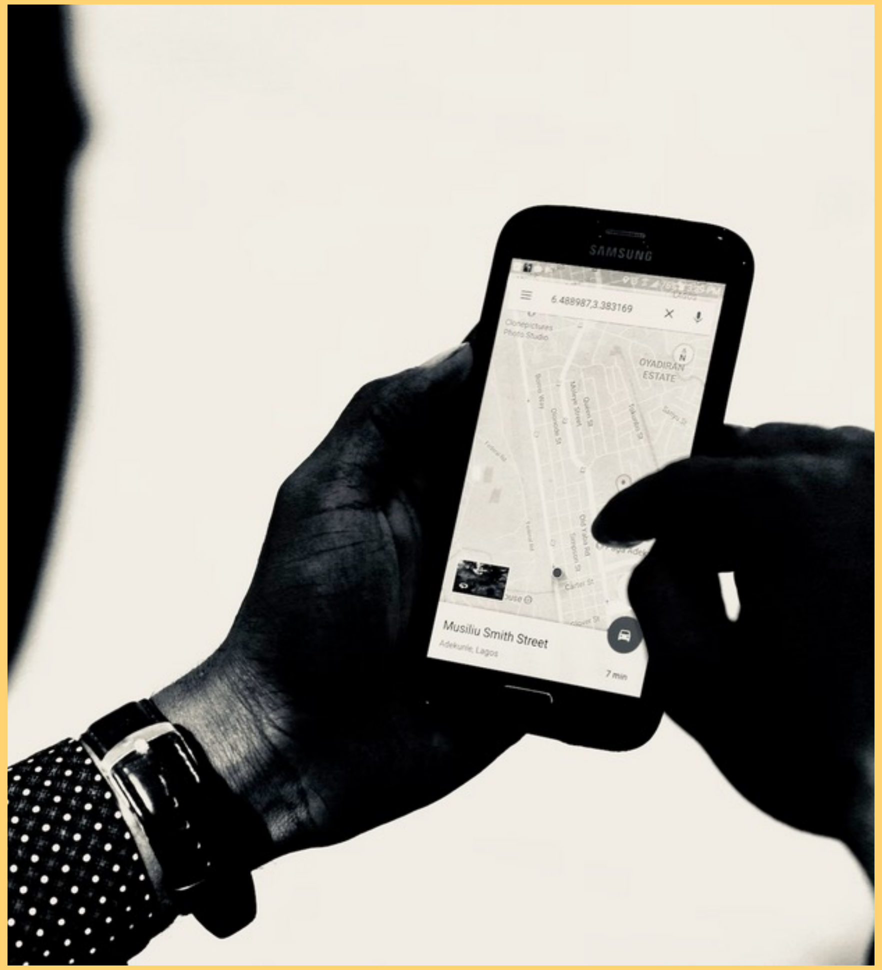
RESEARCH STRUCTURE | USER ANALYSIS | SYSTEM DEVELOPMENT

RESEARCH STRUCTURE



SYSTEM DEVELOPMENT

The GIS Maps mobile application based on PWA, web-technologies would be developed using these, with inclusion of Mapbox API



mapbox

React JS

JS

node JS

supabase

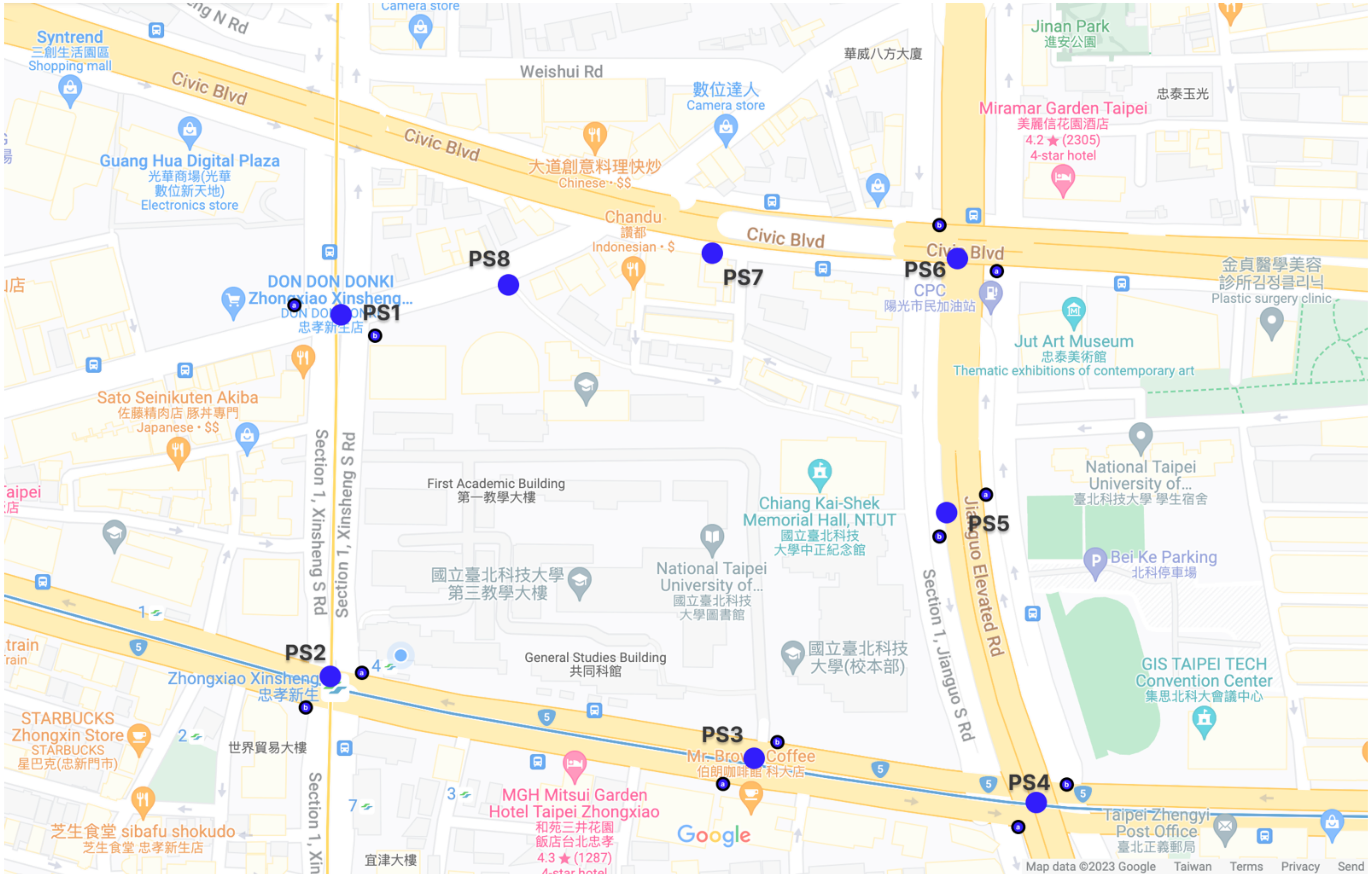
05

PILOT STUDY

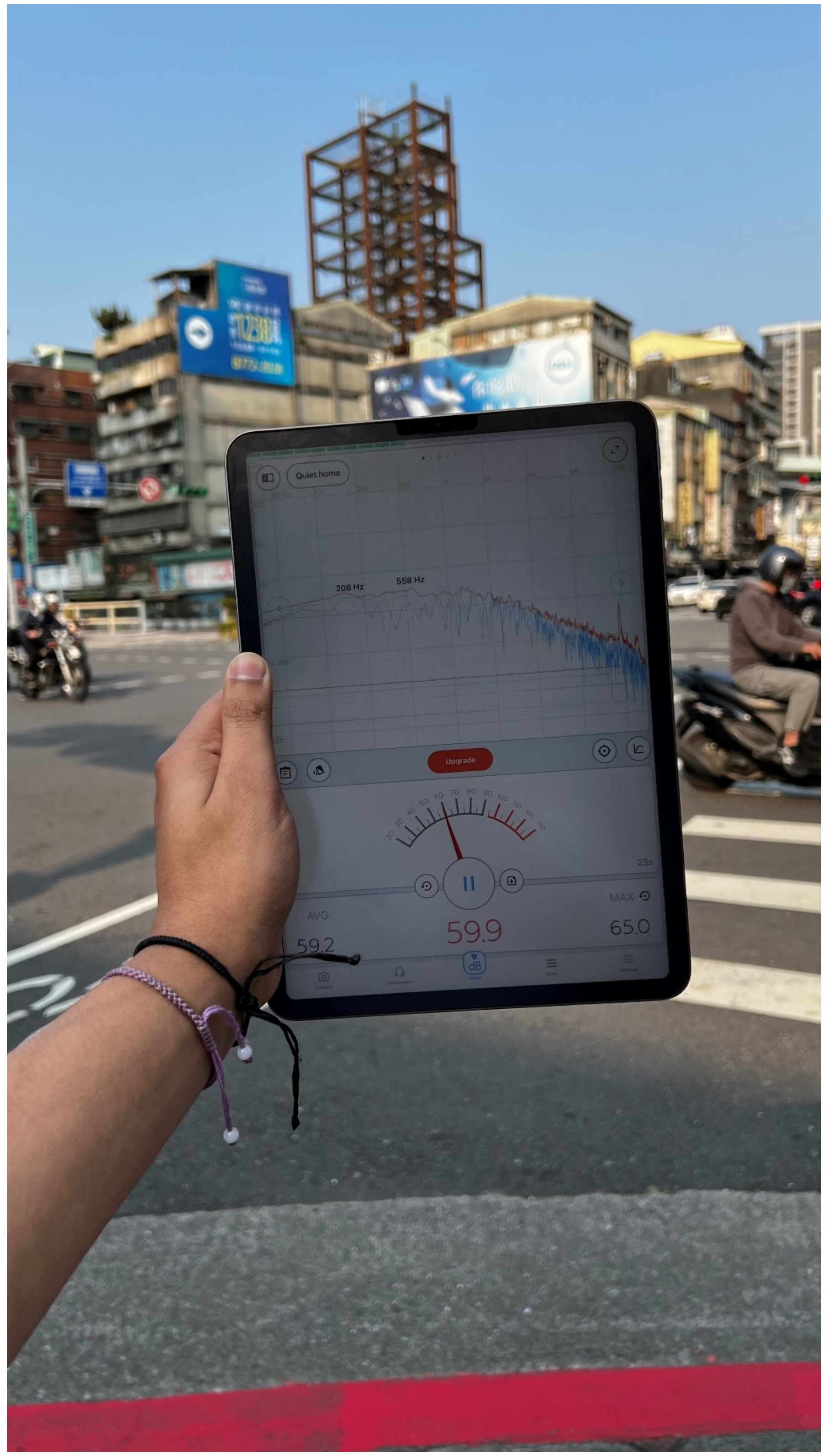
RESEARCH SCHEDULE | RESOURCES REQUIRED

PILOT STUDY AREA

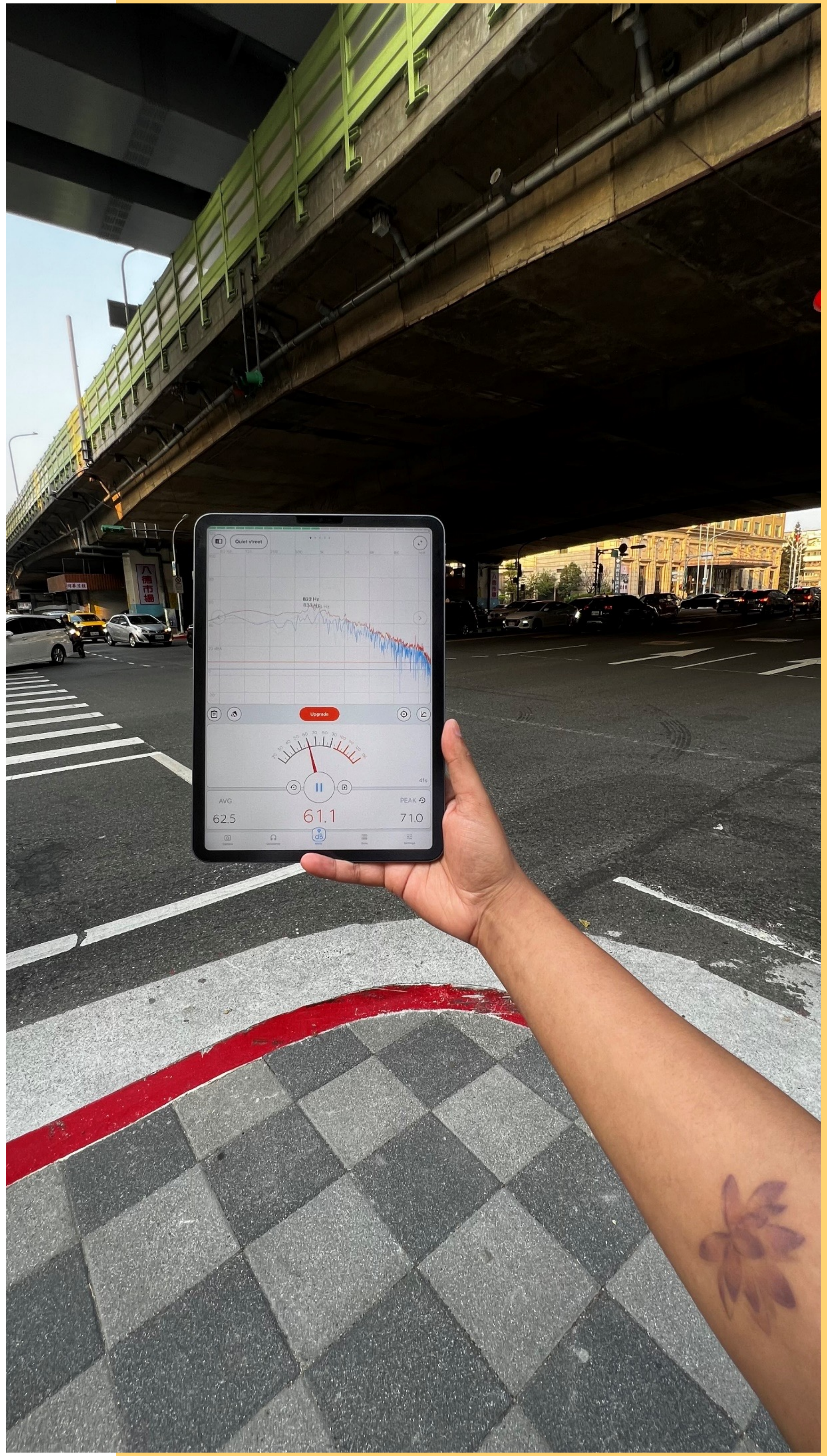
- The noise-data was collected at 8-points around **National Taipei University of Technology** Area.
- The noise-data was collected for a **duration of 120s**; at **Frequency Weighting dB(A)** with a **Slow Response Time of 500ms**
- With the data-collected, we used **Noise-Modelling Application** with WPS Builder and **QGIS** to visualize the **noise-propagation** in the area, and estimate levels.



PICTURES


AVG
59.2
59.9
MAX
65.0


ISUZU
AVG
59.1
62.6
PEAK
71.6

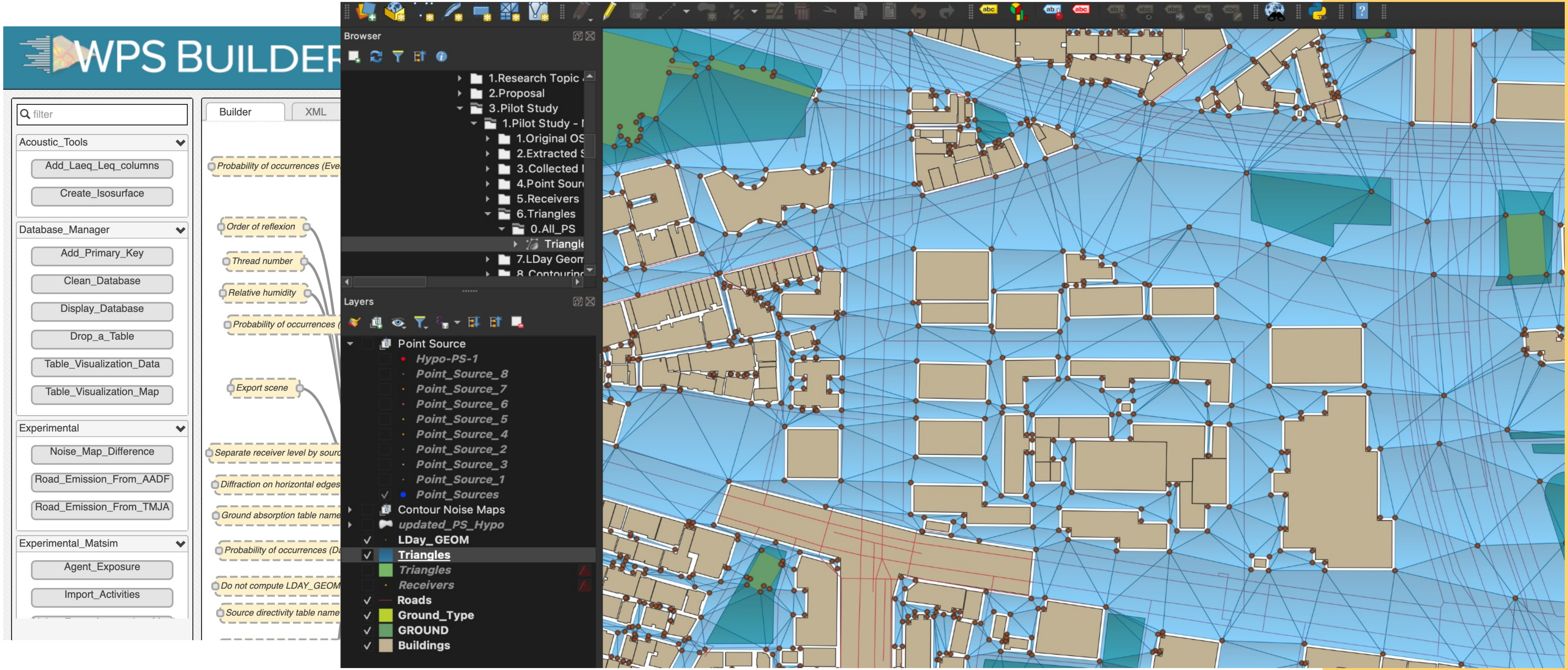

AVG
62.5
61.1
PEAK
71.0

DATA COLLECTED & PROCESSING

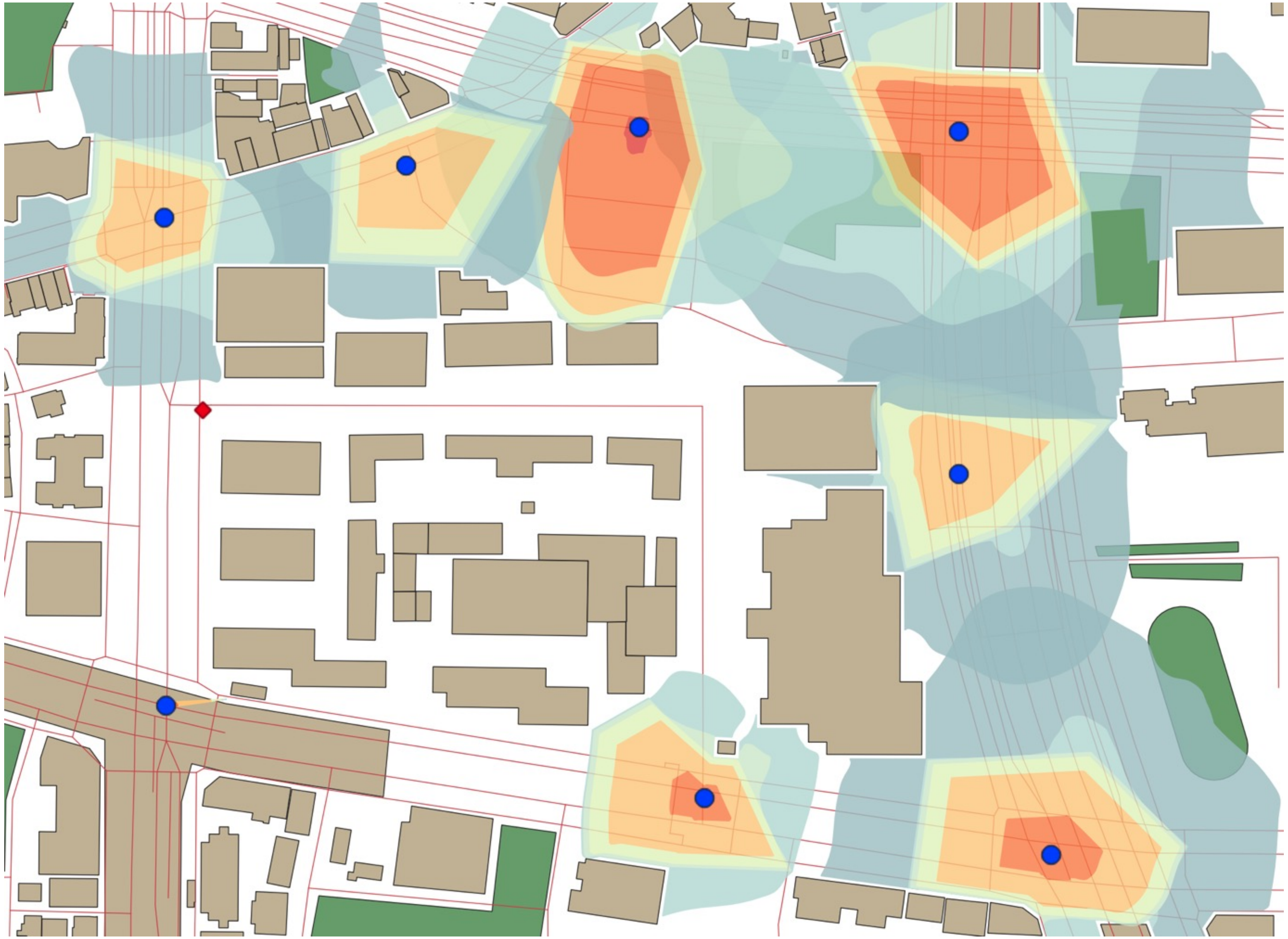
Point Source (PS)	Datapoint	Minimum - dB(A)m	Maximum - dB(A)M	Peak - db(A)p	Average - dB(A)a	Exported Value - avg. [(dB(A)a]
1	a	51.7	67.9	72.8	58.4	**59.1**
	b	48.8	68.7	73.6	59.8	
2	a	51.1	70	72.6	59.2	**59.65**
	b	50.3	69.1	71.2	60.1	
3	a	43.8	71.3	74.6	61.7	**60.5**
	b	46.4	73.4	78.2	59.3	
4	a	49.3	68.3	71.6	61.2	**61.05**
	b	47.2	68.1	70.7	60.9	
5	a	43.4	62.6	66.9	56.7	**57.75**
	b	52.4	69.8	72.4	58.8	
6	a	54.1	74.3	78.3	63.4	**64.35**
	b	52.3	71.2	75.1	65.3	
7	N/A	54.2	72.5	77.2	64.7	**64.7**
8	N/A	52.8	71.3	74.4	58.3	**58.3**
99 (hypo test)	N/A		HYPO DATA			**80**

Table 1: Collected Noise Data

NOISEMODELLING WPS & TRIANGULATION



GENERATED NOISE PROPAGATION MODEL

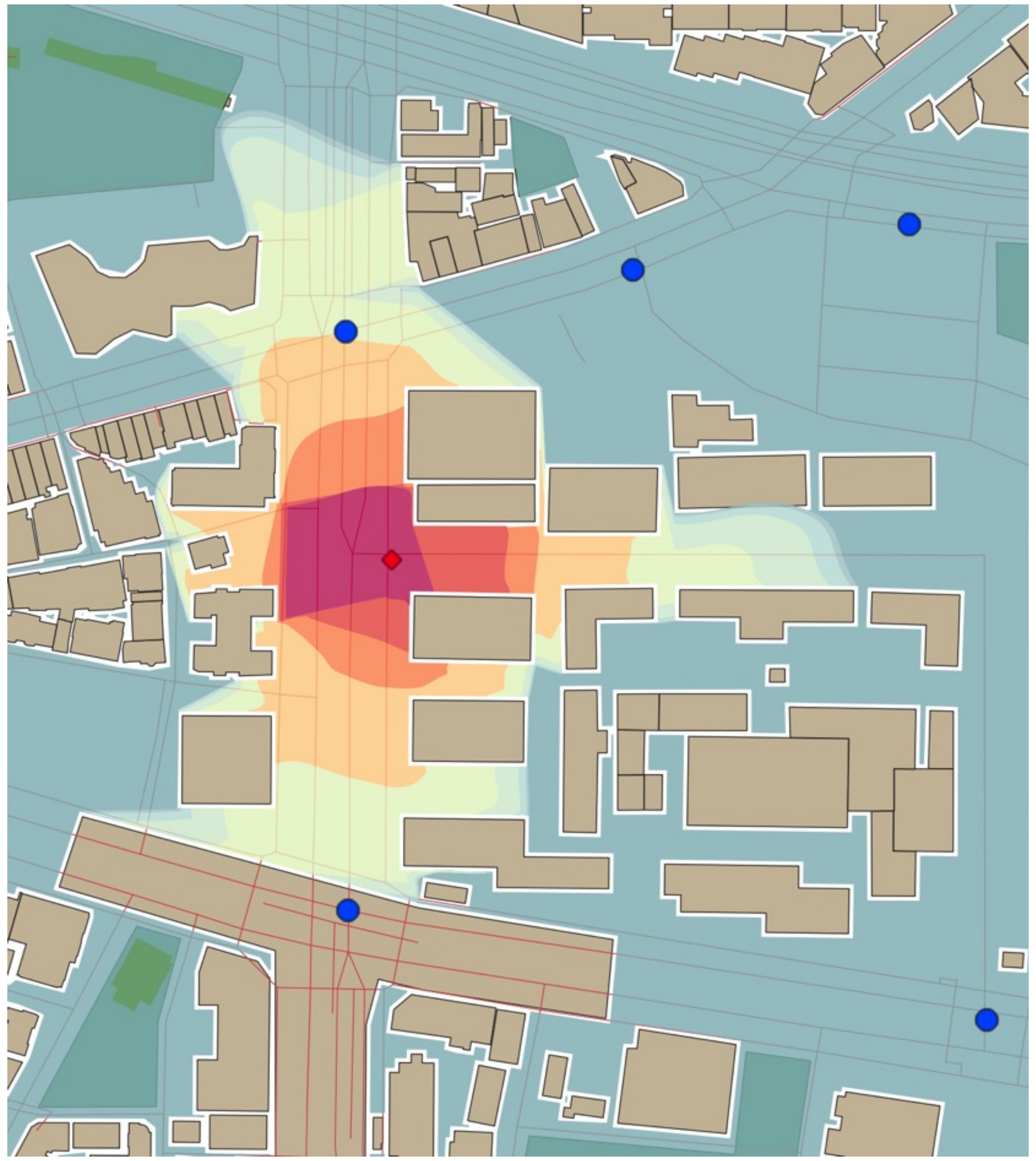


PILOT PHASE II

- Select one particular Source Point (SP) and measure noise-levels and propagation over **different points simultaneously**.

- Understand how well different architectural structures in the vicinity suppress (damp) or re-direct noise. Eg: **Green Gate at NTUT**, Open Building Corridors, et cetera

- Evaluate **Noise Modelling Application** Performance and **Limitations** for future projects and case-studies



(i) Calculated Contour Noise Map Generation (Hypothetical Point); (ii) NTUT Green Gate

06

LIMITATIONS & FUTURE WORKS

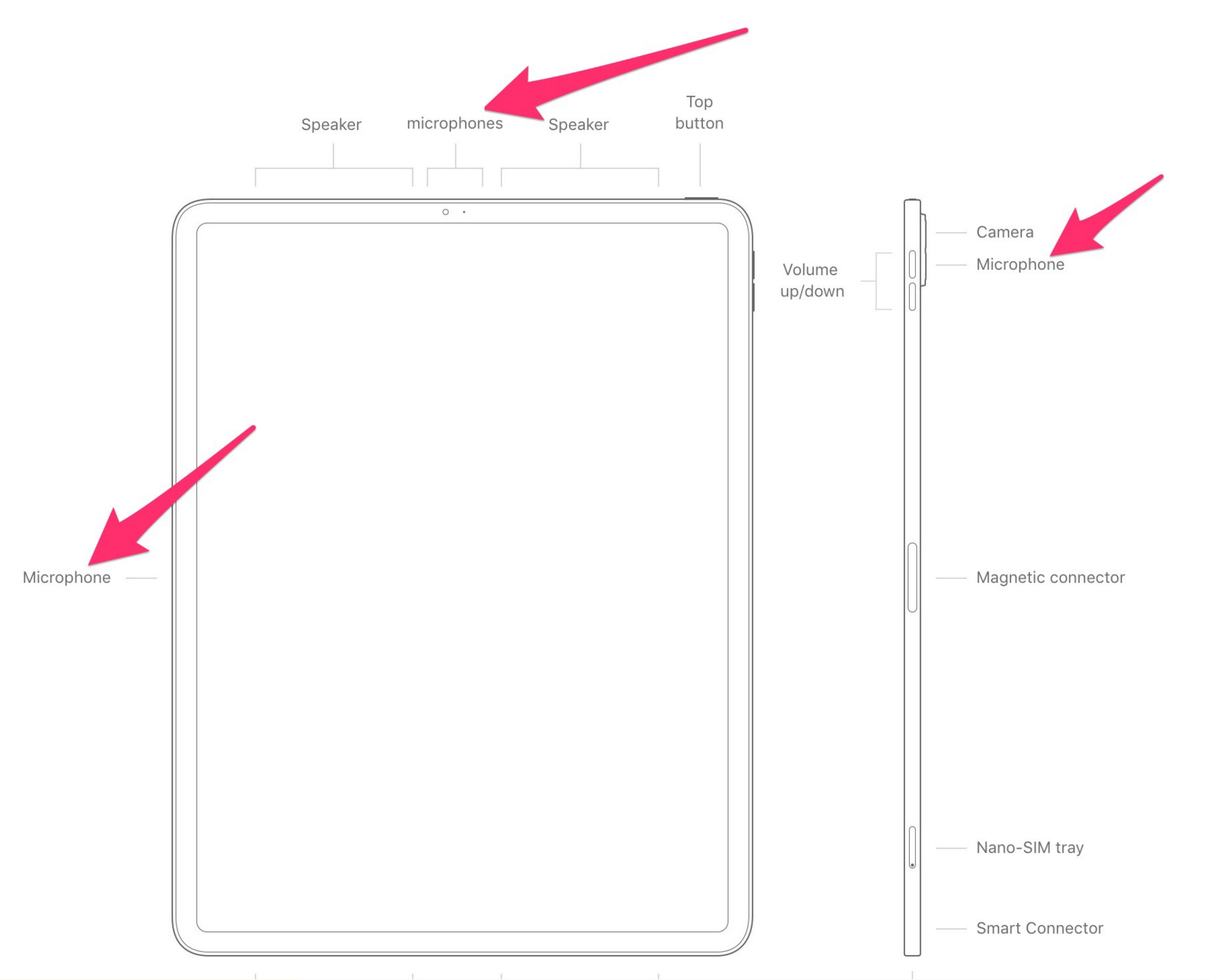
LIMITATIONS | FUTURE WORKS & ADVANTAGES

LIMITATIONS

(i) **Calibration of Device** – The noise data was collected from an iPad 11 Pro, which has 5 directional microphones. There is lack-of-confidence on the data since the device itself was not calibrated in a professional or semi-professional setting of noise capture.

(ii) **Collection of Noise Data (h/w)**– The noise data itself has a high likelihood to be inaccurate taking into consideration the device itself, which is made for human-speech optimization and not environmental.

(iii) **Software** – Preferable, environmental noise data should be collected at 500Hz, with dB @ A-weighting (dB(A))



FUTURE WORKS & ADVANTAGES

PRIMARY GOALS

Allowing mass-users to collect, and enable them for **open-source mapping** of noise in **Urban Environments**

Calibration of Devices (Mobile Phone) & **Meshing Mapping Technique**

Application Development as a **POC** – roll out to users and smoothline better noise-mapping in urban environments

LONG TERM PLANS

Understanding how **architectural components** and **human-behaviour** interacts with **Noise in Urban Spaces**

Model for providing a more **realistic Sound-Propagation & Sensing** in **Virtual Reality / Metaverse** Settings

Development of Solutions for actively combatting **Noise Pollution** with knowledge in **Monitoring** and its **Effects**

THANK YOU

Will pay heed to your all feedbacks and critical judgements

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