MusiCityX: Conceptual Tools for Urban Architectural Design through Music Composition

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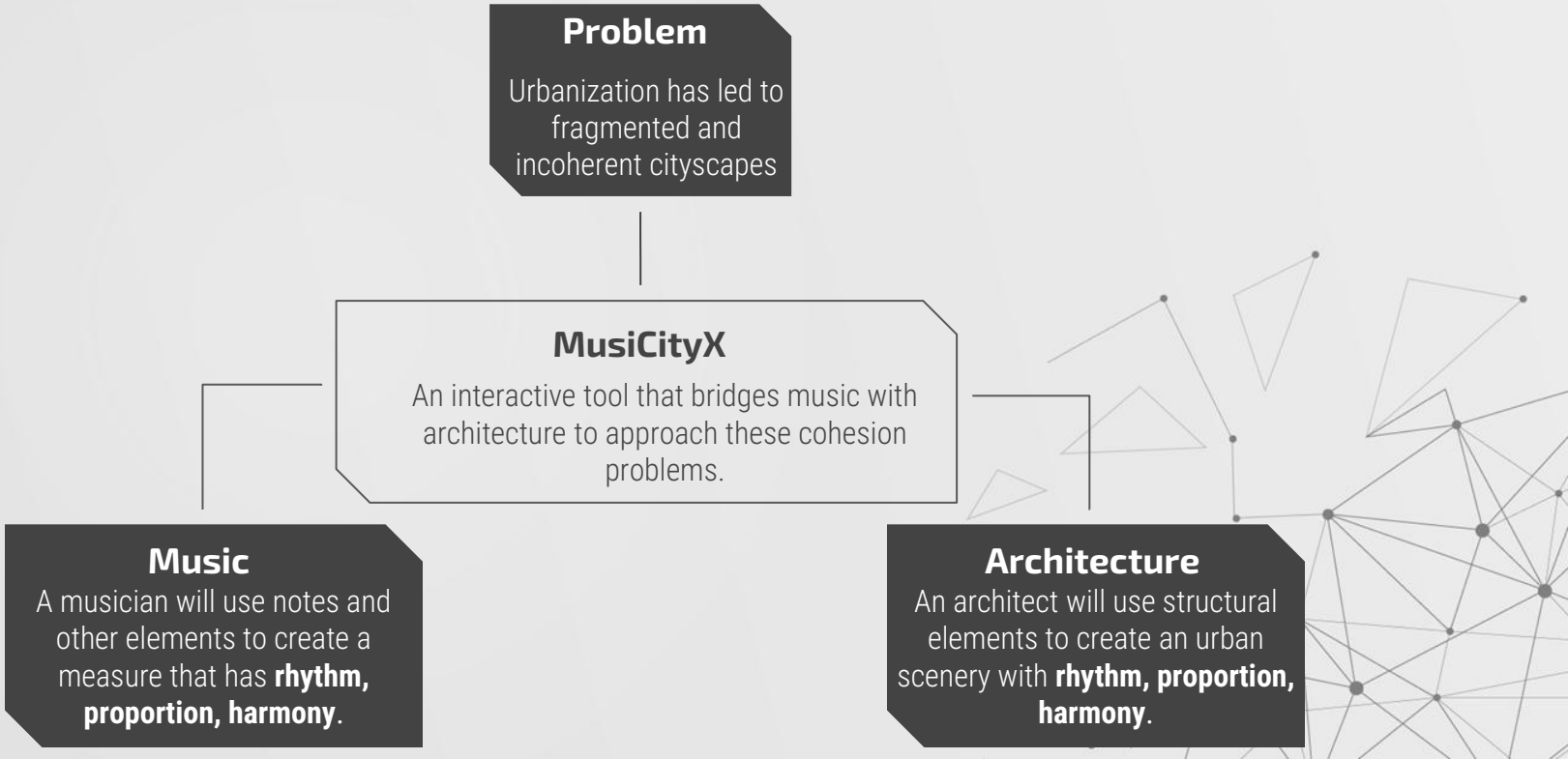
Theoretical Approach

MusiCityX can result to **a creative experience** composing urban environments with different aspects that would not result only through the vision-based digital designing tools.



Connections of music with architecture

VITRUVIUS

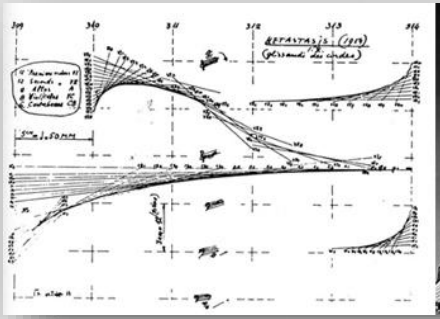
The architect should have a **knowledge of music** in order to grasp **mathematical relations**.

GOETHE

"Music is liquid architecture; Architecture is frozen music"

PALLADIO

"The proportions of the voices are **harmonies for the ears;** those of measurements are **harmonies for the eyes**."



NOVAK

“Archimusic”
Describing the art and science resulting from the conflation of architecture to music

XENAKIS

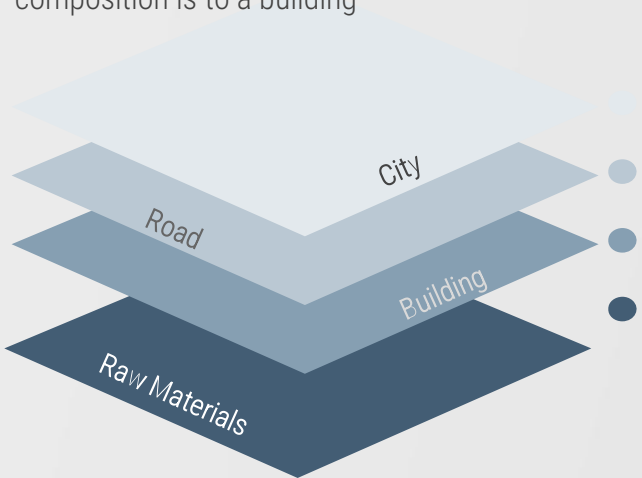
Composing music through the use of mathematics.
Composing buildings through music.
Phillips Pavillion

Composition: A Shared Language of Music and Architecture

From an **atom** to the **universe,** everything around us is a composition of things.

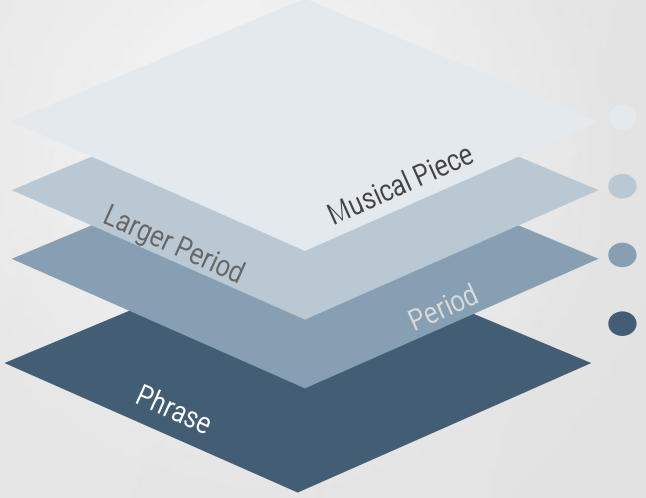
Urban Composition

- Gives form & order to the city
- Transforms **raw materials** → **roads** → **buildings** → **city**
- In cities, urban composition = what architectural composition is to a building



Musical Composition

- Smallest unit = **phrase** (“musical molecule”)
- Phrases form **periods** or **sentences**
- These combine into larger pieces → full musical work



Translation - Chords

triad = structure

- Every building is being translated into a **Western triad (1–3–5) – chord**
- 1st = root (scale); 3rd = quality; 5th = structure
- Add extensions on top when needed
- **The length of the chord is the length of the building's face.**

N extensions

5th

3rd

1st

Number of floors

5th factor

Height of the ground floor

3rd factor

Color

1st factor

Color

Architecture
The color does not impact a single building, but the whole image of a street.

→

Music
The root note does not impact a single chord, but it affects its connection with the other chords.

HSV = Hue Saturation Value

V \ S	H = 180° (Cyan) 1	¾	½	¼	0	H = 0° (Red) ¼	½	¾	1
1									
⅞									
¾									
⅝									
½									
⅜									
¼									
⅛									
0									

Divide: 2 categories / 2 octaves / 2 lists
$S > 0.625 \;||\; S \leq 0.625$

$$V_{new} > V_{old}$$
$$S_{new} < S_{old}$$
$$H_{new} < H_{old}$$

Highest Note

Lowest Note

Height of the ground floor

Architecture

- The height of the ground floor **(HGF)** is at eye level so it changes the spectator's view greatly.
- 4 choices (2.5 m, 3 m, 3.5 m, 4 m)

Music

- **3rd factor** defines if the chord is major minor or suspended, so it offers a big level of impact
- Offers the needed options for the translation of the HGF

S_{HGF} = {1,2,3,4}, (2.5m→1, 3m →2, 3.5m →3, 4.0m→4), $HGF_{option} \in S_{HGF}$

Calculate the average HGF for every road: $HGF_{average}$

For every building calculate: $Difference = HGF_{average} - HGF_{option}$

$$PositionOfNote = 5 - Difference$$

1	2	3	4	5	6	7	8	9	10	11	12	No.
1				5			8					major
do	do#	re	mib	mi	fa	fa#	sol	lab	la	sib	si	
do#	re	mib	mi	fa	fa#	sol	lab	la	sib	si	do	

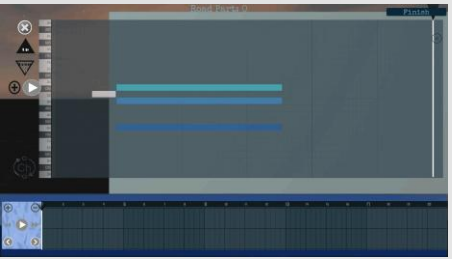
Number of floors

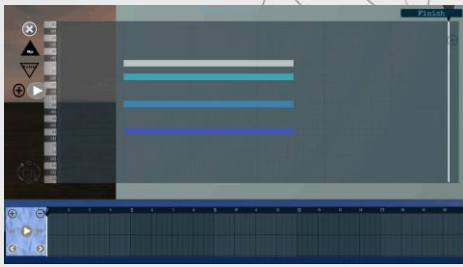
Architecture

- The number of floors (NF) affects the urban design.
- The widest range of options

Music

- 5th factor defines if the chord is augmented or diminished, so it has a great impact to the chord
- The only factor that can cover the range of options





S_{NF} = {1,2,3,4,5,6,7,8,9,10}, $NF_{option} \in S_{NF}$

Calculate the average NF for every road: $NF_{average}$

For every building calculate: *Difference* = $NF_{average} - NF_{option}$

If $NF_{option} < NF_{average} - 1$:

$PositionOfNote = 7$

$PosExtraNoteBefore = 9 - |Difference|$

If $-1 \leq Difference \leq 1$:

$PositionOfNote = 8 - Difference$

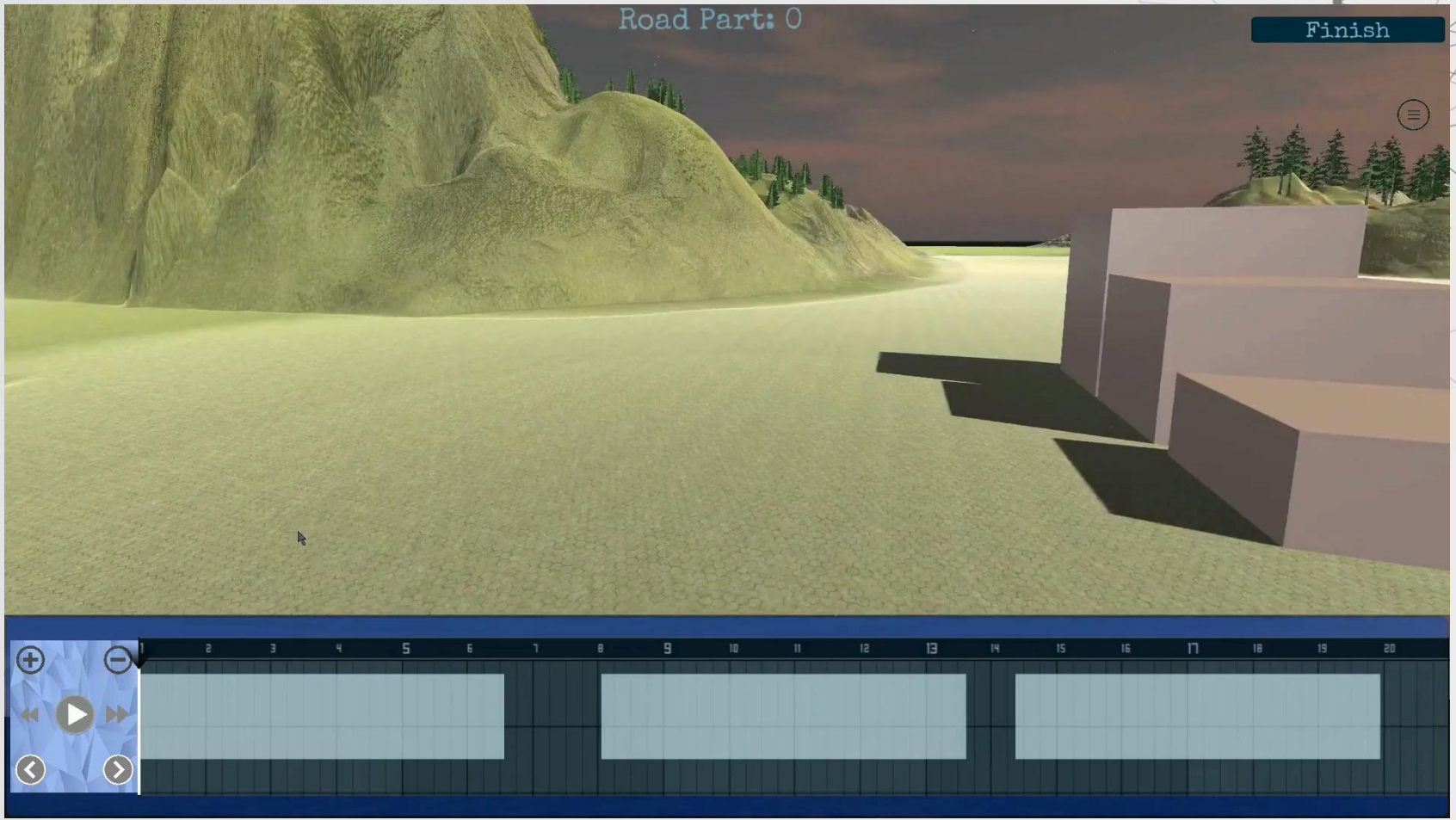
If $NF_{option} > NF_{average} + 1$:

$PositionOfNote = 9$

1	2	3	4	5	6	7	8	9	10	11	12	No.
1				5			8					major
do	do#	re	mib	mi	fa	fa#	sol	lab	la	sib	si	
do#	re	mib	mi	fa	fa#	sol	lab	la	sib	si	do	

Difference	PosExtra[1]	PosExtra[2]	PosExtra[3]	PosExtra[4]
2	11	X	X	X
3	12	X	X	X
4	12	14	X	X
5	12	15	X	X
6	12	15	17	X
7	12	15	18	X
8	12	15	18	20
9	12	15	18	21

Number of floors



Melody

The **elements** added to every building such as windows, doors and balconies are being translated into the **same notes** of the chord of every building creating a **melody** playing on top of the chord.

The **length** of the notes are defined by the length of the elements.
The **position** of them are defined by the position of elements on the x-axis of the building's face.
If the building has a roof then **we add the root note with violin**

5th factor

Windows

3rd factor

Balconies

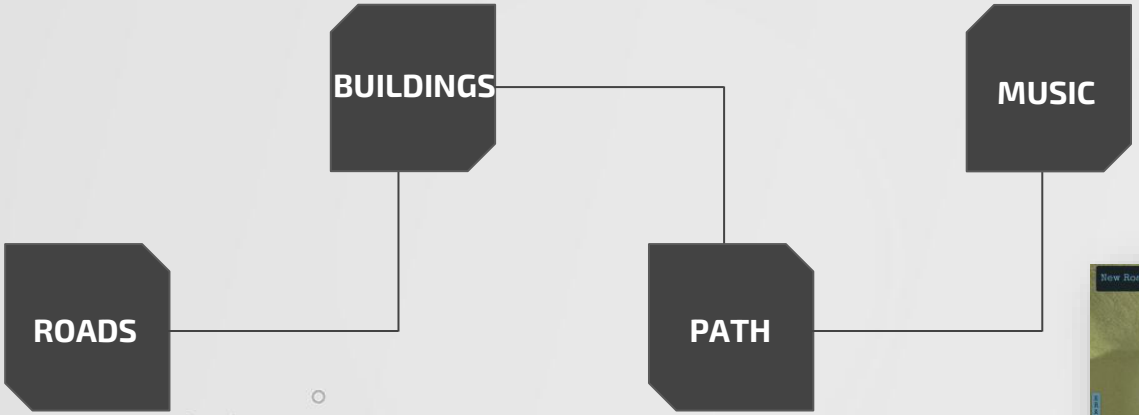
1st factor

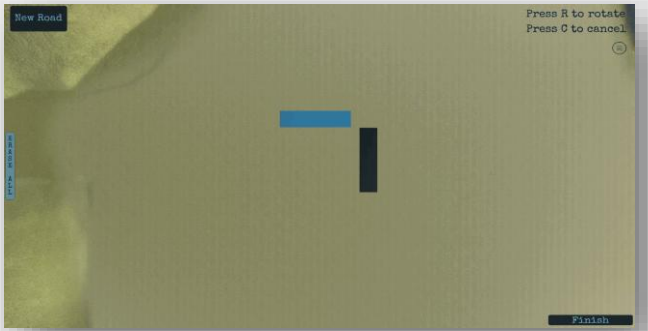
Doors

Melody

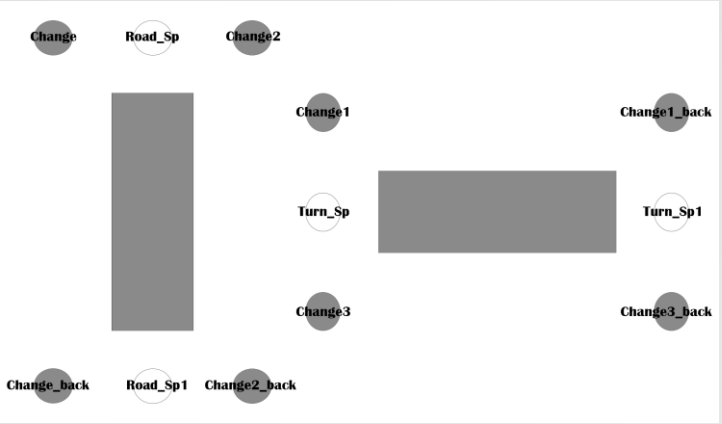
System Overview

The program is subdivided into **four** parts.

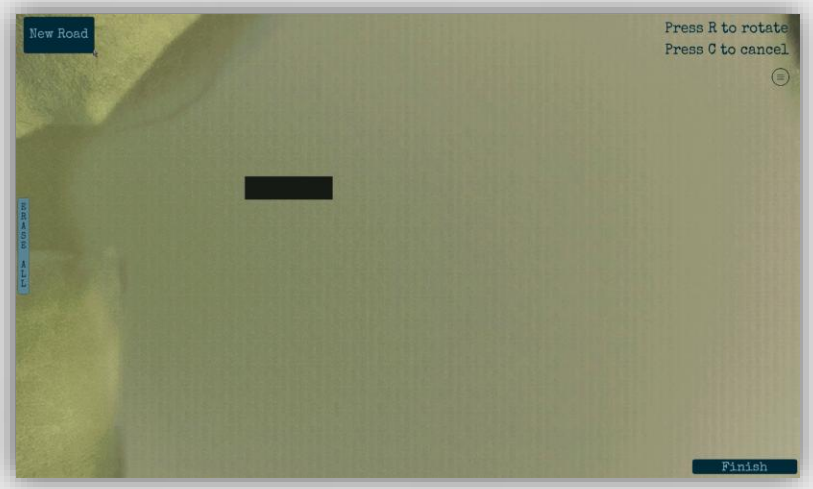




Roads



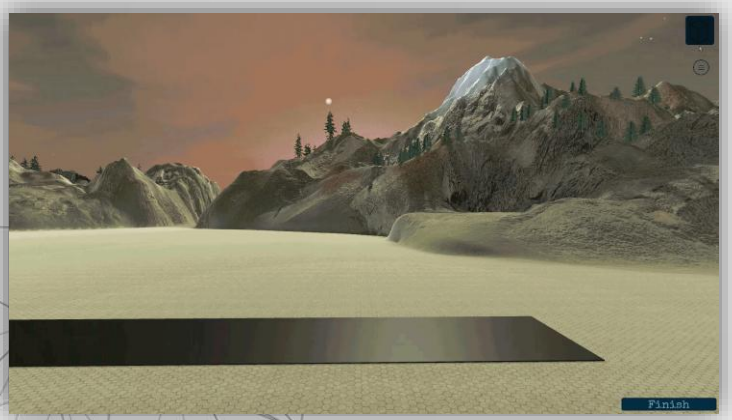
- Press “New Road”
- Instantiated a **prefab**
- **2 prefabs**
- **Use of collision triggers** to determine how the road must be placed
- **If it’s a turn it adds an extra turn road prefab**

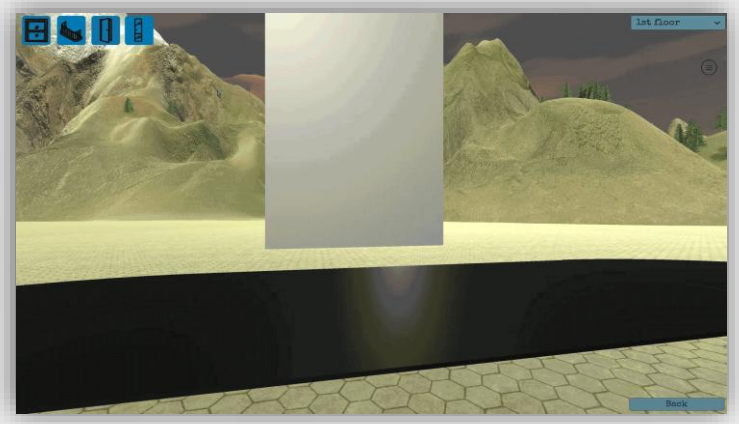


Buildings

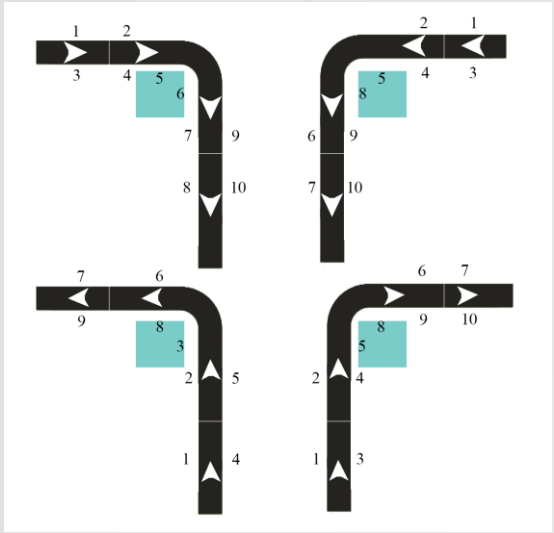
- Press the **building button**
- **Building Control Panel** activates
- Insert **parameters** and press “Build”
- A building **prefab** is instantiated
- A **collision** occurs near a road to place it
- Place the building

- **Press on a side** of a building
- **UI for adding elements** appear (elements based on Revit)
- Choose a floor and an element
- A function determines **the height** that this element will appear **through the chosen floor, the total height of the building and the HGF**.
- Move the element through the x-axis and place it

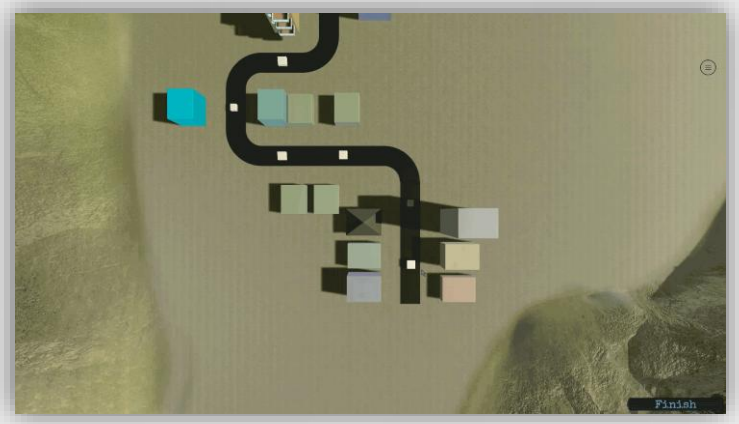




Path



- Choose a road
- A function adds it into the **list of the roads to be translated**
- **The order you choose the roads defines the direction of the translation**



Music – path

On the subdivision of music the **main screen** is divided into two parts and there are **two cameras** activated at the same time.

The **top part** that covers **75%** of the screen is used by the camera that allows the user to **move** and **interact** with their surroundings.

The **bottom 25%** of the screen is used by the camera that shows the screen space - camera canvas that has the **main Digital Audio Workstation (DAW)** where the **chords of the buildings** of every part of the roads **appear as white squares followed by their melody.**

The user through this DAW can:

- **Listen to the music translation of the path**
- **Change every building's position and length**.

Music - building

When the user **clicks on the building** they want to interact with another DAW appears on the top screen which is the **individual DAW** of the chosen building.

In this DAW the **notes of the chord** are shown **separately** and the notes of the melody are also there.

The user can **choose the note** they want to change and buttons will appear to choose how they want to **change this note**.

While changing the note they will notice the **instant change** of the corresponding architectural compound.

Evaluation

Demo

Tasks

1st task: 1 road, 1 building

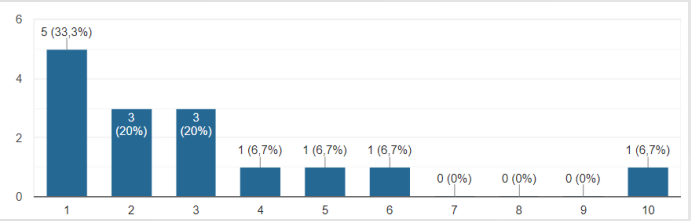
2nd task: 1 road, many buildings 1-3 floors, 1 building higher than 7 floors

Questionnaire

3 sections

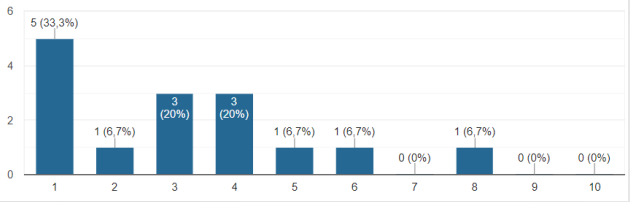
Questionnaire

1st section: education and knowledge in music

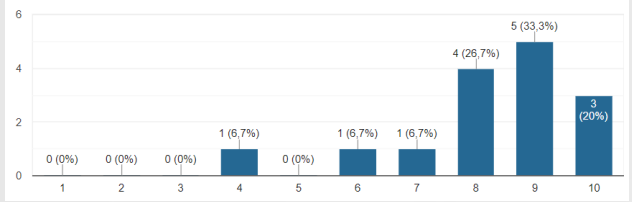


1. Music Knowledge

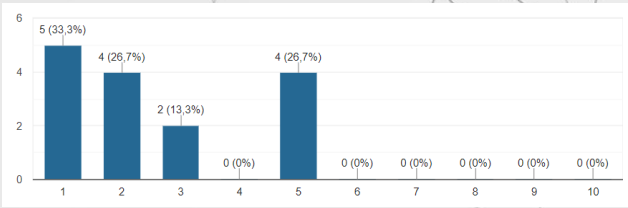
2nd section: NASA-TLX assessment tool (1. Mental Demand, 2. Performance, 3. Effort, 4. Frustration)



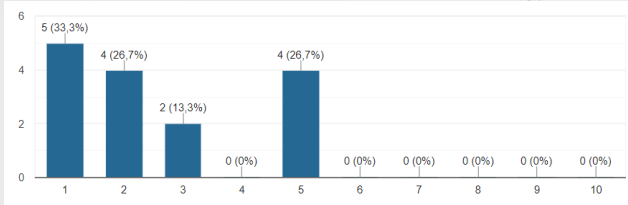
1. Mental Demand



2. Performance

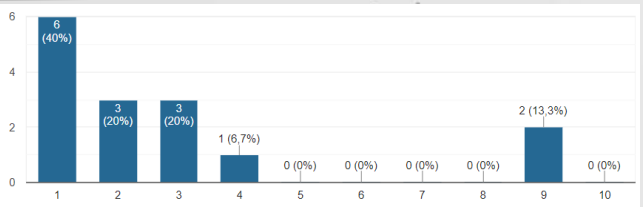


3. Effort

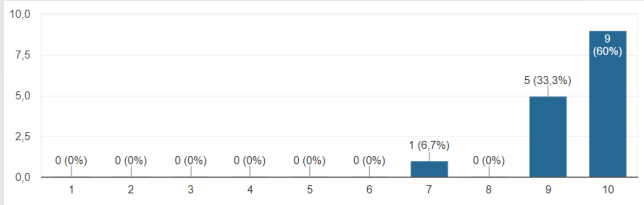


4. Frustration

3rd section: assessment of layout and total project



1. Layout difficulty



2. Achievement of main

Words from participants

"It (MusiCityX) ***offers an experiential way to find and explain to others the faults of an urban landscape****. And it could be developed to receive more variables".*

"This program ***reminds me of jazz music****, which was developed through the sounds of the city, and the music translation also sounds like jazz."*

*"This program reminds me of the quote "****Architecture is frozen music****""*

"It can help to urban designing or to designing residential complexes or ***residential complexes with a mall*** *into them, where the mall sometimes ends up huge compared to the residential buildings of this area."*

"If an architect wants ***to create a building as a statement and wants purposely to disrupt the coherence of a road****, they can use this program too, to define the parameters of this building."*

"The translation is not kept in a basic level and that softens the result, ***it makes it sound nice but also it let's you hear where something is wrong****."*

"I like the idea that as an architect when I have some primitive designing ideas, after trying materializing them, ***I would take an extra step to see how harmoniously my idea works on the total frame****."*

*"****I would use it again even as a tool to think*** *something architecturally but also from a directing (assembling the scene) point of view."*

"It is very productive to study everything that involves the principle of composition and comparing one to another. Because ostensibly through seeing their results they may seem irrelevant, but ***on the most basic level the way I compose something is the same for everything****, either it is a theatrical piece, a painting, a statue, a building etc…*

When the architect designs experientially, they can make themselves experience how they feel in a building*, or in this case in a neighbourhood, in a set of roads or in a path, all the senses must be combined and all the senses together must end up in one result and one conclusion.*

Future work

- Add urban features like curvature, traffic elements, and citizen movement.
- The translation algorithm could also integrate musical styles—matching architectural eras and places with genres (e.g., Baroque for 18th-century buildings)—to enrich the experience.
- It could also serve educational purposes by offering an engaging way to explore spatial coherence and design principles.

By linking vision and sound, the system fosters a new mode of urban thinking—one where cities can not only be seen but also heard.

THANK YOU

Questions?