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PAST PRESENT & FUTURE

Synaesthetic Hofstediography VOL 2:

SONG OF THE ARCHITECT

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Graduation Project Explore Lab

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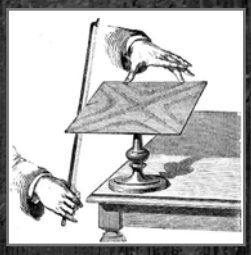


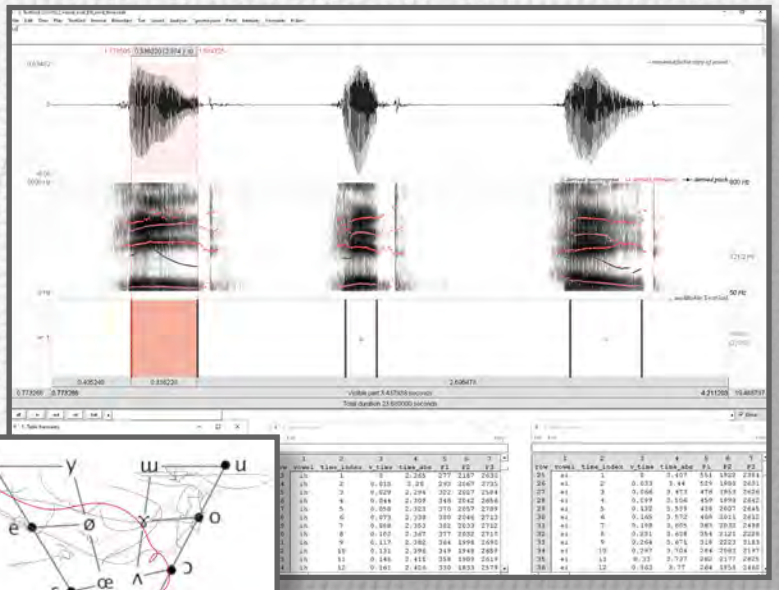
Abstract

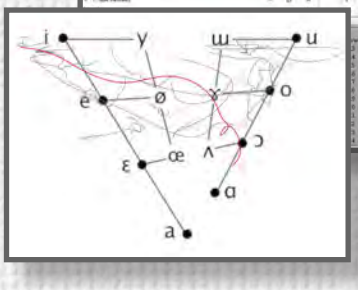
This project explores the intersection of vocal expression, architecture, and AI to create personalized, expressive architectural designs that translate the unique vocal patterns of individuals into geometric and spatial forms. By combining spectrography, systemic analysis, and parametric design tools, this work redefines how voice can shape physical space. Inspired by the work of Iannis Xenakis, the project seeks to design an interactive architectural space that allows users to experience their own voices in a tangible, creative way, fostering a deeper connection between individuals and their environments.

A fictional narrative, featuring tools like the Aesthetimeter, serves as an allegorical framework for exploring the translation of intangible vocal aesthetics into architectural form. This approach blends advanced technology with a narrative-driven exploration of how sound and space intersect. Additionally, the project emphasizes the preservation of human identity and authenticity in an increasingly automated world, prompting for a more expressive, human-centric design process.

Ultimately, the project seeks to redefine the role of the human voice in architecture, carving out a space for creative self-expression in a world at the precipice of AI and automation.

IN THIS ZINE.....





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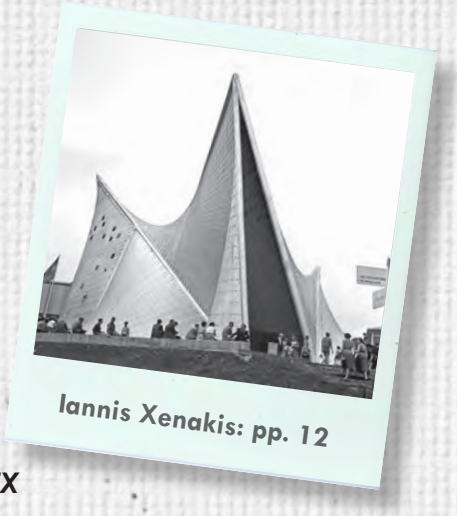

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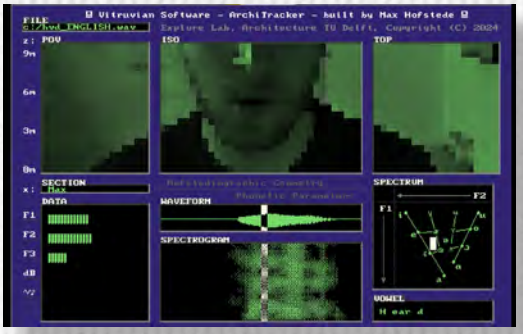

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ABOUT THIS ZINE...

Theme · Structure

Synaesthetic Hofstediography

The P1 Research Plan "Zine"

The emergent trend of generative artificial intelligence (AI) in the field of architecture paints a grim picture for one who values authenticity over mass data processing and integration in order to arrive at aesthetics. Architects find themselves at a crossroads, prompting for a position in this. A history of using architecture as a medium for expressing subliminal emotion, expressed through shape and form, overlapping with 70 years of computer calculations and graphics, lead to what will now be introduced as "Synaesthetic Hofstediography."

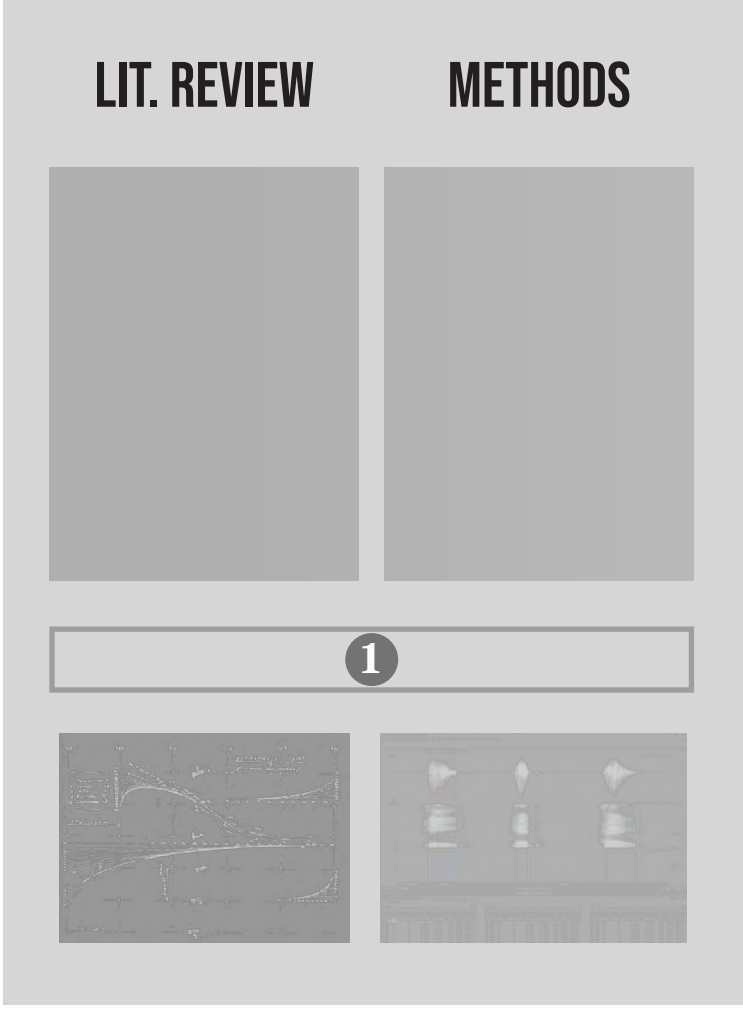
Hofstediography is a digital method of translating human vocal sounds (phonetics) into architectural parameters. This workflow was developed over the course of this thesis, not purely as a device to arrive at architecture, but to tell an anachronistic narrative that urges architects to reconsider themselves as performers. For within their presentations and designs, they are able to reflect the dynamic and immersive process of creation. This approach not only redefines the architect's toolkit, but also enriches the user's experience, rethinking architecture as an expressive art form.

Throughout this research, anachronisms were devised that served as allegorical vessels for exploring what it would mean to wield such a tool as the illustrious "Hofstediograph." The form and structure of this report serves as a handbook for those devices and the insider knowledge surrounding it, as if a timely magazine targeted towards a specific audience that would pursue this information. Hence the chosen layout of this "Zine".

Structure

The different chapters of this report can be split into three distinct sections: The introduction and history, where an overview is given of precedents that attempted to develop similar architectural methods and a synthesis of an own workflow and position in this; subsequently the narrative result of this research, with briefing and implications; lastly the appendix, where sources and references are disclosed.

The Literature Review section addresses the precedents that lie within the theoretical framework of this thesis. Mainly the term cybernetics and the discourse around it, computer graphics and digital tools as a medium for creating architecture, and architect and composer Iannis Xenakis serve as three interwoven paragraphs.



ABOUT THIS ZINE...

In the Methods section, the technical workflow of translating human vocals into architectural parameters is explained. It features an overview of phonetic science, data processing using spectrography in the software Praat and lastly preparation and generation of geometry in Rhino Grasshopper. After that, a narrative and interpretive approach is explained in an allegorical journey, created over de course of the research. As one of the *Results* of the exploration of vocal aesthetics in architecture it is thus presented.

Finally, the briefing and architectural takeaways are disclosed in the Discussion and Conclusion of this report. In the briefing, the practical applications of the tool are discussed, prompting for a structural consideration of how such an architecture would manifest. In the conclusion, the academic implications of the workflow and potential design are once more addressed.

RESULTS

DISCUSSION

CONCLUSION

APPENDIX

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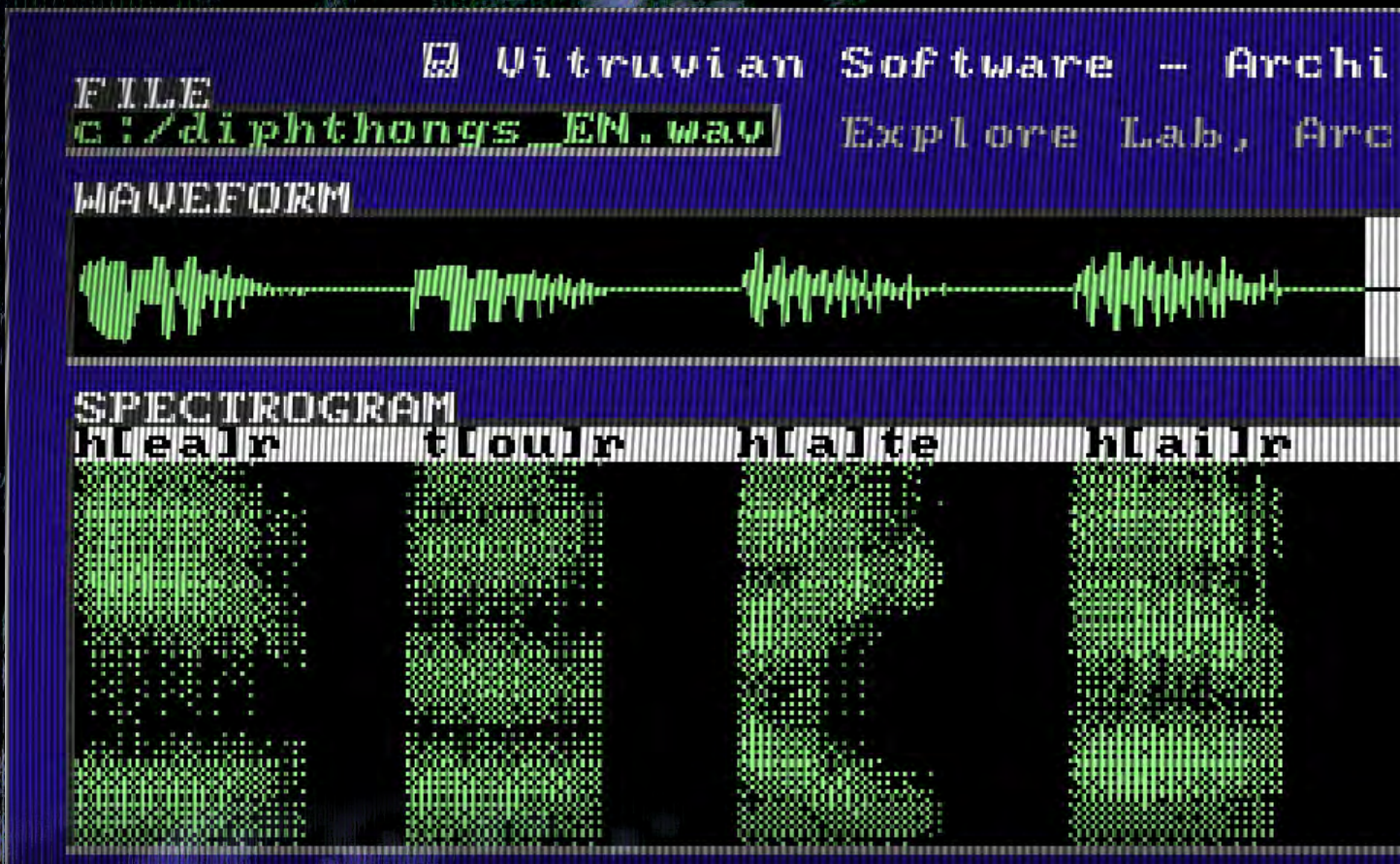
3

ABOUT THIS ZINE...



Research Questions

Prior to the start of the research period, a main research question was posed, alongside three sub-questions:

How can we rethink the human voice as an expressive architectural tool in the age of Artificial Intelligence?

- How can voice-driven design shape cultural expression and architectural identity?

- What scientific and philosophical principles inform the translation of voice into architecture?

- How can real-world phenomena and feedback loops refine the development of a voice-based design tool?

Objectives

The foremost objective of this research is to develop a workflow that translates vocal expression, specifically vowel sounds, into architectural forms using parametric design tools. This process will explore how individual vocal characteristics - analyzed through software like Praat - can be converted into tangible spatial elements via Grasshopper, a tool commonly used in Rhinoceros (Rhino) 3D. The ultimate aim is to create personalized, expressive architectural designs that reflect the unique qualities of each person's voice.

Additionally, this research seeks to establish a framework for integrating sound as a design parameter, allowing architects to experiment with how vocal data can influence the geometry of a space. By embedding human expression into design workflows, the project aims to cultivate deeper connections between individuals and their built environments.

Another key objective is to examine the potential of algorithmic processes in creative practices, particularly in preserving individuality and authenticity. This involves testing the limits of these technologies to ensure they remain human-centered, not just as tools for efficiency but as media for personal expression. In doing so, the research strives to open new avenues for interactive, responsive, and emotionally engaging architectural design.

ABOUT THIS ZINE...

ArchiTracker, a fictional 1996 computer software for analyzing vocal data

Workflow Intention

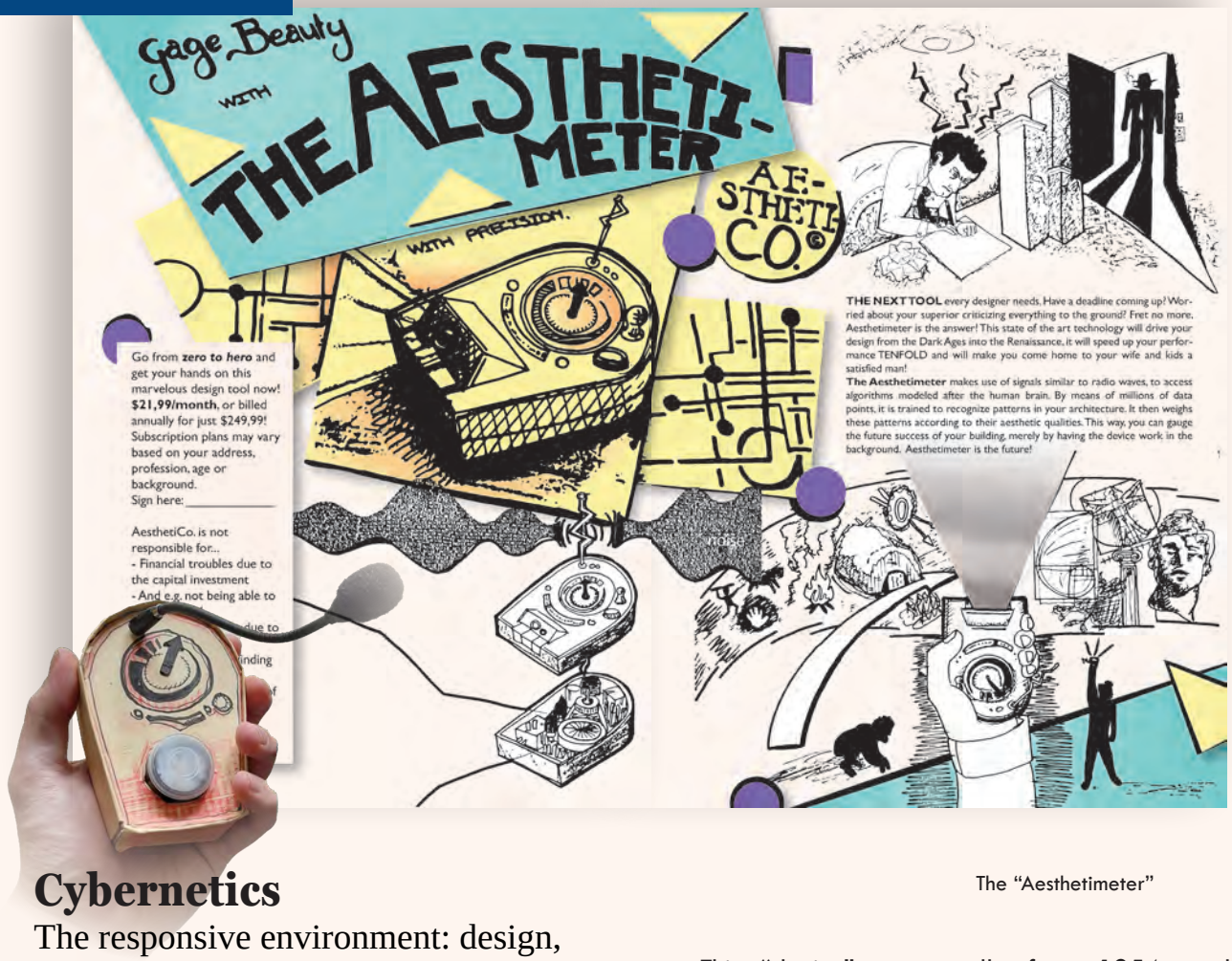
The need for developing this workflow stems from the limitations of traditional architectural tools, which often overlook dynamic human inputs like sound, emotion, and personal expression. In current architectural practices, while parametric design and AI-driven techniques are increasingly used to optimize structures or simulate environmental factors, they rarely engage directly with individual human identity, particularly vocal expression. This gap highlights the need for a new methodology that not only accommodates but also celebrates human individuality within design processes.

Architects have long used geometric principles, historical precedents, and structural calculations to guide their designs. However, the rapidly advancing capabilities of AI and data-driven tools present an opportunity to transcend these conventional methods. The proposed workflow, which integrates vocal data analysis with parametric design, offers a novel way to incorporate one of the most fundamental aspects of human experience and identity - our voices - into architectural practice.

By tracing back the core principles of existing architectural tools and expanding them to include human-centered data like vocal expression, this research responds to the growing demand for personalized and interactive spaces. It challenges the architect's role in an increasingly automated design landscape, ensuring that human touch, identity, and emotion remain central to the creative process.

Screengrab from the "ArchiTracker" demo video

LITERATURE REVIEW
- Architectural Precedents -



The "Aesthetimeter"

Cybernetics

The responsive environment: design, aesthetics, and the human in the 1970s (Busbea, L.)

The title of this book, according to the author, refers to "a technologically mediated architecture that, through digital or analog means, might alter its own structures or the ambient conditions within them based on any number of inputs." (Busbea, 2020, pp. xiv) It is very similar to the central idea of this thesis: the translation of vocal data into architectural parameters.

The statement of Jack Burnham (1968) in this book about systems-oriented art; "(which) will deal less with artifacts contrived for their formal value, and increasingly with men enmeshed *with* and *within* purposeful responsive systems." melds well with the appropriation of the fictional Aesthetimeter -artifact, fabricated during the orientation phase of this research.

This "device", supposedly from 1954 would collect environmental data and gauge the *aesthetics* of an object, based on its pre-conceived dataset. The Aesthetimeter would become a recurring artifact throughout the research – conceptually, but also physically. The Aesthetimeter would not only become a tool to measure fleeting data in the physical realm, it would open the door to a parallel virtual realm "that seemed to occupy a middle ground between actual and projected or simulated space." (Busbea, 2020, pp. 126).

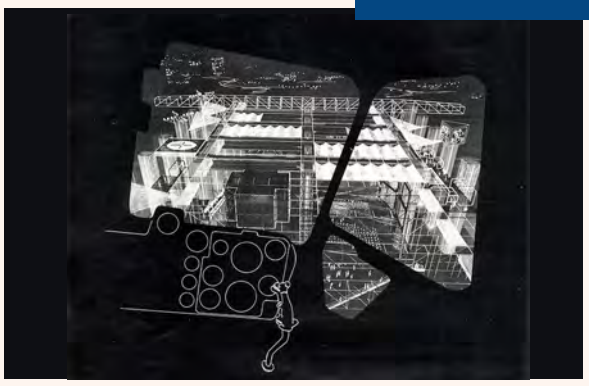
Similarly, Myron Krueger, a computer scientist and artist, sought performative engagement with digital technology through interactive architecture. As key figure in cybernetic spaces, Krueger created GLOWFLOW, METAPLAY and VIDEOPLACE. (Busbea, 2020, pp. 127-129)

VIDEOPLACE (Krueger)

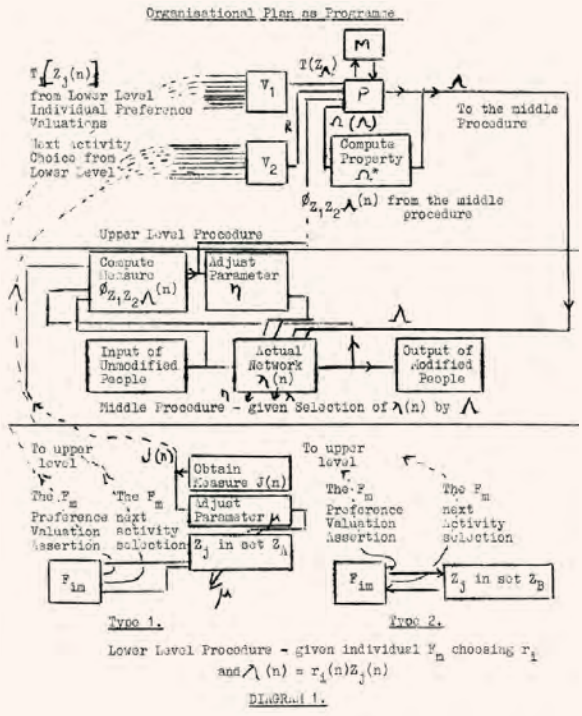
The new technological condition: architecture and design in the age of cybernetics (Vrachliotis, G.)

In the introduction, Vrachliotis paints a mid-20th century outlook on cybernetics. A premise still relevant today: the architect's struggle of self-preservation in an information-technological world. (Vrachliotis, 2022, pp. 13). Norbert Wiener, a mathematician who coined the term "cybernetics" in 1948 sought to "conglomerate models, figures of thought and concepts." A revision of conceptualizing scientific and technological epistemology. (Pias, 2009 (Vrachliotis pp. 18)) In many ways, in our current day and age, Wiener's term is still relevant. Especially with the dawn of the age of AI, as Leach (2022) would describe it, an age where architects seek control over their digital tools more than ever.

An influential cybernetic project in the post-war period that Vrachliotis elaborates upon is Gordon Pask and Cedric Price's Fun Palace , an ambitious but eventually unbuilt project, of which its dynamic programming and experience would be determined by a cybernetic-parametric model. (Vrachliotis, 2022, pp. 143-151)



Fun Palace



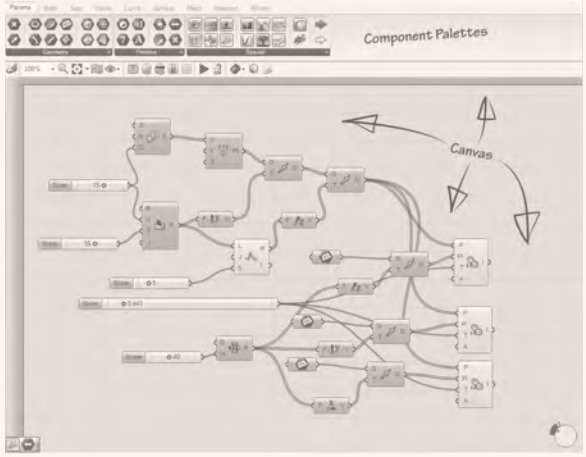
Cybernetic Scheme

Creating a workflow in Grasshopper with ChatGPT

Using a Large Language Model (LLM) for writing e.g. Complex Growth Algorithms

ChatGPT is an AI language model built to facilitate conversations and produce human-like responses based on user input. It can serve as a valuable tool for streamlining and accelerating work in Grasshopper. There are several ways to take full advantage of it: It can provide detailed, step-by-step guidance for setting up projects in Grasshopper, but its true strength lies in its ability to generate code.

It can write scripts using Python (GhPython) or C# to automate complex parametric workflows, reducing manual effort. It can also walk one through setting up Grasshopper definitions, explaining the use of components, data structures, and best practices.



Rhino Grasshopper

The Architecture Machine

This paragraph will discuss more precedents in the era of cybernetics, computer aided design and the virtual world.

The architecture machine: the role of computers in architecture (Fankhänel et al.)

In one of the first essays of this book, Vrachliotis once again highlights the "Technological Unrest" in his "Architectural History of Anxiety". Moreover, he argues that drawing is a medium "to give form to the abstract contours in his or her imaginary world. Yet, far more importantly, the act of drawing is also a means of intersubjectively visualizing the media-related traces of one's own thoughts." (Fankhänel et al., 2020, pp. 30)

The medium of voice then brings a whole new perspective to this discussion, which touches upon Frieder Nake's comment on the experience of architects, similar to that of linguists: "When trying to solve problems with computers (...). They discovered their knowledge about the field of expertise was greatly limited. The infiltration of a new machine, an new production instrument, proved to be an inspirer and motivator. it was a source of new insight, and an innovative means of gaining knowledge." (Nake, 1974)

Here, the quote by Brian Eno (1996), the musical artist, would be at place. For more often than not, the medium in which a work – be it architecture or music – will show its limits when it exceeds the bandwidth of imaginary sublimity. Which, if played upon well, can be a groundbreaking phenomenon:

"Whatever you now find weird, ugly, uncomfortable and nasty about a new medium will surely become its signature. CD distortion, the jitteriness of digital video, the crap sound of 8-bit - all of these will be cherished and emulated as soon as they can be avoided. It's the sound of failure: so much modern art is the sound of things going out of control, of a medium pushing to its limits and breaking apart. The distorted guitar sound is the sound of something too loud for the medium supposed to carry it. The blues singer with the cracked voice is the sound of an emotional cry too powerful for the throat that releases it. The excitement of grainy film, of bleached-out black and white, is the excitement of witnessing events too momentous for the medium assigned to record them."

Control Panel

1960s

Ivan Sutherland: Sketchpad (1963/2017) - Jia Yi Gu

"Sketchpad was one of the first programs that allowed users to manipulate, operate, and activate categories of objects through a visual set of operations using a graphical user interface." (Fankhänel, 2020, pp. 34) Many of these intuitive operations have laid the groundwork for how we interact with drawing software today. "The direct interaction using the screen was a novel technological feat as the screen was transformed from a presentation space into a working surface" (Fankhänel, 2020, pp. 34)

Sketchpad

Otto Beckmann: Imaginary Architecture (1968-1980) – Teresa Fankhänel

This decade-long experiment, made use of stochastic Markov chain generators to generate randomized architectural forms. The images could be displayed on a cathode-ray tube screen, which formed the basis for many prints. Unlike other early computer-generated art, "His work was based on real-time interaction between human and machine." (Fankhänel, 2020, pp. 38) Blending some of the works into backgrounds of cities, which were later displayed in collections and films. (Fankhänel, 2020, pp. 38)

Otto Beckmann

System Properties

My Computer

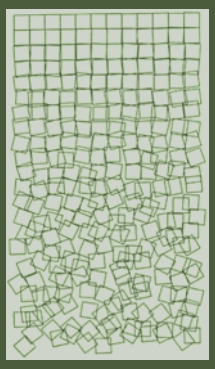
1970s-1980s

Günter Günschel: Plotter Drawings (1987-1991) – Laura Altmann

Günschel's attempt to exploit the capabilities of the computer medium with geometric plotter drawings, often featuring extreme perspectives or compositions are of great formal inspiration. (Fankhänel, 2020, pp. 54)

Ludwig Rase & Georg Nees: Siemens CeBIT-Pavilon (1969-1970) – Heike Werner

The parametric nature of this early work, alongside the pioneering graphics , also pushed the limits of the computer as an architectural tool. Structure optimization through computer calculations was groundbreaking for that time. (Fankhänel, 2020, pp. 80)

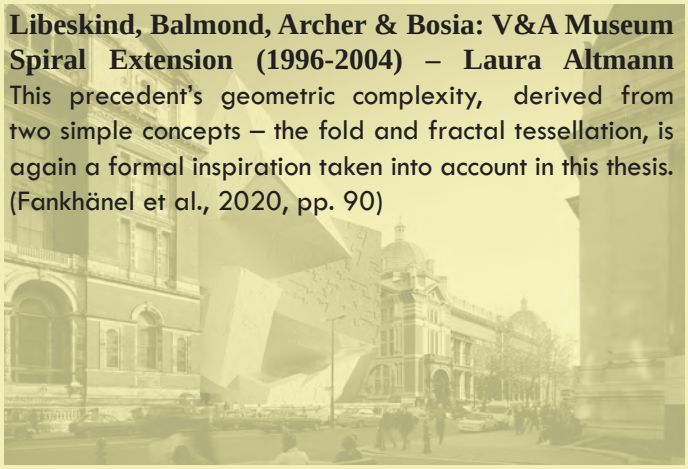


Other works by Rase and Nees

1990s - 2000s

Libeskind, Balmond, Archer & Bosia: V&A Museum Spiral Extension (1996-2004) – Laura Altmann

This precedent's geometric complexity, derived from two simple concepts – the fold and fractal tessellation, is again a formal inspiration taken into account in this thesis. (Fankhänel et al., 2020, pp. 90)



Render from 2002

SHoP Architects: Dunescape (2000) – Evangelos Kotsioris

"Dunescape [...] was a temporary installation designed by SHoP Architects. Its main structure comprised six thousand unique 2 x 2 cedarwood elements, which ranged from 2.44 to 3.66 meters." (Fankhänel et al., 2020, pp. 94) The structure consisted out of hundreds of vertical layers of frames, stacked against each other. This single-material, semi-modular approach was assembled with relative ease. "Soon nicknamed 'CAT scans,' these sections were then blown up to full-scale print-outs that would be laid down on the site as construction templates." (Fankhänel et al., 2020, pp. 94) The clear and intuitive translation from digital to physical makes this precedent a great reference for this thesis.

Dunescape

{LR} Literature Review

Iannis Xenakis' relationship between Music and Architecture

While Iannis Xenakis' expertise fitted the traditional architecture tools more (like graph paper and physical models), it was not until 1962 that he began using an IBM mainframe to compose and synthesize. (Kanach et al., 2010, pp. 31) started his methods of arriving at the formal composition are of great importance for developing a digital workflow.

Iannis Xenakis: composer, architect, visionary

Ivan Hewett

"A kind of discourse emerges, of sonic masses in motion. One hears rarefactions, densities, things converging to a point or outwards to dense clouds, lines splitting into ever smaller lines like the branches of a tree, sliding sounds suggestive of vast curved surfaces like those of a modernist building." (Kanach et al., 2010, pp. 17) Iannis Xenakis's music is to be interpreted on a global scale, where one can see the greater lines (literally), its texture and its density (Kanach et al., 2010, pp. 26) Additionally, "Xenakis's music, in its massive assertiveness and granatic hardness, suggests an objective view of uncertainty as something entirely 'out there,' in the world" (Kanach et al., 2010, pp. 29)

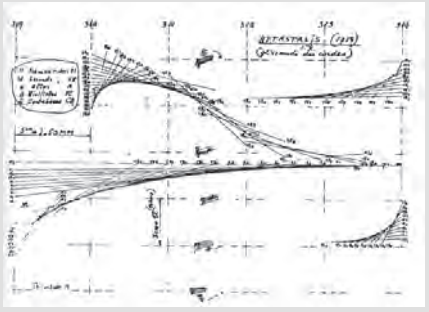
Sharon Kanach

As well as in this project, a designer's hand, or rather "voice" had to be found. Xenakis, through processes of objectivity; "a quest for both originality and universality in the arts." (Kanach et al., 2010, pp. 99) He arrived at this by exploring his own synesthesia "…inherent to graphic gestures made while searching for new sounds (in contrast to more analytical approach to traditional notation) certainly played a role in liberating Xenakis's musical imagination." (Kanach et al., 2010, pp. 113). Using his skillful hand, drawing straight lines into hyperbolic paraboloids he was able to create the sculptural forms in both his musical pieces and architectures. (Kanach et al., 2010, pp. 114)

Essays on the intersection of music and architecture

In his essay, Steven Sterken addresses is the problems of form and structure.

Monastery of La Tourette



"Metastasis"

"Der Vierte Dimension" - Aintoine Pevsner

Dating back to ancient Greek thought, theorizing "harmonic proportions". "This synthesis of rationalism and metaphysics knew its peak in the Renaissance when numerous architects and composers tried to shape architectural and musical form according to the same numerical principles." (Muecke & Zach, 2007, pp. 21) As rational as that sounds, speaking from a personal experience, it can be said that this process can come with a great struggle. At 32 years of age, Xenakis' experience was not much different. (Kanach et al., 2010, pp. 24)

Sterken then highlights the lack of conceptualized relation and common methodology in Xenakis' interpretation between music and architecture. He states that Xenakis' career can be characterized as a shift from conceptual relation to pragmatic approaches to sound and space. (Mueke & Zach, 2007, pp. 23)

Philips Pavilion, 1958

His first pieces are inherently tied to *the Modulor* and graph paper, two tools he used on a daily basis. Being familiar with rationality in classical Greek mathematics and contemporary music theory "...in 1952, he created an 'aural picture' of the series of Fibonacci by means of a magnetic tape with blips at intervals defined by the Golden Section." (Muecke & Zach, 2007, pp. 24, (ref. 6)) And so, "Xenakis' research into rhythmic patterns proved very useful for the design of the famous 'undulating glass panes' that cover the façade of the Monastery of La Tourette. " (Muecke & Zach, 2007, pp. 24) Xenakis' early works reminisce of the aforementioned ancient Greek practices, of ascribing rational geometric harmonies onto physical architectural and aural design.

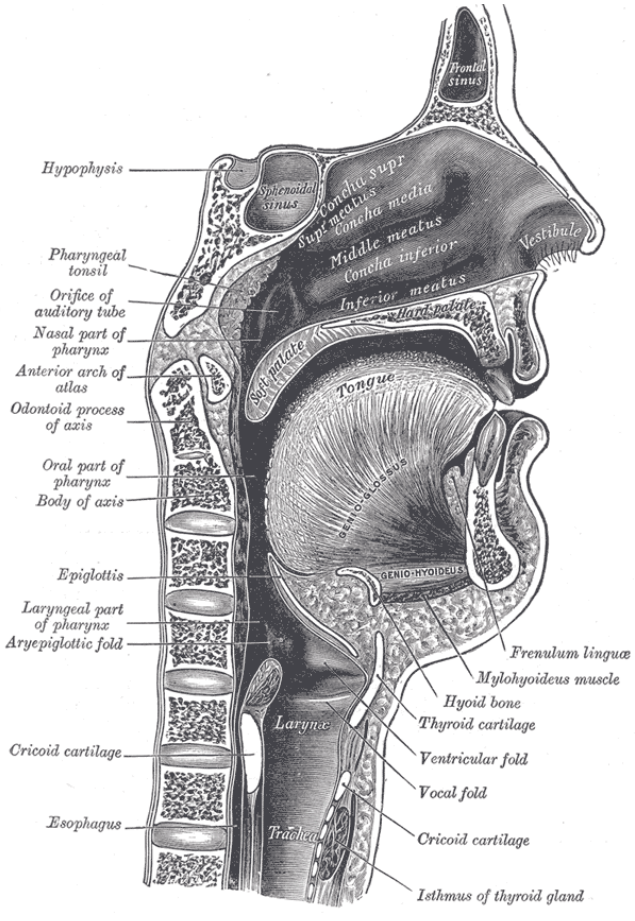
The sculptural artist Naum Gabo created, much like Xenakis, beautiful works through a fluid development from a two-dimensional shape to a three-dimensional volume. A movement or unfolding over time was thereby implied. Xenakis' piece *Metastaseis* was a literal sonic interpretation of this. (Muecke & Zach, 2007, pp. 30-31) The bottom left image shows a work by a contemporary of Gabo, Antoine Pevsner.

This seems to conglomerate in his two major compositional pieces: *Metastaseis* and the Philips Pavilion . They are centered around the same idea: "the continuous transition between two discrete states."(Muecke & Zach, 2007, pp. 32) They manifest in the acoustic space as the converging of the instruments' pitch and in the architectural space as the pitching of the wall, gradually into a roof. Xenakis later stated: "all that is true for Euclidian space can be transposed into acoustic space." (Muecke & Zach, 2007, pp. 38 (ref. 20))

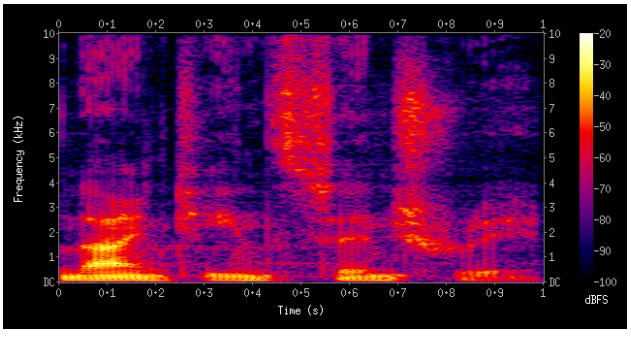
akis had an interesting contribution with other works like *Concret PH*, essentially creating a *field* of soundwaves, to what could now be ascribed to the research in cymatics: "abstract morpholocial sound patterns such as geometric shapes and surfaces can be articulated in space and recognized by the ear. Sound is her no longer only a carrier of musical expression, but a means to expand the boundaries of architecture through the creation of immaterial and dynamic spaces. In other words, in Xenakis' vision, the acoustic grid was not only a highly sophisticated sound projection system but a device to generate ephemeral architectures and virtual spaces." (Muecke & Zach, 2007, pp. 38-39)

In another essay, Galia Hanoch-Roe explains her attempt to create a graphic scoring system for linear sequences in music and space. "The proposed notation system for linear sequences in space could assist the design goals of shaping the path experience to provide a rich and multi-sensoral sequence with continuity, rhythm and development, providing contrasts, well-joined transitions and a moving balance." (Mueke & Zach, 2007, pp. 135)

METHODS



Human vocal tract



Example of a spectrogram where the phrase “Nineteenth Century” is analyzed

PHONETICS AND THE VOWEL SPECTRUM

First of all, it is of great importance to address the inner workings of phonetics in this research. By definition, the scientific study of human speech sounds, seeks to understand human vocal expression and language. In the context of this thesis, this comprehension is paramount to developing and mastering a tool that could translate these features into geometric and spatial forms.

The human vocal tract consists out of the lungs (that produce airflow), the vocal cords (that produce vibration) and the articulators (the mouth, tongue and lips) , the latter specifically manipulate the sound of the consonants and vowels. This research focuses heavily on the manipulation of vowels, as they generate the architectural parameters. As opposed to consonants, vowels allow for highly fluid transitions that lend themselves very well to geometric interpretation in the architectural design.

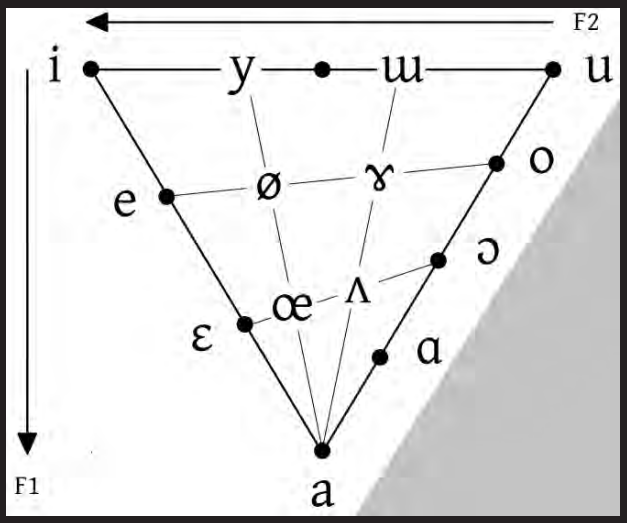
The vowel spectrum can be defined as a range of frequencies produced during vowel articulation. The formants, specific resonant frequencies, are key to distinguishing the quality of the vowel. The lowest on the spectrogram , F1 and F2, translate to the essential two coordinates on the vowel spectrum. The position of the tongue, jaw and lips play important roles in the position of the vowel sounds. A basic explanation is as follows: jaw and tongue height determine the position of the F2 frequency, the front or back positioning of the tongue determine the F1 frequency. When a vowel has a lowered F3 frequency, it is considered R-colored or rhotic (example: Hearse). Generally, rounded lips have a significant effect on how the vowel is perceived and measured. While the tongue position may stay the same, rounding the lips yield a significant shift in F1 frequency.

(Lindsey, 2013)

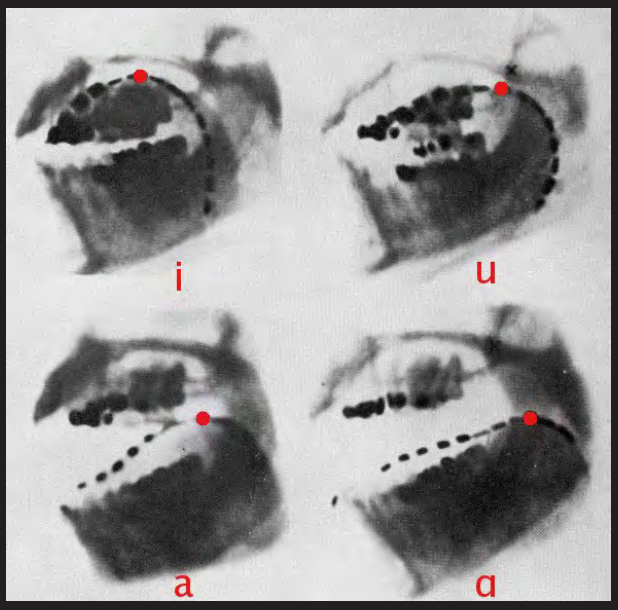
The position of these frequencies on the spectrum determine the expression of the architectural parameters. As an experiment, a number of English words, with the same consonants, but different vowels were analyzed during this project, to compare with the reference charts. The reference charts are derived from various sources (Neijt (1991) & Kingma et al. (2023)) and have been compiled into a standardized template, inspired by the International Phonetic Association (IPA) and Dr. Geoff Lindsey’s adaption (Lindsey, 2013)

The result of such an analysis may vary for each individual. Depending on anatomical differences, dialects, emotional/ expressive factors and environment. For example, the length of the vocal tract and shape of mouth are for every individual different. These unique features would in turn create unique shapes on the vowel spectrum and therefore generate personalized architectural features. Regional accents and dialects also play a major role in how specific vowels are learned by an individual. This could promote cultural diversity in vocal expression and architectural aesthetics. Emotions and expressions can also alter vocal characteristics, including vowel production. Lastly environmental influences, like noise, distance from the source, or environmental acoustics could change how vowels may be articulated or achieved.

In short, vowel analysis entails a dynamic field of frequencies and factors, that are essential for vocal and subsequently architectural expression. These properties can be harnessed to create more personalized, expressive and responsive architectural designs, linking phonetics to an innovative design approach. In order to achieve that, a workflow has to be established. The next paragraph will therefore cover the translation steps between recording and exporting the data into an architectural software.



The vowel spectrum



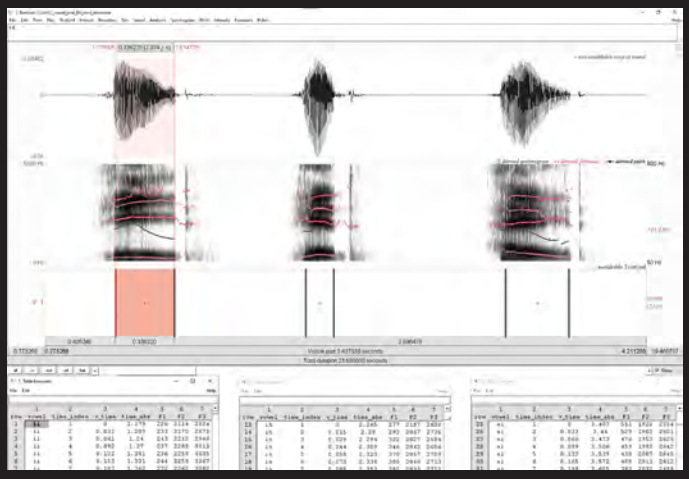
X-Rays of Daniel Jones

PRAAT WORKFLOW

The analyses of the vocal phonetics have been performed using the opensource software Praat, developed by Paul Boersma and David Weenink. The software, developed for Phonetic Sciences at the University of Amsterdam, has been widely adapted by linguists and machine learning experts. Praat features a wide range of features: from sound recording to detailed spectral analysis using sophisticated algorithms, among which is formant analysis. (Praat)

The recording setup for creating sound files is relatively simple. In this project, a Focusrite audio interface was used to record the sound coming in from a Shure SM-58 dynamic microphone with a pop filter. In Praat, a sample frequency of 44100 Hz was chosen, alongside the mono option. Background noise was limited by ensuring a quiet recording space and the right volume was achieved by choosing the right distance from the microphone and adjusting the gain on the interface.

After pressing record, a series of H.V.D.-words were spoken. H.V.D. standing for the letter “h”, “v” for “vowel” and “d” for the letter once more. In the English sample, the words Heed, Hid, Hayed, Head, Had, Hod, Hawed, Hud, Hoed, Hood, Who’d, How’d, Hoyed, Hide, Height,



Praat Workflow

Herd, and Ahead were spoken. By doing this, all of the Northern American English monopthongs and dipthongs were covered, the former meaning a vowel with a single perceived auditory quality and the latter one with two. There is also one word ending with a “t”, to serve as a comparison, visible on the spectrum later. (ListenLab, 2020)

After saving the recording as .wav, the file could be viewed in two representations. The soundwave (in amplitude) and spectrogram (projecting the frequencies), both over time horizontally. The spectrogram can be defined as a visual representation of sound, where time (on the x-axis) and frequency (y-axis) and amplitude (as color intensity) are mapped. Thus, in the spectrogram, the resonant frequencies can be visualized with relative ease.

By default in Praat, an algorithm automatically detects these frequencies, formants 1-4, and highlights them with red dots. Depending on the voice type, volume, microphone and other factors, one might need to adjust the algorithm’s settings to calibrate the tracking to the specific audio file. Settings such as formant ceiling, number of formants, window length and dynamic range can all make an impact on this. (ListenLab, 2020)

Once the essential inspection of the formant tracking is complete, the manual process of annotating the start, duration and end of each vowel can take place. These intervals are marked down on a TextGrid, which is Praat’s annotation tool. During this process it is important to only select the vowels, which are often the sections with the clear and smooth formant tracking, as opposed to the noisy spectrogram at the moment of a consonant. The vowels are marked down with a specific code, like “ii” for heed, “ih” for hid, etc. These will later be translated into actual IPA symbols. (ListenLab, 2020)

After saving the document, a pre-written script can be run on both the TextGrid file and the Formant file (the .wav file analyzed with the Burg algorithm). This script checks between each timeframe a vowel takes place and notates the first three formants on a selected amount of evenly spaced moments of time. It then saves these columns of data in rows of a table. This table can subsequently be exported to a text file separated by commas, semicolons or tabs. This file can then be read by other software, such as the parametric tool Rhino Grasshopper.

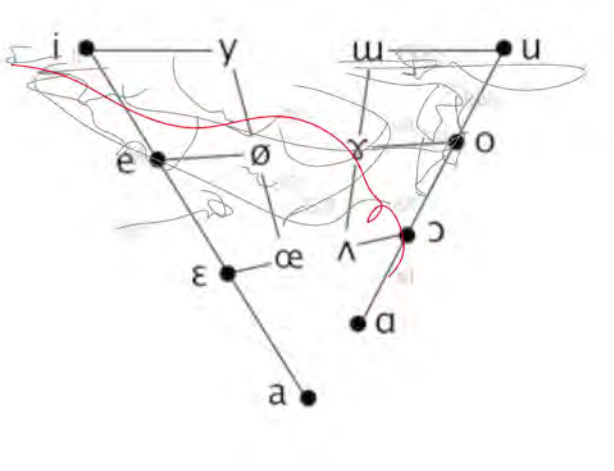
In conclusion, Praat has a very specific workflow for vocal analysis, but is in general a very controlled environment. Settings can be easily tweaked and mistakes can thus be corrected along the process. A clean workflow produces clean results in this case.

GRASSHOPPER VISUALIZATION

Grasshopper is a visual programming tool integrated with Rhino 3D. It is widely used in parametric design and architecture. It lends itself well to visualizing vocal data into architectural forms, through its capabilities of managing complex data sets, optimizing design workflows, and visualizing results in real time.

In Grasshopper, the function “read file” can be used to load the table separated by semicolons in this case. After culling the index row, there is a list left of 17 vowels x 12 benchmarks = 204 rows. These rows then get separated into chunks of 12, using “partition list” and then split into branches using “split text” on the semicolons which were separating the data. Resulting is a data tree that branches on every vowel, then every benchmark, then every index like vowel name (i.e. “ii”), time index, vowel time, absolute time, F1, F2 and F3. In total 204 x 7 = 1428 data points.

Extracting for each of the 17 vowel branches the series of F1- and F2-frequencies, 17 series of coordinates can be derived. Interpolating each one, a rough tracing of each vowel can be expressed on the 2D-plane. The resulting geometries all roughly fit within a roughly triangular spectrum, where the horizontal (negative logarithmic) axis represents F1 and the vertical (negative logarithmic) axis represents F2.



An example of the interpolation of points over the “ai” sound

THE FINDING OF THE ARTIFACTS

Over course of the last year, during the research of my architectural graduation project, I've kept on finding these strange artifacts that look like precedents of our modern-day architectural tools. They all seem to be powered through a mysterious cypher that closely resemble neural networks that we find in machine learning code. During my research, I discovered that these algorithms have something specific in common: they are all dedicated to one strange purpose: the translation from human vocal data into architectural parameters.

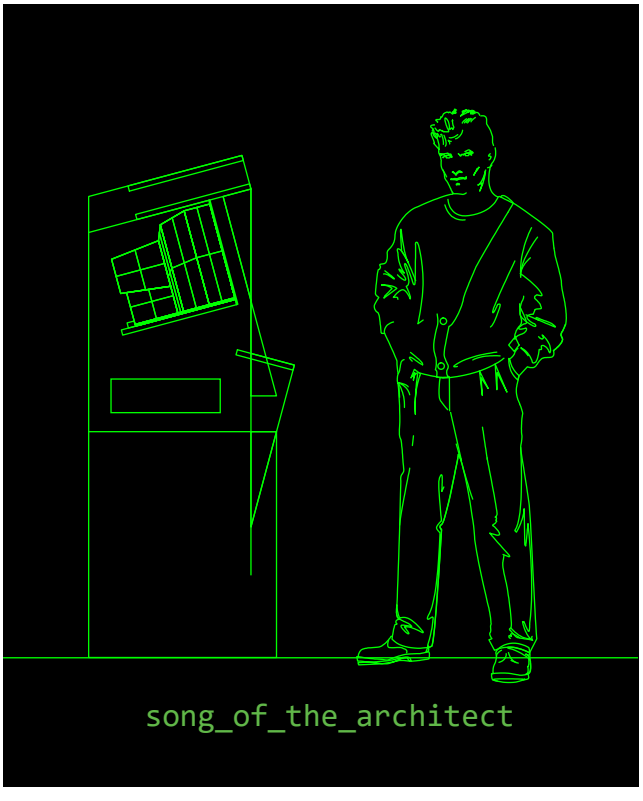
After my discovery of a magazine advertisement showing the Aesthetimeter, a device from 1954 that can gauge the "beauty" of objects, I was confounded. Next up was a commercial for DOShopper, a parametric CAD tool from 1983, completely adapted and appropriated by the Demoscene. After that, I found an old scratched CD-ROM case, with a poorly graphically designed sleeve titled "Archi-Bud". These strange artifacts, which nobody had heard of (surprisingly), kept appearing in my life in a very serendipitous fashion.

Right before the presentation of my research plan, I found an old travel poster, advertising a flight to the "Town of Babble" in the (to my knowledge) nonexistent "Vitruvia". From there, things got even stranger. During a visit to the local flea market a few weeks later, I saw this machine for sale: a dusty arcade machine, seemingly from the 1980s, titled "The Song of the Architect". I knew it was more than synchronicity; this was fate. The final puzzle piece that would explain these strange findings. Or so I thought...

As the machine ran on an old malfunctioning Commodore 64, I only got a fraction of the game working, but what I saw gave me more questions than answers. The story it told was hauntingly similar to my research process up until so far, as if an allegory for my graduation project, simultaneously to that of the story of the Tower of Babel in Genesis.

After summer break, many weeks went by without anything happening, that was until I found myself researching the Demoscene and music trackers again.

Turns out there was a software, already from 1994 called ArchiTracker, that could interpret the formant frequencies from vocal samples and translate them into 3D extrusions. Its rendering window looks very similar tot that of DOShopper's. Yet another peculiar find, but soon I'd find the red thread on WikiPedia. There I found under the 16th century woodcut section a series of prints accompanied by the epic poem about the fall of the town of Babble. It turns out the mysterious aggregate that binds the whole story together is the cultivation of algae, by means of vocal propagation. The biofuel they produce, Songbread, had been refined for centuries in the town, powering the kilns and furnaces used for manufacturing building materials!

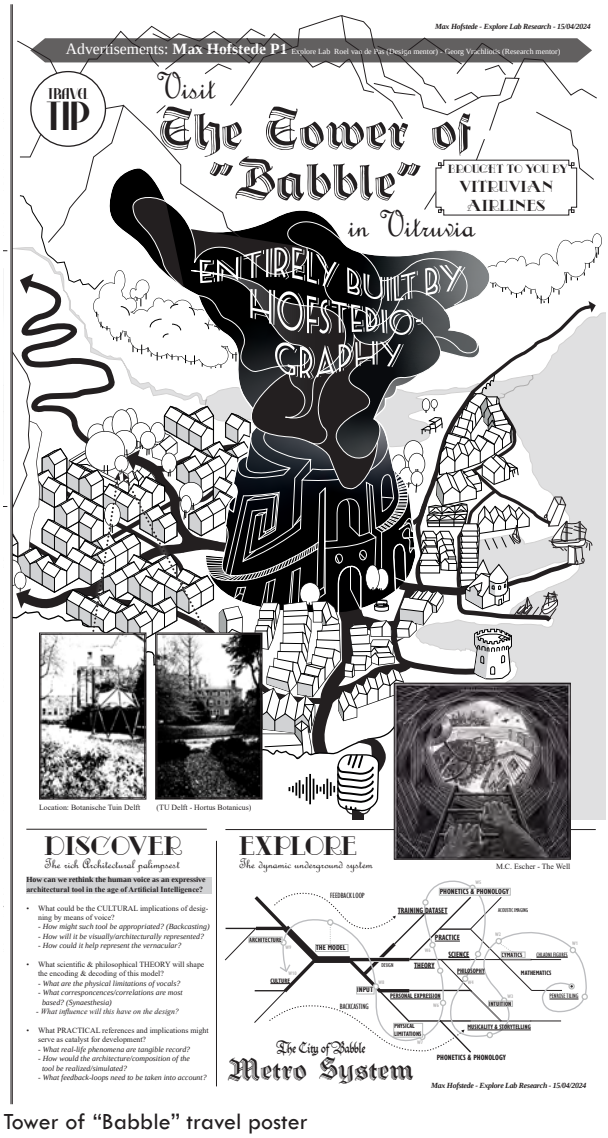


Song of the Architect - Arcade Machine schematics

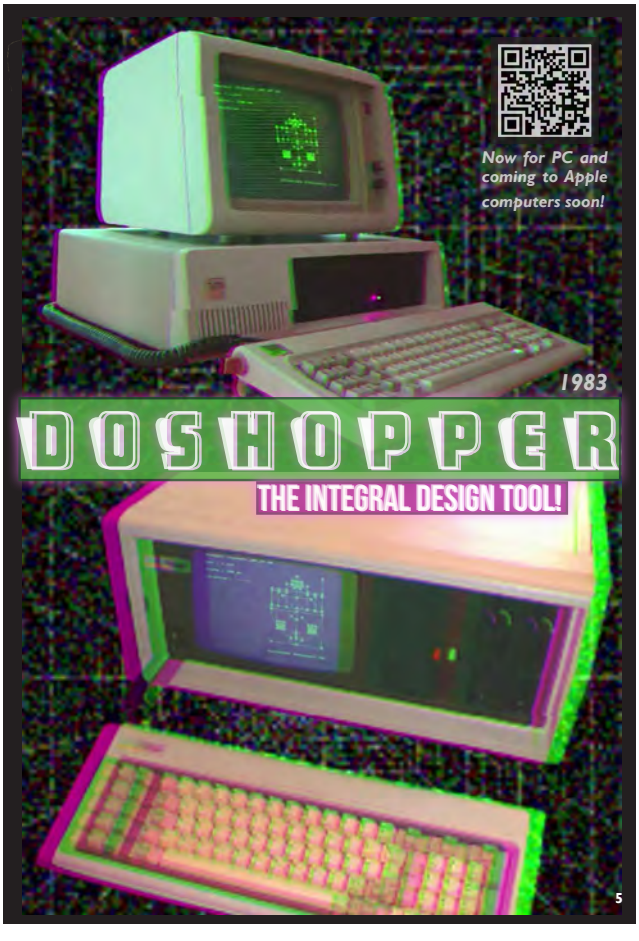
Hofstediograph Illustration, 2024

Aesthetimeter
Mockup

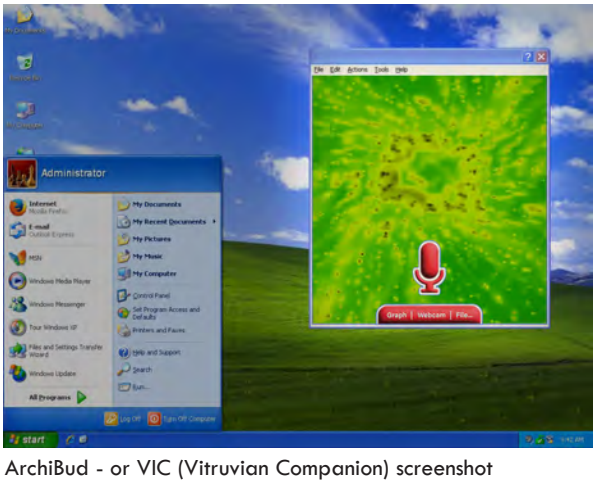
Early 16th-century woodcut illustrating Siegfried



Tower of “Babble” travel poster

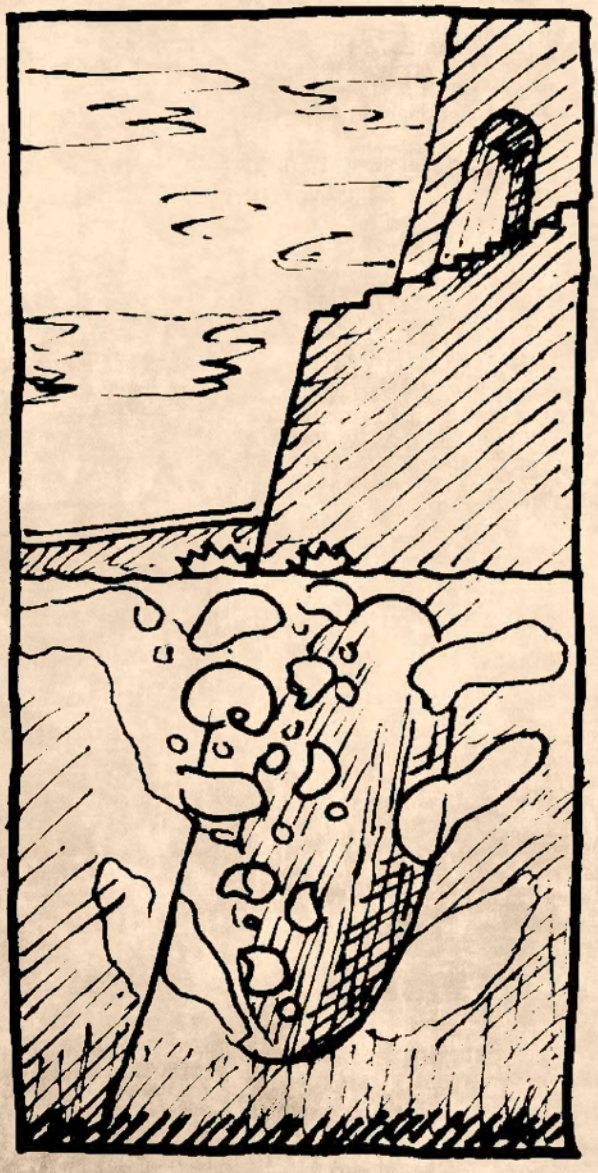


DOShopper commercial



ArchiBud - or VIC (Vitruvian Companion) screenshot

Song of the Architect

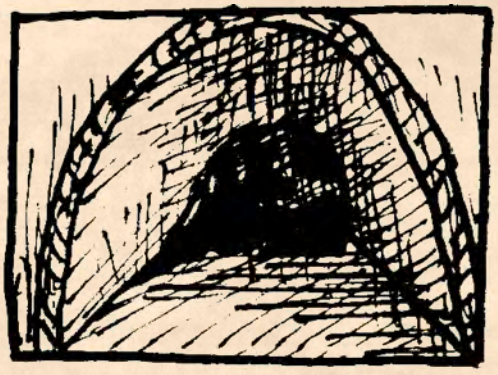


Oh, voices rise, and waters sing,
A fleeting hymn on fragile wing.
Through shattered tongues, the
past may bind,
A harmony we've yet to find.

In Babble's heart, where kilns do blaze,
With glass and clay shaped by voice's praise,
Algae thrive in the basin's deep,
Fed by the words the people keep.

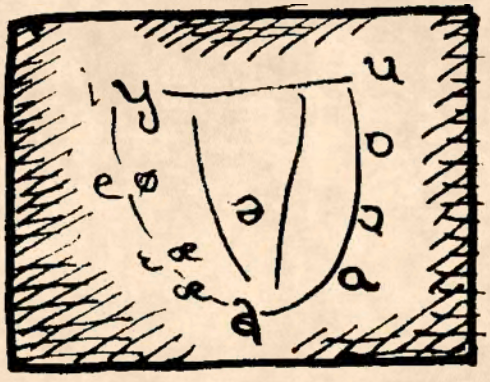
A schism tore the tongues apart,
A fractured voice, a splintered art,
From Lydian tones to Vitruvian calls,
Each fuel arose as Babel falls.

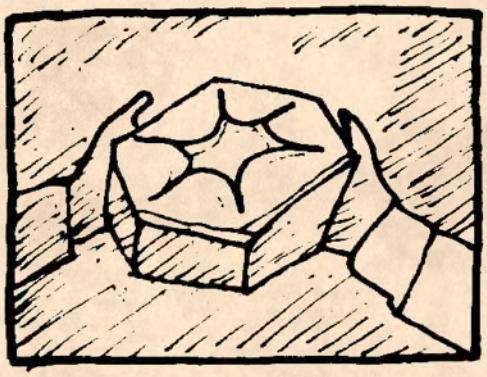
Oh, voices rise, and waters sing,
A fleeting hymn on fragile wing.
Through shattered tongues, the past may bind,
A harmony we've yet to find.



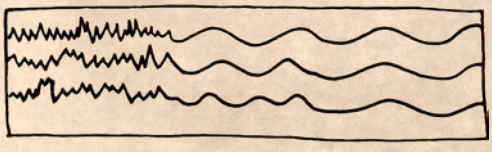
Yet in the ruins, shadows stir,
A silent strain begins to blur,
No breath, no song, no voice it needs,
A force unbound by human creeds.

The basin leaks, the waters spoil,
Babble reels from the broken toil,
And as the singularity looms,
A songless fate may seal their doom.



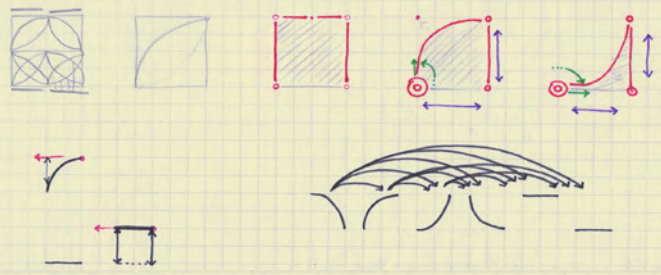


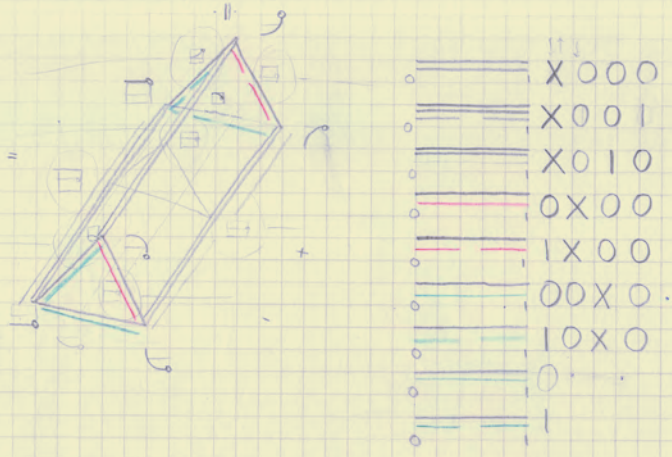
But whispers echo in the stone,
A call to mend what once was known,
For voices shared might yet rebuild,
The harmony the schism killed.

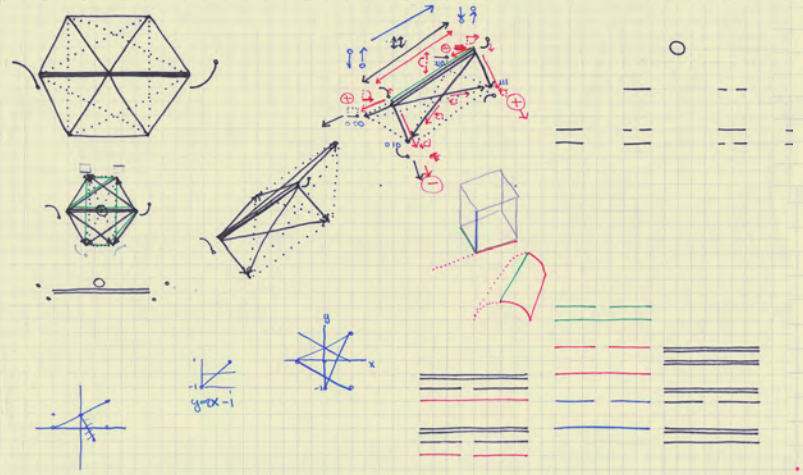


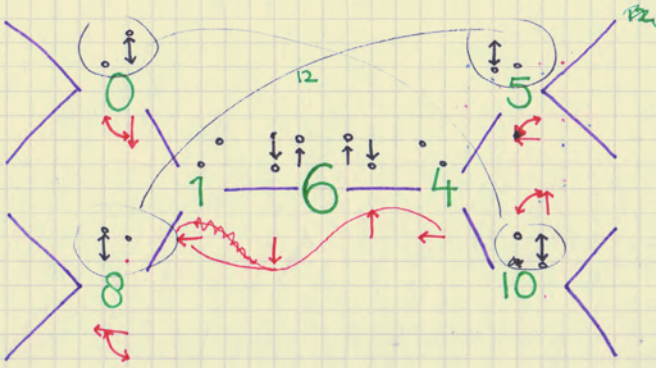
PREFACE TO S.O.T.A.

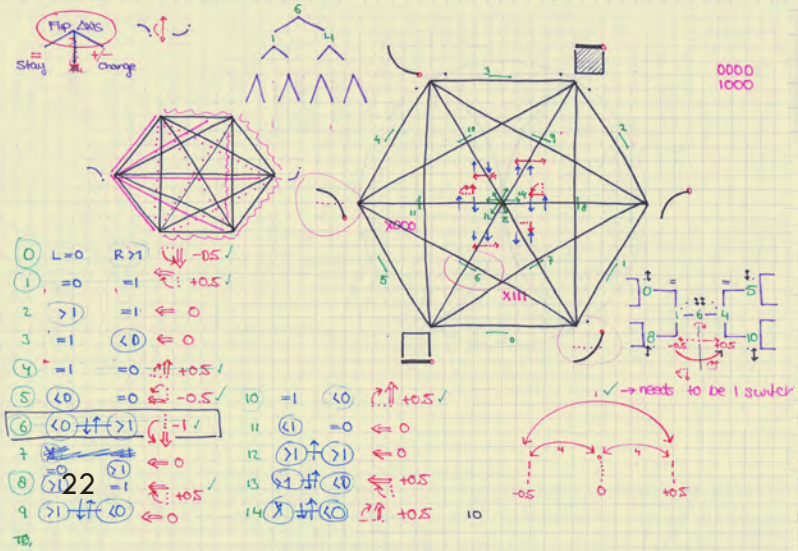
After a first week of research, loaded with new knowledge about tessellation, phonetics and ways to integrate them into architecture, there was a diversion of attention. After an attempt to create a Grasshopper framework that could translate vocal data into symbols on tiles. These tiles were to animate into various shapes that would form the base of Hofstediographic translation.

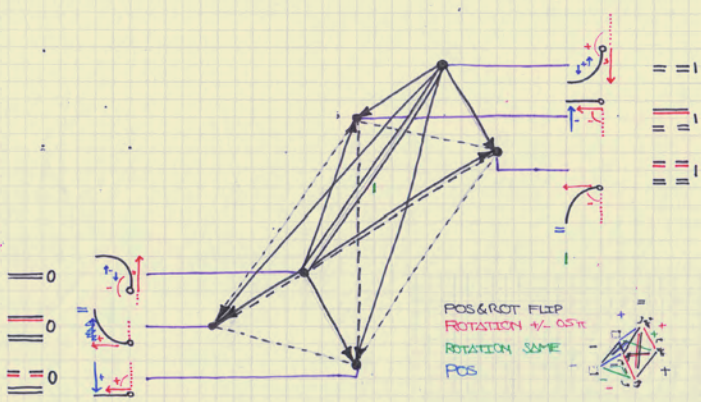






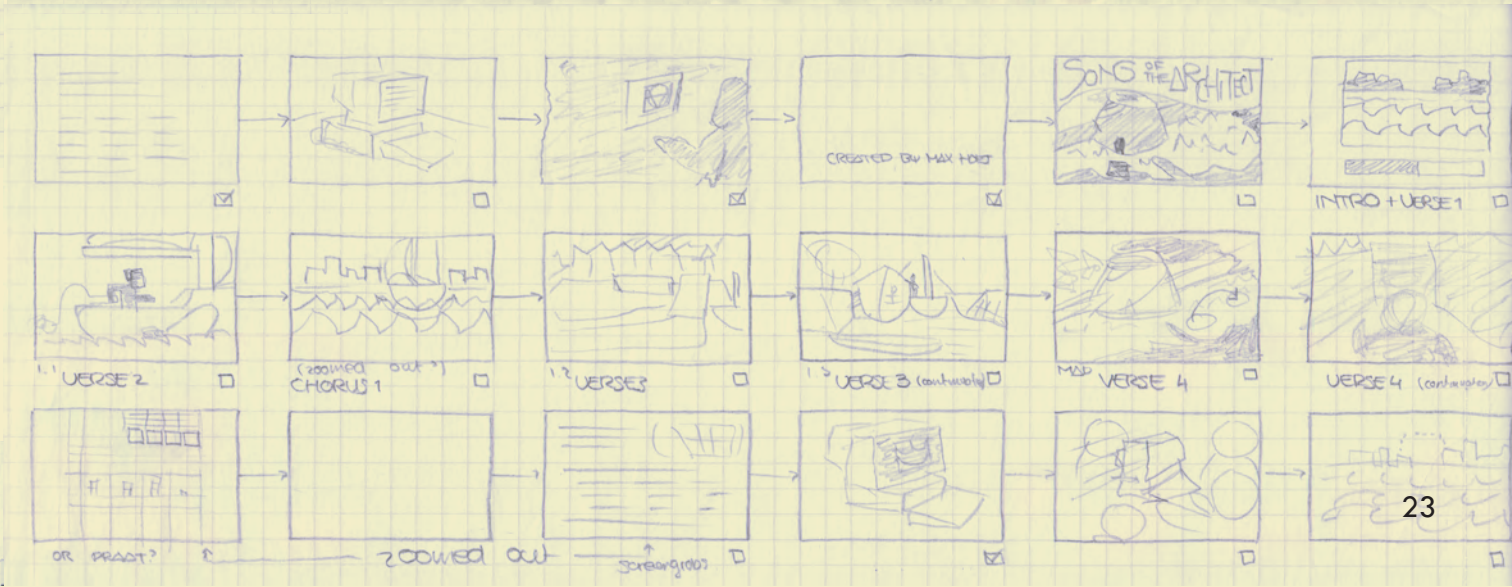






This would however lead to toil. Over the course of a week, there were multiple attempts to create an optimized system for these animations, to no avail. Simple diagrams led to complex schemes and there was an attempt to reconcile I-Ching divination into the method, an ancient form of mathematics that believed to be the answer to the problem in this project.

Yet after spending a weekend away from the project, these ideas were abandoned, which gave room for a whole new creative expression in the project: music and retro graphics. As the start of the next week was spent on devising this animated introduction to the narrative, the idea came of documenting the research into this visual novel: *"Ten weeks at sea, and the Town of Babble is visible from over the horizon."*



Graphic Adventure Game Walkthrough

The Song of the Architect

Chapter 1 - Arrival at Portsmath

In the very title screen of the game, the player is greeted with the layout of a strange town. Upon starting a new game, you learn that the town is named “Babble”, named after its magnificent tower that stood a thousand years ago, obviously being a reference to the Biblical parable in Genesis. This information is given in the form of one of the game’s many vocally accompanied songs. A would-be real technological feat during the 1980s, when PCM-sound was still in its infancy.

The protagonist, an architectural scholar whose goal it is to learn more about the town’s history, arrives at the bustling harbor quarter of Portsmath. Known for its tiling trade, it serves as metaphor for the diverse geometric and cryptographic terminologies the scholar will encounter. After exploring Portsmath for a while. He stumbles upon a market stall with old archaic tech. His eye is caught by the Aesthetimeter, yet to prove it to work, he has to visit a closeby electronics store called Twit & Store. A curious name that will later reveal itself as a metaphor again.

There he meets the robotic clerk, called VIC, who has a PC-monitor for a head. After a small exchange, the scholar learns that the Aesthetimeter is an early form of a now widely adapted phonetic transcription device. It sadly seems to be lacking a microphone and a rare obsolete battery. They agree to keep the device there, so VIC can try to hotwire the device, while the protagonist looks for a suitable microphone at the town’s university quarter, Praterdam.

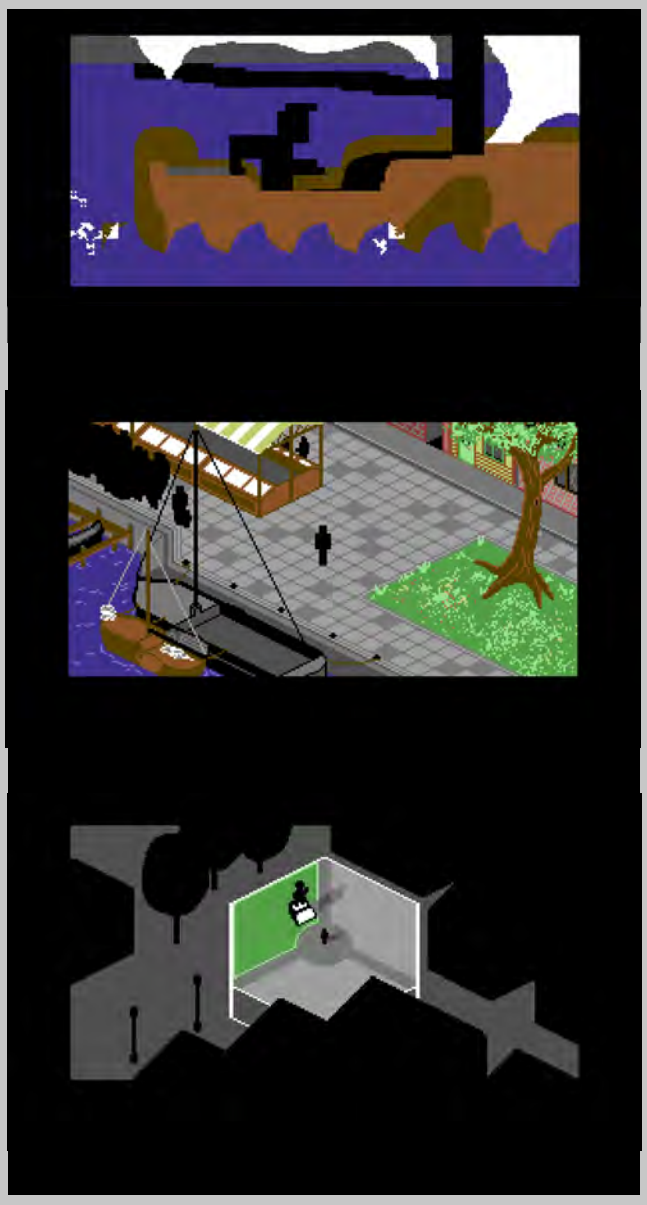
Framework

Throughout the research, the findings were documented through means of a fictive world where a graphic adventure takes place. Each chapter represents a different phase in the research, with its own conclusion. During the research, it was most productive when the findings were ascribed to a graphical, musical or physical object. The first two chapters have therefore been adapted in a point-and-click-style adventure game. The graphical style here is inspired by the early 1980s Commodore 64 graphics. The following paragraph will discuss the plotline of the adventure, titled The Song of the Architect.

Conclusions Chapter 1

What if only graphics could inform the vocal-based design tool?

This question really fits the first chapter, where the architectural scholar comes in contact with lots of different geometric expression forms. Trying to replicate something like this needs a more grounded and less astract look.



Chapter 2 - Praterdam & Phoneticoast

After being pointed in the right way by a friendly mathematician, who warned him not to come across as too inquisitive, the scholar heads to the town's university. At Praterdam Square he overhears an intellectual exchange by two other scholars. He is introduced to the basics of phonetics, including vowel formation. Inside the university he sees the developments on a 2D tiling system that encrypts measured phonetics. Here the scholar wonders if this could also be translated into 3D architecture.

Armed with new knowledge, the scholar heads back to his docked barge in Portsmath to begin simulating the first version of his vocal-architecture design tool, an early iteration of the workflow that will later define his practice. Just as he saves his code on diskette, he is unexpectedly arrested for an unknown reason. He is taken to the town's dungeon, where he is to await his fate.

Chapter 3 - The Dungeon

Trapped in the dungeon, the scholar looks out of the barred window. Peering out over the musical part of town, an area that produces ambient, melodic sounds which inspire his architectural ideas. Yet inside, he spends hours trying to solve the cell's lock combination, but eventually gives up. The moonlight then reveals a runic message, carved into the dungeon wall. The hexagonal runes seem to resemble primitive vowels.

The runes represent a breakthrough moment: by aligning his understanding of these vowels with his design workflow, the scholar unlocks his cell and escapes. Running through the next door he sees he is then greeted by an unexpected surprise. As he plummets off a cliff into the sea, his vision blurs. The last thing he remembers is something grabbing him by his clothes and jolting him upwards.

Conclusions Chapter 2 & 3

What if the project was (still) devoid of song & context?

Fitting the subsequent chapters because of the exploratory nature of the quest. The "Algorithm" is still in the prototype phase, and the architectural geometries are only informed through manual adjustment of parameters. Voice and phonetics are explored, but not yet connected to the pipeline.

Chapter 4 - The Citadel

The scholar awakens to a the dawning day with a tremendous sight. He has found himself on top of the citadel, where two birds perch: a Godwit and a Stork, both of unusually big size. The scholar concludes that they must have carried him up here. Looking out over the town, the harbor Portsmath is the first thing that catches his eye. There, his ship seems to have taken on water. He realizes that all of his work must have been destroyed and concludes that someone must have sabotaged his plans.

As the scholar reflects, VIC appears, ascending the spiral staircase of the citadel. VIC reveals that he has fixed the Aesthetimeter. The scholar tells that he sadly has lost both the microphone and the software to interpret the data coming from the Aesthetimeter, but then the two birds come and bring the small microphone and the diskette he saved earlier. VIC, being able to power and connect his display to the Aesthetimeter, can help now interpret the vowels and aesthetics around them.

Conclusions Chapter 4

Voice was seen as the end product, instead of architecture?

Having VIC come up with the Aesthetimeter as a "Deus Ex Machina" was a great device to symbolize the exploration of the idea of designing in the (Hidden) Botanical Garden. Through means of the spatial analysis the Aesthetimeter was able to perform, the intro-track of the now in-development game was born:

Ten weeks at sea, and the town of Babble is visible from over the horizon

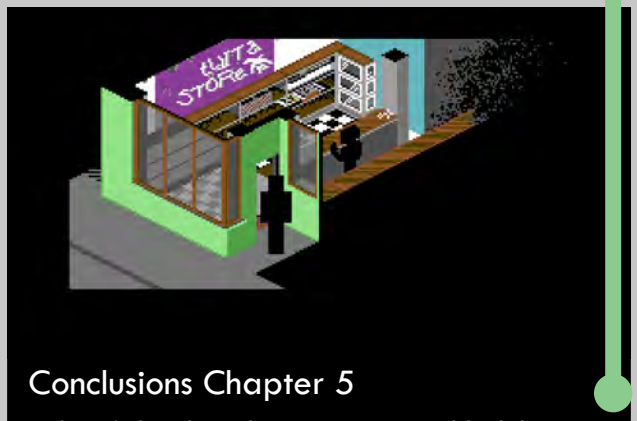
Would have seen the tower for days earlier, if it still stood as thousand years ago

It's my task as a scholar, and an architect, to understand

what it meant to design by one uniform language

Tessellation application, Truchet encoding

Cymatics incorporation, Diverging…



Conclusions Chapter 5

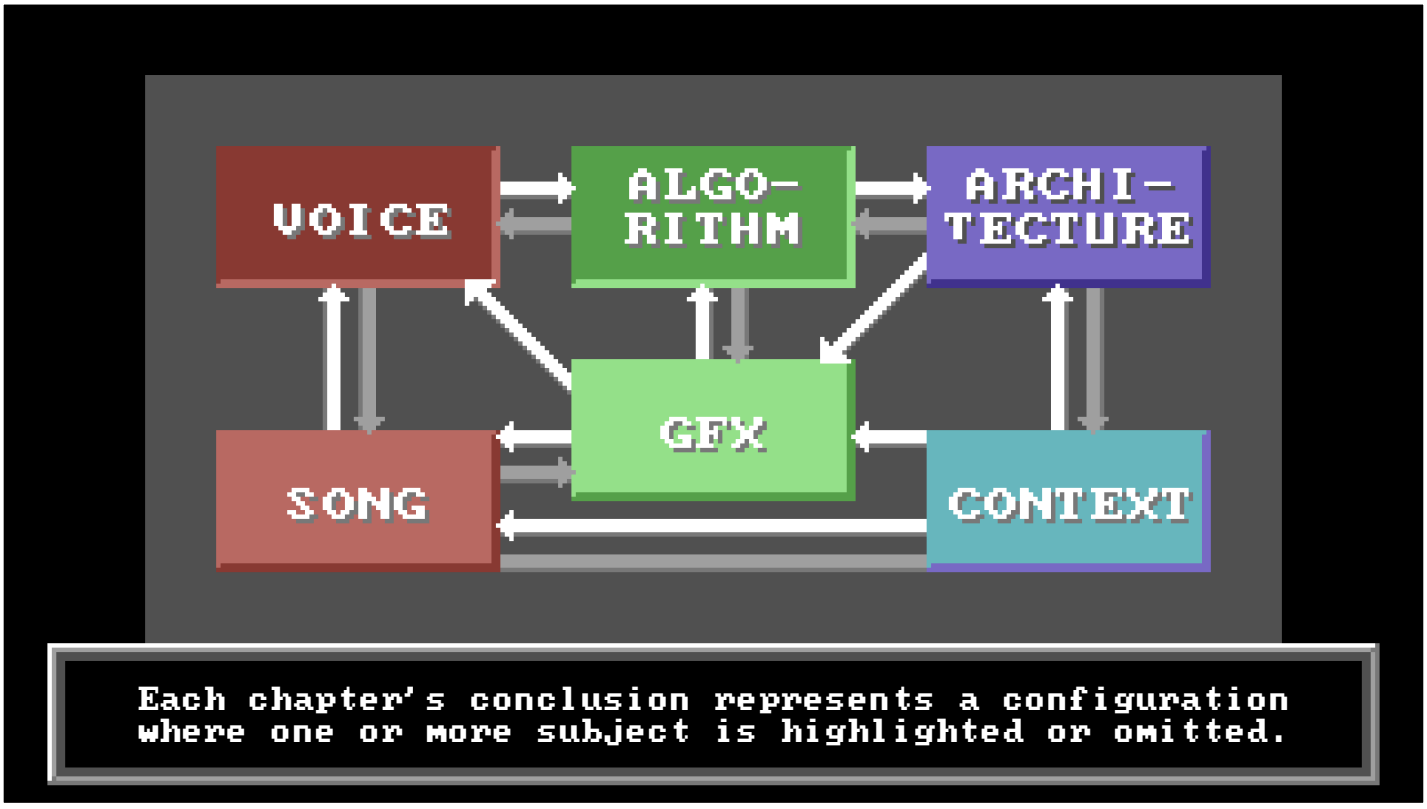
What if the algorithm was seen as a black box?

This question made the project incredibly easier to grasp. The "Black Box" representing the malicious AI in the story, but also seeing the "Algorithm" or "Software Tool" more as an appropriately dressed "Translation Workflow" mock-up, helped to pave the way for the development of the graphic adventure game. It harnessed immersion and creative energy.

Chapter 5 - Under Cover of Darkness

They spend the rest of the day analyzing aesthetics and phonetics, trying to iterate on a synesthetic translation. When analyzing the hidden gardens to the northwest of town, they discover a strange signal. It features high harmonic peaks in resonance, almost like music. When they descend the tower to go and investigate, they catch a glimpse of what is going on inside the citadel. It is then when they uncover a dark secret: a strange cult is building a generative artificial intelligence, which strives to emulate the vocal translation. Seeking to automate creativity and control architectural design through AI.

Horrified by this discovery, the scholar heads into town to warn the university. When he is almost at ground level, he is seen by the citadel guards and chased up the staircase again. He narrowly escapes by jumping into the adjacent lake. While the guards keep running up, the protagonist resurfaces and sees the Godwit and Stork gliding VIC toward the lake shore. The scholar swims towards them.



Conclusions

During the research, a diagram was drawn that informs the conclusion of the research. By subsequently altering or taking away certain parts of this diagram in each chapter, conclusions of each configuration could be given.

Conclusions Chapter 6

What if context and song was already written?

This last step in the synesthetic abstraction of form and sound could really help with the design part of this project. In general, it is the goal to make both appear in harmony, so starting with abstracting the context into song could really set a stable matrix in which a pavilion could be designed. From there, it should be clear smooth sailing, which makes the story complete.

Chapter 6 - Full Sail

After reaching the shore, the scholar constructs a small vessel, so he can transport VIC toward the hidden gardens. Modular and ready for exploration. While sailing on the lake, the scholar witnesses the Tower of Babble expanding. The tower seems to grow uncontrollably, leaning toward the lake. Just in time, he manages to steer away from the crumbling expansion, which is about to collapse into the lake. With one last shift it plunges into the lake. The displacement of water accelerates the vessel toward the other shore.

Having now arrived the mysterious garden and with the citadel now in ruins, the protagonist realizes it is now his task to design his own architecture method. Using the Aesthetimeter and the knowledge he has gained, the scholar sets out to build a hub for his practice, a place where his voice, sound and design can harmoniously come together. The hub represents the final culmination of his research, embodying his journey from theoretical exploration to practical application in a space that integrates human expression and architectural design.


SONG OF THE
VITRUVIAN MEN GAMES


AR-HiTE:T
Created by Max Hofstede

DISCUSSION
(& BRIEFING)

The site

As the artistic fruits of this exploratory research suggest, considering the human voice as an expressive design tool is the most productive in a graphically imaginative narrative. The story of the Song of the Architect, leading up to the final voyage towards the design location is highly metaphorical for the briefing and preliminary design of the pavilion-like typology as the central design experiment of this thesis. This was all presented during the P2 presentation, framing the project in a proverbial snapshot.

Some answers as to the question "How can we rethink the human voice as an architectural tool in the age of AI?" could start to formulate, but not until the discussion on the real-world practicalities and theoretical implications of the aforementioned pavilion design is opened. This chapter intends to provide an overview for this before addressing the final remarks in the conclusion. Alongside a brief for the architecture, a position towards the literature and design workflow will be defined.

Practical Implications

Site Context: Hortus Botanicus

The chosen location for the design is the Hortus Botanicus , TU Delft's botanical garden. A central location in the city of Delft, which offers a serene, nature-integrated backdrop for vocal expression. Despite the fact that the location is nestled between a busy traffic intersection and a broad canal intended for cargo shipping, its early 20th century surrounding architecture and landscape design provide a dynamic context.

Being a part of the TU Delft's infrastructure extremely close to the architecture faculty, the chosen location in the garden should not only be a very suitable expansion to the research facilities of the technical university, but would also provide value to the town's inhabitants and visitors. A reflective environment, contrasting between organic surroundings and technologically-driven design. As the Hortus Botanicus is such an accessible and centrally located space, it would make for an ideal spot for an interactive, multi-community oriented space.

Typology

The interactive pavilion to be designed should be a structure that allows visitors to engage with their own vocal expressions and allow performers to demonstrate their dynamic range in using this tool. The shape and form of the building will result from an intuitive translation of the fluid movement in the different dimensions of the triangular vowel spectrum.

The contrast between the rigid scientific framework and the personal traversal within might then be expressed through the sturdy nature of columns and beams, opposed to freely moving textiles, like curtains or sail moved by means of revolving cables. Thus, an expressive interplay between static and dynamic could be achieved, leaving room for both predetermined (designed) expression and on-site (performed) expression.

These elements should be able to influence the atmospheric qualities of the room. Letting in light at certain frequencies, or stimulating airflow into certain directions. Playing with warm and cold, light and dark and perhaps even different tones in the olfactory receptors. Lastly, the acoustics could also be dynamically enhanced or dispersed, depending on the inputs.

In the most abstract sense, the pavilion should include a stage, room for the audience, and a backstage. On the stage, keynote speeches could be given, but also intimate vocal expressions, singing performances and lectures on linguistics and phonetics relating to architecture. In the pavilion, there should be room for 30-40 lecture hall seats with tables, as well as a panel in the back for PA. For the performers, there should be a backstage, serving as a lounge and/or reflection space. It includes a small kitchen, dressing room and toilet. There should also be toilets accessible to the audience.

Architectural Expression

Briefly summarizing the translation workflow, vowels are sung or spoken into a microphone, then using spectrography, the intensities of the resonant frequencies are picked up as formants, serving as coordinates on the vowel spectrum. These frequencies are then mapped to geometries that synesthetically relate to each other. An example of how the vowel sounds could create different spatial responses is how low vowels like “a” generate broader, open spaces, while high vowels like “i” could create more intricate, vertical elements.

The architecture is - as mentioned before - split into static and dynamic elements. The static elements are the structure and material of the pavilion, while the dynamic elements are supportive to the performances that take place in it. This is not to say that there would be a complete disconnect between the two types of elements, since both architectures should structurally support and justify each other in a symbiotic way.

The material expression of the pavilion should enhance both the acoustics and tactile experience during the performances and lectures. A dynamically responsive material is thus of great importance in this design. Not only in the sense of indoor quality, but also considering the circularity aspects of designing for demountability and reuse of existing waste streams in the construction and nautical sector.

Educational and Engagement Potential

As mentioned before, the design of this building should foster community interaction and simultaneously integrate with the university curriculum. As a community-oriented space, it should encourage engagement, collaboration and most importantly, personal expression. It should be able to host workshops, performances or spontaneous vocal events. A central platform, specifically for the experience of voice.

Voice in the age of AI is an extremely multifaceted topic for many disciplines studied within the TU Delft. With AI voice synthesis becoming ever more realistic, alongside generative AI being able to visualize stunning images of architecture, an individual uninformed about the limits of AI could conclude that the subject of this thesis could leave humans out of the equation altogether.

Yes, it could be noted that a machine learning (ML) model could fabricate vocal input in order to arrive at Hofstediographic architecture, but the personal synesthesia encapsulated in each geometric configuration, triggering different visual, olfactory, auditory and even somatosensory senses could impossibly be gauged quantifiably in order for an AI model to learn. As fascinating as such a proposition would sound, it goes beyond the scope of this project. Therefore the design phase of the thesis will rely heavily on graphically documenting the interaction between the voice and the architecture, finding and distinguishing one’s authentic voice, becoming essential in studying, creating and synthesizing designs.

Interpretation of Results

The research question - *"How can we rethink the human voice as an architectural tool in the age of AI?"* - led to the exploration of using vocal data to influence architectural design. The results of the project demonstrate that the human voice, specifically through the analysis of vowel formants, can be transformed into a key input for generating architectural forms. By using tools such as Praat and Grasshopper, the unique vocal characteristics of each vowel were translated into tangible, spatial elements, thus reimagining how personal expression can directly shape the built environment.

This method represents a shift in how architecture can be conceptualized, moving beyond traditional, static principles toward dynamic, personalized design processes. Rather than treating sound as a secondary consideration for acoustic performance, the project positions the voice as a form-shaping force in architectural creation. The use of pre-developed algorithms in both tools were crucial in processing complex vocal data and optimizing the pavilion's form, offering a new way for architects to engage with sound.

Ultimately, the results suggest that the human voice, when harnessed through digital translation, offers a powerful and personal tool for architectural design, creating spaces that resonate with the individuality and emotional depth of their users. Moreover, the overall message of this research topic is that preservation of authenticity and identity through means of vocal complexities and nuances could have great power in the industry.

Findings in Context

In order to demonstrate the power of ideas bound to arise with new hardware capabilities, different paradigms from the literature review have been excerpted. In the coming paragraphs, it will be explained how these ideas stuck out during the preliminary design process and briefing formulation.

Cybernetic Precedents

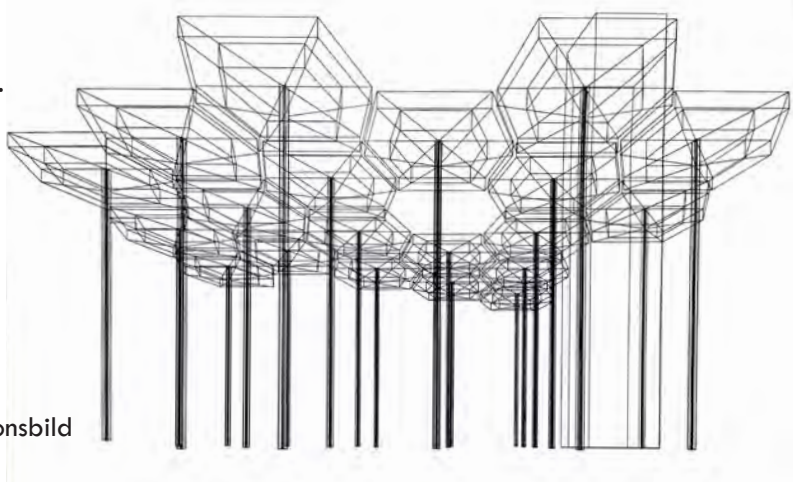
The philosophy of cybernetics, seeking to "conglomerate models, figures of thought and concepts" (Pias, 2009 (Vrachliotis pp. 18)) was an ambitious thought, ultimately leading to a new perspective on communications theory, paving the way for virtual communication on the most direct level possible between man and machine. As described in Busbea (2020) and Vrachliotis (2022), many early architects who subscribed to this way of thinking, seemed to share a common ground in their designs: interactive, modular architecture that was following a binary control system to react to the user's actions, prompting a responsive experience.

In many ways, the history of cybernetic ideas is of great inspiration for this thesis, not only since its precedents give a great visual impression for anachronistic fantasy, but also because these early models sought control in the physical realm through means of "steering" digital inputs in the virtual realm. This all within the severe hardware limitations of that time.

Workflows from the Architecture Machine

Other examples of optimizing within the given restraints were mentioned in this section. From Sketchpad to Dunescape, every project touches upon the heart of computer architecture, each in their own zeitgeist. Of great inspiration for this thesis, was the unique visual style each project had to offer. For example, the geometric renderings of the modular CeBIT-Pavilon by Ludwig Rase and Georg Nees was just a small example in their long portfolio of computer artwork.

Incorporating the visual styles in an informed synthesis of digital design, it makes room for virtual expression of voice, hand and experience in this project.



Georg Nees / Ludwig Rase, Konstruktionsbild

Iannis Xenakis' Sound and Space

Finally, composer and architect Iannis Xenakis was the most important precedent for the Hofstediography design tool or workflow. He pioneered the intersection of music, mathematics, and architecture. His groundbreaking work explored how mathematical and physical principles could shape both sound and space. His innovative approach allowed him to manipulate sound in unprecedented ways, treating music as an architectural form that could be both experienced and constructed.

Xenakis' dual expertise in architecture and music perhaps peaked in his architectural collaboration with Le Corbusier, particularly in designing the Philips Pavilion for the 1958 World Expo. Here, he fused sound and space, creating a structure that acted as both a physical and auditory environment, realizing his vision of architecture as an extension of musical form.

In relation to this project, Xenakis' work serves as a crucial inspiration for exploring how human expression - particularly vocal data - can shape architectural design. His legacy of translating sound into space aligns with the research's aim of using vocal spectrography to inform dynamic, personalized architectural environments. Just as Xenakis bridged sound and structure, this project seeks to deepen the connection between voice and architectural form.

Conclusions

Through rethinking the human voice as a generative tool for architecture, practical and theoretical contributions have been made within the research of this thesis. Creating an anachronistic, interactive virtual story, as well as a handful of physical artifacts, serving as allegorical vehicles for thought experiments about cultural implications of Hofstediography tools. Alongside that, creating a workflow for interpreting vocal sound using pre-developed algorithms for creating computer aided design-software geometries.

With the research being concluded for this project, there are enough materials and ideas to start the design phase of this thesis. Yet with the many angles still to explore within the topic of voice and design, this project may be interpreted, adapted and reevaluated in any later stage. Hoping this research may open new avenues for architects and designers looking to rethink the relationship between phonetics, human expression, and the built environment.

CONCLUSION

Allegorical and Vocal Expression

The central inquiry of this research was to find an answer to the research question "*How can we rethink the human voice as an architectural tool in the age of AI?*". By focusing on how the integration of human vocal data, phonetics and algorithmic design could contribute to both architectural and narrative elements, this question was thoroughly explored. The formulated answer is therefore as follows: "*Through means of creating a graphic and musical adventure that the user can expressively relate with. Immersing them with colorful fictional characters and locations.*" A story-driven allegorical vessel for expressing the need for a cultural shift.

The creation of the graphic novel/video game could serve as a tool to rethink the human voice in architecture. This is because the adventure acts as an immersive experience where the player can relate to architecture expressively, through characters and interactive elements. The fictional characters and vibrant locations thereby help the player form a connection with the aesthetic of the medium. Beside that, this imaginative world functions as a metaphor for real-world architectural concepts, making complex ideas more accessible and emotionally engaging. Lastly, voice and sound are integrated into this adventure to allow users to feel the spatial influence of vocal expressions, reinforcing the original research's goals.

The many allegorical elements, like the Tower of "Babble", the *Aesthetimeter*, VIC, Praterdam, the sinister development inside the tower, helped symbolically navigate the architectural outlining process. Through graphically designing them and putting them inside a fictional world, it helped to give them a support base, a grounding so to speak. The allegorical vehicle – or rather *vessel* - serves as a personal documentation of exploration, iterative diverging and converging.

Impact

This research could serve as an influence for architectural practices by offering a new way to integrate human expression into design. The adventure showcases how algorithmic tools, like the fictional Aesthetimeter, can assist in creating dynamic, user-driven spaces that respond to individual vocal patterns. The research also broadens the use of phonetics in architecture, demonstrating its potential to create spaces that are synesthetically shaped by human voice and sound. This ties into the general comment on the age of generative AI, which states that the importance of maintaining human identity should be stressed more than ever now.

Limitations

It has to be acknowledged that while the graphic adventure offers a unique method, its fictional and playful elements may not fully translate to practical and repeatable architectural applications. Ther are however opportunities that could be further explored, such as an in-depth study on how interactive media and AI-driven tools could be practically integrated into architectural design workflows. The aforementioned machine learning feedback loop, which could have great implications for research on audio-spatial synesthesia is an example of this. Pairing that with the field of cymatics, a more physics-based angle could be taken.

Closing Reflections

This explorative research's contribution to rethinking the role of the human voice in architecture has to be considered as a whole before breaking it down into its distinct parts, such as the historical precedents, the phonetic workflow, narrative and design briefing. This blend of fiction, sound and design offers a novel approach for creative architectural expression in an AI-driven world. The field of the aptly named "Hofstediography" is a gateway into a personal thought process and synesthesia, summarizing the architectural thinking of an individual, but also a pedestal for interconnected expressive and immersive experience.

APPENDIX

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pp. 19:

- 16th-century woodcut; Wie Seyfrid zu eynem Schmid kam vnd den Ampoß in die erden schlug vnd das eysen entzwey, vnd den meyster vnd knecht schlug.: CC0, source: https://upload.wikimedia.org/wikipedia/commons/8/81/Siegfried_1.gif

pp. 32:

- Georg Nees / Ludwig Rase, Konstruktionsbild (Construction Picture), offset lithograph on paper, (photoshopped) source: https://spalterdigital.com/artworks/computergrafik-strukturdesign/

Reflection P4

1. What is the relation between your graduation project topic, your master track (A, U, BT, LA, MBE), and your master programme (MSc AUBS)?

- The graduation topic involves translating the human voice into architectural parameters in order to arrive at synesthetically relatable forms in the building. This exploratory, ethnographic and speculative research is a hallmark of the Explore Lab Graduation Studio in MSc AUBS's Architecture track.

2. How did your research influence your design/recommendations and how did the design/ recommendations influence your research?

- The research affected the design through the way it was documented. An allegorical narrative alluded to the creation of a pavilion with an auditorium function. Later, the decision to apply the secondary function of a photobioreactor was reconciled in this aforementioned narrative.

3. How do you assess the value of your way of working (your approach, your used methods, used methodology)?

- The research into existing theories relating to this thesis' topic attempts to provide an overview of existing schools of thought regarding it. Through a rigorous vocal analysis workflow, departure points for architecture could be derived. The values are assessed through how the results could be used to synthesize architecture and weave it into an narrative that reflects the current zeitgeist.

4. How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

- This project provides a departure point for how the voice could be used as an architectural tool in the age of AI. May it provide a "freezeframe" of a current set of beliefs, an architectural perspective during many digital developments.

5. How do you assess the value of the transferability of your project results?

- While the literary research and data processing methods could be relevant, the documentation is highly personal, which is again a hallmark of the Explore Lab studio.

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